

2011 Report of the Arab Forum for Environment and Development

ARAB ENVIRONMENT 4 GREEN ECONOMY

SUSTAINABLE TRANSITION IN A CHANGING ARAB WORLD

EDITED BY:

HUSSEIN ABAZA

NAJIB SAAB

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Preface

Green Economy: Sustainable Transition in a Changing Arab World is the fourth of a series of annual reports on the state of Arab environment, produced by the Arab Forum for Environment and Development (AFED). The first AFED report, published in 2008 under the title Arab Environment: Future Challenges, covered the most pressing environmental issues in the region. The second report, Impact of Climate Change on Arab Countries, was published in 2009 and addressed the vulnerabilities to climate change facing Arab countries. The third report, Water: Sustainable Management of a Scarce Resource, was published in 2010 and covered water issues in the driest region of the world.

The AFED Board of Trustees selected Green Economy as the topic for the 2011 report in November 2010. Soon after, the Arab Spring started in early December and has since been at the center of global news coverage. It was then that we decided to focus on how green economy can help to navigate a sustainable transition in a changing Arab world, ushering in a new direction for economic and environmental sustainability. At the moment the prospects are not good for either one. However, political reforms should be expected to clamp down on administrative corruption as well as the mismanagement of natural resources. More representative governments should bring stronger political will to the sustainable management of environmental resources through effective public policy, whereby the civil society and people whose lives are most impacted by these concerns will have more say in shaping political decisions. Hence we should expect better governance in general to have spillover effects on environmental governance. Only time can tell. Inequality, oppression and poverty are at the core of environmental destruction. As part of the transformation, we should also expect civil society to be freer and more effective.

Despite the high oil revenues reaped from hydrocarbon resources and their spillover effects on non-oil producing countries, Arab economies suffer from structural problems, with fragile political systems, precluding them from adopting effective green transformations. Arab economies remain undiversified. They largely rely on oil and low-value added commodity products such as cement, alumina, fertilizers and phosphates.

Demographic transitions present a major challenge: population increased from 100 million in 1960 to about 400 million in 2011. Sixty percent are under 25 years old. Urbanization has increased from 38 percent in 1970 to 65 percent in 2010. If rural development does not become a priority, the increasing rural migration into the cities in search of jobs will put even more strain on the already inadequate infrastructure.

Current economic development patterns will increasingly strain the ability of Arab

governments to provide decent-paying jobs. For instance, youth unemployment in the region is currently double the world average.

The demand for food, water, housing, education, transportation, electricity, and other municipal services will rise. Power demand in Saudi Arabia, for example, is rising at a fast rate of over 7 percent per year. Agricultural land around Amman, Cairo and other Arab cities is being lost to the expansion of suburbs. Whereas higher learning institutions are proliferating, the quality of education offered is below average. Gated communities and high-rise office buildings are sprawling, while decent low-income housing is ignored. Even when capital is available, investments are typically misdirected.

The 2010 AFED report found that the Arab region is facing impending catastrophic water shortages, to start taking effect as early as 2015. The 2009 AFED report found that the impact of climate change in the region will multiply the risk of water and food scarcity. Irrigation efficiency in the region also stands at a very low level of 30 percent, often to produce low-value crops demanding vast amounts of water. Cropping patterns and varieties should be changed to produce more with less water, even if this eventually means radical changes in eating habits. Arab countries should also do their part in reducing emissions, through greater energy efficiency, cleaner utilization of oil and gas, and wide use of renewable energy.

Given these challenges, transitioning to the Green Economy is not only an option for the Arab region; rather it is an obligation to secure a proper path to sustainable development.

Taking advantage of its position as a unique regional organization grouping the private sector in the Arab world, together with civil society, academic institutions, and media, with government institutions as observers, AFED took the lead to advance the concept of a green economy as a basis to transform Arab economies in a direction which allows them to achieve sustainable development. To AFED, this means a transformation from the 'virtual economy', primarily based on speculation in real estate and financial markets, to 'real economy' focusing on sustainable production, which alone can protect the natural capital and generate long term job opportunities.

This comprehensive report on options of green economy in Arab countries represents the first phase of the AFED green economy initiative. Over one hundred experts have contributed to the report, and discussed its drafts in a series of consultation meetings, leading to the production of the report and the regional annual AFED conference in October 2011 to present and debate the findings. The report is intended to motivate and assist governments and businesses in making a transition to the green economy. It articulates enabling public policies, business models, green investment opportunities, innovative approaches, and case studies, and addresses eight sectors: agriculture, water, energy, industry, cities and buildings, transportation, tourism, and waste management.

Phase II of AFED Green Economy Initiative involves putting policy recommendations into practice by implementing demonstration green projects with national institutions as partners. AFED has produced a Water Efficiency Manual, and launched a series of Water Efficiency Workshops including water audits, in cooperation with the Ministry of Water and Electricity in Saudi Arabia

and other partners. Other activities include an Energy Efficiency Handbook for buildings and workshops promoting Green Finance, Water Efficiency in Industry, and Sustainability Reporting. The process will continue with inclusive consultations, also involving governments, to help develop a broad understanding and strong regional position leading to the United Nations Conference on Sustainable Development (Rio +20) in June 2012, which will discuss green economy as main topic. Rio +20 presents an opportunity to employ green economy as a tool to achieve sustainable development.

As the recent developments in Arab countries proved, sustainability cannot depend on a choice between freedom and stability. Equally true, we cannot win a “war on terror” if we fail to wage a determined war on poverty, oppression and injustice.

AFED hopes that this report will contribute to introduce the concepts of green economy to the Arab region and put them into action, including catalyzing institutional reforms. If this report can inform and help shape public policy and private sector involvement for a transition to green economy to boost sustainable development in the Arab world, then it would have served its purpose.

AFED Secretariat wishes to thank all those who supported this work, specifically the authors and experts who helped in laying down the methodology and appraising of the outcome. AFED’s special thanks go to the OPEC Fund for International Development (OFID) for its continuous genuine support to the Forum’s program, the Islamic Development Bank (IDB), the Kuwait Fund for Arab Economic Development (KFAED) and all corporate and media partners who made this endeavor possible. Thanks are also due to the editorial and production team of *Al-Bia Wal-Tanmia (Environment & Development)* magazine for their dedication to produce this report and book up to the highest standards and in record time.

Najib Saab

Secretary General

Arab Forum for Environment and Development (AFED)

EXECUTIVE SUMMARY

GREEN ECONOMY IN A CHANGING ARAB WORLD

2011 Report of the Arab Forum for Environment and Development (AFED)

Arab economies have underperformed over the past four decades. Arab countries have adopted aggressive economic growth models, but in doing so have gravely undermined progress on social and environmental issues. The ensuing forms of poverty, unemployment, food and water security threats, and environmental degradation continue to plague Arab economies. These shortfalls are not necessarily borne out of natural limitations. Rather, they are the outcomes of policy choices.

The shortcomings in the performance of Arab economies have also significantly contributed to deteriorating social conditions. The persistent poverty and unemployment have led to social marginalization, which is further compounded by income disparities. The aggregate impacts of these shortfalls have caused social and political instability. Demands for change across Arab countries reveal that the mounting economic, social, and environmental strains and the resultant implications on livelihood security have become unsustainable.

This report of the Arab Forum for Environment and Development (AFED) advocates a development model rooted in a green economy. A fundamental tenet of a green economy is giving equal weight to economic development, social equity, and environmental sustainability. This report argues that meeting these three goals provides a sound foundation for addressing the shortcomings of Arab economies, from curbing poverty and unemployment, to attaining food, water, and energy security, to achieving more equitable forms of income distribution. Moreover, a green economy places great emphasis on the efficient use and deployment of natural assets to diversify the economy, which in turn provides immunity against the volatilities and recessionary pressures of the global economy.

The systemic strains caused by Arab development models can be appreciated by examining indicators across a range of dimensions. Poverty continues to afflict 65 million people in Arab countries. Economic insecurity is further aggravated by disturbingly high unemployment rates of 14.8% for the general population, reaching 27.3% among the youth. Collectively, these economies have scored less than a 0.5% rise in real gross domestic product (GDP) per capita from 1980 to 2004. These figures cast doubt on the ability of Arab economies, as currently structured, to create 51 million new jobs projected to be required by 2020, just to accommodate new entrants into the work labor force, while keeping current unemployment rates the same.

Arab development strategies continue to be dominated by investments in extractive commodity products earmarked for export markets. These industries

require high initial investments but generate low levels of employment. Despite generating high GDP growth, this model leaves Arab economies more vulnerable to global market volatilities, while failing to significantly create jobs. The lack of income diversification is a primary cause of the structural weakness of Arab economies.

SHORTFALLS OF ARAB DEVELOPMENT MODELS

The state of water resources is nearing a crisis in most Arab countries, driven mostly by policies that encourage over-consumption and tolerate over-exploitation of the scarce water resources available, leaving future generations to pay the price of current policies. In Arab countries today, more than 45 million people accounting for 10% of the population lack access to clean water and safe sanitation.

Food security poses another major threat to Arab countries, driven primarily by negligence and underdevelopment of the agricultural sector, resulting in poor agricultural productivity, low irrigation efficiency rates, and weak extension services to farmers. The net import bill for the main food commodities was \$30 billion in 2008, including \$18.3 billion for cereals. The escalating food import bills cause large trade deficits, strain the public budgets of Arab countries, and make them vulnerable to export bans by other countries.

Arab economies continue to unsustainably deplete renewable natural resources, motivated by short-term profits, causing environmental impoverishment of scarce land and water resources while discounting the value of these resources to future generations. The average annual cost of environmental degradation in Arab countries has been estimated to be \$95 billion, equivalent to 5% of their combined GDP in 2010.

Nearly 60 million people in Arab countries lack access to affordable energy services, limiting their opportunities for improved living standards. Energy security is becoming a serious concern for oil-importing countries because of high oil prices. A number of Arab economies are among the least energy efficient in the world, measured by their annual CO₂ emissions per capita and per unit of GDP. With the demand for electricity escalating in these countries, the policy of building more power plants and providing energy subsidies will no longer be economically sustainable.

Transportation policies in Arab countries have focused primarily on highway and road construction rather than on mass public transit. The lack of effective intervention policies in the transportation sector has resulted in serious traffic congestion in urban centers, poor air quality in many cities, and land degradation.

Cities in the Arab region suffer from chaotic land-use patterns and excessive urban sprawl, leaving infrastructure systems incapable of adequately supporting their populations. Rural-to-urban migration and high housing costs in many Arab cities have contributed to the spread of slum areas, characterized by inadequate - if not entirely absent - basic services.

Energy and water use in the existing building stock across the region, and in particular in commercial and public buildings, is alarmingly inefficient. The internationalized approach to architecture and construction in the region is

insufficiently attuned to the local climatic conditions, resulting in wasteful use of energy.

The waste management sector in Arab countries is characterized by underdevelopment, underinvestment, and high-risk waste dumping practices. The sector is plagued by insufficient regulations and weak waste disposal standards. In many Arab countries, over 50% of all waste generated remains uncollected. Open-air burning is often used at dumpsites, allowing decomposing waste products to pollute the air, soil, and ground and surface water.

CHANGING COURSE: TRANSITIONING TO A GREEN ECONOMY

Making the transition to a green economy will require a fundamental review and redesign of public policies to stimulate shifts in production, consumption, purchasing, and investment patterns. The chapters of this report present proposed enabling policies and conditions that will be needed to transition to a green economy across eight priority sectors.

The report calls upon Arab governments to prioritize agricultural rural development as a strategic policy objective to alleviate rural poverty and reverse years of neglect. Such a policy shift would enable farmers, aided by well-designed extension services, to improve seeds, irrigation efficiency, soil conservation, agricultural yields, and sustainable practices. Revitalizing the agricultural sector will increase its share in the productive labor force, improve living standards, and limit rural to urban migration. A shift to a 40% share in the labor force by agricultural workers in the Arab region would generate more than 10 million jobs in the sector. In addition, shifting to sustainable agricultural practices is expected to result in savings to Arab countries of between 5-6% of GDP, amounting to about \$100 billion annually, as a result of increased water productivity, improved public health, and better-protected environmental resources.

Policy shifts in the water sector must begin with the introduction of institutional and legal reforms that affect water use, regulation, and governance. Arab states need to concentrate on policies that control and regulate water access, promote irrigation and water use efficiency, prevent water pollution, and establish protected areas vital to water resources.

Volume of wastewater treated should increase from below 60% today to a 90-100%. The portion of treated wastewater which is reused should increase from 20% today to 100%. Innovative technologies for water desalination should be developed locally, incorporating the use of solar energy.

For the energy sector, the report proposes sustained investments in energy efficiency and in renewable energy sources through a mix of regulatory standards and economic incentives. A reduction in the average annual per capita consumption of electricity in Arab countries to the world average through energy efficiency measures would generate electricity consumption savings that are estimated in monetary terms to reach \$73 billion annually. A 25% reduction in energy subsidies would free up over \$100 billion over a three-year period, an amount that can be shifted to finance the conversion to green energy sources.

Arab countries should develop low-carbon industrial development strategies

motivated by the opportunity to become energy-efficient economies. This would enhance local industrial competitiveness, income diversification, and job creation. The viable reduction in energy requirements per ton of product is estimated to be in the order of 30%. For example, energy efficiency enhancements in cement manufacturing can reduce energy consumption per ton of cement by 20% to 40%, leading to a cost advantage to the producer through lower energy costs.

One of the most important measures to reduce emissions is deploying the most efficient production technologies in new plants and retrofitting energy efficiency equipment in existing plants where it is economically viable. A 30% reduction in energy requirements due to more efficient industrial processes is estimated to result in annual savings of 150,000 billion kWh or \$12.3 billion.

For the transportation sector, the report argues for policies in favor of mass public transit systems and vehicle fuel efficiency standards. These policy interventions have been demonstrated to have a relatively low cost while yielding high economic, social, and environmental dividends within a short period of time. The benefits would include the provision of dependable, affordable, and safe transportation services that are energy efficient, while minimizing pollution, congestion, and unmanaged urban sprawl. A projected target of 50% greening of the transport sector, resulting from higher energy efficiency and increased use of public transport and hybrid vehicles, should generate savings of \$23 billion annually.

To create healthy and economically competitive urban communities that offer a high quality of living for their inhabitants, the report advocates for the adoption of zoning regulations and mixed-use development. Moreover, traditional design approaches in Arab architecture, which are in many cases more responsive to environmental considerations, should be adapted and applied where relevant and appropriate, thus contributing to environmental, social, and cultural sustainability.

For buildings, a holistic design approach that incorporates environmental principles in building form, materials, orientation, equipment installations, and other aspects is proposed to yield the highest energy efficiency gains. Building efficiency codes and standards are seen as the most effective institutional levers for influencing construction practices. Integrating energy efficient considerations in the design of buildings is expected to result in a reduction of about 29% of projected CO₂ emissions by 2020, which would cut consumption by 217 billion kWh and generate savings of \$17.5 billion annually. In addition, spending \$100 billion in greening 20% of the existing building stock in Arab countries over the next 10 years, by investing an average of \$10,000 per building for retrofitting, is expected to create four million jobs.

The report argues that there is an urgent need for a fundamental shift in the approach to municipal solid waste from waste dumping, burning, and/or land filling to a resource management approach that seeks to capture value from waste materials through reduction, reuse, recycling, and recovery. It is estimated that greening the waste management sector would save Arab countries \$5.7 billion annually. Green waste management contributes to job creation because it is labor-intensive and stimulates the demand for products, systems, and services in other industries. Moreover, it offers unique investment opportunities in recycling,

composting, and energy production. Organic food waste, which accounts for 40-80% of municipal waste in Arab countries, can be used as a raw material to produce compost for agricultural use and biogas to replace fossil fuels. Agricultural waste can also be used as a potential raw material for biofuels production.

In Arab countries today, mainstream economic planning is still anchored in short-term GDP growth and quick fixes, while disregarding the underlying causes of poverty, inequity, unemployment, and environmental degradation. It is clear that to date, the policy response to these shortfalls and associated disparities in income and power has been extremely inadequate.

This report advocates a response anchored in a transition to a green economy. It argues forcefully that the region does not have to choose between economic development, social equality or healthy ecosystems. By design, the green economy seeks to achieve economic, social, and environmental policy goals. The transformative changes called for in this report will require shifts in economic policies and systems.

Making the transition to green development is not a one-time event that can be achieved by a single high level decision. Rather, it must be viewed as a long and arduous process guided both by top-down policy prescription as well as bottom-up public participation. This approach gives transition the political and social legitimacy needed to ensure wide-scale mobilization of efforts to make it a reality.

INTRODUCTION

GREEN ECONOMY IN A CHANGING ARAB WORLD

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Throughout human history, nature has been treated as a supplier of infinite natural resources. Activities were assessed purely in financial terms, without economic valuation of non-cash benefits and without taking into account environmental and social considerations. There was an implicit assumption that natural and human-made capitals were substitutable, that nature's ability to supply humans with life support benefits was boundless, and that nature had an unlimited capacity to absorb the waste generated by economic activities. Experience has shown otherwise, as evidenced by the deteriorating environmental conditions worldwide.

An alternative paradigm of viewing the interaction between human activities, social conditions, and the environment is the green economy. In contrast to mainstream economic planning, which deals with the environment in isolation, the green economy aligns the macroeconomic policies of the state with environmental and social policy goals. It is an approach based on integrating economic development, environmental sustainability, and social equality. The green economy assigns a value to natural capital, allowing externalities of human activities to be incorporated into decision-making processes, in the hope of achieving economic development without exceeding the ecological limits of ecosystems or undermining social conditions.

The Arab Forum for Environment and Development (AFED) believes that although ecosystems have inherent values that must be protected, arguments for preserving the integrity of the earth's ecosystems are not solely about protecting the planet's forests, oceans, and climate only for nature's sake. Rather, these arguments are also about seeking to improve the economic and social conditions of current and future human generations. Freshwater shortages, degradation of topsoil, and toxics in the air should not be viewed as unintended consequences or by-products of economic growth that can be tolerated and absorbed. Such thinking will afford nations only more time to buy. If not addressed prudently, these environmental damages will over time have rapidly increasing aggregate impacts that may lead to systemic strain on resources, economies, and health. They may even trigger social disruption and political turmoil. These are unsustainable costs to any society.

Livelihoods and economies have always been dependent on the resources and services made available by nature's endowments. Further deterioration of natural and environmental assets by human activities will undermine the long-term productive capacity of these ecosystems--oceans, soils, and lakes--on which economies rely for many essential needs including clean water, food, fiber, and medicines. Therefore, there is a need to live by a more balanced model and according to an agenda that caters to economic, social, and environmental progress equally. All three spheres are interdependent and efforts to accelerate economic growth in ways that weaken environmental or social conditions will eventually be seriously undermined by aggregate impacts and strains.

SHORTFALLS IN ARAB ECONOMIES

Arab development agendas suffer from persistent shortfalls across a range of dimensions. Poverty continues to afflict about 65 million Arabs, according to the Arab Human Development Report 2009. The report found that the share of the population under the upper national poverty line was about 29% in Lebanon and Syria, 41% in Egypt, and 59.5% in Yemen. Rural populations bear the brunt of income poverty and the resultant economic insecurity.

Employment conditions in Arab countries offer another disturbing measurement of economic insecurity. The average rate of unemployment in Arab countries stood at 14.8% in 2009. Youth unemployment rates averaged 27.3% in 2007, accounting for more than 70% of unemployment in Egypt, Jordan, Mauritania, and Yemen. The percentage of those 15 years of age or younger within the total Arab population was 35.5% in 2005. It is estimated, therefore, that Arab countries will need to create 51 million new jobs by 2020 just to accommodate new entrants into the work labor force (while keeping current unemployment rates the same). These figures cast doubt on the ability of Arab economies, as currently structured, to expand and create employment opportunities for the large number of job seekers over the next decade.

The acute unemployment and persisting poverty in some Arab countries point to the failure of the Arab development model of the past four decades. How else do we explain that 45 million people lack access to clean water or safe sanitation or that 60 million people lack access to affordable energy services, relying instead on non-commercial fuels like wood, dung, and agricultural residues – to meet their daily heating and cooking needs? The challenge remains as valid now as it was in the 1970s, 1980s, and 1990s: Why have Arab economies not been able to provide robust employment opportunities for job seekers, many of them educated? Why have Arab economies not been able to meet the basic needs of millions of people?

The answer lies in the inability or unwillingness of Arab states since the 1970s to diversify their economies. Although oil and gas revenues have unquestionably contributed to rapid economic and social development in Arab countries, Arab economies have remained over the course of the past four decades vulnerable to global oil price volatilities. The boom and bust cycles in the global oil markets, particularly in the 1970s, 1980s, and 1990s, have subjected Arab countries to severe economic shocks, the results of which were manifested in negative economic growth (Kuwait and Jordan), high levels of debt (Egypt, Morocco), and the halving of GDP (Saudi Arabia). In fact, the Arab Human Development Report (AHDR) 2009, asserts that “for nearly two and a half decades after 1980, the region witnessed hardly any economic growth”, and that “World Bank data show that real GDP per capita in the Arab countries grew by a mere 6.4 per cent over the entire 24 year period from 1980 to 2004 (i.e. by less than 0.5 per cent annually).”

The failure of Arab states to promote economic diversification through agricultural and industrial development lies behind their inability to create real employment opportunities. The AHDR concludes that “overall, the Arab countries were less industrialized in 2007 than in 1970, almost four decades previously.” Arab governments’ policy choices that resulted in long-standing neglect of agriculture, rural development, and manufacturing, are those same policies that have created consumptive and import-based economies.

Today, buoyed by the 2002-2008 rise in oil prices, the Arab oil-producing countries are relentlessly pursuing investments in energy-intensive industries such as petrochemicals, aluminum, cement, and steel. Arab states are also promoting the extraction of raw materials including phosphates, copper, gold, and iron. As commodity products earmarked for export markets, earned income from these investments will remain vulnerable to highly volatile global commodity price fluctuations and boom and bust cycles. In addition, because they are capital intensive, these commodity industries require high initial investments but generate low levels of employment. This approach leaves Arab economies more vulnerable while failing to create a significant number of jobs.

The high income from these activities has contributed to the development of mega real-estate projects in almost all major cities of the Arab world, including those cities in war zones or under occupation. Office towers, mixed-use resort-commercial centers, and even entire cities built from scratch are the dominant forms of real-estate developments. The fast pace of conception and construction of these cities combined with the incentives for overconsumption (via energy and water subsidies), raises many questions about the long-term implications of these investments, economically, socially, and environmentally.

Arab development agendas have so far not addressed the food and water security needs in the region. The management of freshwater resources has always been dominated by a culture of over-exploiting water supplies to placate rising demand, while ignoring the management of this demand. As a result, it is feared that the per capita freshwater share will be so diminished by 2015 as to become a limitation to economic development, human health and wellbeing, and perhaps even becoming life-threatening in some Arab countries. Moreover, access to water resources is contested in many parts of the Arab world, resulting in many instances in unequal access by large corporate users, wealthy investors, and others in entrenched power positions. It has proven difficult to mobilize sufficient support for vital policy reforms, in particular as these entrenched interests benefit significantly from and thus actively preserve the status quo.

Food security poses another major threat. Most Arab countries rely on food imports to offset the increasing deficit in food supply, and consequently run large trade deficits in agricultural commodities. Arab countries are the largest net importers of cereals in the world, with Egypt being the world's biggest wheat importer. As a result, most countries in the region are highly vulnerable to increases in food prices, such as those in recent years. The net import bill for main food commodities was estimated to be \$30 billion in 2008, including about \$18.3 billion for cereals. In constant 2008 prices and a growth rate of net imports equal to the projected growth in Arab population of about 1.6% per annum over the period 2010-2030, the net import bill for the main food commodities and cereals, will reach about \$96 billion and \$25 billion, respectively, in 2030. For cereals alone, the cumulative cost of net imports over the period 2010-2030 will be over \$450 billion.

In addition to the strain on public finances, Arab countries are vulnerable to export bans by other countries. For example, Egypt was left scrambling to replace more than 500,000 tons in wheat purchases after Russia imposed a nearly 11-month grain export ban in August 2010, as a drought decimated its crops. The inability of Arab countries to become self-sufficient in essential food commodities is also attributed to the adoption of policies that replaced the cultivation of cereals, which are likely to be affordable by the majority of the population, with feed (to raise

meats) and vegetables, commodities that are affordable by only the rich. It has been estimated that Egypt grows more food to raise animals than for humans to consume.

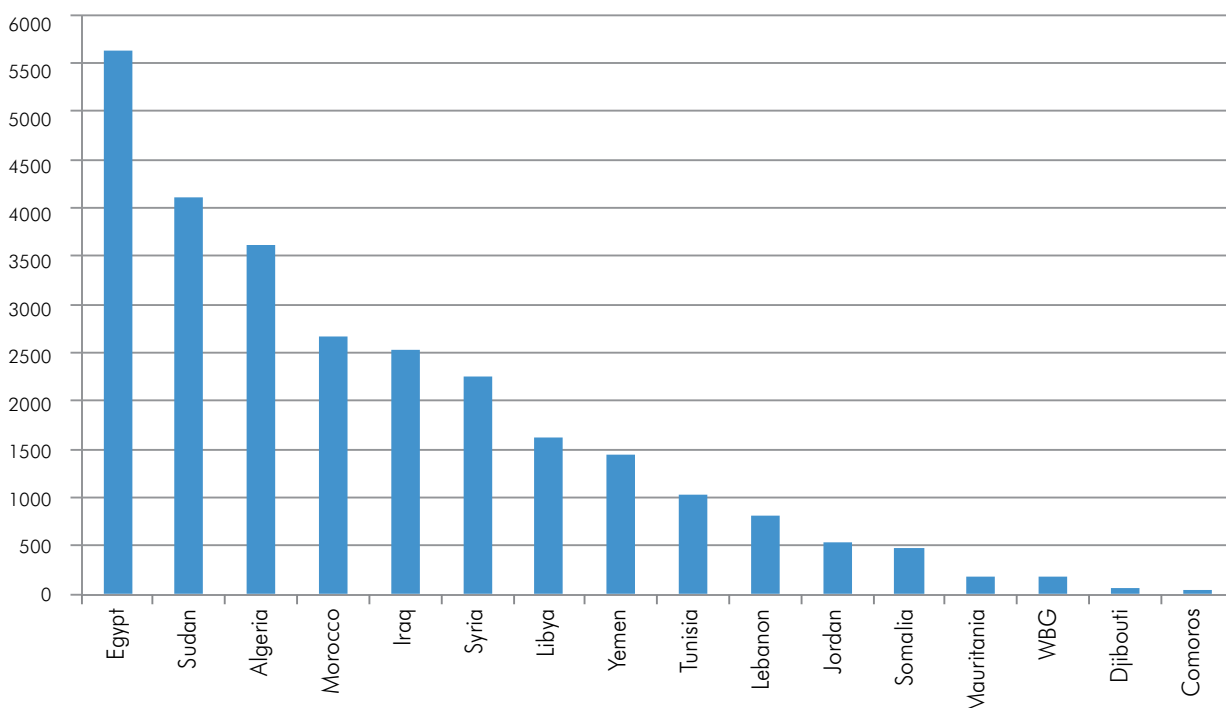
Compounding the issues of poverty on one side and food and water security on the other is climate change. The 2009 AFED report on the effects of climate change on Arab countries concluded that the impact of climate change in the region would significantly aggravate the risks of water and food shortages, threatening many livelihoods, particularly those with limited capacities to adapt. Despite stern warnings about impending threats to agricultural productivity and water availability caused by climate change, Arab governments have yet to formulate coherent strategies of mitigation and adaptation.

The economic development paradigms adopted by Arab states have contributed to impoverishment of the environment, reflected in the progressive deterioration in the qualities of air, water, and soil. For example, the release of toxic emissions by power plants, vehicles or industrial plants into the air causes harm to those exposed to air pollution. The dumping of wastewater into rivers or lakes may make freshwater unusable. Unsustainable agricultural methods and overgrazing cause soil degradation and undermine land productivity over time. Overexploitation of renewable water resources beyond their regeneration limit will cause fast depletion and deprive future generations of resource use. These types of environmental degradations impose real economic costs and distort the wellbeing of people and communities.

An assessment of the cost of degradation in 16 Arab countries associated with three environmental categories has been prepared for the Arab Economic Forum. The study addresses the health care costs linked to inadequate potable water, sanitation and hygiene, and to outdoor air pollution as well as the land degradation costs caused by agricultural crop cultivation. According to the assessment study, the annual cost of environmental degradation in these 16 countries was US\$27 billion in 2008. The cost estimates for each country are indicated in Figure 1. The annual cost in the ten countries covered in the study with the highest GDP per capita (Algeria, Egypt, Iraq, Jordan, Lebanon, Libya, Morocco, Syria, Tunisia, West Bank and Gaza) was on average equivalent to 3.1% of GDP, and equivalent to 8.7% of GDP in the other six countries (Comoros, Djibouti, Mauritania, Somalia, Sudan, Yemen). Of the 16 Arab countries studied, the highest annual costs were observed in Egypt at US\$5.6 billion, Sudan at US\$4.1 billion, and Algeria at US\$3.6 billion. The cost assessments of environmental degradation presented here are limited to three environmental categories, and do not include costs of rangeland, forest, and freshwater degradation, groundwater over-extraction, coastal and fishery degradation, inadequate waste management, desertification, potential losses in biodiversity and quality of protected areas, and the impacts of global climate change. Moreover, the costs of environmental degradation are sometimes incalculable. For instance, fertile topsoil, clean air, and a stable climate have no substitutes or engineered alternatives that are sustainable and economically affordable.

While monetary figures indicate the magnitude of the environmental damages imposed, and provide a measured tool of which environmental category should be prioritized, the inflicted harm must also be examined from a different angle. The poor, marginalized communities, and women and children often bear a greater burden of these costs, manifested in high child diarrheal mortality rates and child malnutrition resulting from inadequate access to clean water, sanitation,

FIGURE 1

ESTIMATED ANNUAL (2008) COST OF ENVIRONMENTAL DEGRADATION IN THREE ENVIRONMENTAL CATEGORIES (US\$ MILLION)

Source: Larsen, B. 2010. Cost Assessment of Environmental Degradation in the Middle East and North Africa Region - selected issues. Prepared for the Economic Research Forum, Cairo.

and hygiene. The inability of members of these groups to meet their most basic needs in health raises questions for Arab governments about social inequality and income disparities.

The shortfalls of Arab economies articulated above illustrate the negative repercussions of the “brown” economy model adopted by Arab countries. A development paradigm based on GDP growth, while contributing to social marginalization and resource depletion carries too high a risk for the wellbeing and stability of Arab societies.

THE ROLE OF AN ARAB GREEN ECONOMY

The long-standing belief that sustainable wellbeing can be achieved by raising GDP growth while neglecting or undermining sociopolitical and environmental progress needs to be fundamentally reconsidered and amended. The transformation AFED advocates for Arab countries needs to position economic development, environmental sustainability, and social equality as three equally indispensable dimensions to achieving human wellbeing. This forms the basis of the green economy.

As such, the green economy is about articulating values on how we define progress and prosperity. It is also about prescribing an approach for development guided by these values. The green economy is in essence an approach where economic expansion is promoted, the biosphere is protected, and social equality is

guaranteed simultaneously, with no progress along one dimension coming at the cost of deterioration in other dimensions. This framework entails that economic investments be promoted conditioned on the sustainable use of resources within earth's ecological limits, while enabling livelihood security and economic opportunity for all.

Furthermore, the green economy is characterized by attention to the vast potential to maximize resource productivity (particularly of energy and water) and reduce waste generation. In a green economy, investments are directed to the sustainable management of natural resources to maximize their economic and environmental productivity, and their capacity to create green jobs and support the poor. To enable these efficiency and productivity gains, the green economy must eliminate subsidies (particularly to fuel, electricity, and water) and other distortive incentives. Subsidies encourage overconsumption, typically do not adequately reach the poor, cause damage to environmental resources, and undermine green investments. Broad subsidies should be replaced with targeted subsidies to those who are most in need for assistance. The public funds saved can be reallocated to finance green infrastructure projects and various green incentive programs. In a green economy, participatory governance of natural resources is adopted inclusive of all stakeholders, particularly those groups with weak institutional power. This would ensure accountability and transparency in how natural resources are managed. These green economy characteristics are particularly relevant to addressing the shortfalls of current Arab economies and the policy gaps of the past four decades.

Public policy will play a key role in enabling green economy goals and enshrining its core values in policy and practice. Making progress towards an Arab green economy will require a fundamental review and realignment of current Arab public policies. In undertaking such a review, environmental and social goals must be accorded the same level of priority granted to economic goals. The new approach should ensure that short-term economic results do not ignore long-term social and environmental policy goals.

Today, Arab countries are undergoing seminal transitions politically and demographically. Over the period 2002-2008, Arab countries have experienced rapid rates of economic growth. However, those at the bottom of the economic pyramid have not felt the effects of this latest economic boon. The political uprisings made clear the popular demand for change. These trends provide Arab governments with an opportune time to respond to these changes by offering a new agenda for development that resonates with the demands of the people of the region. Arab governments should redirect their energies and vast resources towards making a transition to a green economy.

Making a transition to an Arab green economy entails pursuing sustainable development or "green" investments in those sectors (e.g. agriculture, energy efficiency, renewable power, waste management) that have been noticeably neglected by Arab governments, as well as transforming to a sustainable or green basis those sectors (water, transportation, tourism, industry, buildings) that have been developed unsustainably as part of the brown economy.

A green development agenda for Arab countries will generate economic dividends, while improving environmental and social conditions. In addition to meeting the demand for change, an Arab green economy will address the

shortfalls of past Arab economic performance, from poverty and unemployment to food and water security threats.

The Arab green economy will demand investments anchored in physical assets including public transportation infrastructure, regional railway lines, waste-to-energy plants, renewable power plants, energy efficiency, and distributed solar energy systems in rural areas that lack grid connections. These green investments are all locally based with a captive market serving a rising population, ensuring stable dividends in the long-term while being partially sheltered from global market ups and downs. Moreover, these and other forms of green investments in clean production will generate significant and well-paying employment opportunities.

In addition, investments in natural resource sectors such as agriculture and associated value-adding industries and services are potentially vast. Investments in agricultural productivity as well as irrigation efficiency improvements are particularly needed. The production of biofuels derived from agricultural wastes is an idea that requires investments in research and development, but if risks can be hedged, the financial rewards could be high. Investments in agriculture will contribute to rural development and higher incomes, and provide the needed economic opportunities to farmers to get out of debt and poverty. Moreover, investing in sustainable agriculture and irrigation efficiency are key ingredients to achieving food and water security. Particular attention should be given to sustainable agricultural practices that contribute to soil conservation.

The second area in which an Arab green economy may address brown economy shortfalls is in making the economy more efficient over the long term, which would enhance economic productivity, lower costs, and reduce per unit of GDP waste, pollution, and the use of materials and energy. Creating a market for efficiency products and services will stimulate investments in research and new products and the creation of jobs.

Finally, the Arab green economy will contribute a new vision for a different social and political order for millions of people in Arab countries. The specifics of this new vision will take shape through the actions of millions of Arabs during this transitional period. The current uprisings in a number of Arab countries have revealed that improved sociopolitical conditions including social justice, social equality, and economic and social empowerment are integral to development. The uprisings have also revealed the extent to which the brown Arab economy has contributed to the concentration of power, wealth, and decision-making in the hands of a few, causing deprivation and marginalization.

ARAB GREEN ECONOMY: OPPORTUNITIES AND CHALLENGES

To meet the demands of a truly sustainable development agenda, Arab governments need to develop long-term strategies that address the economic, social, and environmental challenges facing the region. This report was prepared by the Arab Forum for Environment and Development (AFED) to initiate and communicate a plan for a green economic development agenda. It is directed to Arab policy makers as well as to the Arab public. This report articulates the set of public policy options for making a transition to a green economy in eight sectors: agriculture, energy, water, cities and buildings, transportation, industry, waste management, and tourism. The report presents findings about

the performance of each sector under current policies and outlines the enabling conditions for green strategies and their potential benefits on economic, social, and environmental conditions.

This section presents a summary of the implications of current policies on the performance of each sector, followed by suggested policy recommendations.

Agriculture

Decades of distortive state policies, negligence, and misdirected investments have driven agriculture in the Arab region to its current precarious state. Agricultural strategies by Arab governments have lacked the integrated approach needed to promote development and alleviate poverty in rural areas, where institutional structures and organizations are weak and effective extension services are lacking. As a result, small farmers remain marginalized and indebted. Foreign aid by international financing and development institutions has benefited large landholders, state agents, and multinationals, further marginalizing small and poor farmers.

Most water irrigation systems in Arab countries are inefficient. Agriculture already uses over 85% of available natural freshwater resources with an efficiency of less than 50%, reaching as low as 30% in many Arab countries. With domestic and industrial water demand rising, the allocation of water will only become more contested in coming decades. Agricultural policies and practices in Arab countries have often disregarded the protection of natural resources and ecosystems, leading to soil erosion, land degradation, salinization, water pollution, and depleted aquifers. Such externalities are exerting increased pressure on limited agricultural resources, with short and medium-term benefits achieved at the expense of long-term agricultural sustainability. As a result, crop productivity, especially of cereals, grain legumes, and fodder crops, is at a very low level in the Arab region.

A more sustainable approach is needed for utilizing the limited land and scarce water resources, built on a mix of policy reforms and best agricultural practices. Subsidy and land reforms need to be introduced. The empowerment of farmers and agricultural workers needs to be at the core of broader social and economic development strategies. The concentration of land in relatively few holdings and the problem of landless agricultural families need to be addressed. Appropriate policies are needed to maintain the sustainability of surface and ground water resources and to ensure their efficient utilization in irrigation, with emphasis on water productivity rather than yield maximization per unit of land. The application of an appropriate structure for incentives and regulations can be instrumental in raising irrigation efficiency, which in turn leads to increasing water and crop productivity and reduces negative impacts on the environment.

These policy reforms can have significant ramifications on Arab food and water security. It is estimated that raising cereal productivity from its low level of 1,700 kg per hectare in six Arab countries (Algeria, Egypt, Iraq, Morocco, Sudan, and Syria) to the world average of 3,700 kg per hectare, coupled with an improved irrigation efficiency of about 70%, would yield significant benefits. Overall cereal production in these countries would increase by 50 million tons, enough to offset the current 20 million tons shortage and even generate a surplus of about 30

million tons and 12 million tons in 2030 and 2050, respectively. If Sudan alone were able to raise cereal productivity from its current level of 567 kg per hectare to that of the world average, it would increase its cereal production by 28 million tons, enough to more than meet the estimated 2030 cereal production shortage of 20 million tons.

The dominance of rain-fed agriculture in the Arab region makes it imperative to undertake actions to promote the productivity of rain-fed crops. This objective can be achieved if suitable quality inputs become available and are used in appropriate quantities. Research is an indispensable core activity for arriving at the optimal mix of inputs and discovering drought-resistant cultivars and salt-tolerant crops. New eco-agricultural methods, protective of soils, land, and water, such as organic and conservation farming methods, should be promoted and supported.

Globally, the market for organic produce has grown from US\$15 billion in 1999 to US\$55 billion in 2009. Organic agriculture provides more than 30% more jobs per hectare than traditional forms of agriculture. Promoting sustainable agriculture in Arab countries will generate new jobs and incomes for rural populations, while creating a market niche for Arab agricultural products in international markets.

In general, investing in rural economic development cannot be underestimated. Over the past two decades, the share of the labor force in the agricultural sector in the Arab region has declined from 44% to 29%. Revitalizing the agricultural sector will thus increase its share in the labor force, improve living standards, and limit rural to urban migration. Increasing the share of workers in the agriculture sector to 40% in the Arab region would generate more than 10 million jobs in the sector (from 27.5 to 37.8 million), based on 2010 estimated Arab population figures. Given that 76% of the poor in the Arab region live in rural areas, the prospect of providing economic and social lift to rural and agricultural communities will contribute to promoting equity and stability.

Adopting the various strategies highlighted above have the potential to offer significant and tangible benefits to Arab countries. For example, shifting to sustainable agricultural practices are expected to result in savings to Arab countries of between 5-6% of GDP as a result of increased water productivity, improved public health, and protected environmental resources. Based on 2010 Arab countries' GDP figures, the savings will amount to US\$114 billion.* In addition, revitalizing the agricultural sector through adequate investments and research and development should result in at least a 30% reduction in imports over the next five years, thus contributing to increased food security. This would result in at least US\$45 billion savings for the region over a five-year period.**

NOTES

* This figure is based on the estimated cost of environmental degradation provided by the World Bank for Morocco in 2000, which did not factor in other benefits and savings such as positive health impacts, increased potential for accessing external markets, reduced rural to urban migration, and increased employment opportunities.

** Based on 2008 cost of imports of food for the region estimated at US\$29.9 billion, and without factoring in increase in food demand due to population growth, and increase in food prices.

Water

The state of water resources is nearing a crisis in most Arab countries, driven by misguided short-term outlooks and political inertia when it comes to introducing reforms. As a result, the Arab world is expected to face the prospect of severe water scarcity as early as 2015, where the per capita water share per year will be less than 500 cubic meters. This is less than one-tenth of the global average of over 6,000 cubic meters. An annual per capita water share below 1,000 cubic meters is considered to pose a significant constraint to economic development, health and wellbeing; below 500 cubic meters, water scarcity becomes a threat to life.

In Arab countries today, more than 45 million people, or 10% of the total population, lack access to clean water and safe sanitation. Government public budgets are already constrained and can hardly sustain efficient levels of water services to current populations, which are growing at 2-3% annually. This growth is adding pressure to already crowded and inadequately serviced cities. The political economy of low water tariffs and water subsidies in Arab countries has contributed to the overuse of scarce water resources. Due to such distorted incentives, an ethic of moderate use and rational consumption of water is critically lacking, an alarming fact given the water scarcity in the region.

Arab states have often encouraged the over-exploitation of groundwater resources to placate farmers, industrialists, and developers. Non-renewable water aquifers are disappearing fast, while renewable groundwater resources are being over-exploited beyond safe yield levels. While these practices may provide a respite in the short term, the sustainable health of these freshwater resources will be diminished in the long term; future generations will pay the cost of these unsustainable practices. In addition, water pollution is a serious challenge in the region, attributed to the use of high levels of chemicals in agriculture as well as to increasing inflows of inadequately treated domestic and industrial waste into water bodies. The lack of sanitation facilities for large segments of the population contributes to water pollution by raw sewage.

The annual health care cost associated with the lack of clean water and sanitary conditions in 16 Arab countries was found to be approximately US\$8.5 billion in 2008, equivalent to 2.7% of the countries combined GDP. Increasingly, a large proportion of families' income is now being used to purchase drinking water. The costs of water-borne diseases continue to mount. The increased incidence of these illnesses contributes to absenteeism from work and school and to lost productivity.

Addressing the challenges of the water sector in Arab countries must begin with introducing institutional, legal, and policy reforms that affect water use, regulation, and governance. Arab states need to shift the focus from large-scale investments in supply side projects and instead concentrate on demand side policies that control and regulate water access, promote irrigation and water use efficiency, and prevent water pollution. For example, economic incentives can be established to reward efficient water use while enforceable penalties can be instituted for violations. Water demand management has demonstrated the ability to yield significant benefits, by improving efficiency, cutting losses, and protecting water from overuse and pollution, while often proving to be more cost-effective than conventional supply management measures.

The water crisis will require policy action across multiple dimensions. Land tenure reforms, water subsidies, water rights, regulatory frameworks, fair water allocation, watershed management, public participation, social empowerment, and democratic governance are all necessary pieces of the overall policy reform effort. Additionally, empowering women's groups, the poor, and farmers to have a voice in participatory decision making is needed, to ensure that their views, as traditionally voiceless stakeholders, are taken into account.

It is estimated that Arab countries will need to allocate at least 1.5% of their GDP annually to investments in clean sanitation, water infrastructure, innovative water efficiency, and recycling technologies in order to meet the expected rise in water demand. Based on 2010 GDP figures, this amounts to US\$28 billion annually.

Wastewater reclamation and grey water recycling are promising strategies for making use of marginal water. Building codes should make grey water recycling mandatory for new residential and commercial construction projects. A strategy for wastewater recycling should commit to strong institutional coordination and planning to ensure that wastewater is properly treated and appropriately reused according to requirements for protecting health and the environment.

Energy

Energy security in all Arab countries has become a major concern caused by rapidly increasing demand and the lack of diversification. The Arab energy system today is heavily dependent on fossil fuels to meet domestic demand, with oil and natural gas accounting for nearly 98.2% of total energy consumption in 2009. Almost all Arab economies are significantly vulnerable to the volatility of the global oil market. For oil-importing countries, reducing the size of the energy import bill continues to be a high priority, due in no small part to energy's significant burden on public finances.

Management of the local energy sector in many Arab countries is characterized by distortive policies, which bring about negative spillover effects. Collectively, Arab governments currently spend US\$135 billion on energy subsidies annually, a figure that accounts for about 7% of Arab countries' 2010 GDP. Energy subsidies tend to promote substantial wasteful consumption, send wrong signals to consumers and suppliers, undermine the economic viability of energy efficiency and renewable energy investments, aggravate environmental pollution and greenhouse gas (GHG) emissions, and pose a rapidly increasing burden on government finances. Moreover, subsidies typically disproportionately benefit the more affluent segments of Arab societies as the poor are smaller per capita consumers of energy.

Despite large-scale investments and subsidies in Arab energy infrastructure in recent decades, wide disparities exist in access to affordable modern energy services between different countries, and between urban and rural populations within the same country. Nearly 60 million Arabs lack access to affordable energy services, limiting their opportunities for economic development and improved living standards. In countries such as Sudan and Yemen, almost one-fifth of the population relies on non-commercial fuels like wood, dung, and agricultural residues, to meet their daily heating and cooking needs; the figure lies between 5-10% in Algeria, Egypt, Morocco, and Syria. These are not insignificant segments of the population. The indoor air pollution caused by these practices inflicts particular

harm to the health of women and children, who usually attend to cooking and other household chores.

Although levels of carbon emissions by Arab countries are among the lowest in the world, contributing only about 5% of the global total, the rate of increase in greenhouse gas (GHG) emissions is one of the fastest. This rate of growth was 4.5% from 1990 to 2003, which was surpassed only by South Asia which had growth of 4.9% during the same period. Moreover, the levels of CO₂ emissions per capita and per unit of GDP in some Arab countries are among the highest in the world. Qatar, Bahrain, the United Arab Emirates, Kuwait, Saudi Arabia, and Oman were among the top 20 CO₂ emitters per capita in 2006. Jordan, Saudi Arabia, and Syria were among the top 20 CO₂ emitters per unit of GDP in 2006. The 2008 average per capita electricity consumption in Arab countries (5,343 kWh) was double the world average (2,782 kWh), with the figure being particularly high in United Arab Emirates and Kuwait, whose per capital consumption was about 6 times that of the world average in 2008.

These figures indicate that Arab economies are spectacularly inefficient. Driven by urbanization, industrialization, population growth, and life style changes, the demand for energy in Arab countries is rising rapidly. Yet long-term national strategies to scale up energy efficiency are absent and the installed capacity of renewable energy sources, such as solar energy, remains negligible. Per illustration, Arab investments in renewable power sources make up less than 2% of global investments in renewable energy.

The environmental impacts of the fossil fuel-based Arab energy system threaten the socioeconomic development gains of the past few decades and contribute to local, regional and global ecosystem degradation. The burning of fossil fuels has caused the levels of air quality to deteriorate severely in urban centers such as Cairo, Damascus, and Sana'a, to mention a few. Air pollution levels in many Arab cities exceed World Health Organization standards, causing increased incidence of respiratory and cardiovascular illnesses and premature death.

The consequences of greenhouse gas emissions on Arab countries cannot be ignored, even though Arab countries' contribution to GHG emissions is only 5%. Desertification, predicted variations in precipitation, sea level rise, and more frequent droughts are particular concerns for the region, with likely impacts including decreased agricultural productivity, water scarcity, and the spread of diseases. Arab countries have a great stake in global agreements on the mitigation of GHG emissions. The negative impact of climate change on the region is expected to be substantial when translated in financial terms. According to the World Bank, the cost of environmental degradation attributed to climate change is estimated at 2.1% of GDP for Tunisia and 4.8% for Egypt. Taking the average (3.5%) of these two figures to represent the cost to the entire region, environmental degradation attributed to climate change will cost Arab countries US\$65.7 billion annually.

Against this background, only a policy shift towards sustained investments in energy efficiency and in renewable power sources can provide the underpinning necessary to drive the change to an economically and environmentally more sustainable energy sector. Based on global investment projections in the energy sector over the next decade, and assuming that Arab countries will capture 20% of global projected energy demand, the level of Arab investment in energy is

estimated to be US\$200 billion annually. A strategic long-term shift in Arab countries to renewable sources of energy by 50% will require US\$100 billion of investments annually.

A gradual shift to renewable energy sources can be mandated by introducing renewable energy portfolio standards combined with incentives such as feed-in tariffs and tax exemptions to the early adopters. Energy efficiency investments targeting buildings, manufacturing, and transportation can be spurred through a mix of regulatory standards and economic incentives. Building codes that set minimum requirements for energy-efficiency have demonstrated to be effective in reducing energy use and carbon emissions over the lifetime of the building. To rein in demand growth for transport fuel, Arab governments must mandate by law vehicle fuel economy standards, particularly given the rapidly growing vehicle fleet size and the large share of energy consumption by the transportation sector in Arab countries. Regulatory authorities in Arab countries should also mandate efficiency performance standards for electric appliances, equipment, and lighting in homes, commercial buildings, and industrial facilities.

Savings resulting from energy efficiency measures in the Arab region can potentially be very significant. Taking the 2008 average per capita consumption of electricity (5,343 kWh) in Arab countries as a baseline, a reduction to the world average per capita consumption of 2,782 kWh through the energy efficiency measures described earlier would generate electricity consumption savings of about 900,000 billion kWh. Based on an average unit cost of electricity of US\$0.081 per kWh from natural gas, the monetary savings to the economies of Arab countries would reach US\$73 billion annually.

In addition to lowering the energy bills for end-consumers (or the cost of subsidies), there are other significant indirect benefits. The peak electric demand levels will be lower, which will reduce the need to build costly new power plants to meet this demand, yielding billions of dollars in cost savings. Other benefits include improving the long-term reliability and stability of the electric grid and other sub-systems of the energy infrastructure system and reducing the emissions of toxic air pollutants and of greenhouse gases.

Along with introducing efficiency standards, the gradual phase-out of fossil fuel consumption subsidies is fundamental to shaping the long-term evolution of the energy system. The savings from reducing or removing government subsidies can be re-allocated as financial incentives to spur investments in energy efficiency and renewable sources of energy. A 25% reduction in energy subsidies would free up over US\$100 billion over a three-year period.

Investing in renewable energy and in energy efficiency measures across different sectors has been demonstrated to generate employment opportunities. Studies indicate that the renewable energy sector generates more jobs than conventional energy. The total labor force in the Arab region in 2009 was estimated at 94.6 million, out of which about 3% were employed in the energy sector. An investment of US\$100 billion annually in renewable energy alone is expected to create about 565,000 new jobs over ten years.

Contemplating the future of the Arab energy system leaves us to examine Arab governments' desire and ability to invest in nuclear power. The ability of Arab countries to manage the entire lifecycle of nuclear power is highly questionable.

Critical safety and technical issues such as nuclear waste storage and disposal remain to be resolved. Moreover, the technical capacities to build, operate and maintain nuclear power plants in Arab countries is extremely weak, which raises potential energy security and dependency concerns over the heavy reliance on expatriate labor. Coupled with the restrictions to import enriched uranium from other countries, nuclear energy might not be a viable policy option for long-term energy supply or security in the Arab region. Priority should be given to investing in renewable sources of energy, such as solar and wind, energy efficiency, and cleaner use of locally available energy sources. Such investments bring with them significantly reduced safety concerns, can be developed with local human and technological capabilities, and will have a greater impact on economic development through job creation. As far as the use of nuclear power, Arab governments should commission public studies about the costs and benefits of investing in energy efficiency and renewable sources of energy on one hand, and nuclear power on the other hand. Moreover, Arab governments should facilitate public input about the future of nuclear power in Arab countries.

Industry

Despite their dependence on oil and gas resources to generate revenues and promote industrialization, many Arab countries have not yet developed coherent carbon-management strategies that could reduce energy consumption and carbon emissions and meet long-term conservation goals for future generations. Carbon-intensive industries, such as oil and gas, chemicals and utilities, taken as a sector, are the most significant human-made contributors to GHG emissions. Arab governments have not taken a proactive approach to GHG emissions reduction, although the benefits go beyond short-term economic gains. The lack of low-carbon industrial strategies is emblematic of Arab governments' failure so far to balance short-term economic growth with long-term economically and environmentally sustainable development.

Investing in carbon-reduction programs and projects in Arab countries can contribute to turning the growing global pressure around climate change into an economic opportunity. Arab countries should develop low-carbon industrial development strategies motivated by the opportunity to become energy efficient economies. This would have the effect of enhancing local industrial competitiveness, income diversification, and new job creation. In addition to mitigating GHG emissions, air quality stands to be improved.

Developing national and regional low-carbon strategies requires targeting energy-intensive sectors, where significant and cost-effective impacts can be gained. One of the most important measures to reduce emissions is deploying the most efficient production technologies in new plants and retrofitting energy efficiency equipment in existing plants where it is economically viable. The reduction in energy requirements per ton of product can be on the order of 30%. For example, energy efficiency enhancements in cement manufacturing can reduce energy consumption per ton of cement by 20% to 40%, leading to an advantage to the producer through lower energy costs.

Other initiatives that contribute to improving the efficiency of manufacturing processes include the use of efficient motors, efficient heating and cooling systems, and renewable energy sources. It is important that Arab governments support such initiatives with adequate financial incentives, particularly given the low prices of

electricity that prevail in most countries. The cost of supplying these incentives will be more than offset by the cost savings through a reduction in peak load electricity generation requirements.

The share of the industrial sector in electric power consumption in Arab countries stands at about 500,000 billion kWh. A 30% reduction in energy requirements due to more efficient industrial processes is estimated to result in a saving of 150,000 billion kWh annually, which translates to approximately US\$12.3 billion.

To upgrade existing industries, a number of measures can be used to stimulate the local market for energy-efficient products by providing the right incentives for private sector players. Governments can impose minimum energy and water efficiency standards that products must meet if they are to be sold in the country. Alternatively, utilities can offer rebates to industrial enterprises buying new equipment that fulfill certain minimum efficiency standards, or replace old, inefficient equipment for a nominal fee. Raising electricity tariffs or re-structuring them in such a way as to make overconsumption more expensive, can make the business case for buying new, more efficient equipment much more attractive.

To create and grow new low-carbon industries, Arab governments are required to develop national industrial policy strategies to support the private sector. The industrial policy should provide an appropriate institutional setting, develop a favorable policy and regulatory framework for low-carbon industries, and promote research and development (R&D) capabilities.

Contrary to popular belief, addressing GHG emissions can be profitable. Energy efficiency measures, central to many GHG emissions management initiatives, generate direct cost savings by reducing fuel consumption. In many cases, energy efficiency measures pay for themselves, with payback periods of less than three years.

Transportation

The transportation sector in Arab countries suffers from deficiencies and poor performance. This is primarily driven by public institutions' capacity gaps to develop adequate intervention strategies, allocate investments effectively, and improve regulatory capabilities. As a result, the capacity of the transportation sector to provide reliable, affordable, and safe transportation services has for the most part not materialized. Although the demand for transportation services in Arab countries has been rising, efficient public transport systems remain underdeveloped, leading to excessive reliance on private cars. For instance, annual growth rates of 7-10% in vehicle fleet size have been observed in Jordan, a pattern similar to those in other Arab countries. Despite investments in road transport networks and infrastructure in recent decades, the performance of the sector continues to be undermined by serious traffic congestion in urban centers, poor air quality in many cities, land degradation, and high rates of greenhouse gas emissions.

Uncontrolled growth and poor planning in Arab cities have been responsible for urban sprawl, longer travel distances, and increased vehicle use. The construction of more highways has led to the loss of agricultural land around the urban centers such as Amman and Cairo. Regional transport networks suffer from inefficiency and delays. Fatalities and injuries from road transport in a number of Arab countries remain high compared with other regions of the

world, causing suffering, lost incomes, and high health care costs, all of which translate to economic losses.

The Arab transport sector is a large and inefficient consumer of energy, accounting for 32% of the total energy consumption and 22% of the total greenhouse gas emissions in Arab countries. In addition, poor fuel quality and an ageing vehicle fleet contribute significantly to the poor air quality observed in a number of Arab cities. Greenhouse gas emissions and air pollution are identified as the most alarming implications of current transportation policies and infrastructure development. For example, the total cost of damages from air pollution in Jordan averaged \$161 million in 2006, or 1.15% of GDP. The health care costs of air pollution (not all of it caused by transportation) have been estimated to be US\$10.9 billion in 2008 for 16 Arab countries, equivalent to 1.2% of their combined GDP.

These transportation trends impede efforts in Arab countries to create jobs, promote rural socioeconomic development, and improve regional integration. Arab cities are increasingly choked by traffic congestion, poor air quality, noise pollution, and poor visibility, which do not bode well for the wellbeing of their inhabitants or for the cities' economic competitiveness. The lack of adequate mass public transport in many Arab cities deprives many communities access to economic centers and social services. These trends lead to significant losses in economic productivity, on the order of a 3-10% loss to a country's GDP. The lack of adequate public transport also perpetuates social inequality and exclusion.

Government policy interventions affecting transportation planning, financing, regulations, and vehicle technologies can provide the underpinning necessary to drive the change to a sustainable or green transportation sector. The target of these policies should be the provision of dependable, affordable, and safe transportation services that are energy efficient, while minimizing pollution, congestion, and unmanaged urban sprawl.

Of the policy interventions that have been demonstrated to have relatively low cost but high economic, social, and environmental dividends over a short period of time are investing in mass public transit and introducing mandated vehicle fuel efficiency standards. A green approach to transportation planning should limit the continuous supply of more vehicles and highway construction to meet rising demand, and focus alternatively on managing transportation demand by promoting public transit and providing incentives to increase vehicle occupancy and reduce the number of kilometers travelled. Practices and measures that influence travel behavior and decrease dependence on cars have more lasting effects and are more cost-effective than investments sunk into road building and highway expansion that often remain short-term fixes.

The capacity and performance of public transportation institutions should be improved to enable the introduction of effective intervention strategies. Financial resources should be directed at expanding public transport systems and other demand management practices, improving accessibility to rural regions and marginalized groups, and deploying green transportation technologies.

It is critical to invest in public transport, be it an underground or a surface metro system, trains, buses or waterway transport systems whenever possible. The financial

savings to public budgets can be significant, while contributing to socioeconomic development, reduced GHG emissions, and improved air quality.

A projected target of 50% greening of the transport sector, resulting from higher energy efficiency and increased use of public transport and hybrid vehicles, should generate savings of 280 billion kWh or US\$23 billion annually. Energy efficient opportunities for rail transport of up to 40% are possible, as well as 20% improvement over 1997 aircraft efficiency standards is likely by 2015 and of up to 50% by 2050. It is estimated that shifting 25% of all air travel under 750 km to high speed rail travel by 2050 would result in a reduction of around 0.5 billion tons of CO₂ per year. By shifting 25% of all road freight over 500 km to rail, 0.4 billion tons of CO₂ per year could be saved. Decreasing transportation-related CO₂ emissions by 50% in Arab countries would reduce GDP losses by 1.5-5%. Applying an average of 3.25% would result in annual savings of US\$61.8 billion (based on 2010 GDP figures for Arab countries).

Cities And Buildings

Cities in the Arab region suffer from inadequate urban planning, and are characterized by chaotic land-use patterns and excessive urban sprawl. The uncontrolled growth of Arab cities has had numerous negative consequences. Arab cities have grown so fast that their infrastructure systems, such as those related to transportation, supply of water and electricity, and waste management, have all become incapable of adequately supporting their populations. Overwhelming traffic congestion and poor planning heavily impede mobility in these cities. Air pollution levels, primarily from vehicular emissions, have become extremely high in the Arab world's larger cities. Many cities suffer from solid waste and wastewater management problems. The lack of efficient sewage disposal networks has meant that sewage is often illegally dumped, usually making its way to city streets or coastal waters. Moreover, many Arab wealthier cities are currently undergoing massive urban transformations in a race to claim a globalized city status and become a regional capital for finance, culture, education, media or medicine. The scale and quality of these top-down undertakings raise serious questions not only about cultural alienation and the role of identity in urban development, but also about environmental sustainability.

Environmental degradation in and around Arab cities has reached alarming levels. Air, water, and soil contamination now pose serious health risks and threaten various economically important activities, particularly those related to food production. Numerous ecosystems and agricultural land in and around Arab cities have been destroyed as a result of uncontrolled urban growth. Scarce agricultural land, forested areas, grazing areas, and water bodies, such as streams, all have been decimated because of such growth. Public green areas, which serve as cities' breathing spaces and essential places for relaxation and leisure for inhabitants, are very much lacking in Arab cities. While most cities in the United States feature 20-40 square meters of green areas for each inhabitant, in Dubai, where there have been serious efforts to develop public green areas, the figure remains less than 14 square meters; in Beirut, the figure is less than 1.

Land prices and construction costs in Arab cities make access to adequate housing beyond the financial means of many. This lack of access to decent-quality affordable housing has contributed to the spread of slum areas, characterized by inadequate - if not completely absent - basic services and by ambiguous conditions regarding

land tenure. Slum areas are environmental blights where systems for solid waste management and sewage treatment are painfully lacking. In contrast to the spread of informal settlements that serve the poor of the city, privately managed gated communities and expansive suburban developments that serve affluent residents are becoming increasingly widespread. In addition to exacerbating socioeconomic segregation in cities, these low-density developments further contribute to urban sprawl and further expand the geographic limits of the city to unhealthy levels, resulting in inefficient, costly, and poorly functioning infrastructure systems.

There are also tremendous inefficiencies in energy consumption, which pervade all sectors and city activities, with some Arab countries ranked in the top 10 CO₂ emitters per capita and per unit of GDP. In Arab countries, buildings account for an average of 35% of all final energy consumption. The prevailing pattern in the region is of a building sector that has evolved without taking environmental and social considerations into account. Energy and water use in the existing building stock across the region, and in particular in commercial and public buildings, is alarmingly inefficient. In most commercial buildings, the currently installed systems for heating, ventilation, and air-conditioning (HVAC) have the lowest energy efficiency performance among available options, because of preferences for low cost systems over more efficient ones. This practice is aided by the prevalence of large subsidies for electricity in most countries of the region; in 2006, for instance, energy subsidies exceeded 7.1% of the region's GDP.

Among the challenges facing initiatives to introduce building efficiency regulations and codes are the lack of sufficient knowledge base within the industry, weak innovative capacity within local building supply chains to meet the demand for better materials and components, and weak institutional capacity within public agencies for monitoring and enforcement of environmental requirements.

To remedy these shortfalls, a new approach is needed for city planning and governance, built on environmentally sustainable urban design principles. Such an approach should entail protecting agricultural land in and around cities, safeguarding natural water resources, creating a safe public transportation system, designing energy-efficient buildings, adopting efficient water use, maintaining open green areas of native plant species, and rethinking the concept of waste management to incorporate extensive recycling. These efforts will create healthy and economically competitive urban communities that offer a higher quality of living for their inhabitants.

In order to facilitate the transition to green cities and buildings, a number of existing practices need to be "greened" and new green measures need to be introduced. One of the most effective urban planning policy tools for city and municipality authorities is zoning, which determines in fundamental ways what may be built where in and around the city, and how much may be built. City governors must have adequate transparency and accountability mechanisms in place to shield municipal staff from developers and entrenched economic interests groups who may attempt to influence and manipulate zoning regulations, such that decisions are made in the public interest above all.

Zoning can be best utilized to promote healthy urban density levels and mixed-use development of city neighborhoods. This would allow for a more efficient provision of various urban services and for residential, commercial, educational, cultural, and recreational centers to co-exist in proximity to each other. This

would allow for easy movement between them and allow their residents to enjoy numerous facilities, such as schools, shops, office space, and parks, close to their residences, reducing urban traffic congestion. High-density urban areas need to be coupled with efficient public transportation systems that facilitate movement between different parts of the city. High urban densities allow for public transportation systems to be more cost effective. There is also a very pressing need to make Arab cities more pedestrian-friendly, and even bicycle-friendly where appropriate.

A holistic design approach, incorporating environmental principles across the various design stages including building form, orientation, heating and cooling components, and other architectural aspects, yields the highest results. The cost to benefit ratio of passive design elements, which do not use mechanical and electrical systems, are much more rewarding than the 'active' approach that uses newer technologies. Therefore, passive design elements that take advantage of the climate, for example to heat or cool a space, should be exhausted before investing in state-of-the-art high technology components. Integrating energy efficient considerations in the design of buildings is expected to result in a reduction of about 29% of projected emissions by 2020. In Arab countries, applying this percentage reduction to the building sector's energy consumption share of 748 billion kWh would cut consumption by 217 billion kWh by 2020 and generate savings of US\$17.5 billion annually.

In terms of construction work and building materials, building codes and standards are the main institutional levers for influencing construction practices and material selection. Governments can create policies for procurement, contract specifications, building performance, and building codes regulating municipal standards. In addition to design and construction technology, buildings' environmental performance can be improved through the choice of installations and components such as heating and cooling systems, lighting, appliances, and water fixtures. The potential savings from promoting energy saving households appliances, light fixtures, and office equipment can result in significant reductions in energy consumption, to the order of about 50% relative to current levels.

Transforming conventional buildings into green buildings will contribute to addressing the unemployment problem in urban centers and create a new cadre of workers for which a growing market is expected in the region and worldwide. According to a United States study, greening buildings is said to create between 10-14 direct and 3-4 indirect jobs for every US\$1 million spent on efficiency retrofits. This figure is expected to be double or triple in the Arab region given the lower average labor productivity and cost factors. Spending US\$100 billion in greening only 20% of the existing building stock in the Arab countries over the next 10 years, by investing an average of US\$10,000 per building for retrofitting, is therefore expected to create 4 million jobs. The payback period for energy and water efficiency retrofits ranges between 2-7 years, based on the level of subsidy.

The case for green transformation of the building sector is also an economic and social one. Removing water and energy subsidies and directing a portion of these savings towards green social housing will help reduce the cost burden on low income households for basic services (through efficiency gains). In this context, investing in green buildings can complement other strategies in improving access to basic services and living conditions for the poor. At the same time, this shift in

subsidies removes one of the key market distortions and provides an economic justification for green buildings in the housing market. Consequently, promoting green building practices will have far reaching implications for sustainable urban transformation and for socioeconomic development in a region experiencing rapid urbanization and high unemployment rates.

It is estimated that the amount of spending on building and construction in Arab countries will reach US\$116-233 billion in 2012. If Arab governments commit to greening the construction sector, spending will have to increase by at least 20% resulting in additional investments of between US\$23-46 billion in the same year. These additional green investments will create 10% more green jobs in the same year.

Traditional design approaches in Arab architecture are in many cases more responsive to environmental elements. These approaches incorporate much of today's knowledge about climatic design - a process of identifying, understanding, and controlling climatic influences at the building site - for achieving comfortable and healthy environment for inhabitants. Devices such as wind towers, courtyards, vegetation, fountains, shading elements, the orientation of the house, and the various means of dealing with passive energy in traditional architecture, are typical examples of environmentally sustainable traditional design. The rich architectural heritage of the region should be considered, adapted, and applied where relevant and appropriate in the context of contemporary conditions and should complement modern technologies, and as such contribute to environmental and cultural sustainability.

Solid Waste Management

The waste management sector in Arab countries is characterized by underdevelopment, underinvestment, and high-risk "waste dumping" practices. Although the volume of waste generated is alarmingly increasing, high-level political commitment to waste management is weak, with many Arab countries lacking national strategies or integrated plans for municipal solid waste (MSW) management. It is estimated that MSW generated in Arab countries in 2020 will exceed 200 million tons per year. Although close to 80% of total MSW generated is decomposable and recyclable, the recycling rate is lower than 5%.

The sector is plagued by insufficient regulations and weak waste disposal standards. Proper waste collection and transport systems are lacking and coverage is inadequate. In many Arab countries, uncollected waste may account for up to 50% of all waste generated with most of the waste directed to open or controlled dumpsites. Open-air burning is often used at these dumpsites. Moreover, MSW is commonly mixed with industrial and medical wastes during disposal. Improper dumping and open-air burning of solid waste allow decomposed waste products to pollute the air, ground and surface water, and soil. These pollutants may then find their way into the air or enter the food chain, causing direct health hazards. In general, financing for waste management is strained by limited budgets and inadequate cost recovery. It is common for cities to spend 20-50% of their available recurrent budget on solid waste management. Yet it is also common for one half of the urban solid waste to remain uncollected and one half of the city population to be unserved by MSW collection services.

It is estimated that the annual damage costs from inadequate waste management as a percentage of GDP were 0.3% of GDP for Arab countries in 2006, which means that greening the waste management sector would save Arab countries US\$5.7 billion annually based on 2010 GDP figures.

Given the sector's state of underdevelopment and unsustainable practices, there is an urgent need for a fundamental shift in the approach to MSW from waste dumping, burning, and/or land-filling to a resource management approach that seeks to capture value from waste materials through reduction, reuse, recycling, and recovery. This can only be achieved by regarding waste not only as a costly liability, but as an economically valuable resource that can be altered and reused in a manner that addresses public health and environmental concerns.

Arab governments need to develop national waste management strategies and master plans that provide political backing for undertaking a waste minimization and diversion approach to MSW. The aim of waste reduction is to eliminate waste before it is produced and to reduce both the quantity and toxicity of waste. The broader definition of minimization encompasses three elements which are, in order of desirability, avoiding or reducing waste generation and increasing waste quality at the source, material recovery through reuse, and recycling.

In order to achieve financial sustainability, the first step is to have an understanding of the actual cost of MSW services in Arab countries. Investment needs in the sector over the next 10 years in West Asia and North Africa have been estimated at over US\$21.6 billion annually, broken down as follows: collection and transfer (38%), land filling and composting (27%), mechanical and biological treatment (17%), dump upgrade or closure (12%), and waste-to-energy (6%).

Financing can be made available through a combination of tariffs and local taxes, attracting private sector investments, extending producer responsibility, and raising revenue from the sale of reused and recycled products. However, what creates the most dividends is building a foundation for waste minimization in the first place, and investing in the infrastructure for waste recovery.

Government public policies, public-private partnerships, and/or innovative financing and cost recovery schemes would encourage investment in waste reduction, reuse, and recovery. These green policies can take the form of economic incentives, mandates for extended producer responsibility, regulations in favor of green solid waste management, and cost recovery. The effectiveness of these policies can be significantly increased by sustained campaigns for public awareness, mass education, and social marketing. Political engagement and public participation are necessary preconditions.

Municipal solid waste management directly stimulates the economy because it is labor-intensive and requires investments in machinery and equipment for handling, transport, and processing. Developing a green MSW management sector provides opportunities for the diversification of Arab economies. It contributes to job creation and stimulates demand for products, systems, and services in other industries including agriculture, manufacturing, construction, waste-to-energy, processing, transportation, retailing, and professional services.

In addition to stimulating multiple economic activities, green MSW

management offers outstanding investment opportunities in recycling, composting, and energy production. Organic food waste, which accounts for 40-80% of municipal waste in Arab countries, can be used to produce compost for agricultural use and biogas to replace fossil fuels. Converting waste into value-added products while recovering energy is still in its infancy in the Arab world with a significant potential for expansion. Incentives for producing organic compost or recovering energy from solid waste are needed to attract investment.

Tourism

Tourism has become an important sector in the economies of most Arab countries, contributing to economic diversification, job creation, and foreign exchange earnings. However, adverse environmental and social effects tarnish the sector's economic achievements. The unregulated procurement, travel, accommodation, recreation, and hospitality services, coupled with uncontrolled resort construction, have led to the excessive use of energy, irresponsible use of water, and the generation of large amounts of waste. The sector's contribution to global GHG emissions continues to grow annually by 2-3%. The extensive

PROPOSED REGIONAL INITIATIVES

Apart from efforts at the national level to facilitate the transition to a green economy, cooperation among Arab countries needs to be promoted. AFED is proposing some regional initiatives in this direction, which should be established and managed by governments as well as regional bodies, such as the League of Arab States (LAS), the Gulf Cooperation Council (GCC), and the Arab Maghreb Union (UMA).

Arab Sustainable Development Institute (ASDI): A regional Arab institution will be needed in order to provide policy guidance to public policy makers and policy institutions in Arab countries. The proposed Arab Sustainable Development Institute can do so by articulating the types of public policies that will be needed for a transition to a green economy. The institute's mandate will include developing and assessing the benefits and costs of proposed sectoral policies including incentives, price signals, subsidies, tax credits or exemptions, grants, green financing mechanisms, and revenue neutral rebates, among other mechanisms. Issues such as equity and fairness, impact on different stakeholders, and potential implications on different segments of the population, particularly the poor, should be taken into account in assessing policies. The proposed Arab Sustainable Development Institute should also be given the mandate to organize on a regular basis short executive policy education courses to develop and enhance the capabilities of mid-level Arab

policy-makers to formulate public policies. Seminars and briefing sessions can also be organized for policy makers to disseminate best practices and share lessons of sustainable development policies.

Arab Fund for Research and Development (AFRD): Innovative green technologies, products, and processes will be needed to address the specific requirements of the region's transition to a green economy. Innovation is spurred through research and development (R&D) that is locally established and funded. Therefore, investment in research and development is necessary to build an Arab-based pipeline of innovations at various stages of development. The proposed Arab Fund for Research and Development would provide the funding needed to support R&D activities at research institutions, public and private sector organizations, and universities. Aside from transforming green concepts into new products, R&D is fundamental to creating and capturing distinctive high value-adding opportunities that drive high-margin profitability and fuel economic expansion.

Arab Renewable Energy Center (AREC): Renewable energy programs, of different scopes and in various countries of the region, remain scattered and largely experimental, with little or no regional coordination. The Arab Renewable Energy Center (AREC) is proposed to promote renewable energy

construction of sea resorts causes coastal and marine ecosystem degradation. In addition, questions have been raised about the implications of introducing globally inspired models of tourism on society, culture, and community development.

The Middle East and North Africa have approximate shares of 6% and 2% of global tourism, respectively. The share of international tourism to GDP varies between 26% in Lebanon, 17% in Jordan, 12% in Egypt, 10% in Morocco and Tunisia, and 9.0% in Bahrain. The share of international tourism receipts to total exports in 2009 was highest in Lebanon (33%), followed by Jordan (28%), Morocco (26%), Egypt (22), and Syria (19%). In Egypt, tourism was responsible for one in every seven jobs in 2010. In 2010, the contribution of tourism to total employment in the Arab region was about 4%.

Given the region's potential to attract international tourism and the need for economic diversification and employment opportunities, the sector has been the target of significant investments. Apart from the coastal resorts in the North African Arab countries, other countries in the region including Abu Dhabi and Dubai (in the UAE), Oman, and Qatar have identified the market for conventions, conferences, and cultural attractions as a feasible tourist niche.

solutions suitable for the region, and coordinate between national initiatives to facilitate cooperation and transfer of experience.

Regional Center for Sustainable Communities (NCSC):

Given the fast pace of urbanization and construction activity in the region, and the impact on the demand for, provision, and allocation of services, it is critical to adopt sustainable urban design principles and practices when managing the growth of cities. The proposed National Center for Sustainable Communities will be entrusted with disseminating best practices on land use patterns, mixed-use development, zoning regulations, and smart growth. The center should also develop standards and building codes for green and sustainable buildings including wastewater and solid waste recycling.

Regional Network for Cleaner Production:

Arab countries should establish an effective network of national cleaner production centers to promote R&D and disseminate best practices in clean production and processes. The mission of such a network would be to develop the capacity of manufacturers to shift to more sustainable patterns of production, reduce waste, and use resources efficiently.

Regional Agricultural Projects: Promoting cooperation between Arab countries in the field of

sustainable agriculture is critically needed. Joint agricultural initiatives and collaboration should optimize the use of land and water resources in the region, based on the comparative advantage of each country, while contributing to regional food security and rural development. Regional agricultural projects can be designed to bring the resources of different Arab countries including land, labor, water, finance, and know-how to complement each other. Investments in regional sustainable agricultural projects should seek to create jobs, increase the productivity of cultivated land and to bring additional arable land under cultivation using sustainable agricultural practices.

Arab Regional Transport Network: Arab countries should consider building an efficient, clean, and affordable network of rail lines connecting all countries of the region. This network will not only facilitate the movement of individuals but also merchandise, hence promoting trade and regional economic integration. A railway network will reduce transportation costs, provide access to regional markets that otherwise would be inaccessible, and stimulate the economies of those villages, towns, cities, and even regions that dot the path of the railway lines. This will have the effect of boosting agricultural, industrial, touristic, cultural, educational or service economic activities. The viability of introducing electricity-driven railway trains should be a priority.

The current trend of tourism development in a number of leading destinations in Egypt, Jordan, Morocco, Tunisia, and the Gulf countries is focused on integrated tourism centers (ITC), which usually are large-scale developments of over 200,000 m², located in coastal areas. Formed as clusters of hotels, residential homes, retail stores, marinas, and golf courses, ITCs are large consumers of energy and water and large generators of waste. One of the main concerns of ITCs in Arab countries is the maintenance of golf courses, which consume large amounts of water, a critically scarce resource in the region. The average water consumption of one golf course in the Gulf region is estimated at 1.16 million m³ per year, reaching 1.3 million m³ in Dubai, enough to cover the annual water consumption needs of 15,000 inhabitants.

The absence of binding regulations and the lack of monitoring are principal barriers to transitioning to a sustainable tourism sector. Green initiatives in the Arab tourism sector are currently almost entirely voluntary because Arab governments are unable or unwilling to formulate and enforce necessary regulatory standards to govern the behavior of investors and developers. Furthermore, limited investment incentives exist for green tourism. Conditions for ITC development rarely stipulate any environmental measures. In fact, governments typically even subsidize electricity, water, and fuel, leading to their overuse and associated negative environmental impacts.

Environmental impact assessment (EIA) studies are conducted only on a project-by-project basis, making it difficult to actually assess the cumulative impacts of tourism activities on the environment and the economy. Moreover, government agencies entrusted with reviewing EIA studies often lack expertise to make further recommendations for corrective actions.

While ministries of tourism would be expected to formulate the overall strategy for the tourism sector, it should be developed in close consultation and collaboration with other relevant ministries and stakeholders. This is because issues related to water, energy, transport, building, waste management, infrastructure, and socioeconomic development, do not fall within the jurisdiction and mandate of the ministry of tourism. The required coordinated policy response to promote sustainable and green tourism should involve the design of a package of policy instruments to include regulations, incentive measures, finance, environmentally sound technologies, and capacity building efforts coordinated across multiple relevant ministries and agencies.

Ecotourism as well as community-based cultural tourism play a significant role in nature conservation and in supporting local economies and halting rural-to-urban migration, thus contributing positively to the eradication of poverty. It is therefore important for international organizations and Arab governments to provide financial support to this small but important market niche.

Sustainable tourism, which is a broader concept than ecotourism, is being increasingly recognized internationally as the preferred option over conventional tourism. Destinations that enjoy clean and safe environments attract more tourists and generate more income than polluted and overcrowded destinations. Therefore, increased investments in sustainable tourism by Arab countries will increase their share of international tourism, while generating additional green jobs and higher income.

A 12% higher share of international tourism in Arab countries is estimated to generate

at least US\$228 billion annually, based on 2010 GDP figures, and an additional 5.6 million jobs, which would raise the sector's share of employment to 10%.

The impacts of sustainable tourism on energy and water consumption can also be assessed to determine the impact of efficiency measures on consumption reduction. Based on 2010 estimates, the Arab tourism sector attracted about 59.2 million tourists. The average energy consumption of a tourist staying for one week is estimated to be 798 kWh, which is some 20% higher than the average consumption in the region. The combination of adopting energy efficiency measures and utilizing renewable energy sources is estimated to reduce energy consumption by 45%, which could generate energy savings of 360 kWh per tourist per week or 21,300 million kWh per year for the Arab region. It will also reduce CO₂ emissions by 52%. Water efficiency measures will have the effect of reducing water consumption by 18%. Assuming an average water consumption of 300 liter per day per tourist, an 18% drop in water consumption will save Arab countries 22,400 million liters of water per year.

CONCLUDING REMARKS

Arab economies have underperformed, failing to meet basic aspirations once thought to be within reach. The current development paradigm adopted by Arab countries is not yielding improved conditions for millions of people in the Arab world. Unemployment rates are alarmingly high, poverty is stubbornly persistent, food and water security remain illusive, and the environment is impoverished, while Arab economies continue to be structurally fragile, undiversified, and inefficient. These shortfalls are the logical outcome of a development model based on a high throughput, energy-intensive economy, driven by consumption, services, and low value-adding activities.

However, the shortfalls of today's Arab economies go beyond policy gaps and distorted models. Arab governance systems have for a long time been unable to recognize that the economy, environment, and society are linked. Even when such recognition has existed, they did not have the capability or the political willingness to address these linkages. Therefore, Arab economies have not fostered sustainable development strategies. And this simple fact may explain why they are now confronted with aggregate impacts that may have reached the breaking point. The Arab uprisings may be one manifestation of the breaking point. In addition to policy gaps and distortion in development models, Arab economies' shortfalls are becoming rooted in social inequality, political disempowerment, and the concentration of wealth and power.

Thus, Arab economies today face a number of challenges and a choice between two futures. The brown economy future promises short-term economic growth in GDP terms while continuing to diminish the stocks of social and environmental capital. The green economy future offers the prospect of stimulating economic development while ensuring improved social and environmental conditions. This report lays the argument for why Arab governments should want to invest in the green economy future. All things being equal, the green economy offers the conditions for social stability, environmental sustainability, economic resiliency, and an authentic cultural identity that the Arab world desperately aspires to.

Arab countries are often described in terms of rapidly growing populations in a

region with scarce water and agricultural land resources. Although these taken-for-granted facts may represent some of the truth, there is little controversy over the fact that public policies have a significant role in promoting the sustainable management of these resources in a manner that meets the essential (food and water) needs of all people. Public policies do matter and can make a difference in sustainable resource use.

The willingness to pursue a green economy agenda provides a window of opportunity to initiate a fundamental re-examination and amendment of current public policies in Arab countries. The authors of this report have presented in each chapter the enabling policy reforms needed to make the transition to a green economy. This report does not have the last word. AFED intends for the ideas presented to stimulate discussions and debates across the Arab world about the costs, benefits, and risks inherent in different policy choices.

Agriculture

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I. INTRODUCTION

Agriculture comprising irrigated and rain-fed farmland is a complex activity with a multifunctional character encompassing economic, social, and environmental dimensions. The combination of agriculture and rangelands and livestock husbandry has played a key role in producing food and other commodities for human survival and development throughout the history of mankind. Today the ability of humans to sustain agricultural functions has come under close scrutiny triggered by population growth and increased pressure on limited resources.

Perhaps there is no region in the world today where agriculture faces daunting challenges to the extent that is the case in the Arab region. Population growth in Arab countries is among the highest in the world. Average per capita natural freshwater resources, only about one-tenth of the world average, is already at critical levels in most Arab countries. Agricultural productivity of principal food commodities such as cereals is the lowest in the world. Past agricultural policies and practices have compounded soil erosion,

land degradation, water logging, soil salinity, and water pollution. Furthermore, climate change disruptions are likely to inflict severe damage on agricultural productivity and water availability in the Arab region.

The advent of the recent food crises of 2007-2008 has generated renewed interest by Arab countries in promoting agriculture for food security. This adds to pressures on agriculture to combat poverty and provide economic opportunities in rural areas and redirect some of its share of clean water to meet the rising demand for urban and industrial water use. Adopting a business-as-usual scenario for agriculture in the Arab region is untenable and could eventually be detrimental to the long-term sustainability of agriculture. Changes in agricultural policies and practices are needed to develop agriculture without undermining its role as a provider of environmental services.

In this chapter we will highlight the implications of unsustainable agriculture on Arab economies, and suggest a set of enabling conditions required to facilitate the transition to a green and sustainable agricultural sector in the Arab world.



TABLE 1 CONTRIBUTION OF AGRICULTURE TO GDP

Country	Agricultural GDP (Million \$)			Contribution of Agriculture to GDP (%)		
	1990	2000	2008	1990	2000	2008
Algeria	5,334	4,600	11,197	9.6	8.4	6.6
Egypt	4,675	15,474	20,520	16.0	15.5	12.6
Iraq	16,467	1,206	4,477	21.4	5.8	4.1
Morocco	3,933	4,917	11,202	15.5	13.3	13.1
Saudi Arabia	6,713	9,326	10,947	6.4	4.9	2.3
Sudan	3,062	4,796	17,922	29.3	35.7	29.3
Syria	3,949	4,667	10,741	27.4	24.7	20.4
Sub-Total	44,133	44,986	87,006	13.9	10.3	7.8
Other Arab countries*	7,197	11,406	16,382	5.8	4.7	2.1
Total	5,330	56,392	103,388	11.6	8.3	5.4

* Bahrain, Djibouti, Jordan, Kuwait, Lebanon, Libya, Mauritania, Oman, Qatar, Somalia, Tunisia, United Arab Emirates, and Yemen
Source: AFESD et al., 1993; GSLAS et al., 2009

II. IMPLICATIONS OF PAST AND CURRENT AGRICULTURAL PRACTICES AND POLICIES

Agriculture is an important sector in most Arab economies as a contributor to gross domestic product (GDP) and employment, and as a main source of income generation and livelihood for the majority of the rural population. The sector also plays a key role in maintaining public health and nutrition and in providing environmental products and services.

A. ROLE OF AGRICULTURE IN ARAB ECONOMIES

i. Agricultural GDP

Since most Arab countries are located in arid and semi-arid areas, their agricultural production has been vulnerable to the effects of weather constraints and recurrent droughts. Variations in arable land and water resources among Arab countries affect to a large extent the role of

TABLE 2 CULTIVATED AREA AND VALUE OF AGRICULTURAL OUTPUT (2008)

Country	Cultivated Area (1,000 Hectares)	Agricultural GDP (Million \$)	Cultivated Area (%)	Agricultural GDP (%)
Algeria	4,861.49	11,197	9.10	10.83
Egypt	3,541.52	20,520	6.63	19.85
Iraq	3,826.25	4,477	7.16	4.33
Morocco	6,983.90	11,202	13.07	10.83
Saudi Arabia	971.76	10,947	1.82	10.59
Sudan	18,783.66	17,922	35.16	17.33
Syria	4,610.66	10,741	6.63	10.39
Sub-total	43,579.24	87,006	81.58	84.15
Other Arab countries*	9,840.46	16,382	18.42	15.85
Total	53,419.70	103,388	100.00	100.00

* Bahrain, Djibouti, Jordan, Kuwait, Lebanon, Libya, Mauritania, Oman, Qatar, Somalia, Tunisia, United Arab Emirates, and Yemen
Source: AOAD, 2009a; Table 1

TABLE 3 AGRICULTURAL LABOR IN SELECTED ARAB COUNTRIES

Country	Population (1,000)		Total Labor (1,000)		Agricultural Labor (1,000)		Agricultural Labor (%)	
	1990-1992	2005-2007	1990-1992	2005-2007	1990-1992	2005-2007	1990-1992	2005-2007
Algeria	25,667	33,480	6,160	29,264	1,109	2,428	18	19
Egypt	53,923	71,373	16,716	12,780	7,021	8,491	42	29
Jordan	3,784	5,599	870	2,237	87	148	10	7
Lebanon	2,789	3,917	836	1,495	117	37	14	2
Mauritania	2,067	3,054	682	1,558	471	765	69	49
Morocco	25,018	31,570	8,258	13,612	3,798	5,009	46	37
Oman	1,580	2,610	442	1,142	217	339	49	30
Saudi Arabia	15,706	23,680	4,555	8,464	2,186	532	48	6
Sudan	25,927	36,311	9,074	14,421	6,534	7,529	72	52
Syria	12,537	18,676	3,260	6,849	717	1,560	22	23
Tunisia	8,233	10,127	2,470	3,007	642	556	26	18
United Arab Emirates	1,630	4,272	815	2,809	41	133	5	5
Yemen	12,633	22,661	3,158	6,809	1,990	2,748	63	40
Total	191,494	267,330	57,295	104,592	24,930	30,275	44	29

Source: Computed and compiled from data in GSLAS et al., 2009; Other various Unified Arab Economic Reports

agriculture in each country's economy.

Despite an increase in the value of agricultural production in past years, the average contribution of agriculture to Arab countries' GDP experienced a sharp decline from 11.6% in 1990 to 5.4% in 2008 (AFESD et al., 1993; GSLAS et al., 2009), with a wide variation in the contribution of agriculture to GDP among Arab states, as indicated in Table 1.



Table 1 indicates that seven countries in the region (Algeria, Egypt, Iraq, Morocco, Saudi Arabia, Sudan, and Syria) accounted for 85% of total agricultural GDP in 2008. The same countries accounted for 82% of actual cultivated area in 2008 (AOAD, 2009a), as indicated in Table 2.

It is evident from Table 2 that a country's share in total cultivated area does not presume a similar share in the value of agricultural output. The most striking disproportionateness between the two variables is in Egypt and Saudi Arabia where the share of each to the value of total agricultural product is way above that of its share in cultivated area. The case is opposite in Sudan, where about 35% of the total cultivated area contributes only about 17% to the total value of agricultural product in the region. This wide variation is an outcome of the complexity of agriculture whose output is conditional upon the quantity and quality of numerous inputs such as soil, irrigation, fertilizers, mechanization, and labor skills, in addition to extension services, technology, and weather conditions.

The contribution of agriculture to the GDP of Arab countries as a group is modest, yet it remains

an important economic activity contributing 10-30% to GDP in seven countries, namely, Egypt, Mauritania, Morocco, Sudan, Syria, Tunisia, and Yemen.

In general, agricultural performance in terms of annual growth in most Arab countries surpassed that of the world average of 2% and 2.5% for the two periods 1990-1992 and 2005-2007, respectively, with agricultural growth in Algeria, Egypt, Syria, Tunisia, and the United Arab Emirates (UAE) exceeding world growth and that achieved by most other regions in the world (World Bank, 2010). Comparing growth in agriculture between countries and across regions is not necessarily a measure of performance of a complex economic activity whose output is dependent on interactions among a host of inputs as already pointed out. Even the value added or total factor productivity (TFP) growth remains a deficient indicator of agricultural performance without duly accounting for the impact of agricultural practices on environmental aspects, including soil erosion, land degradation and desertification, and biodiversity loss. Such agricultural externalities are exerting increasing pressure on agricultural limited resources, with short and medium-term benefits achieved at the expense of long-term agricultural sustainability.

Agriculture has a strong and demonstrable record in development as a lead sector and an engine for overall growth in agricultural-based countries (World Bank, 2008). In the past, the neglect of agriculture in most developing countries due to underinvestment, lack of incentives, and distortive policies has hampered the sector from playing a leading role in economic growth. The recent global food and financial crises have revived interest in agriculture as a precursor to poverty reduction, food security, and economic growth in general. Arab and other developing countries have ranked agriculture at the top of their development agendas to make it a lead sector for growth and development.

It is important to note that agricultural GDP figures for Arab countries, already presented in Table 1, are apparently overstated because externalities associated with the economic costs of agriculture-related environmental degradation are not factored in. For example, the estimated

TABLE 4

SOME AGRICULTURAL INDICATORS FOR ARAB COUNTRIES*

	1990-1992	2005-2007
Population (1,000)	191,494	267,330
Total Labor (1,000)	57,295	104,592
Agricultural Labor (1,000)	24,930	30,275
Agricultural Labor (%)	44	29
Value Added per Agricultural Labor (\$)	1,985	2,332
Agricultural GDP (Million \$)	49,487	70,586
Per Capita Agricultural GDP (\$)	258	264

* 13 Arab countries (Algeria, Egypt, Jordan, Lebanon, Mauritania, Morocco, Oman, Saudi Arabia, Sudan, Syria, Tunisia, United Arab Emirates, and Yemen). Values in constant \$ 2000
Source: Population and Labor figures compiled and computed from data in GSLAS et al., 2009 and other various Unified Arab Economic Reports. Value added per agricultural labor from World Bank, 2010

total cost of environmental degradation in Morocco was 3.7% of GDP in 2000, with water, agricultural land, and rangeland degradation accounting for 41% of the GDP loss (Sarraf and Jorio, 2010). This is a significant loss arising mainly from unsustainable land and water resource management practices, which if not reversed will lead to further degradation over time. This would endanger the sustainability of agriculture with serious consequences on food security, poverty alleviation, and people's livelihoods.



TABLE 5

**TOTAL FACTOR PRODUCTIVITY
(AVERAGE ANNUAL PERCENTAGE CHANGE)**

	1961-1981	1981-2000
Algeria	-0.8	3.2
Egypt	1.1	2.1
Iraq	-3.1	-1.0
Jordan	-3.4	1.6
Lebanon	3.8	2.7
Libya	4.6	4.5
Morocco	1.7	2.9
Saudi Arabia	-3.3	4.8
Sudan	-0.7	2.0
Syria	1.4	0.3
Tunisia	3.3	2.0
Yemen	-10.3	2.1

Source: FAO, 2005a

ii. Employment

Agriculture is a major source of employment in Algeria, Egypt, Mauritania, Morocco, Oman, Sudan, Syria, Tunisia, and Yemen, where the average percentage of men and women working in agriculture ranged between about 20% and 50% of the total labor force over the period 2005-2007 (GSLAS et al., 2009), as indicated in Table 3.

It is important to note that the decline in the contribution of agriculture to GDP has been accompanied by a similar decline in the average percentage of agricultural labor from 44% to 29% in the selected Arab countries over the two periods 1990-1992 and 2005-2007, respectively, as can be deduced from Table 3. This had significantly enhanced the productivity of agricultural workers in these countries with the value added per worker rising from about \$1,985 over the period 1990-1992 to about \$2,332 over the period 2005-2007 (World Bank, 2010), as indicated in Table 4.

A comparison of average value added per worker with that of agricultural GDP in Arab countries reveals a considerable difference between their average growth rates over the two periods shown in Table 4. While figures on value added per agricultural worker embodied an average growth rate of about 1.4% per annum over the period from 1990-1992 to 2005-2007, agricultural GDP grew at almost double this rate (about

2.7%) over the same period. This wide divergence between the two growth rates signifies the effect of expansion of the cultivated area associated with agricultural sector reforms.

Analysis of data gathered on total factor productivity (TFP) in developing countries include the TFP of agriculture in a number of Arab countries over two periods, as indicated in Table 5.

Table 5 demonstrates that TFP has improved substantially in most Arab countries during the period 1981-2000. Another study focused on the Middle East and North Africa (MENA) region (19 Arab countries and Iran) shows that the TFP index (taking 1961 as the base year for growth rate changes in TFP) increased sharply from an average growth of 0.1% annually during the period 1965-1984 to an average growth of 2% annually over the period 1985-2006 (IFPRI, 2010). This improvement in TFP growth during the second period corresponded roughly with agricultural policy reforms initiated by most Arab countries in the mid 1980s. During the pre-reform period many governments in the region were pursuing food self-sufficiency goals, particularly in cereals, and therefore farmers and agro-food processors were supported by a variety of measures, including subsidies for various inputs, and adopting a trade policy with extensive use of tariffs and non-tariff barriers, giving rise to distorted patterns of production, trade, and reduced economic efficiency (IFPRI, 2010).

iii. Impact of Subsidies

Arab agricultural policies are characterized by blanket subsidies. Many Arab countries offer their farmers guaranteed prices for their crops. While subsidies lower the price of fertilizers, pesticides, irrigation water, and fuel for farmers, "such untargeted subsidies are not focused on the poor, have a fiscal cost, reward low-value cropping, and encourage the overuse of water" (Yamouri, 2008).

iv. Impacts of Trade

In addition to the implications of agricultural practices and policies on GDP and income, inappropriate trade policies can have serious economic, social, and environmental consequences.

CONSERVATION AGRICULTURE

Boghos Ghougassian

For 25 years the vast fruit orchards of Gaby & Seto Company in the Kefraya area of West Bekaa, Lebanon, have been managed by the application of conservation agriculture (CA) principles. Five types of fruit trees are mainly grown, namely: apples, pears, plums, nectarines, quince, and their varieties.

The two main CA principles, minimal soil disturbance and permanent soil cover, are practiced in a 120-hectare plot of land. Mr. Seto, the General Manager of the company, indicates that "CA is a management technique for us that combines profitable agricultural production with environmental concerns and sustainability, and this has been proven to work for 25 years in our fruit plantations."

On the flat plots, 60 hectares in size, no tilling takes place and flood irrigation is practiced in the summer season. The grass covering the surface is not tilled or killed by herbicides. Rather, the grass is just cut and left in its place. This measure lowers evapo-transpiration rates and reduces irrigation water requirements by 25%, compared with conventionally tilled land. The accumulated grass acts like a carpet on the ground, protecting fruit from damage upon falling. About 75% of those fallen pieces of fruit are marketed as second grade fruit, generating reasonable revenue from sales. Without the grass cover, the falling fruit would have been damaged and spoiled within a few hours. The dried accumulated grass acts as mulch and eventually turns into an organic soil conditioner, a fodder for soil microorganisms. Due to the presence of a grass cover, the water penetration in the soil is improved. And during the rainy season the cover grass holds precipitated rainwater, protecting the land from flooding and the soil from erosion.

The other half of the fruit orchards, also 60 hectares in size, is located on hills or inclined plots of lands. There a drip irrigation system is used, taking care to water the area located directly under the fruit tree. This method of irrigation protects the soil from water erosion. Grass growing under young trees, 10 years old or younger, is cut manually and left under the trees. For trees older than 10 years, grass is eliminated by spraying with safe agrochemicals. In this hilly area, minimum tillage is practiced at a rate of one tilling per year and only after the rainy season. For these older trees, no soil erosion problems have been encountered.



The fruit orchards are properly managed with high quality agricultural inputs. For irrigation, unpolluted water is withdrawn from 4 wells replenished by the snowmelt of the nearby Barook Mountains. Only high quality agrochemicals are utilized. For instance, pesticides that are known to be safe for bees are used. Beekeepers are encouraged to bring in more than 300 beehives in the orchards of the company. Beekeepers claim that at the orchards of Gaby & Seto Company, bees proliferate and beehives increase in number, thus boosting honey production significantly.

The resulting fruit products are of distinctive taste and quality, with 80 to 95% of them marketed as first grade fruit. Because of those traits, the demand for the company's products is competitively high.

The adoption of conservation agriculture principles has enabled this orchards company to protect its land assets and boost its business bottom line in a sustainable manner. The company uses less labor, less irrigation water, and less machinery and fuel, while protecting the soil from erosion. These advantages have resulted in lower production costs and higher income.

Conservation agriculture provides a model for profitable agriculture and environmental gains, while consumers benefit from high quality fruit products of distinctive taste.

Boghos Ghougassian is president, Lebanese Appropriate Technology Association (LATA)

Arab countries are net importers of agricultural products and run a large trade deficit in agricultural commodities. They seek to promote production of agricultural commodities to meet local demand and for export. They have made efforts to liberalize trade, but “without the right environmental policies in place, trade liberalization could have negative consequences for developing countries” (UNEP, 2005). Prevailing agricultural practices and policies in the Arab region have caused environmental degradation and biodiversity loss. Unless policy reforms for more sustainable patterns of agriculture are introduced, the contribution of agriculture to the economic and social wellbeing of the rural population will be seriously affected. Policies and incentives to optimize the use of agro-chemicals and encourage sustainable and organic farming practices are necessary to achieve agricultural sustainability and enhance the role of the sector as a supplier of safe and healthy food for local consumption, as well as for accessing external markets, which require compliance with regulations and standards of agricultural products, particularly with respect to food safety and the environment.

v. Agricultural investments

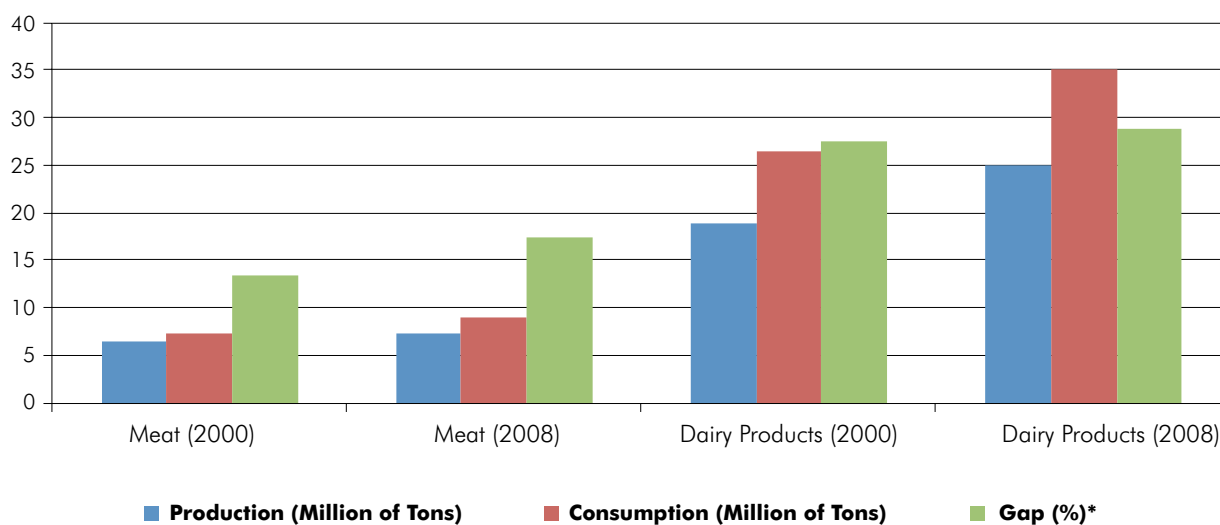
Despite its importance as a lead sector for economic growth and rural development “agriculture has not been used to its full potential

in many countries because of anti-agriculture policy biases and under investment” (World Bank, 2008). Over the past five decades, most Arab and other developing nations financed investments from their own resources, in addition to assistance provided by donors and international development institutions. However, neglect of the sector is evidenced by the sharp decline in official development assistance (ODA) to agriculture during the last three decades due to a complex set of underlying reasons.

The underlying causes of neglect in the Arab agricultural sector mirror those highlighted by the World Bank for explaining the dramatic decline in ODA for financing agricultural investments in developing countries. In general, they include past agricultural investments in an environment of falling international commodity prices, competition for ODA from social sectors, opposition from donor country farmers to supporting agriculture in their major export markets, and opposition from environmental groups to agriculture because of its contribution to natural resource depletion and pollution (World Bank, 2008). Implementation challenges of spatially dispersed programs with weak governance are also cited as contributing to this neglect.

Globally, official development assistance (ODA) for agriculture in developing countries

FIGURE 1 SELF-SUFFICIENCY GAP IN MEAT AND MILK IN ARAB COUNTRIES (2000-2008)



* Net imports as percentage of consumption.
Source: AFESD and KFAED, 2010

EARLY DROUGHT WARNING SYSTEM IN MOROCCO

When a drought occurs nationwide, the policy applied so far consists of setting up a national drought plan to combat the deleterious consequences of drought. The main components of the plan are designed to assist rural populations in solving the problems associated with: (i) drinking water, (ii) livestock protection, (iii) jobs creation, (iv) agricultural credit debt relief, and (v) public awareness. This is typically a crisis-management oriented approach whose cost is tremendous in terms of public spending, time, and human resource needs.

To our best knowledge, Morocco is the only country in the Arab world that has an institution charged with drought mitigation and early drought warning. In 2001, the National Drought Watch (NDW) was created within the Ministry of Agriculture, Rural Development and Fisheries. As a result of a ministerial decision, it was located physically in an academic institution allowing multidisciplinary collaboration, giving it some neutrality with regard to policy pressures.

The NDW is designed to operate as an institutional network with a Central Management Unit and Regional sub-units, thus benefiting from existing structures, particularly of scientific human resources both centrally and regionally. It has a structure involving regional centers in research institutions, and a framework for working groups that can include and be led by a number of partner institutions. For example, the impressive capacity and track record of the National Meteorological Office (DMN) is an outcome of the multidisciplinary and policy oriented work of the National Drought Watch. The same observation applies to the Royal Centre for Remote Sensing of Morocco, which has a good working program with NDW.

Ameziane, T.E., Alaoui, S.B., Imani, Y., Belhamd, A., Belghiti, M., Ezzine, H., Ouassou, A., Sibou, T., Zyad, M (2007). Integrated Water and Drought Management in Morocco. Contribution of the Medroplan Team/National Drought Observatory, Medroplan Project

fell dramatically over the last three decades. Agriculture's share of ODA dropped from as high as 18% in 1979 to 3.5% in 2004, and also declined in absolute terms (measured in 2002 constant prices) from about \$8 billion in 1984 to \$3.4 billion in 2004 (World Bank, 2008). A paper on ODA directed to agriculture was produced by the Agriculture and Natural Resources Team of the UK Department for International

Development (DFID) in November 2004 shows ODA flows from the Organization for Economic Cooperation and Development (OECD) and multilateral financial institutions to world regions, as indicated in Table 6.

The figures in the Table above show that the Middle East and North Africa region witnessed the sharpest decline in agricultural ODA in absolute

TABLE 6 REGIONAL DISTRIBUTION OF ODA TO AGRICULTURE, 1980-2002 (CONSTANT 2002 US\$ MILLION)

Region	1980	(% of Total)	1985	(% of Total)	1990	(% of Total)	1995	(% of Total)	2002	(% of Total)
Sub-Saharan Africa	1450.0	25.2	1872.8	30.2	2035.2	40.7	1108.4	41.5	713.6	37.4
Middle East and North Africa	553.7	9.6	251.3	4.1	256.4	5.1	199.4	7.5	60.5	3.1
Far East Asia	944.0	16.4	882.2	14.2	1064.2	21.3	636.4	23.8	479.8	25.1
South and Central Asia	2593.4	45.0	2608.8	42.1	1400.9	28.0	632.8	23.7	442.2	23.2
South America	220.0	3.8	580.5	9.4	238.9	4.8	95.8	3.6	213.9	11.2
All developing regions	5761.1	100.0	6195.6	100.0	4995.6	100.0	2672.8	100.0	1910.0	100.0

Source: DFID, 2004

TABLE 7

POPULATION AND RURAL POPULATION
IN ARAB COUNTRIES

	1981	1990	2008
Population (Millions)	171.5	232.2	344.1
Rural Population (%)	56	50	45

Source: World Bank, 2010

and relative terms. Its share dropped drastically to only US\$60.5 million or 3.1% of total flows in 2002. Nevertheless, whatever their level is, ODA resources are limited and competition for them and for public funds from other social sectors such as health and education is mounting.

Efforts by Arab countries to enhance agricultural development, particularly for food security, has led to the establishment of the Arab Authority for Agricultural Investment and Development (AAAID) in 1976. AAAID accomplishes its mandate through investments in plant and animal production, food processing, manufacturing of agricultural equipment and inputs, and provision of related services.

Investments by AAAID in 32 existing companies reached a total of \$336.1 million distributed over 13 Arab countries, with Sudan capturing

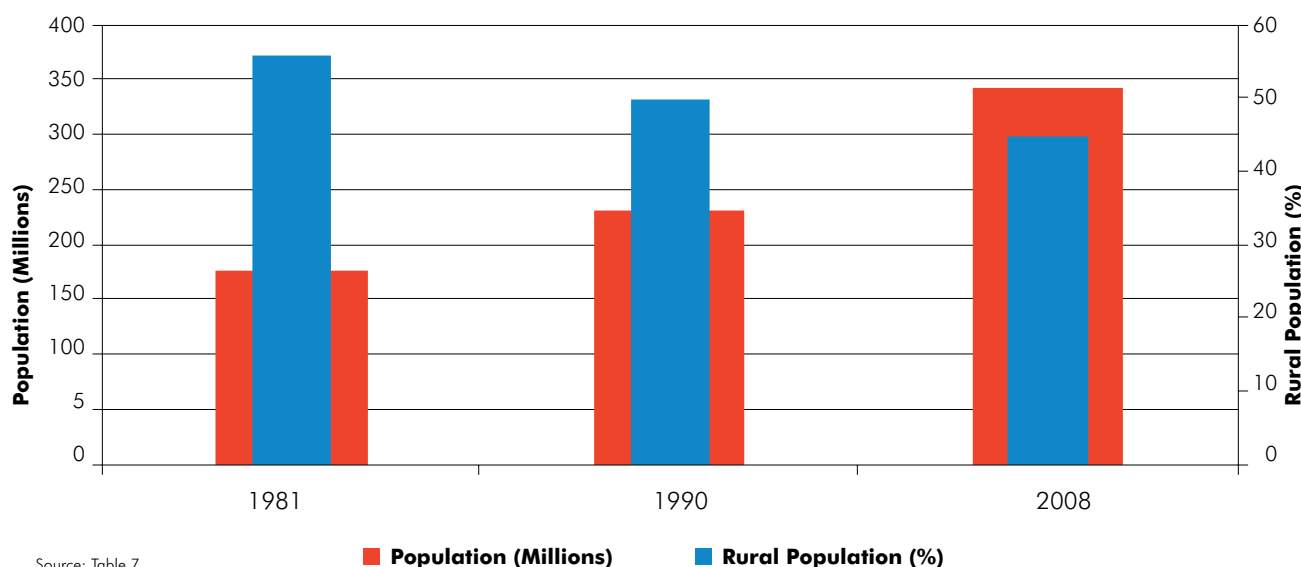
about 56% of all investments. The total amount invested by AAAID and its public and private sector partners amounted to \$2.45 billion by the end of 2008, with the public sector contributing a share of 56.3%, the private sector 30.1%, and AAAID 13.6% (AAAID, 2008).

These figures indicate that despite its concerted efforts over three decades of agricultural activities, AAAID's investments remain dominated by the public sector and overshadowed by investments in one country (Sudan). Furthermore, the average annual investment at about \$80 million per year is considered low, with the private sector contributing only \$25 million.

It is not surprising that AAAID could not attract more funds for its investments, given the bias against agriculture, in general, stemming from the perception that agriculture is an area fraught with risk and low return. The Arab Investment and Export Credit Guarantee Corporation (AIECGC) estimated inter-Arab direct investments at about \$35.9 billion and \$19.2 billion in 2008 and 2009, respectively. Four countries (Jordan, Libya, Tunisia, and Yemen) attracted investments from other Arab countries amounting to about \$1.6 billion in 2009, with the bulk of this amount channeled for the industrial and services sectors, and only a mere share of 0.23% for agriculture (AIECGC, 2008).

FIGURE 2

POPULATION AND RURAL POPULATION IN ARAB COUNTRIES



Source: Table 7

Support for investments in agriculture in Arab countries has not been confined to inter-Arab direct investments or to ODA from international donors and development organizations. Members of the Arab Coordination Group consisting of Arab national and regional development institutions, which include Abu Dhabi Fund for Development, Kuwait Fund for Arab Economic Development, Saudi Fund for Development, Arab Bank for Economic Development in Africa, Arab Fund for Economic and Social Development, Arab Monetary Fund, Islamic Development Bank, and the Organization of Petroleum Exporting Countries (OPEC) Fund for International Development (OFID), have been a main source of agricultural investments in the region. These institutions have supported numerous food production and infrastructure projects in Arab and other developing countries. Their financial contributions to food security, development of water resources, and construction of dams are estimated to be \$6.7 billion, or about 12% of their total operations as of the end 2008 (GSLAS et al., 2009).

Despite efforts made so far to develop the agricultural sector in Arab countries, particularly as a source of food security, there are still various impediments to achieving the desired outcomes. As summarized in the Unified Arab Economic Report, the barriers include the lack of a suitable investment climate including necessary laws, legislation, and incentives, inadequate infrastructure, and the lack of preferential treatment for agricultural projects. Movement of the factors of production capable of establishing an Arab regional market conducive to attracting agricultural investments is unnecessarily limited. In addition, having similar agricultural production patterns limits utilization of each country's comparative advantage and weakens Arab countries' competitiveness in external markets (GSLAS et al., 2009).

The Arab Economic, Development and Social Summit held in Kuwait in January 2009, adopted a resolution for an Emergency Program for Arab Food Security to be implemented over the period 2010-2030, with an estimated cost of about \$65 billion to be funded by equal shares from the public and private sectors. This

is an ambitious program in terms of its cost and objectives. The success of the resolution hinges, among other things, on laying down the groundwork for implementing economically and financially viable projects.

vi. Livestock husbandry and rangelands

According to the Arab Center for the Study of Arid Zones and Dry Lands (ACSAD, 2007), Arab countries have significant livestock resources in terms of headcount and species. Farm animal resources include 38 breeds of sheep, 54 breeds of goat, and 38 breeds of camel, with the majority of breeds adapted to dry environmental conditions. In addition, there are 22 breeds of cattle, 9 breeds of horses, and 3 breeds of buffalo. Despite rich farm animal genetic resources in Arab countries, their productivity of meat and milk is considered sub-average or low, as indicated in Figure 1, due to the lack of significant genetic improvement programs, poor production systems, and the mismanagement of natural resources particularly water and rangelands. The low productivity in animal products has caused many socio-economic challenges for the local communities, including lower income than what can potentially be attained (ACSAD, 2007).

Most rangelands in the Arab region are distributed in the semi-arid and arid areas with a variable and non-uniform rainfall distribution. The alternation of moist and long dry periods in this area predetermines the productivity and carrying capacity of rangelands. Poor soil fertility aggravates the impact of socio-economic factors which are the result of poverty, market conditions, land tenure (inheritance, land fragmentation), the absence of policy, and weak implementation of legislation regulating rangeland management (Darwish and Faour, 2008).

In the event of a multi-year drought, rangelands and livestock deteriorate and crops fail. Rangeland degradation takes multiple forms: the loss of plant cover and in turn the capacity to provide feed for the livestock, as well as the invasion of species (Kassas, 2008). Rangeland degradation is caused by overgrazing, i.e., exploiting the range beyond its carrying capacity (Kassas, 2008). Recurrent droughts and the absence of any conservation measures compound the problems associated with overgrazing.

TABLE 8 THE POOR* ARE CONCENTRATED IN RURAL AREAS (2008)**

Country	Percent of urban who are poor (%)	Percent of rural who are poor (%)	Percent of poor in rural areas (%)
Algeria***	10	15	52
Djibouti***	39	83	31
Egypt***	10	27	78
Jordan***	12	19	29
Mauritania****	30	50	78
Morocco***	5	15	68
Sudan****	27	85	81
Syria***	8	15	62
Tunisia***	2	8	75
West Bank and Gaza***	21	55	67
Yemen***	21	40	84

* Poverty as determined by national poverty line

** Data for Mauritania and Sudan are for 2007

Source: *** World Bank, 2008; **** IFAD and FAO, 2007

Though there is no statistical information about the actual decline in the contribution of rangelands to livestock production, changes in vegetation composition and the downward trend in monitored sites in the region are indicative measurements. A general trend is a decreasing contribution of rangelands to livestock feed and an increasing contribution of other types of feed such as wheat straw and stubble, standing barley and barley grain, and agro-industrial by-products (Mirreh, 2009). In Tunisia, the contribution of rangelands to livestock diet has decreased from 65% to 10% (Nefzaoui, 2002). In Jordan, rangeland ecosystems used to provide 70% of the feed requirements for animal grazing; today, the contribution of rangelands to feed has declined to 20-30% (Roussan, 2002).

Past attempts to introduce unrealistic technical packages developed in the stable environments of high potential areas were unsuccessful. Even the research programs conducted in dryland range sites did not offer applicable results, and most of the findings have remained 'on the shelves' unutilized. The complexity of rangeland improvement technologies, lack of full comprehension of socio-economic conditions, ecological unsuitability, lack of incentives to undertake time-consuming and expensive conservation and management

activities in publicly-utilized areas are but a few of the many reasons for poor adoption by livestock owners. In addition, research and technology transfer programs are not based on traditional and contemporary practices of the local populations. Therefore, future attempts for technology development and transfer should be demand-based and predicated on applied and adaptive research supervised and implemented by the stock-owners themselves (Sidahmed, 1996).

The traditional wisdom and knowledge of the nomads and extensive livestock herders is becoming the center of attention. Therefore, future research and technology transfer should be based on well-identified demand by the herders and should build on what was known from the past. New technologies should complement, support, or modify useful indigenous skills and practices.

Given the animals' seasonal feeding patterns, a mismatch between land carrying capacity and grazing pressure is observed indicating the necessity to develop alternative fodder resources to reduce pressure on rangelands. This could be achieved through the development of irrigated fodder crops where arable land could be secured for such purposes, and intermixed irrigated pasture-fruit

ORGANIC FARMS IN OUR CITIES?

Hala Chaoui

In most countries, agricultural production happens out of sight out of mind, far from urban areas. Migration into cities is creating a disconnect between people and their food, and most farms do not meet the standards of the general public because they treat animals inhumanely and cause environmental side-effects. But what if we didn't have to choose between farms or cities — what if we lived in healthy environments that combined both, by growing food in edible urban gardens? These would filter the air, soften the visually polluted urban landscape, increase local food production, and save on food costs. It would also create a sink for urban food waste (if recycled as fertilizer) and reduce the carbon emissions caused by transporting food from remote farms.

Before moving into the city however, agriculture has to be free of environmental health hazards, space-efficient, and convenient. Conventional agricultural practices are unappealing to the urban work force, require large plots of lands, and can cause health issues to operators (carcinogenic pesticides). In addition, conventional synthetic inputs (fertilizers, pesticides) are fossil-fuel based and are not environmentally sustainable. Their use results, for example, in aquatic death-zones due to phosphorous and nitrate leaching into underground water.

Organic farming is an ecological alternative that would fit in cities and is a growing business sector at the fringes of North American cities. Time magazine published an article on the subject titled "Inner City Farms" (July 24th, 2008). Vertical farms powered by green energy optimize the use of urban resources, including land and organic waste, to grow plants. These are described by Dickson Despommier in the book *Vertical Farms* (2010) and shown in Figure B1. New technologies such as weeding robots are emerging to equip small organic farms. These reduce labor needed for weeding, which is the most strenuous part of organic farming. They include the Hortibot plant nursing prototype robot described by Jørgensen and co-authors* in Denmark. A transplanting robot developed in Japan by Nagasaka and co-authors¹ also reduces farm labor and increases the crop's competitiveness against weeds. Robots can also repel pests mechanically, such as the bird-repelling Scarebot, developed by Hall and co-authors¹, which repels fish-predating birds with water jets.

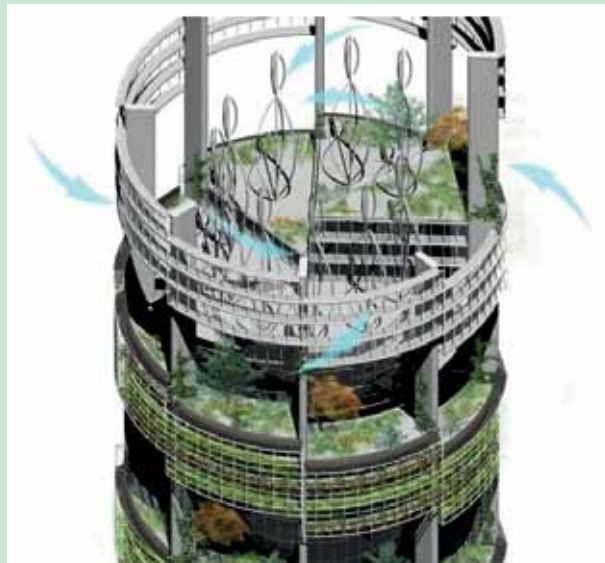


Figure B1. Adapted from VerticalFarm.com by Despommier (Accessed July 2011). Photo credits: Architectural Design by Rolf Mohr; Modeling and Rendering by Machine Films; Interiors by James Nelms Digital Artist @ Storyboards Online.

A small country like Lebanon could have more agility than large, established economies in terms of adopting new urban organic farming technologies. The country also has urgent reasons to green the cities and increase food security. In a country where new ideas catch on fast, high-tech urban organic farms could be among these ideas.

Dr. Hala Chaoui is Principal, Urban Farms Organic Inc., Toronto, Canada. She designs small-scale equipment to conveniently turn food waste into organic fertilizer.

* Chaoui, H. I. and Sørensen, G. C. (2008). Review of Technological Advances and Technological Needs in Ecological Agriculture (Organic Farming). June 2008, Providence, Rhodes Island.

TABLE 9 AREA OF FOREST COVER AND DEFORESTATION RATE IN SOME ARAB COUNTRIES

Country	Forest Cover		Primary Forest		Loss		Gain		Tons of Carbon in Living Biomass (Millions)
	Area (ha)	% of Total Area	Area (ha)	% of Total Area	Area (ha)	% of Total Area	Area (ha)	% of Total Area	
Algeria	1,492,000	0.6	404,000	27.1	8,750	0.52	N/A	N/A	70
Egypt	70,000	0.1	70,000	100.0	1,300	2.95	26,000	59.1	7
Iraq	825,000	1.9	15,000	1.8	1,050	0.13	21,000	2.6	1
Jordan	98,000	1.1	47,000	48.0					2
Kuwait	6,000	0.3	6,000	100.0	150	5.00	3,000	100.0	1
Lebanon	137,000	13.4	11,000	8.0	300	0.23	6,000	4.6	2
Libya	217,000	0.1	217,000	100.0					6
Morocco	5,131,000	11.5	621,000	12.1	4,100	0.08	82,000	1.6	223
Oman	2,000	0	2,000	100.0					1
Saudi Arabia	977,000	0.5							6
Syria	491,000	2.7	294,000	59.9	5,950	1.60	119,000	32.0	1
Sudan	69,949,000	29.4	6,068,000	8.7	321,600	0.42			1393
Tunisia	1,006,000	6.5	690,000	68.6	18,100	2.82	363,000	56.5	9
U.A.E.	317,000	3.8	317,000	100.0	3,600	1.47	72,000	29.4	16
Yemen	549,000	1.0							5

Source: Data collected from rainforests section of Mongabay.com, 2010

TABLE 10 FOREST BIODIVERSITY IN SOME ARAB COUNTRIES

Country	Number of Species of Amphibians, Birds, Mammals, & Reptiles	Endemic Species (%)	Threatened Species (%)	Number of Vascular Plant Species
Algeria	582	1.0	4.5	3164
Egypt	717	2.5	4.0	2076
Iraq	608	0.5	4.9	n.a.
Jordan	571	0.7	3.9	2100
Kuwait	358	0.3	3.9	234
Lebanon	494	0.6	3.2	3000
Libya	486	1.2	3.1	1825
Morocco	675	4.3	4.3	3675
Oman	629	2.2	4.8	1204
Saudi Arabia	636	1.4	4.4	2028
Syria	519	0.8	3.3	3000
Sudan	1431	1.6	2.0	3137
Tunisia	516	0.6	4.3	2196
UAE	339	0.0	5.0	n.a.
Yemen	566	7.2	4.1	1650

Source: UNEP-WCMC, 2010

n.a.: Not available

tree production for supplemental feeding during the dry months, especially in mountainous regions where irrigation water is available.

Rain-fed farmlands and rangelands could be 'integrated' in a mutually beneficial relationship between farmers and herders, whereby herders are allowed to use farmland stubble (after harvest), with livestock droppings improving the condition of the soil. Conflicts between the two groups arise when farmers expand their use onto rangelands, often in years with above average rainfall (Kassas, 2008).

B. AGRICULTURE AND SOCIAL DEVELOPMENT

i. Agriculture and Rural Development

Decline in the share of agriculture in Arab countries' GDP (Table 1) and that of agricultural labor in the total workforce (Tables 3 and 4) is associated with a similar drop in the percentage of population living in rural areas. Over the last three decades, the average percentage of people living in rural areas in Arab countries fell from

about 56% in 1981 to about 45% in 2008 (World Bank, 2010), as indicated in Table 7 and Figure 2.

Migration from rural to urban areas in Arab countries is a multi-dimensional phenomenon. Agriculture, primarily a rural activity, has not been able to cope with absorbing a commensurate share of the labor force growing at a rate faster than that in population growth. The figures in Table 4 demonstrate that the Arab population grew at a rate of 2.3% from 1990-1992 to 2005-2007, while the labor force increased by 3.6% annually, with the share of employment in agriculture declining at a rate of 2.3% annually over the same period. The lack of diversification in rural economies, coupled with weak links between agriculture and related industrial activities, such as small scale food processing and agro-industries, have impeded expansion of employment opportunities that would support livelihoods in rural areas.

Rural to urban migration in Arab countries has been exacerbated by inadequate infrastructure and social services. In considering the underlying motives for internal migration in some Arab countries,



Ben Jelili (2010) highlights the significance of the push and pull factors in the context of rural-urban migration. He points out that “one of the strongest factors in Egyptian internal migration is the search for better work opportunities than those existing at points of origin.” In the Moroccan case, he emphasized that “if rural poverty has been the main push factor, urban amenities such as education, health, and cultural services have been the main pull factors.” He further added that “in most Arab countries, the shift from a rural agrarian society to an urban industrial society involved widespread social and economic disruption, un-evenly distributed employment, and sometimes higher unemployment.” These social dislocations will be compounded by climate change disruptions, from more intense droughts to variable rainfall, jeopardizing agriculture and livelihoods in many rural areas. If agriculture is seen as a key sector for employment of rural labor and a main path out of poverty, rural-urban migration poses serious threats to efforts that address poverty reduction and unemployment.

ii. Impact of agricultural policies on rural poverty and livelihood security

If parts of the region have come to be known for opulence, millions of people in other Arab countries still suffer from multi-dimensional poverty. About one quarter of the population of Arab countries is poor, and 76% of the poor live in rural areas, as demonstrated in Table 8.

Households in extreme poverty may sacrifice productive inputs to purchase food, reducing their earning potential in the following years. Some poor households are undoubtedly forgoing spending on health and education in order to feed themselves, ultimately sacrificing the productivity of future generations. Household assets, such as land, physical capital, education, and health, are crucial factors in the ability of farmers to secure rural livelihoods and to participate and compete in agricultural markets (World Bank, 2008). Enhancing access to these assets is therefore critical to improving the purchasing power of farmers and will require significant public investment.

With three quarters of the poor living in rural areas, up to 40% of the population in the Arab Mediterranean region depends on agriculture, producing fruit, vegetables, and cereals. Decisions



on pace, sequencing, and scope of agricultural trade liberalization will undoubtedly have an impact on rural livelihoods in the region (Oxfam, 2004).

Investing in smallholder farmers is essential to eradicating rural poverty and increasing food security at the national level. Enabling smallholders to become more productive contributes to household food security, which contributes in turn to national food security. Therefore, securing the livelihood of smallholder farmers should be recognized as a food security goal (IFAD and FAO, 2007; FAO, 2008).

iii. Extension services and rural development

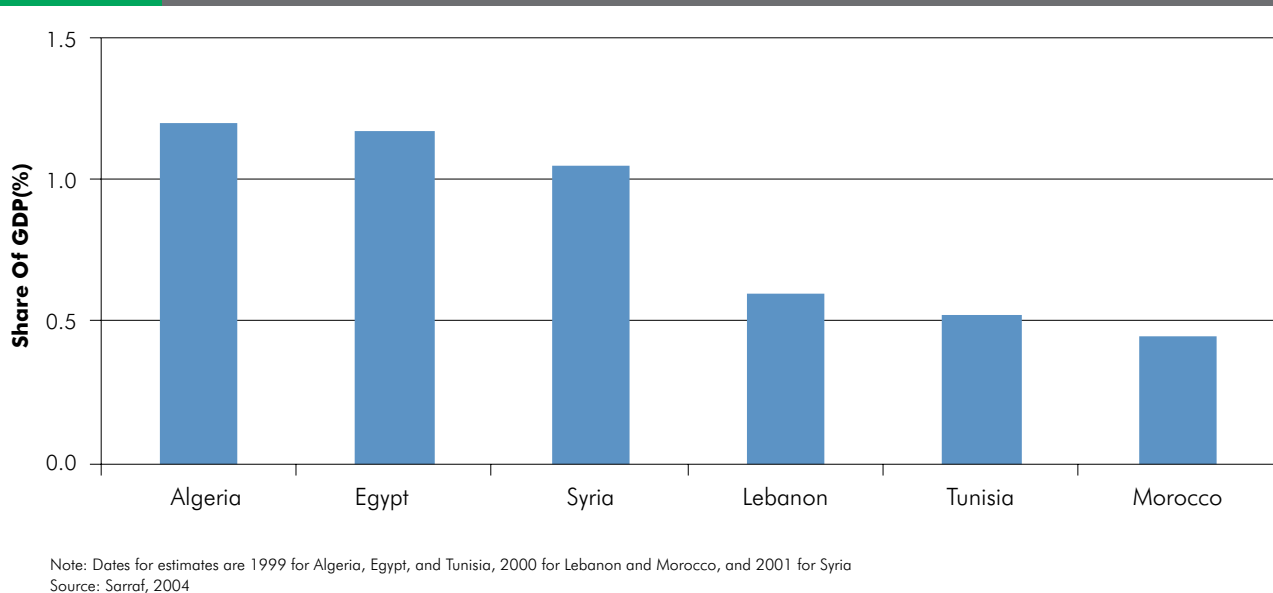
The Arab region is known for its weak rural institutional structures and organizations (Yamouri, 2008). The agricultural sector in most Arab countries suffers from the lack of effective extension services. In addition, farmers need more responsive research and the capacity to utilize knowledge effectively. There is a great variation in production among farmers within a growing season, and from one season to another.

Irregular yields combined with the lack of regular marketing outlets for agricultural products deprives small farmers of a steady income stream. Smallholders may produce less food per hectare and per farmer than larger farms, but they make up a large proportion of the target population; extension's biggest failure has been not providing them with basic information (IAASTD, 2009). Though women participate actively in all farming operations, they do not benefit from extension services. Saito and Spurling (1992) indicated that, while some women may be trained as extension officers, very few of them venture out of their offices to interact with farmers.

iv. The impact of globalization

Global forces are challenging the ability of developing countries to feed themselves (Altieri, 2009). A number of countries, including many in the Arab region, have organized their economies around a competitive export-oriented agricultural sector, based mainly on monocultures. This approach brings a variety of economic, environmental, and social problems, including negative impacts on public health,

FIGURE 3 ANNUAL DAMAGE COSTS FROM LAND DEGRADATION



ecosystem integrity, food quality, and in many cases disruption of traditional rural livelihoods, while accelerating indebtedness among thousands of farmers (Altieri, 2009).

C. IMPLICATIONS OF AGRICULTURAL POLICIES ON ENVIRONMENTAL SUSTAINABILITY

i. Desertification

Desertification and land degradation are considered to be major environmental problems in Arab countries. The major causes of desertification are recognized to be the combined result of both human activities and natural environmental factors such as global climate change, drought, and soil erosion. Unsustainable human activities that are believed to contribute significantly to the degradation of land in the region include inefficient irrigation practices, overgrazing, uncontrolled agriculture, logging for fuel, and the mismanagement of water resources. Despite the lack of precise data for each source of land degradation, Sarraf (2004) developed order of magnitude estimates of the annual costs from land degradation to reveal the economic impact of degradation in six Arab countries, as indicated in Figure 3.

Agriculture and forestry are highly exposed to

climate change since they depend directly on climatic conditions. Forests regulate freshwater quality by slowing soil erosion and filtering pollutants. They also assist in regulating the timing and quantity of water discharge. From the range of goods and services provided by forest ecosystems, one of the most important for human development and wellbeing is preserving biodiversity and carbon storage. Forest vegetation and soil hold almost 40% of all carbon stored in terrestrial ecosystems. Forests in Arab countries are threatened by conversion to agricultural and other land uses, habitat fragmentation, and logging. Forest clearance and degradation are together a net source of carbon emissions. Expected growth in plantation areas will absorb carbon. However, at the current rate of deforestation, forests will remain a net source of carbon dioxide emissions and a contributor to global climate change (IUCN, 2008).

The condition of forest ecosystems from the standpoint of carbon storage is clearly declining, but with appropriate economic incentives, this trend could potentially be reversed. Table 9 below indicates the total area of forested area in some Arab countries, and the percentage of deforestation, as well as reforestation in each country and the total volume of carbon in the living biomass. The term primary forest refers to the most biodiversity and carbon-dense form of the forest.

TABLE 11 WATER AVAILABILITY AND USAGE IN ARAB COUNTRIES

Country	Annual Availability			Annual Water Usage		% Use by Sector		
	Natural Renewable Resources Bm ³ /year	Desalinated End Water Bm ³ /year	Wastewater Reuse Bm ³ /year	Bm ³	As a % of Total Water Resources	Domestic	Industry	Agriculture
Algeria	11.50	0.07	Neg.	4.59	40	25	15	60
Bahrain	0.11	0.14	Neg.	0.25	170	26	3	71
Djibouti	0.02	0.00	Neg.	0.02	113	88	0	12
Egypt	61.90	00.06	5.90	73.10	108	6	8	86
Iraq	80.00	0.03	n.a.	42.80	48	3	5	92
Jordan	0.87	0.00	0.07	0.98	104	26	7	68
Kuwait	0.11	0.65	0.12	0.76	87	37	2	60
Lebanon	3.20	0.00	n.a.	1.29	40	28	4	68
Libya	0.80	0.03	n.a.	3.89	469	9	4	87
Morocco	20.00	0.02	0.07	16.84	84	5	-	95
Oman	1.60	0.12	0.02	1.22	74	9	1	93
Qatar	0.05	0.12	n.a.	0.28	n.a.	23	3	74
Saudi Arabia	2.50	2.28	0.15	17.00	506	9	1	90
Sudan	24.00	0.00	0.00	19.00	5	6	5	89
Syria	18.70	0.00	0.26	14.70	78	9	1	87
Tunisia	3.35	n.a.	0.14	2.53	72	12	4	84
UAE	0.20	0.95	0.14	1.60	180	24	10	67
West Bank & Gaza	0.76	0.00	0.01	0.44	57	51	49	58
Yemen	2.50	0.02	0.03	3.20	126	5	2	93

Source: Barghouti, 2010

n.a.: Not available

Neg.: Negligible amount of water

Biodiversity loss reduces the productivity of ecosystems and undermines their resiliency in the face of natural disasters or human-caused stresses, such as desertification, thereby shrinking the basis for sustainable livelihoods. Not only are forest areas shrinking, but the capacity of remaining forests to maintain biodiversity appears to be significantly diminished. Forest cover enriches biodiversity by fostering different amphibians, birds, mammals, and reptiles. Table 10 below displays some statistics on the effect of forest cover on biodiversity in some Arab countries.

ii. Water

Driven by population growth, industrialization, and improved standards of living, demand for

water in Arab countries is projected to increase significantly over the next decades. Dwindling natural water resources, estimated at about 313 billion m³ in the Arab region (FAO, 2003), further limit expansion in agriculture. Of the 536 million hectares (FAO, 2005a) of agricultural land in Arab countries, the cultivable area does not exceed 197 million hectares, of which about 72 million hectares, including fallow areas, are currently under cultivation (GSLAS et al., 2009).

At the national level, annual per capita freshwater share has dropped in 13 Arab countries below the critical level of 500 m³ per year, compared with a per capita world average of over 8,000 m³ in 2007 (WRI, 2010). Under a business-as-usual scenario, the critically low water availability per capita will

be worsened by the effects of climate change. Table 11 summarizes annual water availability and usage in Arab countries. With 85% of available renewable water resources consumed by the agricultural sector, as indicated in the Table, the potential for increasing irrigated agriculture in Arab countries is limited. With limited and increasing scarcity of existing water resources, the remaining irrigation potential stands at about 7.3 million hectares (IFPRI, 2010).

As indicated in Table 11, the agricultural sector is a primary user of available water resources in the Arab region. Its share exceeds 75% of total available water, rising to 85% of available renewable resources. Some 60% of the region's water flows across international borders, further complicating the resource management challenge and posing serious uncertainties for agricultural output.

The scarcity of water resources has many consequences. It poses a challenge to food security and social stability of a growing population in the Arab region. It leads to further stress and degradation to ecosystems. It also causes long-term damage to soils and aquifers

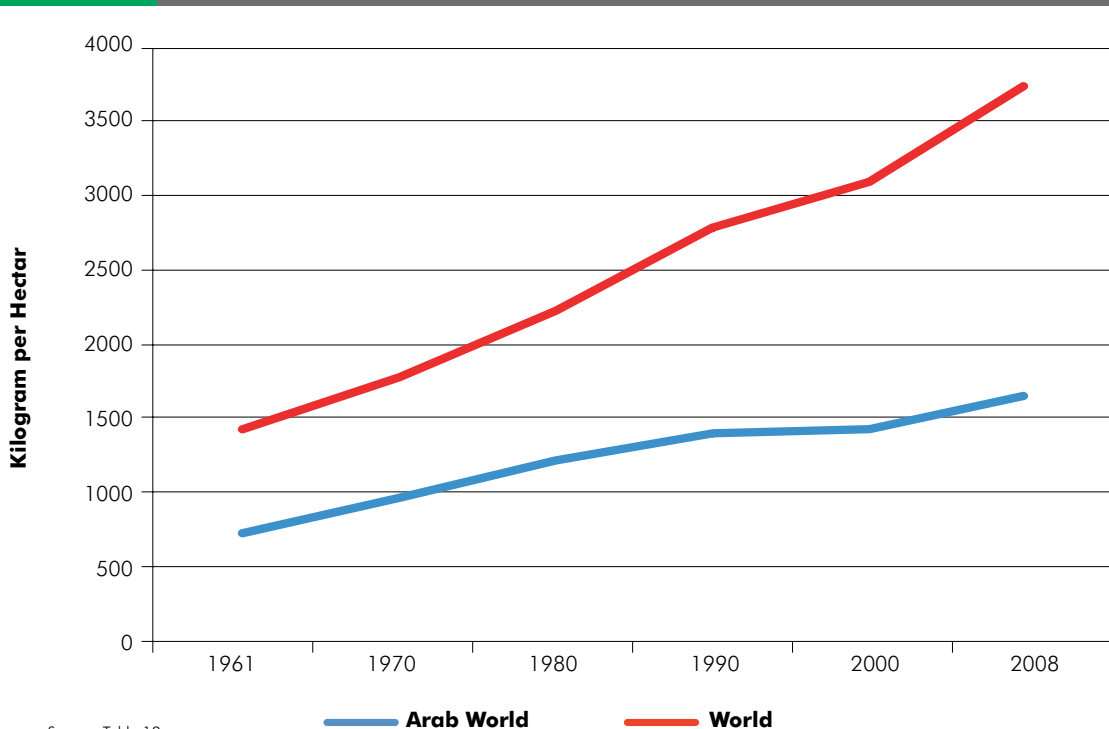
that may not be easily recoverable. The over-extraction of groundwater beyond safe yield levels has resulted in the pollution of existing groundwater aquifers.

Arab countries have made water available at a low cost to farmers through public financing (Malik, 2008). Irrigation water prices in most Arab countries cover only a modest percentage of operation and maintenance costs. Water users often pay little for irrigation water publicly supplied to them, and incentives to change their growing patterns of water-intensive crops or to conserve water are absent (Barghouti, 2010). This policy has resulted in highly subsidized irrigated agriculture (Abu-Zeid, 2001), where low water prices have contributed to the extension of irrigated areas, increases in agricultural water demand, and the misallocation of the resource among users and uses. Low-cost recovery and poor maintenance have caused infrastructure deterioration, and poor water distribution efficiency, and irrigation performance (Malik, 2008).

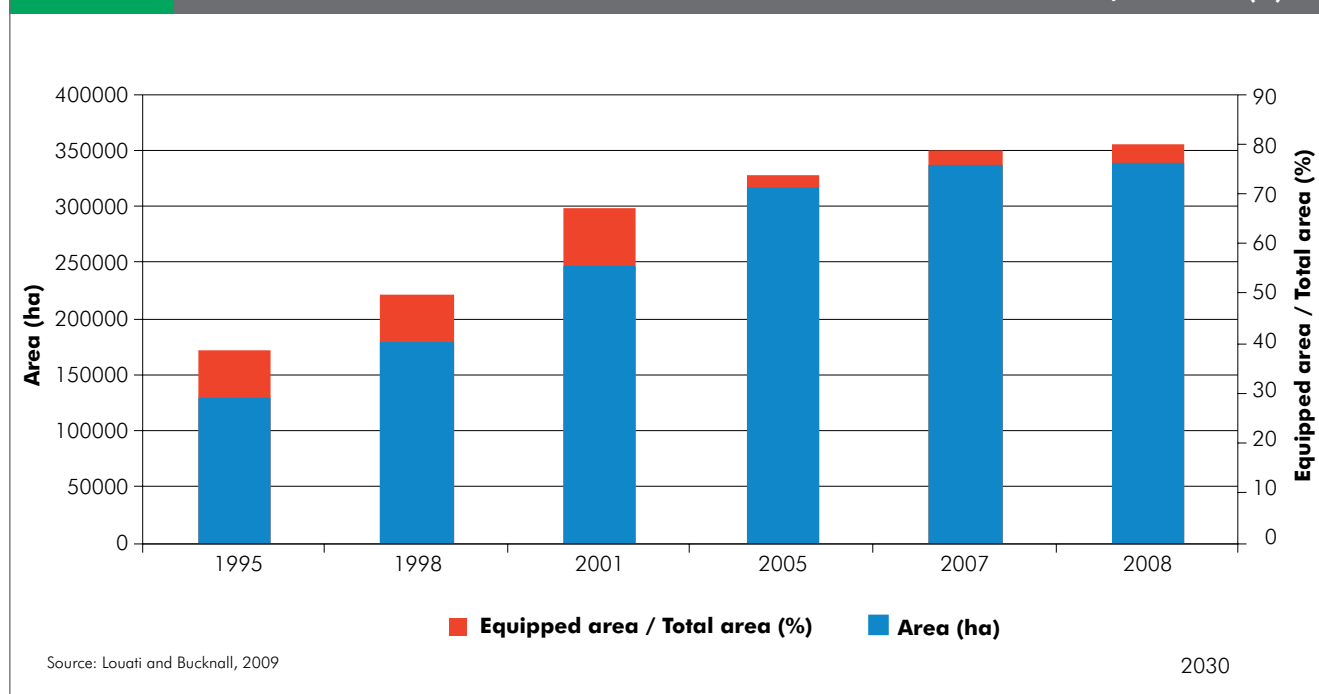
Increased competition among sectors using water is affecting the quality and quantity of water being allocated to agriculture. Traditional irrigation

FIGURE 4

CEREAL YIELD: KILOGRAM PER HECTARE FOR SELECTED ARAB COUNTRIES



Source: Table 13

FIGURE 5 TUNISIA IRRIGATED AREA EQUIPPED WITH EFFICIENT ON-FARM IRRIGATION SYSTEM, 1995-2008 (%)


technologies (irrigation by gravity), which involve water delivery to plants through gravitation and have usually resulted in substantial water losses and limited uniformity in water distribution, have been replaced only in some areas by modern irrigation or pressurized irrigation (sprinkler and localized irrigation).

Water diverted and used for irrigation often causes environmental externalities and degrades natural resources (Malik, 2008). There are externalities due to over-extraction from, or contamination of, common-pool resources such as lakes and underground sources (Malik, 2008). From such a perspective, it is suggested that the costs of these externalities need to be considered while determining the cost of irrigation water.

In their case studies, Croitoru et al. (2010) considered the cost of salinity and water logging in Tunisia. They estimated the overall cost of water pollution and sedimentation that occurred in 2004 on irrigated agriculture in the country. Their conservative estimate of the total cost over 25 years ranged between US\$46 million and US\$62 million, with nearly 60% of these costs caused by salinity and water logging. The authors also estimated other costs attributed to water pollution including loss in fish production,

public health and tourism related costs, and biodiversity losses. The overall cost of water degradation and groundwater overexploitation in Tunisia was estimated to be on the order of US\$165.8 million, or 0.6% of GDP in 2004. The largest cost of environmental damage inflicted on the agricultural sector was caused mainly by the impact of salinity and water logging on irrigated agriculture. Over-extraction of groundwater caused the second largest economic loss due to costs incurred by pumping additional water and building new wells to make up for aquifer depletion (Croitoru et al., 2010).

High land productivity in certain locations can be achieved at the expense of sustainable use of renewable water resources, particularly ground water. Average water productivity in the Arab region is estimated to be US\$700/m³, which is only about 35% of the world average of US\$2000/m³ (AOAD, 2008). All Arab countries use much greater quantities of irrigation water than is required. In 14 Arab countries the quantity of water required for irrigation was estimated to be 83 billion m³. Yet the actual quantity of water used was 198 billion m³ in 2000, representing an irrigation efficiency of only about 40% (FAO, AQUASTAT). For countries that are completely dependent on irrigated agriculture and groundwater, such as countries of the Gulf

VIRTUAL WATER

Virtual water is defined as the water embodied in a product, not in real sense, but in a virtual sense (Hoekstra et al., 2002). It has also been called 'embedded water' or 'exogenous water,' the latter referring to the fact that import of virtual water into a country means using water that is exogenous to the importing country. Thus, exogenous water is to be added to a country's 'indigenous water' (Haddadin, 2003). Hence, virtual water (net import of water in a water scarce nation) can relieve the pressure on a nation's own water resources. Virtual water can be seen as an alternative resource to water. Using this additional source can be an instrument to achieve regional water security.

Every year, farmers and traders in the Middle East move volumes of water equivalent to the flow of the Nile into Egypt, or about 25% of the region's total available freshwater. The water imported in this way is called "virtual water" (Allan, 1997).

Virtual water and water productivity combine agronomic and economic concepts, with emphasis on water as a key factor of production. The agronomic component addresses the amount of water used to produce crops, while the economic component involves the opportunity cost of water, which is its value in other uses that may include production of alternative crops or use in municipal, industrial, and/or recreational activities.

The virtual water perspective is consistent with the concept of integrated water management, in which many aspects of water supply and demand are considered when determining the optimal use of limited water resources (Bouwer, 2000). This concept might also reduce the financial burden of developing a new infrastructure for water distribution. In particular, the opportunity cost of water use, which is a key component of the virtual water perspective, must be considered when seeking an efficient allocation of scarce water resources.

As a scarce commodity, water should be treated economically and allocated efficiently according to its economic, social, and ecological value in alternative uses. The virtual water concept is economically appealing. It affords water-scarce countries a valuable solution to food security by importing water-intensive products at cheaper prices instead of using water to produce water-intensive products with low value.

However, the virtual water concept remains a debatable issue in the context of international trade in agricultural products, as is the case with the highly subsidized export products of the United States and the European Union, which render local prices of importing countries uncompetitive and counterproductive to the development of their agriculture. Furthermore, concern over timely and uninterrupted access to food due to shortage in supply or restrictions on exports constrains the adoption of the economic principles of the virtual water concept. It is a controversial issue, which emphasizes the complex links between water, agriculture, and politics (UNESCO, 2003a).

Under these circumstances, Arab countries need to optimize the use of virtual water and adopt flexible policies for employing virtual water for food security according to agricultural potential and comparative advantage. Such policies should be based on a thorough evaluation of alternatives for food security with a mix of practical options that lead to generating maximum economic, social, and environmental benefits. While virtual water can relieve pressure on scarce water resources in the region, cooperation between Arab countries according to comparative advantage in agricultural resources is essential for enhancing the security of food supply. Furthermore, ensuring the long-term security of food supply through the virtual water concept can be attained by cooperation between Arab countries with investable funds and other developing countries endowed with adequate land and water resources based on mutual benefits.

Cooperation Council (GCC), higher relative crop productivity is achieved by undermining the sustainability of their water aquifers, as a result of over-pumping.

According to Massarruto (2002), the social cost of water supply is not just the cost of the goods and

services that are required in order to make the water available for use, but also the costs that society has to bear in terms of reduced opportunities of using water resources in alternative ways and the costs that are necessary for maintaining and improving the quality and quantity of the water capital up to a level that is considered sufficient for long-term sustainability.

iii. Effects on life support systems

Agriculture is a driver of environmental and climate change. Agricultural practices in Arab countries extract water from aquifers faster than they are being recharged. Through use and often misuse, toxic herbicides and insecticides are accumulating in ground and surface waters causing water pollution. These chemicals reduce biodiversity in the soil and pose health risks to agricultural workers who apply them in the fields. Chemical fertilizers run off the fields into water systems—lakes and rivers—causing changes in the biology of these aquatic systems that disrupt ecosystems and kill fish by depriving them of oxygen. In addition to land use changes that contribute significantly to greenhouse gas emissions, agriculture is an energy intensive activity, consuming large amounts of fossil fuels to produce, transport, and apply agrochemicals.

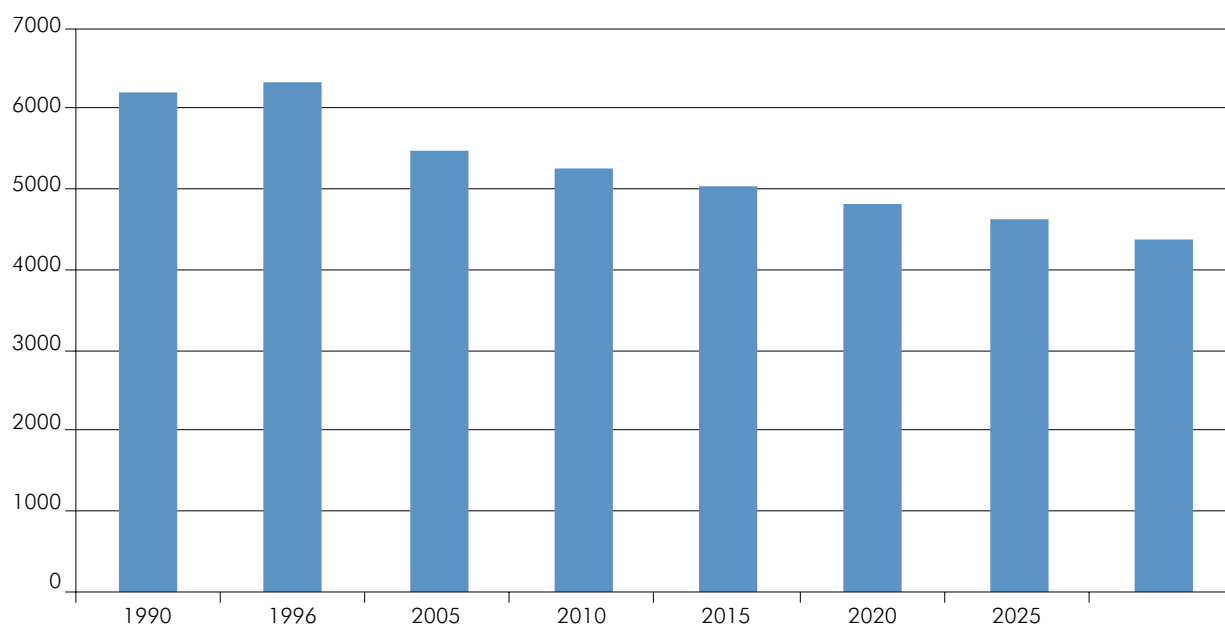
III. FOOD SECURITY

Growth in world population, mounting pressures on limited land and water resources, and the environmental impact of the expansion and

intensification of agriculture raise high concerns about the prospects for future food security in the world. However, a study by the Food and Agriculture Organization (FAO) points out that “the historical evidence suggests that the growth of the productive potential of global agriculture has so far been more than sufficient to meet the growth of effective demand,” and “at global level sufficient production potential can be developed to meet the expected increase in effective demand in the course of the next five decades.” But it warns that “unless local agriculture is developed and/or other income earning opportunities open up, the food insecurity determined by limited local production potential will persist, even in the middle of potential plenty at world level. The need to develop local agriculture in such situations as the condition sine qua non for improved food security cannot be overemphasized” (FAO, 2006a).

According to the World Food Summit (1996), food security exists “when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life.” This definition implies that food

FIGURE 6

EVOLUTION OF MEAN WATER ALLOCATIONS PER IRRIGATED HECTARE, 1990-2030 (M³/HA)

Source: Louati and Bucknall, 2009

IMPROVING THE PRODUCTIVITY AND STABILITY OF RAIN-FED CEREAL PRODUCTION

Mahmoud Solh

Dry areas, by definition, are characterized by lack of water. Renewable water resources are limited and rainfall is highly variable and unpredictable. This short-term climatic variability is likely to be exacerbated by longer-term climate change. Most climate change models predict that the dry areas of West Asia and North Africa will become much drier and hotter with changes in seasonal and spatial distribution of precipitation leading to an increasing incidence and magnitude of extreme weather events (droughts and floods). Countries with a high dependence on rain-fed agriculture will be at most risk as they are highly vulnerable to shifts in seasonal climatic pattern.

Crop production in the Arab world is limited by low, variable, and unpredictable yields. Production of staple food and feed crops, even in good years, is not adequate to satisfy demand. Domestic production of wheat, a major component of national diets, meets just over half the average annual consumption. Barley, grown principally in rain-fed marginal areas, is the principal livestock feed in the region. So, any improvement in the domestic production of cereal crops would contribute to import substitution and food security. With scarce renewable water resources, opportunities for expanding irrigation are limited and competing demands from urban and industrial uses are likely to limit the water already available for agricultural production. Under conditions of increasing water scarcity, the key to enhancing cereal production is in improving the productivity and reliability of rain-fed agriculture.

Average rain-fed cereal yields in the region are low. They also fluctuate considerably from year to year depending on rainfall, as indicated in Figure B1. The potential to increase rain-fed cereal productivity is demonstrated, first, by the yields achieved in experiments on research stations in the region, and second, by the yields achieved in other dryland countries, for example Australia, as Figures B2 and B3 indicate. The yield gap, the gap between yields on farmers' fields and those achieved on research stations, is due to a number of factors including environmental constraints, pests and diseases, and farmers' crop management practices.

The productivity and reliability of rain-fed cereal

production can be improved through an integrated approach that includes:

- a. Use of improved varieties that are adapted to both abiotic and biotic stresses.
- b. Using limited rainfall more efficiently and effectively by:
 - Improving on-farm soil, water, and crop management practices that conserve soil moisture and increase water use efficiency.
 - Using irrigation water conjunctively with rainfall through supplemental irrigation.
- c. Creating an enabling environment: identifying institutional and policy options that support the dissemination and adoption by farmers of productivity enhancing technologies.

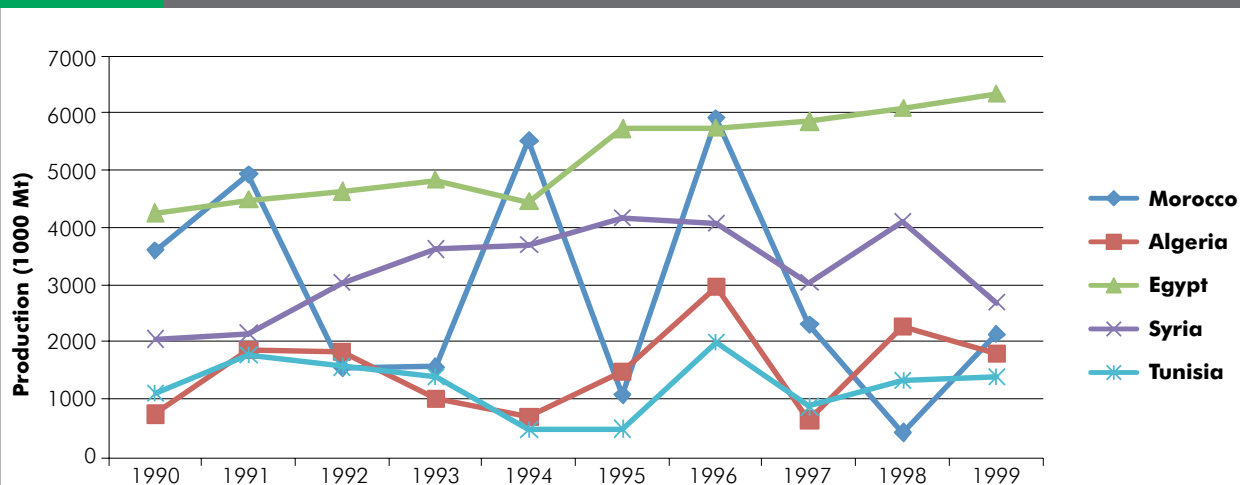
1. Improved germplasm and seed systems

Environmental stress factors, such as drought and heat, impose major limitations on crop productivity in dry areas and, with the growing evidence of climate change, dryland crop production systems are likely to be affected by increased and unpredictable drought and heat stresses. Improved germplasm with diverse drought and heat tolerant mechanisms, higher yield potential, resistance to diseases and pests, and with preferred traits for end-use requirements are needed. In addition, the improved varieties need to be targeted and disseminated to the production zones for which they were developed.

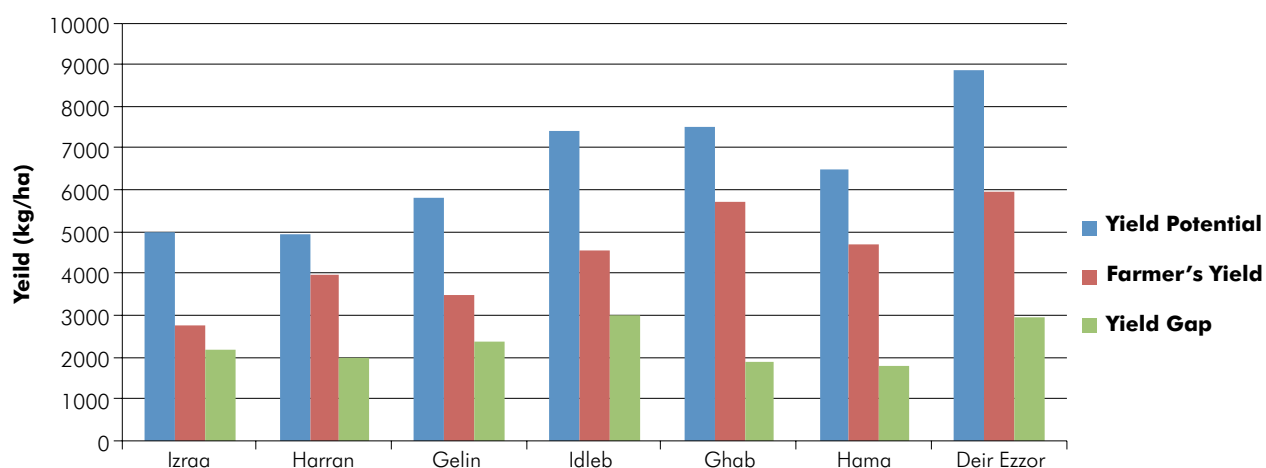
The benefits of improved varieties will only materialize if their seed is available to farmers. Seed security has become an increasingly important issue. Particularly in the less favorable and marginal environments, farming communities continue to rely on their own internal sources of seed. The capacity of both formal and informal seed systems needs to be strengthened in order to supply farming communities with quality seed of adapted varieties in a cost-effective and sustainable manner.

2. On-farm management practices

Improved varieties will only achieve their full potential if accompanied by integrated pest and disease management practices, based on environmentally sound interventions including bio-control, together with soil, water, and crop

FIGURE B1 FLUCTUATIONS IN PRODUCTION (TON) FROM YEAR TO YEAR


Source: ICARDA, 2007

FIGURE B2 YIELD GAP IN SYRIA: THE DIFFERENCE BETWEEN FARMERS' YIELDS AND YIELD POTENTIAL AS DEMONSTRATED IN RESEARCH TRIALS


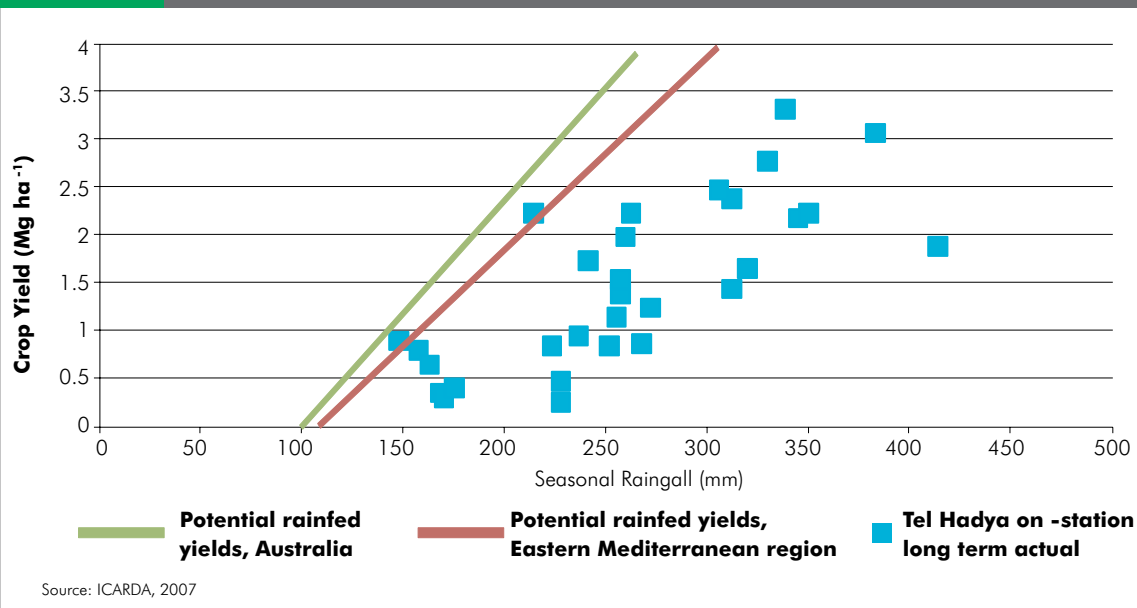
Source: ICARDA, 2007

management practices. Good soil and crop management practices can considerably increase the efficiency of plant water use and productivity. These include use of recommended sowing date, seed and fertilizer rates, crop rotations, and disease and pest management practices. Maximizing the use of rainfall for crop growth can be achieved by good soil management that would reduce evaporation from the soil surface and improve infiltration and soil water holding capacity, thereby increasing the water uptake and transpiration by the crop.

The conjunctive use of rainfall and limited amounts of irrigation at critical periods to alleviate moisture stress substantially increases the yields of rain-fed crops. Trials at ICARDA show that adding supplemental irrigation of 70 mm, in a season with a rainfall of 320 mm, more than doubles yield. The use of supplementary irrigation is also a more efficient use of irrigation water. The productivity (yield per unit of water) of supplementary irrigation is substantially higher than it is in fully irrigated systems.

FIGURE B3

LONG-TERM RAIN-FED WHEAT YIELD MODELING RESULTS (1980-2010): ACTUAL WHEAT YIELDS ON ICARDA'S PRINCIPAL RESEARCH STATION AT TEL HADYA, SYRIA, AND SIMULATED YIELDS FOR THE EASTERN MEDITERRANEAN REGION AND FOR AUSTRALIA



3. Institutional and Policy Support

Technology development by farmers requires institutional and policy support. Circumstances that may constrain or enhance the adoption of technologies need to be identified. This includes identifying the policy, institutional and social, environment under which rural

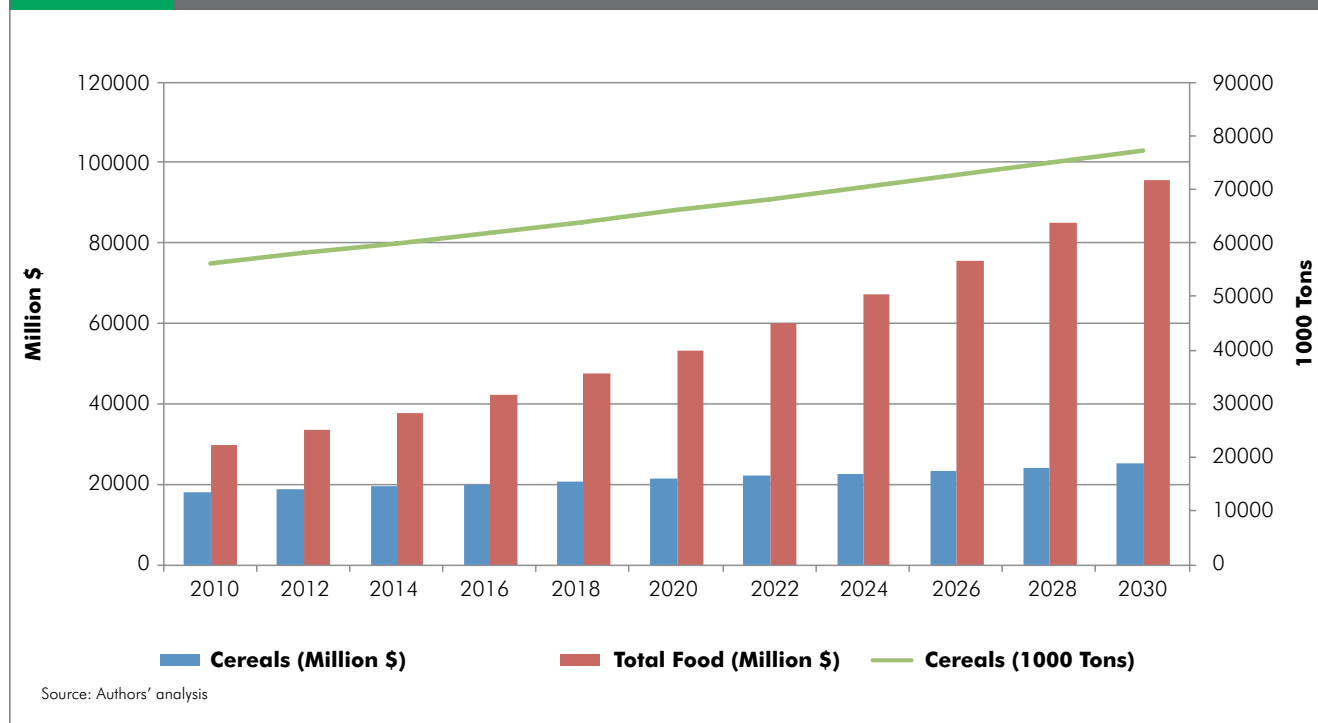
producers and communities make their decisions and the incentive and disincentive structures that shape their resource management, production and livelihood strategies.

Mahmoud Solh is Director General, International Center for Agricultural Research in the Dry Areas (ICARDA).



FIGURE 7

PROJECTION OF FOOD IMPORT BILL: ARAB COUNTRIES (CONSTANT \$ 2008)



security rests on three main pillars consisting of availability of food, accessibility to it, and affordability for obtaining and using it.

Availability of food is a critical pillar in the structure of food security. It can either be made available from external or domestic sources, or a combination of both. Food security, regardless of the source of food, is a broader concept than self-sufficiency and local food production. Achieving food security through the broader or narrower approach depends on the agricultural resource endowments of a country, and its ability to manage them efficiently and sustainably.

Dramatic increases in world food prices in 2007-2008, caused by a number of factors, created a global food crisis with varying political, economic, and social implications on both developing and developed nations. Restrictions or outright ban by some countries on exports of main food commodities such as cereals undermined the concept of food security in the context of economic globalization and free trade. These developments renewed greater interest in the pursuit of food self-sufficiency by many developing countries, including Arab countries, with agricultural development reinstated at

the top of their agendas. The Arab Economic, Development, and Social Summit, which was convened in Kuwait on January 19-20, 2009, endorsed assigning a high priority for Arab regional food and water security, and approved action plans for their implementation.

In what follows we examine the agricultural potential in Arab countries for achieving self-sufficiency in main food commodities, focusing on cereals, which top Arab countries' food security programs. Arab countries are the largest net importers of cereals (World Bank et al., 2009), which constitute about 60% of food intake in the Arab region.

a. Food Gap

The food gap in Arab countries is widest in such commodities as cereals, sugar, and fats and oils. Statistics on self-sufficiency in major food commodities show that Arab countries achieved a self-sufficiency rate of about 45%, 32%, and 29% in cereals, fats and oils, and sugar, respectively, in 2008 (AOAD, 2009b). Closing the gap in cereals is much more important than that in fats and oils or sugar, because of cereals' relative fiscal impact on trade balances. The value of net cereals

“SOUK EL TAYEB”: LEBANESE MARKET FOR ORGANIC FOOD

“Souk El Tayeb” is the first farmers’ open-air weekly market held every Saturday at Beirut Souks, Downtown Beirut, where fresh organic and traditional food is sold by producers from across Lebanon.

Farmers’ markets are first about creating a link between producers and consumers. Food is not anymore a commodity product on a supermarket shelf, but the labor of hands and traditional knowledge accumulated over generations by farmers. It is not just a loaf of bread, but the bread of Rima, the lettuce of Tony, the kebbeh of Suzanne. It is bringing back a major dimension to food: its human and cultural dimension. Food gets a face, and consumption becomes linked to production: farmers and producers receive recognition as well as a fair return on their labor. Food consumers get to build relationships with their farmers. The consumer, as an aware foodie, is offered food with an extra dimension of tradition (not any cheese, but darfyieh or serdeleh) and regionalism (not any olives, but those of Hasbaya or Aakkar). For many city inhabitants, the experience at the Souk re-establishes their relationship with the land as the source of their food. By linking the producer and the consumer, Souk El Tayeb helps shed away the nearly outcast position of the farmer, as a Fellah, reminding urban inhabitants of the appreciation and respect they owe the farmer.

A farmers’ market is no longer a conventional place to buy and sell, but a meeting place to bring the rural to the urban, to provide economic opportunities to small-scale farmers and producers, and to bring awareness about healthy eating and living. In short, it is a public space for interaction and learning about healthy nutrition and sustainable agricultural practices from organic farming to integrated pest management.

Created in 2004, Souk el Tayeb is a producers-only market, where producers sell directly to consumers without middlemen or intermediation. Souk el Tayeb is a one-day event: tents are set in the morning, and producers arrive with trucks holding their own production to sell for the day before they return to their farms. Souk El Tayeb events have been held weekly since 2004, without any interruption.

The number of participants has grown from 10 farmers in 2004 to about 60 farmers in 2011. The turnover ranges from \$300 to more than \$1000 a day per farmer. Producers offer four main categories of products at Souk El Tayeb: fresh fruit and vegetables, preserved food or “mouneh”, cooked food, and crafts (e.g., baskets, jewelry). One third of vendors at Souk El Tayeb are certified organic growers, with formal certification granted by organizations such as Istituto Mediterraneo Di Certificazione (IMC) or Liban Cert. Those farmers who are not certified practice traditional production methods, following strict rules and regulations that have been set up by the managers of Souk El Tayeb.

The demand for organic food has definitely increased since 2004. While sales figures are not available, Souk El Tayeb has experienced a steady rise in the number of organic produce growers—evidence of a growing customer base.

The success Souk El Tayeb has led to the expansion of the weekly market to include:

- One-day regional food festivals: Food & Feast are a series of festivals taking place in different Lebanese regions including Beirut, to promote local traditions and food specialties. The festivals are organized by Souk El Tayeb in partnership with local municipalities.

imports in Arab countries constituted over 61% of the total value (US\$29,863 million) of net imports of major food commodities in 2008, while fats and oils did not exceed 18%, and sugar only about 9% (AOAD, 2009a).

b. Cereal Production

Cereals production in Arab countries varies widely and so is self-sufficiency, ranging between 0% in Djibouti to about 75% in Sudan, with an average of about 45.5% (2008) in the Arab region (AOAD, 2009a), as indicated in Table 12.

Three factors, namely, population, cultivable land, and water resources, play a key role in the future prospects for self-sufficiency in cereals in Arab countries. Arab population is projected to increase from 359 million in 2010 to about 493 million in 2030, and to about 600 million in 2050 (UN, 2010), with an implied growth rate of 1.6% over the period 2010-2030, and a rate of 1% over the period 2030-2050.

Per capita cereal consumption in Arab countries averaged about 309 kilograms annually over the period 2007-2009 (AOAD, 2009b).

- Dekenet Souk El Tayeb: A private label product line has been created containing a selection of the best items from a variety of small farmers and producers.
- Farmers' kitchen: Tawlet is where farmers and producers from the weekly market and from across Lebanon come to prepare traditional Lebanese dishes based on old family recipes. A salary is paid to each woman who cooks at Tawlet. Tawlet will buy any surplus food. The cooks and menus change daily, highlighting their specific village or region's cuisine.
- Souk@school includes a series of educational activities with schools and universities.
- El Tayeb Newsletter (and soon e-magazine) is published to inform, raise awareness, and discuss a variety of topics about green living, food, urban planning, eco-tourism, and green lifestyle.

Souk El Tayeb brings economic opportunities to small farmers by providing them with a stable stream of revenue. The fee for participating in the farmers' market has not changed since 2004. Farmers may also generate additional sources of income by participating in the Food & Feast festivals, Dekenet Souk El Tayeb, and farmers' Tawlet.

By way of expanding, Souk el Tayeb is working on building the Eco Souk, which would be a semi-permanent green space designed to serve as a farmers' market and meeting place. The Eco Souk will house a community garden, eco-playground for kids, communal kitchen, co-op shop, and a mini sorting and recycling plant. The space will adopt green architectural principles. The design calls for the reuse of locally recycled building materials and for power to be provided by renewable energy sources. This innovative concept seeks to bring Lebanese communities together in an eco-friendly green space, which is currently lacking but desperately needed in Beirut.



Notwithstanding the additional cereal production needed to tackle the existing malnutrition in certain Arab countries, and assuming a constant average of per capita consumption (309 kilograms annually), total cereal consumption is projected to reach about 152 million tons in 2030, and about 185 million tons in 2050. The Arab region would need to increase its current cereal production of about 52 million tons by about 100 million and 133 million tons in 2030 and 2050, respectively, to attain self-sufficiency. It is apparent that a significant increase in cereal production through expansion in irrigated land is

constrained by water scarcity. A more promising option can be found in using available water efficiently and productively.

c. Cereal Productivity

Cereal productivity is a key factor in cereal availability for consumption in the Arab region. Unfortunately, it lagged behind compared to other regions of the world, and did not catch up with the technological advances that led to remarkable growth in cereal yields, especially in Latin American and Asian countries, by virtue of

SAVE AND GROW

A policymaker's guide to the sustainable intensification of smallholder crop production

This is the title of a new book published by the Food and Agriculture Organization (FAO), which calls for a new approach to produce more food for a growing world population in an environmentally sustainable way. It stresses that the present paradigm of intensive crop production is no longer capable of meeting the challenges of the new millennium.

The new approach builds on the lessons learned from the Green Revolution of the 1960s and its quantum leap in food production and bolstering food security in much of the developing world through decades of intensive farming based on high-yielding varieties, irrigation, agrochemicals, and modern management techniques. It is now recognized that the Green Revolution has not only lost its momentum as evidenced by the decline in the yield growth rate of major cereals, but it has also seriously jeopardized agriculture's natural resources base and its productive potential in the future.

FAO's new paradigm is based on "sustainable crop production intensification (SCPI), which produces more from the same area of land while conserving resources, reducing negative impacts on the environment and enhancing capital and the flow of ecosystem services". It calls for targeting mainly smallholder farmers in the developing world and helping them to save and grow through such practices, among others, as conservation agriculture, precision irrigation which derives more crop for the drop, and integrated pest management.

Highlights of an overview of the book chapters are quoted below as follows:

1. The challenge

To feed a growing world population, we have no option but to intensify crop production. But farmers face unprecedented constraints. In order to grow, agriculture must learn to save.

2. Farming systems

Crop production intensification will be built on farming systems that offer a range of productivity, socio-economic, and environmental benefits to producers and to society at large.



3. Soil health

Agriculture must, literally, return to its roots by rediscovering the importance of healthy soil, drawing on natural sources of plant nutrition, and using mineral fertilizer wisely.

4. Crops and varieties

Farmers will need a genetically diverse portfolio of improved crop varieties that are suited to a range of agro-ecosystems and farming practices, and resilient to climate change.

5. Water management

Sustainable intensification requires smarter, precision technologies for irrigation and farming practices that use ecosystem approaches to conserve water.

6. Plant protection

Pesticides kill pests, but also pests' natural enemies, and their overuse can harm farmers, consumers and the environment. The first line of defense is a healthy agro-ecosystem.

7. Policies and institutions

To encourage smallholders to adopt sustainable crop production intensification, fundamental changes are needed in agricultural development policies and institutions.

Source: Adapted from FAO, 2011

the Green Revolution of the 1960s. The pattern of cereal yield in the Arab region and in the world over the period 1961-2008 is indicated in Table 13 and Figure 4.

Table 13 above indicates that average cereal yields depict wide variation by country, ranging from 567 kg per hectare in Sudan to 7,506 kg per hectare in Egypt in 2008. The strikingly low yield in Sudan and mediocre yields in other Arab countries, with the exception of Egypt and Saudi Arabia, compared with the world average, as indicated in Figure 4, can be partly explained by the quantity and quality of inputs such as irrigation water, seed varieties, fertilizers, and mechanization. Irrigation in the Arab region is applied to only about 27% of the total cultivated area, with an average fertilizer use of about 51 kg per hectare. In Saudi Arabia and Egypt, irrigation covers 95-100% of the total cultivated area, respectively, and fertilizer use is over 366 kg per hectare in the former, and about 99 kg per hectare in the latter (AOAD, 2008).

The relatively low cereal yields in most Arab countries could also be attributed, among other factors, to the degradation of rangeland, cropland, and forestland. In Morocco, degradation is believed to have been caused by the combined factors of the country's fragile soil, over-exploitation of rangeland resources by farmers, and the conversion of productive rangeland to marginal cropland under the pressure of population growth and increased demand for agricultural and livestock products (Sarraf and Jorio, 2010). Sarraf and Jorio had estimated the impact of land degradation on crop productivity in terms of losses in cereal yields, as most agricultural land is cultivated with cereals. For rangeland degradation, they estimated the total loss of forage production. The cost estimate of cropland and rangeland degradation in Morocco was US\$134 million in 2000, the equivalent of 0.4% of GDP. Cropland degradation accounted for 88% this cost. Since these cost estimates do not capture other effects, such as the impact of salinity on irrigated soil, the average cost estimates quoted here most likely underestimate the total cost of land degradation (Sarraf and Jorio, 2010).

d. Irrigation Efficiency

Irrigation efficiency is a relative term. It could be relatively low or high depending on whether it is estimated at the farm level or the water basin

level. It also depends on how much of the water lost replenishes underground aquifers, or on whether proper drainage systems were installed when irrigating with reused water. Nevertheless, improving irrigation efficiency requires appropriate policies which are no less important than modern irrigation systems and techniques in providing benefits by raising the level of irrigation water use efficiency (Sadik and Barghouti, 1997).

Paying little for irrigation water, water users have no incentives to change their pattern of growing water-intensive crops or to conserve water (Barghouti, 2010). Pricing irrigation water in accordance with its economic value not only improves cost recovery and reduces the burden on public budgets, but it also creates incentives for farmers to rationalize water consumption in irrigation. The application of appropriate cost recovery measures and the adoption of modern irrigation techniques can be instrumental in raising irrigation efficiency, which in turn leads to increasing water and crop productivity and reduces negative impacts on the environment.

According to Malik (2008), governments have been compelled to revisit their policies and engage in pricing reforms in order to improve cost recovery and, more recently, to shift to demand-management policies. Pricing experiences in Morocco and Tunisia are being oriented towards the objective of cost recovery, which contributed to the reduction of public financing of irrigation schemes in these two countries.

Louati and Bucknall (2009) refer to Tunisia's National Program of Irrigation Water Conservation (PNEEI) adopted in 1995 to improve irrigation efficiency to at least 75% by 2006 through the installation of efficient on-

TABLE 12 CEREAL PRODUCTION, NET IMPORTS AND CONSUMPTION (1,000 MT)

	2001-2005 (Average)	2008
Production	51,712.29	46,679.71
Net Imports	46,998.78	58,770.44
Available for Consumption	98,711.07	105,450.15
Self Sufficiency (%)	52.39	45.48

Source: AOAD, 2009a

TABLE 13 CEREAL YIELD: KILOGRAM PER HECTARE FOR SELECTED ARAB COUNTRIES

Country/Region	1961	1970	1980	1990	2000	2008
Egypt	2,906	3,912	4,094	5,703	7,280	7,506
Kuwait		2,000	3,188	3,653	2,324	2,690
Lebanon	1,067	933	1,745	1,878	2,415	2,186
Oman	1,115	1,219	905	2,160	3,199	3,323
Qatar			2,623	2,897	4,099	3,560
Saudi Arabia	1,319	1,277	588	4,245	3,516	5,049
Sudan	913	721	630	456	505	567
Arab countries	798	1,004	1,159	1,417	1,437	1,686
World	1,430	1,829	2,307	2,882	3,065	3,707

Source: World Bank, 2011a

farm irrigation equipment. They point out that drip, sprinkler, and upgraded gravity irrigation were applied on 310,000 hectare, or 75% of the irrigated area, as Figure 5 indicates. Since the end of the 1980's, with the introduction of conservation measures and the provision of 40-60% subsidy for efficient on-farm irrigation equipment, water consumption per hectare started to decline sharply, dropping from 6,200 m³/ha in 1990 to about 5,500 m³/ha in 2005 and is projected to decline further, as demonstrated in Figure 6 (Louati and Bucknall, 2009). If allocated water per irrigated hectare reaches 4,100 m³/ha by 2030, about 840 million m³ of water would be saved for an irrigated area of 400,000 hectare, which is sufficient to increase wheat production by about 840,000 tons, assuming an improved water productivity yielding 1 ton of wheat per 1000 m³ of water.

In pursuing self-sufficiency in cereals, Arab countries are confronted with limited irrigation potential arising mainly from mounting water scarcity. Irrigation is essential, not only for increasing yields, but also for dampening fluctuations in production from year to year. Figure B1 depicts a relatively regular annual production of cereals over the period 1990-1999 in Egypt, where irrigation covers about 95% of the cultivated area, whereas in Morocco, where irrigation covers only about 16% of the cultivated area and drought is a recurrent phenomenon, wide fluctuations in cereal production have been observed over the same period (AOAD, 2008). Nevertheless, future prospects for increased

cereal production depend on improving cereal yield, raising irrigation efficiency and water productivity, and expanding cereal cultivation in rain-fed areas. Optimizing the use of virtual water (see Box: Virtual Water) and improving the productivity and stability of rain-fed agriculture will also contribute to increased cereal production (see Box: Improving the Productivity and Stability of Rain-Fed Cereal Production).

e. Prospects for Self-Sufficiency in Cereals

In 2008, six countries (Algeria, Egypt, Iraq, Morocco, Sudan, and Syria) accounted for about 89% of all land under cereal production in all Arab countries and for about 88% of total cereal production. Increasing cereal production is largely limited by water scarcity. Therefore, improving irrigation efficiency is significantly important for boosting the potential of irrigation in raising cereal production.

Table 14 indicates projections for cereal demand and supply and for domestic and industrial water demand for the period 2010-2050 on the basis of a growth rate equal to the rate of population growth at 1.6% and 1.0% over the two periods 2010-2030, and 2030-2050, respectively. The projections also assume that irrigation efficiency is increased from its current level of 40% to 70%. Water savings, resulting from efficiency improvements, are accounted for by allocating them to cereal production.

TABLE 14 PROJECTION OF WATER AVAILABILITY FOR CEREAL PRODUCTION IN SELECTED ARAB COUNTRIES*

Water Uses (Million m ³)	2008	2010	2030	2050
Domestic and Industrial	31,518	32,595	46,372	57,372
Agricultural Uses: Irrigation (efficiency 40%)	175,482	175,482	175,482	175,482
Total Water Uses	207,000	208,077	221,854	232,854
Total Natural Water Resources	254,880	254,880	254,880	254,880
Water Balance	47,880	46,803	33,026	22,026
Cereal (1,000 tons)				
Cereal Demand	74,000	76,000	101,000	119,000
Cereal Production (Current)	46,000	46,000	46,000	46,000
Cereal Surplus (Deficit)	(28,000)	(30,000)	(55,000)	(73,000)
Water Availability (Million m³)				
Water Saved (Irrigation efficiency 70%)	-	-	52,645	52,645
Using Water Saved per Requirements for Cereal Production (1,500 m³/ton)				
Cereal Production (1,000 tons)	-	-	35,000	35,000
Cereal Surplus (Deficit) (1,000 tons)	-	-	(20,000)	(38,000)

* Algeria, Egypt, Iraq, Morocco, Sudan, and Syria

Source: Authors projections on the basis of data in AOAD, 2009a; World Bank, 2010; World Bank, 2011b; and FAO, AQUASTAT

Table 14 contains rough estimates of the impact of constrained water resources on cereal production in the selected countries. The calculations reveal first that improving irrigation efficiency to 70% would save about 53,000 million m³ of water. The projections also show that allocating water savings to cereal production at a rate of 1,500 m³/ton would reduce the cereal gap to only 20 million tons and 38 million tons in 2030 and 2050, respectively. Reducing irrigation losses can contribute significantly to increasing cereal production, but improving cereal productivity offers even better prospects for reducing the cereal gap. Raising productivity from its low level of about 1,685 kg per hectare in the six countries to that of the world average of about 3,707 kg per hectare, coupled with an irrigation efficiency of about 70%, would increase cereal production by about 50 million tons, enough to generate a surplus of about 30 million tons and 12 million tons in 2030 and 2050, respectively. If Sudan alone were able to raise cereal productivity from its current level of about 567 kg per hectare to that of the world average, it would increase its production by about 28 million tons, enough to close the cereal gap of 20 million tons in 2030 (Table 14).

IV. GREENING THE AGRICULTURAL SECTOR

A new approach is needed for utilizing the limited land and the scarce water resources, built on best agricultural practices and enabling policies for developing economically viable and environmentally sustainable agriculture. Policy reforms should be designed with an integrated strategy comprising regulations and incentives and accompanied by targeted investments to provide the enabling environment for transformation. Along with institutional changes, Arab countries need to invest in rural infrastructure development, farmers' extension services, agricultural water productivity, research and development, and efficient irrigation.

A. Regulating irrigation water use

Water is an important input factor that should be regulated because most suitable and accessible fresh water sources in Arab countries have already been developed. The rising cost of new water resource development projects should steer Arab governments towards managing the available water resources more judiciously.

Arab countries should design policies that

TABLE 15 AGRICULTURE RESEARCH AND FUNDING IN NATIONAL AGRICULTURAL RESEARCH INSTITUTIONS

Country	Potential researcher years (PRYs) ^a	Funding (millions of 2000 US\$)	PRYs/100,000 rural residents	Funding as percent Ag-GDP
Algeria	575	14	8	0.4
Bahrain	32	3	457	17.9
Egypt	6,710	68	27	0.5
Iraq	770	—	30	—
Jordan	198	6	35	1.2
Lebanon	83	4	66	0.4
Libya	261	13	83	1.6
Morocco	606	40	6	0.9
Sudan	595	3	3	0.1
Syria	1,058	15	22	0.4
Tunisia	368	15	16	0.6
UAE	73	—	46	—
Yemen	245	6	3	0.8
Arab world	11,574	187	14	0.5
Brazil	3,943	924	11	1.4
Mexico	3,097	357	12	1.6
Argentina	1,858	270	45	1.0

^a PRY: potential researcher year

Source: ICARDA et al., 1999 and IFPRI, 2008

promote efficient irrigation practices. A shift in policy focus from supply to demand management of water resources is universally considered to be the most cost-effective approach, particularly where water is scarce. Policies enforcing water demand management should be combined with water pricing to create the needed incentives for farmers to alter their irrigation practices and crop selection patterns. Appropriate water pricing can be critical in raising irrigation efficiency and increasing water productivity. In addition, improved cost recovery will result in better upkeep of agricultural infrastructure such as repairing leakage in water delivery systems. Irrigation efficiency can be promoted by providing incentives to farmers for the adoption of more efficient irrigation techniques such as sprinkler, drop, and localized irrigation. Such incentives may include access to credit for purchasing new equipment, among others.

Laws and regulations are also needed to control withdrawals from surface and underground aquifers

in order to maintain the sustainability of these water resources, ensure their efficient utilization, particularly in irrigation, and prevent the pollution of fresh water resources. In addition, more water would have to be allocated to ecosystems to enable their restoration and enhance their capacities to provide environmental services.

Raising crop productivity is key to making progress towards food security in the Arab region. Changing the focus from land to water requires not only new technologies and policies for water management but also a change in land use and cropping systems (Shobha, 2006). Conventional water management guidelines designed to maximize yield per unit area need to be revised for achieving maximum water productivity as opposed to land productivity (Shobha, 2006). Therefore, national policies need to be adjusted to encourage more efficient water use in agriculture and a new land use and cropping system that maximizes water productivity (Oweis and Hachum, 2003). Several research projects

TABLE 16 EXAMPLES OF CURRENT PLANT GENETIC ENGINEERING RESEARCH AT AGERI/EGYPT

Discipline	Potato	Tomato	Cotton	Maize	Fava beans	Cucurbits	Wheat	Banana	Date palm
Virus resistance		•			•	•		•	
Insect resistance	•	•	•	•					
Stress tolerance		•	•		•		•		
Genome mapping and fingerprinting		•		•					•
Fungal resistance		•		•	•				

Source: Madkour, 1999

undertaken in the Arab region have demonstrated substantial increase in crop yield in response to the application of relatively small amounts of supplemental irrigation. Average rainwater productivity in Arab countries is about 0.35 kg/m³, although it may be increased to as high as 1.0 kg/m³ with improved management and favorable rainfall distribution (Shobha, 2006). Efficient on-farm water use techniques, coupled with improved irrigation management options, better crop selection, improved genetic make-up, and timely socioeconomic interventions, can help to achieve this objective.

B. Agricultural subsidy reforms

As part of a comprehensive strategy for rural, social, and economic development, Arab agricultural policies should reconsider the role of blanket subsidies. Whether they are politically or socially motivated, subsidies are poorly allocated investments that do not contribute to long-term livelihood security and always lead to over-consumption of agricultural inputs. What is required is an active policy to reverse years of neglect to the agricultural sector by investing in the agricultural economy, upgrading rural infrastructure, and providing social services in rural areas. A climate favorable to private investment and value addition in agribusiness and agro-industry needs to be created. To do so, governments should increase spending on rural infrastructure to facilitate access to markets and improve the delivery of services to agricultural businesses. Moreover, governments should provide incentives, assistance, and training to enable farmers to go beyond the production of raw commodities, and engage in value-added activities such as food processing. Such a strategy would lead to improved agricultural

practices, income diversification in rural areas, and decreased pressures on public government spending. It would also reduce rural-to-urban migration.

C. Investment

The basic justification, in principle, for launching an Emergency Program for Arab Food Security is the growing net import bill for main food commodities, estimated to be \$30 billion, including about \$18.3 billion for cereals in 2008 (AOAD, 2009b). In constant 2008 prices and a growth rate of net imports equal to the projected growth in Arab population of about 1.6% per annum over the period 2010-2030, the net import bill for the main food commodities and cereals, will reach about \$96 billion and \$25 billion, respectively, in 2030, as demonstrated in Figure 7.

For cereals alone, the cumulative cost of net imports over the period 2010-2030 amounts to over \$450 billion. These indicative estimates point to the heavy burden on trade balances caused by the food gap. While much can be gained from achieving food self-sufficiency, this objective faces formidable challenges, and the extent of realizing it is closely linked to the actions, policies, procedures, and practices which will govern the exploitation of the available agricultural resources while maintaining their economic viability and environmental sustainability.

The long-standing neglect to agriculture and the complex factors contributing to this neglect, as highlighted earlier, cannot be tackled overnight. Serious efforts have yet to be made to establish an environment conducive to investment in agriculture, especially through private sector interventions.

The economic and financial viability of agricultural investments is of paramount importance for attracting funds from local and foreign public and private investors, as well as from donors and development institutions. It is hard to prescribe a size-fits-all approach to ensuring economic and financial viability of prospective agricultural investments, but gathered experience and lessons learned point to some common essential requirements necessary for better performance of agricultural projects.

Future investments in agriculture in Arab countries need to focus on boosting productivity — particularly water productivity — which forms the cornerstone of the economic and financial viability of any project, and should be coupled with all other investments in infrastructure and facilities needed to move the products from the farm to market without loss in their quantity or quality.

Recognizing that productivity cannot be overemphasized for enhancing the viability of agricultural investments, it will remain stagnant unless supported by research. “An overview of 289 studies on economic returns of agricultural research and extension, everywhere in the world, found medium rates of return of 58% on extension investments, 49% on research investments, and 36% in research and extension combined” (FAO, 2005b).

Comprehensive feasibility studies are an essential pre-requisite for designing and implementing agricultural investments. Very often such studies focus on computing economic and financial rates of return based on capital and operating costs without due consideration to the availability of suitable inputs such as seeds, fertilizers, and extension services. A development approach to agricultural investments is required. This would entail self-contained studies with terms of reference that span the whole spectrum of ingredients, activities, and structures related to agricultural production with a view to identifying bottlenecks and proposing solutions. Evaluating agricultural projects and drawing conclusions on their viability should be based on the multifunctional character of such projects, and their economic, social, and environmental dimensions.

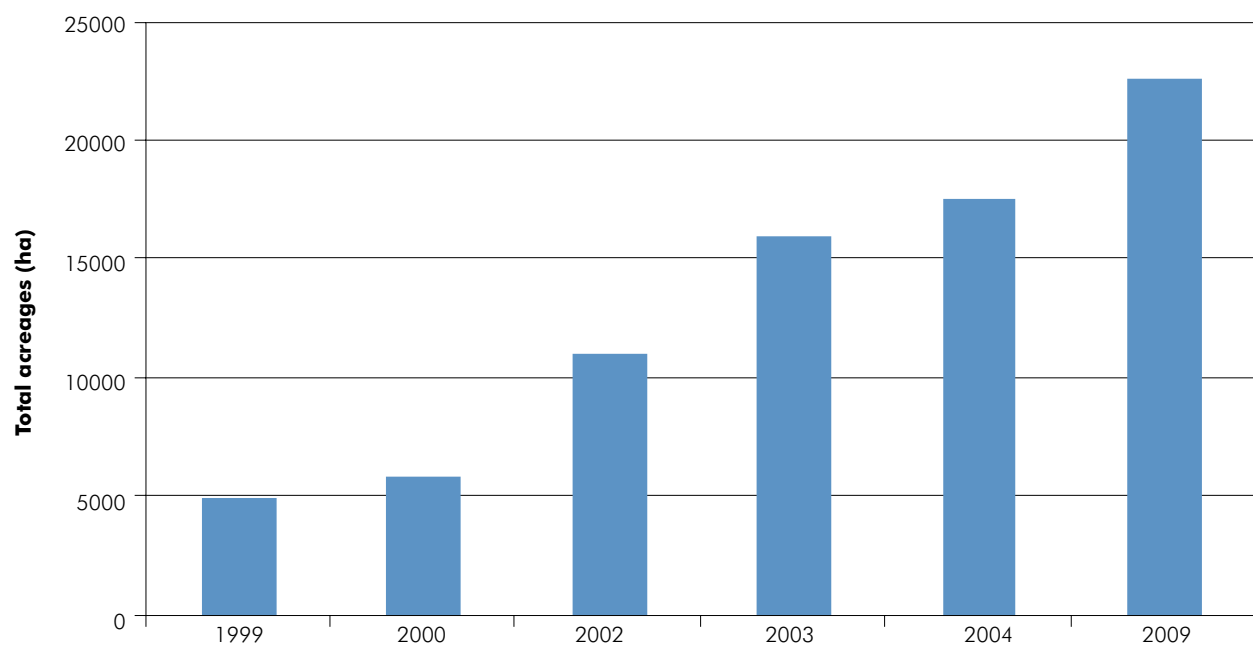
D. Knowledge based agricultural practices, training, and extension

Governments must view farmers as equal partners in any strategy to transform the agricultural sector. This will require radical change in decades-long attitude about farmers not having decision-making powers and being at the receiving end of subsidies and set government prices. Farmers' associations and co-operatives must be strengthened in order to give farmers a strong voice in rural development and agricultural decisions. By establishing their own organizations, farmers will be better positioned to negotiate with agribusinesses and government regulators, cope with market changes, access information, and share knowledge about improved agricultural practices. Moreover, farmers' associations can contribute to improving the quality of interactions with scientists and experts and give legitimacy to farmers' traditional knowledge.

The complexity of agriculture demands that farmers have access to effective extension centers and training, reaching large and small farmers alike, to enable them to make the right decisions regarding seed selection and irrigation techniques. Therefore, it is critically important to train farmers and equip them with the necessary education, skills, and knowledge to build up their capacity to deal with ensuing issues such as new scientific applications or more sustainable farming techniques. For example, policies on crops to be grown based on their yield and economic return, as well as their water productivity (net revenue per unit water), adaptation to the climatic conditions, and impact on the environment should be addressed at the beginning of every growing season and made available to farmers.

Extension services should also provide up-to-date information to advise farmers on soil-water-plant relationship and proper irrigation scheduling as a function of crop growth stage and time. This concept is lacking among most farmers who rely on irrigated agriculture, despite their utilization of modern irrigation system technologies. Proper irrigation scheduling and deficit irrigation will improve irrigation efficiency and increase the quality and quantity of crop yield.

Knowledge-based agricultural practices, coupled with effective extension, will assist farmers with

FIGURE 8 TOTAL ACREAGES OF ORGANIC FARMING IN EGYPT


Source: Compiled from several sources

accessing markets for their products and enhance livelihoods in rural areas.

Furthermore, in the face of global trends, the concepts of food sovereignty and ecologically based production systems have gained much attention in the last two decades. New approaches and technologies involving the application of blended modern agro-ecological science and indigenous knowledge systems, spearheaded by thousands of farmers, non-governmental organizations (NGOs), and some government and academic institutions, have been shown to enhance food security while conserving natural resources, biodiversity, soil, and water in hundreds of rural communities in several regions (Pretty et al., 2003; Altieri, 2009).

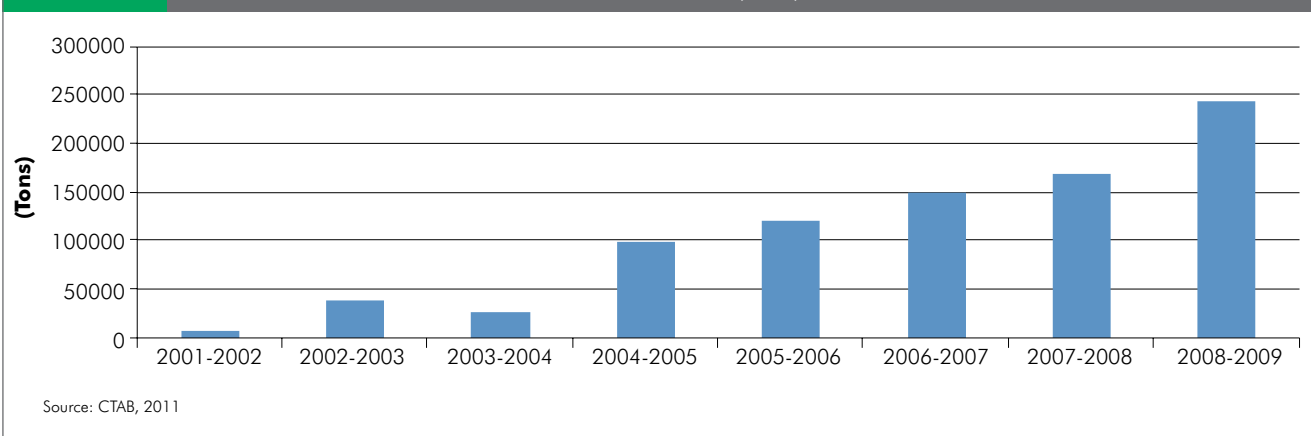
Although the conventional wisdom is that small family farms are backward and unproductive, research shows that small farms are much more productive than large farms if total output is considered rather than yield from a single crop (Altieri, 2009). As the world's population continues to grow, redistributing farmland may become central to feeding the planet, especially when large-scale agriculture devotes itself to feeding cars through growing agro fuel feedstocks (Altieri, 2009).

E. Incentives for sustainable agricultural practices

Current approaches to agriculture, aided by government-funded subsidies, involve intensive use, and often misuse, of chemical inputs that are known to contaminate soil, pollute rivers and aquifers, and cause damage to ecosystems. On the other hand, more sustainable forms of agriculture “treat the farm as an integrated system composed of soil, water, plants, animals, insects, and microscopic organisms whose interaction can be adjusted and enriched to maximize yields. This kind of agriculture is highly productive, takes advantage of natural systems and processes rather than ignoring or fighting against them, and is sustainable far into the future” (UCS, 2008).

Sustainable agricultural practices play a key role in maintaining soil fertility, conserving water, protecting ecosystems, and adapting to droughts or extreme weather conditions. These practices are grounded in traditional and modern science as well as in the economics of agriculture. To disseminate sustainable agricultural practices, effective extension services are needed to update farmers on emerging science. Targeted subsidies can help

FIGURE 9 TUNISIAN PRODUCTION OF ORGANIC PRODUCTS (TON)



farmers convert from intensive farming to more sustainable forms of agriculture.

i. Investment in conservation and low input agriculture

Conservation agriculture can help reduce food insecurity particularly in rural areas where agriculture is the main economic activity. This farming practice helps conserve soil moisture while improving soil fertility. It is a low input technology and it helps crops adapt to changing climatic conditions. Some of the benefits of conservation agriculture include: (i) minimal soil disturbance, (ii) use of mulch such as grass, leaves, crop residue, and manure, (iii) diversified crop rotations and intercropping to help improve soil structure and minimize pest outbreaks, and (iv) with timely land preparation and weeding, farmers can get good yields even in the event of a drought (Tsiko, 2011).

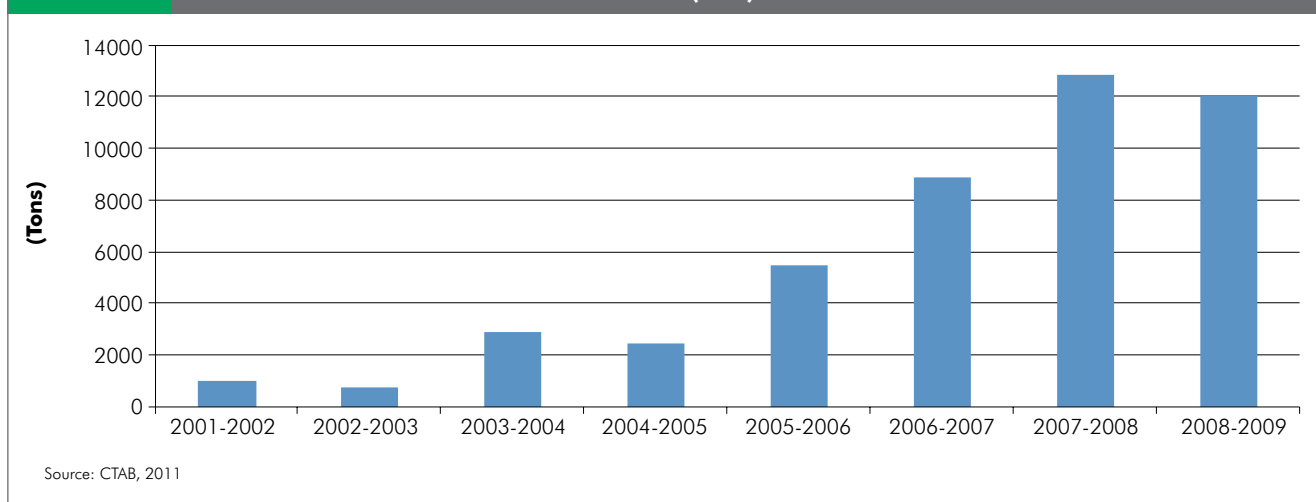
ii. Deficit irrigation

Deficit irrigation is defined as applying water to the plant at a fraction of the climatic demand or actual evapo-transpiration rate. Deficit irrigation is an optimization strategy under which crops are deliberately allowed to sustain some degree of water deficit and yield reduction. Deficit irrigation is a sustainable practice to cope with water scarcity. The optimization model objective is to maximize water productivity (revenue per unit water). Deficit irrigation is also an irrigation management tool. The user of deficit irrigation should have a very basic understanding of the soil-plant-water-climate relationship. Deficit

irrigation as a function of root depth of two crops, tomatoes and potatoes, was applied in Lebanon. The results for two seasons were encouraging (Nimah and Bashour, 2010). When deficit irrigation was applied using only 60% of the water requirement, the yield was not significantly different from that attained with full irrigation. If deficit irrigation is combined with plastic mulch, up to 60% of irrigated water can be saved without affecting yield. Plastic mulch is used to cover the soil with plastic sheets to control weed growth and prevent direct water losses through evaporation from the soil surface. Deficit irrigation will sustain irrigated agriculture, conserve water, and protect ecosystems. Therefore, Arab governments are urged to incorporate training in their extension services at the farm level to promote the adoption of deficit irrigation where possible.

iii. Composting for reduced water and energy consumption and for improved soil fertility and productivity

Arable land in most of the Arab countries is characterized generally by low organic matter content, which affects water retention as the amount of water used for irrigation is directly linked to the percentage of organic matter in the soil. Sustained plant growth requires slow release of water into the soil. High retention reduces the need to replenish water, and healthy plants in a moist bed rich in organic material need watering less frequently. Compost is not the only organic soil amendment available, but it is one of the least expensive and earth-friendly. Recycling vegetable waste and crop residues can help cut water bills.

FIGURE 10 TUNISIAN EXPORTS OF ORGANIC PRODUCTS (TON)


Soil organic matter is a key mechanism of holding water and nutrient. Any soil with structural problems, whether it is clay or sandy loam, will have improved water capture and retention with the application of compost. The addition of compost to loam soils with low soil organic matter can result in water savings of 20%. Water savings of 10% are readily achievable on a range of soil types. Typically, yield is directly related to the relative abundance of water. The addition of compost will enable storage of water near the root zone through the increased negative charge on humid surfaces. Substantial cost savings (both in reduced water usage and reduction in the use of commercial fertilizers) can be gained as a result of compost additions. Careful use of compost can significantly improve profits for a range of crops (Mangan Group, 2011).

A 22-year organic field study found that organic systems performed better in four out of five years of moderate drought by maintaining high levels of soil organic matter that helped conserve soil and water resources. Improving soil organic matter increases soil fertility while also increasing the water retention capacity of soils, thereby reducing the impacts of droughts, as well as reducing the risk of floods (Niggli et al., 2008; Altieri and Koohafkan, 2008; ITC, 2007). Sustainable farming practices such as mulching and integrating perennial crops and trees onto farms also conserve soil moisture and reduce the damage from extreme weather events.

iv. Water harvesting

Water harvesting has been a historically

common practice in many parts of the Arab world to cope with water scarcity. This practice may take on a new significance today because of the increased regularity of short duration, high intensity rainstorms believed to be induced by climate change. Water harvesting provides an opportunity to capture this voluminous runoff of rainwater.

Although, water harvesting at a household level and on the small farm level is of limited volume, it will partially supplement water requirements with good quality water. The harvested water can be mixed with less inferior water quality and can be used to supplement water demand for irrigation.

F. Research and development

Arab countries invest approximately \$1.4 billion annually in agricultural research and development (Pardey et al., 2006). This is about 1.3% of their combined agricultural GDP in 2008 (Table 1) and is higher than the developing country average of 0.53%, but far below the recommended investment level of 2% of agricultural GDP (IAASTD, 2009) and the level of investment by the developed countries. Arab countries increased spending on agricultural research and development (R&D) by only 0.05% of agricultural GDP from 1981 to 2000, whereas developed countries increased their spending by 0.95% (World Bank, 2008).

The number of agricultural researchers in Arab countries is relatively high, but they are under-

funded and under-equipped, as indicated in Table 15.

A potential researcher year is the equivalent of one year's worth of research. This unit is used because many researchers have a position that also consists of teaching, extension, and consulting, making them part-time researchers only.

For scholars with doctorate degrees, the financial incentives in a career in public sector research at national agricultural research institutes (NARIs) are generally inferior to the incentives in academia. Those who do join NARIs are often under equipped to be efficient in their research. Low investments in information technology and support staff are impediments to high quality research (IAASTD, 2009). Improving financial rewards and making resources available will attract competent researchers to agriculture and will drive the innovation needed to increase agricultural productivity.

i. Breeding for new seed varieties

Plant breeding has played a decisive global role in the upsurge in yearly yields in agriculture, with 1-2% annual growth in recent decades. Progress in breeding has many facets and is consistently achieved for all crops, year after year (Bussche, 2009). The use of improved seeds, including disease resistant strains and other genetically engineered crops, certified as safe, needs to be widely adopted.

However, according to Ceccarelli (2003), yields of key crops are chronically low and crop failures are common in many parts of the Arab region. According to the same author, conventional

breeding programs aimed at improving crops have had little effect, largely because most farmers reject the adoption of the new varieties. Selection in well-managed experimental stations tends to produce cultivars that are superior to local landraces only under favorable conditions and improved management. These favorable conditions are not at the disposal of resource-poor farmers in Arab countries.

In the past, researchers have been able to depend on farmers to retain sufficient crop diversity and provide 'new' genetic material. But homogeneous modern agriculture threatens that source of genetic diversity, and thus threatens both local and global food security (Vernooy, 2003). The high-yielding varieties developed by the formal research system are often high-maintenance varieties. Many farmers reject plant breeders' offerings simply because they are not designed for marginal farmland; they meet neither the farmer's needs nor local preferences. Comparing the conventional and participatory plant breeding, Ceccarelli et al. (2001) mentioned that in the former, new varieties are released before knowing whether the farmers like them or not, while in the latter the delivery phase is reversed because the process is driven by the initial adoption by farmers at the end of a full cycle of selection. Rethinking conventional breeding strategies means recognizing the key roles of farmers and their knowledge and social organization in the management and maintenance of agro-biodiversity (Vernooy, 2003).

According to Kamal's (2008) survey and lessons learned, the main limitations and key challenges to plant breeding are the: (i) lack of financial resources to carry out field and laboratory experiments, (ii) need for an overall breeding strategy and priorities for future targeted crops

TABLE 17

CLASSIFICATION OF MEDITERRANEAN BIOCLIMATIC ZONES IN THE MIDDLE EAST BY PRECIPITATION

Zone type	Annual rainfall (mm)	Percent of arable area
Super-arid	< 200	0
Semi-arid 1	200-400	74
Semi-arid 2	400-600	14
Sub-humid	600-800	10
Humid	800-1200	1
Super-Humid	> 1200	1

Source : Hazell et al., 2001

and activities in plant breeding, in light of recent advances of science and globalization of the world economy, (iii) inadequate number of senior scientists and lack of coordination among plant breeders and with scientists from other disciplines such as biotechnology for sustaining and improving breeding efficiency, (iv) lack of integrated data management information systems, and (vi) property right for protection of genetic resources and released varieties.

ii. Use of biotechnology for biotic and abiotic stresses

Worldwide, private and publicly funded plant breeders are concentrating on a relatively small number of species. Biotechnology and genetic engineering appear, however, to reinforce this trend even further. Investments are concentrated worldwide on maize, rice, soya, and rapeseed. Other important species such as wheat, barley, and sunflower follow, but at a considerable distance. There are activities where the more important 'minor crops' are considered but to a much smaller extent (Schellnhuber et al., 2001).

Although more difficult to control and engineer than the usually monogenic traits of resistance to biotic pests and herbicides, the genetically complex response to abiotic stress is globally and regionally far more important. Therefore, breeding for plant tolerance to drought and salinity stress should be given a high research priority in all future agricultural biotech programs (Altman, 1999).

Among the opportunities for deploying modern biotechnological approaches in Arab countries, the following activities in Egypt can be enumerated: (i) producing transgenic plants resistant to indigenous biotic and abiotic stress, (ii) reducing

the use of agrochemicals and pesticides, and hence addressing their environmental risks, (iii) improving the nutritional quality of food crops, and (iv) reducing the dependency on imported agricultural products (seed-crops). Table 16 presents examples of current plant genetic engineering research at the Agricultural Genetic Engineering Research Institute in Egypt.

iii. Use of neglected species and rehabilitation of abandoned crops

Efforts to re-establish neglected and underutilized species (NUS) can contribute to rural social development by improving the prospects of food security and income generation for small farmers (Will, 2008). The rehabilitation of NUS also offers significant potential to conserve agro-biodiversity and ecosystems. In addition to playing a role in a more balanced diet, some NUS can have medicinal applications. To take advantage of NUS according to Noun (2006), there is a need for: (i) detailed taxonomic studies to identify and classify plant species, (ii) investment in research on the potential use of local flora in medicinal applications and establishing realistic supply links to markets, (iii) promoting conservation of local and useful flora through cultivation and use, (iii) raising public awareness about the potential value of NUS for food security, biodiversity protection, and poverty reduction in rural areas, and (iv) protection policies of plant genetic wealth. According to Will (2008), "only about 30 plant species out of the global agricultural biodiversity are used to meet 95% of the world's food energy needs." Therefore, investing and establishing the market value of locally based NUS can have the effect of shielding rural economies from globalization currents, commodity price volatilities, and food

TABLE 18 TOTAL EGYPTIAN EXPORTS OF ORGANIC PRODUCTS (TON)

Crop	2000	2004
Cotton	1,159	n.a.
Legumes (onion, potatoes, garlic, green peas)	5,850	30,000
Aromatic & medicinal plants (fennel, basil, wormwood, mint)	78	160
Fruits (strawberry, grapes)	26	40

n.a.: Not available
Source: Hamdi, 2006



import bans. Rehabilitating NUS will also contribute to preserving traditional knowledge and nutrition.

iv. Drought resistant crops

Research into conventionally bred and genetically modified drought-resistant cultivars and salt tolerant crops is essential for keeping rain-fed agriculture economically viable (El Obeidy, 2006). Arab governments should invest more in R&D activities to develop drought resistance crop varieties suited to their local environments. In this regard, Arab governments should adopt an aggressive approach in funding innovation efforts across a variety of key technologies as part of a risk management approach dictated by failures in climate policy and technology transfer. As pointed out by Tomlinson et al. (2008), failure to incorporate these potential scenarios into future mitigation plans will dramatically lower the likelihood of successful climate stabilization.

v. Drought mitigation and early warning forecasts

About 88% of arable land is in semi-arid areas, receiving an annual rainfall between 200 and 600 mm, as Table 17 indicates. Drought has long been a significant factor in the West Asia and North Africa region, particularly for low-rainfall

crop-livestock systems and for herders in the vast grazing areas of the steppe (Hazell et al., 2000).

In addition, climate change threatens land and water resources and cannot be ignored any longer. Adaptation to climate change must be accounted for in any agricultural plans and investments in order to mitigate the disruptive effects of droughts, variable rainfall, higher temperatures, and species redistribution.

With respect to risk management, droughts increase the level of indebtedness by rainfed farmers, who borrow to finance their agricultural production, which in turn puts agricultural financial institutions at risk after repeated drought occurrences. In Morocco, since 1999, the Public Agricultural Bank (CNCA), which finances more than 80% of all agricultural loans, has made the purchase of drought insurance a mandatory condition for obtaining an agricultural loan in drought prone areas (World Bank, 2001).

Most of the drought-coping strategies implemented by governments of the Arab region have focused on mitigation measures and emergency plans. With greater population growth rates and higher demand on declining water resources, governments need to address the drought as a structural phenomenon. The careful management of water resources will

become increasingly important in mitigating the impact of drought on the economies of the region in the future (Shobha, 2006).

In principle, the ability to provide early warning forecasts of drought could be a powerful tool for avoiding many of the economic costs associated with the misallocation of resources that arise when farmers, herders, and other decision makers have to commit resources each year before key rainfall outcomes are known. The economic value of season-specific forecasts depends indeed on the degree to which farmers can adjust their plans as the season's rainfall unfolds. If most decisions have to be made upfront each season, the scope for mistakes will be much greater and the potential economic gains from reliable forecast information will be forfeited (Hazell, 2000).

“Many governments have intervened to help manage drought losses, but usually on the basis of crisis relief once the drought has set in. Since the primary motive is typically humanitarian

assistance, not much thought is given to the longer-term impacts of drought interventions on farming practices and productivity. The result is often an inappropriate set of economic signals to farmers and herders, leading to unsustainable farming practices in many drought-prone areas that increase both future drought losses and government's cost of providing drought compensation” (Hazell, 2000).

All Arab countries have experienced, and continue to experience, high population growth rates and increased pressure on land and water resources, which threatens the sustainability of current land uses and exacerbates the impact of drought on rural populations (DePauw, 2000). The region has an overwhelming need for modern and effective drought early warning systems to enhance the ability of governments to plan for future water shortages in a region where instrumental weather records go back less than 50 years, and which has experienced a resurgence of devastating droughts.



G. Promoting Organic farming

Organic farming is a form of agriculture that relies on ecosystem management and attempts to reduce or eliminate external agricultural inputs, especially synthetic ones. It is a holistic production management system that promotes and enhances agro-ecosystem health, including biodiversity, biological cycles, and soil biological activity.

Heavy agricultural reliance on synthetic chemical fertilizers and pesticides is having serious impacts on public health and the environment (Pimentel et al., 2004). Organic and agro-ecological farming can significantly increase yields for resource-poor farmers, improve food security, and sustain and enhance the environmental resources.

i. Current status of organic farming production in the Arab region

Compared to the status of organic agriculture worldwide, the Arab region is lagging behind what could be a vital and promising sector. Egypt is by far the most advanced country in terms of organic agricultural development in the Arab region. The total acreage of organic farming in Egypt is 24,548 hectare (Willer and Yussefi, 2006), as indicated in Figure 8.

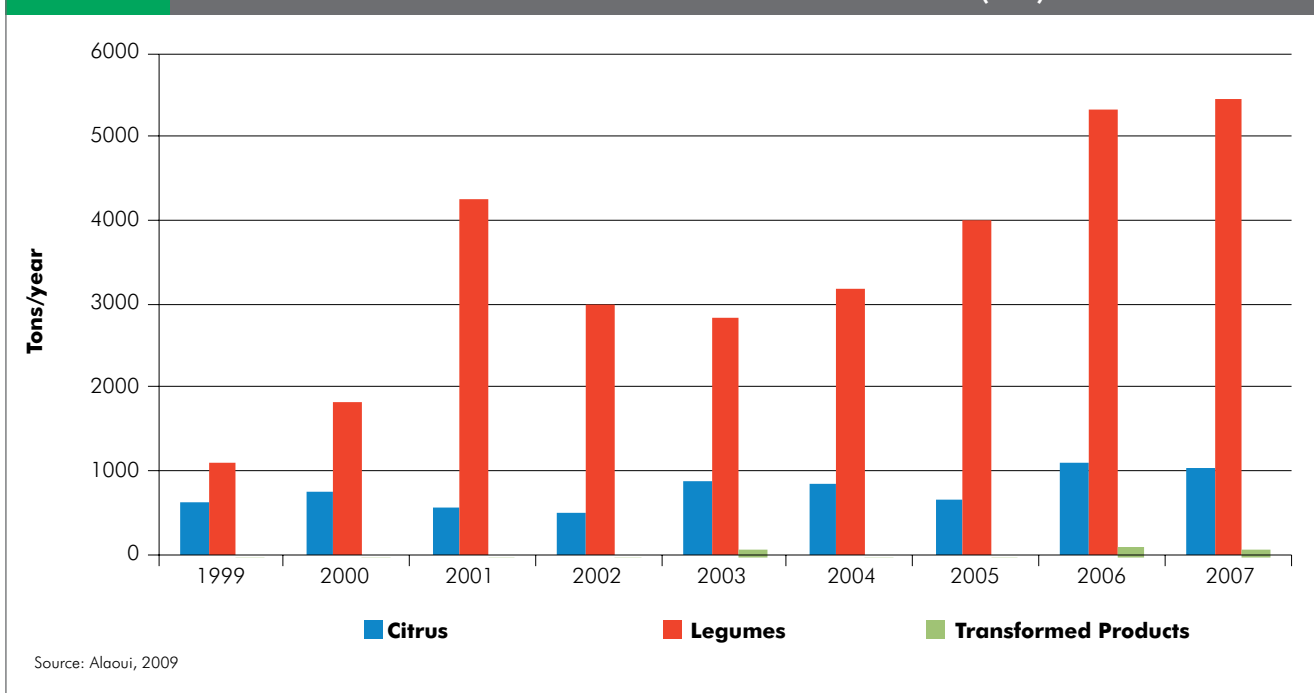
The main organic crops include fresh vegetables, tropical fruit trees, cotton, herbs and spices, medicinal plants, and cereals (Willer and Yussefi, 2006). Table 18 demonstrates remarkable growth in Egyptian exports of selected organic products

Organic agriculture has been practiced in Tunisia since the 1980s, with a total area of 335,897 hectare under cultivation (CTAB, 2011). Production and exports of Tunisian organic products are indicated in Figures 9 and 10, respectively.

According to EACCE (2007) and further estimates, the acreages of certified organic farming in Morocco has increased from 200 hectare in 1997 to 5,955 hectare in 2007, as indicated in Figure 11.

There are about 331 organic farms in Lebanon covering an area of 2,490 hectare, as of 2006 (ALOA, 2011). There are about 3,256 farms practicing organic farming in Syria, with a total certified acreage of 28,461 hectare (CIHEAM, 2008). Syria exports about 1,302 tons of organic cotton annually at a 30% higher premium than what the local market commands (MAAR, 2011). Organic agriculture in Algeria is in its infancy and has been launched in the country by state owned agencies.

FIGURE 11 EVOLUTION OF MOROCCAN ANNUAL EXPORTS IN ORGANIC PRODUCTS (TON)





ii. Current consumption of organic products and how to improve it

Unfortunately, organic agriculture in most large producing Arab countries is being developed primarily for export. Egypt exports between 40% and 50% of its organic produce (FAO, 2006b). Seeking to raise consumer demand, promote organic value chains, and establish market linkages in Saudi Arabia, the Department of Organic Agriculture in Saudi Arabia is preparing a market development program for organic agriculture. The local consumption of agricultural organic products in Morocco and Tunisia is still limited because the sector is export-oriented. Arab governments should pursue the development of local markets for organic produce.

iii. Organic processing

Organic processing in Lebanon is mostly focused on production of foods typically used in Lebanese cuisine, such as organic olive oil, oregano mix, orange blossom water, and traditional Lebanese

jams and recipes (ALOA, 2011). Olive is the main organically produced commodity processed in Tunisia. Organic wild capers in salt, organic Tunisian Harissa or hot pepper, and organic sugar cane are also produced. Except for Argan oil, most organic products produced in Morocco are exported without any processing.

iv. Certification of organic products

Most Arab countries do not have their own certification and inspection bodies. Having such institutions would: (i) lower the cost compared with that of international inspection and certification, (ii) allow continuous capacity building for national inspectors and operators, (iii) reduce language barriers, (iv) offer competitive cost of laboratory analysis, and (v) motivate more farmers to convert to organic farming.

v. Future perspectives of organic agriculture

Until now, most Arab countries have not taken



practical measures to promote organic agriculture at a large scale, while neighboring countries in Europe and Africa are promoting rapid growth in the sector. Arab countries are urged to implement their own certification processes. To promote domestic production and consumption of organic food, Arab countries should offer incentives to assist farmers make the conversion to growing organic crops. Because of the scarcity of organic fertilizers and bio pesticides and their high prices in the market, it is becoming urgent to offer incentives for the private sector to make these products more available and affordable. This can be achieved by exempting these products from import taxes and by promoting their production locally. Special effort should be made by all Arab countries to develop organic fertilizers and bio-pesticides as an alternative to the intensive use of conventional agrochemicals. Producers and

consumers of organic products should develop plans to expand the value chain for their products (Alaoui, 2009).

V. CONCLUSION AND RECOMMENDATIONS

Agriculture in the Arab region has reached a precarious state driven over time by inappropriate policies and agricultural malpractices. Its capacity to continue to perform its economic, social, and environmental functions is at great risk. While agriculture has been a significant activity in the structure of most Arab countries' economies, its achievements have been undermined by a mix of problems manifested in various phenomena on the ground such as soil erosion, land degradation, loss of biodiversity, desertification, salinization,

water pollution, and depleted aquifers in various areas in the Arab region.

Irrigation potential in Arab countries is limited. Agriculture already uses over 85% of available natural water resources with an efficiency of less than 50%, while demand for industrial and domestic uses is on the rise. Emphasis on water supply rather than demand management, and the lack of appropriate laws, regulations, and incentives have created the conditions for improper practices such as the inefficient use of irrigation water, with detrimental consequences on environmental resources and biodiversity.

Against this background, and in an arid and semi-arid region, where agricultural land is limited and water resources are critically scarce, Arab countries have pushed up agriculture to the top of their development agenda with the aim of enhancing food security. It is imperative that a new approach to agricultural development with specific action plans is adopted to position agriculture on a sustainable path. To this end, Arab governments are urged to design comprehensive agricultural development strategies focusing on the following:

a. Water Resources

Water is an essential agricultural resource. Its critical scarcity in the Arab region will be further exacerbated by the potential impacts of climate change. A shift of focus from supply to demand management of water resources is critically important. Appropriate laws, regulations, and policies are needed to maintain the sustainability of surface and ground water resources and to ensure their efficient utilization, particularly in irrigation, with emphasis on water productivity rather than yield maximization per unit of land. In this regard, rational water pricing should be adopted to motivate prudent water use and to generate revenues that can be used to finance the maintenance and operation of agricultural infrastructure. Modern irrigation techniques such as sprinkler, drop, and localized irrigation can greatly enhance the efficiency of water use and prevent water logging.

In addition, more efforts should be made to augment water resources from non-conventional sources including harvesting, drainage, and treated

wastewater, while adopting required precautionary measures to ensure safety of use.

b. Agricultural Productivity

Crop productivity, especially that of cereals, grain legumes, and fodder crops, is at a very low level in the Arab region. Raising productivity and crop diversification are key to food security and to the financial and economic viability of agricultural investments. The limited irrigation potential and the dominance of rain-fed agriculture in the Arab region call for undertaking actions to promote the productivity of rain-fed crops. This objective can be achieved if appropriate quality inputs become available and are used in measured quantities. In this regard, research is an indispensable core activity for arriving at the optimal mix of inputs, and discovering drought-resistant cultivars and salt tolerant crops.

c. Food Security

Food security on a country level in the Arab region is unattainable. Prospects for making progress towards food security at the regional level require concerted and coordinated efforts of Arab countries and their cooperation to utilize land and water resources according to their comparative advantage. It is equally important to adopt policies that facilitate trade in agricultural commodities, and at the same time build the infrastructure necessary to access each other's markets.

d. Investments and Financing

Agriculture is an under-financed sector in the Arab region in terms of spending levels on infrastructure and research and development. Large sums of funds are required for both rehabilitation and development, in addition to funding research programs. It is utterly important that Arab governments introduce laws and policies to create an environment conducive to local and foreign direct investment, and to design agricultural investments attractive for private and public-private partnerships. Official development assistance remains a significant source of financing agricultural operations, especially because of its leveraging effect on the overall cost of capital. Assigning priority to agricultural investments supported by well studied and prepared projects

can be an effective vehicle for accessing ODA resources from national, regional, and international financing and development institutions.

e. Integrated Approach

Past agricultural operations were often designed and implemented in a fragmented manner, lacking the supportive and facilitative components for achieving economic, social, and environmental objectives. It is essential that agricultural operations are not confined to production aspects, but be broadened enough to incorporate associated supply chain facilities and services such as transportation, packaging, storage, and marketing to bring produce and other commodities to consumers without loss in quantity or deterioration in quality.

f. Environmental Considerations

Agricultural policies and practices in the Arab region have often been un mindful of the protection of natural resources or ecosystems. New eco-agricultural methods, protective of soils, land, and water, such as organic and conservation farming methods should be promoted and supported. Furthermore, climate change necessitates the need for building suitable mathematical models for forecasting local and regional climate changes to assess their impact on agricultural resources and products, and introduce adaptation measures accordingly.

g. Farmers

The complexity of agriculture and its scientific applications demand those involved in practicing farming, especially farmers to possess the skills, knowledge, and expertise to make the right decisions regarding seed selection, fertilizers, pesticides, irrigation techniques, and other related farming disciplines. Therefore, it is critically important to train farmers and equip them with the necessary education, skills, and knowledge to build up their capacity to deal with ensuing issues. Establishing agricultural cooperatives and service centers for extension and training as well as assisting farmers in accessing markets for their products are necessary for supporting farming activities and enhancing livelihoods in rural areas. Farmers should also be organized to facilitate learning and sharing of farming practices that contribute to agricultural sustainability.

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Water

ARAB FORUM FOR ENVIRONMENT AND DEVELOPMENT (AFED)



I. INTRODUCTION

If “water is life” and adequate clean water is a “fundamental human right” as argued in international forums, why is the progress in dealing with the water crisis in Arab countries so slow? One reason is inadequate finance. The funding in most national budgets and international assistance loans or grants is surprisingly low. There is a discrepancy between commitments and actions, between needs and actual spending.

A combination of national government budgets, international and bilateral funding, debt relief, private sector investments and community-level resources are required. Arab governments must also establish the enabling institutional framework for encouraging private investments and public-private partnerships for clean water and sanitation. Another key source of funding is revenues from water pricing.

Artificially low prices for water services (and sometimes no pricing at all) are at the root of inefficiency, overuse, excessive pollution releases and environmental degradation. Simply put, free water is wasted water. While water pricing has been advocated for a long time, particularly in irrigation, it is seldom enacted even though it is central to increased investment in the sector. Arab governments cannot meet the investment demands for water services now, let alone in the future. And the private sector will not invest unless it can be assured a reasonable return. Yet Arab governments continue to resist water pricing and the phase-out of subsidies, arguing that the poor cannot afford to pay. In fact, middle class areas pay low prices for networked water services, while the poor pay much higher prices for poorer quality water from street vendors.

While substantial financial resources are needed, finance alone will not solve the water crisis. Moreover, experience shows that technological or engineering solutions by themselves will not be effective without the necessary policy, institutional and legal reforms. Land tenure reforms, demand management practices, transparent water rights and allocation systems, economic incentives, improved legal and regulatory frameworks, creation of basin management authorities, and public participation are all necessary pieces of the policy reform. Empowering women's groups,

the poor, youth, and community-based groups to have an adequate voice in participatory decision-making is also essential.

Ultimately, the water crisis cannot be addressed in isolation from other crises such as land degradation, deforestation and ecosystem loss. Taking an integrated approach that considers the links between water, land and people, and making the necessary reforms and investments in all these areas can go a long way towards sustainable water management. Deforestation and degradation of watersheds mean that less fresh water is available. Conserving fresh water ecosystems through better management would not only help maintain the quantity of available water, but its quality as well.

In water management, the task sometimes seems overwhelming. How to coordinate services, industry, trade, transport, agriculture, fisheries, science, environment, development goals, waste management and diverse populations? How to involve various international agencies, levels of government, the private sector and non-governmental organizations (NGOs)? How to forge international action when upstream nations see little direct benefit in preventing pollution that affects downstream users; when coastal nations see little incentive for protecting wetlands that sustain fisheries used by other nations; when countries with trans-boundary groundwater aquifers feel no obligation to protect recharge zones from degradation that affects the wells of their neighbors?

These are not insignificant questions since 43% of the world's population lives in international river basins, which cover almost half the planet's land surface and contain over 80% of the fresh water river flow. There are also countless aquifers that cross political boundaries. Water scarcity has the potential to increase tensions among nations that share water resources. The water crisis, however, has many dimensions and varies across regions. Water supplies are scarce in some regions and relatively abundant in others. And the effects of long-term climate change are also likely to vary across regions.

All features of the global water crisis manifest themselves in the Arab region. The state of water resources and management in most Arab

This chapter is compiled from the comprehensive report on Arab water published by Arab Forum for Environment and Development (AFED) in 2010, entitled *Water: Sustainable Management of a Scarce Resource*, and recommendations of the 2010 AFED annual conference which debated the report's findings. It also refers to the flagship report on Green Economy published in 2011 by the United Nations Environment Programme (UNEP).



countries is precarious. Population growth and escalating demand for water in the region have reduced per capita supply to one-fourth of its 1960 levels. Without fundamental change in policies and practices the situation will get worse with both political and economic ramifications.

The 2010 annual report of the Arab Forum for Environment and Development (AFED), *Water: Sustainable Management of a Scarce Resource*, highlighted the state of water management and use in Arab countries and articulated the policy reforms needed. This chapter is a summary of its findings and suggested recommendations.

II. WATER SECTOR OVERVIEW

The water sector in Arab countries suffers from multiple strains. Arab countries rank last in renewable freshwater availability per capita compared to other regions of the world.

Currently, 13 Arab countries are among the world's 19 most water-scarce countries. Per capita water availability in 8 Arab countries is below 200 m³ per year. By 2015, it is expected that average annual freshwater availability in Arab countries will be below 500 m³ per capita, designated the severe water scarcity mark. In 2025, only Sudan and Iraq are expected to be above the water scarcity level. In some Arab countries, total water withdrawals already exceed available renewable water resources. In fact, internal renewable freshwater resources per capita in most Arab countries are already below the water scarcity level of 1,000 m³, compared to a world average of over 6,000 m³. More than 45 million people in the Arab world still lack access to clean water or safe sanitation. The growth in population in the coming two decades, 90 percent of which will occur in urban areas, will increase the political pressure to meet these demands especially for domestic and industrial use.

TABLE 1 WATER AVAILABILITY AND USAGE IN ARAB COUNTRIES

Country	Annual Availability				Annual Water Usage		% Use by Sector				
	Natural Renewable Resource Bm ³ /year	Desalinated End Water Bm ³ /year	Wastewater Reuse year Bm ³ /year	Per Capita Renewable Availability m ³ (2006)*	2015** (AFED) m ³	2025** (AFED) m ³	Bm ³	As a % of Total Water Resources	Domestic	Industry	Agriculture
Algeria	11.50	0.07	Neg.	350	297	261	4.59	40	25	15	60
Bahrain	0.11	0.14	Neg.	157	125	106	0.25	170	26	3	71
Djibouti	0.02	0.00	Neg.	367	306	260	0.02	113	88	0	12
Egypt	61.90	0.06	5.90	773	641	552	73.10	108	6	8	86
Iraq	80.00	0.03	n.a.	2652	1989	1551	42.80	48	3	5	92
Jordan	0.87	0.00	0.07	164	114	98	0.98	104	26	7	68
Kuwait	0.11	0.65	0.12	7	5	4	0.76	87	37	2	60
Lebanon	3.20	0.00	n.a.	1110	999	919	1.29	40	28	4	68
Libya	0.80	0.03	n.a.	99	80	67	3.89	469	9	4	87
Morocco	20.00	0.02	0.07	940	620	558	16.84	84	5	-	95
Oman	1.60	0.12	0.02	550	440	365	1.22	74	9	1	93
Qatar	0.05	0.12	n.a.	71	50	40	0.28	n.a.	23	3	74
Saudi Arabia	2.50	2.28	0.15	96	77	64	17.00	506	15	1	84
Sudan	24.00	0.00	0.00	1711	1369	1122	19.00	5	6	5	89
Syria	18.70	0.00	0.26	865	650	550	14.70	78	9	1	87
Tunisia	3.35	0.00	0.14	450	405	373	2.53	72	12	4	84
UAE	0.20	0.95	0.14	35	26	20	1.60	180	24	10	67
West Bank & Gaza	0.76	0.00	0.01	215	160	120	0.44	57	51	49	58
Yemen	2.50	0.02	0.03	97	70	50	3.20	126	5	2	93

Source: World Bank, 2003
(Figures collected in 2002-2003)

Neg: negligible volume of used water
n.a.: Not available

* Total Actual Renewable Water Resources (TARWR) per capita figures from World Water Development Reports 2 (2006) and 3 (2009), UNESCO. TARWR tables are based on AQUASTAT FAO. Index web-update site accessed on 19 July 2010. http://www.unesco.org/water/wwap/wwdr/indicators/pdf/Table_4.3_Updated.pdf

** 2015 and 2025 projections developed by AFED, based on actual changes between 2000-2006, and average projected rate of population growth for each country, as per data of the UN Population Division, published in the World Population Prospects, 2008 revision <http://esa.un.org/unpp/index.asp?panel=2>

The figures are mainly indicative trends because of the different methods and tools used to calculate the aggregate main source of water. The projections take the lower side of population growth in the region, and do not take into account the impact of increase in GDP and other variables which push the demand upward, nor factors such as increasing drought and other climate change impacts which drive water availability downward.

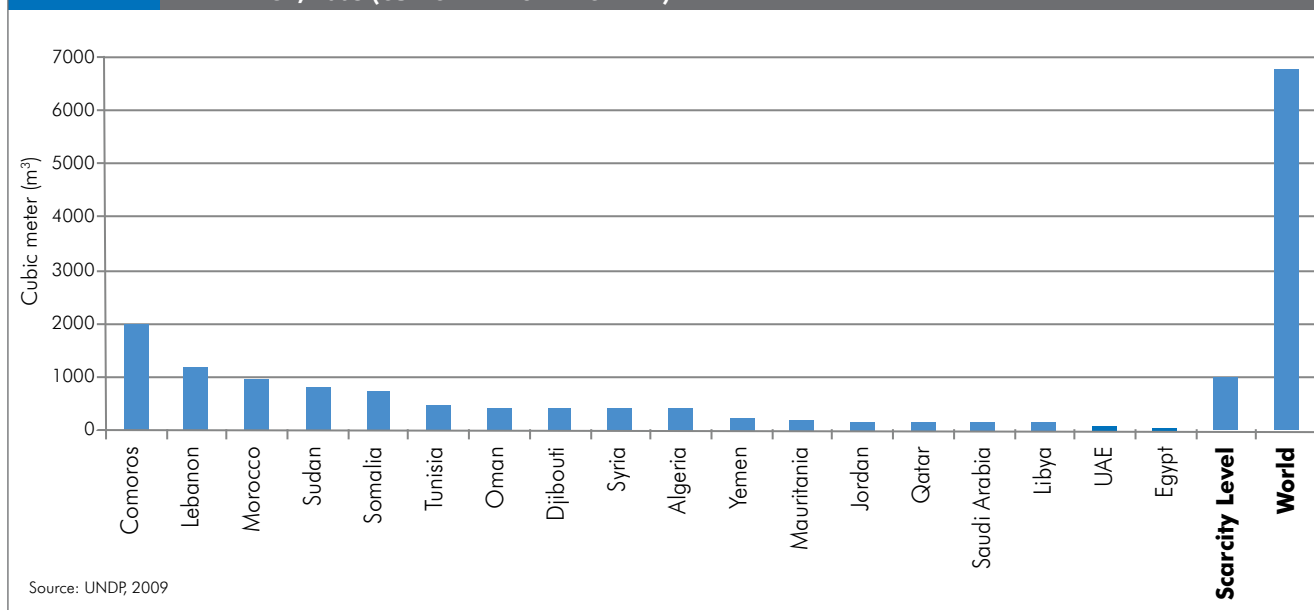
However, public budgets are already constrained and can hardly sustain efficient levels of water services to current populations, which are growing at 2-3% annually. Most of this growth is adding pressure to already crowded and inadequately serviced cities and towns. Ambitious plans for rapid economic growth and increased pace

of industrialization will further add to water shortages.

The political economy of low water tariffs and high fuel and water subsidies in Arab countries has contributed to overuse of scarce water resources and has deprived providers of desperately needed

FIGURE 1

ARAB INTERNAL FRESHWATER RESOURCES ARE OFTEN BELOW SCARCITY LEVELS AND THE WORLD AVERAGE, 2005 (CUBIC METERS PER CAPITA)



revenues to maintain the financial health and physical condition of urban and rural water supply networks. The price charged for water is estimated to cover only about 35 percent of the average cost of supply, and charges in many irrigation systems are much less.

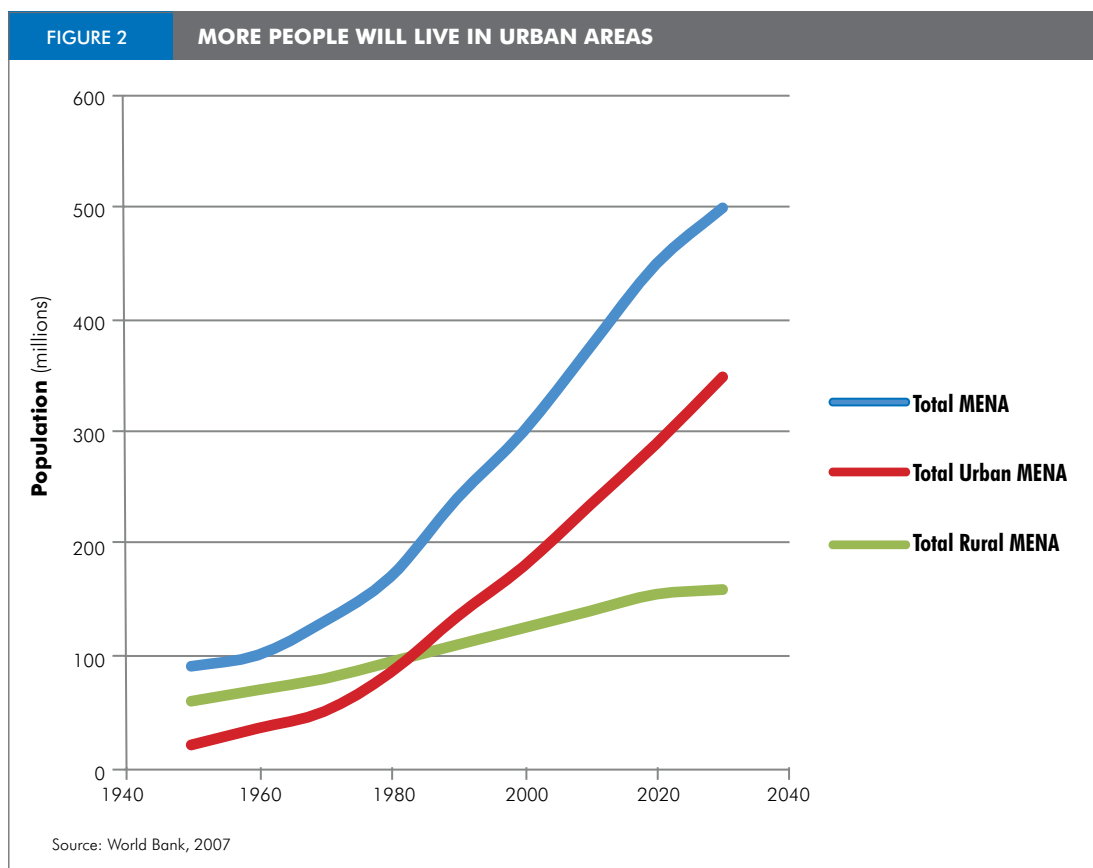
Because renewable water resources cannot meet growing demand, governments have often encouraged the over-exploitation of groundwater resources. For example, the average annual abstraction from groundwater in all sub-basins in Jordan is about 160% of the annual renewable average of recharge. In Yemen, groundwater is being pumped at a rate that is four times greater than natural recharge, forcing farmers to abandon once productive valleys. The over-extraction of groundwater beyond safe yield levels has resulted not only in dramatic declines in the water table, but also in the pollution of groundwater aquifers in coastal areas by saline seawater. Some countries are expanding investment in desalination of seawater and in wastewater treatment and reuse. Proper treatment of wastewater and controlled reuse, however, continue to be of high concern posing serious risks to public health and the environment.

Water pollution is also a serious challenge in the region, attributed to the use of high levels of chemicals in agriculture as well as to increasing

inflows of domestic and industrial wastewater into water bodies. The lack of sanitation facilities for large segments of the population contributes to water pollution by raw sewage. The discharge of brine effluents from seawater desalination plants causes degradation to coastal marine areas. The Gulf countries flush about 24 tons of chlorine, 65 tons of pipe-cleaning anti-scaling agents, and about 300 kg of copper into the Gulf daily.

Quick fixes and short-term solutions are not adequate to address the challenges of the water sector in Arab countries. Policy-makers need to change course and adopt policy reforms that address key strategic issues. They need to make a strategic shift away from investing in the development of water supplies to efficiently managing the available supply of water resources. Water demand management has proved to yield significant benefits and may often be more cost-effective than traditional supply management measures. Managing demand will provide policy-makers with the opportunity to create mechanisms to adjust water allocation more equitably, rationally, and sustainably. The water needs of the municipal, industrial, and agricultural sectors are legitimate, but so are the priorities to maintain water flows to wetlands, aquifers, river basins, and other ecosystems.

When introducing new policy frameworks, a



high priority should be given to articulating and measuring reliable performance indicators to monitor the effects of policy reforms. Reliable accounting of the economic, social, and environmental effects of new policies provides useful guideposts for navigating a transition to a sustainable water future.

The UNEP flagship report on transitioning to the green economy (UNEP, 2011) points out that greening the water sector provides numerous opportunities. One such opportunity is investing in biodiversity and ecosystem services, as global assessments of the health of the world's water river systems and aquifers suggest that the aggregate trend is one of decline in terms of ecosystem health and function. Another opportunity is the investment in sanitation and drinking water supply. The UNEP report estimates the cost of achieving the 2015 Millennium Development Goals (MDG) at US\$142 billion per year for providing sanitation services and US\$42 billion per year for drinking water supply to households. Although the amount of funding needed seems massive, the Organization for Economic Co-operation and

Development (OECD) estimates that in Ghana, for example, "investment of US\$7.40 per person per year over a decade would enable the country to meet its MDG target" (UNEP, 2011).

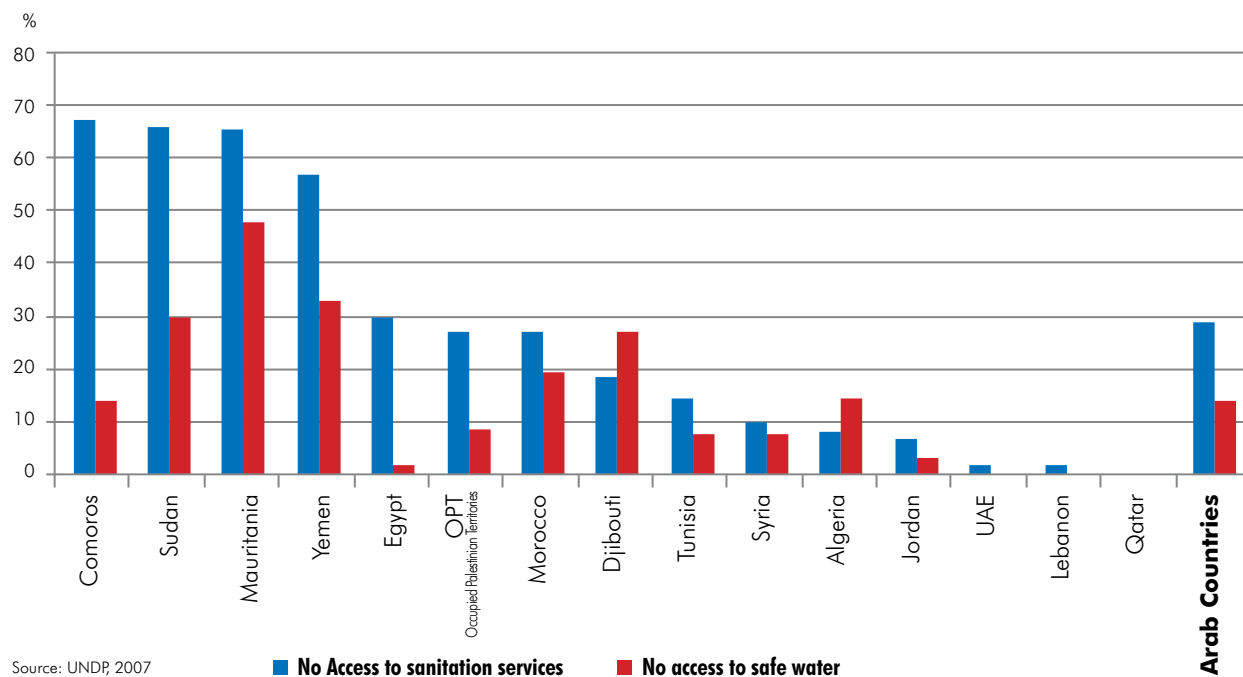
The UNEP report also highlights the fact that there is a flow of benefits from investment in the water supply and sanitation sector. The returns to investment in the water sector are often indirect. As stated in the report: "Build a toilet for girls in a school and they are more likely to go to school. This simple statement highlights the fact that investment in water opens up other opportunities for development."

A. Water Resources and Climate Change

As a result of climate change, the atmospheric processes responsible for the aridity of the Arab region are projected to intensify. By the end of the 21st century, Arab countries are predicted to experience an alarming 25% decrease in precipitation and a 25% increase in evaporation rates, according to climate change models. As a

FIGURE 3

PERCENTAGE OF POPULATION WITHOUT ACCESS TO SAFE WATER AND SANITATION SERVICES, 15 ARAB COUNTRIES, 2007



Source: UNDP, 2007

result, rain-fed agriculture will be threatened, with average yields declining by 20% in Arab countries overall, and by 40% in Algeria and Morocco. Water deficits, already a fact driven by natural water scarcity and unrelenting rising demand in the region, will be exacerbated. Failing to develop adaptation strategies now will contribute to greater suffering in the future.

In addition to climate disruption, water resources in Arab countries are vulnerable to other stresses such as population growth, changing land use patterns, variable rainfall, and natural water scarcity. Vulnerabilities to these stresses are not unlike those to climate change. Therefore, a vulnerability-based approach would be most effective in advancing targeted intervention policies to address existing vulnerabilities (e.g., inherent aridity) as well as future ones (e.g., climate change). It would also permit policy-makers to formulate strategies based on accumulated knowledge of the region's resiliency factors and adaptive capacity.

B. State of Freshwater Ecosystems

Freshwater ecosystems supply the Arab region

with water and provide critical habitats for aquatic biodiversity. Therefore, information about the condition of freshwater ecosystems matters. Arab countries for the most part have been unable to provide systematic, reliable, and up-to-date information on the state of wetlands, marshes, lakes, river basins, oases, and their biological endowments. Arab governments are thus urged to provide support and to commit resources to establish an evaluation, monitoring, and reporting mechanism for conducting assessment studies about the state of freshwater ecosystems. To ensure their effectiveness, the assessment studies have to be scientifically credible and relevant to decision-makers' needs.

As human interactions with freshwater ecosystems accelerate in Arab countries, assessment studies will be needed to address how freshwater ecosystems are changing, whether they are thriving or diminishing, what new challenges they are facing, and whether policy-makers are addressing these ecosystem challenges effectively. They should also highlight the threats to biodiversity and ecosystem sustainability.

Arab governments are also urged to increase their

Virtual water (also known as embedded water, embodied water, or hidden water) refers, in the context of trade, to the water used in the production of a good or service. The precise volume can be more or less depending on climatic conditions and agricultural practice.

WATER NEEDED TO PRODUCE... (LITERS)



Apple
70 L/apple



Orange
50 L/orange



Cheese
5000 L/kg



Milk
1000 L/1 litre



Wheat
1300 L/kg



Bread
40 L/slice



Coffee
140 L/cup



Tea
30 L/cup



Rice
3400 L/kg



Chocolate
2400 L/100 grams



Jeans
10855 L/pair of jeans



Paper
10 L/sheet of paper. (A4)



Goat meat
4000 L/kg



Beef Meat
15500 L/kg



Sheep Meat
6100 L/kg



Hamburger
2400 L/hamburger

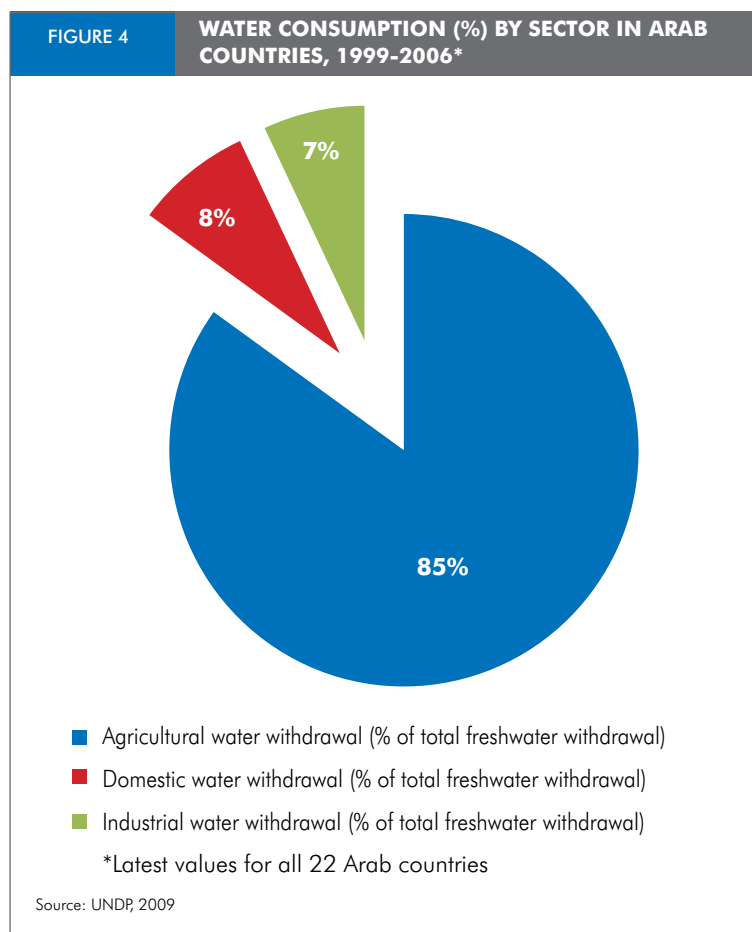
capacity to utilize that knowledge and muster the political will to transform this knowledge into action. This will enhance the ability of water resources professionals to design, implement, and evaluate effective interventions for the sustainable management of freshwater ecosystems.

C. Agricultural Water Management

Agriculture accounts for over 83% of water use in the Arab region, reaching 90% in some countries, against a world average of 70%. Despite serious water shortages, irrigation efficiencies remain at 30-40%, low water prices are still common, groundwater reserves are fast depleting, and incentives for irrigation improvements are lacking. The demands placed on the agricultural sector are plenty, almost unrealistic. Arab agriculture is expected to contribute to food security, reduce the Arab world's food import bill, provide rural employment, redirect some of its share of fresh water to municipal and industrial use, acclimatize to marginal-quality water for irrigation, and adapt to climate change. Agricultural practices are also blamed for increased soil and water salinity, toxic pollution from the use of agro-chemicals, damming of rivers, and the loss of biodiversity associated with wetlands destruction.

These concerns, though serious and multi-dimensional, can be addressed through a mix of institutional reforms, changes in incentive structures, and technical innovations. A mix of economic mechanisms such as rebates, reduced taxes, targeted subsidies, price signals, access to water rights, tradable water permits, and other economic incentives should be considered by policy-makers to persuade farmers to adopt irrigation-efficient technologies, change cropping patterns, improve irrigation scheduling, reduce over-abstraction, and in general shift agricultural activities towards higher-value crops. For Arab countries, where water resources are scarce, increasing crop productivity per unit of water consumed rather than per unit of land is a necessary step towards the shift to a green economy.

Arab governments should also provide financial support to research efforts focused on developing new local crop varieties tolerant to aridity and salinity conditions. For countries that rely on rain-fed agriculture, a new drive to improve and



invest in rainwater harvesting systems is highly recommended.

In effect, these policy reforms would result in a new political economy of water. This change requires Arab governments to consider the wisdom of acquiring water 'virtually' through the import of, say grains, from water-rich countries, while allocating scarce water resources to low-water consuming, high value-adding crops that can generate foreign exchange. It is more realistic to attain food security through trade policies.

D. Wastewater Treatment and Reuse

The volume of wastewater generated by the domestic and industrial sectors in Arab countries is approximately 10 km³/year, of which 5.7 km³ undergoes treatment. These figures suggest that on average 43% of annually generated wastewater is discharged in untreated form. Of the volume of wastewater that is treated, only one third is

STRATEGIC WATER RESERVE IN ABU DHABI: AQUIFER STORAGE AND RECOVERY

Mohamed A. Dawoud

Abu Dhabi depends on desalination of seawater and brackish groundwater to meet the Emirate's main water domestic supply. The total present desalination capacity is about 635 million gallons per day (MGD). The Abu Dhabi Water and Electricity Authority (ADWEA), which is responsible for providing water and electricity for the Emirate, uses a number of desalination technologies to produce water including multi stage flash (MSF), reverse osmosis (RO), and multi effect distillation (MED). MSF is the main technology used because it is mature and reliable, produces high quality water with low total dissolved solids (TDS) (2-150 mg/l) in large quantities, and has a low risk of bacterial or pathogenic contamination. At each desalination plant, there are water storage tanks for back-up use. The size of potable fresh water tanks at the desalination plants varies between 0.2-0.4 million m³. The total amount of storage at all plants is 1.51 million m³, which is less than one day's production. The arid climate of the Emirate results in increased consumption in the summer months, which is reflected in production data. In the winter months of January and February, production declines slightly and then gradually increases through the spring months of March and April. Water production during the hot summer season from May through August shows another gradual increase. Thereafter, the production attains constancy until the end of December.

During the peak summer season, desalinated water is directly consumed, while in the winter months there is excess production. This excess is used for the irrigation of green landscaped public spaces throughout the Abu

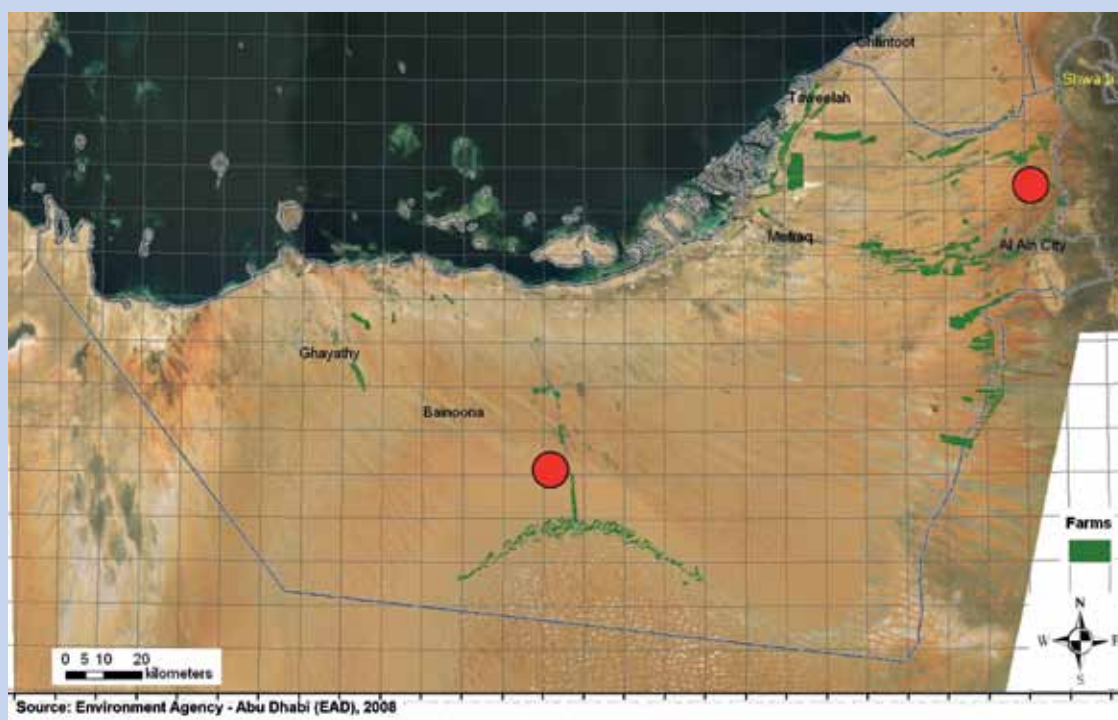
Dhabi Emirate. An alternative option would be to store this excess water in aquifers during the winter months to be recovered when demand rises. In addition, to maintain an uninterrupted water supply during times of emergency (natural disasters, industrial accidents, war, or other crises), Abu Dhabi needs to have long-term storage capacity equivalent to at least 1 year's fresh water demand. To study the feasibility of underground water storage in aquifers, two sites were selected as pilot projects in 2002. The first one is in Al Shweib in the Eastern Region and the other is in the Western Region as shown in Figure B1.

For the Eastern Region, water from the Qedfaa plant was injected in the shallow alluvial aquifer system. The results of the study indicate that aquifer storage and recovery (ASR) is a viable alternative for augmenting the depleted aquifer. The second project was located in the Western Region between Madinat Zayed and Meziyrah. It was designed for an infiltration capacity of 500 m³/h and recovery capacity of 750 m³/h. A shallow to medium-deep aquifer north of the Liwa Crescent was selected as the study area for the following reasons: (1) existence of a large natural fresh groundwater lens, with salinity less than 1,500 ppm, partly meeting the TDS-limit of the international World Health Organization drinking water standard of 1,000 ppm, (2) sufficient lateral extension and aquifer thickness, (3) sufficient depth of groundwater table, (4) relatively homogenous lithology, (5) far from already existing well fields, and (6) favorable hydro-chemical conditions. This study has clearly indicated that the recharge of desalinated water into and efficient recovery from an existing freshwater aquifer are feasible on a large scale.

reused. The volume of generated wastewater in Arab countries is expected to grow quickly due to increased utilization of water by rising populations, industrialization, and higher standards of living. The quality of treated wastewater in Arab countries must also be questioned. Wastewater treatment plants in Arab countries have highly variable efficiency. They are allowed to handle waste loads that exceed their capacity limits, hampering their effectiveness. The practice of combining domestic and industrial wastewater for treatment imposes limitations on the ability of plants to operate satisfactorily. In some Arab countries, crop irrigation by untreated wastewater is practiced due to the unavailability of fresh water.

The untapped potential of wastewater treatment and reuse for augmenting Arab countries' water supplies requires appropriate policy interventions. Policy-makers need to demonstrate a long-term political commitment to a national strategy for the utilization of wastewater treatment and reuse and to establishing proper institutional structures and water reuse policies. The development of appropriate policies for promoting reuse and reuse options, dissemination of practical knowledge, development of best practices, cost recovery mechanisms, professional training, public awareness campaigns, and the adoption of adapted standards and guidelines that take into consideration reuse

FIGURE B1 SITES OF PILOT PROJECTS



Countries of the Gulf Cooperation Council (GCC) rely on desalinated water as a main source of domestic water supply. The maximum capacity of the emergency water reserve in surface ground reservoirs and distribution networks ranges between 2 to 5 days. This storage capacity is insufficient during weeks or months-long crises. Increasing the storage capacity via surface reservoirs is costly and not environmentally friendly. Groundwater storage using artificial recharge can be

a promising tool for strategic water reserve. Storing fresh water in groundwater aquifers is safer and more reliable and fixable for use in terms of time and location. It is recommended to conduct more extensive studies to further establish the feasibility of artificial recharge schemes.

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schemes and technical and financial resources.

Because reclaimed wastewater represents a valuable resource in a water-scarce region, it is desirable to treat all generated wastewater and to reuse all treated water. Beyond meeting quantitative goals, however, judicious planning calls for wastewater to be properly treated and suitably reused according to requirements for protecting health and the environment.

Viable options based on different treatment levels and different end-uses of wastewater (including food and non-food crops, landscaping, or groundwater recharge) should be assessed. Treatment options

should consider the ease of replication and upgrading as well as the availability of a local trained workforce to operate, monitor, and maintain plant facilities. For reuse in agriculture, selection criteria for crops, irrigation methods, and application periods should be considered. Wastewater treatment technologies should be suitable to local conditions, acceptable to users, and affordable to those who will pay for them. Finally, reuse must be part of a larger water strategy that manages and regulates demand effectively.

E. Desalination

Shortages in renewable and non-renewable

GREYWATER IRRIGATES A FRUIT GARDEN IN SOUTH LEBANON

Boghos Ghougassian

In the water-scarce town of Aitaroun, located in the border zone of South Lebanon Province, Mrs. Adla Taubeh has been reusing treated greywater (GW) to irrigate fruit trees in her garden since 2008.

Mrs. Taubeh has been growing fruit trees for 15 years with very unsatisfactory results. Due to the lack of sufficient irrigation water, the fruit used to dry before maturation and fall down. This changed four years ago, when she began recycling treated greywater (coming from her kitchen, showers and sinks) to irrigate her garden. The trees look healthier and are giving good yields. Mrs. Taubeh's home garden boasts 50 fruit trees including lemon, apricot, plum, mulberry, quince, and apple trees, in addition to old olive trees. Mrs. Taubeh can now harvest good quality fruit trees sufficient for home consumption and for sharing with friends and neighbors.

The greywater treatment system and the drip irrigation network in Mrs. Taubeh's garden were installed in 2008 by Civil Volunteers' Group (GVC), an Italian nongovernmental organization, and the Lebanese Appropriate Technology Association (LATA).

The greywater system has made Mrs. Taubeh's gardening task far easier. Greywater from the kitchen reaches the treatment tanks by gravity, where particulates and floatable material are filtered out. Greywater is treated by anaerobic digestion in barrels for two days, after which the treated effluent is automatically pumped through the drip irrigation network to various parts of the garden. Because treated greywater contains nutrients that are useful for plant growth, fertilizers are not used.

Mrs. Taubeh has since enlarged the original capacity of the treatment kit to allow her to accommodate greater quantities of greywater for treatment and reuse. The capacity expansion has allowed her to enlarge the garden and plant additional fruit trees. Today, the amount of greywater reused in irrigation exceeds 500 m³ per year. The GW treatment system and the drip irrigation network are kept in good shape by regular maintenance. There has not been any observed leakage of greywater in any part of the treatment or irrigation system. During the pumping cycle, which lasts for less than 10 minutes per day, a weak odor is detected, which is quite normal since anaerobic digestion is taking place in the GW tanks. The odor is not considered a nuisance. In addition, the greywater treatment system is water-tight, insect-proof, and odor-proof, and complies with the international standards for safe reuse of greywater in irrigation. Only greywater is used for treatment and recycling. Wastewater (blackwater) from the latrines is not utilized and is directed through a separate piping system to the septic tank.

Mrs. Taubeh has also been able to improve the irrigation network by installing branch valves, so that she can irrigate her target crops on demand. She is now planning to upgrade the site of the GW treatment kit.

In addition to fruit trees, the availability of more irrigation water has allowed Mrs. Taubeh to grow vegetable seedlings at a rate of 20 to 30 thousand seedlings per year. She uses 50% of the seedlings for growing thyme (zaatar) and tobacco and sells the other 50% to farmers, which brings earnings to her large family.

In addition to the income generated from the sale of crops, the GW treatment system has brought about significant financial savings directly and indirectly. The ability to recycle

water sources have compelled a number of Arab countries to rely on desalination for supplying the bulk of their municipal and industrial water needs. Arab countries, with 5% of the world population, have a 50% share of all cumulative desalination capacity contracted for in the world since 1944. The high rate of annual increase in contracted capacity will be maintained over the next decade, doubling current capacity by the year 2016. This comes at a high cost. Annual investments to produce, manage, and operate seawater desalination plants in the Arab world are predicted to reach US\$15 to US\$20 billion in the next decade. At present, 25% of Saudi oil and gas

production is used locally to generate electricity and produce water. With present growth rates for demand, this fraction will be 50% by 2030, according to Saudi officials. Despite the high cost incurred in producing desalinated water, there is no relief from the demand side. Water tariffs cover on average 10% of cost. Water subsidies, if they continue to be unchallenged, could consume up to 10% of oil revenues in some countries of the Gulf Cooperation Council (GCC) by 2025. Water leakage rates in the distribution network are estimated to be 20-40%. In countries of the GCC, average daily water consumption per capita has reached 300-750 liters, the highest in the world.



GW for reuse has relieved Mrs. Taubeh's family of the annual purchase cost of 500 m³ of water for irrigation. Over the past four years, Mrs. Taubeh has saved \$1,200 in water bills.

Because greywater is no longer mixed with blackwater, the quantity of wastewater pumped to the septic tank is significantly less. Prior to installing the GW treatment system, the septic tank used to be emptied with vacuum trucks monthly, at a cost of \$50. With GW diversion for reuse, the septic tank needs to be emptied only once per year.

In addition, the septic tank does not overflow anymore, which goes a long way to improve the sanitary, hygienic, and environmental conditions.

Given all of these positive characteristics, Mrs. Taubeh believes that every family in water-scarce regions can benefit from installing a greywater treatment system — both financially and environmentally.

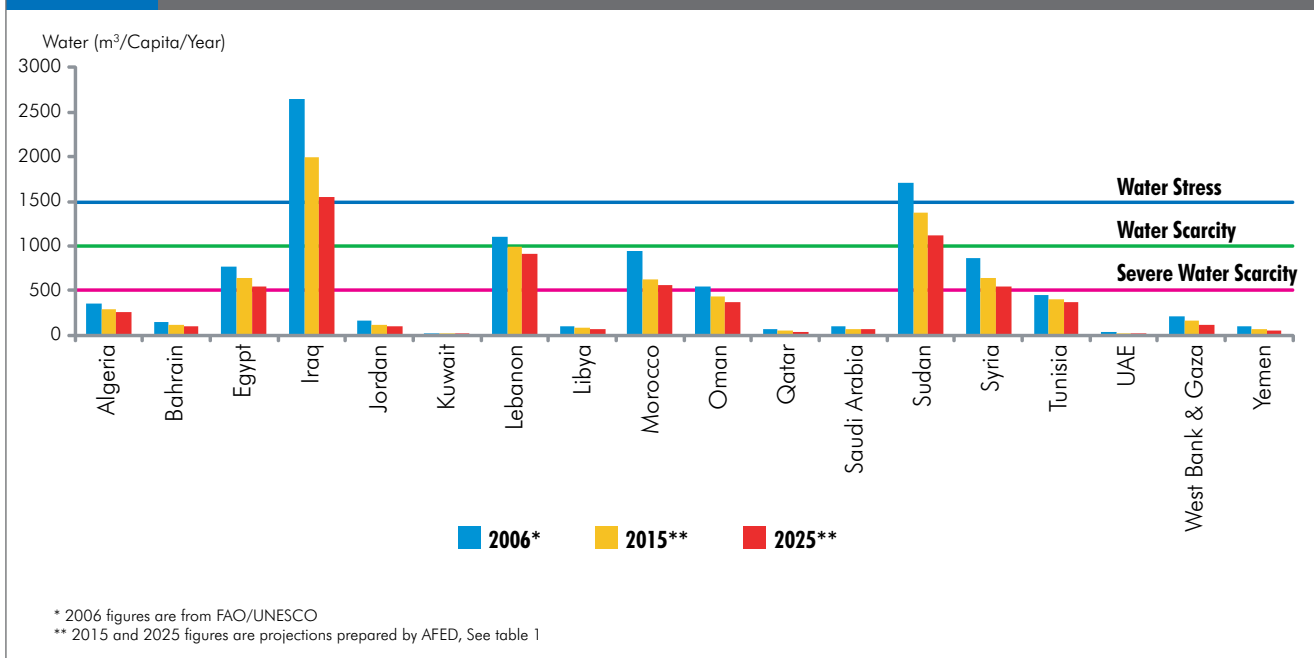
Boghos Ghougassian is president, Lebanese Appropriate Technology Association (LATA)

These high costs are untenable in the long term, necessitating bold reforms to allay concerns about the sustainability of the desalination sector. Before sinking large capital in desalination plants, managing costs by reducing distribution water losses and promoting efficiency in water production and use should be given a high priority by water governing institutions. This is the least expensive option for meeting rising demand. Governments should re-think their pricing strategies by charging tariffs that recover costs while offering rebates to consumers as incentives for efficient water use.

Taking a longer-term perspective, governments

are urged to divest from plant ownership and operation and assume the role of a regulator. This shift would automatically provide opportunities for the private sector to develop, with government incentives, a more competitive locally and regionally-based desalination industry encompassing design, manufacturing, construction, operation, and research and development (R&D). Given the large market size and the strategic role of desalination in some Arab countries, the economic benefits cannot be overestimated. To address concerns about carbon emissions, Arab governments should link any future expansion in desalination capacity to heavy

FIGURE 5 PROJECTIONS OF FRESHWATER AVAILABILITY IN ARAB COUNTRIES



investments in abundantly available renewable sources of energy.

F. Water Laws and Customary Water Arrangements

With very few exceptions, Arab states do not yet have well-defined water legislation. Different water-related legislations have been drawn up over time to address different or specific water issues. Still, the substance and scope of most of their respective mandates tend to be limited and fragmented. The result has been either only minimal legislation dealing with water resources, or overlapping laws that are outdated and do not satisfy current requirements.

Although diverse customary arrangements have been demonstrated to effectively complement formal legal arrangements for utilizing water resources in some Arab countries (e.g., Oman), several Arab states continue to focus on the use of statutory arrangements. Many Arab countries seem not to appreciate the relevance of their societies' rich tradition of customary arrangements to provide guidance to today's issues of water governance, regulation of services, management of water resources, water allocation, conflict mediation, infractions and sanctions, and conservation and protection of

water resources and ecosystems.

Arab governments should enact comprehensive national water legislation that can facilitate institutional reforms and provide legal protection for more bottom-up forms of participatory water governance. In doing so, legal experts and water managers need to heed the living legacy of customary water arrangements and institutions and identify possibilities for incorporating this tradition into water legislation in harmony with statutory water laws.

Responsive water legislation in Arab states must address existing gaps in current laws. Water laws should establish mechanisms to control and regulate water access, promote water use efficiency through a system of economic instruments and incentives, enable pollution control and environmental impact assessment enforcement, facilitate institutional arrangements, establish protected areas vital to water resources, provide for land use planning, and set enforceable penalties for violations that cause damage to water resources. Finally, the realities of climate change dictate that provisions in water laws not be set in stone. Because water availability and quality will be more subject to climate-induced variations that cannot be predicted with confidence, water legislation needs to cater for these uncertainties.



G. Trans-boundary Water Resources

Most Arab states depend for their water supply on rivers and/or aquifers that are shared with neighboring countries. Of all renewable water resources in Arab countries, two thirds originate from sources outside the region. And yet not a single formal agreement for joint management of shared water resources exists in the region. Only seven Arab states have ratified the UN Convention on the Non-Navigational Uses of International Watercourses, which codifies the core principles of International Water Law and is often used to conclude joint management and water sharing agreements.

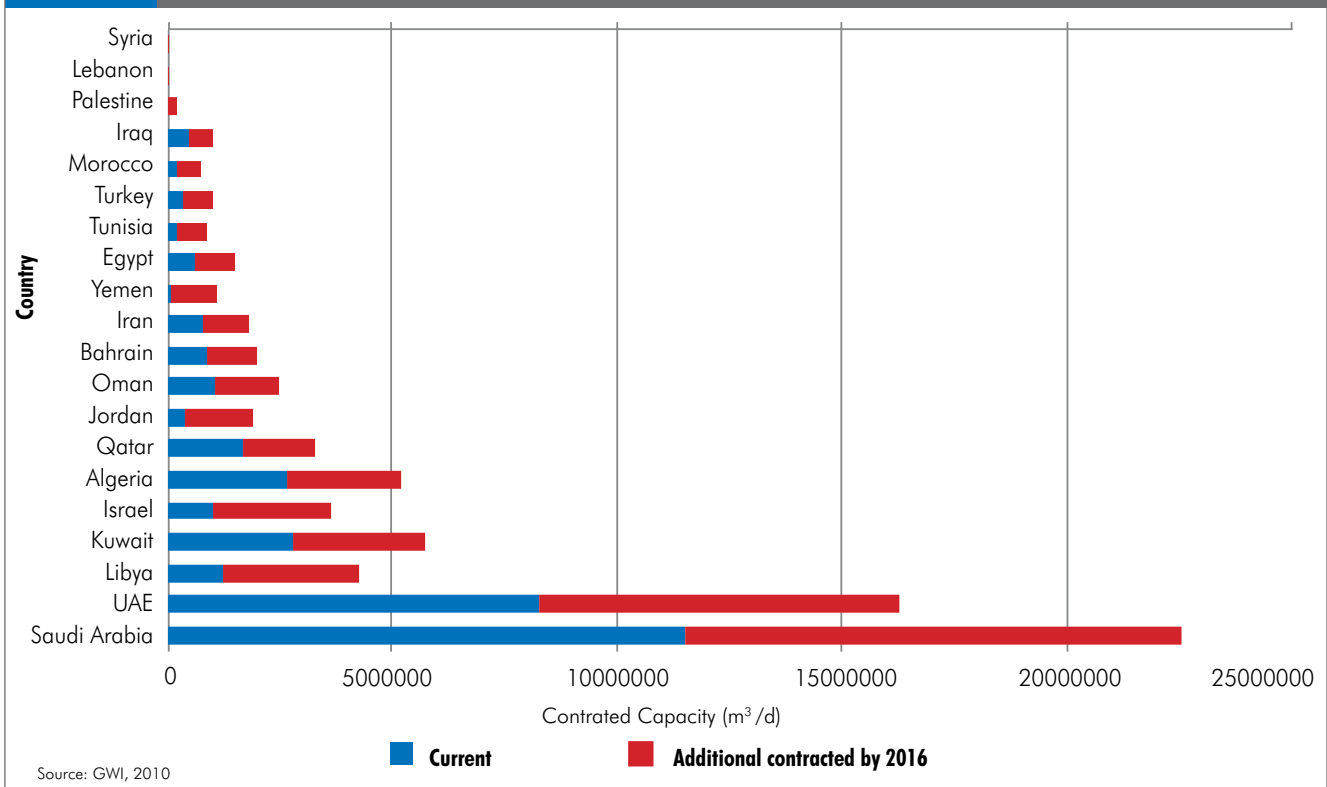
To foster joint management of shared water basins or aquifers, Arab countries should pursue cooperative agreements drawing on principles of the UN Convention on the Law of Non-Navigational Uses of International Watercourses. It is prudent to move beyond data sharing and basic consultations and take bold steps to identify a sustainable formula for sharing waters guided by legal principles of equitable and reasonable use and the obligation not to cause harm, rather than relying on existing power imbalances. Arab countries which are not parties to said UN Convention should sign and ratify the Convention.

Managing shared water resources should not be left within the domain of only water resources professionals, but should also be placed on the agenda of the country's top diplomats and foreign affairs specialists. Decision-makers at the highest levels in Arab countries should review the constraints to concluding effective and fair agreements on sharing and managing trans-boundary water resources and take steps to provide the country's water professionals the mandate as well as the administrative and financial resources needed to draft and execute such agreements.

H. Water Governance

The development of the water sector in Arab countries has been associated with a weak water governance structure. Large public water sectors, subsidies, and unhelpful political economies have conspired to limit public voice, accountability, and participation. This is reflected in inequitable allocation, wasteful use, increasing pollution trends, lack of transparency, and inefficient water services. Although water user associations (WUA) have been established in a number of countries as a form of participatory irrigation management, adequate legal mandates to support and empower their mission are still lacking or slow in the making. This despite the evidence that WUAs do contribute to a more efficient sector including

FIGURE 6 ACCUMULATED CURRENT AND NEAR TERM TOTAL CONTRACTED CAPACITY IN MENA



improved collection of charges for infrastructure, operation, maintenance, and use.

Most public sector organizations in Arab countries (serving both irrigation and urban water supply needs) do not function properly and have been unable to serve their customers efficiently. Responsibility for managing water and water services is dispersed across multiple institutions, which rarely coordinate among themselves. Decision-making processes take top-down direction with absent or ineffective stakeholders' participation. Information is hardly shared between policy makers and authorities charged with implementation or between governmental and non-governmental actors. Apart from efficiency concerns, there are serious equity problems with current water practices, with the poor, women, and children suffering the most. Moreover, the water sector in the region has not recognized that many of the decisions governing its performance are made outside the sector.

The 2011 UNEP report on the green economy stresses the fact that establishing a high-level political support for arrangements that boost



effective governance is essential to investment in water infrastructure. Good governance should be seen as a vehicle to improve water resources management. Arab policy-makers should put in place institutional processes to permit all communities of water users and beneficiaries to participate in water decision-making as well as management. Public sector reforms need to be introduced to increase decentralization and promote the transfer of responsibility and authority to local user groups. More effective institution-strengthening measures and legal frameworks are needed to expand public-private partnership (PPP) capacity, while managing risks and social equity.

III. RECOMMENDATIONS

AFED's Annual Conference in November 2010, during which the Water Report was presented and debated, came out with a set of recommendations to governments and various sectors.

1. Arab governments are urged to:

- a. Commit to cutting to half the 45 million
- b. lacking access to clean water and sanitation in Arab countries by 2015.
- b. Make a sustained effort to introduce policy, institutional, and legal reforms to enable a shift from a culture limited to securing more supplies through expensive water development, to one which manages demand, by improving efficiency, cutting losses, protecting water from overuse and pollution, and changing consumption patterns to more sustainable practices.
- c. Adopt economic criteria for enabling water efficiency and prioritizing the allocation of the available supply of water resources among competing sectors. Governments are urged to introduce water tariffs that rationalize water use, achieve cost recovery in a gradual manner, and promote equity through targeted subsidies.
- d. Support new agricultural policies by offering economic incentives, research assistance, training, and public awareness campaigns to persuade farmers to improve irrigation

MEMBRANE DISTILLATION OF REVERSE OSMOSIS BRINE

Amir Basha

Membrane Distillation (MD) is a new technology that can become an energy saving alternative to presently existing water separation technologies. MD works at ambient pressures and can be run on low-grade waste heat. The process exhibits a high level of rejection and produces high quality permeate. The concentration efficiency of MD has been proven in many laboratory experiments.

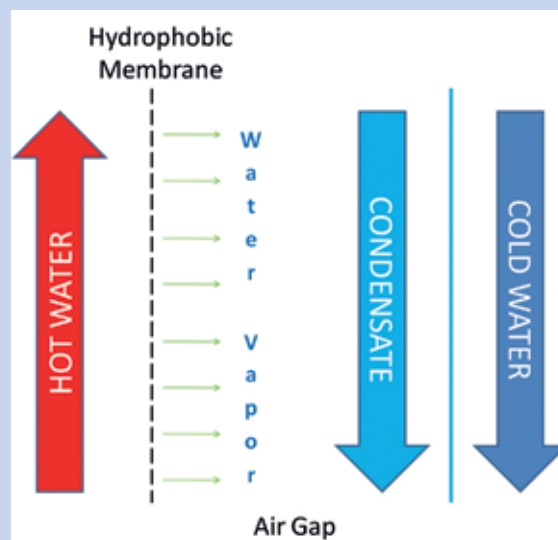
The production of permeate in a standard reverse osmosis (RO) unit is about 40-50% of the seawater feed. Since MD can be operated close to saturation, MD can be a good complement to RO. Treating and concentrating the brine will increase the recovery ratio and may also, if complemented with crystallization or evaporation, be used as a base for zero liquid discharge.

An industrial-size demonstration MD unit was supplied by Xzero AB of Stockholm, Sweden, to Moya Bushnak's WESSCO desalination plant in Jeddah, Saudi Arabia, in order to jointly test the performance of membrane distillation for the first time.

The test equipment was of the air-gap type, as shown in Figure B1.

In the pilot test skid, RO brine is heated and passed on one side of the membrane. Water vapor diffuses across the membrane and the air gap and condenses on a surface that is cooled by water. The overall process is driven by a gradient in water vapor pressure, rather than a difference in total pressure. Thermal energy is required to elevate the vapor pressure of water in the hot stream.

FIGURE B1 AIR GAP TYPE MD MEMBRANES



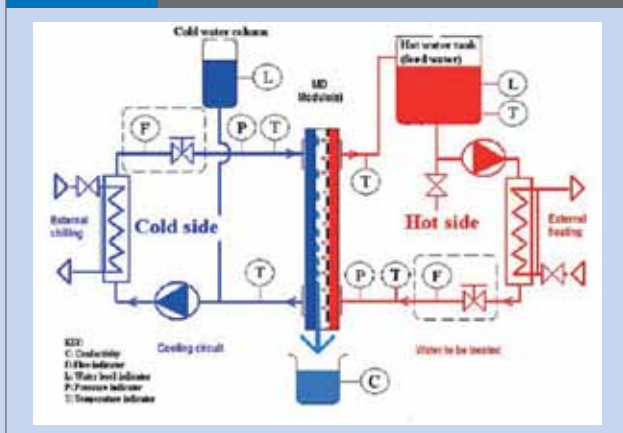
The demo skid supplied by Xzero had a capacity of producing 0.2-1 m³/day high quality permeate from RO concentrate. The membranes are hydrophobic with pore sizes in the range of 0.05 to 0.2 μm—the same range as microfiltration. The module has a membrane area of 2.8m². Auxiliary equipment consists of a tank (boiler) for hot water, variable flow gear pumps to drive the hot and cold water, digital pressure transducers to measure pressure drop, digital thermo probes to measure temperatures, and a personal computer (PC) for data logging and control.

A process flow diagram of the demo unit is shown below

efficiency, change cropping patterns, improve irrigation scheduling, shift toward higher-value adding crops and agricultural activities, and decentralize management of irrigation projects.

- e. Develop adaptation policies to climate change predicated on using saline water in agricultural production, developing new local crop varieties tolerant to aridity and drought conditions, and rehabilitating water harvesting systems.
- f. Reorient the role of state water authorities from that of a water provider to that of an effective regulator and planner, including establishing legal frameworks that enable private investments and public-private partnerships to provide clean water and safe sanitation, while maintaining transparency and accountability.
- g. Promote, through a mix of economic incentives and publicly sponsored research programs, opportunities for the private sector to assist in developing locally-based competitive desalination technologies, while encouraging the application of solar energy.
- h. Commit to a national strategy for tapping

FIGURE B2 PROCESS FLOW DIAGRAM OF THE MD UNIT



in Figure B2, which describes the basic set-up of the hot and cold water flow circulation. Permeate is measured and collected in the conductivity vessel.

The major purpose of the test was to: (a) increase feed water concentration to measure permeate stability, (b) assess the technology's performance over a range of operating parameters, and (c) attempt to deduce controlling factors based upon experimental results. A secondary goal was to evaluate membrane stress and the durability of the module.

No pre-treatment with acid dosing or coagulant dosing was provided for the water other than basic media pre-filters. Flows and temperatures were recorded directly by a computer. Distillate production was measured in a volumetric flask.

The total running time for the demonstration was 170 days.

FIGURE B3 PHOTOGRAPHS OF MD PILOT PLANT



For the first two weeks, the permeate flux was measured between 4.6 and 6.0 liters per hour (in one module). The degree of separation measured by comparing the conductivities of feed water and permeate was 99.99%.

The feed water concentration was increased gradually from 39.5 g/l to 136.8 g/l during the test period by adding salt. The degree of separation achieved was over 99%. The quality of the permeate remains constant regardless of increases in feed water concentrations.

This demonstration has proved that membrane distillation can be successfully employed for the concentration of RO brine to increase the recovery of potable water using very low power input and low-grade heat. The test results obtained thus far will motivate further development of the MD technology on a larger scale.

Amir K. Syed Basha is Senior Vice President, Moya Bushnak

the underutilized potential of wastewater reclamation as well as greywater recycling to augment Arab countries' water supply. The strategy should commit to strong institutional coordination and planning to ensure that wastewater is properly treated and suitably reused according to requirements for protecting health and the environment.

- i. Commit to investing in scientifically credible and policy-relevant research that addresses the practical problems of water management in Arab states.
- j. Enact comprehensive national water
- k. Foster joint management of shared river basins or aquifers and identify a sustainable formula for sharing trans-boundary waters, fairly guided by customary legal principles of 'equitable and reasonable use' and

legislation that addresses existing gaps in current laws and establishes mechanisms to control and regulate water access, promote water use efficiency, enable pollution control regulations, establish protected areas vital to water resources, provide for land use planning, and institute enforceable penalties for violations that cause damage to water resources.



the 'obligation not to cause harm'. Arab governments are also urged to sign and ratify the UN Convention on the Law of Non-navigational Uses of International Watercourses, and draw on its principles for concluding effective and fair water sharing agreements.

- l. Launch sustained public awareness campaigns, starting from schools, to cultivate a water ethic of care among the public, inspire behavioral changes, and inform water users about economic incentives for achieving water efficiency targets. Civil society, including non-governmental organizations, academia, and the private sector groups, should be included in water reform planning. Water user societies should be encouraged and enabled.
- m. Allocate sufficient funds for research and development in water efficient technologies and in locally-based desalination technologies and know-how.

2. Private industrial enterprises should apply extensive water efficiency measures to substantially reduce the quantity of water used per unit of output, prevent pollution at the source, make process changes whenever possible to minimize the volume of wastewater generated, and ensure that wastewater is treated to meet strict regulatory standards prior to disposal.

3. Real estate developers and users, and municipalities should accord water efficiency a high priority in the design and operation of buildings and take advantage of water retrofits to make existing buildings water efficient.

4. Nongovernmental organizations, academia, and the private sector should cooperate fully in the implementation of these recommendations.

IV. CONCLUSION

The Arab world is already witnessing a water crisis. Comprehensive and sustained water

policy reforms are still lacking. Can the trend in deteriorating water quantity and quality be stopped or better yet reversed? Can an impending, or rather present water crisis be averted?

AFED's water report has pointed to policy and institutional reforms underway in some Arab countries. These reforms, however, are in their infancy and it will take a number of years before their outcomes materialize. Abu Dhabi has recently commissioned the preparation of a Water Resources Master Plan to introduce reforms and guide a strategy for integrated management of the Emirate's water resources. The Arab Water Academy is leading inspiring efforts to redefine the development of human capital and institutional capacity in Arab countries. Water user associations are now established in Egypt, Jordan, Libya, Morocco, Oman, Tunisia, and Yemen. In some countries, the private sector is making strident contributions in water services provision. Tunisia and Jordan have made remarkable progress in wastewater treatment and reuse. Traditional water management systems, such as the Aflaj in Oman, have been uniquely successful in instituting effective water governance systems based on customary arrangements. Universities and regional water research centers are becoming more committed to conducting high quality research to develop and strengthen the region's adaptive capacity.

Despite these positive efforts, Arab countries are slow in adopting more far-reaching water reforms. Water tariffs remain below cost and irrigation efficiency is stubbornly low. Underground water aquifers are being over-exploited and freshwater ecosystems are being destroyed. Pollution of water calls for serious remedies. Some Arab countries still boast the highest annual per capita water consumption rates in the world. Arab governments' growing investments in tourism, raw materials extraction, and power, to name a few sectors, do not bode well for the future of water in the region.

The 2011 UNEP green economy report outlines several market-based instruments that can be harnessed to foster a green economy. These instruments include payments for ecosystem services, and strengthening consumer-driven accreditation schemes. Furthermore, recommendations are made for



improving entitlement and allocation systems. Well-designed systems must be established to define rules to determine how much water is to be allocated to each part of a river or aquifer, and an entitlement system is then used to distribute this water among users. Reducing input subsidies and charging for externalities is another condition necessary for the development of a green economy. Water charging and finance arrangements must also be improved should a green economy be established, taking into consideration how to finance access to water and sanitation services for the poor (UNEP, 2011).

Given the severity of water strains, it is difficult to pin hopes on partial solutions. Public-private partnerships cannot succeed if current water pricing structures remain unaltered. Water user associations cannot succeed if legal protection is not accorded. Water use efficiency will not improve if across-the-board subsidies are not removed or significantly reduced. Wastewater treatment plants cannot be effective if industries continue to discharge their waste streams untreated. Are these reform efforts then a case of too little, too late? It does not have to be so if Arab leaders make a commitment to launching and sustaining a genuine and comprehensive policy reform effort. The starting point for transformation rests with commitment and action at the highest political level.

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Energy

IBRAHIM ABDEL GELIL
FARID CHAABAN
LEILA DAGHER



I. INTRODUCTION

Access to affordable energy services is fundamental to human development and economic growth. The abundance of hydrocarbon resources in some parts of the Arab region has played a major role in the region's socioeconomic development in multiple ways. As in other regions of the world, the Arab energy system today is heavily dependent on fossil fuel resources. For energy-rich and energy-poor Arab countries alike, how energy resources are obtained and managed play a determining factor in governments' spending, balance of payments, energy security, environmental quality, and economic growth.

Today, the decisive role of the energy sector in fueling sustainable economic growth in the region has come under close scrutiny. Because oil and gas are global commodities, Arab economies remain exposed to market price volatilities and global demand, which in the past has caused immediate disruption to cash flows and government spending, while continuing to pose serious challenges to economic diversification and sustainable socioeconomic development. For energy-poor countries, dependence on imported fossil energy sources leaves them vulnerable to disruption in oil and gas supplies. Reducing the size of the energy bill in some of these countries continues to remain a major preoccupation of



government officials, due in no small part to energy's significant burden on public finances.

In Arab countries today nearly 60 million lack access to affordable energy services. Without access to energy, their opportunities for economic development and improved living standards are severely constrained. The wide disparities in access to affordable modern energy services between different countries and between urban and rural populations within the same country aggravate inequality, worsen poverty, and threaten social stability.

The environmental impacts of the fossil fuel-based Arab energy system threaten the socioeconomic development gains of the past few decades and

FIGURE 1

OIL AND GAS CONTRIBUTION TO GDP IN SELECTED ARAB COUNTRIES (2008)

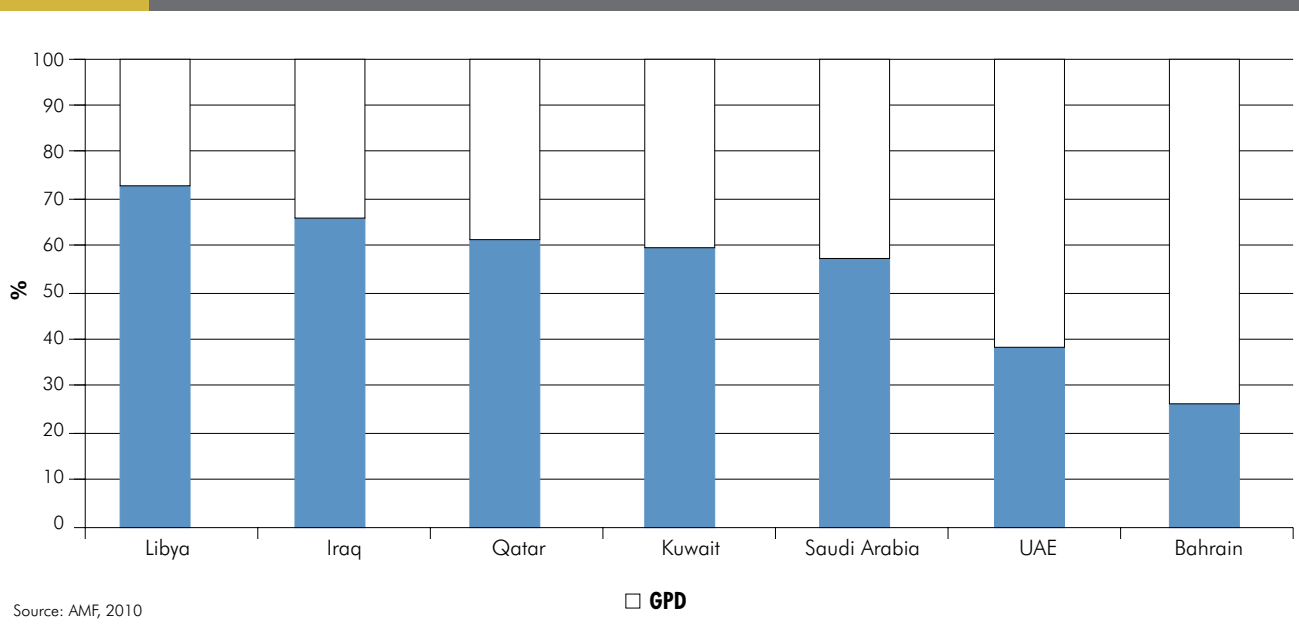
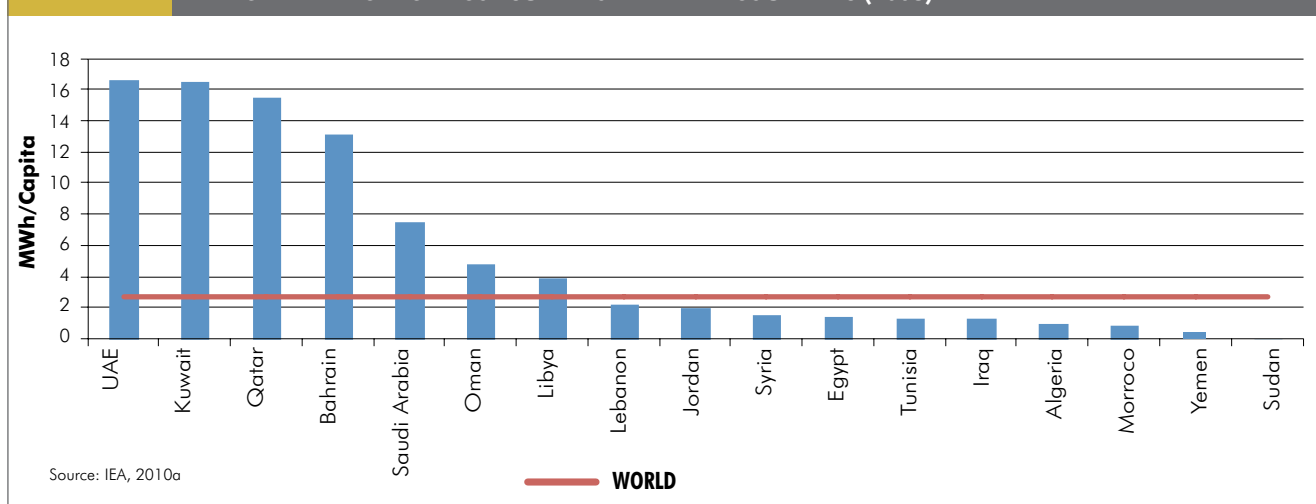


FIGURE 2

PER CAPITA ELECTRICITY CONSUMPTION IN ARAB COUNTRIES (2008)



contribute to local, regional and global ecosystem degradation. Human health is threatened by high levels of air pollution emissions from the burning of fossil fuels. Anthropogenic greenhouse gas (GHG) emissions, mostly from the production and use of fossil energy, are causing climate disruption, with serious impacts on agriculture, water availability, and infrastructure.

Alleviating poverty, mitigating climate change, and providing access to affordable and safe energy services without undermining economic development or ecosystems health will require drastic shifts in the Arab energy system. This chapter will describe current trends in the Arab energy system and propose a set of policies to shift to more sustainable patterns of energy production and consumption.

Given the large disparities in the Arab region, the transition to a green economy will vary considerably across different countries. Two groups of Arab countries could be considered in this context. The first are those countries which have attained high levels of gross domestic product (GDP) growth, but often at the expense of their natural resource base, reflected in high carbon intensity and large per capita ecological footprint. The challenge for these countries is to reduce their per capita ecological footprint without impairing their level of GDP growth. For those Arab countries that still maintain a relatively low per capita ecological footprint, the challenge is to achieve better human development without drastically increasing their ecological footprint.

II. CURRENT ARAB'S ENERGY SCENE

A. The Significance of the Energy Sector to Arab Economies

The energy sector in the Arab region has been and will continue to play a critical role in the region's socioeconomic development. Oil and gas revenues, estimated at US\$571 billion in 2008 (AMF, 2010), have been the major source of income in most Arab countries, especially in the Gulf region. According to the Arab Monetary Fund (AMF), the oil and gas sector makes up about 38% of total Arab gross domestic product (GDP). The contribution of the oil and gas sector to the GDP of selected Arab economies is indicated in Figure 1. Additionally, the petroleum industry plays an important role indirectly in the social and economic development of many non-oil producing countries in the region, through workers' remittances, trade, and bilateral or multilateral aid projects (OAPEC, 2009). The Arab oil and gas sector represents the largest economic sector in countries of the Gulf Cooperation Council (GCC) and the region as a whole. Over the past three decades, the major oil and gas exporters in the region have witnessed an unprecedented economic and social transformation. Oil proceeds have been used to modernize and expand their infrastructure and improve human development indicators. The GCC countries in particular have become an important center for regional economic growth.

FIGURE 3 ENERGY INTENSITY IN SELECTED ARAB COUNTRIES (2008)

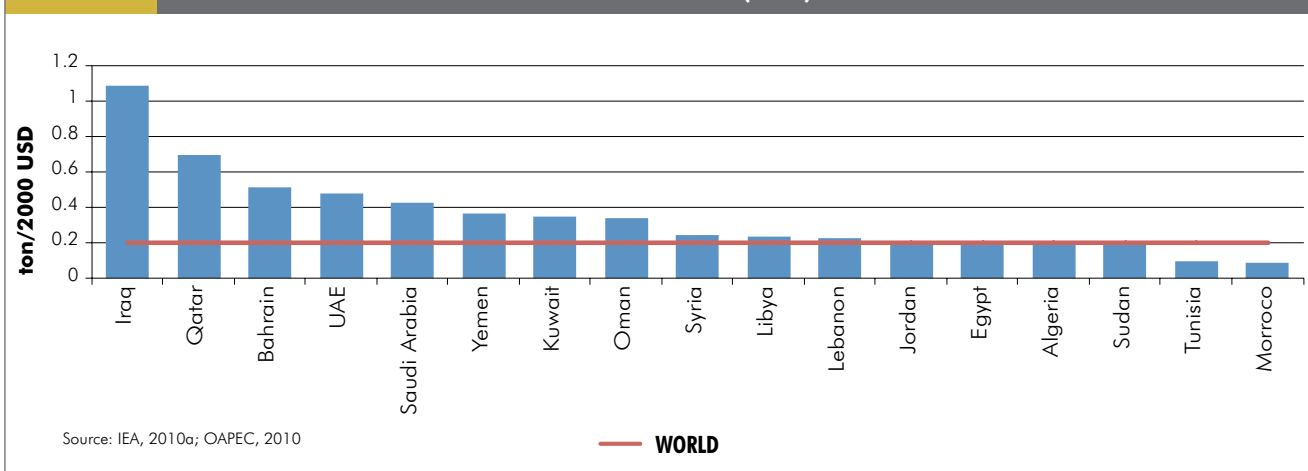
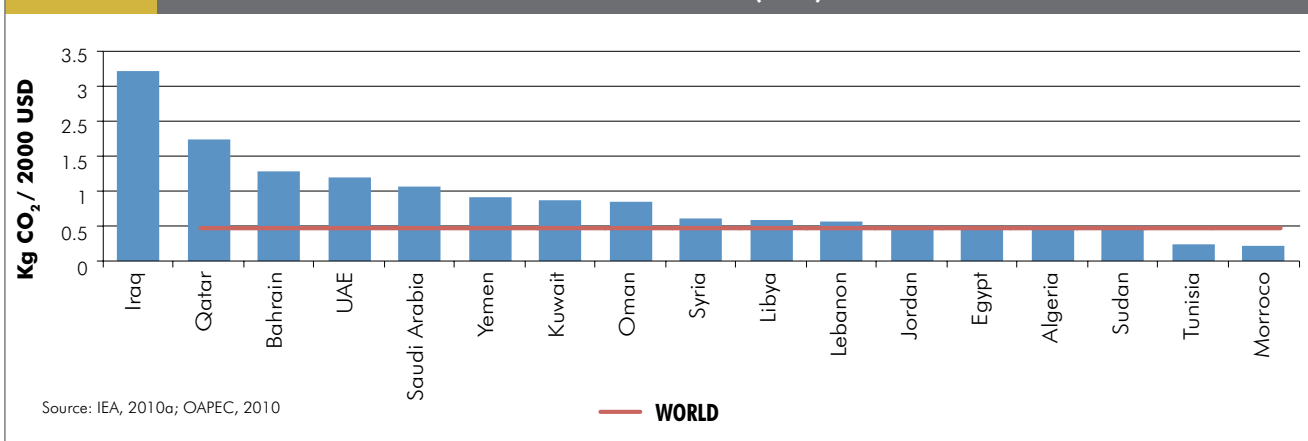


FIGURE 4 CARBON INTENSITY OF SELECTED ARAB COUNTRIES (2008)



According to the Organization of Oil Arab Exporting Countries (OAPEC), members' revenues from oil exports in 2009 totaled US\$352.8 billion, a decline of 39.7% from the preceding year's revenue. The drop in revenues has forced some Arab countries to drastically slow down planned projects for expanding crude oil production capacity (OAPEC, 2009).

B. Major Energy/economy indicators

Per capita energy consumption varies greatly between oil producing and non-oil producing countries. The per capita consumption in Qatar is 18.8 tons of oil equivalent (toe), highest among Arab countries and four fold the average per capita consumption (4.56 toe) level of the Organization of Economic Co-operation and Development (OECD) countries (IEA, 2010a). Per capita energy consumption in 14 Arab countries is lower than

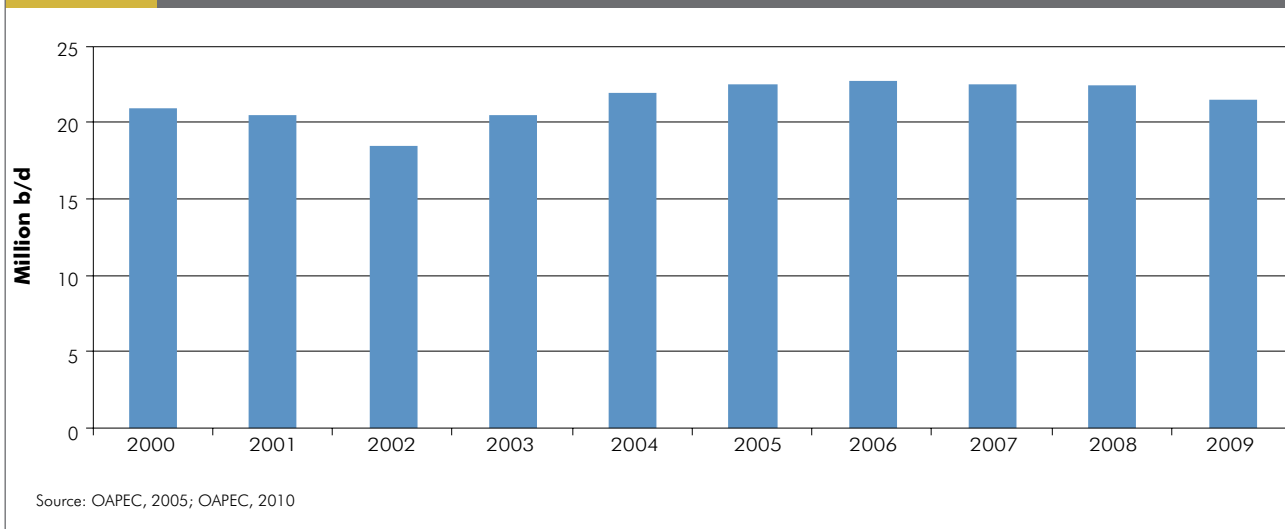
the world average (1.83 toe). Although the Arab region is rich in energy resources, almost one-fifth of the Arab population relies on non-commercial fuels like wood, dung, and agricultural residues – to meet their daily heating and cooking needs, particularly in Comoros, Djibouti, Somalia, Sudan, and Yemen, as well as 5 to 10% in Algeria, Egypt, Morocco, and Syria (ESCWA, 2005).

Figure 2 indicates that the 2008 average per capita electricity consumption in Arab Countries (5343 KWh) was double the world average (2782 KWh). The per capita electricity consumption in the United Arab Emirates (UAE) and Kuwait was about 6 times that of the world average (IEA, 2010a).

The availability of fossil fuels at low production costs pushed oil-producing countries to invest in energy-intensive industries such as desalination, petrochemicals, and aluminum smelting. Figure

FIGURE 5

CRUDE OIL PRODUCTION IN ARAB COUNTRIES, 2000-2009 IN MILLION B/D



3 indicates that the average primary energy intensity in the region is 0.45 toe per thousand, 2000 US\$ (It means that energy intensity - total energy consumption per unit of GDP - is equal 0.45 Ton Oil Equivalent per one US\$, using the value of US\$ at year 2000) compared to a world average of 0.19 toe (IEA, 2010a; OAEPC, 2010). This is also reflected in carbon intensities, where the region is among the world's highest, as Figure 4 demonstrates.

C. Arab Energy Resources

Parts of the Arab region have some of the largest oil and gas reserves in the world, in addition to an abundance of renewable energy resources such as solar and wind. This section gives a brief account of these resources.

i. Oil

The Arab countries hold nearly 58% of the world's oil reserves (OAEPC, 2009). The proven oil reserves of Arab countries at the end of 2009 totaled 683.6 billion barrels, representing a 5.6% increase over 2000 (646.8 billion barrels). Proven reserves in the Kingdom of Saudi Arabia, estimated to be 264.6 billion barrels, ranks the Kingdom at the first place in the world. They constitute 38.71% of Arab reserves and 22.5% of world's aggregate reserves (OAEPC, 2005; OAEPC, 2010).

Crude oil production in Arab countries averaged

21.3 million b/d in 2009, a 6.5% decrease from 2008, but still accounted for 30% of world crude production (OAEPC, 2010). During the last decade, the average total daily Arab oil production was estimated to be 21.6 million b/d. Figure 5 indicates crude oil production in Arab countries over the period 2000-2009.

ii. Natural Gas

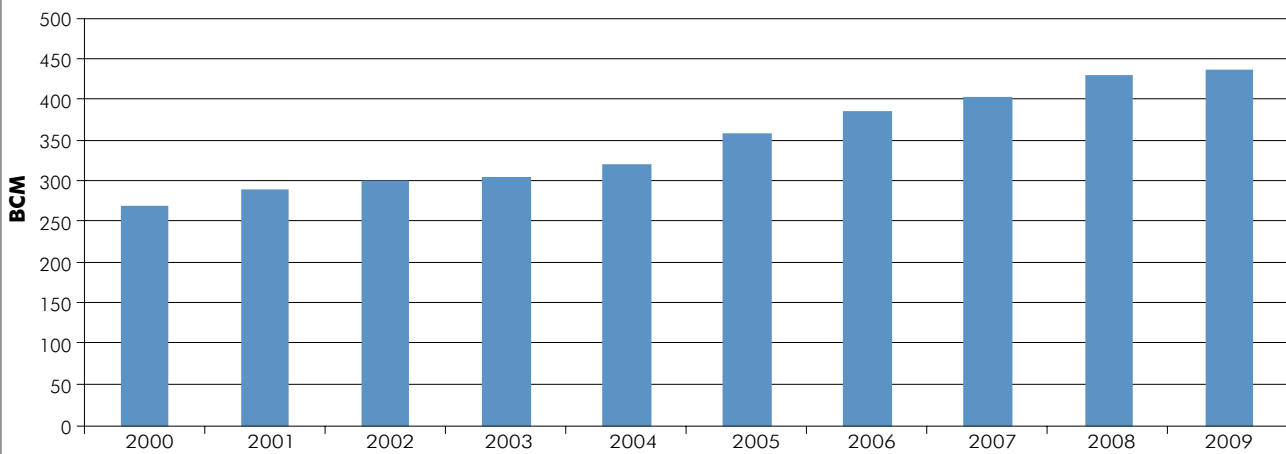
The Arab region holds nearly 29% of the world's gas reserves. Proven Arab natural gas reserves recorded a gain in 2009 compared to 2000. They increased from 36.91 to reach 54.48 trillion cubic meters (cum), representing 29.1% of world reserves. Qatar has the largest Arab gas reserves amounting to 25.4 trillion cubic meters, which represents 46.6% of Arab and 13.6% of world reserves, respectively (OAEPC, 2005; OAEPC, 2010). Further, Qatar is the fourth largest exporter of natural gas in the world and the largest exporter of liquefied natural gas (LNG).

The last decade has witnessed a steady growth of natural gas production in the Arab region. Figure 6 demonstrates an increase from 270.6 billion cubic meters in 2000 to 432.6 billion cubic meters in 2009 (OAEPC, 2010).

iii. Coal

The Arab region has limited coal resources and they are found in a small number of Arab countries, namely, Algeria, Egypt, Lebanon, and

FIGURE 6 MARKETED NATURAL GAS IN ARAB COUNTRIES (BILLION CUBIC METERS)



Source: OAPEC, 2005; OAPEC, 2010

Morocco. El-Maghara mine, located in the Sinai Peninsula in Egypt, is the only operating coal mine. Coal production in Egypt totaled 21.5 thousand tons in 2008 (IEA, 2010a). Morocco has plans to re-exploit coal from some of the country's closed mines. Total Arab consumption of coal was about 20.7 thousand tons in 2009, mainly in the steel industry (OAPEC, 2009).

iv. Nuclear

Nuclear energy is not part of any Arab country's mix of power generation, although plans are underway to contract with multinational consortiums for the procurement and construction of nuclear power plants. The United Arab Emirates signed an agreement with a consortium led by the state-owned South Korean Electric Power Corporation to supply four nuclear power plants, each producing approximately 1400 MW of electricity (WNA, 2011). The first reactor is expected to come online in 2017. Kuwait and France signed a cooperation agreement for the peaceful use of nuclear energy (UPI, 2010). Egypt has signed an agreement with Russia to pave the way for building the first mega nuclear power plant in the country, on a site west of Alexandria on the Mediterranean shore (OAPEC, 2009).

The Arab policy to invest in nuclear power needs to be scrutinized. The viability of Arab countries to manage the entire lifecycle of nuclear power is questionable. Critical safety issues remain to

be resolved. Apart from the risk of accidents in nuclear power plants, nuclear waste storage and disposal is still unresolved, and would pose serious risk to public health because of the lack of local capability to manage this waste. International concerns about nuclear weapon proliferation associated with nuclear fuel cycle and uranium enrichment has resulted in global restrictions on these technologies, which would force Arab countries to rely on the international supply market for nuclear fuel even if local uranium reserves were available. In other words, Arab states would have to forego mining their own uranium reserves. Furthermore, local technical capabilities to build, operate, and maintain nuclear power plants in Arab countries is extremely weak, which raises major energy security and dependency concerns over the heavy reliance on foreign expatriate labor. In a region known to invest very little in research and development (R&D) relative to other regions of the world, it is improbable that Arab countries will be able to develop domestic human resource capability in nuclear science and engineering that will be able to transfer, adapt, and adopt nuclear power know-how anytime in the foreseeable future. In addition, local preparedness, response, and risk management systems are weak, which would compound the risk in the case of a nuclear accident. These arguments don't necessarily mean that Arab countries should completely dismiss nuclear power. Rather, Arab governments may still wish to consider investing in education and R&D capability in nuclear power technology in

THE CONCEPT OF ENERGY RE-USE

Mazen Bachir

The scarcity of clean water resources and the costs associated with potable water production (e.g., seawater desalination) have resulted in new market trends for water and wastewater treatment. These recent trends are focused heavily on the concept of energy re-use.

Membrane technology has been at the forefront of water re-use applications, given the high purity of product water achievable through the use of micro-filtration, ultra-filtration (wastewater re-use) and potentially nano-filtration.

This achievement, however, has come at the cost of higher energy demand. Despite traditionally low and subsidized energy costs in the Arab region, the associated cost of energy can, and should, no longer be ignored in a time of economic crisis, resource scarcity, and impending climate change disruptions.

While energy recovery technologies continue to improve the performance of water purification plants (e.g., seawater desalination applications), they are neglected in wastewater treatment, as the focus is solely on product water quality, with little regard to processing and operating cost.

The necessity to introduce the concept of energy re-use is justifiable in a time when energy costs are rising. Within the desalination industry, recent trends and technology advances have resulted in energy recovery systems coupled with high-pressure pumps. Pressure exchange devices are now used in reverse osmosis plants to ensure that the energy 'waste' embedded in the high-pressure reject stream is recovered. This would permit a lower energy demand that is needed to pressurize the feed stream, thus reducing overall energy consumption by as much as 30-35%.

While successfully implemented globally and in the Middle East and North African region, employing sludge digestion in wastewater treatment plants to recover energy has not yet been largely adopted. Sludge digestion is the treatment of the solid organic waste by-products generated from wastewater treatment. Digesting sludge and incorporating

cogeneration technology results in lower volumes of solid waste by-products, while allowing the recovery of energy by thermally converting organically released gases. Sludge digestion allows the recovery of no less than 50% of the energy contained in digested organic matter.

Ideally, sludge digestion can be incorporated into a new plant design. However, sludge digestion can also be considered the most useful add-on for almost any existing wastewater treatment plant. The energy savings created by sludge digestion more than pay for the investment.

Among the benefits offered by sludge digestion are:

- Reduced sludge volumes and dry solids content.
- Enhanced biological treatment and plant capacity.
- Reduced odor and air pollution emissions.
- Stabilization of sludge, leading to easier disposal and/or easier down-stream treatment.
- Energy recovery, which can be used instantly on-site to reduce the overall power requirements.

Even in countries where energy costs are low, sludge digestion can still be used in advantageous ways, over and above those named above:

- Increasing plant capacity: By incorporating an external anaerobic digestion process, the biological capacity of existing plants can be increased. The oxygen requirements associated with the stabilization of sludge can be used for treating higher biological loads. Energy derived from digester off-gas can be used to partly power the plant itself.
- Enhancing sludge drying: Alternatively, should the energy derivation concept not be economically necessary, the heat generated from the digester off-gas can nonetheless be used to greatly reduce the area required by sludge drying beds, through enhanced solar heating of the sludge. This is especially attractive in countries with traditionally hot climates.

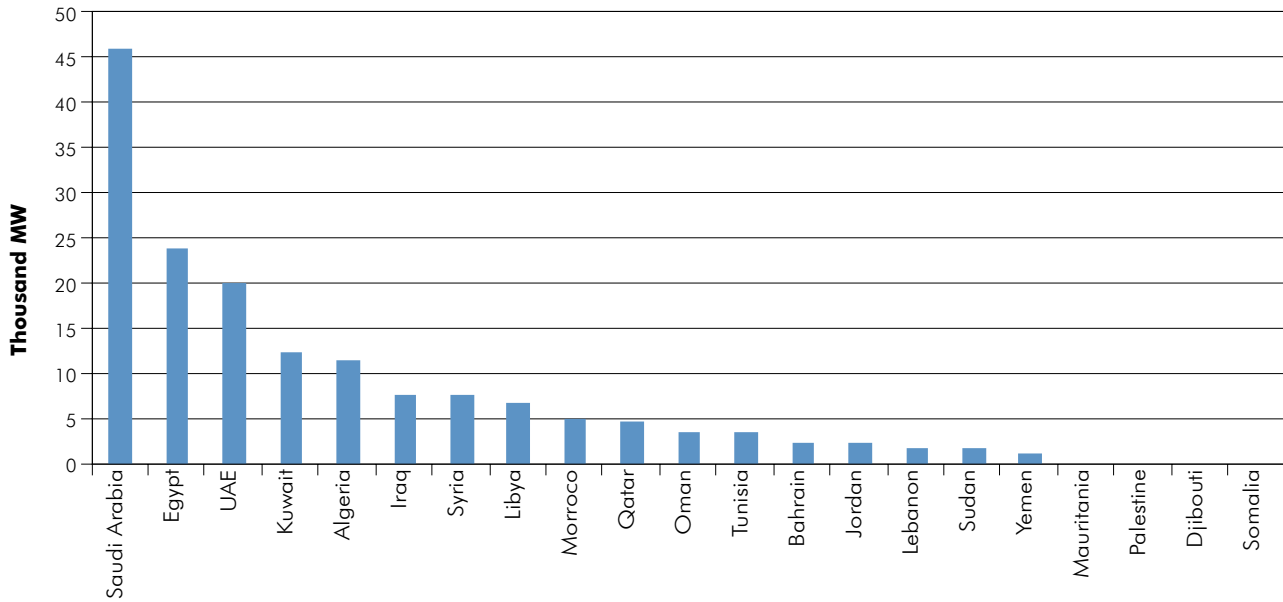
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order to keep their long-term options open. As an alternative to nuclear power, Arab countries have the option to invest now in the huge potential of solar and wind power, and should strive to take a leading position in developing and deploying

renewable energy technologies in the region and aspire to become major exporters of green energy. Nuclear energy might not be the most viable policy option for long-term energy supply or security in the Arab region.

FIGURE 7

INSTALLED CAPACITY OF ELECTRICITY GENERATION IN ARAB COUNTRIES IN 2009



Source: OAPEC, 2001; OAPEC, 2010

v. Renewable Energy Sources

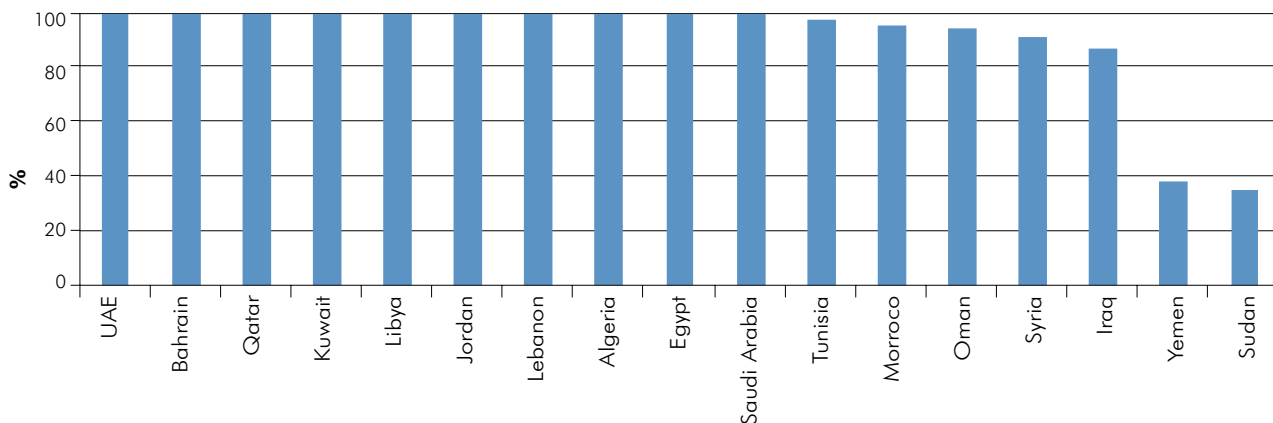
The Arab region enjoys tremendous renewable energy resources. Arab countries have an installed hydroelectric power capacity of 10,683 MW (OAPEC, 2010). Large hydropower plants exist in Egypt and Iraq, while small plants exist in Algeria, Jordan, Lebanon, Mauritania, Morocco, Sudan, Syria, and Tunisia. The production of hydro electricity in 2008 reached nearly the equivalent of 21 TWh (IEA, 2010a).

Average wind speeds of 8-11 m/sec in the Gulf of Suez, Egypt, and 5-7 m/sec in Jordan have been recorded, making these locations suitable sites for power generation from wind. Grid-connected wind power at commercial scales of 550 MW and 280 MW have been installed in Egypt and Morocco (NREA, 2011), respectively, while stand-alone wind units are in use for small applications in Jordan, Morocco, and Syria.

A large part of the Arab region falls within the

FIGURE 8

ELECTRIFICATION RATES IN ARAB COUNTRIES (%) IN 2008

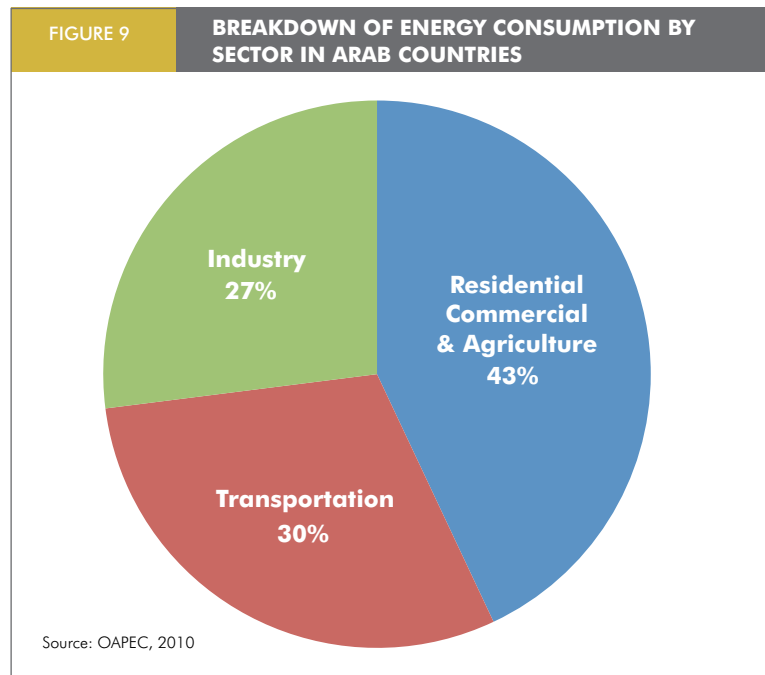


Source: UNDP, 2010

so-called 'sun belt,' which benefits from the most energy-intensive sunlight on the globe (in terms of both heat and light). Solar energy resources in Arab countries vary between 1,460-3,000 KWh/m²-year. Solar energy generation using photovoltaic (PV) technology is used in several standalone applications especially for water pumping, telecommunications, and lighting in remote sites. The largest PV program in the region exists in Morocco, where 160,000 solar power home systems have been installed in about 8% of rural households with a total capacity of 16 MW (Abdel Gelil, 2007). Photovoltaic pumping applications are relatively developed in Tunisia with a total existing peak capacity of 255 KW (Komoto et al., 2009).

Solar water heaters are achieving different degrees of market penetration, and are currently most successful in the residential and commercial sectors in Egypt, Jordan, Lebanon, Morocco, and Palestine. It should be noted that solar water heaters are mostly used in Arab countries that have relatively few or no hydrocarbon resources.

Saudi Arabia and North Africa have vast stretches of desert areas with abundant sunlight, which can be exploited for the production of solar power. To date, installed capacity of solar power remains negligible, with less than 3 MW of photovoltaic (PV) power in Saudi Arabia and a 10 MW installed capacity in the United Arab Emirates (UAE). There are no concentrated solar power (CSP) plants yet in the region, although some countries



have announced plans to invest in CSP plants.

Construction is underway for a 100 MW Shams 1 solar thermal project in Masdar City. Masdar has also started the tendering process for a 100 MWp grid-connected PV plant in Abu Dhabi. In Saudi Arabia, King Abdullah Petroleum Studies and Research Center awarded the construction of a 3 MWp PV system and Aramco awarded a 10 MWp shade mounted PV plant located in Dhahran, which will be the largest shade mounted PV plant in the world.

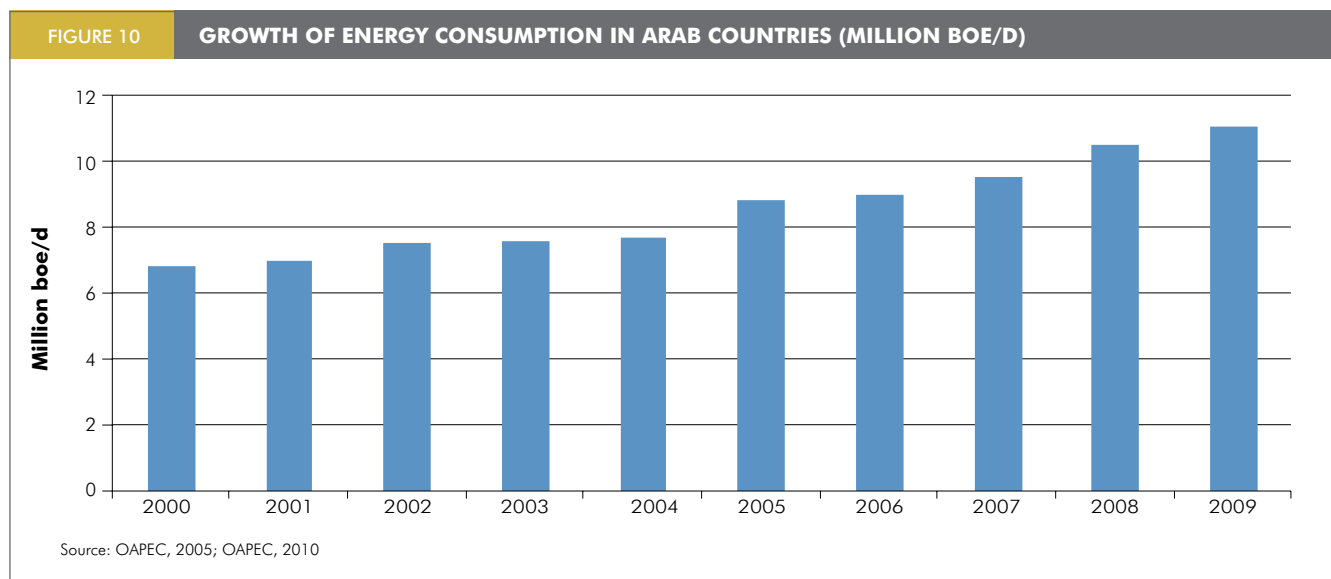
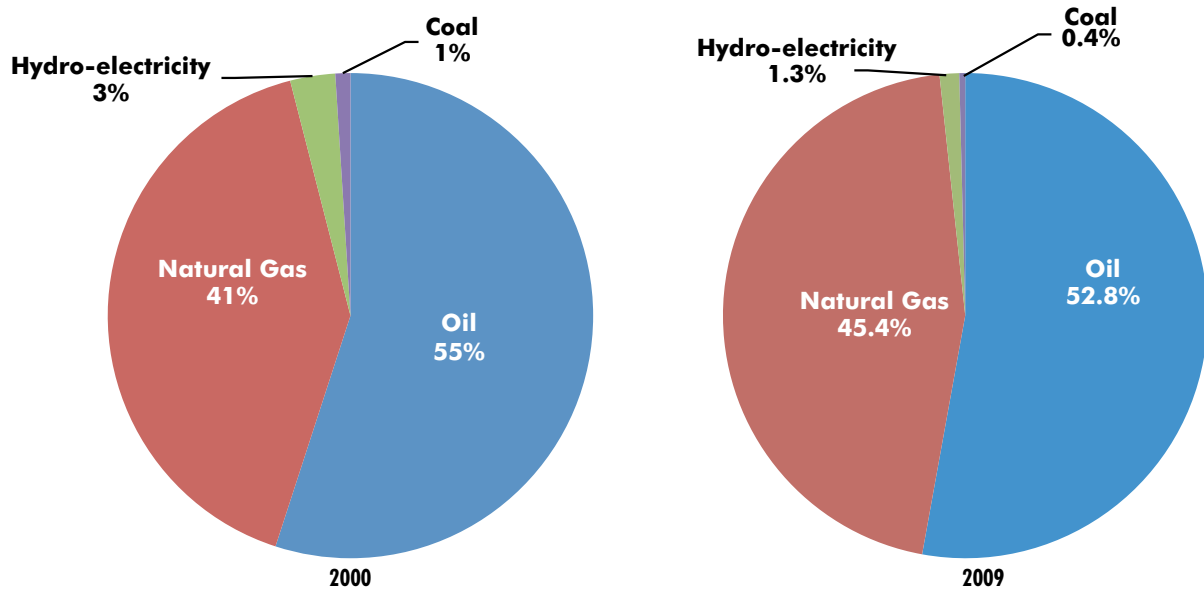


FIGURE 11

CHANGE IN ENERGY CONSUMPTION PATTERNS IN ARAB COUNTRIES OVER THE PERIOD 2000-2009



Source: OAPEEC, 2001; OAPEEC, 2009

The government of Oman has launched a study for the development of a 150 MW solar plant. In Bahrain, the national Oil and Gas Authority (NOGA) is developing a project to install a 20 MW grid-connected solar PV system.

Furthermore, Egypt is commissioning a 140 MW integrated solar combined cycle (ISCC) power plant with a capacity of 120 MW combined cycle from natural gas and 20 MW from solar input, at Kuraymat near Cairo. Other ISCC hybrid plants are underway in Algeria and Morocco, and feasibility studies have been undertaken for an ISCC plant in Kuwait. Qatar has announced an ambitious but, as yet, unspecified plan for a US\$1 billion solar project (Freshfields, 2010). Another project remarkable for its scale is a proposed US\$9 billion Moroccan solar power initiative, which includes the installation of 2 GW of solar power capacity to meet 10% of Morocco's electricity demand by 2020 (Recharge, 2010).

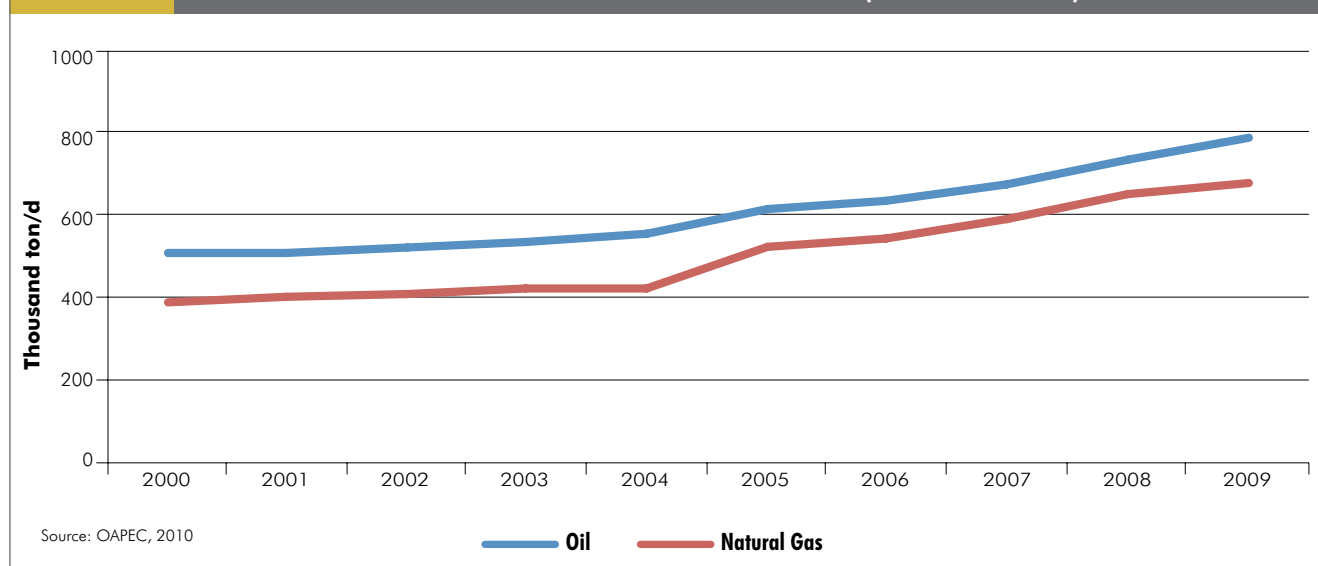
In addition, plans have been proposed to generate solar electric power in Arab countries for domestic consumption as well as export to Europe. A group of companies from the European Union (EU) has founded the 'DESERTEC Industrial Initiative' (DII) to lobby for this initiative. DESERTEC aims to generate up to 550 GW of electricity over the next 40 years,

from installations that will initially be located in Algeria, Egypt, Libya, Morocco, and Tunisia, and later on in the region stretching from Turkey through Jordan to Saudi Arabia (DESERTEC Foundation, 2011). An initial US\$5.5 billion in funding was announced in December, 2009, by the World Bank's Clean Technology Fund. The power will be used to meet local demand, as well as for export to Europe, through high-voltage, direct current cables laid under the Mediterranean Sea (DESERTEC Foundation, 2011). Another important initiative is the 'Mediterranean Solar Plan,' designed to develop 20 GW of renewable electricity capacity by 2020 on the Southern Mediterranean, as well as the necessary infrastructures for electricity interconnection with Europe (ENPI, 2011). This was launched in 2008 within the scope of the 'Barcelona process: Union for the Mediterranean (UfM)'.

D. The Electric Power Sector

The electric power sector in the Arab region has been greatly developed in the course of the last decade and has contributed to its socioeconomic development. The total installed capacity has increased from 99,788 MW in 2001 (excluding Comoros and Palestine) to 165,203 MW in 2009 (excluding Comoros). Electric power

FIGURE 12 OIL AND NATURAL GAS CONSUMPTION IN ARAB COUNTRIES (THOUSAND TOE/D)



generation is dominated by thermal power plants, which account for more than 93% of total installed capacity. As indicated in Figure 7, the highest installed electric power capacity is in Saudi Arabia (45,477 MW) followed by Egypt, and the lowest is in Djibouti and Somalia (80 MW) (OAPEC, 2010).

The rate of electrification in Arab countries is relatively high with Yemen and Sudan being the two exceptions, as indicated in Figure 8. Electrification rates in Arab countries are higher than the world average. Some oil-producing countries, such as the UAE, have electrification rates as high as 100% (UNDP, 2010).

E. Energy Consumption

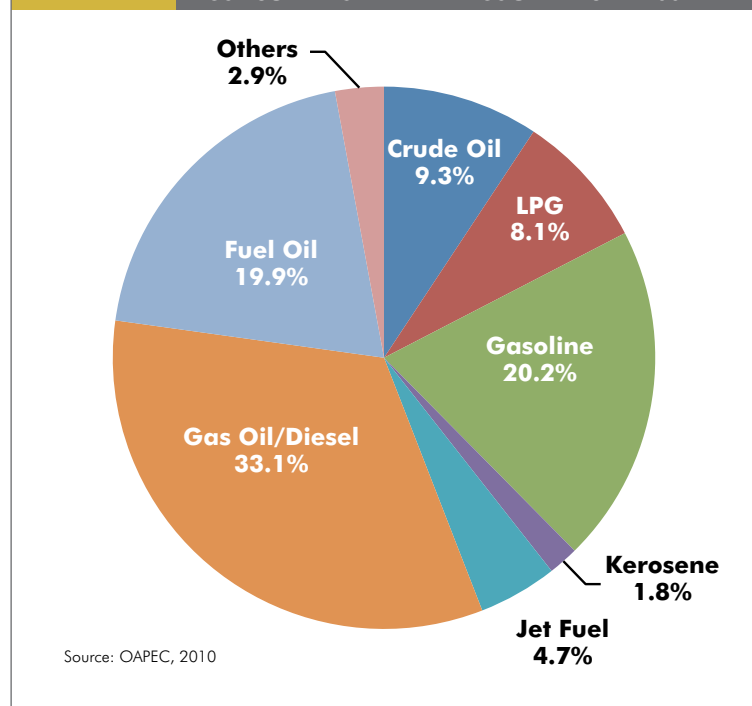
The rise in energy consumption and demand in Arab countries is driven by urbanization, increased economic activity, population growth, and industrialization. Arab countries rely heavily on oil and gas to meet domestic energy demand, accounting for nearly 98.2% of the total Arab energy consumption in 2009 (OAPEC, 2009).

As demonstrated in Figure 9, transport is the major energy-consuming sector in the Arab region, accounting for about 30% of total consumption, followed by the industry sector (27%) (IEA, 2010a). The residential, commercial, and agricultural sectors make up the remaining 43%. This pattern of energy

consumption determines the major sources of GHG emissions, and in many instances, informs policy priorities and measures that will be needed to reduce such emissions.

The growth in domestic consumption in the region over the past decade is indicated in Figure 10. In 2009, total energy consumption amounted

FIGURE 13 BREAKDOWN OF PETROLEUM PRODUCTS CONSUMPTION IN ARAB COUNTRIES IN 2009



ENERGY-SAVING LAMPS IN LEBANON

Pierre El-Khoury

On March 10, 2010, the Government of Lebanon approved the national action plan submitted by the Ministry of Energy and Water (MEW) to allocate US\$9 million to finance energy conservation programs in the country. The allocation was diverted from a budget initially assigned to subsidize diesel fuel. One of the main goals of the plan is to replace, free of charge, 3 million incandescent lamps, with 3 million compact fluorescent lamps (CFL) in households across Lebanon, at a cost of US\$7 million.

CFL lamps have been demonstrated to have lower power consumption than incandescent lamps while costing less over their lifetime. They also provide effective illumination. The replacement program will be part of an effort to phase out incandescent lamps. One million residential electricity subscribers, out of a total of 1.4 million, will benefit from this plan and will take part in this first-of-its-kind Clean Development Mechanism (CDM) project. The initiative is accompanied by an awareness campaign urging the public to adopt energy conservation measures.

The project is rolled out as per the Clean Development Mechanism (CDM) procedures in order to claim CO₂ reduction credits. The savings according to CDM calculations are 970 GWh of electricity, equivalent to US\$181 million. CO₂ emissions will be reduced by 806,000 tons. In addition, the project will reduce the load demand by 160 MW of capacity at peak load. The reduction in peak load demand translates into crucial savings for the government's public budget. The public will benefit from reduced air pollution emissions as well as from lower energy bills.

Distribution of the CFLs has already started in October 2010, and will be completed in 6 phases. Public stakeholder consultation meetings have been conducted in each area of the country while simultaneously conducting an awareness campaign. The lamps are being distributed across Lebanon through municipalities and in collaboration with collectors of electricity bills at Electricité du Liban (EDL).

Pierre El-Khoury is Project Manager, Lebanese Center for Energy Conservation.

to 10.9 million barrels of oil equivalent per day (boe/d) compared to 6.8 million boe/d in 2000 (OAEPC, 2009; OAEPC, 2005).

As mentioned earlier, energy consumption in the region has been dependent on oil and natural gas, which account for about 98% of total energy consumption. Oil continues to be

the main source of energy despite the increasing use of natural gas. Oil meets over half of the Arab countries' energy demand, accounting for nearly 53% in 2009. However, the last decade has witnessed a gradual shift to natural gas from 41% in 2000 to nearly 45% in 2009. However, the last decade has witnessed a gradual shift to natural gas from 41% in 2000 to nearly 45% in 2009 (OAEPC, 2001; OAEPC, 2009), as demonstrated in Figure 11.

Figure 12 indicates the trends in oil and gas consumption in the Arab region. During the past decade the average annual growth of oil consumption was 6.4% compared to 9.8 % for natural gas (OAEPC, 2010; OAEPC, 2005).

Consumption of petroleum products in Arab countries has reached 4.8 million b/d in 2009. Crude oil is still used directly as a fuel in power plants and refineries in several Arab countries, accounting for 9.3% of total petroleum products' consumption. Figure 13 indicates petroleum products consumption patterns in Arab countries (OAEPC, 2005; OAEPC, 2009). The transport sector is the major consumer of petroleum products, accounting for about 58% of total consumption.

F. Current Arab energy policies

As discussed earlier, relying heavily on fossil fuels means that current trends in the Arab energy sector are unsustainable. Achieving more sustainable patterns of energy production and consumption requires adopting green energy policies to minimize economic vulnerabilities, meet the rising demand cost-effectively, reducing air pollution, and addressing carbon emissions. This is well stipulated in the "The Arab Regional Strategy for Sustainable Consumption and Production" (LAS, 2009), which identified a set of strategic objectives, among which are improving energy efficiency, increasing the share of renewable power in the energy sector, and disseminating renewable energy technologies especially in rural and remote areas. The same strategy delineates a comprehensive list of needed policy interventions to achieve those objectives. These include, but are not limited to, introducing reforms in existing energy policies affecting regulations and incentives using subsidies, taxes, and pricing in order to internalize environmental and social costs, while maintaining energy subsidies for the poor; improving energy

AL-SHAHEEN OIL FIELD GAS RECOVERY AND UTILIZATION PROJECT

Nidaa Hilal

In many oil fields, large volumes of hydrocarbons are produced with crude oil when it is brought to the surface. This was true in Al-Shaheen field in Qatar, where much of the 300,000 oil barrels produced daily has a high proportion of this “associated gas” (AG). When the field, sitting 70 Kilometers off the northeast coast of Qatar, was built in 1992, there was little demand for gas. Thus, associated gas was usually burned off, in a process known as “flaring,” which contributes to greenhouse gas emissions and climate change. Furthermore, flaring is a waste of resources and revenue. But demand for gas has grown ever since, and Qatar, being a top producer, ranked among the highest emitters of CO₂ per capita in the world.

Al-Shaheen field operations alone were responsible for 20% of Qatar’s flaring, with only 3% of AG utilized for onsite consumption. In 2004, Maersk Oil Qatar (MOQ) and Qatar Petroleum (QP) launched Al-Shaheen Oil Field Gas Recovery and Utilization Project to be qualified under the Clean Development Mechanism (CDM). At the 2,214 square kilometer

field lying over the North Gas Field, the world’s largest, new facilities were installed for the gathering and delivery of AG to North Field Alpha platform, and its subsequent transfer to the Mesaieed gas processing plant. Since then, about 6.2 million cubic meters of AG is produced at the field daily, including dry gas, liquefied petroleum gas (LPG), and condensate. Of that amount, 3.5 million m³/d is transferred to Mesaieed for local consumption and export, 850 million m³/d is consumed onsite for power and heat generation, and only 1.1 million m³/d is flared.

To date, the project is Qatar’s largest for reducing CO₂ emissions, cutting an average of 2.5 million tons of CO₂ per year. It is also contributing to the country’s energy efficiency efforts by increasing power supply without raising fossil fuel consumption. Moreover, MOQ and QP believe they are setting a new mechanism for funding green technologies and encouraging development of clean-technology demonstration projects in Qatar and the Middle East.

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efficiency, particularly in energy intensive industries, transport, and power generation; promoting large-scale development of renewable energy technologies; and supporting air quality management through better urban planning.

To achieve these objectives, the same strategy recommended a wide array of policies and measures to be considered by Arab countries in order to move towards a more economically and environmentally sustainable management of the energy sector. These policies and measures seek to:

- Increase access to energy for all communities mainly in rural and remote areas.
- Review existing energy policies and incentive measures, including energy tariffs to ensure the integration of environmental and social costs, and to support the sound management of the sector while maintaining energy subsidies for the poor.
- Promote investments in cleaner technologies for oil and gas exploration and production, and adopt measures for reducing the sector’s

environmental as well as social impacts.

- Promote intra-regional electric grid interconnections and natural gas network projects.
- Encourage private sector participation in the establishment and management of energy facilities, including power plants and distribution networks.
- Improve energy efficiency of energy production and consumption, particularly in energy intensive industries, transport, and power.
- Promote the production and use of cleaner fuels.
- Develop and promote the use of renewable energy technologies.
- Support the promotion of cleaner production in the energy sector.
- Support air quality management through better urban planning and land use, and the establishment of regional and sub regional systems and networks for sustainable transport and use of cleaner vehicles.

A partnership on energy for sustainable development (SD) has already been established



through the Council of Arab Ministers Responsible for the Environment (CAMRE) in close cooperation with regional organizations, including the Organization of Arab Petroleum Exporting Countries (OAPEC), the United Nations Environment Program (UNEP), and the United Nations Economic and Social Commission for Western Asia (UN-ESCWA).

Similarly, the Arab Economic and Social Development Summit held in Kuwait in 2009 has exclusively stressed the promotion of Arab cooperation in the field of energy, particularly in improving energy efficiency, supporting energy research, and promoting renewable energy development as a means of achieving sustainable development (General Secretariat of Arab Electricity Ministers, 2010).

G. Barriers for Shifting to Green Energy

Despite pronouncements by Arab countries for a more sustainable energy strategy, there are barriers that still need to be addressed to achieve progress. The high per capita energy consumption by oil producing countries as well as the higher energy and carbon intensities than world averages pose serious challenges to shifting to more sustainable patterns of energy use. Non-oil producing countries, on the other hand, must provide reliable energy

services in rural areas as part of their efforts to eradicate poverty and improve the quality of life. In general, Arab countries are experiencing rapidly rising demand for energy driven by population growth, urbanization, and economic development. Decoupling economic growth from escalating energy and carbon intensity while making the transition to more sustainable forms of energy systems must be addressed. It has been recognized that a number of barriers need to be overcome in order to promote sustainable energy in Arab countries.

A set of barriers often put green energy solutions at an economic, regulatory, or institutional disadvantage relative to fossil forms of energy. The situation in the Arab region is no exception. These barriers could be classified as follows:

• **Policy barriers**

1. The policy barriers to promoting energy efficiency and renewable forms of energy include:
2. Lack of or weak political will both at the government and corporate level.
3. Lack of national energy policy with specific targets and mandates to promote energy efficiency or renewable energy. Only 9 Arab

OPINION

DIVERSIFYING POWER RESOURCES AND NATIONAL ECONOMY**Suleiman Al-Herbish**

With oil set to be the main energy resource for the foreseeable future, another aspect of the next 50 years for the Organization of the Petroleum Exporting Countries (OPEC)- and one to which people do pay too little attention- is the increase in the consumption in Member Countries. The President and CEO of Saudi Aramco, Khalid A. Al-Falih, said in Boston recently that domestic energy demand was expected to rise by nearly 250 percent by 2028— from about 3.4 million barrels a day of oil equivalent in 2009 to around 8.3 mboe/d— and that this would greatly reduce the amount of oil left for exports. The same holds true for Iraq—If Iraq is going to start producing around four million barrels a day, then you have to imagine how much they are going to consume, because they are in the process of rebuilding the country and are relying entirely on oil.

Next, there is the issue of the “resource curse” and the need for diversification. OPEC’s first resolution states: “The Members must rely on petroleum income to a large degree, in order to balance their annual national

budgets.” If I were to write this now, I would recommend the opposite. I would say that Member Countries “should not rely on...” In other words, they should diversify. This clause has been a constraint on our Member Countries from day one. Along with diversification, of course, is the need to develop human resources.

Nevertheless, in my opinion, this calls for a stronger Organization, and there is a case for the strengthening of the framework through which OPEC pursues its policies, together with the budgetary support. This is not a new issue. The First Solemn Declaration of 1975 stated: “The Sovereigns and Heads of State attach great importance to the strengthening of OPEC.” More recently, the Long-Term Strategy of 2005 called for strengthening the Secretariat, and I am sure the forthcoming updated Strategy will recognize this as a continuous process.

Diversifying power resources goes hand in hand with diversifying national economies.

Suleiman Al-Herbish is Director General, OPEC Fund for International Development OFID

countries have announced such targets so far.

4. Weak legal and institutional frameworks. Few Arab countries have a well-developed legislative framework to promote energy efficiency and renewable energy technologies. Only Algeria has had a feed-in-tariff framework to promote renewable energy resources.
5. Slow and incomplete liberalization process of energy and electricity markets. In most Arab countries, energy markets are still dominated by state monopolies. Grid connection and access are not evenly provided to renewable sources of energy technologies.
6. Weak domestic research and development (R&D) programs. Public and corporate R&D expenditures are low and renewable energy and energy efficiency research institutions in Arab countries are severely underfunded.

- **Market barriers**

Energy efficiency and renewable energy markets in Arab countries are distorted due to a number of factors including:

1. Weak capacity for managing and disseminating information about market opportunities for energy efficiency or renewable energy technologies. Market intermediaries such as industry associations are rare.
2. Low level of consumer awareness leading to low market demand. There has been widespread skepticism about performance and reliability of renewable energy technologies due to past technology failures, weak products’ performance, or lack of information.
3. Lack of national standards, testing, and certification schemes that have led to installations of poor quality technologies causing a variety of technical problems and leading to consumers’ distrust. For

LEBANON SUBSIDIZES SOLAR WATER HEATERS

Pierre El Khoury

In 2010, the Ministry of Energy and Water (MEW) in Lebanon launched the first solar water heater (SWH) subsidy program based on providing financial support to first time buyers. Through a partnership with the Central Bank of Lebanon (DBL), commercial banks are offering SWH buyers interest-free loans with a repayment period of up to 5 years. In addition, MEW is offering grants to buyers in order to accelerate market penetration of solar water heaters. Consumers who purchase SWH systems from companies qualified by the Lebanese Center for Energy Conservation (LCEC) are eligible to benefit from a US\$200 grant. The grant from MEW will cover the first 7,500 solar water heaters with a budget of US\$1.5 million. The calculated savings resulting from the installation of 7,500 solar water heaters could reach 22.5 GWh per year.

The SWH subsidy program by MEW-DBL seeks to facilitate the installation of more than 20,000 SWHs. The goal of the interest-free loan is to accelerate the market development of solar water heating in Lebanon. The Lebanese Center for Energy Conservation is seeking to meet a set target of 190,000 m² of new installed collector area between 2010 and 2014, and an annual sale of 50,000 m² reached by the end of the project. Market growth of SWH is expected to reach the

set target of 1,050,000 m² of total installed capacity by 2020. This has been estimated to correspond to over 1,000 GWh of avoided, new fossil fuel power capacity by using solar power instead of electricity for water heating. The estimated cumulative greenhouse gas (GHG) emission reduction will exceed 3 million tons of CO₂ by the end 2020.

These targets have been set by a national initiative launched by the Ministry of Energy and Water, in partnership with the Global Solar Water Heating Market Transformation and Strengthening Initiative, a joint collaborative program of the United Nations Development Program (UNDP), the United Nations Environment Program (UNEP), and the Global Environment Facility (GEF).

The program was successful in creating a positive momentum in the market, which witnessed a soaring demand for solar water heaters reaching as high as 300%. The latest revision of the national database of solar water heater companies published by LCEC now has more than 88 qualified companies.

The final target is to meet the objective of “a solar water heater for every house” in Lebanon.

Pierre El Khoury is Project Manager, Lebanese Center for Energy Conservation

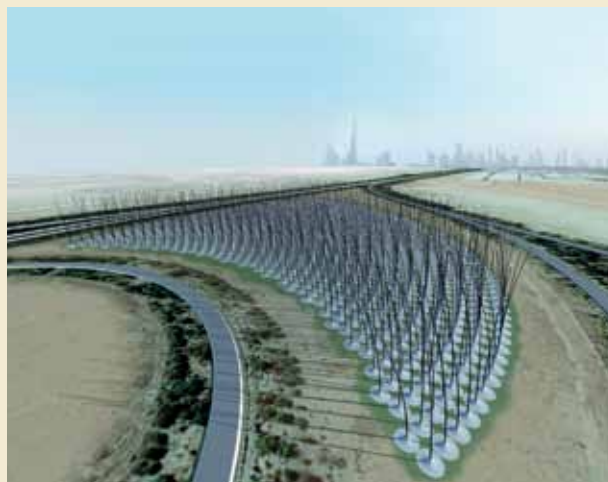
4. Weak capacity of local assembly/manufacturing, distribution, installation, and maintenance of energy efficiency (EE) and renewable energy (RE) technologies. Few countries, such as Egypt, have developed local capacity in manufacturing and assembling EE and RE technologies. This has caused countries to rely more on higher cost imported systems, which led to low levels of market penetration due to weak purchasing power.
5. Lack of education and training programs for EE and RE professionals at all levels. RE and EE are rarely introduced in educational curricula or in vocational training institutions.
6. The unavailability of credit and lack of proper financing schemes. Consumers or project developers may lack access to credit to purchase or invest in renewable energy and/or energy efficiency because of poor creditworthiness or distorted capital markets. This is also true in rural areas where third party finance or “micro credit” is absent. Lebanon, Morocco, and Tunisia started to overcome these barriers by introducing innovative financing schemes.
7. The misallocation of subsidies has introduced market distortions while doing little to assist

STALKS INSTEAD OF WIND FARMS IN MASDAR CITY

Cue the Windstalk is a new concept developed by New York design firm Atelier DNA. Rather than using huge blades to sweep the wind from the sky, the 55-metre resin stalks, reinforced with carbon fibre, are made up of a series of ceramic disks and electrodes connected by a single central cable. When the stalk sways in the wind, the disks are compressed together, creating a charge in adjacent electrodes. Effectively, it works on piezoelectric (kinetic energy) principles: converting motion into power.

The resulting current is collected by the cable and stored in two batteries at the base of the stalks. Atelier DNA claims that the total electricity output of a Windstalk array could equal that of a traditional turbine farm, largely because the stalks can be much more densely situated.

The design won second place in the Land Art Generator Initiative, which awards installations which combine artistic merit with large scale clean energy generation. Although at present it is just a concept, the Windstalk has already been earmarked for Abu Dhabi's Masdar City, the world's first zero-carbon, zero-waste metropolis. The \$20 billion



dollar project's first phase is due to be completed by 2015, with 1,203 Windstalks tasked with feeding 20MW into the grid.

Al-Bia Wal-Tanmia (Environment & Development) magazine
Sam Jones, <http://www.forumforthefuture.org/greenfutures/articles/windstalks-aesthetic-alternative-turbines>

the poor. Subsidies have played a critical role in the development of rural areas and in increased access to modern energy services to the poor. The number of people below the poverty line in the region is high especially in some countries of low per capita income. Therefore, removing energy subsidies might lead to negative social impacts. However, inefficient subsidies systems tend to benefit the rich more than they do the poor. Subsidy reform is critical to promote green

energy solutions. Jordan and Morocco have successfully managed to smoothly phase out their energy subsidies. Policy reforms are needed in order to ensure that subsidies reach the targeted population.

- **Economic barriers**

Economically, EE and RE technologies often face unfair competition in the market due to economic barriers. These include:

TABLE 1

ANALYSIS OF ENERGY POLICIES IN SELECTED ARAB COUNTRIES

	Targets	Legal frameworks	Agency	Financial incentives	Obligations	Energy service companies	Awareness
Algeria		X	X	X	X		X
Egypt	X			X	X	X	X
Jordan	X	X	X	X			X
Lebanon		X	X	X			X
Morocco	X	X	X	X		X	X
Palestine			X				X
Syria		X	X			X	X
Tunisia	X	X	X	X	X	X	X
Yemen	X						

Source: Kraidy, 2010

OPINION

NUCLEAR REACTORS OR HERNIA SURGERY?**Najib Saab**

The debate on the use of nuclear power in Europe inspired the Italian cinema company MOROL Productions to produce a documentary entitled, 'The Nuclear Question.' This documentary was shown at the Rome Film Festival in October 2009, and received awards for presenting the nuclear question from ethical, environmental and economical perspectives.

A quarter of a century following the Chernobyl disaster and its repercussions, and three decades after the Three Miles Island nuclear accident in the US, the film poses several questions: is there a moral justification for accepting the potentially disastrous results of nuclear accidents in order to meet raising energy demands? Is the nuclear energy option inevitable? Or was Italy's 1987 decision to ban nuclear reactors, based on a referendum following the Chernobyl disaster, a wise decision?

When MOROL approached me in August 2010 to request an interview for another documentary on nuclear energy in the Arab region, I welcomed the idea, and found it useful to contribute to a serious discussion on the subject. At that time, the thought of a global nuclear disaster on the scale of what happened seven months later in Fukushima was considered mere fiction.

"Are you afraid of the devastating effects of nuclear radiation in the Arab region, considering the possibility of an accident similar to Chernobyl at an Iranian nuclear

reactor?" This opening question surprised me, because before the Lebanese should fear, for example, the effects of an accident 2000 km far in Iran, they should fear a nuclear accident in the Israeli Dimona reactor, which is only 200 km away, that is if we limit the fears to a mere accident. The Dimona reactor produces fuel for nuclear warheads and is located in a country which is at war with its neighbors, and which refuses to sign the Treaty of Non-Proliferation of Nuclear Weapons. Iran has signed that treaty, but still is suspected to pursue its nuclear program with military ends. What guarantees can the Lebanese and the Arabs have against an intentionally triggered nuclear apocalyptic attack, especially from a country with which most are officially in a state of war?

Furthermore, at the opposite end of the Mediterranean, dozens of nuclear reactors exist in France, and it is enough for one accident to occur for radiation to reach Arab countries across the sea. Moreover, Turkey is preparing to construct nuclear reactors on the Akoya coast close to Cyprus, only 300 km away from Beirut.

These reactors are all closer to us, I pointed out to my interviewer, and he commented that, in spite of this, many Arab countries have begun to build nuclear power stations. "This is true", I told him, "and Arab countries have multiple motives, as some suffer from a deficit in energy sources, yet own stocks of uranium, and plan to extract it and use it to produce electricity from nuclear energy, as is the case in Jordan. Still, the 'nuclear club' imposed on Jordan the condition of buying ready-to-use enriched uranium in order

1. Heavy government subsidies to the oil and gas industry make it difficult for new or disrupting technologies, such as EE and RE products and services, to achieve high rates of market diffusion.
2. High custom duties on EE and RE technologies add to the high initial capital costs, impairing economic feasibility. For example, custom duties have been a major barrier for the dissemination of compact fluorescent lights (CFL) in Egypt until their very recent removal. Promoting local manufacturing of these products proved to be a sound policy to reduce initial costs.
3. The external costs of fossil fuels use compared

to clean energy technologies are ignored. The heavy reliance on oil and gas is associated with environmental degradation, negative public health outcomes, energy insecurity, and international price volatilities, all of which impose economic costs on Arab governments' budgets. The environmental impacts of adopting fossil fuels often result in public health costs (i.e., productivity loss, hospitalization costs), declines in forests and fisheries, and ultimately infrastructure losses associated with climate change. World Bank studies have found that the costs of environmental degradation in 7 Arab countries range from as little as 2.1% to as much as 7.4% of GDP for different countries and years (Croitoru and Sarraf, 2010). The studies have estimated these

to allow building a reactor.” Feasibility studies often ignore the cost of dismantling nuclear reactors and dealing with the waste and possible disasters, which, apart from the environmental and human risks, would increase the liabilities and outweigh potential economic benefits.

Moreover, other Arab countries, rich in conventional energy like oil and gas, still want to ‘purchase’ nuclear technology under the banner of diversifying energy sources and accelerating development. The danger lies in luring some countries into buying ready-made nuclear technology and equipment, under the pretext of a regional balance of power, which may lead to wasting national wealth in an absurd race. This race is not based on developing and owning technology, but on buying ready equipment from ‘international sales representatives’, including heads of state, who offer both nuclear reactors and military equipment on the same plate, sometimes as part of so-called peace initiatives.

It seems my answer provoked my interviewer, so he asked: “Are you against Arabs acquiring advanced technology, including nuclear?” Of course I want Arabs to develop and own all technologies, and invest in science, literature and art. But what does buying nuclear reactors mean, when Arab citizens still have to travel to hospitals in Europe and USA for treatment of the simplest injuries or diseases?

Before we talk of nuclear reactors, what have we achieved in the field of scientific research, whether in medicine, engineering, physics, economics or sociology? The Arab region still ranks amongst the lowest in the world in terms of budget allocation to scientific research. A stark manifestation is that while Arab countries produce 60

percent of desalinated sea water in the world, they continue to fully import desalination technology, equipment and spare parts, and in most cases also foreign scientists, managers, technicians and workers. So we have to ask whether the construction of nuclear reactors should be accorded a priority over building a factory to produce membranes for water desalination, let alone complete desalination plants? Is building a nuclear reactor more important than developing medical services, so that citizens are not forced to travel to foreign hospitals like the Mayo Clinic for surgeries as simple as removing hernia or a gallbladder? And what will be the level of response to potential nuclear disasters, in countries which have still to show capability to adequately respond to a slight excess in rainfall, often flooding their capitals, wiping structures and humans?

Ultimately, is it not more useful to invest in renewable energies, especially sun and wind, which are clean, safe and abundantly available in the Arab region, before seeking to produce nuclear electricity, fully depending on imported equipment, technology, and enriched uranium?

Arabs have the right to develop and own technology, including nuclear, on the condition they identify priorities and applications according to real needs and in compliance with safety and security considerations. We should beware, however, of falling victims to an artificial nuclear race that only serves international salesmen.

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losses to account for 4.8% of GDP in Egypt (1999), 3.7% in Morocco (2000), and 3.6% in Algeria (1998). Yet the capacity to internalize these costs into national accounting is lacking in the Arab region.

III. POLICIES CONDUCTIVE TO GREENING THE ENERGY SECTOR

Shifting to more sustainable patterns of energy production and consumption will require a new approach for balancing the demands of energy security, poverty reduction, clean air, and climate stabilization, while continuing to underpin economic development. Investing in a green energy system should be conceived

as a basis for addressing these demands and managing the tension with each other. Making the shift from a ‘brown’ economy to a ‘green’ economy in Arab countries can be achieved by introducing policy reforms and institutional changes. The needed enabling conditions should be able to address the market, political, and economic barriers discussed earlier, while suggesting specific regulations and incentives for transformation.

Some Arab countries have already introduced various energy policies and programs targeting buildings, transportation, and industries. These policies include regulatory directives, voluntary agreements, and incentives. According to the Regional Center for Renewable Energy and

BIODIESEL IN UAE FROM MCDONALD'S WASTE OIL

Neutral Fuels, a company specialized in energy-efficient operational solutions, has begun to produce biodiesel by converting vegetable oil from local McDonald's restaurants in the United Arab Emirates. The biodiesel produced is used to fuel McDonald's logistics trucks, and can be used by any normal diesel engine. The oil received from McDonald's is the waste from food preparation, and therefore reduces carbon emissions by 60 to 80% as compared to traditional diesel fuel.

This biodiesel program is not the first of its kind, as it is already in operation by McDonald's in Germany, the UK, and areas in Brazil and the US. The process works better in the UAE, though. Robin Mills, a Dubai-based energy analyst, explained in an interview with the BBC that the danger of biodiesel is that there is the possibility of it clogging up, forming a gel and eventually freezing at low temperatures. Of course, low temperatures are not a problem in the UAE, thus eliminating this risk.

One problem the country does face is that the UAE subsidizes the price of fuel at the pump, making it harder for companies like Neutral Fuels to compete and make a profit. Nonetheless, chairman of Neutral Fuels Karl Feilder takes this as an opportunity "to be even more efficient and even more competitive."

The UAE is the world's eighth largest oil producer, rendering it quite surprising that the biodiesel project is gaining support. Other restaurant chains are beginning to express an interest in the program as well.



"Nowadays companies are becoming more environmentally conscious and they want to, as much as they can, be environmentally sustainable," says Abdulla Al Jallaf, managing director of Neutral Fuels in Dubai, which became the first commercial producer of 100% biodiesel in the Middle East. The operation has been supported by Dubai Government's Department of Economic Development (DED).

McDonald's is currently Neutral Fuels' only client and the project is restricted to the UAE, but there are hopes to expand the project across the wider region.

Energy Efficiency (RCREEE), several Arab countries have already identified the barriers to energy efficiency and have taken measures that promote reductions in energy demand (Kraidy, 2010). Table 1 summarizes these measures taken by some Arab states to increase energy efficiency.

A. Regulations

Regulations are usually introduced when it is recognized that economic instruments alone would not be sufficient to achieve energy policy objectives. In general, regulations impose specific measures using legal mandates and/or governmental decrees. A range of regulatory measures that can be adopted by Arab countries may include:

i. Renewable energy portfolio standards

Renewable portfolio standards (RPS) are state policies or regulations mandating a country to generate a certain percentage of its electricity from renewable energy sources. The RPS mechanism generally places an obligation on power utilities, public or private, to produce a specified fraction of their electricity from renewable energy sources. Each country would generally fulfill this mandate using a combination of renewable energy sources, including wind, solar, biomass, geothermal, hydro, or other renewable sources. Some RPS mandates will specify the technology mix, but it is more prudent to let utilities determine the best combination of renewable energy sources to invest in to meet the standard based on

technology viability and economic feasibility. Being a market mandate, RPS relies mostly on the private sector for its implementation. Since power utilities in most Arab countries are owned by governments, RPS implementation would require accelerating institutional reforms in the energy sector to allow for independent power producers (IPP). This would also require the establishment of a regulatory body to issue rules and ensure compliance by different IPPs. By 2010, over 100 countries had some type of policy measures for renewable energy targets, compared to 55 countries in 2005 (REN21, 2010).

A number of Arab countries have already set renewable energy targets, as indicated in Table 2. The Lebanese government has declared that it intends to meet a renewable energy portfolio standard of 12% by the year 2020 (REN21, 2010). Wind power is regarded as the most economically feasible source for renewable power. In Tunisia, wind power is expected to account for about 85% of renewable energy share by 2020. Egypt has an annual wind power generation capacity of around 550 MW (NEEAP, 2010a). In Jordan, it is estimated that the deployment of renewable energy sources through a RPS will account for 10% of the country's primary energy production by 2020 (REN21, 2010).

ii. Energy efficiency standards

Improved end-use energy efficiency in residential and commercial buildings, manufacturing,

and transport is globally recognized as one of the surest and most cost-effective strategies to reduce energy consumption and greenhouse gas (GHG) emissions (for the same amount of utility derived). Energy efficiency (EE) standards are being adopted worldwide to help manage electricity demand growth, decrease electricity prices, reduce emissions, and address system reliability concerns (IEADSM, 2010).

Several Arab countries have announced energy efficiency targets. Morocco has set a target of achieving 12% savings from EE by 2020, Lebanon 5-10% by 2020, Algeria 16% by 2020, and Egypt 10% by 2020 and 15% by 2030 (Kraidy, 2010). Tunisia has set a target of 20% by 2011, and it is estimated that between 2005 and 2008, the clean energy plan has shaved \$1.2 billion off the Tunisian government's energy bill (NEEAP, 2010b). In the Palestinian Territories, the 2009 General Electricity Law stresses the promotion of energy efficiency in various economic sectors and sets a target of achieving 10% energy savings by 2020.

iii. Energy-efficient building codes

Energy efficiency building codes and standards are generally used to set minimum requirements for energy-efficient design and construction for new and renovated buildings that impact energy use and the resulting emissions over the lifetime of the building. Energy-efficient buildings, in addition to their advanced architectural features,

TABLE 2

ARABS' RENEWABLE ENERGY TARGETS

Country	Targets
Algeria	Wind: 100 MW by 2015; solar thermal: 170 MW by 2015; solar PV: 5.1 MW by 2015; cogeneration: 450 MW by 2015; solar CSP*: 500 MW by 2010
Egypt	Renewable generation: 20% by 2020, including 12% from wind (about 7,200 MW) and 8% from hydro and solar photovoltaic (PV)
Jordan	Wind: 600-1,000 MW; solar PV: 300-600 MW; waste-to-energy: 20-50 MW
Kuwait	Renewable capacity: 5% by 2020
Lebanon	Renewable capacity: 12% by 2020
Libya	Wind: 280 MW by 2012 and 1,500 MW by 2030; solar CSP: 50 MW by 2012 and 800 MW by 2030; solar PV: 150 MW by 2030
Morocco	Solar hot water: 400,000 m ² by 2012 and 1.7 million m ² by 2020; wind: 1,440 MW by 2015; small hydro: 400 MW by 2015
Palestine	Renewable capacity: 20% by 2020
Tunisia	Wind: 330 MW by 2011; solar PV: 15 MW by 2011; solar hot water: 740,000 m ² by 2011

* CSP: Concentrated solar power

Source: REN21, Global Status Report 2010

offer economic and environmental benefits. They are more comfortable and cost effective to operate. Energy efficient buildings can also create economic opportunities for business and industry by promoting demand for new energy efficient-materials and technologies.

The buildings sector in the Arab region offers an attractive field for energy efficiency and emission reduction, given the scale of building activity. In Lebanon, thermal standard requirements for buildings have been established to improve the thermal performance of building envelopes, which should be reflected in improved comfort and reduced energy needed for space heating and cooling (Ministry of Public Works and Transport, 2005). A regional project on Energy Efficiency in the Construction Sector in the Mediterranean Countries (MED-ENEC) has been initiated with funding from the European Union to increase the use of energy efficiency measures and renewable energy systems in buildings in southern and eastern Mediterranean countries (MED-ENEC, 2011). Apart from policy advice and business development, special emphasis is placed on the support for large, more energy-efficient building programs.

Mandates for solar hot water in new construction could represent a strong and growing trend at both national and local levels. National building codes should require minimum levels of solar hot water in new construction and renovation.

iv. Vehicle fuel efficiency standards

Transport is the major energy-consuming sector in Arab countries, accounting for about 30% of total consumption (see Figure 9). Moreover, gasoline and diesel fuels for transport vehicles account for 53% of all petroleum products (see Figure 13). Therefore, Arab countries should set and enforce average fuel economy standards for new vehicles and impose performance standards on imported vehicles. Vehicle fuel efficiency standards have been demonstrated to be effective in reducing fuel consumption and greenhouse gas emissions over the lifetime of the vehicle. It should be noted that no Arab country yet has vehicle fuel economy efficiency standards. Given that vehicle fleet size is growing rapidly in Arab countries, implementing vehicle fuel economy standards should be a priority.

v. Appliance, equipment, and lighting efficiency standards

Regulatory authorities in Arab countries should mandate efficiency performance standards for electric appliances, equipment, and lighting in residential buildings, commercial offices, and industrial facilities. Moreover, incandescent light bulbs should be phased out. Such standards, coupled with energy performance labels, are now being adopted worldwide in order to achieve the largest possible improvement in energy efficiency. Where they have been implemented, these measures have often resulted in significant energy savings and emissions reduction.

Residential equipment categories should include central and room air-conditioning, heaters, lighting fixtures, water heating, refrigerators, freezers, clothes washers and dryers, and dishwashers. For commercial buildings, equipment categories should include central air-conditioners, chillers, heat pumps, fans, water heating, lighting, refrigeration, and office equipment (computers, copiers, printers, scanners, monitors, and vending machines). Efficiency standards for industrial facilities should address motors of various types and sizes, electric resistance and radio frequency devices, heating, ventilating, and air-conditioning systems (HVAC), and incandescent, fluorescent, and high-intensity discharge lighting.

Energy-related standards adopted in the region vary from one country to another. Syria, for example, has established a 15-year efficiency-labeling program for refrigerators in 2003, with potential savings projected to total 51 GWh of electricity per year as a result of implementing these standards. In 15 years, the labeling program would cut electricity usage by 750 GWh, a quantity that would have required the construction of a 100 MW power plant (Bida and Kraidy, 2010). Lebanon's energy policy will ban the import of inefficient incandescent lamps by 2014. The country has also launched a project to distribute 3 million energy efficient compact fluorescent lamps to residential units across Lebanon for free. Egypt has established energy efficient standards for refrigerators, washing machines, and air-conditioning units (Plan Bleu, 2007).

MARKS & SPENCER-DUBAI ADOPTS EFFICIENT LIGHTING SOLUTIONS

Marks & Spencer in Deira City Center, Dubai, is one of the leading brands represented by Al Futtaim Group. Adopting more sustainable practices, Al Futtaim's most recent was a new store concept developed for Marks & Spencer per the guidelines of their international team. Lighting was a key parameter of this concept, and an innovative solution was designed by Philips central design team.

Philips energy efficient and LED light fixtures were installed throughout the sales area, changing rooms, and back of the store. The goal was ensuring optimum quantity of luminary to achieve the desired lighting features. Savings were achieved by reducing

the connected electrical load and by trimming the maintenance schedule.

Dynalite lighting controls were also used in the changing rooms to create interactivity with the shoppers and ensure additional energy efficiency.

Marks & Spencer now enjoys optimum crisp bright light with a typical energy saving of 20% on its lighting electricity usage, in comparison with other stores using conventional light sources. It is also believed that the LED lighting solution will reflect the true colors of clothing, hence creating a more enticing shopping environment for the customers and adding to the bottom line results for sales.

B. Incentives

i. Subsidy reforms

Targeted energy subsidies are needed to lift low-income households and rural communities out of poverty. However, broad fossil fuel and electricity subsidies in Arab countries often fail to focus on the poor. Such untargeted subsidies lead to overuse of energy, impose a burden on public finances, and constrain the ability of regulatory agencies to rein in demand. The indirect effects include lower economic productivity, increased air pollution, and higher rates of GHG emissions.

The gradual phase out of fossil fuel consumption subsidies can be a powerful tool for governments to shape the long-term evolution of their energy system. The savings from reducing or removing government subsidies can be used as financial incentives to spur investments in energy efficiency and renewable sources of energy. These incentives will be needed to accelerate market diffusion of renewable energy technologies during the early phase of market development. According to the International Energy Agency (IEA, 2009), the complete removal of subsidies would lead to a 5.8% reduction in CO₂ emissions by 2020.

ii. Providing incentives for end-user purchase of energy efficient equipment

Arab governments should consider initiatives that offer incentives for the purchase of energy-efficient equipment and appliances by households

and institutional buyers. For example, financial incentives can be made available for interior lighting, building envelope, heating, cooling, ventilation, or hot water systems that would lead to a reduction in a building's total energy and power consumption. A graduated scale can be used whereby the amount of financial incentive is proportional to the decrease in energy consumption relative to the conventional baseline. Such incentives that reduce the purchasing cost of energy efficiency products and services play a key role in stimulating demand for them and developing a robust energy efficiency value chain.

Financial incentives for energy efficiency may include a variety of forms including tax incentives, grants, low-interest loans, rebates, bond programs, leasing/lease purchase programs, and performance-based incentives (DSIRE, 2011). Some initiatives have already been implemented. Energy-efficient bulbs have been distributed for free in Lebanon and the United Arab Emirates, and at subsidized costs in Egypt and Morocco. In Tunisia, low-interest loans are offered for replacing old, inefficient refrigerators that have been in use for more than 10 years, whereby a total of 400,000 units have been replaced.

Promoting energy efficiency standards and labels on appliances would provide strong incentives for producers to improve energy efficiency of their products, while providing consumers with the knowledge they need to make more informed purchasing decision. In combination with setting up efficiency standards and labeling for appliances



and equipment, Arab governments should launch a sustained educational and awareness campaign about these efficiency labels as part of an effort to educate buyers and consumers.

iii. Promoting a shift to renewable energy sources

For the installation of renewable energy systems, incentives that reduce the initial capital cost play a key role in stimulating demand and developing a robust supply chain. Subsidies for solar water heaters (SWH) are now common in several Arab countries including Egypt, Lebanon, and Tunisia. Capital grants, rebates, low-interest loans, and value-added tax (VAT) exemptions are made available to subsidize the initial purchasing cost of SWHs or renewable energy installations. To further increase the wide scale adoption of renewable energy production in Arab countries, incentives and policies for selling renewable power to the grid and reducing and/or removing electricity and fossil fuel subsidies are needed.

The feed-in-tariff (FIT) policy has been widely adopted in many countries and regions in recent years. The feed-in tariff policies have spurred innovation and increased interest and investment in renewable energy resources, mainly wind, solar, and biofuels. They have had the largest effect on wind power but have also influenced solar photovoltaic (PV), biomass, and small hydro development. Strong momentum for feed-in tariffs continues around the world as countries enact new policies or revise existing ones (UNEP, 2010). In the Arab region, only Algeria has so far enacted a feed-in-tariff policy, while it is under consideration by Egypt, Lebanon, Saudi Arabia, UAE, Tunisia, and Yemen.

Few countries in the region have established special renewable energy and energy efficiency funds to directly finance investments, set standards, and offer technical support through research, education, and public awareness. The National Energy Efficiency and Renewable Energy Account, NEEREA, in Lebanon, has been recently established to offer both financial and technical support for energy efficiency and renewable energy projects in the country. NEEREA works cooperatively with the Central Bank of Lebanon to evaluate applications for grants and low-interest loans for these projects.

iv. Promoting demand response management to reduce peak loads

Demand response management refers to mechanisms to manage electricity consumption by end-consumers in response to supply conditions or market pricing. Demand management permits cutting back load during times of system emergencies, system peaks, or high market prices. The most commonly used demand response program entails interruptible electricity service for commercial and industrial end-users during peak loads. It is primarily used as a strategy to reduce energy demand and to impact the shape of the load curve.

Demand management gives customers more control over their energy costs, and allows them to realize energy savings that would result from changing their consumption behavior. Demand response can also avoid costly outages when the demand for power peaks. In these instances, end consumers agree to curtail their consumption of

ARAMEX DUBAI LOGISTICS CITY: LEED GOLD CERTIFIED WITH PHILIPS LIGHTING

As a 29-year old global provider of comprehensive logistics and transport solutions in more than 54 countries, Aramex understands the importance of warehousing within the wider supply chain, and the environmental footprint of those facilities. The company is investing in cutting-edge green technology to ensure meeting customers' storage requirements and inventory management needs with minimal carbon footprint. Dubai Logistics City emerged as one of Aramex's key facilities to become energy efficient under "A LEED Gold Certified" project, in partnership with Philips.

The challenge was to provide a simple yet smart lighting solution to meet the application requirements, while consuming 40% less energy than stipulated by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers' (ASHRAE) standards. The project required luminaries-based, stand-alone lighting controls for occupancy detection in the warehouse area

and daylight optimization in the offices.

Philips made an intelligent selection and customization of standard luminaries. For the lighting controls, it customized the standard TMX204 luminary with an occupancy sensor in the warehouse area to provide the ideal scenario: light when and where needed. The Smartform TBS460 luminaries in the office spaces have been fitted with Luxsense controllers, which save energy by automatically regulating the luminary in accordance with the level of daylight available. Fugato Compact and Performance downlights with PL-R lamps were used for circulation areas.

Dubai Logistics City project reflects Aramex's continuous commitment to reduce its carbon footprint, optimize power consumption, and raise awareness among other activities in its 307 locations around the globe.

Both Aramex and Philips are AFED corporate members.

power according to a preplanned scheme in return of financial incentives. Some consumers may have options for on-site power generation that may not be connected to the grid, giving them more flexibility to manage their power consumption.

v. Promoting shift to low-carbon fuels

To reduce GHG emissions, alternative, low-carbon fuels can be used as substitutes for conventional fuels in transport and power generation. Short and medium-term options already adopted in several Arab countries include the shift to cleaner and cheaper natural gas for both power production and in transport.

This may require conversion of vehicle engines and new fueling infrastructure, depending on the type of fuel. Alternative fuels—such as liquefied petroleum gas (LPG), compressed natural gas (CNG), biofuels, and electricity—offer reductions in GHG emissions from 10-100% over the full fuel cycle depending on how they are produced and used (PEW, 2007). Arab governments, in partnership with the private sector, should develop appropriate incentives to promote the transition to low carbon fuels. Egypt has taken a leading role in the shift to natural gas for transport by building a nationwide network for gas storage and distribution.

Plug-in hybrids and all-electric cars have higher costs and limited driving range and lack a fuel supply and refueling infrastructure at the present time. For biofuel production, redistributing farmland for harvesting agro fuel feedstocks must be avoided at all costs. The conversion of agricultural waste into biofuels is the most sustainable and desired option. Low-carbon fuels can provide long-term solutions, but economic, technological, and structural hurdles must first be overcome and environmental benefits demonstrated.

A clean fuel partnership should be established in Arab countries to bring together a wide range of organizations with a stake in the shift to cleaner vehicles and fuels. Such a partnership could benefit from similar initiatives in Europe and other regions, and its members may include government regulators, vehicle dealers and producers, fuel and energy industries, automotive technology providers, transport operators, consumer groups, environmental organizations, academic centers, and investors, (PEW, 2007). The objective of such a partnership is to promote transport solutions that ensure sustainable growth, while mitigating negative externalities of the sector. It should also support integrating land use developments with mobility needs, promoting the shift to energy-efficient modes of

GEOTHERMAL HEATING AND COOLING IN JORDAN

Adi I. Asali

Jordan, like many Arab countries, faces the problem of soaring energy prices accompanied by a lack of available resources. The Middle East and North Africa (MENA) Geothermal Ground Energy and Investment Company has dedicated its efforts to introducing geothermal heating and cooling systems to Arab countries as an economic, energy saving, and environmentally sustainable solution to the region's energy problems.

Two geothermal systems were designed and are currently being installed by MENA Geothermal at the American University of Madaba (AUM), Jordan, to meet the full heating and cooling demands of two College of Science and College of Business buildings. The geothermal heating and cooling systems at AUM, once completed, will be the largest in the Arab region. In addition to the enormous savings in operating costs, the system will eliminate all carbon dioxide emissions emitted by conventional systems.

Geothermal Energy Fundamentals

The Earth acts as an enormous energy storage tank that is able to absorb about 50% of the sun's energy. As a result, the temperature below the earth's surface remains relatively constant throughout the entire year. Because



heat naturally flows from high temperature to low temperature zones, geothermal systems use electrically powered heat-pumps to transfer heat back and forth between heated or cooled buildings and earth.

During the heating cycle, constant underground temperatures provide an excellent heat-source that is significantly warmer than the cold air outside. A geothermal system uses a ground loop to extract

FIGURE B1

AUM'S OPERATING COST COMPARISON CONVENTIONAL VS. GEOTHERMAL (HEATING COOLING)

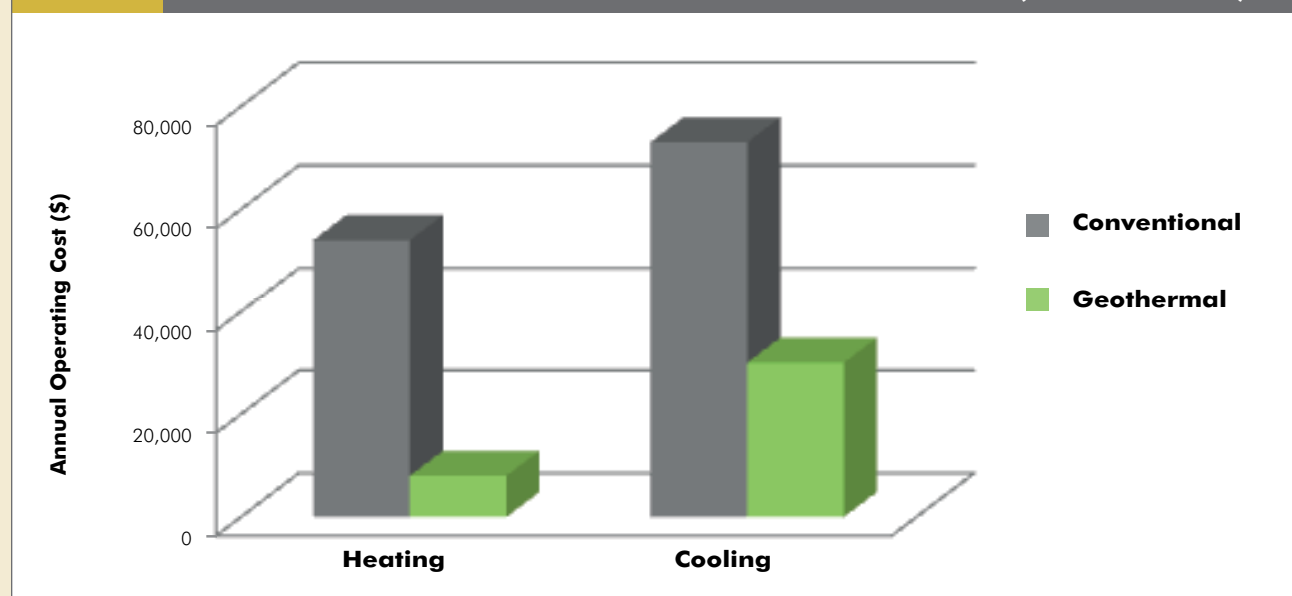
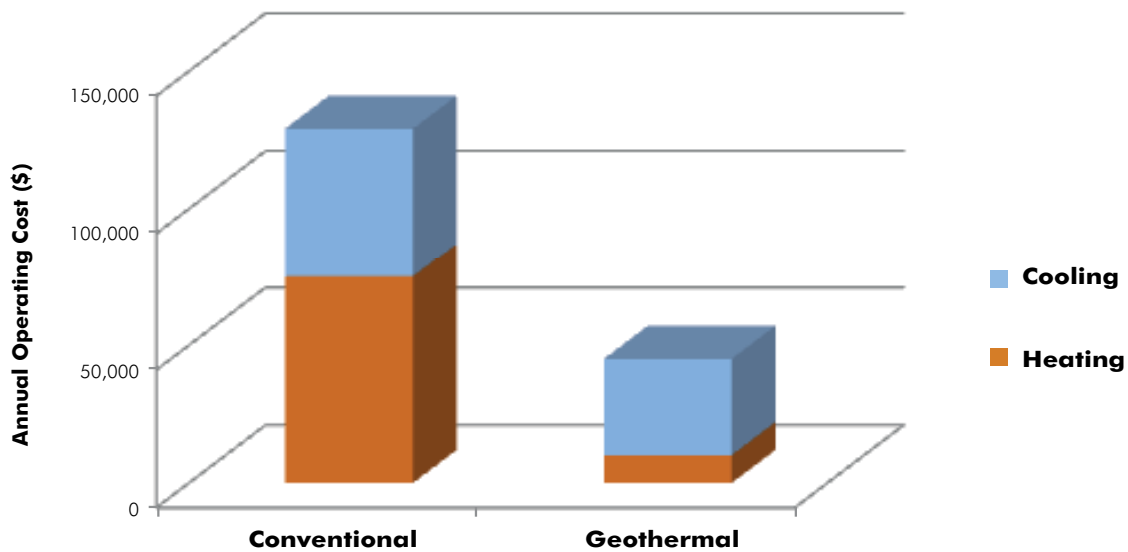


FIGURE B2

AUM'S OPERATING COST COMPARISON CONVENTIONAL VS. GEOTHERMAL (TOTAL)



heat from the ground and utilizes this heat to warm up the building and its domestic hot water supply. In the cooling cycle, a geothermal system simply works in reverse. The constant underground temperatures provide an excellent heat-sink that is significantly cooler than the hot air outside. Instead of extracting heat from the ground, heat is extracted from the building and is either rejected into the earth loop, or used to preheat the building's domestic hot water supply.

In short, geothermal heating and cooling systems provide an efficient and environmentally sustainable method for heating and cooling residential and commercial buildings, and for supplying part of their domestic hot water.

Geothermal System Features at AUM

The College of Science's geothermal system is designed to meet a cooling load of 1020 kW (291 tons), and a heating load of 880 kW (251 tons), while the College of Business's geothermal system is designed to meet a cooling load of 660 kW (189 tons) and heating load of 470 kW (134 tons). Due to the large size of both geothermal systems, it was determined that a vertical borehole configuration would be the best option to

use while designing the ground loops of the systems. A total of 420 boreholes (255 for the science building, and 165 for the business building) were drilled at roughly 100 meters deep to supply the energy required for heating, and to absorb the energy rejected during the cooling by the system.

The geothermal heating and cooling system at AUM is designed to achieve a coefficient of performance (COP) of 4.0 in heating and cooling cycles. That is, for every unit of electricity consumed by the geothermal system, four units of heating or cooling are supplied to the building.

Annual Energy and CO₂ Savings. Compared to conventional heating and cooling systems used in Jordan, AUM's geothermal heating and cooling system is expected to have annual savings of over 200,000 kWh of electricity in the summer months (cooling), and 90,000 liters of diesel fuel in the winter months (heating). In total, AUM will generate annual savings of over \$85,000. Moreover, the geothermal system is expected to eliminate 365 tons of CO₂ emissions every year.

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transportation, and improving vehicle and fuel technologies (LowCVP, 2010).

C. Knowledge Management

As mentioned earlier, the demands placed on a national energy strategy to address society's economic, security, and environmental goals are pressing. How Arab countries manage and obtain their energy resources plays a determining role in socioeconomic development, balance of payments, and environmental quality, among others. Therefore, knowing how to balance the diverse and multiple goals of an energy strategy, with the attending tensions and competing demands, requires having the capability to create interdisciplinary and multi-sectoral knowledge and the capacity to utilize this knowledge at different scales.

Science and engineering will always play a key role in advancing our knowledge about new technologies or processes that lead to increased efficiencies, better integration, and lower costs. However, developing an energy strategy demands a great deal more than technological advances. To develop a sound energy strategy will require considerable investment in applied, integrative, and policy-oriented knowledge that can elucidate the costs and benefits of different energy choices economically, socially, politically, and environmentally. Developing the capacity to utilize this knowledge effectively requires processes and institutions to communicate these understandings to policy makers as well as to the public.

Moreover, the crafting of regulations and incentives to influence society's patterns of energy production and consumption depends significantly on such practice-based, policy-oriented studies. These studies are needed to develop an understanding of the effects of public policies and to ensure that they are perceived to be fair. Therefore, Arab countries should establish communities of research and teaching at the intersection of science, technology, and public policy. These communities may emerge at academic institutions, non-governmental organizations, and think tanks.

Energy use is vital to every sector of the economy, e.g., agriculture, industry, transport, housing and construction, and tourism. Therefore, crafting an

energy strategy should not be left entirely to the Ministry of Energy. Governmental cooperation should take place at the highest levels to ensure policy integration and coordination. This also poses a challenge in integrating different perspectives and sources of knowledge related to the type of energy end-use, pricing, and assessment of each sector's demand growth.

D. Public awareness

Much of energy consumption behavior is influenced by societal and cultural values. Therefore, public education and awareness campaigns are critical to creating a green culture and mass social learning in support of energy efficiency and renewable sources of power.

Strong evidence suggests that households and institutional consumers of energy lack knowledge about their own consumption of energy and about the opportunities available to improve energy efficiency. Therefore, sustained public awareness is a key component of any energy strategy.

Furthermore, for the regulations and incentives discussed earlier to be effective in changing behavioral patterns, they have to be accompanied by easy-to-understand information to help households and institutional consumers make 'green' decisions about energy purchases and installations. Informational materials should inform consumers how to take advantage of incentive programs, provide updates about new and existing incentives, and offer basic templates for computing the costs and benefits of purchasing decisions.

An example of a public outreach program is the United Arab Emirates' 'Heroes of the UAE', a jointly developed by the Emirates Wildlife Society in association with the Worldwide Fund for Nature (EWS-WWF) and the Environment Agency-Abu Dhabi, which aims to alert the public to the fact that drastic action must be taken now to drastically curb energy consumption and avert dangerous shortages. The campaign also seeks to point out that straightforward, practical, and successful solutions are readily available (The UAE Heroes Campaign, 2011). The Lebanese Center for Energy Conservation (LCEC) is another example of an outreach program that seeks to influence consumer behavior through skillful design of media ads.

SOLAR PHOTOVOLTAIC POWER FOR PUBLIC SCHOOLS IN LEBANON



Reliable energy is critical for economic growth, social development, fiscal sustainability, and regional and global integration. Indeed, several studies undertaken by the World Bank in many countries show a very clear correlation between access to energy and gross domestic product (GDP) growth.

Although Lebanon is 100% electrified, most regions of the country, mainly near the borders, suffer from very long electricity black-out periods and have very low voltage levels, which doesn't enable them to use electrical appliances or even enjoy adequate lighting levels.

While generally an inconvenience for everyone, for children these black-outs can have negative effects, particularly on their education. Since public schools cannot afford adequate alternative energy sources, children have no access to sufficient lighting or to reliable power to permit the use of classroom technologies.

With a mandate to deploy sustainable energy projects in Lebanon, the country energy efficiency and renewable energy demonstration project for the recovery of Lebanon (CEDRO), which is managed by the United Nations Development Program (UNDP), initiated in 2010 projects for the installation of solar photovoltaic (PV) systems in 25 public schools and community centers in Akkar, Bekaa, and in the South. Kherbet Selem public school in the south of Lebanon was selected for the pilot project.

The solar PV system is designed to supply power to the school independent of the grid. However, it is connected to the grid to allow the system's batteries to be charged when they are low on stored energy. In the future, a feed-in option will be installed to allow the solar PV system to supply power to the public grid during school days off or when there is power surplus.

The installed solar PV system consists of three mono-crystalline modules and has a capacity of 1800 Watt-peak (Wp). The solar modules comprise of cells that produce electrical direct current (DC) when exposed to sunlight. The electricity produced is stored in batteries and then converted to alternative current (AC) by an inverter. The batteries will supply essential power load to the building in the event of a grid power failure. The amount of power supplied will be sufficient to meet the load requirements of all necessary electrical equipment. In addition, more efficient lighting fixtures have been installed to provide the same required illumination for classrooms and offices, while consuming less energy.

The back-up batteries are required to provide uninterrupted power supply in the case of a grid failure. Therefore, the solar PV system will work as the school's own generator and will supply the essential load. When solar radiation is low, power will be withdrawn from the public grid to charge the batteries. When the school is not occupied, during 3 months of the year, it will be possible for the solar PV system to feed renewable power into the public power grid.

E. Research and development (R&D)

The energy sector depends heavily on R&D for advancements in materials, technology, and implementation. The green energy industry in general, and renewable energy and energy efficiency industries in particular, need a skilled workforce of technicians, designers, engineers, and managers to follow up and examine evolving issues and research requirements. Although some countries in the Arab region have begun renewable energy projects, there is a need for substantial collaborative efforts in research and development. Countries and research units that move quickly could build a sizable and sustainable competitive advantage. Arab countries generally lack sufficient research institutions, and R&D spending by the public and private sectors is low compared with other nations.

Collaborative R&D projects on greening the energy sector should be undertaken by regional and international research and academic centers. These projects should target power and transport sectors management as well as building systems' integration including practices by architects and engineers that can lead to zero-energy buildings. The American University of Beirut (AUB), Lebanon, has joined the Zero Net Energy Innovative Housing (ZENITH) project. The ZENITH (or ZeroBuild) project is focused on developing sustainable building energy technologies and systems. The ZeroBuild project will reinforce the cooperation capacities of the American University of Beirut (AUB) and the Lebanese Center for Energy Conservation (LCEC) and will enable them to develop and implement green energy practices.

IV. SOCIOECONOMIC AND ENVIRONMENTAL IMPLICATIONS OF CURRENT ENERGY POLICIES

A. Economic Implications

Any increase in economic activity is expected to lead to an increase in energy consumption, the magnitude of which depends on the income elasticity of demand. Though, in the last several decades, a number of developed countries have been able to decouple energy consumption and economic activity. Even China has been moving recently in this direction. Higher energy efficiency

can reduce energy consumed to produce the same level of energy services (energy intensity). Since 1990, global energy intensity has decreased at a rate of 1.3% per year due to both structural effects as well as physical energy efficiency improvements (El-Ashry, 2010).

Thus, any energy policy must be designed to take into account the implications of such a relationship. Long-term expansion strategies for the different energy sources are necessary so that the growth in energy demand due to the growth in its different determinants, most notably economic activity and population, can be satisfied in a timely manner. In line with strategies in other countries, these plans can and should incorporate smooth transition paths from a fossil fuel based economy to one focused on renewable clean energy sources. Such a move carries major benefits that will be discussed in the sections below.

Past studies have shown renewable energy to be more labor intensive than conventional forms of electricity production (LBNL, 2007). Estimated figures depend on the mix of renewable technologies considered and other assumptions. In line with experiences in the rest of the world, it is expected that a shift to clean energy in Arab countries would lead to a net growth in jobs related to green energy products and services. The Pew Charitable Trusts (2009) finds that from 1998 to 2007, clean economy employment in California grew faster than employment in the economy as a whole, accounting for approximately 125,000 jobs. By 2010, this number has grown to 300,000 Californians engaged in jobs related to green products or green services, or 3.8% of the state's workforce (California Employment Development Department, 2010).

Analyses by the United Nations Environment Program (UNEP) confirm these trends. According to UNEP (2011), "national studies show that green investments tend to be more employment intensive even in the short to medium term." The same report indicates that employment in the renewable energy sector has become quite substantial with more than 2.3 million people worldwide estimated to be working either directly or indirectly in the sector in 2006.

Although a few of the current energy policies in Arab countries encourage the use of renewable energy technologies, they do not provide the

WIND ENERGY IN SYRIA- A PERSONAL EXPERIENCE

Maan Kaadan

In 1990, I produced my first small 2.4 kW wind turbine. With additional development over a 2-year period, I was able to produce a 10 kW wind turbine in 1992, which has been used to power submersible pumps. I sold two of them to private farmers.

In 1994, I began producing 50 kW wind turbines, which were capable of driving up to 40 hp pumps. Sales were not significant, though. I sold eight 50 kW and a few 10 kW wind turbines. The availability of highly subsidized diesel fuel at the time made my wind turbines uncompetitive. Potential private sector buyers found the turbines expensive, while the public sector did not have an interest in the technology. Some public sector organizations did purchase a few wind turbines informally, not as part of an official policy to adopt a new technology.

I stopped my development work on wind turbines in 2000 because there was no convincing business model.

In 2008, the Syrian government reduced the subsidies on diesel, pushing the diesel fuel price up from 7 Syrian Pounds (SL) to 25 SL per liter. I began receiving many inquiries from farmers who wanted to switch from diesel to wind energy, and new orders for wind turbines were placed.

I re-launched my wind-turbine-making business. I was able to install two 30 kW wind turbines at a cost of US\$30,000. Only well-to-do farmers could afford to purchase these turbines. Despite advocating renewable energy adoption, the Syrian government did not offer any incentives to potential buyers such as low-interest loans. An opportunity to support Syrian-made wind turbines and stimulate economic opportunities locally and regionally was lost.

Therefore, I quit my business once again for the last time. The total installed capacity of wind energy operating in Syria is equal to the sum of my installations, which stands at 650 kW.

To bring about change in energy policy, public policy makers need to understand the benefits and costs of new sources of energy and develop the institutional capacity to evaluate their feasibilities. When I was advocating wind



energy in the early 2000s, a high-ranking government official made the claim that wind turbines need wind speeds up to 11-12 m/s to produce the nominal power. Since the average wind speeds in most Syrian sites are between 6 and 8 m/s, it was thought that the potential for wind energy generation is not promising. The failure to understand the difference between average and nominal wind speeds is emblematic of the institutional barriers to informed public policy. It was explained that what matters is not so much average wind speeds, but the actual upper and lower end of the speed of wind at a particular location.

Installation of wind power or PV (photovoltaic cells) in Syria will contribute twice as much to the reduction of greenhouse gas emissions than it would if installed in the UK or Germany (<http://www.goumbook.com/tag/syria/>). This public official offered his support for wind energy in the country. However, the institutional knowledge disappeared with his departure due to retirement. The education process for public government officials had to start from scratch.

Maan Kaadan is A Syrian mechanical engineer.

regulatory and institutional framework or incentive measures for the creation of a competitive energy efficiency and renewable energy industry. Energy efficiency and use of clean and renewable sources of energy in the production process increases the competitiveness of the region. Moreover, the development of such a clean energy industry would lead to energy and economic diversification, as opposed to heavy reliance on oil.

In recent years, Arab countries have seen a substantial increase in investments in clean energy; in 2007 investments totaled US\$475 million, while in 2009 they have jumped to US\$2.5 billion (El-Ashry, 2010). But, even this figure represents less than 2% of global investments in renewable energy (DOE, 2010).

Egypt is a leading example in the region in the commercial use of wind power. It continues to develop a wind energy-manufacturing sector in cooperation with international organizations such as the United Nations Industrial Development Organization (UNIDO) and bilateral donor countries such as Germany. As early as 1992, when the second wind plant was installed in Hurghada, 45% of the wind turbine components were locally manufactured.

A number of Arab countries have been adopting an energy pricing policy that aims at securing energy access to all segments of the population at affordable prices, as well as promoting industrialization as a means to economic diversification. Apart from being heavily subsidized, domestic prices of oil and petroleum products, electricity, and natural gas have been

stagnant for a long time, a practice that has resulted in substantial wasteful consumption.

The GTZ's International Fuel Prices survey in 2009 ranked Bahrain third with Iran on top, followed by Saudi Arabia among countries subsidizing gasoline and diesel prices. Iran has since removed its fuel subsidies. The pump prices of both gasoline and diesel in Bahrain were lower than the price of three international benchmarks, namely, lowest EU prices (in Spain), the US market, and the price of crude oil in the world market (Abdel Gelil, 2011).

Subsidies tend to promote inappropriate consumer behavior, send wrong signals to consumers and suppliers, impair economic viability of energy efficiency and renewable energy technologies, aggravate environmental pollution and GHG emissions, and pose a rapidly increasing burden on government finances, particularly in the electricity sector.

It is well established that energy demand is price sensitive, especially demand for electricity. So, price reform will save large quantities of energy, especially in the long run, and consequently can make a substantial reduction in GHG emissions from countries with distorted prices. On the other hand, improving energy efficiency offers a viable solution for consumers to compensate for price increase.

The World Bank review of "win-win" policy reforms makes three important points about energy subsidies:

- They are burdensome; they represent from 2 to 7 times higher government expenditure than expenditures on health in some countries such as Egypt, India, Indonesia, and Pakistan.
- They are poorly targeted; the poor's share of the subsidy is usually less than their share of the population.
- They increase emissions of CO₂; for example, countries that subsidize diesel fuel emit twice as much CO₂ per capita as other countries with similar per capita income.

Lebanon presents a typical case that is worth examining. The country's annual transfers to Electricite du Liban in 2006 were just under a billion US\$, which corresponds to 4% of GDP

TABLE 3

FUEL CONSUMPTION SUBSIDY AS A PROPORTION OF THE FULL COST OF SUPPLY (2009)

Country	Subsidy Rate
Algeria	41.4
Egypt	56.3
Iraq	47.4
Kuwait	53.3
Libya	52.0
Qatar	63.2
Saudi Arabia	78.9
UAE	55.7

Source: IEA, 2010b

LAFARGE MAROC: FIRST CEMENT COMPANY TO BUILD A WIND FARM

The first wind farm at the cement manufacturer Lafarge Maroc was commissioned in June 2005, to supply its cement plant in Tetouan, Morocco with electrical power. This wind farm supplied a little less than 40% of the plant's power requirements. It was also the first innovation worldwide for a cement factory.

Eligible for the Clean Development Mechanism (CDM) established by the Kyoto agreement, the project was certified in September 2005. By replacing the electricity produced via thermal power plants, the wind farm reduced emissions of greenhouse gases (GHG) by about 30,000 tons of CO₂ per year.

The effectiveness of this first wind farm, combined with the rising cost of electricity, encouraged the company to seize the opportunity offered by the new regulatory framework in Morocco authorizing self-generation of electric power up to 50 MW from 10 MW.

Therefore, Lafarge Maroc decided to triple the existing wind farm in two phases. The first phase became operational in December 2008, while the second phase started operation in 2009, when the second line of the cement plant in Tetouan was about to be launched. The company now owns a 32 MW wind farm, and is currently preparing the CDM certification for the



wind farm expansion which will reduce greenhouse gas emissions (GHG) by about 58,000 tons per year. Lafarge wind farm supplies about 65% of the energy needed by the plant, or about 20% of the overall power consumption of its existing 4 cement plants.

The overall cost of this wind farm was about 500 million Moroccan Dirham (MAD) or US\$63.7 million. The investment is not highly profitable, but it contributes to securing continuous electricity supply for the plant and to fulfilling the company's concern for sustainable development.

or more than 20% of government revenues (Ministry of Finance, 2010; World Bank, 2008). If subsidies were to be removed, dependence on imports would be reduced leading to an improvement in the country's fiscal position. The revenue savings could be reallocated to tackle other urgent needs in other sectors, such as health and education.

According to the Egyptian General Petroleum Corporation (EGPC), direct fuel subsidies in Egypt totaled nearly US\$8 billion in 2005/2006. Recent escalation of international oil prices has magnified this impact, particularly when imports of gasoline and diesel were needed. As a point of comparison, in 2003/2004, the cost of liquid fuel subsidies was roughly equal to the annual revenues from the Suez Canal. Pump prices of diesel are almost 10 times lower than in Cyprus, and more than 5 times lower than the corresponding prices in Lebanon, Morocco, and Tunisia (American Chamber of Commerce, 2004).

Similarly, in Syria the total annual energy subsidy for light fuel oil, diesel, gasoline, natural gas, liquefied petroleum gas (LPG), and electricity costs US\$6 billion. Subsidies have been as high as 340% of real prices. The government seeks to phase out subsidies gradually in order to achieve international price levels within the next decade (Abdel Gelil, 2007). Table 3 displays energy subsidies as a proportion of the full cost of supply in selected Arab countries.

For net oil-exporting countries, fossil-fuel subsidies represent the opportunity cost of selling the subsidized amount of fuel at market prices, whereas in net oil-importing countries these subsidies represent direct government expenditure. Alternatively, part of the subsidies could be removed and the other part redesigned to achieve the stated goal of the subsidy mechanism. For example the International Energy Agency (IEA) suggests providing subsidies for rural electrification that make energy services available and affordable to the poor. Since 2003 Jordan has



removed all direct fossil-fuel subsidies (except LPG for households) and introduced cross-subsidies in favor of rural areas, water pumping, street lighting, and low-income households. Jordan no longer has access to Iraqi oil, once received at concessionary prices, forcing the introduction of price reforms. Other Arab countries have also announced plans to reduce their subsidies; Egypt plans to eliminate energy subsidies to all industries by the end of 2011, while the United Arab Emirates have started reducing gasoline subsidies in April 2010 and plans to bring them in line with international market levels (IEA, 2010b).

Most of the Arab economies, if not all, are vulnerable to volatility of the global oil market. Oil producing countries depend mainly on oil exports revenues to finance their development plans with severe adverse economic impacts when international oil prices fall. On the other hand, oil-importing countries such as Jordan and Morocco would be greatly affected due to any increase in oil prices. Energy efficiency, diversification of energy sources, and encouraging investment and wide

dissemination of renewable energy technologies are key to reducing the vulnerability of Arab economies to the volatility of oil prices, and enhance energy security in addition to delivering environmental benefits.

Greening of the energy sector requires substituting investments in carbon-intensive energy sources with investments in clean energy as well as energy efficiency improvements. Many opportunities for improving energy efficiency pay for themselves and reduce running costs, while investments in renewable energy technologies are already growing in today's market as they are becoming increasingly competitive. Other measures may cost more and can result in countries becoming economically competitive with the adoption of a modest price on carbon emissions. Moreover, green energy options would be more competitive when the societal or external costs of fossil fuel technologies are taken into account. The current global carbon market with any potential future development post-2012 on carbon emissions and pricing may offer a strong incentive for shifting to green energy.

B. Social Implications

Despite the Arab region's rich energy resources, "in 2002, about 65 million people in the Arab countries (21.4%), mostly in rural areas, [had] no access to electricity; a further 60 million are severely undersupplied, both in rural and poor urban areas" (ESCWA, 2005). Energy poverty is associated with poor attainment in education and health and retards the integration of poor communities in rural areas in productive economic activities. To provide these communities with access to modern energy services, distributed renewable generation systems can be more cost-effective than conventional centralized energy supply systems. Although renewable technologies typically have higher capital costs, these costs can be more than offset by the savings in transmission and distribution costs and in savings in power losses associated with them, as well as by operating costs.

Traditional biomass fuels, used for cooking and heating, are associated with high levels of indoor pollution and poor health (IEA, 2009). Expanding rural electrification through the use of traditional or decentralized renewable energy sources helps poor rural families turn away from biomass use. This would address the energy poverty afflicting many in Arab countries and contribute to social development goals. When deployed in rural areas, renewable energy technologies promise to make a significant contribution to promoting development, improving living standards and health in rural and remote areas. Green energy sources would free up the time used to collect biomass to other more productive activities such as education for children. A one-time subsidy for connection to natural gas or electricity in Morocco was used as an incentive for consumers to switch from biomass to cleaner sources of energy (World Bank, 2010). In some cases, such energy subsidies were successful in poverty alleviation; petroleum subsidies in 2005-2006 have reduced the incidence of poverty by 8% in Yemen and by 5% in Morocco (IEA et al., 2010c).

Cost effective solutions include decentralized solar photovoltaics, with low operating costs and flexible, small-scale projects. A leading example of such a shift is the rural electrification program in Morocco. It sought to provide PV solar electricity to a total of 34,400 villages inhabited by approximately 12 million people living in

rural areas during the period (1995-2007). Because of the increased costs in connecting rural households to the electricity grid, grid extension is not feasible, and individual photovoltaic solar home system (SHS) was the best choice. Further, the "PROMASOL" project to scale up the use of solar water heaters in the commercial facilities in Morocco aimed to save about 800,000 barrel of imported oil over 4 years. This is equivalent to nearly US\$700 million and a reduction of about 1.3 million of CO₂ equivalent. PROMASOL has had definite impacts that have gone far beyond the mere objective of contributing to the reduction of the country's dependency on fossil fuels. On the environmental front, PROMASOL is also expected to reduce about 920,000 tons of CO₂ per year until 2020.

With regard to its economic impacts, PROMASOL has increased the installed capacity of SWHs from about 35,000 m² of solar panels in 1998 to more than 240,000 m² in 2008, and the number of companies importing and/or manufacturing SWHs from about five to more than 40. In terms of its social results, the program is projected to create about 13,000 new jobs by 2020 (Allali, 2011).

C. Environmental Implications

The current fossil fuel-based energy system in the Arab region, as well as in other regions of the world, causes severe environmental damages along every stage of the energy value chain including exploration, extraction, transportation, processing, and conversion. Fossil fuel infrastructures are responsible for most air pollution exposure, hydrocarbon and trace-metal pollution in groundwater and soil, oil spills in oceans and rivers, and most greenhouse gas emissions. The costs to Arab societies are not only limited to the direct consequences on environmental degradation and negative health care outcomes, but they also entail costs affecting the entire productive capacity of Arab economies. Climate change will particularly threaten the economic and social gains achieved in Arab countries. It has been demonstrated that "climate strongly influences (so climate change directly affects) the availability of water; the productivity of farms, forests, and fisheries; the prevalence of oppressive heat and humidity; the geography of disease; the damages to be expected

from storms, floods, droughts, and wildfires; the property losses to be expected from sea-level rise; the investments of capital, technology, and energy devoted to ameliorating aspects of climate we don't like; and the distribution and abundance of species of all kinds" (Holdren, 2008; AFED, 2009). The costs to Arab countries from climate change impacts in most of these dimensions under a business-as-usual scenario will be substantial. Arab countries may have already begun experiencing some of the effects of climate change.

A transition to a green energy sector offers many benefits, though, depending on the technologies used, in some cases environmental issues might arise. These benefits can result from the shift in patterns of electricity generation. First, carbon dioxide emissions can be greatly reduced and in some cases totally avoided. Typically, displaced emissions are considered to range between 0.22 ton CO₂/MWh and 0.73 ton CO₂/MWh, depending on the technology used (LBNL, 2007). Second, nitrogen oxides, sulfur dioxide, and particulate matter, all of which are harmful to human health and cause environmental problems, reduced visibility, and ground-level ozone, can potentially be reduced (IEA et al., 2010). Acid rain caused by sulfur dioxide can make lakes and rivers too acidic for animal and plant life, and also damage crops and buildings. Nitrogen oxides combine with other chemicals to form ground-level ozone or smog, which can irritate the lungs causing bronchitis and pneumonia. Third, water consumption that is usually used in traditional power plants for cooling purposes can be conserved. Note, however, that some designs for concentrating solar power plants (CSP) use significant amounts of water (NREL, 2010). Fourth, damage to land and water in the form of oil spills that kills plants and animals, or damage resulting from mining, drilling, refining, and transporting fossil fuels can be avoided. Some renewable energy technologies do affect land and water but to a much lesser degree; wind turbines can affect bird and bat species, and hydro projects have in some cases affected wildlife and ecosystems.

The economic costs of environmental degradation as a fraction of GDP in selected Arab countries were estimated by a World Bank study to range between 2.1% in Tunisia up to 4.8% in Egypt (Larsen, 2010). This was associated with health

care costs of inadequate potable water, sanitation, and hygiene, health effects of outdoor air pollution in urban areas, and degradation of renewable natural resources (land and freshwater). Coastal degradation (affecting mainly recreation and tourism), health effects of household air pollution from use of solid fuels for cooking, and waste management were associated with substantially lower costs (Larsen, 2010).

V. CONCLUSIONS AND RECOMMENDATIONS

The energy sector in the Arab region has been and will continue to play a critical role in the region's socioeconomic development. Both Arab oil exporters and importers are highly vulnerable to the volatility of the global oil market. Greening the energy sector in the Arab countries would entail a myriad of economic, social, and environmental benefits.

Given the large disparities in the Arab region, the transition to green energy will vary considerably across different countries. Countries of high levels of GDP growth such as the GCC group with high carbon intensity and large per capita ecological footprint need to reduce their energy intensity without impairing their level of human development. Countries that still maintain relatively low per capita ecological footprints, should strive to achieve better human development without drastically increasing their ecological footprints.

The transition towards a green energy system aims, among others, at reducing energy poverty. This means providing energy to about 60 million people who currently lack electricity in the Arab region. Renewable energy technologies and supportive energy policies promise to make a significant contribution to improving living standards and public health in rural and remote areas.

Another direct benefit of shifting to green energy is to create "green jobs." Global experiences indicate that shifting to renewable energy technologies tends to generate more jobs than conventional energy technologies.

Adopting energy efficiency improvements

and renewable energy sources reduces the vulnerability of Arab economies to oil price volatilities, enhances energy security, and contributes to economic diversification. Improving energy efficiency would reduce energy demand and improve the trade balance, thus improving economic competitiveness. Green energy solutions reduce carbon emissions as well as exposure to air pollution.

A number of policy, market, and economic barriers need to be overcome in order to promote green energy in the Arab countries. This analysis recommends Arab countries to:

1. Remove the current barriers to transitioning to a green energy system including the lack of investment in R&D, education and capacity building, and integrated policymaking.
2. Reform the current legislative and institutional framework to facilitate transitioning to a green economy.
3. Provide an incentive system that encourages investment in energy efficiency and renewable energy technologies.
4. Adopt energy efficiency, demand-side management, and renewable energy as the cornerstones of a new energy policy, based on coordinated efforts involving government, the private sector, the financial sector, and the other concerned stakeholders.
5. Continuously adjust energy prices to reflect the real economic cost, scarcity, long-range marginal cost, and environmental damage. Energy pricing reform is an effective tool for the rationalization of energy consumption and shifting to low carbon development, while at the same time resulting in substantial increases in government revenues. These revenues should be reallocated to spur expansion in energy efficiency and renewable energy technologies.
6. Initiate a policy debate to formulate a new institutional mechanism to secure coherence of energy and climate policies in the Arab region.

Arab countries should embark on a massive long-term, regional program to scale up the use of wind and solar energy. Such a program would help diversify Arab economies and ensure the security of energy supplies, while guaranteeing Arab countries a sustainable and leading market position as green energy exporters.

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NOTE

Maha Abdel Wahab, Arabian Gulf University (AGU), contributed to this chapter by updating statistical energy and emission data.

Industry

TAREK EL SAYED
WALID FAYAD



I. INTRODUCTION

Increasing awareness about mankind's contributions to climate change is creating new pressure for carbon-intensive sectors to reduce their greenhouse gas (GHG) emissions. The potential for irreversible consequences has prompted national governments around the world to devise ambitious plans to address global warming and its possible damage to ecosystems and the global environment.

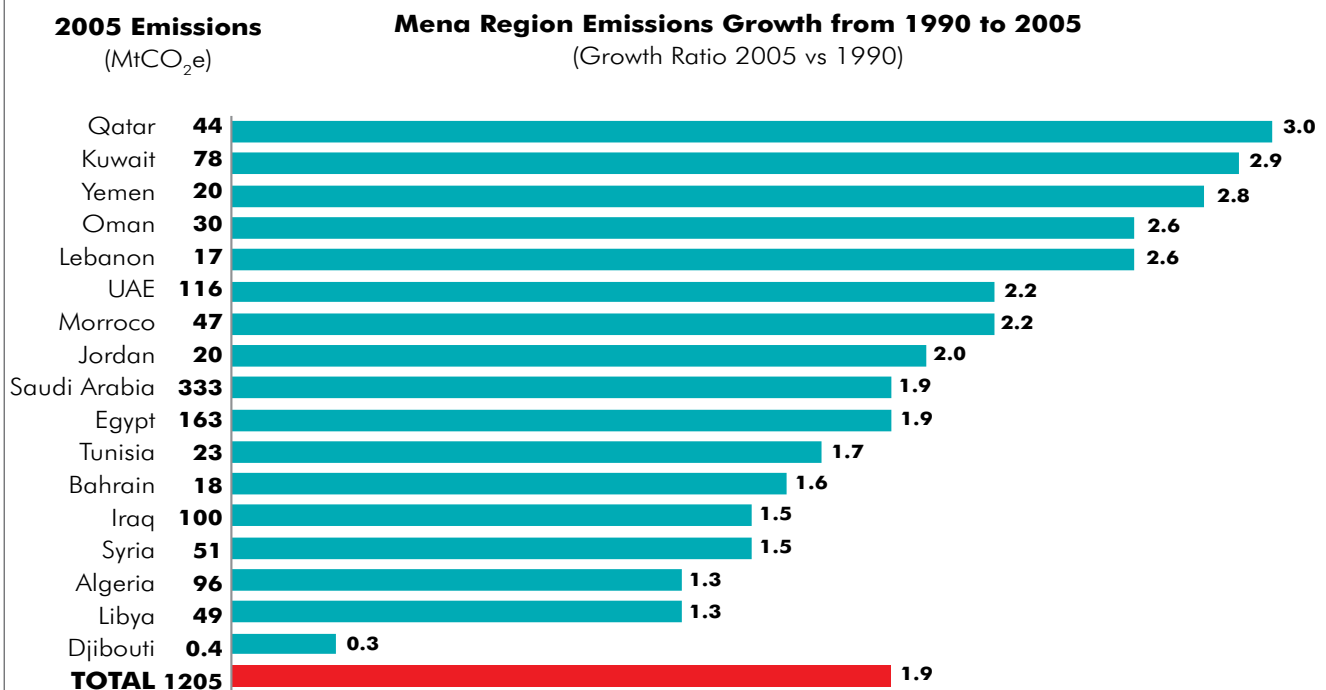
Although Arab countries have increased their emissions substantially over the past two decades, as illustrated in Figure 1, they are still relatively moderate emitters of GHG emissions, making up a minor fraction of global emissions. Furthermore, Arab countries are currently not legally bound by an accord that obliges them to reduce their emissions.

However, Arab countries should develop low carbon industrial development strategies motivated by the opportunity to:

1. **Prepare local industries for a low-carbon world.** The shift to low-carbon products could significantly impact the competitiveness of Arab industries. The European Union and the USA for example, have proposed measures to penalize free-riding behavior of countries with no GHG emissions targets, which could potentially impact trade and exports of developing countries that do not act to reduce their emissions.
2. **Take advantage of opportunities to generate jobs and diversify gross domestic product (GDP).** The upcoming energy shift will create opportunities to enter new industries such as the manufacturing of solar and wind equipment and exporting renewable energy to Europe. Arab countries can take advantage of these new opportunities to generate employment and diversify their GDP, helping them in their transition to become knowledge-based economies.
3. **Save fuel and reduce cost. Saving fuel**

FIGURE 1

ARAB COUNTRIES CO₂ EMISSIONS' GROWTH FROM 1990 TO 2005



* MtCO₂e: Metric ton carbon dioxide equivalent
Source: Pennell et al., 2009

is a major driver for GHG emissions reduction. Helping domestic industries become more energy-efficient will lower domestic energy consumption, freeing hydrocarbons in oil-producing countries for export rather than electricity generation. Reducing consumption can also lower peak power demand, directly impacting investment requirements in new power plants.

4. **Address climate change effects and reduce pollution.** Due to global warming, Arab countries may be prone to significant impacts from global climate disruption including decreased rainfall, intensified desertification, increased extreme weather events such as droughts and floods, rising sea level, ocean acidification, biodiversity loss, and even human deaths caused by heat waves. GHG management initiatives will contribute to mitigation and adaptation measures. Mitigating carbon emissions will also indirectly reduce the emissions of air pollutant substances such as particulate matter (PM), nitrogen oxides (NO_x), and sulfur oxides (SO_x), which threaten public health.

5. **Access financial and technical support.** While a final agreement has not yet been reached, developed nations recognize the need to provide financial and technical assistance to developing countries in order to accelerate their shift to a low-carbon world. Arab countries could benefit from financial support such as the Clean Development Mechanism (CDM) under the Kyoto Protocol (or its successors under future agreements), and nationally appropriate mitigation actions as well as transfer of low-carbon technologies. Developing a low-carbon industry in the region will require the collaboration of relevant public and private stakeholders, in order to ensure that their perspectives, priorities, and concerns are taken into account.

This chapter examines low-carbon economy from two different angles. It takes a national economy-wide, sector-level approach before examining the question from the perspective of a private sector industrial entity.



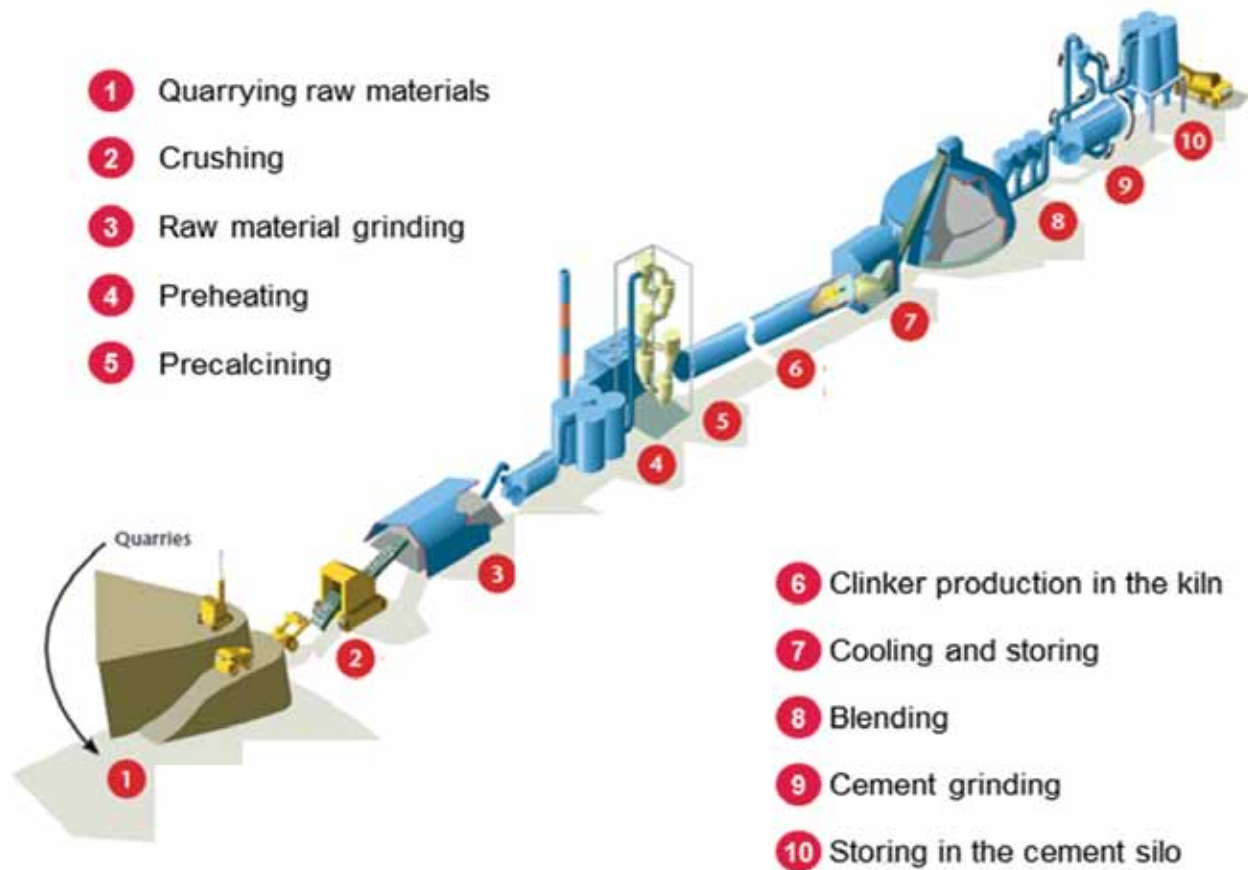
II. A NATIONWIDE LOW-CARBON INDUSTRIAL DEVELOPMENT STRATEGY

Developing a national low-carbon strategy requires a large number of initiatives that can be grouped under three categories: (a) targeting highly energy intensive industries, (b) undertaking cross-cutting energy efficiency initiatives, and (c) manufacturing products for a low-carbon world.

A. Targeting emission reduction initiatives in energy-intensive industries (cement example)

Initiatives that tackle energy-intensive sectors are more likely to have a significant impact on greenhouse gas emissions reduction. For example, examination of a cement production process, illustrated in Figure 2, indicates that significant emissions reduction can be made by increasing energy-efficiency, substituting fossil

FIGURE 2 CEMENT MANUFACTURING PROCESS



Source: WBCSD/IEA, 2009

fuels with alternative fuels, and using lower-carbon materials.

As illustrated in Figure 3, over 93% of CO₂ emission in cement production is due to reaction and fuel combustion processes. Hence, one of the most important measures to reduce emissions is increasing thermal and electrical efficiency by deploying the most efficient production technologies in new cement plants and retrofitting energy efficiency equipment where it is economically viable. This can reduce energy requirement per ton of cement by 20% to 40%, which also leads to a cost advantage to the producer through lower energy costs.

The second method is the use of less carbon-intensive fossil fuels and more alternative fuels in the cement production process. Replacing fossil fuels for kiln heating by alternative fuels can

dramatically lower carbon emissions resulting from the process.

Other opportunities can involve substituting carbon intensive clinker with other lower carbon materials that have cementitious properties, and developing alternative materials with properties similar or superior to Portland cement but requiring lower energy requirements.

B. Undertaking cross-cutting energy efficiency initiatives

Initiatives to improve the efficiency of manufacturing processes are applicable in a wide range of industries and can impact, directly and indirectly, competitiveness and employment in thousands of small and medium enterprises. Common examples include the use of efficient motors, efficient heating and cooling systems, and renewable energies.

Motors in machines and pumps, for example, consume a large share of the electricity used in manufacturing industries. Thus, replacing fixed speed motors by high-efficiency variable speed drives saves energy, while producing better performance.

Heating and cooling are required for processes in many industries such as metal fabrication or food processing. Hence, properly insulating processes and cascading heat and cold from one process to the next can save significant amounts of primary energy.

Furthermore, the relatively low-grade heat used by many industries can be generated from waste heat sources or from renewable sources such as solar or geothermal energy.

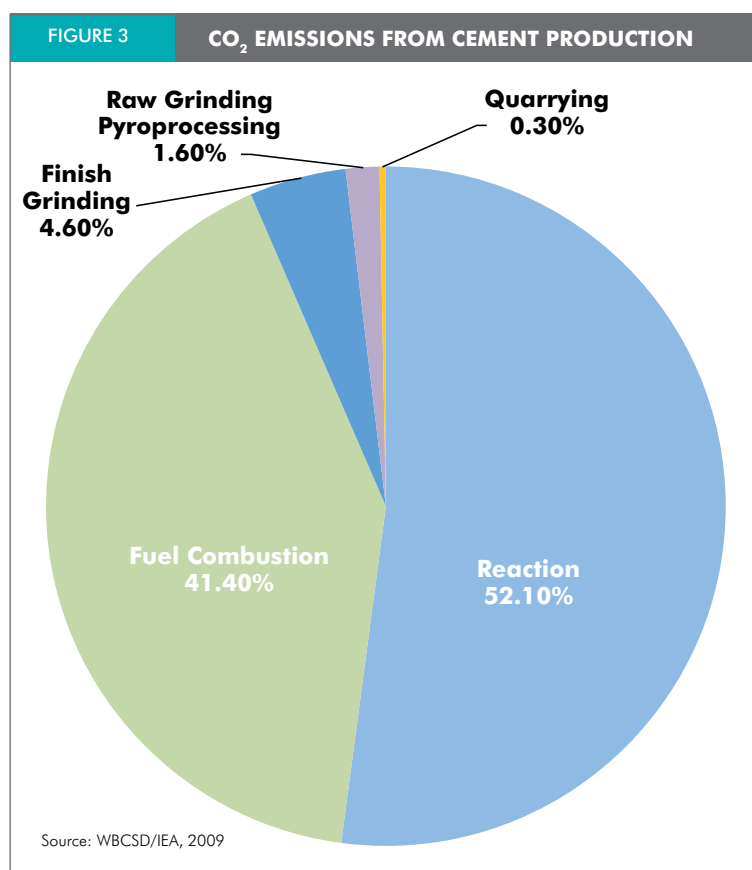
It is important that Arab governments support such initiatives with adequate financial incentives, particularly given electricity's low prices that prevail in many countries. The incentives will be more than offset by the reduction in peak load requirements as well as by freeing hydrocarbons resources for export or other value-adding opportunities (e.g., petrochemicals).

The financial incentives required to support energy efficiency initiatives in the industrial sector can range from grants to support the deployment of efficient equipment to rebates on the electricity bills, among other measures.

C. Manufacturing products for a low-carbon world

Initiatives to manufacture products for a low-carbon world can be divided into those aiming to upgrade existing industries and others that create and grow new industries to produce low-carbon content products, renewable energies, or energy efficiency equipment.

In terms of upgrading existing industries, a number of measures can be used to stimulate the local market for energy-efficient products, providing the right incentives for private sector players. Governments can impose minimum energy and water efficiency standards that products must meet if they are to be sold in the country. For example, efficiency standards



on air-conditioning devices would have a significant impact on energy consumption as well as on power peak load requirements. Alternatively, utilities can offer rebates to consumers buying new appliances that fulfill certain minimum efficiency standards, or even replace old, inefficient appliances for a nominal fee. If the efficiency improvement potential is large enough, financial support for early retirement of appliances and devices can be beneficial from the perspective of both the consumer and the utility. This is particularly the case in countries where electricity prices are supported by the government.

Rising electricity tariffs for end-consumers, or structuring them in such a way as to make overconsumption more expensive, can make the business case for buying new, more efficient appliances much more attractive. Labeling or rating systems make the energy consumption of appliances and devices more transparent to the consumer and will encourage a shift to more efficient appliances by making energy efficiency a part of buyers' decisions.

DUBAL DX TECHNOLOGY



Ali Mohamed Al Zarouni

Driven by a quest for continuous improvement and ongoing innovation, Dubai Aluminium Company Limited (DUBAL) has developed advanced reduction cell technologies that improve production efficiency, reduce energy consumption, and enhance environmental performance for more than 25 years. This commitment to developing its own smelting technologies in-house that can compete with similar technologies on the world market in terms of productivity, capacity, and efficiency, while maintaining the highest standards of environmental performance culminated most recently in introducing the proprietary DX Technology.

Developed in 2006, then further refined through extensive research and development, the DX Technology was deployed in a dedicated 40-cell demonstration pot-line at DUBAL's Jebel Ali smelter complex and commissioned in 2008. Over the first two years of operation, the amperage of these cells was successfully stepped up from 340 kA to 380 kA, with stable results, thereby demonstrating the capability of this technology to operate at high amperage levels.

Consolidated at 380 kA, world-class performance standards are consistently achieved by the DX Technology demonstration pot-line in terms of current efficiency (95.45%), net specific energy consumption (13.2 kWh/kg Al), reduced net carbon consumption (< 0.415 kg C/kg Al)

and pot emissions. With perfluorocarbons (PFC) emissions of 0.010 CO₂eq ton/ton Al produced, DX Technology has achieved a new benchmark. The DX Technology now ranks among the most efficient aluminium reduction-cell technologies available. And with continual improvements being implemented, the DX Technology is rapidly becoming established as a sector-leading innovation.

DX Technology has also been licensed to, and installed in, the first phase of the green-field Emirates Aluminium Company Limited (EMAL) smelter complex at Al Taweelah, Abu Dhabi, which was commissioned in 2010. Currently operating at 353 kA, the 756 cells at EMAL Phase I consistently surpass projected performance levels by delivering current efficiency greater than 96.6% and achieving net specific energy consumption of less than 13.0 kWh/kg Al.

Reflecting DUBAL's commitment to continuous improvement, ongoing research and development has led to the redesign of DUBAL's DX Technology cells to enable operation at even higher amperages. Five new generation cells, built in the pilot line at DUBAL's Jebel Ali site, have been operating at 420 kA since August 2010. The improved technology — known as DX+ Reduction Technology — is underpinned by the proven, inherently robust DX reduction technology.

Ali Mohamed Al Zarouni is Vice President, Smelter Operations, DUBAL.

Educational campaigns focusing on the environmental costs and benefits of more efficient devices can also be used to raise consumer awareness and influence consumption and production patterns. Education and awareness campaigns can be powerful, if they bring trusted stakeholders in transmitting a clear message. For example, the ‘Heroes of the UAE’ (2009) is jointly developed by The Emirates Wildlife Society in association with the Worldwide Fund for Nature (EWS-WWF) and The Environment Agency-Abu Dhabi, and is endorsed by the Ministry of Energy, the Ministry of Environment and Water, Masdar, and the Abu Dhabi Water and Electricity Authority. Over 45,000 energy-saving bulbs have been handed out to residents across the UAE in three months as part of a nationwide campaign to illustrate simple and effective ways to reduce energy consumption, air pollution, and government expenditures at home.

To create and grow new industries, a coordinated effort from the government is required to support the private sector. This involves:

1. Putting in place the appropriate institutional setting. In many countries in the region, there is no clear ownership at the government level of issues related to renewable energy. Governments must appoint and empower an entity to lead the development of policies and regulations and follow up on their implementation.

Strong financial support—in the form of



guaranteed markets for renewables or similar instruments—is not sufficient to get renewable projects off the ground. Numerous administrative barriers unintentionally block renewable energy projects: wind turbines often surpass existing height limits for buildings, projects can face excessive permit requirements, limited cooperation from local utility companies in providing

ALBA RECYCLES WATER FOR LANDSCAPE IRRIGATION

At the Aluminium Bahrain (Alba) plant complex, trees, flowers, and shrubs are scattered over a 240,000 m² area. An artificial oasis with an estimated area of 90,000 m² was created in 2009, containing many types of plants and trees. The Oasis is surrounded by palm trees, fruit trees, shrubs, and other shade trees. There are more than 100 native palm trees, more than 600 Washingtonian trees, and approximately 1,000 other lush flowers and shrubs.

The oasis is irrigated using water that is recycled from various parts of the Alba plant. First, recycled water is pumped into a lake located at the entrance of the oasis. A portion of the lake water is recycled from the wastewater treatment plan, and another portion is drained from the

cooling water towers. The water is filtered naturally in a bed of gravel and with the aid of plants. Lake water is used for irrigation at a rate of 500 m³ per day.

The lake supports aquatic species such as turtles, golden fish, and other fish species. During the winter season, migratory birds such as flamingos, sea gulls, and water chickens, have been spotted by the lake.

Expansion plans call for utilizing blow-down water from the power and utility sections at a rate of 300 m³ per day, to be used for irrigating more green spaces. The use of recycled water for irrigation reduces the demand for freshwater production as well as the associated costs of energy use and environmental degradation.



grid connections, and overlapping jurisdictions of multiple administrative bodies. An entity that oversees and coordinates the regulation of the renewable energy sector can help clear the administrative thicket.

2. Developing a favorable policy and regulatory framework. In most Arab countries, the regulatory environment is such that national utility companies define power generation requirements, which they are mandated to meet at the lowest possible cost. Accordingly, their delivery models usually involve private developers under

independent water and power producer (IWPP) schemes. This procurement model is geared toward large-scale, conventional power stations, which meet specific generation requirements such as dispatchability. Furthermore, IWPPs involve complex contracts justified by the scale of the investments and the nature of the financing involved.

Renewable energy projects, particularly small-scale ones, cannot be readily integrated into this model. It is not only that renewable energy projects can not meet dispatch requirements, but for them to be viable and bankable, they must be able to rely on revenue streams that are independent of demand, and commensurate with the investments required. Accordingly, Arab countries must make substantial changes in the regulatory framework to create incentives that would kick-start renewable energy investments.

Policymakers may want to consider investment grants, research and development (R&D) grants, tax incentives, renewable portfolio standards (RPS), feed-in tariffs (in which utilities are obligated to purchase renewable energy at a specified price), and tendering schemes that result in competitive bidding for renewable developments. In Denmark, for instance, a combination of feed-in tariffs and investment grants has been instrumental in driving the development of a renewable generation.

WASTE HEAT RECOVERY AND POTABLE WATER PRODUCTION FROM THE CALCINATION OF GREEN PETROLEUM COKE

The coke calciner plant at the Aluminium Bahrain (ALBA) complex was commissioned in 2001 with a total installed capacity of 450,000 metric tons per year (MTPY) of calcined petroleum coke (CPC). The plant contains two calcining units of identical capacity. Waste heat from the calcining units is recovered and used as a source of energy for operating two boiler units. The steam produced by the boilers is used by 4 independent multiple-effect distillation lines designed to produce 41,000 cubic meters of potable water per day.

The calcination of green petroleum coke (GPC) takes place in rotary kilns via an exothermic reaction, releasing a significant amount of heat upon the

combustion of volatile combustible matter (VCM) and carbon.

Flue gases from the rotary kilns, at a pressure of 25 bar and 1200 °C, are directed to the boilers, where heat is recovered and used for generating steam. The flue gas exits the boiler at 175 to 210 °C. The boiler steam is then used to provide heat for the desalination of seawater using multiple-effect distillation (MED) technology. The MED units operate at a capacity of 41,000 m³/day of potable water. The largest share of potable water is supplied directly into the water mains of the Ministry of Electricity and Water at a rate of 32,000 m³/day. About 6,000 m³/day of water is directed to the ALBA complex, while the remaining balance is distributed to miscellaneous customers.



3. Developing R&D capabilities and a sufficient talent pool. The energy efficiency industry needs a skilled workforce of technicians, designers, and engineers. There is a global shortage of such skilled workers, and the problem is even more acute in Arab countries, since its relatively small industrial base has not created a significant pool of trained workers who could be shifted to such tasks.

In addition, this sector depends heavily on R&D for advancements in materials, technology, and implementation. Pioneers in this sector are often located in close proximity to world-class research institutions. Arab countries currently lack such research institutions, although they have started to address this shortcoming through a number of regional initiatives such as the Masdar Institute of Science and Technology (MIST), King Abdullah University of Science and Technology (KAUST), and King Abdullah City for Atomic and Renewable Energy (KA-CARE).

III. REDUCING EMISSIONS WHILE MAKING PROFIT

Contrary to popular belief, addressing GHG emissions can be profitable. One national oil

company, for example, identified the potential for a 43 percent reduction in emissions with a net present value of several billion U.S. dollars. For carbon-intensive industries, such as oil and gas, chemicals, and utilities that take a proactive approach to GHG management, the benefits can extend beyond profit.

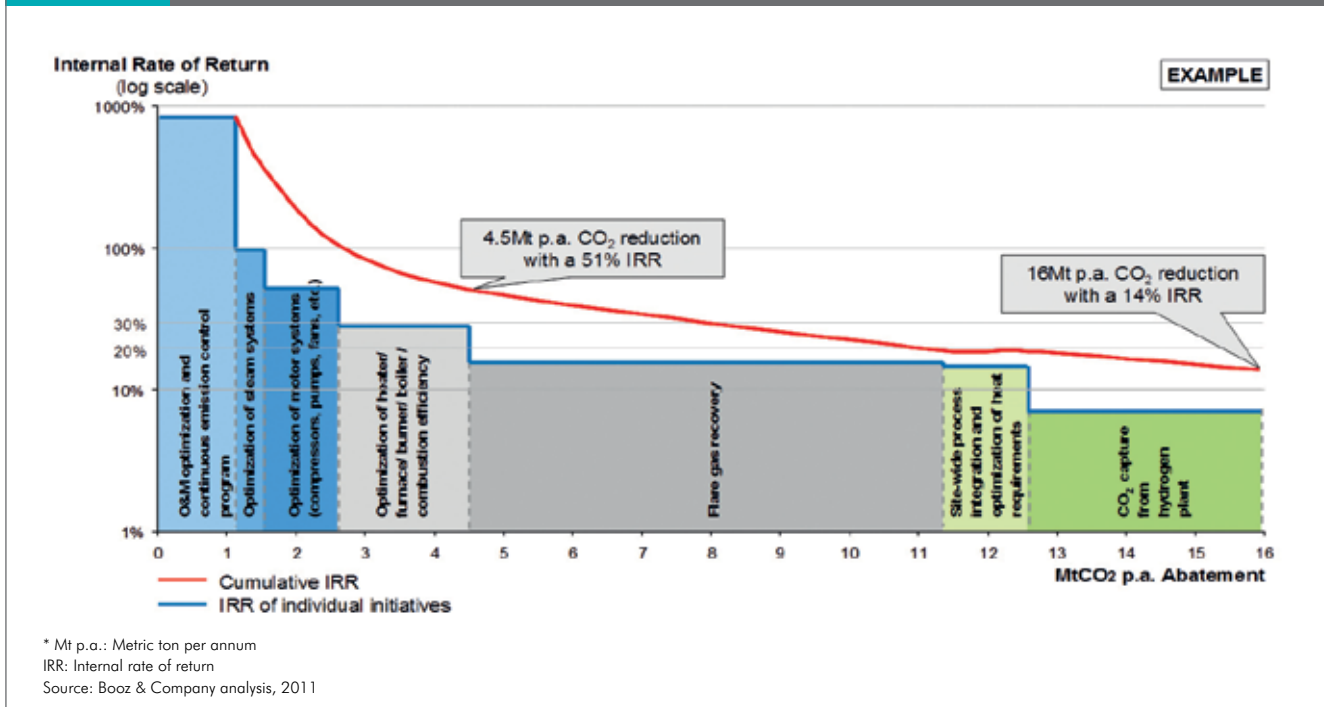
1. Long-term competitiveness of hydrocarbons.

GHG abatement measures in oil and gas operations reduce the carbon footprint of these fossil fuels. Accordingly, the implementation of a GHG management strategy contributes to the long-term competitiveness of oil and gas as the world transitions to low-carbon energy sources.

2. Energy efficiency returns.

Energy efficiency measures, central to many GHG emissions management initiatives, generate direct cost savings by reducing fuel consumption. In many cases, energy efficiency measures pay for themselves and some are very profitable, with payback periods of less than three years. National oil companies specifically have an additional opportunity at the broader national level: they have much to gain from reductions of GHG emissions in their respective economies as this implies lower capital investments to

FIGURE 4 EMISSIONS REDUCTION (MT P.A.)^{*} INVESTMENT CURVE FOR A NATIONAL OIL COMPANY IN THE MIDDLE EAST



meet local energy requirements and increased crude available for export. Accordingly, national oil companies in the region should drive the implementation of energy efficiency measures not only to improve the economic and environmental performance in their own operations, but also in the power and transport sectors of their countries.

3. Access to carbon finance and technical support. The clean development mechanism (CDM) under the Kyoto Protocol allows qualifying emission reduction projects in developing nations to benefit from financial and technical support. To date, CDM has remained relatively unexploited in the Middle East. With a large number of CDM methodologies already in place for energy efficiency and alternative energy applications in the oil and gas, petrochemicals, and utilities sectors, there is great potential for companies to take advantage of carbon finance support.

4. Improved image. With GHG emissions management programs, companies in carbon-intensive sectors will demonstrate their commitment to reducing emissions and help deflect increasing public scrutiny about their contributions to climate change.



Although it may be tempting for companies to view GHG emissions management initiatives strictly as part of their corporate social responsibility agenda, these wide-ranging benefits point to an economic imperative as well, and one that should not be overlooked or underestimated. To capture these benefits, companies in Arab countries should adopt a systematic and methodical approach to reigning in their emissions, articulated in three key steps:

i. Choosing a strategic course

Defining a strategic position should be a company's first major step in tackling GHG emissions because that will guide its course of action, as well as its level of involvement in driving the low-carbon agenda at the national level. Setting the right course, though, takes an understanding of the company's baseline emissions¹, which will help identify the biggest contributors and compare emission levels to international benchmarks.

Once the company has established its emissions

baseline, its leadership should articulate a vision for dealing with its GHG footprint. Through this process, companies are likely to settle on one of four broad positioning options for aligning their strategic vision with the right set of emissions reduction initiatives:

1. Compliant. Companies that fit under this category would implement GHG emissions reduction measures solely to comply with the requirements of national and international regulations. Initiatives designed for this purpose are not governed by a programmatic approach and represent the bare minimum of what is required.

2. Efficient. This positioning would account for companies seeking to go a step further than basic compliance by improving the efficiency of their operations and attempting to benefit from carbon finance support. They would target investments in readily available and robust technologies, typically at the equipment level, with short payback periods.



3. Enlightened. This category applies to companies aspiring to be leaders in their region in emissions control. It involves complex but tested technologies, typically at the process and plant levels. Understanding and implementing these activities require significant capabilities and knowledge. Under this positioning, companies would collaborate with other energy stakeholders at the national level on selected GHG emissions reduction initiatives with the aim of reducing national fossil fuel consumption. Examples of such initiatives might include a national oil company supplying the utility sector with low-emissions fuels or collaborating with utility sector stakeholders to implement alternative energy projects.

4. Differentiated Leader. The greatest benefits in terms of emissions reduction would go to those companies that seek to establish best-in-class GHG emissions reduction performance and innovation on a global scale. Many of the emissions reduction solutions in this category would be considered cutting-edge technologies, offering companies the opportunity to take a competitive position in generating intellectual property in this area. Additionally, companies that are ready to assume a leadership role in their country's emissions-reduction efforts can establish themselves as national champions by working with

the country's environmental agencies to develop a detailed national carbon inventory and low-carbon development plan. In this role, companies would support national initiatives to establish the institutional setting for accessing international carbon finance support and contribute to setting energy efficiency standards and developing initiatives in other carbon-intensive sectors, such as the implementation of alternative energy projects.

ii. Developing a greenhouse gas reduction program

Once companies establish their vision for GHG emissions management at the corporate and national levels, they should identify potential emission reduction initiatives across the value chain. These opportunities can be grouped into five broad categories:

1. Continuous operations and maintenance (O&M) improvements. Companies may achieve emissions reductions and fuel savings through improved process controls and direct inspection and maintenance programs. For example, in the oil and gas sector, this includes systematic defouling (removing unwanted material deposited on solid surfaces using chemical solutions) and operational measures leading to reduced

REDUCING AIR POLLUTION IN RAS LAFFAN INDUSTRIAL CITY, QATAR

One of the world's leading liquefied natural gas (LNG) producers, RasGas Company Limited (RasGas), is proactively taking emissions reduction measures to meet the requirements and regulations set by Qatar's Ministry of Environment. As a result of its leadership, RasGas's nitrogen oxide (NO_x) emissions reduction program is ahead of the milestones set by the government, making it a true pioneer and contributor to safeguarding the environment.

When RasGas learned in 2003 that the government was implementing new regulations the following year, it turned to its global technology partner General Electric (GE) to find a solution which supports both the government's initiative as well as its business objectives. GE provides gas turbines to the company.

With the objective of achieving both full compliance to the new environmental policy and ensuring maximum performance of the gas turbines, GE proposed applying its dry low NO_x (DLN) combustion technology to the installed units. GE's advanced DLN1 combustion system allows gas turbine operators to reduce the amount of emissions without the injection of diluents.

GE and RasGas embarked on the retrofit project in 2008. To fit RasGas site conditions and requirements, the project required the customization of the technology. To date, GE and RasGas have retrofitted seven Frame-6



and two Frame-7 gas turbines.

As a result of the hard work, the gas turbine NO_x emissions, which were in the range of 70 parts per million (ppm) when the project started, are now achieving a reading of 10-15 ppm on the retrofitted gas turbines. In addition, according to RasGas, the projected reduction in NO_x emissions following the retrofit of the remaining Frame-7 gas turbines is almost 50%, from around 30,000 tons in 2007 down to approximately 15,000 tons by 2014. RasGas is taking the lead on its environmental commitment to help Qatar and the region meet their vision for economic and environmental sustainability.

emergency flaring. Such improvements require little capital investment, yet have the potential to yield emission reductions of as much as 10%.

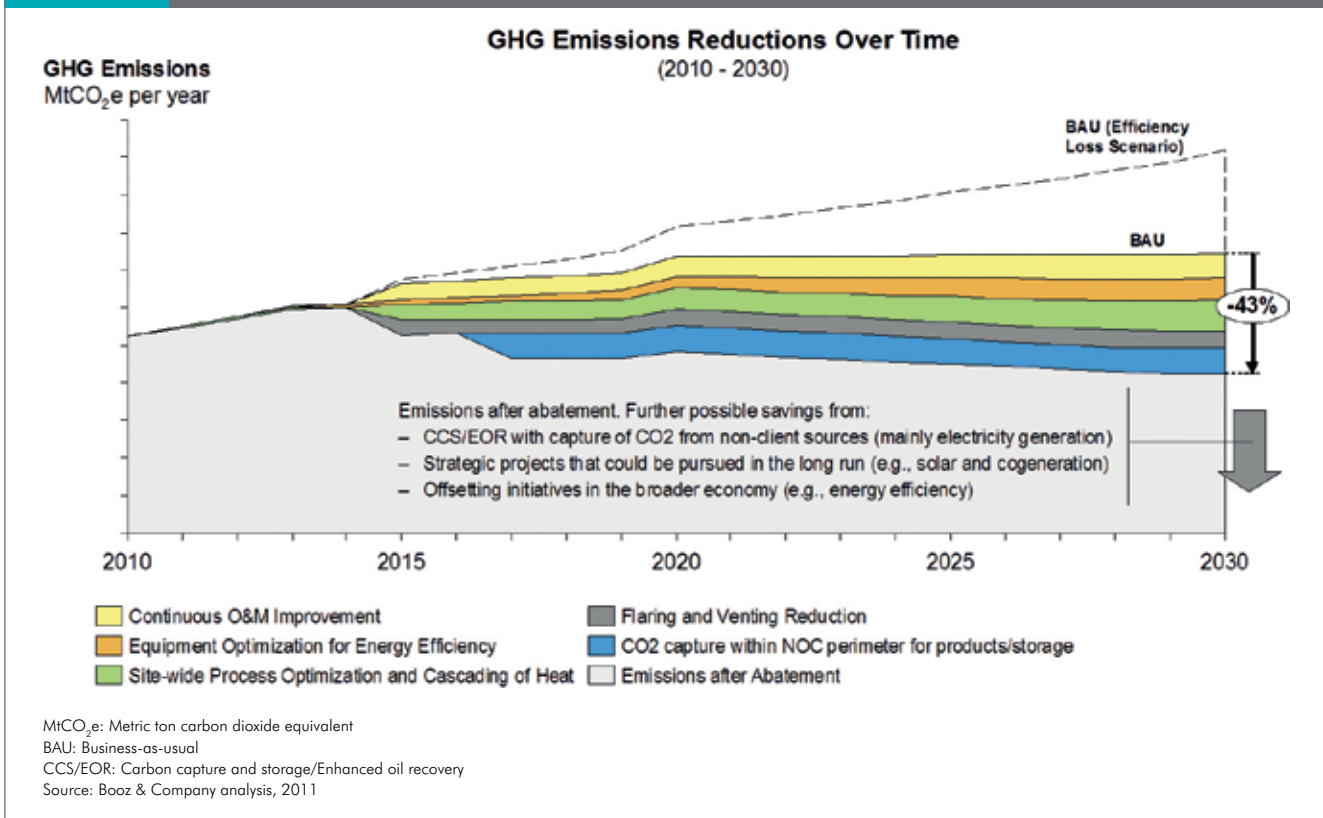
2. Improving equipment efficiency. These initiatives target GHG emission reductions by improving the efficiency of equipment such as heaters, burners, boilers, compressors, turbines, and motor systems. In refineries, such equipment typically accounts for 65% of emissions. At one refinery, optimizing the combustion efficiency of heaters, burners, and boilers required an investment of approximately \$120 million with a potential investment rate of return of nearly 30% and a potential payback of less than 3 years.

3. Reducing heat requirements through process improvements. Companies in process industries can realize energy efficiency improvements via the

optimal use of heat and optimization of steam systems. To achieve this, they will need to conduct pinch analysis—i.e., systematic analysis of energy flows and use in processes, which helps determine the minimum energy a process requires.

4. Flaring and venting reduction. In the oil and gas and petrochemicals industry, venting is a major source of direct methane emissions that often results in losses of significant value. Hydrocarbon vapors often have higher heat content than pipeline quality natural gas, making them more valuable than natural gas. Vapor recovery systems (VRS), which can capture up to 95% of hydrocarbon vapors, can capture this value by allowing the vapors to be resold, used on-site as fuel, or fed to processing plants to recover valuable natural gas liquids. Industry experience reveals that the installation

FIGURE 5 USING ALL AVAILABLE MEASURES CAN REDUCE EMISSIONS SIGNIFICANTLY



of VRS can be quite profitable. In one example, an independent oil company installed VRS at two locations at a cost of \$200,000 and saw its investment recouped in less than two months due to the high value of the gas recovered.

5. Structural initiatives. While the initiatives enumerated above can be launched unilaterally,

companies may also selectively pursue more challenging and complex projects that involve multiple stakeholders or business units. These initiatives, such as cogeneration with grid tie-up and the use of residual heat, the application of solar thermal for providing heat to processes, and the development of solar power to offset power consumption, offer great potential for emissions



IMPROVING THE ECO-EFFICIENCY OF THE STONE AND MARBLE INDUSTRY IN JORDAN

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Lamia Dabbas

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The stone and marble industry is one of the major contributors to Jordanian economy; in 2008 it contributed 40 million Jordanian Dinars (JD) to the country's gross domestic product (GDP). The sector employs 7500 people and exports stone and marble products to international markets. However, the industry is also a major water consumer. The production process uses water and generates a white slurry wastewater containing limestone particles. Most factories apply a basic settling technique to recycle and reuse treated water. However, the settling process is inefficient, leaving behind large quantities of slurry (containing 70% water), which are dumped in various sites.

In order to address waste dumping and improve the recovery of water, the Jordan Business Alliance on Water (JBAW) conducted a study to evaluate the effectiveness of implementing a treatment and reuse system for the slurry in different locations. JBAW is a recent initiative established to create private, public, and community partnerships to improve the management of water resources in Jordan. Under the current initiative, 3 locations in Amman, Irbid, and Mafraq have been selected as sites for the pilot projects. This set up was necessary because stone and marble workshops exist in clusters of micro enterprises around many cities in Jordan.

The JBAW assessment revealed that significant savings could be obtained. Water savings would reach 350,000 m³/year, amounting to cost savings of about 1 million JD; savings in transport would be approximately 1.5 million JD, while reducing CO₂ emissions by 280 ton annually.

The yearly cost of the treatment process (including initial investment, operation, and maintenance) is estimated at 1.7 million JD. Thus the net financial benefit is equal to about 0.8 million JD annually, which makes the water recovery process economically viable. It has also been acknowledged that the local municipalities have expressed their willingness to contribute to the project by providing land, while the chamber of industry will provide the umbrella for overall project implementation in addition to contributing to covering the purchase cost of the treatment systems.

The social benefit of the project is reflected in water resource recovery, which would improve water supply to households in the communities where stone enterprises are located. In addition, dumping slurry water on random sites can now be avoided. These transformations are expected to improve the quality of life for communities.

In a country with a very low annual per capita share of freshwater, improving the eco-efficiency of industrial water use becomes a strategic business decision with economic, social, and environmental implications. Increased water efficiency by micro-enterprises in the stone and marble sector will reduce costs, lift profit margins, and improve the sector's economic competitiveness, while contributing to more sustainable patterns of water management.

** Jordan Business Alliance on Water (JBAW) is a joint initiative chaired by HRH Prince Faisal bin Al Hussein and supported by the Ministry of Water and Irrigation, Ministry of Planning & International Cooperation, Jordan Chamber of Industry, American Chamber of Commerce, US Agency for International Development (USAID), Deutsche Gesellschaft fuer Internationale Zusammenarbeit (GIZ) funded by the German Federal Ministry of Economic Cooperation and Development (BMZ), and the World Economic Forum (WEF).*

reductions. Additionally, national oil companies (NOC) can consider carbon capture and storage (CCS) with enhanced oil recovery (EOR)², while companies in the petrochemicals sector can explore carbon conversion, involving the use of captured CO₂ as feedstock—for instance, for urea and methanol processing.

Once companies have identified the extent to which the above opportunities are applicable

to their operations, they should prioritize them based on the tradeoff between their emissions reduction potential and their cost and difficulty of their introduction. This ensures that efforts are focused on those opportunities with the greatest potential for emissions reduction in the context of practical capacity constraints.

Companies must then analyze in greater detail the initiatives that make the shortlist to determine

OPINION

LOWER CARBON ECONOMY-IMPLICATIONS FOR DEVELOPING COUNTRIES**Mohamed El-Ashry**

In many forums around the world we are having incomplete public debates about climate change. As we should, we are trying to address questions about caps on pollution and timetables, cost of action and inaction, carbon markets and allocations, but are not giving much attention to the principal, long-term objective—building a robust clean energy economy. While climate policy to prevent dangerous global warming is not about sacrifice or trade-offs, this is a golden opportunity to address simultaneously the related challenges of finance, jobs, energy, health, water, and food that the world has been facing recently.

Rebuilding the global economy beyond the financial crisis on the foundation of low-carbon energy will create millions of jobs—what some are calling “green collar jobs.” The number employed in climate-related activities worldwide since 2004 has more than doubled from just over 1 million to about 2.4 million. But it will take policy and political leadership to unleash the creativity and investment of entrepreneurs in solving these great challenges. Smart policy would treat low-carbon energy as a strategic asset and an opportunity to drive innovation and new investment across national economies. As the financial crisis has shown, government action and government policy are crucial to restoring order on the economic front. Likewise, government action and government policy are crucial for addressing climate change and for pursuing a low-carbon and sustainable future.

According to the International Energy Agency (IEA), with no new policies, world primary energy demand and related CO₂ emissions will grow by almost 50% by 2030. About 80% of that growth will be in developing countries, with China and India accounting for over half of this incremental demand. According to McKinsey and Company, 77% of the world’s future infrastructure needed by 2030 is yet to be built and most of it will be located in developing countries.

Setting in place a clean energy infrastructure, with an emphasis on renewable sources, makes economic and environmental sense. The technical potential of renewable energy is huge and is several times the current total energy demand, especially in electricity generation. The renewable sector has the potential to stimulate economies, create millions of jobs, cut greenhouse gas emissions and other pollutants, improve energy security and provide energy access to those who are currently lacking it.

The renewable energy sector is one of the fastest growing sectors in the world. Overall investment in renewable energy and energy efficiency has increased dramatically in recent years, up by more than four times globally and by 14 times in developing countries between 2004 and 2007. In 2008, investment in renewable energy defied the global recession, growing by about 5% from 2007 to \$155 billion. One of the most remarkable milestones for 2008 was that businesses selling low-carbon goods and services now generate more revenue than the aerospace and defense sectors combined, making the sector one of the new lynchpins of the global economy, according to research by HSBC. Similarly, more than 50% of total added power capacity in 2008 in both the U.S and Europe was renewable—more than new capacity for oil, gas, coal, and nuclear combined.

According to a survey by New Energy Finance and Deutsche Bank, 75% of 106 institutional investors—including pension, banking, and insurance funds with \$1 trillion in assets under management—expect to increase their involvement in clean energy and other low carbon investments by 2012. Renewable energy was by far the most popular investment theme for respondents, with 97% expressing interest, while energy efficiency was the next popular theme with 64%. Not a single asset owner participating in the survey said that they were less likely to invest in clean energy now than they were 12 months ago.

their investment requirements, economic attractiveness, and potential risks. This assessment should also determine eligibility for carbon finance support and identify whether relevant CDM methodologies exist. Shortlisted initiatives may be mapped on an emissions reduction investment cost curve to capture the returns associated with each opportunity, as illustrated in Figure 4. As indicated by the investment curve,

the most profitable opportunities feature returns well above the typical returns expected for capital projects and make the overall economics of GHG emissions management very attractive at the portfolio level.

In the aggregate, the opportunities available to companies in the process industries in Arab countries can potentially reduce emissions by more than 40%,

The trends in the renewable energy industry are encouraging but will need significant scaling up to match the size of the challenges we face. A number of developing countries are leading the way. For example, China has adopted a target whereby 30% of its total energy supply in 2030 will come from renewables. India has a target of 20,000 megawatts from solar energy by 2022, the biggest target for solar energy anywhere in the world. They are constructing the largest solar power complex of 3,000 megawatts at \$10 billion in the state of Gujarat.

In the Arab region, there are also a number of promising developments, even though its investment of \$2.6 billion in renewable energy and energy efficiency was only a fraction of Asia's \$24.2 billion and South America's \$12.3 billion. Last year, Qatar announced it was investing about \$240 million in the Qatar-UK Clean Energy Technology Fund. Kuwait is planning a tender in 2010 for a solar energy plant and is aiming to generate 5% of its electricity from renewable sources by 2020. Egypt, in addition to a number of wind energy farms, is building a solar thermal power plant with support from the Global Environment Facility (GEF). Tunisia has adopted a renewable target of 10% share of its total primary energy by 2011, and Abu Dhabi has an electricity share target of 7% by 2020 and is pioneering a zero-carbon city, Masdar, which aims to be completely carbon neutral, and which promises to put the region in the spotlight by becoming a center of innovation. It is worth mentioning that the headquarters of the new International Renewable Energy Agency (IRENA) will be based in Masdar.

On the other hand, while 64 countries around the world had some type of policy to promote renewable energy, Algeria and Tunisia are the only Arab countries to have adopted promotion policies. For example, Algeria has a policy for feed-in tariff and with Tunisia they have policies for investment and tax credits, while Egypt is engaged in developing feed-in policies.

The huge unfulfilled potential of renewable energy in the Arab region is attracting the attention of Europe,

and European investments. The Mediterranean Solar Plan is under implementation and will produce 20,000 megawatts of renewable energy from North Africa by 2020. \$6 billion have been committed to Morocco alone. Recently, a consortium of European corporations and investment banks, including Munich Re, Deutsche Bank, and Siemens, has announced a proposal to develop a massive amount of solar thermal generating capacity in North Africa, much of it for export to Europe. In total, DESERTEC could easily exceed 300,000 megawatts, which is roughly three times the electrical generating capacity of France. DESERTEC is a much longer-term plan than the Mediterranean Solar Plan.

Where does this leave the Arab region? Is it enough to wait for the rest of the world to innovate and import the technologies at some later date? Or should the Arab countries join hands together, out of self interest, to pool human and financial resources as well as to catalyze foreign investment and be a leader in the clean energy field. Investing today in the development and deployment of clean technologies will not only help some countries in diversifying their energy sources and in achieving energy security. It will also create jobs, promote innovation, and improve people's health and the environment. As the world moves to a low carbon economy, there will be a competitive advantage for those who embrace clean technologies first.

The AFED report addresses the impacts of climate change on the Arab region and recommends policies and actions for adaptation to climate impacts. But the Arab region also has a great opportunity to become a leader on the mitigation front, especially in the area of renewable energy—not because it has an obligation in the short-term to reduce emissions, but because it would carve for itself a piece of the future now.

Mohamed El-Ashry is Vice Chairman of AFED Executive Committee and former CEO of Global Environment Facility (GEF).

(Keynote Speech at Arab Forum for Environment and Development Conference, Beirut, November 20, 2009)

with even greater potential when factoring in major structural opportunities such as carbon capture and storage, as illustrated in Figure 5.

Designing the GHG emissions management program to implement emissions-reduction initiatives in phases will allow companies to focus first on “quick win” projects with short implementation lead times, accelerated payback

periods and near-term emission reduction potential. By prioritizing projects in this way, companies will be able to generate early positive cash flows to fund more capital intensive projects later on, as well as gain greater insights in setting annual emission reduction objectives. Importantly, achieving quick wins will also boost confidence in such projects by raising awareness of their successes.



iii. Establishing processes and infrastructure

Once companies have established their strategic course and the design of the program, they will need to act upon three critical aspects of their business to lay the foundation for the program's successful implementation by: (i) developing an operating model, processes, and capabilities for GHG emissions management, (ii) institutionalizing GHG emissions management through active monitoring and market-based transfer pricing policies, and (iii) managing communication about GHG emissions strategy implementation and results.

Designing an operating model for GHG management involves defining the activities, processes, and organizational structure required to govern and implement the program, including the mechanisms to allocate and approve funding for chosen initiatives. A key challenge here resides in achieving a balance between central consolidation and control on one side, and sufficient latitude for business units to manage their respective parts of the GHG emissions

reduction program on the other. Companies will also have to ensure that they have the right set of capabilities to deploy the GHG emissions management strategy. For instance, in order to fully leverage carbon finance mechanisms, companies will need to develop specific capabilities related to CDM project identification, registration, evaluation, development, and implementation. Carbon finance is a world unto itself, and many companies don't have the in-house expertise required to manage the process for obtaining CDM credits. In particular, the ability to demonstrate CDM additionality by analyzing investment barriers is critical. Overall, workforce training and recruiting programs focused on building both foundational and incremental skills are fundamental to building an effective GHG management team.

The second key aspect companies will need to address is the institutionalization of GHG management, including the ongoing monitoring of GHG emissions. After companies have established an emissions baseline, they will need to maintain accurate carbon inventories to

regularly assess the effectiveness of their GHG emissions reduction management strategy or to identify areas in need of improvement. Another component of the institutionalization of GHG management is the adoption of market-based transfer pricing policies, as fuel and electricity prices are key inputs in conducting cost-benefit analyses of GHG management projects. When these costs are subsidized, as is often the case in Arab countries, they distort this analysis and can deter companies from making investments that would have been profitable when factoring in opportunity costs.

Accordingly, companies should review transfer pricing policies and set evaluation guidelines to ensure that their assessments are based on the real market value of these inputs. The last key component of institutionalization is the integration of GHG management into the company's performance management framework. Companies should adapt their performance management framework to ensure that their operations are aligned with the overall GHG management strategy. This is done by setting implementation milestones early in the deployment phase, and establishing results-based indicators to monitor on-going performance in emission reductions against target objectives. The performance management system should be tied to existing incentive structures to ensure that company leaders and employees are motivated to drive the strategy's implementation.

Finally, a comprehensive communication plan is necessary to engage employees and external stakeholders. Internally, the plan should seek to educate, enlist, and reward participants, including company leadership, staff, contractors, and business partners. Internal communications may involve written publications such as newsletters, but also more participatory forums such as workshops and town hall meetings. Companies should gear external communications toward raising national awareness about the implications of climate change and the importance of energy efficiency. Communication should celebrate successful emission reduction initiatives. In any communication, messages should be carefully constructed to avoid compromising the company's ability to qualify for CDM assistance.



IV. CONCLUSION

Governments and companies in carbon-intensive sectors in Arab countries can turn the growing global pressure around climate change into an economic opportunity. By adopting a systematic and programmatic approach to managing their greenhouse gas emissions, they can support the long-term sustainability of the industrial sector, while improving their economic, competitive, and environmental performance.

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NOTES

1. The first challenge: Establishing a baseline

Before companies can begin identifying and investing in GHG emissions reduction initiatives, they need to obtain a proper and exhaustive inventory of their GHG footprint. A detailed baseline of emissions allows companies to identify areas with a high potential for emissions reduction, based on comparisons with best-in-class benchmarks. An emissions baseline also forms the basis for deriving a "business as usual" scenario, which projects future emissions in the event that no actions are taken. Such scenarios make it easier to set goals for emission reductions and also serve as a valuable reference point for monitoring performance on an ongoing basis.

The raw information contained in such an inventory is often already available, but companies don't generally aggregate it because they are not required to do so. To gain greater insights about emissions reduction potential, companies must distill this data in a well-structured baseline for every subsidiary or business unit. They should also delineate between direct emissions (e.g., combustion, flaring and venting, and fugitives) and Scope 2 emissions resulting from imported sources (e.g., electricity and water).*

Companies can compile two types of emission inventories: equity-based and control-based. For pragmatic reasons, companies may choose to use a control-

based approach, as they will have more power to implement changes in subsidiaries in which they own a controlling stake.

2. Carbon capture and storage and enhanced oil recovery

Carbon capture and storage (CCS) encompasses a variety of technologies to capture, transport, and sequester carbon dioxide emissions. Countries around the globe are pushing ahead with investments in CCS in the hopes of enabling commercial scale deployment by 2020. Governments are dedicating a collective US\$15 billion each year to fund more than 200 projects and induce investments from the private sector.

Leading oil companies should assume an important role in the development of CCS, as they are in a unique position to leverage their upstream capabilities (e.g., geological characterization and overall reservoir management) for the storage of carbon dioxide in oil and gas reservoirs and other geological formations.

Investing in CCS projects has become more attractive since it was included, by the Climate Summit in Cancun in December 2010, with the technologies eligible for support under the Clean Development Mechanism.

Enhanced oil recovery (EOR) storage represents the most attractive application of CCS for Arab NOCs in the near term. EOR – a reservoir management technique for tertiary recovery – has the potential to significantly improve the economics of CCS projects due to the additional oil—and, thus, revenue—it extracts. Although EOR benefits vary substantially according to recovery rates and prevailing oil (or gas) prices, Booz & Company analysis suggests that EOR may completely offset the costs of integrated CCS projects in the most favorable cases.

* Scope 1 emissions are emissions that a company and/or business generates directly while Scope 2 emissions result from the import of goods and/or utilities such as power and water that bear a carbon content.

Transportation

ISAM KAYSI
FARID CHAABAN



I. INTRODUCTION

Transportation is fundamental to the functioning of a modern society and a necessary requirement for a growing economy. An efficient transport sector will contribute significantly to economic opportunities and social integration by linking rural with urban areas, enabling trade, and providing access to markets and services. To meet these challenges, access to transportation services must be reliable, affordable, and safe. Therefore, government investment in transportation must be seen not as an end in itself, but as a conduit to achieving social development and economic integration. In addition to contributing to the competitiveness of any modern economy, the transport sector by itself is a large employer. In fact, “transportation is globally considered to be the largest sector in the world in terms of financial turnover, resource consumption, and workforce,” according to a report on transportation in the Arab region by the United Nations Economic and Social Commission for Western Asia (ESCWA, 2009a).

This chapter will highlight existing policies, practices, and major trends in the transport sector in Arab countries, emphasizing the benefits and costs of current policies on economic development, social integration, and the environment. We will argue for the adoption of transportation strategies that promote sustainable development and reduce poverty.

The chapter will propose alternative policies and strategies to promote green mobility, and articulate the implications of green transport on economic growth, social cohesion, and environmental sustainability. We define green transportation in broad terms to mean the provision of safe, affordable, and reliable mobility options that are energy efficient, while minimizing pollution, congestion, and random urban sprawl.

II. CURRENT PRACTICES IN THE TRANSPORTATION SECTOR

The urban population in Arab countries makes up 57.5% of the total population, compared to a world average of 49.1% (Croitoru and Sarraf, 2010). Increased urbanization and population growth have contributed to a rapid rise in the demand for urban transport and hence to a high rate of private car use and high traffic densities, particularly as mass public transit remains underdeveloped for the most part. These dynamics are contributing to high emission rates, noise pollution, and land degradation. A transport sector brief by the World Bank (2010) has thus concluded that “many of the [Arab] region’s large urban areas, where the bulk of [gross domestic product] GDP is produced, face increasingly difficult transport problems with a high degree of traffic congestion, reduced mobility, and deteriorating air quality.”

Transportation trends in Arab countries are characterized by:

- Rapid sprawling in the region’s major urban centers such as Amman, Baghdad, Beirut, Cairo, and Damascus, whose populations exceed one million inhabitants.
- Government-subsidized gasoline and diesel fuel in many Arab states.
- An ageing vehicle fleet in most of the region’s cities, where the average age of cars is 15 years, with countries of the Gulf Cooperation Council (GCC) being an exception. Cars are generally not well maintained, which contributes to high fuel consumption and elevated levels of emission rates.
- Inefficient and inadequate public transport systems and excessive reliance on private



cars.

- The existence of government policies that encourage private car ownership as opposed to other modes of transport such as public transport, cycling, and walking.
- Inefficient traffic management systems and insufficient public awareness.
- Poor urban and physical planning resulting in long travel distances between residential and service center areas and places of work.
- Inadequate governance setup to adequately manage the transportation sector manifested by weak and insufficiently enforced environmental policies and regulations.
- For most Arab countries, “especially those with a large rural population such as Morocco, Egypt, and Yemen, all-weather access in rural areas is limited by the poor condition of road networks and the inadequacy of basic transport services” (World Bank, 2010).
- High road traffic mortality rates relative to other regions of the world. Table 1 shows that estimated death rates (per 100,000 population) in Arab countries are the highest compared with other regions of the world. In fact, the period from 1990 to 2000 has seen a 20% increase in road

TABLE 1

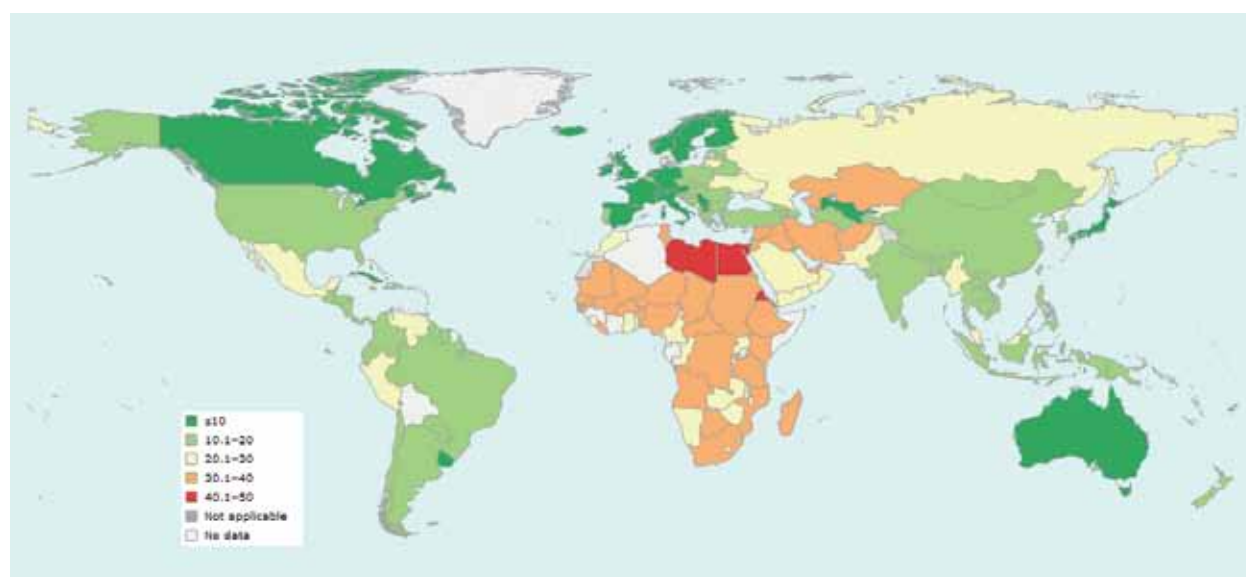
ESTIMATED ROAD TRAFFIC DEATHS (PER 100,000 POPULATION) IN 2006-2007

Country	Death Rate
Bahrain	12.1
Egypt	41.6
Iraq	38.1
Jordan	34.2
Kuwait	16.9
Lebanon	28.5
Libya	40.5
Mauritania	35.5
Morocco	28.3
Oman	21.3
Qatar	23.7
Saudi Arabia	29
Sudan	34.7
Syria	32.9
Tunisia	34.5
United Arab Emirates	37.1
Yemen	29.3
Regional rate	32.2
African region	32.2
Region of the Americas	15.8
South-east Asia region	16.6
European region	13.4
Global	18.8

Source: WHO, 2009; WHO, 2010

FIGURE 1

ROAD TRAFFIC MORTALITY RATES (PER 100,000 POPULATION), 2006-2007



Source: WHO, 2010

accident deaths in the Middle East, whereas in Australia, Europe, and Japan, mortality decreased by 10% during the same period (ESCWA, 2009a). Figure 1 shows that some countries in the Arab region have the highest road traffic mortality rates (per 100,000 population) in the world.

Although policies and measures envisioned by Arab countries aim to some extent at creating sustainable transportation systems (AFED, 2009), deficiencies continue to exist in major areas: poor urban transport services characterized by inadequate mass public transport, congestion, and poor air quality; limited access to rural areas; significant contribution to greenhouse gas emissions that cause climate change; and weak trade flows caused by inefficient transport systems.

Against this background, some Arab governments are increasingly investing in green transportation. One of the most ambitious projects has been the construction of the underground metro network in Cairo, which is being expanded. In 2009, Dubai inaugurated an urban rail transit system, with further expansion of the network expected. Other noteworthy measures include the introduction

of alternative fuels, such as compressed natural gas (CNG), to be used by taxi and public bus fleets in Cairo, offering duties and tax exemptions to accelerate the replacement of old inefficient vehicles with more efficient ones, the construction of a bus rapid transit system in Amman, and electrification of existing diesel trains on some routes (AFED, 2009).

Arab countries have also been taking up fuel quality upgrades to remove lead from gasoline and reduce the content of sulfur in gasoline and diesel fuels. For instance, currently in Morocco the gasoline sold is lead free and the Sulfur level in fuels is at 50 parts per million (ppm) or less, while Tunisia has phased out leaded fuel in January 2010 and is adopting new sulfur level standards for gasoline, in conformity with European standards (Allam, 2010). As for other countries, Table 2 is a matrix developed by the 'Partnership for Clean Fuels and Vehicles' that shows the status of lead phase-out as of January 2011. According to the matrix, most Arab countries have switched their gasoline fuel to unleaded. Yemen remains far behind. Exposure to leaded gasoline poses serious developmental risks in children.

The United Nations Environment Program's (UNEP) 'Partnership for Clean Fuels and

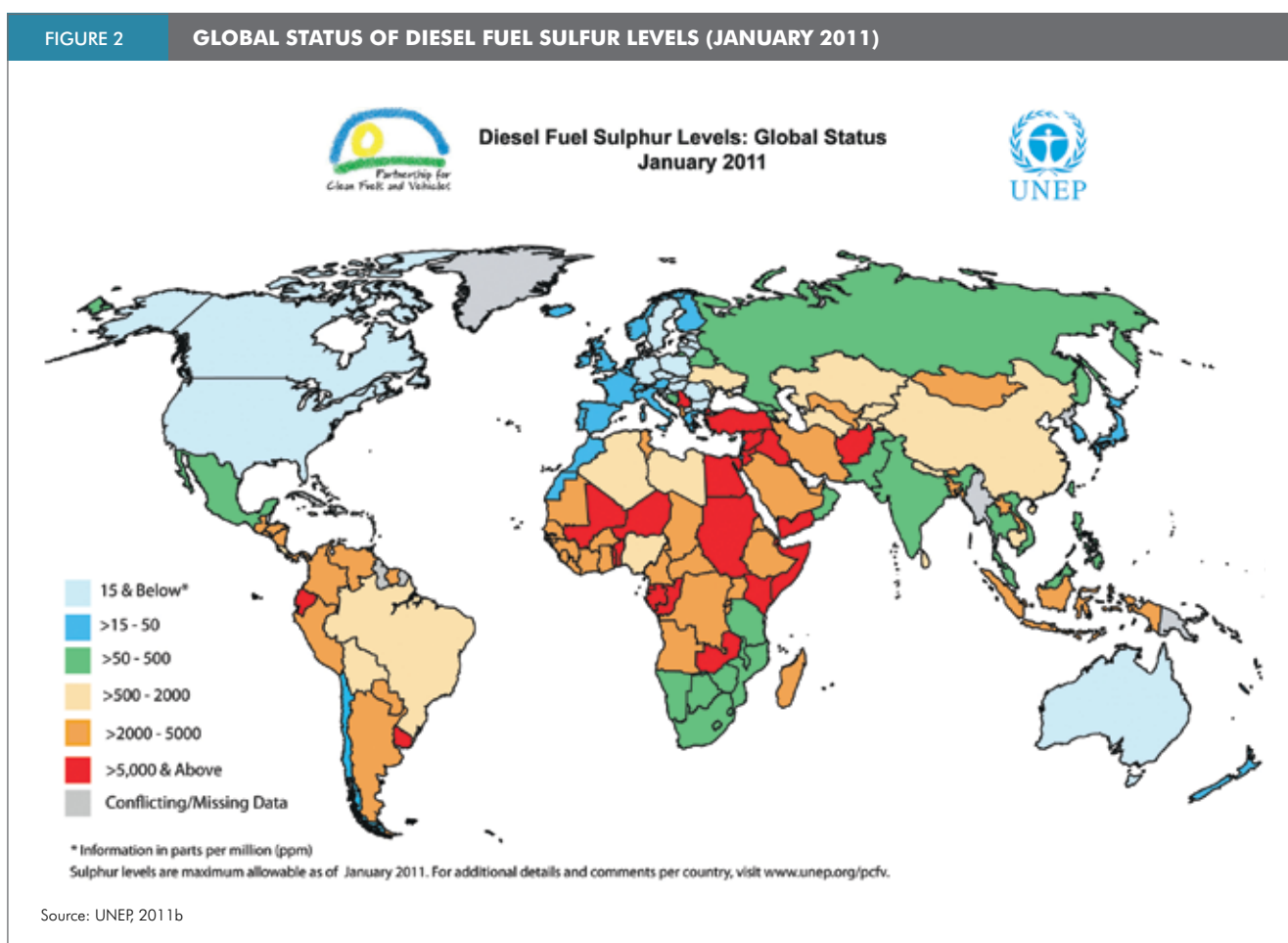
TABLE 2

LEAD IN GASOLINE MATRIX IN ARAB COUNTRIES (JANUARY 2011)

Country	Current Status of Lead in Gasoline Fuel			Comment
	Leaded Only	Unleaded Only	Dual System	
Algeria			✓	
Bahrain		✓		
Egypt		✓		
Iraq			✓	
Jordan		✓		
Kuwait		✓		
Lebanon		✓		
Libya		✓		
Morocco		✓		
Oman		✓		
Palestine		✓		
Qatar		✓		
Saudi Arabia		✓		
Syria		✓		
Tunisia		✓		
United Arab Emirates		✓		
Yemen			✓	10% unleaded

Source: UNEP, 2011a

FIGURE 2 GLOBAL STATUS OF DIESEL FUEL SULFUR LEVELS (JANUARY 2011)



Vehicles' initiative undertook a study in 2009 to demonstrate the status of diesel fuel sulfur levels worldwide. Figure 2, last updated in January 2011, compares the Arab region's performance with the rest of the world. As demonstrated in the Figure, in most Arab countries today, sulfur levels in diesel fuel remain high, which contributes significantly to high emission rates of particulate matter (PM) in cities and urban areas. Not only is PM linked to lung cancer and other cardiovascular illnesses, but it also contributes to climate change.

In many Arab countries, old and inefficient vehicles on the road pose a significant challenge because they contribute to a higher proportion of fuel consumption and air pollution emissions than newer models. Arab countries have their own import, inspection, and maintenance standards for vehicles and fleets. Table 3 summarizes the main standards and testing procedures currently adopted in the region.

Arab investments in the transport sector

Population growth, industrialization, and economic growth projections have compelled Arab governments to invest in transportation infrastructure. According to the online business intelligence platform, Zawya (2010a), "as much as \$147 billion has been committed for infrastructure developments such as road, rail, and public transport in the Middle East that would drive the growth of land, air, and seaborne logistics industry in the region." A \$25 billion railway line linking the six countries of the Gulf Cooperation Council (GCC) has been proposed, and will be complemented by internal railway lines within each country. Saudi Arabia is completing construction of its north-south railway project for freight use only, while the east-west railway line, supposed to link Jeddah, Dammam, and Jubail, will consist of passenger and freight tracks (Arab News, 2010). Egypt has attracted foreign direct investment to develop

TABLE 3 VEHICLE & FLEET STANDARDS IN ARAB COUNTRIES

Country	Import Requirements	Fleet (motor vehicles/1000 people)
Algeria	Imported second-hand vehicles must be less than 3 years old	112
Bahrain	No import restrictions found	509
Egypt	All imported vehicles must be equipped with a catalytic converter; imported second-hand vehicles must be 3 years old	43
Iraq	No information found	50
Jordan	Imported second-hand vehicles must be less than 5 years old	146
Kuwait	Imported second-hand vehicles must be less than 5 years old	507
Lebanon	Imported second-hand vehicles must be less than 8 years old	434
Morocco	No import restrictions found	71
Oman	Import of second-hand vehicles requires permission by Ministry of Commerce and Industry	225
Palestine	Imported second-hand vehicles must be less than 3 years old	-
Qatar	Imported second-hand vehicles must be less than 5 years old	724
Saudi Arabia	Imported second-hand vehicles must be manufactured after 1974	336
Syria	Imported second-hand vehicles must be less than 2 years old	62
Tunisia	Imported second-hand vehicles must be less than 3 years old	114
United Arab Emirates	No import restrictions, but strict inspection upon arrival to UAE	313
Yemen	Imported second-hand vehicles must be less than 5 years old	35

* Inspection and maintenance
Sources: UNEP, 2008; Wikipedia, 2011; World Bank, 2011a

Standards & I/M*	Comment
Indication of roadworthiness inspection system, no indication if it includes emissions	State-owned trucks make up about 80% of the vehicle fleet; since 1980s there has been a policy for development of the LPG vehicle sector
UN report indicates there are emissions control regulations	Has ongoing air quality monitoring program, and UN report indicates there are air quality standards
Vehicle inspection system, including emissions testing; I/M program for transit buses; Euro2 standards were meant to be in effect from January 2002, but fuel specs were incompatible- sulfur too high (PCFV document)	According to USAID report, Egypt plans to integrate emissions inspection, safety inspection, and vehicle registration in "one-stop" government facilities
New traffic code established in 2004 requires vehicle inspections, with stations to be located at traffic police stations	
Indication of roadworthiness inspection system, no indication if it includes emissions	
Cars over three years old require an annual roadworthiness test that is administered by the Traffic Department; no indication if it involves emissions testing	
Roadworthiness inspection system established in 2004 for vehicles over two years old; inspection is annual for petrol vehicles, every six months for diesel vehicles	
Air quality program established in 2005 to check vehicle emissions – includes two stations and a mobile laboratory	
Vehicle inspection system in place, though no indication if it includes emissions testing	
No emissions standards, no indication of any vehicle testing	
Roadworthiness inspection system in place; inspections are regular, no information as to time interval	
Indication of roadworthiness inspection system, no indication if it includes emissions	
UN ESCWA report indicates a vehicle testing program is in place	
Indication of vehicle emission testing	
Vehicle inspection system in place, though no indication if it includes emissions testing	

BUS RAPID TRANSIT IN LEBANON

Isam Kaysi

In an attempt to study the potential of mass transit in Lebanon, various studies have endeavored to estimate the costs and benefits of different mass transit options. From those studies, the Lebanese government can decide on the best option that allows for the shift from passenger auto use to public transport use. In a relatively recent study conducted in 2003 by DMJM+HARRIS Inc. in association with IBI Group — the “Beirut Suburban Mass Transit Corridor Feasibility Study” — some criteria were followed to rate several mass transit alternatives including Bus Rapid Transit and Light Rail Transit. The criteria upon which every option was evaluated are the following:

- Anticipated ridership increase
- Cost
- Environmental impact
- Time-frame for implementation
- Risk of implementation and performance
- Private sector involvement
- Ease of physical implementation
- Enforcement
- Policy implications
- Impact on private operators, service operators, and travelers on the corridor
- Impact on the government
- Impact on businesses along the Right of Way (ROW)

- Impact on travel time, on emissions, and on parking
- Impact on additional roadway construction
- Impact on trade and job balance

Light Rail Transit (LRT) emerges in this analysis as less desirable than Bus Rapid Transit due to its much higher cost. Hence, the study recommended initiating mass transit in Lebanon by introducing Bus Rapid Transit along the right of way of the old coastal rail line in Lebanon, which has been abandoned for about 50 years. Although benefits might not occur immediately upon implementation, the study verifies that there will certainly be long term benefits. Based on the above mentioned criteria, Bus Rapid Transit had a superior score on the more critical criteria such as anticipated ridership increase, environmental impact, and impact on travelers on the corridor.

A related study focused on the economic indicators related to major impacts of the implementation of suburban mass transit system for Beirut for the period between 2005 and 2015. Based on a cost-benefit analysis, the bus Rapid Transit with Feeder/Distributor system proved to be the superior choice among other options, and its benefits proved to outweigh its costs. The benefits resulting from this option are:

- Decrease in the total amount of time required to commute and the monetary savings resulting from this reduction

Year	Vehicle-km per peak hour - With MT	Vehicle-km per peak hour - Without MT	Vehicle-km savings per peak hour	Vehicle-km savings per year
2005	949,500	1,111,400	161,900	323,800,000
2015	1,205,700	1,391,600	185,900	371,800,000

more of the country’s logistics and transportation infrastructure covering tourism railway lines (AMEinfo.com, 2006). Iraq is also poised to invite private investors to help the country develop road infrastructure, railway networks, river ports, and airports (Global Arab Network, 2009). In Morocco, the rate of passenger rail use is increasing by 10-15% annually, and plans are underway to construct 1,500 km of high speed rail lines by 2030, some of which will be powered by solar energy (ENN, 2007). In general, it is

estimated that “the transport and logistics market in the Middle East – encompassing ground transport, air and sea freight, freight forwarding, warehousing, and supply chain management – has seen double-digit growth in recent years and will have a total value of \$27 billion by 2012” (Zawya, 2010a).

Since these investments are being committed now, Arab governments have a unique opportunity at this early planning phase to develop a transportation



- Reduction in the amount of land required for automobile parking and the subsequent cut in costs incurred from parking spaces
- Reduction in the need for roadway construction
- Increase of governmental revenues as a result of import reduction
- Creation of new jobs related to the new implemented system

Most importantly, knowing that the mass transit system is likely to reduce trips, vehicle use, and travel time, the system is expected to result in significant reduction of pollutant emissions. The adjacent table shows the expected vehicle-km savings due to the implementation of the Mass Transit system between Jiyeh and Jounieh,

passing around Beirut.

The region's dependence on automobiles and the severe congestion ensuing from it should encourage the Lebanese government to work towards reducing passenger auto use and shift to mass transit system. Based on the above, implementing the Bus Rapid transit system seems to be a cost effective solution. Its execution is expected to be a major step towards mitigating the Lebanese economic and environmental challenges and, as a result, will help to bring a better quality of life to the citizens of Lebanon.

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sector that promotes sustainable development and reduces poverty. How transport investments are made over the next 10 years will determine whether or not more sustainable patterns of transport will emerge in Arab countries.

III. IMPLICATIONS OF CURRENT TRANSPORTATION POLICIES

The unsustainable trends in the transport sector on a global scale are made obvious by the rapidly growing demand for

transport activity (for both passenger and freight) where "it is predicted to roughly double between 2005 and 2050" (UNEP, 2011c). In the absence of institutional capacity that can introduce regulations and offer incentives for more sustainable patterns of transport, the economic, societal, and environmental costs of these trends will lead to deterioration in the quality of life. The effects of unsustainable trends in transportation can be summarized as follows:

- Increased energy consumption, which is associated with energy security risks for oil-importing countries,



- and opportunity costs for oil-producing countries.
- High contribution to greenhouse gas emissions that cause climate change.
- Traffic congestion and associated time delays and productivity losses.
- Deterioration of rural and agricultural communities (through land misuse and migration).
- Inequitable access to jobs, services and markets and hence increased poverty.
- Weak contribution to equitable social development and cohesion.
- Deterioration in public health (caused by air pollution and stress).
- Reduction in human safety (reflected by high death and injuries rates caused by traffic accidents).
- Depletion of resources and increased contribution to solid waste loading.

a. Implications of transportation policies/infrastructure on the economy

Transportation infrastructure is critical to improving the competitiveness of a country and for integration with other countries and regions through trade, “with the potential to accelerate economic growth and investment” (Zawya, 2010b). Therefore, gaps and unsustainable trends in the transportation sector will always have negative consequences on any economy.

The World Resources Institute (WRI) has estimated gross domestic product (GDP) losses caused by unsustainable transport. According to WRI (2007), “the economic cost of congestion has reached over three percent of gross domestic product (GDP) in many cities. Furthermore, urban road accidents cost developing countries \$65 billion each year,

WHAT ARE THE EFFECTS OF REDUCING PRIVATE VEHICLE USE?

“During the [1996] Atlanta [Summer] Olympics, Georgia officials expanded their transit system with roughly 1000 buses, promoted travel alternatives, telecommuting, and travel incentives, and cut morning peak traffic levels by almost one-fourth while the region accommodated a million visitors over three weeks. This cut [ground-level] ozone 28 percent and cut hospital visits for asthma by 42 percent.”

Source: EDF, 2007

and in the most heavily polluted cities, economic losses from air pollution reach 10 percent of GDP. Developing countries also stand to suffer most from the consequences of climate change, with the poorest countries losing an estimated five to nine percent of their total GDP.”

The Arab transport sector is a large and inefficient consumer of energy, accounting for 32% of the total energy consumption in Arab countries (AFED, 2009). High rates of car ownership and use in some Arab countries and the lack of fuel economy standards contribute to high on-road fuel consumption. The increased pace and intensity of construction activities also contributes to high rates of diesel fuel consumption by off-road construction equipment vehicles. Investments in tourism, special economic zones, and seaports as global trade hubs add to fuel consumption in air, marine, and land transport. For oil-importing countries, inefficiency in fuel use by the transport sector coupled with the ever-increasing demand for transport pose oil security threats and puts a financial burden on their energy import bill. For oil-producing countries, larger proportions of their crude oil are diverted to local markets at highly subsidized rates, with high opportunity costs associated with forfeiting high oil revenues from the sale of crude or refined oil on the international market.

Low performing transportation infrastructure in the Arab region has adversely affected trade due to higher costs, delays, and uncertainty. As trade is one of the main drivers for economic activity, transportation infrastructure remains not fully attuned to economic growth in many countries in the region.

Population growth and urbanization in Arab cities have induced a rapid growth in urban transport demand, while improvements in the transport system and supply have not kept pace with the growth in demand, creating a shortage in supply levels. This shortage is causing higher levels of traffic congestion and air pollution, and inefficiency in the movement of goods and people, ultimately leading to a decline in Arab cities’ economic productivity and competitiveness.

Moreover, current transport infrastructure investment trends encourage urban sprawling, with negative social, economic, and environmental

STANDARDS IN CHINA

The Chinese national government has been concerned about the trend to larger and more powerful vehicles and has taken two steps to control this trend in the future. First, it has imposed fuel economy standards that are more stringent for heavier vehicles than lighter vehicles. Second, it has lowered the tax rate on vehicles with engines smaller than 1.6L from 3% to 1%, while increasing taxes on vehicles with engines over 3L from 15% to 25%.

Source: GFEI, 2011

consequences. The result is restricted mixed land use practices in urban areas, increased demand for more roads, increased levels of private car ownership, and inefficient rural and urban development.

b. Social Implications of current transportation policies/infrastructure

Transportation can contribute to equitable social development by providing populations in rural



PUBLIC TRANSPORTATION VIA LIGHT RAIL TRANSIT IN DUBAI, UAE

The Dubai Metro has started operations in September, 2009. When fully, expanded, it is predicted to reduce the number of cars (1 million) in Dubai, by 30%, hence creating less demand for private car ownership. It is expected to generate fuel cost savings, while providing enhanced mobility to places of work and minimizing time losses in congested roads.

Source: Nasr, 2010 and ESCWA, 2009a



and urban centers, especially the poor, affordable, dependable, and safe access to marketplaces, health care centers, schools, and other destinations where social and administrative services are delivered and economic activities take place. A World Bank (2010) transport sector brief suggests that in Arab countries “there are specific areas, namely road safety, women’s empowerment, and the accessibility of persons with reduced mobility (PMR), where the sector’s contribution could be enhanced if there was greater understanding of issues among governments and focused interventions whenever justified.” Although several Arab countries are signatories to the Convention on the Rights of Persons with Disabilities, none seem to have started to implement the Convention in the transport sector. Although action towards transport infrastructure growth and expansion is taking place in Arab countries, the benefits have not been large enough or equally distributed, forfeiting social, environmental, and economic opportunities.

Poor road and traffic system design in some Arab countries has taken a large toll on road safety. The relatively high death and injury rates in Arab countries caused by road transport causes suffering, lost incomes, and high health care costs, all of which translate to economic losses.

c. Implications of transportation policies/infrastructure on environmental sustainability

According to a report by UNEP (2011c), “transportation consumes more than half of global liquid fossil fuels; emits nearly a quarter of the world’s energy-related CO₂; generates more than 80% of the air pollution in developing countries; results in more than 1.27 million fatal traffic accidents per year; and produces chronic traffic congestion in many of the world’s urban areas.” The report further adds that these costs to society, which can add up to more than 10

per cent of a country's GDP, are likely to grow, primarily because of the expected growth of the global vehicle fleet (UNEP, 2011c).

In the Arab region, the transport sector is becoming increasingly linked to economic and environmental problems. It accounts for 32% of the total energy consumption in Arab countries (AFED, 2009) and 22% of the total greenhouse gas emissions (ESCWA, 2009a).

Given population growth and increased urbanization in Arab countries, the region is witnessing a rapid rise in transport demand and in private car ownership. For example, in Jordan vehicle fleet is rapidly increasing at an annual rate of 7 to 10 percent (Croitoru and Sarraf, 2010).

In a study on the environmental impacts of transportation performed by Rodrigue and Comtois (2009), greenhouse gas emissions and air pollution are identified as the most alarming implications of current transportation policies and infrastructure development. On-road vehicles and off-road vehicles that use internal combustion engines emit pollutants that affect air quality, causing damage to human health. They also cause damage to vegetation and reduce crop yields. The emissions include carbon monoxide (CO), volatile organic compounds (VOCs), nitrogen oxides (NO_x), sulfur oxides (SO_x), and particulate matter (PM). Ground-level ozone, which causes lung damage and triggers asthma attacks, is formed when NO_x and VOCs react in the presence of sunshine. Smog, which is a highly reactive and oxidizing mixture of airborne particles and ground-level ozone, can now be observed in some Arab cities. Those toxic air pollutants are associated with lung cancer and cardiovascular, respiratory, and neurological diseases. The health care costs and productivity losses associated with these diseases lay a burden on a country's budget and economy. For example, a World Bank study found that the total cost of damage from air pollution in Jordan averages about \$161 million, or 1.15 percent of GDP in 2006 (Croitoru and Sarraf, 2010).

A new study on air pollution in Beirut published in January 2011 has shown that the transport sector in the city is contributing to oxides of nitrogen concentration levels much higher than international norms (AUB, 2011). High levels

GREEN SCHOOLS TRAVEL MODULE IN IRELAND

The SmarterTravel policy recognizes the need to achieve significant modal shift, and the Minister has made €2 million available in 2008 and 2009 (with similar funding projected in the years to 2012) to enable a significant expansion of support for the Green Schools Travel Module. This scheme is funded by the Department of Transport ... through the Dublin Transportation Office (DTO). The Module aims to reduce dependency on car transport for journeys to and from school (and create a life-long culture of using alternatives to the car) and is an important element of implementing the SmarterTravel policy and the National Cycle Policy. In 2008, the initiative reached around 70,000 school children in 264 schools, and the target for 2012 is to reach over 1,000 schools and 265,000 pupils. The pilot project in 2007 delivered excellent results with walking and cycling increasing by 31% and 52% respectively.

Source: Department of Transport, 2002

of particulate matter were consistently recorded as well. The World Bank (2010) transport sector brief states that "in Cairo, ambient concentrations of pollutants exceed, most of the time, World Health Organization's (WHO) guidelines." Similar results were reported in other cities including Algeria, Amman, Damascus, and Dubai. "All this reduces social and economic opportunities and quality of life, especially for the poorest, while affecting cities' competitiveness and economic growth" (World Bank, 2010), the brief concludes.

Furthermore, transportation infrastructure such as roads, harbors, airports, and railways, as well as the construction activities associated with them, will often pose challenges to the health and integrity of land and marine ecosystems. Marine shipping activities "can create environmental problems through the discharge of ballast wash, the modification of water systems during port construction, canal cutting and dredging, sanitation discharges, and, in the event of an accident at sea, environmentally devastating oil spills" (ESCWA, 2009a).

The environmental impacts of transport can have negative spillover effects on other economic sectors. Worsening air pollution, traffic congestion, and increased marine pollution will reduce the attractiveness of a city or region as a destination for tourism, international conferences, or business meetings.

HOW MUCH ADDITIONAL CO₂ SAVINGS ARE POSSIBLE IF INCREMENTAL PUBLIC TRANSPORTATION PASSENGER RIDERSHIP IS INCREASED?

"A solo commuter switching his or her commute to existing public transportation in a single day can reduce their CO₂ emissions by 20 pounds or more than 4,800 pounds in a year."

Source: SAIC, 2007



IV. ENABLING POLICIES AND CONDITIONS FOR A GREEN TRANSPORT/MOBILITY SECTOR

Creating conditions for a green transport system requires government-mandated regulatory measures together with incentive measures that motivate a shift in behavior. Voluntary actions by the private sector have an important, reinforcing role in accelerating this shift. The ultimate objective of a green transportation sector is to provide an affordable, reliable, and safe mobility services to all segments of the population, while minimizing the sector's contribution to greenhouse gas emissions, air pollution, non-renewable energy use, and degradation of ecosystems.

The transportation sector in Arab countries today poses serious challenges in meeting the goals of sustainable development. It is imperative for Arab governments to engage in an effort to reform current transportation policies and adopt innovative policies that are more conducive to making the transition to a green transport system. These policies, in the form of regulations, incentives, subsidy reforms, public-private partnerships, financing, and awareness campaigns, if adequately designed and implemented, can be the catalysts to enabling the transition to a green and sustainable transport system. For example, studies have clearly indicated that investments in both mass public transit and improved vehicle efficiency generate exceptionally high payback, while a green, low carbon, transport sector can reduce greenhouse gas emissions by 70% without major additional investment (UNEP, 2011c).

These steps would significantly reduce the consumption of fossil fuels as well as the number of vehicles on the road. To succeed in achieving these transformations, the set of enabling conditions and policies articulated by government planning agencies have to be well developed and contextually relevant to local conditions in order to motivate consumers, developers, investors, and other stakeholders make the transition to a green transport sector.

a. Regulations

Appropriate regulations are essential to a green and sustainable transport sector. In addition to being effective in reshaping behavior, regulations have to be socially and politically acceptable.

Based on analysis of current trends in the Arab transport sector, the following regulations are suggested so that undesirable trends may be eliminated and conditions favorable to green transport can be cultivated:

- Adopting national fuel economy standards for vehicle fleets.
- Regulating vehicle emissions by issuing national standards and qualifying emission control technologies.
- Imposing clean fuel quality standards for gasoline and diesel. Because diesel is the fuel of choice for medium and heavy-duty vehicles (trucks), buses, and off-road vehicles, such as construction equipment, the reduction of sulfur content in diesel should become a priority for transportation planners and policy makers.
- Imposing import regulations with respect to car model, year of production, and emission standards.
- Imposing requirements upon renewal of vehicle registration to include safety, maintenance, and emission standards testing.
- Mandating mixed urban planning to institutionalize public transit and minimize travel distances.
- Dedicating safe space for walking and bike-riding.
- Dedicating lanes for high occupancy vehicles.
- Developing transport systems in rural areas.
- Mandating environmental impact assessment

studies and remediation actions for transportation infrastructure projects such as airports, seaports, highways, and railroads.

b. Incentives

To reinforce regulated mandates, incentive measures are often used to send market signals and influence behavior. Incentives are also needed in areas that cannot be regulated by law. A combination of financial as well as non-financial instruments can be used to motivate public and private organizations to utilize strategies to improve the efficiency of transportation use that would in turn result in reduced congestion and distances traveled by car. Local authorities can also create incentives to increase use of mass public transit and reduce use of private cars. The list of incentive measures may include:

- Marketing cleaner fuels at lower prices compared to other types. This measure has proven to be very effective in many countries,

including Lebanon where a price differential of around 6% increased the share of unleaded fuel in the market from 15% to 85% in less than 3 months in 2003 (Chaaban, 2003). Similar results were obtained in other countries in the region.

- Providing funding to public agencies and non-profit organizations to acquire alternative fuel vehicles that have higher fuel economy and lower emissions.
- Offering financial incentives to speed the replacement of the existing stock of old taxis with higher fuel economy, low-emission vehicles.
- Offering financial incentives to speed the conversion from gasoline or diesel fuel to low-carbon fuel such as compressed natural gas (CNG).
- Offering consumer rebates to support the purchase of high fuel economy, lower emission vehicles. Revenue neutral rebate programs can be designed by channeling fees collected from the purchase of inefficient vehicles to

KLM FLIES PLANES ON REUSED COOKING OIL

The Dutch airline KLM announced plans to use recycled cooking oil on 200 flights between Paris and Amsterdam during the fourth quarter of 2011.

The fuel, biokerosene, is derived from used frying oil, which will be tested to ensure it meets the same technical specifications as traditional kerosene.

Airlines are under European Union (EU) pressure to cut their carbon emissions by 3% by 2012.

KLM's interest in biofuels dates back to 2009, when the airliner ran a biofuel test flight with 40 people on-board, including the former Dutch Economics Affairs Minister.

During the 90-minute flight, three of the four engines were powered by traditional aviation fuel. The fourth engine was powered with an aviation fuel that was mixed with 50% biofuel. Under the new plan, flights will use a 50-50% fuel mix of traditional kerosene and biofuel in all engines.

KLM said its supplies of recycled cooking oil - which are collected from hotels, restaurants, and factories before



being sent to the US for refining – are sufficient for only 200 journeys.

But KLM's managing director, Camiel Eurlings, said the airline was aiming to go much further than that: "The route to 100% sustainable energy is enormously challenging. We need to move forward together to attain continuous access to sustainable fuel." The bio-kerosene flights are expected to include some or all six daily flights between the two cities.

<http://www.bbc.co.uk/news/business-13877623>

the purchasers of efficient vehicles.

- Offering financial incentives for the purchase of hybrid electric, plug-in, and all-electric vehicles.
- Developing a clean school bus program to reduce emissions from school bus fleets by supporting the installation of diesel emission control equipment.
- Imposing higher taxes on vehicles with large engines.
- Using parking pricing, particularly in congested areas, to discourage single-occupancy car use and preferential pricing to motivate carpooling.
- Offering financial incentives to commuters who use public transit or shared riding transport to travel to their places of work.
- Adopting innovative car insurance schemes such as pay-as-you-drive, whereby insurance rates are linked directly to the number of kilometers traveled.
- Removing broad fuel subsidies, while developing targeted subsidies to assist low-income groups.

Transportation planners may also combine the implementation of transportation demand management (TDM) with the appropriate set of incentives to influence travel behavior. TDM is a term used to describe practices, procedures, and measures that reduce vehicle trips by increasing

vehicle occupancy, reducing vehicle distances travelled, or both. This can be accomplished by having more people share rides in fewer vehicles, which also reduces traffic congestion. TDM also includes programs that motivate a reduction in single-occupant vehicles such as mass transit, carpooling, biking, and walking. Other TDM strategies work by changing the time of a trip or the need for a trip. This can be accomplished by employer-flexible time programs and telecommuting. By managing the demand for transportation services, TDM reduces the amount of investments sunk into road building and highway expansion that often remain short-term fixes and produce unintended consequences.

One of the most important strategies that can be adopted is shifting to alternative modes of transportation and reducing the use of private vehicles. Promoting mass public transport entails providing reliable, efficient, and environmental friendly busses, trains, and rapid transit at affordable rates, particularly for the low-income groups. The private sector can play a supportive, voluntary role in promoting the use of mass public transport by offering employees group discounts or season ticket allowances.

An effective incentive that has been proven successful in many countries in order to encourage commuters to shift from private to public transport is free shuttle bus services, which can be sponsored by government or private institutions. Such a service is available today in the United Arab Emirates (UAE), where busses transport commuters from pre-determined locations to places such as malls and other service centers.

In addition, improving non-motorized transport has to be associated with improved city planning to make walking and biking more attractive, and space for individual car parking restricted and at a cost. This can be accomplished by ensuring that large sidewalks are designed for safe pedestrian use, by dedicating lanes for bike use, and by promoting bike-sharing programs. To further promote non-motorized means of transport and reduce reliance on private cars, mixed land use planning offers a powerful design tool for shortening travel distances.

With car-ownership rates increasing significantly, as clearly shown in Table 2, preventive measures

ARE THERE FAVORABLE LAND USE IMPACTS THAT PUBLIC TRANSPORTATION CONTRIBUTES TO THAT RESULT IN POSITIVE ENVIRONMENTAL AND SOCIAL BENEFITS?

Public transportation provides many benefits that go beyond energy and CO₂ savings – as transit assets are being used to accomplish these important functions. Investments in public transportation have the benefit of supporting higher density land uses that allow for fewer vehicle miles of travel. While it is difficult to precisely measure this impact, a number of studies have attempted to estimate the relationship between transit passenger miles and vehicle miles traveled (VMT) reduction as a proxy for this effect. The results range from a reduction in VMT of between 1.4 miles and 9 miles for every transit passenger mile traveled. The outcome would be more efficient use of roadways, reduced road maintenance, shorter highway commute times and reduced need for street and off-street parking.

Source: SAIC, 2007

for private car usage should be enforced. Incentives such as introducing road and parking fees are vital to reducing private automobiles usage. Moreover, motivating people to use carpooling or other ride-sharing programs is one method to decrease the number of vehicles on the road. Achieving this might require providing innovative forms of incentives. Cash or parking vouchers for sharing on a daily basis, regular draw prizes, dedicated parking spaces for car sharers only, and extra annual leave and time off from work can be applied to encourage employees to adopt carpooling. Most importantly, carpool lanes can be designed to encourage carpooling, thus decreasing single-occupancy use of private vehicles.

To encourage the purchase of fuel efficient, hybrid, or all-electric vehicles, government agencies may choose to offer local fee exemptions, temporary tax credits and/or reduction, lower vehicle registration charges, or reduced custom tariffs in order to minimize the entry barriers of these clean vehicles to the market.

Alternative, low-carbon fuels, such as biofuel and compressed natural gas (CNG), potentially offer options to reducing transportation-related greenhouse gas (GHG) emissions. However, the long-term viability of biofuels will depend on their technological and economic feasibility, as well as on the choice of feedstock used for their production. The development of biofuels should focus on second-generation technologies that utilize sustainable biomass, agricultural waste, and wood chips as feedstock. Substituting carbon-intensive fuels with low-carbon fuels can be accelerated by offering incentives for the purchase of alternative fuel vehicles. Such incentives should also extend to those providing the infrastructure for alternative fueling facilities.

Transportation policies in most Arab countries further exacerbate market distortions, including fuel pricing, vehicles taxation, and public transport tariffs. Fuel price distortions lead to inefficient transport, over-consumption, and waste. Removing market distortions and increasing fuel prices is considered an essential tool for increasing transport sector energy efficiency and reducing GHG emissions. China, Russia, and Vietnam have shifted from low fuel-price policy to a high fuel-price policy, and the associated fears of an economic collapse from such a shift have been

HOW MUCH NET CO₂ IS PUBLIC TRANSPORTATION SAVING IN THE U.S. FROM THE CURRENT LEVEL OF SERVICES BEING OFFERED?

In 2005, public transportation reduced CO₂ emissions by 6.9 million metric tons. If current public transportation riders were to use personal vehicles instead of transit they would generate 16.2 million metric tons of CO₂. Actual operation of public transit vehicles, however, resulted in only 12.3 million metric tons of these emissions. In addition, 340 million gallons of gasoline were saved through transit's contribution to decreased congestion, which reduced CO₂ emissions by another 3.0 million metric tons. An additional 400,000 metric tons of greenhouse gases (GHG) were also avoided, including sulfur hexafluoride, hydrofluorocarbons (HFC), perfluorocarbons, and chlorofluorocarbons (CFC).

Source: SAIC, 2007

proven to be unfounded. Despite these successes, there are still some countries in the Arab region, such as Egypt and Yemen, which regard subsidized fuel prices to be essential for poverty reduction and economic growth.

Across the board fuel subsidies should therefore be incrementally removed, while targeted subsidies can be employed to reduce the vulnerability of low-income groups to high transport or commodity prices. Public government savings gained from the removal of subsidies can be directed towards expanding or improving mass public transit system, and towards reducing the potential impact of higher prices on the poor. Eliminating fuel subsidies reduces the burden on public budgets, spurs improvement in fuel efficiency, and fosters the use of alternative and cleaner fuels. Such policy changes enhance the energy security for oil-importing countries by reducing their energy bill.

While vehicles powered by gasoline are equipped with catalytic converters that capture toxic vehicle emissions, trucks and buses, and other vehicles powered by diesel, lack emission control systems that prevent the release of diesel exhaust emissions. To control these emissions, trucks and buses can be retrofitted with after-treatment systems. The following set of incentives can be introduced to encourage truck and bus fleet owners to install diesel emission control technologies:

- Reduced vehicle registration fees, taxes, or user fees.

COMPRESSED NATURAL GAS (CNG) FOR VEHICLES IN EGYPT

Ibrahim Abdel Gelil

Current natural gas reserves in Egypt are estimated at around 78 trillion cubic feet. Updated estimates and potential new discoveries continue to push the size of these reserves upward. Since the early 1980s, the Government of Egypt recognized that utilizing Egypt's abundant natural gas resources could, in addition to fostering economic growth, make a significant contribution toward improving air quality and protecting public health. Egypt's energy policy was thus developed to maximize switching to natural gas in various economic sectors, given the economic and environmental advantages of natural gas relative to other fossil fuels. Strategies to achieve this policy included developing natural gas infrastructure, whereby a national gas pipeline grid expanded from 1,000 km to more than 17,000 km.

Expanding the local gas market and developing domestic gas demand have proved to be effective strategies. As a result, the share of natural gas in Egypt's primary energy consumption has grown from about 24% in 1990 to nearly 45% at present. The number of domestic gas consumers has reached 3.3 million and is predicted to grow to 5.5 million by 2015. Accounting for about 60% of total gas consumption, the electricity sector is the largest gas consumer. In the years to come, the government plans to switch the electricity generation sector exclusively to natural gas.

In addition to switching to natural gas in power generation, industry, and residential buildings, the

Egyptian government has encouraged the private sector to commercialize natural gas vehicles (NGVs). In December 1994, the first company to convert gasoline vehicles to natural gas was formed. Currently, there are 6 operating compressed natural gas (CNG) companies, 119 CNG fuelling stations, and about 110,000 CNG vehicles in use, 75% of which are taxis, mainly in Cairo. A primary key to the NGV industry's success in Egypt is a package of financial incentives offered by the government including a 5-year tax holiday for CNG companies, low-cost conversion charges for car owners, and a CNG purchase price lower than gasoline. At about \$0.08 per cubic meter of CNG (equivalent in energy content to a liter of gasoline), it is less than a quarter of the local gasoline price of \$0.30 (or 1.75 Egyptian Pound) per liter. In addition, a typical vehicle conversion kit costs about \$900. Owners of high fuel consumption vehicles, such as taxis, can recover their cost of vehicle conversion in as little as six months from fuel savings alone. This clearly explains why taxis have been the most converted fleet.

Another development for Egypt's CNG growth was the joint Egypt/US-sponsored \$63 million Cairo Air Improvement Project (CAIP). This initiative focused on improving Cairo's air quality by reducing vehicles' tail emissions, among others. Part of this program included incorporating 50 dedicated CNG public transit buses into the Cairo public transport fleet. The bus bodies were locally manufactured, but the CNG engines and the rolling chassis were manufactured in the United States. However, replicating the taxis' conversion initiative by funding the conversion of the 5,000 public

- Clean diesel awards/publicity for fleet operators who use retrofit control technologies.
- Funding by government agencies for public and school bus fleets to offset part of the incremental capital costs of these systems.

Vehicles reaching their end-of-life pose a solid waste problem. To encourage end-of-life vehicle materials reuse or recycle, some auto-dealers have put in place a trade-in program, whereby potential car buyers may turn in their old cars for cash applied towards the purchase of a new vehicle. Governments should offer incentives to encourage more auto-dealers to establish trade-in programs, and if necessary mandate a take-back program, whereby auto-manufacturers and auto-

dealers are required to take back their own car brands for reuse and recycle. This would reduce the size of auto-shredder residue going to landfills and generate employment opportunities in solid waste recycling.

c. Finance/Investment

The United Nations Environment Program (UNEP) recommended increasing financing in size and scope to adequately address climate change vulnerability of existing and new transport infrastructure and services. Scaling up financing for sustainable transport must be complemented with sound pricing practices. Moreover, UNEP has suggested that GHG mitigation-related funds



buses operating in Cairo has been a key challenge for the government. With diesel fuel heavily subsidized, the price differential between CNG and diesel has not been compelling enough. So far, the government has managed to increase the number of CNG buses to nearly 200. In parallel, another program is being implemented to convert government-owned vehicles to CNG. To date, more than 2,000 vehicles have been converted.

Furthermore, the government is currently implementing an initiative to replace a fleet of nearly 40,000 old polluting taxis with modern CNG-fuelled vehicles. The initiative started in Metropolitan Cairo, hosting 25% of Egypt's population and about 60% of registered vehicles, and will be expanded to other governorates.

Economic incentives have been critical to the success of this initiative. In addition to concessional loans, new locally assembled CNG vehicles are exempt from about 55% of customs and consumption taxes. In return, participating taxi owners have to scrap their old vehicles. The project will have significant impacts on the air quality of Cairo, a megacity suffering from a high level of air pollution.

Switching to natural gas has improved air quality in Cairo. A recent state of the environment report on Egypt recorded a gradual improvement of air quality, indicating a steady reduction in the concentrations of sulfur dioxide, lead, and carbon monoxide over the period of 2004 to 2008. On the other hand, particulate matter (PM) and nitrogen oxides (NO_x) continue to cause chronic air pollution problems in Cairo and other cities. The average concentration of NO_x during the past five years exceeded Egyptian air quality standards.

Egypt's natural gas switching policy, while achieving economic, social, and environmental objectives, is also considered a cornerstone in mitigating greenhouse gas emissions. Switching to low carbon fuels such as natural gas is eligible for credit under the Clean Development Mechanism (CDM) of the Kyoto Protocol. It is estimated that about one-third of the projected carbon credits to be earned by Egypt within the CDM could come from natural gas projects.

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can be instrumental in providing support for technology/knowledge transfer, capacity building, and policy development, and in leveraging funding and investments by the private sector.

d. Research and development

Arab countries may benefit significantly from investing in research and development for converting agricultural waste into biofuels, to power transport vehicles. To encourage investments in biofuels, governments must demonstrate a long-term commitment to renewable energy sources and provide a set of incentives for key stakeholders to minimize entry barriers to market. Technical and

economic feasibility studies must be conducted to demonstrate profitability margins and environmental quality of the conversion process.

Arab governments should also accelerate the development of an electrification infrastructure for railway trains and vehicles. This can particularly reap great dividends if accompanied by long-term plans to switch to natural gas or solar and wind resources for electricity generation. Many Arab countries already rely on natural gas for power generation, while investments in solar energy and wind farms are on the rise. Technologies used in hybrid, plug-in, and all-electric vehicles provide a transition bridge into fuel cell technology.

e. Institutions and governance

The development of an institutional framework for the transport sector is needed in order to reduce transport-related emissions and meet the rising demand for transport safely and affordably. This requires cooperation and coordination between government agencies, private sector enterprises, and non-governmental organizations. Governments can play a key role in developing the institutional framework for the transport sector by focusing on the development of regulations, coordinating national transport activities, introducing incentive measures, disseminating best practices, establishing partnerships with the private sector, and developing financial plans that sets transport on a sustainable path.

Because public agencies and institutions at the national and municipal levels own large vehicle fleets, the government can set an example by introducing green transport strategies into these public fleets to improve their fuel efficiency and reduce their emissions. Governments can take advantage of economies of scale by aggregating purchasing of fuel-efficient vehicles for public fleets.

There is also a need to institutionalize intra-government coordination at the highest possible levels to promote sustainable practices such as mixed land use. Therefore, urban and transportation planning need to be integrated so that city master plans may incorporate sustainable patterns of transport such as public transit. Considering that the majority of trips made in the city involve short distances, mixed use planning can have significant effects on reducing the demand for transportation while lessening the burden on government budgets.

A transport overview report by the World Bank (2010) recommends the need to increase the performance and capacity of the public sector, indicating that many senior decision makers in Arab countries “often do not have the systems, institutions, or even the staff to formulate and implement adequate strategies and investment plans, and to ensure that operations are organized and managed efficiently.” The report noted the need to build capacity in proper planning and asset management systems,

regulatory capability, improved cross-border facilities, technical competencies in vehicular and fuel technologies, and better governance and accountability.

f. Education

Transportation is an established component in civil and environmental engineering department curricula in a number of universities in the Arab region. Courses addressing the environmental implications of transportation activities and the technological options to make the sector more environmentally sustainable are taught by experienced lecturers within more specialized courses. Green transport concepts, like energy efficiency, are mostly taught as part of broader content areas in the undergraduate programs, and in selected graduate courses. There is a need to establish academic research and education programs that focus on the role of public policy in formulating the right mix of mandates and incentives for more sustainable patterns of transport. If established, such programs could conduct research to evaluate the efficacy of proposed regulations, quantify their market and non-market values, and offer proposals for new measures and for improving existing ones.

g. Training and public awareness

Extensive training is necessary at national and regional levels as part of a long term capacity building program, such as seminars or train-the-trainers workshops, to educate public officials about designing and implementing effective and efficient policies for a green transport sector. In addition, awareness campaigns should be designed and guidebooks produced to provide vehicle owners with tips about proper fuel-saving driving habits. These guides should also include advice about how to reduce the number of trips made and the distance travelled. Corporate fleets have a responsibility to conduct training for their drivers and offer financial incentives for the best performers. Government and public sector institutions should conduct public awareness campaigns for policy and decision makers in order to promote the mainstreaming of sustainable and green transportation in their planning and decision making processes.

V. IMPLICATIONS OF TRANSFORMATION TO A GREEN TRANSPORT SECTOR

Introducing more sustainable patterns of transport in Arab countries will generate significant positive ramifications economically, socially, and environmentally. But sustainable socio-economic development goals cannot be achieved without addressing current deficiencies in the region's transportation sector.

a. Implications of green transport on the economy

Making a shift to a sustainable transport sector will bring gains in productivity, employment, and efficiency to any economy. In fact, the direct value added by the transport sector to the global gross domestic product (GDP) is about 3-5 percent, and transport directly provides 5-8 percent of total paid employment of an average country (ESCWA, 2009a). Investing in national public transit infrastructure and in alternative transport modes such as railway networks has been demonstrated to generate employment opportunities in many countries. Green transportation will save national economies the tremendous costs associated with traffic congestion, traffic-related deaths and injuries, air-pollution health care costs, and climate change-related costs. These costs may account for a significant percentage of GDP, ranging from 3-10% annually. As a sector, sustainable transport is a key component in a country's energy security policy, and contributes significantly to reducing spending on energy imports. Therefore, the effects of sustainable transport policies on productivity, competitiveness, and economic growth cannot be underestimated.

Local, regional, and international trade activities are accelerated or hindered by the quality of transportation infrastructure in a region. More efficient trade activities and financial benefits are eventually reaped from a well-funded, efficient, and strategically planned transport sector. Similarly, the facilitated flow of people and goods across state boundaries translates into higher employment and increased economic opportunities. Increased awareness of the benefits of regional cooperation and international trade has been one of the objectives of ESCWA since 2007. It has therefore been working towards empowering countries to implement policies for improving transport



infrastructure and logistics within the framework of the Integrated Transport System in the Arab Mashreq (ITSAM) (ESCWA, 2009b).

b. Social implications of a green transport sector

As indicated earlier, a sustainable transport infrastructure promotes cost effective transport services including public transport. This enhances accessibility to markets, services, employment opportunities, and reduces poverty in communities regardless of gender and age. Improving affordable modes for commuting such as walking, cycling, and public transportation increases overall basic accessibility and economic opportunities.

When sustainable measures are introduced and implemented in the transport sector, remote and rural areas can be connected to the transport grid, which will tend to reduce rural to urban migration, enhance community development and productivity, and improve income distribution.

According to the World Bank (2011b), "efficient transport systems and roads also facilitate access by health workers to often sparsely-populated rural areas as well as the necessary monitoring and supervision of health services and initiatives." This will allow for efficient and affordable delivery of health care services to all regions within a country. Additionally, the impact of sustainable transport on children and women, especially in rural areas, who often suffer disproportionately from poor transport, is often profound. This is a reflection of the fact that better transport services help to ease the risks of travel and thus allow more opportunities for school attendance, home hygiene, and prenatal care.

c. Implications of a green transport sector on environmental sustainability

More sustainable patterns of transportation will significantly reduce GHG emissions and air pollutant levels. While these benefits contribute to environmental sustainability, the benefits extend to reducing the significant economic and social costs of environmental degradation alluded to earlier.

In addition, green transportation infrastructure promotes exercise and recreation and improves health. These are factors which are often overlooked but have essential positive impacts specifically on productivity and human wellbeing.

VI. CONCLUSION AND RECOMMENDATIONS

Deficiencies in the Arab transport sector continue to pose challenges for transitioning to more sustainable patterns of transportation. Urban transport services are characterized by inadequate mass public transport and road congestion. Poor fuel quality and an ageing vehicle fleet contribute significantly to the poor air quality observed in a number of Arab cities. The sector accounts for 22% of all greenhouse gas emissions in Arab countries and consumes 32% of the total energy used, posing energy security risks. In countries with large rural populations, such as Egypt, Yemen, and Morocco, access to rural areas is constrained by inadequate road infrastructure. Regional transport networks suffer from inefficiency. Fatalities and injuries from road transport in a number of Arab countries remain high compared with other regions of the world. Urban and transportation planning are not well integrated, leading to sprawl, land degradation, and increased vehicle use. These trends are exacerbated by the rising demand for transportation and the excessive reliance on private cars, which are driven by increased urbanization, high-income life style, and economic growth.

These transportation trends deprive Arab countries of the economic opportunities, desperately needed, to create new employment, improve competitiveness, and promote rural development. Trade flows are retarded, and so is economic integration, but they are vital for the economic

growth prospects of Arab countries. Arab cities are increasingly choked by high vehicle densities, traffic congestion, poor air quality, noise, and poor visibility. These trends add up to significant losses to productivity and to high health care costs, which place a high burden on government budgets and subtract from its GDP. The lack of adequate mass public transport in many Arab cities deprives many groups from access to economic centers and social services, which contributes to inequitable social development. These costs combined are estimated to lead to a 3-10% loss of a country's GDP.

To bring about a shift to green transportation, Arab governments are urged to take the following steps:

- Invest in public transport and non-motorized forms of transport, while providing incentives to promote their use.
- Invest in rail transport to move freight and to transport people within busy corridors.
- Adopt national fuel economy standards for vehicle fleets.
- Remove broad fuel subsidies gradually, while employing targeted subsidies to reduce the vulnerability of low-income groups to high transport and commodity prices.
- Accelerate car replacement programs using incentives to take ageing, polluting cars off the road, and establish a vehicles emission testing program.
- Upgrade the quality of fuels, particularly by reformulating gasoline and reducing sulfur content in diesel.
- Introduce and promote through incentives low carbon fuels, such as compressed natural gas.
- Apply mixed-use land management concepts in urban planning to reduce travel distances and protect land from degradation.
- Adopt transportation demand management practices that reduce vehicle trips by increasing vehicle occupancy, reducing vehicle distances travelled, or both.
- Accelerate the development of an electrification infrastructure for railway trains and vehicles.
- Improve the performance and capacity of public transportation departments and nurture appropriate technical expertise.
- Design appropriate interventions to reduce road fatalities and injuries caused by accidents.
- Raise awareness about fuel-saving purchasing, driving, and maintenance habits among vehicle fleet owners.

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SUSTAINABLE DESERT DEVELOPMENT CORRIDOR A SUPERHIGHWAY TO SOLVE EGYPT'S PRESSING PROBLEMS

Farouk El-Baz

Introductory Remarks

This paper improves the case for a proposed superhighway west of the Nile from the Mediterranean Sea coastline to Lake Nasser. The proposal would provide numerous opportunities for the development of new sustainable communities, based on sustainable agriculture, industry, trade and tourism around a 2,000 km strip of the Western Desert. The proposal is resubmitted for consideration by the private sector – local, Arab and international investors.

Adequate transportation routes and mechanisms are essential to ever-increasing development. From the time of establishing the Egyptian State over 5,000 years ago, the Nile served as a mechanism to transport people, news, products, armies and tax collectors – all aspects of a unified, sustainable state. Similarly, the Greek, Roman, and Arab civilizations assured the ease and security of travel within the boundaries of their vast territories. More recently, European development was greatly assisted by the ease of transportation at the rise of Western Civilizations. It is also clear that superb transportation systems allowed the United States to better utilize its vast natural resources to reach its present position of prominence.

It is not possible to foresee the establishment of a modern network of transportation systems within the confines of the Nile Valley and its Delta, because that would reduce agricultural land. The fertile soil within the inhabited strip of Egypt was deposited by the Nile River over millions of year, and it is irreplaceable. In the meantime, the growth of population negates the potential of continuing to live on and utilize only 5% of the land area of Egypt. Thus, it is imperative to open new vistas for expansion outside of the inhabited strip, an expansion that would take into account social, environmental and economic development aspects. This proposal provides an innovative solution to the numerous problems that face Egypt today.

In addition to facilitating transport throughout Egypt, the proposed superhighway would ensure the creation of sustainable communities and activities without compromising the environment. It should limit urban encroachment over agricultural land and opens myriad

opportunities for new communities and generate employment close to over-populated towns. It also affords unlimited potential for new schools and training centers, industrial zones, trade centers, tourism; i.e., virgin territory for development initiatives in every field that promotes sustainable development and green investment. This in itself gives hope to generations of Egyptians for a better future. It represents the best possible use of one of Egypt's natural resources – the strip of the Western Desert that parallels the Nile and is close to its high-density population centers.

This particular strip of land was chosen because of its unique natural characteristics. It is basically flat with a gentle northward slope from west of Aswan to the coast of the Mediterranean Sea; the lack of topographic prominences makes it easy to pave. This strip is also devoid of east-west crossing valleys that are prone to flashfloods as in the case of the Eastern Desert. It passes close to vast tracts of fertile soils that are amenable to reclamation; most of such regions have potential for groundwater resources. The strip is also comparatively free of sandy areas; it is not crossed by lines of shifting dunes as in the case of regions farther to the west. Furthermore, the region is endowed with plentiful sunlight and persistent northerly wind. These conditions allow the use of renewable solar and wind energy in the future. Based on the above, the proposed project includes the establishment of the following:

- A superhighway to be built using the highest international standards, 1,200 km in length, from west of Alexandria to the southern border of Egypt.
- Twelve east-west branches, with a total length of approximately 800 km, to connect the highway to high-density population centers along the way.
- An efficient and affordable railroad for fast passenger and freight transport parallel to the superhighway.
- A water pipeline from the Tushka Canal to supply freshwater.
- An electricity line to supply energy from renewable sources.

North-South Highway

The main highway runs parallel to the Nile River from Egypt's Mediterranean Sea coastline to its border with Sudan. Its distance from the Western scarp of the Nile

Valley varies from 10 to 80 kilometers, based on the nature of the crossed land. It begins at a point between Alexandria and El-Alamein, perhaps near El-Hamman, to be selected for the establishment of a new international port. Egypt requires a technologically advanced port to serve future needs of import and export as well as increased trade with Europe and the expansion of maritime transport worldwide. In the meantime, the northern branch of the superhighway extends to Alexandria and its present port and airport and eastward through the Nile Delta coastal highway to Rosetta and Damietta.

The superhighway ends near the border with Sudan to allow a future extension to better link the two neighboring countries. Better ground links between Egypt and Sudan would have a positive impact on the economies of both countries. Near the terminal point, branches extend to Lake Nasser, Abu Simbel, and the Tushka depression – all regions that have promise in development of fisheries, tourism, and agriculture, respectively.

The aforementioned characteristics of the superhighway require the establishment of a private sector organization to manage the road and its maintenance. The organization would be responsible for manning the toll stations, providing emergency services, and maintaining the utility of the superhighway. Naturally, such an organization requires a specific mandate and clear laws and regulations by the Egyptian Parliament to assure the safety and utility of the highway while placing limits on excessive government regulations or company profits.

East-West Connectors

Branches of the main highway oriented in a roughly east-west direction would connect it to the main centers of population, based on comprehensive environmental impact assessment studies. They assure easy transport between the main cities of Egypt and between the main production areas and the outside world. Such branches may include the following:

Alexandria Branch: This branch connects the main north-south highway to the road leading to Alexandria, its port and airport. The eastern terminus of this branch would connect with roads leading to the northern cities and towns of the Nile Delta coastal zone including Rosetta and Damietta.

Delta Branch: This connects the superhighway with the heart of the Nile Delta, for example, at the city of Tanta.

The branch would best be an elevated new road within the Delta to limit encroachment on the fertile land. It also might require a new bridge over the Rosetta Branch of the Nile River. From its terminal point at Tanta, it branches to upgraded roads leading to cities and towns of the Nile Delta. This would assure better links between the Delta and the rest of Egypt and the outside world.

Cairo Branch: This branch connects the superhighway with the Cairo-Alexandria road. It is envisioned to link it with upgraded roads leading to Maadi and eastward to Suez. This would allow the use of cargo land transport between Alexandria and Suez (the Mediterranean Sea and the Red Sea) as an alternative to the Suez Canal when the need arises.

Faiyum Branch: This connector would allow the development of the desert north of the Faiyum depression by establishing sites for tourism, new communities and agricultural areas. It also would allow an extension to the west of the depression for establishment of industries such as cement production.

Bahariya Branch: This branch improves the existing road to the Bahariya Oasis as a northern link to the New Valley Province to the south. It would also allow further development of the natural resources of the Bahariya depression including the iron ore deposits.

Minya Branch: The city of Minya has been one of the major population centers from ancient times. However, little development has reached its shores because of the centralization of projects in and near Cairo. Minya has a university and can generate numerous avenues for local and regional development if it is better connected to the national market.

Assiut Branch: This case is identical to that of Minya in all aspects. In addition, Assiut has an airport that could be upgraded for civilian transport. It is also the end point of the road from Kharga, the capital of the New Valley Governorate, at the Nile Valley. This road is paved over the ancient Darb El-Arbain, the track of camel caravans connecting the Nile Valley and the oases of Darfur in northwestern Sudan, which can be upgraded and revitalized.

Qena Branch: This connector would open for agricultural development a vast area south of the Nile from the Qena Bend in the east to Nag Hammadi to the west. This plain represents fan deposits of streams that were more active

during wetter climates in the past; therefore, groundwater resources would potentially underlie it. A westward road could also connect it with the existing road to the Kharga Oases to link the superhighway with the southern part of the New Valley Province.

Luxor Branch: This branch would allow unlimited growth of tourism and recreation on the plateau that overlooks the largest concentration of ancient Egyptian archaeological sites. It allows the erection of hotels and resorts on top of a magnificent plateau overlooking the Nile Valley.

Kom Ombu-Aswan Branch: Like the Qena Branch, the Kom Ombu segment opens up a vast tract of fertile land west of the Nile for reclamation. The region once hosted the channel of the Nile; segments of its ancient courses were revealed by radar images from space. Because of geological reason, the Nile shifted its course eastward to its present location. Therefore, the abandoned land to the west would include fertile soil of the ancient Nile sediments. This makes it an excellent location for the expansion of agriculture west of the Nile. The Aswan segment connects the superhighway to the city of Aswan. It would allow the transport of products to and from the northern governates and the outside world. It would also allow the expansion of winter recreation resorts and ecotourism near the many archaeological sites and the High Dam.

Tushka Branch: The superhighway goes through the northeastern edge of the Tushka depression, where a canal from Lake Nasser has created several lakes. This region is slated for agricultural expansion. It is presently devoid of an adequate transportation infrastructure. The superhighway would provide all necessary mechanisms to transport people, material and products to and from the Tushka region.

Lake Nasser Branch: This connector is to be selected at a site that is amenable to the development of a major fishing port along the shores of Lake Nasser to the north (downstream) of Abu Simbel. Plentiful fish from the lake could be transported via the railroad to distribution centers throughout Egypt. The concept of sustainable fishing should be promoted with fish providing nutrition for the local population and for export. The branch might also increase the potential use of Lake Nasser for eco-tourism.

Modern Railway

Egypt's railroads are very old and their tracks are laid on relatively soft soils that do not allow fast



movement by heavy loads. Thus, the need exists for an advanced railroad system to serve present and future requirements of development. A rail-track parallel to the superhighway would serve that purpose. If deemed necessary, connecting tracks could be established along some of the east-west road branches in the future. An energy efficient and even an electric railroad system should be considered in order to reduce harmful emissions and their impacts on health, the environment, and ecosystem.

The aluminum manufacturing plant at Nag Hammadi west of Qena represents a good example of the need for a new railroad for industrial uses. At present, the raw material arrives from abroad at Alexandria. It is transported by heavy trucks from Alexandria to the factory in Nag Hammadi on the ailing and very crowded road network of the Nile Delta and Nile Valley. After processing, the aluminum is transported northward along the same road network. A railroad from the Mediterranean port to the Nag Hammadi connector would ease the operation, in addition to saving lives and property along the existing road network.

The superhighway ends at the southern border of Egypt along the Selima-Edfu camel caravan route. At this point, a short segment of road would connect it to the shores of Lake Nasser across from the town of Wadi Halfa, near the

northern border of Sudan. There is a railroad that connects Wadi Halfa to the rest of eastern Sudan. Thus, it would facilitate transport between Egypt and the main cities and town of Sudan.

Water Pipeline

No development could be assured without the presence of freshwater. Even though several areas along the path of the superhighway promise the existence of groundwater, a pipeline of fresh water from the Tushka Canal is required to run the length of the superhighway. It is envisioned that a pipe of about one meter in diameter would provide the necessary resources for human consumption during the early phases of the project. Agricultural and industrial development along the east-west connectors would be supplied either by groundwater resources or subsidiary canals from the Nile. However, measures for the efficient and rational use of water should be introduced, including the recycling of water for reuse.

After pumping the water from the Tushka canal up to the plateau for approximately 300 meters, it would flow northward along the topographic gradient without any need for energy. It is even possible to imagine that the water flow down-gradient might be usable to produce mechanical energy that can be converted to electricity.

Electricity Line

Initial phases of the proposed project require energy for lighting, refrigeration, and other needs. Therefore, a line to supply electricity is one of the requirements of the project. The required power can be supplied mainly from renewable sources of energy (wind and solar).

Urban communities, industrial plants, and agricultural farms to be initiated along the east-west branches should be encouraged to utilize solar and/or wind energy resources as much as possible. It might also be mandated by law to generate at least 25% of total energy needed from renewable resources. This encouragement can be in the form of tax breaks or grants from the Egyptian Government or international environmental agencies.

Project Benefits

It is important to evaluate the pros and cons of any

proposed project. In the case of the present proposal, its design should ensure that it does not result in negative environmental and social implications. The main question that comes to mind though is how long it takes to secure a return on the investment of such an elaborate infrastructure. This question can only be answered by feasibility studies, which should take into account environmental and social costs and benefits.

In the meantime, it is possible to list the benefits of the proposed project as follows:

- Ending urban encroachment on agricultural land in the Nile Valley.
- Opening new land for desert reclamation and the production of food.
- Establishing new areas for sustainable urban and industrial growth near large cities.
- Creating hundreds of thousands of new jobs for Egyptian labor.
- Arresting environmental deterioration throughout the Nile Valley.
- Reducing CO₂ emissions, preserving the environment, the ecosystem and the services it provides.
- Relieving the existing road network from heavy and dangerous transport.
- Initiating new ventures in tourism and eco-tourism in the Western Desert.
- Connecting the Tushka region and its projects with the rest of the country.
- Creating a physical environment for sustainable development projects by the private sector.
- Involving the population at large in the development of the country.
- Giving people, particularly the young, some hope for a better future.
- Focusing people's energy on productive and everlasting things to do.

Method of Execution

Although the project was proposed twenty years ago for execution by the Egyptian Government, its scope and the variety of its benefits suggest that it can best be accomplished by the private sector. At the time of the original proposal, experts placed its cost at six billion dollars. Perhaps now the necessary infrastructure would cost four times as much. However, the cost would not be too high for decisive solutions to many of Egypt's present problems, and tangible options for a better future. Furthermore, it would not represent a burden to

the Egyptian Government, because it would be totally financed by the private sector – local, regional and international investors. Naturally, this would require a vigorous and well thought-out marketing campaign.

During the past twenty years, I have repeatedly written and widely lectured on the proposal at universities and research centers throughout Egypt. Audiences receive it with great enthusiasm and consider it ideal for a “national project,” that is something the whole nation can get involved in its planning, execution and utilization.

Therefore, it is envisioned to involve experts from universities and research centers in the study and evaluation of various aspects of the proposed project. It would also be necessary to plan the training of workers in numerous fields for employment in various aspects of the project. In addition, governorates may initiate lists of the kinds of development projects that could be established in their territories once the project begins.

It would also be advisable to involve the young in the process; the project is proposed to assure a better life for future generations. University students could compete for prizes in recommending projects on either side of the connectors along the superhighway. High school students could be given opportunities to compete for other prizes for naming the east-west branches and the new towns and villages to be established along these branches. If a large number of people become involved in the project, it would have a better chance for being considered a “national project,” one that the society as a whole owns and protects.

Concluding Remarks

My granddaughter Yasmien is 10 years old and attends school in Washington D.C., where her parents live. She returned from school one recent day to tell her mother that the teacher mentioned Egypt in the first lesson in history. She added that the teacher said that history repeats itself and asked if it were true. When her mother answered positively, she excitedly asked: “Does this mean that Egypt can be great again?”

We need to answer the question of this youngster who lives far away, but keeps Egypt in her heart and mind. The answer requires deep thinking and hard work by a generation or two. Egypt has lived through many great



episodes while its people were focused on their work, supportive of each other, and aimed at the common good. Once in a while, Egyptians fall into a quietude, hermitically sealing their minds, and receding from the world around them. But, stagnation events are usually short, and Egyptians spring back into action leading the way to civilized life. Is it fair then to ask: “When will Egyptians return to holding the banner of civilization?”

From the earliest time of recorded history, civilization blossomed among groups of people who were collectively able to achieve the following:

- Production of excess of food, for the growth of their bodies and minds.
- Division of labor among the society, in a fair and well-organized manner.
- Easy and healthy living in urban areas, where some of them could create and innovate.

Therefore, Egypt needs to satisfy these three conditions before paving the road for the re-spread of civilization along the banks of the Nile River. It is my belief that the proposed “Superhighway for Sustainable Development” would go a long way toward achieving these goals. This needs strong faith in the resilience of the descendants of the energetic builders of the Pyramids. It would require a mere generation or two for this development initiative to bear fruit. This is not a long time in the 8,000-year history of Egypt, which deserves a distinguished position among great nations now and in the future.

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Cities and Buildings

MOHAMMAD AL-ASAD
TAREQ EMTAIRAH



This chapter examines the opportunities and benefits that can be made available to city residents in Arab countries by promoting green buildings and cities. The subject is discussed at both the micro and macro levels, addressing the individual building as well as the city.

The promotion of green practices in cities concentrates primarily on limiting energy and water consumption. Reducing energy consumption through energy efficiency and more sustainable practices should and can be achieved by taking a number of measures aimed at avoiding pollution, enhancing the quality of life, and accommodating and even encouraging economic growth.

Most of a society's energy consumption takes place in the city. Energy use statistics vary from country to country, but energy consumption for the upkeep and running of buildings as well as for urban transportation takes up over half of the total energy consumption in the city (UNEP, 2011a). Another quarter of that energy consumption is taken up by industry (UNEP, 2011a). Any measures that curtail energy consumption, while maintaining productivity levels and controlling costs, will greatly enhance overall economic performance.

Promoting green practices in buildings and cities involves a wide range of activities. These include developing energy-efficient, non-polluting transportation systems as well as energy-efficient building practices, water-conserving open green areas, and renewable energy resources. They also include rethinking the concept of waste management to incorporate extensive recycling and water treatment. Water, transportation, agriculture, energy, and waste management will be discussed in separate chapters in this report.

In addition to instating new technologies and practices, there is a need to formulate appropriate legal and administrative frameworks. These would empower and encourage city residents, as well as municipalities and other public institutions involved in managing urban centers, to adopt and promote green and sustainable buildings and urban systems.

Promoting green practices in buildings and cities does not need to reinvent the wheel, for there is much to learn from practices deeply rooted in the region's heritage. New technologies, processes,

models, and frameworks will certainly have to be devised. However, it should be noted that traditional patterns of urban living and building construction prevalent in the Arab world (and elsewhere) generally have followed what would qualify as green practices. This has continued to be true even into the modern period, as late as the 1970s. Examples are found in urban transportation, energy consumption in buildings, water consumption, and waste generation. People had very limited resources available to them, and they therefore used these resources in the most efficient way possible. Increased wealth in the region has destroyed this ethic of conservation. An illusion of endless abundance of resources prevails; energy today is splurged, and the wasteful consumption of resources has become the norm.

Most of the Arab world, however, has reached a stage where current practices are no longer sustainable. The trend of increasing oil prices over the long term is making it impossible to continue with present rates of energy consumption, at least in countries that do not have significant oil reserves. Moreover, environmental degradation has reached alarming levels. Air, water, and soil pollution and contamination now pose serious health risks and threaten various economically important activities, particularly those related to food production. Valuable and scarce agricultural land is being destroyed by excessive urban sprawl and the uncontrollable building activity it brings with it. Solid and liquid waste is being indiscriminately dumped on land in and around cities and in water bodies. The size of a number of cities in the Arab world has reached unmanageable levels. In addition to suffering from the chaotic land-use patterns as well as the unsafe and shoddily-constructed structures that accompany such unregulated growth, Arab cities have to contend with overwhelming traffic congestion. Movement in cities often comes to a standstill, rendering them dysfunctional.

This chapter identifies the challenges that need to be addressed and the opportunities that are available to promote green and sustainable buildings and cities. It discusses existing conditions, and it projects possible scenarios and solutions. Achieving greener buildings and cities in the Arab world is not only a rational way forward, but it is also a necessity. This chapter explores possibilities for achieving this goal and making it a reality.

SECTION ONE: CITIES AND URBAN PLANNING

I. INTRODUCTION

The Arab world generally has invested considerable resources in construction activities. This was especially the case during the oil boom period of the 1970s and 1980s, as well as that extending from 2003 to 2008. Since many of the projects planned during these periods are large-scale and long-term, construction has continued well beyond the period during which oil prices have gone up. Accordingly, although the construction boom of 2003 to 2008 has somewhat subsided as a result of the 2008 financial crisis, many of the large-scale projects that were initiated then are still under construction, and will continue to be for some time.

Most construction activity takes place in cities. Even large-scale projects taking place outside cities are often intended to serve cities, particularly with infrastructure works such as highways, airports, sewage treatment, and power generation plants. There are currently numerous projects to develop new urban centers, often from scratch. For example, new cities are being constructed in Jordan, Saudi Arabia, and the United Arab Emirates (UAE). These include the King Abdullah City next to Zarqa, Jordan, the King Abdullah Economic City and the Jazan Economic City in Saudi Arabia, and Masdar City in Abu Dhabi. The degree to which green practices are incorporated into such building and urban development activities will have a great impact on the rate at which the greening of Arab economies may be achieved.

II. IMPLICATIONS OF CURRENT URBAN CITY POLICIES

Arab countries, like other developing world countries, have, over the past few decades, experienced extensive growth of their major urban centers, particularly their capital cities. These cities have come to fully dominate the political, cultural, and economic life in their respective countries, usually to the detriment of other urban centers. Many have emerged as mega metropolises, housing a huge number of residents. Exact statistics are often hard to find,

but it is clear that the major cities of the Arab world continue to undergo excessive growth. Conservative statistics place Cairo's population at over 12 million (while many other estimates place it closer to 18 million). The populations of metropolitan centers such as Baghdad, Khartoum, and Riyadh have surpassed the 5 million mark. Others, such as Alexandria, Algiers, Amman, Casablanca, Damascus, and Jeddah, have populations that exceed 3 million inhabitants¹ (ESA, 2008).

The rapid growth of these cities has had numerous negative consequences. They have grown so quickly that their infrastructure systems, whether those related to transportation, water and electricity supply, or waste management, have all become incapable of adequately supporting their populations. For example, many suffer from municipal solid waste management problems. This is most clearly evident in Cairo, where city-wide efforts for solid waste management have become more or less dysfunctional (DNE, 2010). Interestingly enough, a considerable amount of the solid waste generated in Arab cities results from construction and demolition work. Some estimates indicate that such waste accounts for over half of the overall waste generated in countries of the Gulf Cooperation Council (GCC) (Khaleej Times, 2011). Infrastructure problems extend even to oil-rich countries in the region. The rapid construction boom in cities like Dubai, Jeddah, Kuwait City, and Riyadh was not matched by a proportionate growth in infrastructure development, as manifested in raw



sewage sweeping coastal beaches, or rainwater flooding streets (AFED, 2008).

The various infrastructure problems in Arab cities create conditions of considerable inefficiency in energy consumption, particularly relating to urban transportation. Mobility in these large cities is heavily impeded by congestion and poor planning. For many, a good part of the day is wasted in traffic rather than being spent in more productive activities. Air pollution levels have become extremely high in the Arab world's larger cities. Most of that air pollution comes from vehicular emissions. Other sources include emissions from the heating and air-conditioning of buildings and from industrial facilities. Traffic

also contributes significantly to noise pollution in those cities.

Cities suffering from such problems are not able to effectively compete with other world cities where growth is better managed, waste is efficiently and extensively recycled, public transportation is efficient, and other infrastructure systems function properly. Prevalent environmentally destructive practices result in various negative consequences for urban residents, including increased health problems, reduced productivity, the pollution of water resources, and the erosion of infrastructure networks.

Also of relevance is the lack of access to adequate

FORTIMO LED STREET LIGHTING IN EINDHOVEN

Located in the south of the Netherlands, Eindhoven is emerging as an energy-saving city. It has long been known as *Lichtstad*, or the "city of light," due to the presence of Philips headquarters since 1891. The local municipality decided to become an environmental leader by replacing existing lamps with light-emitted diode (LED) technology, without sacrificing cost, functionality, or aesthetics.

The municipality introduced the Fortimo LED light technology to its public streets. Unlike traditional LED lighting suitable only for narrow streets, the Fortimo modules can be used for residential streets up to 10 meters in width.

The pilot project recently kicked off in Eindhoven by replacing five luminaries with Residium luminaries fitted with Fortimo LED light modules. The local authority noticed a considerable difference, as the newly installed luminaries produced soft white lights with perfect color rendering compared to the orange color produced by the old high-pressure sodium lamps. The new LED lights performed better.

With a 30-watt light source, the Fortimo seems to produce just as much light as a 50-watt high-pressure sodium lamp. The old lamp consumed 70 watt when used in combination with ballast. This replacement has generated energy savings up to 57% for the municipality, not counting the longer lifetime of the new LED lighting modules. With a lifetime of 50,000 burning hours, the Fortimo lasts three times longer than its predecessor. In comparison with the PL-L lighting used in several parts



of the town, the Fortimo module achieves about a 20% energy saving.

Reducing carbon dioxide emissions is another target set by Eindhoven's municipality. The municipality will soon install 51 Fortimo modules in the *Ministerlaan*, reducing CO₂ emissions by 3.5 tons. This is equivalent to saving a forest the size of a football pitch.

The pilot project demonstrated that investing in energy-saving lighting technology generates cost savings that will offset the higher initial capital cost, while gaining environmental benefits and improved lighting performance.

http://www.lighting.philips.co.uk/subsites/oem/projects/casestudy_ministerlaan.wpd

housing in cities in the Arab world. Land prices and construction costs have reached levels that make them beyond the financial means of many, even those with long-term gainful employment. This lack of access to decent-quality affordable housing has contributed to the spread of slum areas (usually euphemistically referred to as “informal settlements”), characterized by inadequate - if not absent - basic services and by ambiguous conditions regarding land tenure. Slum areas are environmental blights where systems for solid waste management or sewage treatment are painfully lacking. These problems even exist in the cities of the Arab world’s most affluent countries, where large numbers of migrant workers usually live in poorly planned, built, and served districts (Allen, 2009).

In contrast to the spread of informal settlements that serve the poor of the city, privately managed gated communities and expansive suburban developments are becoming increasingly widespread to serve affluent residents (ElSaiyyad, 2011). These are located at a distance from the city center. In addition to emphasizing conditions of socioeconomic segregation in cities, these low-density developments further contribute to urban sprawl and further expand the geographic limits of the city to unhealthy levels. Such urban sprawl means that various urban services, such as transportation networks, the supply of water and electricity, or waste management systems, need to cover larger low-density geographic areas, resulting in inefficient and poorly-functioning infrastructure systems.

Public green areas, which serve as the city’s breathing spaces and essential places for relaxation and leisure for its inhabitants, are very much lacking in Arab cities. In the United States, for example, most cities feature 20-40 square meters of green areas for each inhabitant (Loukaitou-Sideris, 2006). In Dubai, where there have been serious efforts to develop public green areas, the figure remains at less than 14 square meters (Construction Week, 2010); in Beirut, it is less than one square meter (Slemrod, 2011). In addition, water-conserving landscaping concepts are generally absent from existing public green areas.

Water resources have been considerably mismanaged in urban centers as a result of

uncontrolled urban growth. Rivers, streams, and underground aquifers have been heavily polluted or overused, and wastewater is often left untreated. Even the most affluent cities in the Arab world, such as Dubai and Jeddah, have been facing problems related to sewage disposal and treatment. The lack of efficient sewage disposal networks has meant that sewage is often illegally dumped, usually making its way to city streets or coastal waters (Keyrouz, 2008).

Numerous ecosystems and agricultural land in and around Arab cities have been destroyed as a result of uncontrolled urban growth. Agricultural land, forested areas, grazing areas, and water bodies such as streams have all been viciously decimated because of such growth. This is clearly evident in the loss of agricultural land and green areas around cities such as Amman, Beirut, Cairo, and Damascus.



These agricultural and green areas supplied cities with food, tempered its climate, and provided cities located near arid zones with protection from dust storms. Moreover, the Amman Stream that traditionally used to run through the city became an underground sewer conduit. The famed Barada River of Damascus only has a trickle of water running through it during the dry season, and it often resembles an open-air sewer conduit. In the cities of the GCC countries, desalination plants and the construction of massive human-made islands are having disastrous consequences on existing marine ecosystems in the Gulf waters (Dickie, 2007).

There are also tremendous inefficiencies in energy consumption, which pervade all sectors and city activities, particularly in the oil producing countries of the GCC, which feature some of the highest per capita energy consumption levels in the world (WRI, 2007). This is partly a result of the region's high temperatures and high humidity levels, which are addressed by the extensive use of energy-guzzling air-conditioning systems. Moreover, wealth has created a culture of excess. Private car ownership is very high, and private cars dominate movement in cities of the region. These cities are also marked by an abundance of high-water-consuming landscaped areas. The significant amounts of water required for these landscaped areas are secured through desalination. Imported species of plants are widely used, which require vast amount of water and are not suitable for desert condition. As mentioned above, these cause considerable damage to surrounding ecosystems. The "waste" water resulting from desalination activities, with its high levels of salinity, is dumped

into the sea, thus decimating existing marine life. Moreover, desalination plants consume energy intensively and result in considerable air pollution. Although it is possible to keep up such practices in the Gulf region - though with high environmental costs - as long as oil is abundant, they will come to a crashing halt once oil runs out.

All these challenges bring with them significant economic costs and inefficiencies that place serious pressures on the economies of Arab countries.

III. ENABLING CONDITIONS FOR GREEN CITIES

A new approach is needed for city planning and governance, built on environmentally sustainable urban design principles and community participation. Enabling policies and conditions should be introduced with an eye on protecting agricultural and green areas in and around cities, guarding natural water resources, creating well-functioning public transportation systems, constructing energy-efficient buildings, adopting efficient water use, and putting in place efficient waste management systems. Such practices will guarantee that energy and water resources are managed sustainably, food is produced in proximity to the city or even in the city, clean water is more readily available for various uses, and that services meet inhabitants' needs. These efforts will create healthy and economically competitive urban communities that offer a higher quality of living for their inhabitants.

A. Zoning

One of the most effective urban planning policies for city and municipality administrators is zoning. Fundamentally, zoning consists of regulations that determine what may be built where in and around the city, and how much may be built. It is an essential urban planning tool that can be used to (re-) configure cities in a manner that supports energy efficiency, environmental protection, and greater sustainability. Zoning needs to be coupled with other relevant urban management instruments in order to provide incentives for change. One such instrument is taxation. For example, property taxes or property



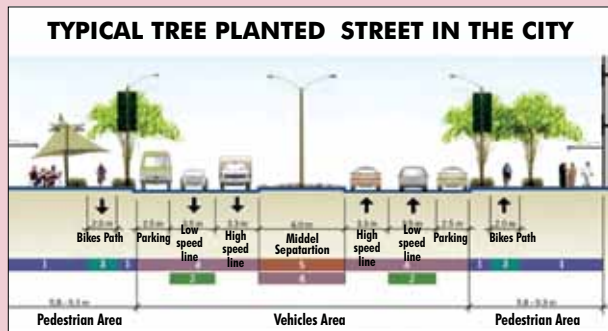
ABU DHABI'S FUTURISTIC STREET DESIGN

The Abu Dhabi Urban Planning Council (UPC) has adopted new street design standards that accord with the guiding principles of the "Vision 2030" which seeks to offer safer, more comfortable, and aesthetic streets throughout the Emirate. "The Urban Street Design Manual" stipulates that all street designs should give priority to satisfying the needs of pedestrians, ensure universal access, and meet the environmental sustainability requirement embraced by the "Estidama" initiative launched by UPC.

The Manual complements the Abu Dhabi transit infrastructure components as per the "Vision 2030" which is designed to enhance the quality of life in the Emirate. This approach shall also be applicable to other development projects supervised by UPC, including waterfronts, community and sports facilities, natural environment, cultural heritage, and revitalization strategies.

The Manual has been released for the purpose of reducing individuals' reliance on private cars for commuting by establishing a public transit network that includes high-speed rail, trams, and buses. Moreover, a network of new streets and retrofitted existing ones to accommodate various means of transport shall make Abu Dhabi a safer and more suitable place for pedestrians, bikers, and public transit commuters. The new design standards shall be applicable to all streets of the Emirate except freeways and rural arterial roads.

The Manual supplies designers with the necessary tools for ensuring that all the components of the area between the pavement and the facades of buildings are in the right place and have the right size. Pedestrians shall have unobstructed sidewalks and due care shall be given to the placement of street lights, traffic signs, utility boxes, benches, and trees.



Following the guidelines of the Manual will render the appropriate design of streets in relation with their surroundings. For example, streets lined with shops shall have wide and better shaded sidewalks that are distanced from the traffic lanes. In addition, there shall possibly be sidewalk cafes and some trees.

On the other hand, streets in residential neighborhoods shall be designed for low traffic speed with safe pedestrian crossings to encourage residents to walk to local services, and to provide quiet family environments.

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sales taxes may be increased or decreased in order to influence development patterns and urban activities. Taxation may be used to encourage green growth in certain cities in a given country while slowing growth in other cities where it has reached unmanageable levels.

Before presenting how zoning may achieve this, a few remarks should be made about maximizing the effectiveness of zoning regulations. They need to be carefully developed to suit local realities such

as available lot sizes in the city, topography, and climate. Zoning must give significant consideration to the preservation and protection of structures and neighborhoods that possess a rich cultural heritage. Moreover, for regulations to be effective, available human resources must be involved in urban management. Competent personnel are required to ensure that urban regulations are implemented and enforced. They also need to be up to date regarding developments in the field of urban planning and the urban management tools it offers.

THE ARAB ORGANIZATIONS BUILDING IN KUWAIT: AN EXAMPLE OF MODERN ECO-FRIENDLY ARCHITECTURE

Among glass high-rise buildings that have invaded the Gulf countries stands a unique building in Kuwait: the Arab Organizations Headquarters Building, a model of modern environmentally-friendly construction. The building, which is home to the Arab Fund for Social and Economic Development, adapts the traditional Arab house design which is built around a courtyard. Therefore, all the offices in the building overlook the spacious central courtyard which carries nature inside. The splendor of the interior is not reflected on the exterior of the building which is seen from a few kilometers as a massive cube of gray granite covering 54,000m², and dotted with deep slanting openings on all sides.

As you enter the building, which was completed in 1994, you feel like swimming in the light. You do not feel any draft blowing from air conditioners, nor do you feel any disturbing heat. Special insulation and lighting systems have created, inside the building, a temperate and comfortable environment. This eco-friendly building consumes less than half the quantity of energy used in any other glass building of the same size. In addition to having all these environmental qualities, the building is an embodiment of modern architecture with all its advanced technologies.

Upon entering the building, a visitor is overwhelmed

by its grandeur, extensive dimensions, and lofty heights. One can sit calmly for hours in the waiting room with nothing to hear but the trickle of water from the fountain and nothing to see but stunning scenes around. Attention is immediately drawn to the left side where there is a great waterfall over a Moroccan, light-colored, hand-made mosaic wall.

On climbing the marble stairs that lead from the Moroccan waiting room to the first floor, one would start to hear a melody coming from above mixing the twittering of birds with the gurgling of water. Once on the first floor, your eyes are caught by extended greenery, bright light and ample space. This is the building's main courtyard, an architectural feat manifesting both artistry and power.

Walls and partitions on all floors are made of glass, making it possible for anyone standing at one end of the building to look through to the opposite end easily.

A critical design challenge was to exclude excessive exterior heat while retaining natural light. This was achieved after a careful study of the sun's rays that reflect on the building throughout the year. The windows were designed in directions that do not allow direct sunlight into the building, and artificial lighting was made in a

Municipal staff as well as others involved in urban management should be able to resist pressures from special interest groups who may attempt to manipulate zoning regulations. Zoning interventions are often accompanied by fierce lobbying from entrenched economic interests. Such lobbying may even take the form of corruption. This is not surprising considering that most zoning regulation will have a considerable impact on real estate values. Real estate owners and developers will lobby to ensure that zoning regulations will not adversely affect the value of their properties, and will push for regulations that increase these values. City governance must hence have adequate mechanisms, such as transparency and accountability, put in place to allow municipal staff to resist such pressures and to provide effective controls that keep excessive building activity in check.

It is essential to assess the economic, social, and environmental impacts of proposed zoning regulations. For example, zoning regulations will greatly influence the intensity and distribution of economic activity taking place in various parts of the city, and will direct economic activity to certain localities and away from others. One issue to be taken into consideration under such circumstances is to ensure access to transportation for those who will seek employment in areas of increased economic activity. If such access is not readily available, both the business owners and workers will be adversely affected. Places of work that are not easily accessible from where people live provide somewhat similar conditions to situations where there is a shortage of work opportunities.

Moreover, care should be taken to ensure that zoning regulations will not negatively affect



way that gives daylight effect without shades. The glass wall of the courtyard is unobstructed from the north to allow light in while blocking direct sun rays.

The concept, design and execution of the Arab Organizations Headquarters Building is a striking

proof of the success of employing modern architectural techniques adapted to local environments at an age when imitation and copying prevail.

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<http://www.arabfund.org/aohq/KUWAIT.HTM>

existing social structures. For example, allowing the construction of high-rise buildings within a low-rise neighborhood, or allowing new types of activities that bring in a large number of people into a neighborhood, may have negative social impacts on the neighborhood. Such zoning interventions will bring in much higher population densities and activity than the neighborhood may be able to accommodate.

Zoning regulations can also have very strong environmental implications. In fact, zoning is a basic tool for protecting agricultural land and green areas since it can prohibit any substantial building activity from taking place there. Unfortunately, the area of agricultural land that has been lost to urbanization over the past few decades in Arab countries has reached tragic dimensions. The least that may be done at this stage is to stop this bleeding of agricultural land

and green areas by imposing strict enforcement and compliance procedures.

B. Zoning regulations and urban density

Within built-up areas, the best way through which zoning may help achieve more sustainable cities is by promoting healthy densities and environments. Zoning regulations should allow residential, commercial, office, educational, cultural, public, institutional, and recreational uses to exist in close proximity to each other. Neighborhoods would offer their residents a degree of autonomy by featuring numerous facilities, such as schools, shops, office space, and parks. This would allow inhabitants to satisfy most of their daily needs without having to travel long distances. This should be accompanied by increased pedestrian accessibility. Urban density allows city residents to live within walking distance

ARZ GREEN BUILDING RATING SYSTEM

Samir Traboulsi

The ARZ Building Rating System is the first Lebanese green building initiative of international standard with its certification process being administered by the Lebanon Green Building Council (LGBC). It has been established to support the growth and adoption of sustainable building practices in Lebanon, with a specific focus on the environmental assessment and rating system for commercial buildings. For each credit, the ARZ Green Building Rating System identifies the detailed intent, requirement, technologies or strategies to achieve the credit.

Unlike other international rating systems, the ARZ Green Building Rating System was developed by Lebanese expertise of LGBC in partnership with the International Finance Corporation, (IFC), a member of the World Bank group.

The dramatic continuous electricity shortages, energy prices, and unavailability of other resources like water, prompted the development of the ARZ Building Rating System. Its aim is to maximize the operational efficiency and minimize environmental impacts. It is a certification on the existing building operational performance. Property owners and managers will drive their operational cost down while increasing occupant productivity in an environmentally friendly manner.

Just before the launching of the Rating tool event in June 2011, the Lebanon Green Building Council provided an extensive number of training hours, and candidates who completed the credentials were certified. Assessors are experienced building industry practitioners who have demonstrated their knowledge of the ARZ rating system certification process.

The Order of Engineers in Beirut was the first registrant requesting the ARZ BRS assessment of its headquarters. Two other reputable building owners are now processing

and preparing for the delivery of the documentation requirements to initiate the assessment task. Building owners are convinced that certified and rated buildings will attract higher occupancy rates, higher rents, and an increase in buildings' values. Using this tool enables building teams to focus on sustainability, gives them options when considering capital improvements or implementation of best practices, and allows them to benchmark and rate the benefits of various building attributes and procedures.

The rating process will provide an automatically generated report that can help to evaluate opportunities to benefit from energy savings, reduced environmental impacts, integrated corporate goals and practices, and lower costs for maintenance.

Certified assessors are asked to sign the ARZ BRS Code of Ethics and are requested to adhere to its contents with no allowance for any conflict of interest, whether apparent or not. Owners on the other hand are entitled to file an appeal if certain credits are denied, and ARZ BRS will be responsible to resolve such claims within a defined period.

A board of Trustees formed from key stakeholders in the Building industry in Lebanon will monitor and supervise the operation and performance of the ARZ BRS unit.

Benefits expected from the certifications range from getting solid data that supports the productivity assertions, energy cost and environmental footprint, and to establish baseline data on present energy and water consumption in all buildings in Lebanon. Owners will have open windows for exploring low interest financing and for exploring grants funding and accessing available incentives as provided by the Lebanese banks.

Dr. Samir Traboulsi is President, Lebanon Green Building Council (LGBC)

to many of the services they use regularly, and also to public transportation systems, thus minimizing the dependence on cars.

Urban densities are marked by having a significant number of people occupy buildings in a given area in order to achieve economies of scale. This would allow for a more efficient provision of various

urban services, whether related to transportation, utilities, or waste management. This depends not only on bringing together a significant number of people in a given area, but also on allowing residential, commercial, office, educational, cultural, and recreational centers to co-exist in proximity to each other in order to allow for easy movement between them. In other words,

urban density levels depend on promoting multi-use zoning practices rather than single-use ones. According to single-use zoning practices, complete urban areas would be reserved for one use, such as residential, commercial, or public. Such an arrangement forces people to travel considerable distances from one area to the other, as with the daily travel between places of residence and work. It also creates conditions where these areas are used only during parts of the day or during certain days of the week, rather than on a continuous basis. Single-use zoning therefore, results in a highly inefficient use of the city, where considerable energy and time is wasted on commuting.

In contrast, multi-use zoning allows for a continuous use of a given area in the city and minimizes the need for commuting. One arrangement that well expresses the spirit of multi-use zoned areas is the building that includes retail shops, office space, and residential units. Such an arrangement allows people to live, work, and shop in the same area.

There are many views on what constitutes healthy density levels, and there are no magic numbers. However, building arrangements featuring 100 residents and jobs per 1,000 square meters of land provide an acceptable high-density level² for central urban areas (UNEP, 2011a). Of course, it is imperative that areas with high density include adequate urban services (public transportation, utilities, waste management) and green open spaces. Otherwise, high density merely becomes a case of overcrowding.

Another advantage to high-density arrangements is that they help achieve better levels of energy conservation in buildings. In a high-density urban area, such as one that includes apartment buildings, individual units shield each other and therefore require less energy for heating and cooling. This is because an apartment is bordered by other apartments from the top, bottom, and sides. In contrast, in a low-density area, as with single-family housing, each individual house is open to the outside environment from all sides. High-density zoning regulations that allow buildings to reach a certain height also provide the street with protection from the heat of the sun. Higher buildings allow nearby streets to be more easily shaded, thus easing and encouraging pedestrian activity.

High-density levels already exist in many cities throughout the Arab world. Such density levels, however, need to also satisfy certain requirements. They should exist in multi-zoned areas, where residential, commercial, office, educational, cultural, and recreational activities are allowed to take place in proximity to each other in order to allow for easy movement between them. They also should be provided with adequate infrastructure services, including green public areas and good quality public transportation.

On a related matter, telecommuting and web-based commercial and government services should be actively promoted. As people are increasingly able to carry out different activities and access various services, whether commercial (payment of bills or delivery of goods) or governmental (payment of fees or renewal of documents), via high-speed data exchange networks, they can limit the trips they have to make outside their homes. This brings about numerous benefits similar to those brought about by increased density, including reduced traffic congestion, reduced energy consumption for transportation, and a more productive use of time.

In order to maintain healthy densities, it is imperative that building sprawl is kept in check. Sprawl of course is connected to both natural population growth and to populations migrating into cities. Controlling sprawl partly depends on effective urban management, as with zoning regulations that promote high densities, or the availability of adequate public transportation. It also depends on other public policy interventions that are not directly connected to urban planning, such as promoting family planning measures, and also improving economic opportunities and the quality of life outside major urban centers.

C. Mobility in the city

As mentioned above, high-density urban areas need to be coupled with efficient public transportation systems that facilitate movement between different parts of the city. Although transportation is addressed in a separate chapter in this report, a few remarks still need to be made here about the subject due to its intimate connection to urban density. High urban densities allow for public transportation systems to be more cost effective. High densities create economies of scale and allow public transportation systems to serve a significant



number of people in relatively small areas more easily. In contrast to public transportation vehicles, such as buses and trains, a privately owned car uses up considerable space for parking and movement in comparison to the number of people it accommodates. A private vehicle can take up an area of about 8 square meters, it is empty when parked, which is most of the time, and very often is occupied by only one to two persons. The ubiquity of private automobiles provides for a highly inefficient use of scarce and valuable urban space.

Increased attention has been given to public transportation systems in Arab countries, particularly over the past decade, and in some cases before that. So far, only one Arab city, Cairo, has a subway system. This is not surprising considering the exorbitant costs of building a subway system. The Cairo subway was inaugurated in the 1980s, and is undergoing continuous expansion. Alexandria and Tunis have had light rail metro systems since the colonial period. A metro system has been inaugurated in Mecca in 2010, while a metro network is planned in Abu Dhabi. Rail systems are being planned for other Arab cities including Algiers, Casablanca, Doha, Kuwait,

Manama, Oran, Rabat, and Riyadh. In Amman, a Rapid Bus Transit system that depends on dedicated bus lanes is currently under construction.

The rail metro system that has been receiving the most coverage is that of Dubai. This is partly because of the considerable resources provided for its development, and partly because Dubai, for better or worse, has emerged as an urban model that is being carefully looked at and emulated in the Arab world and beyond. It remains early to judge the effectiveness of the Dubai Metro considering that it was only inaugurated in 2009 and that only two of its lines are operational at this stage. Moreover, private car ownership plays a very central role in the lives of the residents of Dubai, and it is unclear to what extent they will embrace public transportation. Still, it should be noted that the system already serves a number of Dubai's most important destinations. Those who live and work in proximity to a metro line in Dubai can easily live in the city without owning a car.

There is also a very pressing need to make Arab cities pedestrian friendly, and even bicycle friendly where appropriate. The dominance of private

MASDAR CITY IN ABU DHABI

Mohammad Al-Asad

Masdar is a new planned city conceived by the Government of Abu Dhabi and is intended as a zero-carbon, zero-waste community. The city project, which is expected to cost under \$20 billion, is currently under construction with completion of the first phase scheduled by 2016, and the final build-out by 2020-2025.

Part of the project plan is to attract clean energy technologists, consultants, entrepreneurs, and investors to make the city “the silicon valley for clean, green, and alternative energy.” The city will host the International Renewable Energy Agency (IRENA). This championing of renewal energy technologies is part of an effort aimed at diversifying Abu Dhabi’s economy away from a heavy dependence on oil exports into one that is industry and knowledge-based.

The new city is located seventeen kilometers to the east of Abu Dhabi City. It will occupy a six square-kilometer site and is intended to accommodate 90,000 people (50,000 inhabitants and 40,000 commuters). As a large-scale settlement designed from scratch, it allows for incorporating ideas that would not be feasible in existing urban settlements. The whole city, for example, is raised 7.5 meters above ground level so that infrastructure services, such as transportation, would be accommodated inside that raised base.

The city’s buildings are placed close to each other to create narrow shaded walkways. These are oriented diagonally from the four cardinal directions to reduce the effects of direct sunlight. Their architecture incorporates traditional passive features such as wind towers and various shading devices. Cars will not be allowed in the city, but will have to be parked at its periphery. Mobility within Masdar will be through mass public transit and personal rapid transport systems or through walking. Its compactness allows for walking distances to be kept to a minimum. Masdar will rely on alternative energy resources including solar, wind, and geothermal, and will include a hydrogen-fired power plant. In addition, its solid and liquid waste will be recycled.

Masdar City has been the subject of considerable controversy. Critics of the planned city have focused on



its exorbitant cost and its full dependence on foreign, rather than local, inputs. It is argued that the high costs of many of the energy saving solutions being developed for Masdar make them uneconomical to implement on a wide scale. Accordingly, it is an unsustainable project that very well may become symbolic.

On the other hand, arguments in support of the project state that it is necessary to devote substantial financial resources to a pioneering project that is intended as a prototype, and that much of these resources are needed for the research and development activities. As the project is realized, developed, and tested, it will be possible to reproduce the solutions incorporated in it on a large scale and in a cost-effective manner, and to widely replicate and adapt them elsewhere.

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cars has reached excessive levels. In most cases, there is a shortage, if not absence, of functional sidewalks. Pedestrians are often unable to cross streets with heavy or fast traffic, thus making pedestrian accessibility extremely limited, and often nonexistent. This further strengthens the dominance of the automobile in the city. Increased pedestrian access in the city has multiple advantages, including lowering air pollution levels, allowing residents to lead healthier lifestyles, lowering transportation costs, and encouraging higher levels of direct engagement between the public and service centers. Alternative modes of transportation in the city such as cycling should also be actively encouraged. This will greatly depend on making available dedicated bike lanes, as being planned for Abu Dhabi.

D. Urban management systems – at the local, metropolitan, regional, and national levels

These various interventions are partly constrained by existing policies affecting urban management in Arab countries. Different urban centers, and even different neighborhoods, have their own specificities, and there is no “one size that fits all.” Each has its own socioeconomic and geographic characteristics. Residents and users of different areas within the city should have a say in the manner in which they are administered. This requires giving elected city councils significant authority in running the city and promoting mechanisms that ensure that municipal institutions and their staff are responsive to the needs of their residents, and are also accountable to their constituency. Such responsibilities will make it easier for

neighborhoods and districts to function as autonomous, multi use areas that satisfy the various daily needs of their inhabitants.

Gradually, municipal elections are becoming more widespread in Arab countries. Municipal elections have been held in a few countries that have never had municipal elections before, such as Qatar and Saudi Arabia, and ones that have not had them for over half a century, as is the case with Bahrain. It remains to be seen how much authority these elected municipal councils will have, and how responsive they will be to the needs of city residents at the micro neighborhood level.

Many urban decisions should clearly be made at the local, rather than the metropolitan or national levels. However, one cannot ignore the fact that certain aspects of urban management, such as waste management, urban transportation, or the provision of infrastructure services, depend on economies of scale and need to cover metropolitan urban areas as a whole. This requires considerable coordination between various urban districts within a given metropolitan center.

In addition, certain overall urban planning policies and strategies will still need to be developed at the regional and national levels. These include encouraging growth in certain regions, and protecting agricultural or natural areas from being taken over by settlements. In Saudi Arabia, current national urban planning efforts emphasize creating a series of development corridors that run East-West and North-South in the country. These efforts call for further development of existing medium and

CENTRAL BANK OF LEBANON GOES GREEN

Pierre El Khoury

The Central Bank of Lebanon (BDL) is subsidizing green loans, which consumers can apply for at an affordable interest rate of about 2% over the cost of funds. Managed by commercial banks, the loans were initially meant to support eco-friendly industry and agriculture, but have been extended to support green construction, eco-tourism, and even the renovation of existing facilities to preset environmental standards. To broaden the scope of the initiative, BDL and the United Nations Development Program (UNDP) have agreed to establish the National Energy Efficiency and Renewable Energy Action (NEEREA) to finance energy efficiency, renewable energy, and green building projects across Lebanon.

To facilitate collaboration, BDL and UNDP signed a Memorandum of Understanding (MOU) on June 14, 2010. Using the MOU as a framework for cooperation, BDL and UNDP seek to bring in international donors and organizations to support NEEREA. The two bodies will also organize awareness-raising and capacity-building programs targeting Lebanese commercial banks and consumers to promote energy efficiency and renewable energy projects.

To facilitate loan processing, NEEREA will develop a set of criteria to assess the technical eligibility of green loan applications. These criteria will be used to provide technical validation and certification to potential green projects submitted to BDL through the Lebanese Center for Energy Conservation (LCEC), hosted at the Ministry of Energy and Water.

In parallel, the European Union has signed a €15 million grant contract with BDL and the soft loan program Kafalat, geared at providing financing to small and medium size enterprises (SMEs) that want to invest in energy efficiency and renewable energy technologies.

NEEREA is expected to leverage investments in the range of US\$500 million in the coming few years in order to finance projects with interest rates as low as 0% and repayment periods reaching 14 years, with variable grace periods.

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small-sized cities along these corridors. The cities located along each corridor are within reasonable distances from each other, and all have suitable infrastructure services related to road, water, sewage, and electricity networks. Such networks allow them to easily accommodate additional growth both as individual cities and as city clusters (Al-Asad and Musa, 2002).

If cities in the Arab world are to become places where natural resources are used efficiently, pollution levels are kept to a minimum, energy consumption is effectively controlled, and water resources are managed sustainably, considerable reconfiguration of how these cities are planned, managed, and governed will need to take place. The enabling conditions for making this transformation possible are available to municipality administrators. Implementing more sustainable patterns of urban planning will have a tremendous positive effect on the quality of life for the urban population as well as positive financial and economic implications for Arab countries³.

SECTION TWO: BUILDINGS

I. INTRODUCTION

A. Scope

The building sector is a key target for greening due to the scale of environmental impacts from buildings and related construction work. This section explores opportunities and implications of pursuing green transformation strategies in the building sector addressing both new construction and existing building stock. The economic, social, and environmental arguments for achieving a sustainable building sector are discussed, as well as the enabling conditions required to make this transformation. The broader goal is to encourage action at various policy levels by Arab governments to capitalize on the opportunities from resource efficiency in buildings. The scope of this review does not enable a comprehensive coverage of all the practical and technical aspects of green buildings. Hence, the analysis provided is socioeconomic in focus and by no means exhaustive of all the

opportunities and strategies for the greening of the building sector. Recognizing the vast experiences and differences in building practices within the Arab countries, the analysis focuses on the common challenges and opportunities driven by the prevailing trends across the region.

B. Definition

In this chapter, the concept of green buildings is used to refer to buildings characterized by increased energy efficiency, reduced water and material consumption, and improved health and environment (UNEP, 2011b). This encompasses a life cycle perspective for costs and benefits. Minimizing energy and water consumption over a building's lifetime is crucial to achieving a sustainable transformation of the building sector. Other related concepts for green buildings include sustainable buildings, passive houses, eco-buildings, and energy efficient buildings. The difference among these concepts is a matter of emphasis on particular environmental and social aspects and methodologies for minimizing the environmental impacts. The greening of the building sector will have a wide range of implications for other related economic activities such as construction materials, transport, waste management, energy, water, and wastewater treatment. Therefore, taking an integrated systemic view of the interactions among these sectors will be crucial for a comprehensive scoping of the opportunities and economics of greening not only of one specific sector, but of the economy as a whole.

C. Overview of the building sector

Trends driving the demand for buildings in the Arab region include high population growth and rapid urbanization. Annual urban population growth rates in Arab countries range between 2-6% with an average for the region of 3.8% (UN-Habitat, 2008). These trends are making the building sector one of the fastest growing sectors in the Arab region. According to a recent report produced by the Global Construction Perspectives and Oxford Economics (2011), a total of \$4.3 trillion is forecast to be spent on construction in the Middle East and North Africa (MENA) region over the next decade, representing a cumulative growth of 80%. The bulk of this construction will be directed towards new building projects, including residential,



commercial, and public buildings such as hospitals and schools. In terms of contribution to economic growth, the building and construction sector accounts for 6-12% of the gross domestic product (GDP) of Arab countries⁴ and employs 9-15% of the domestic labor force, as indicated in Table 1, making it among the top three employment sectors in Arab countries after the public and agricultural sectors. Based on these estimates and International Labor Organization (ILO) statistics on construction sector employment accounting in 10 Arab countries (Bahrain, Egypt, Iraq, Kuwait, Morocco, Palestinian Territories, Qatar, Syria, UAE, and Saudi Arabia), the construction sector employs more than 7 million people in these countries (ILO, 2008).

Driven by these trends, the building sector is a significant contributor to economic growth. At the same time, the current building stock and the projected building sector growth present major environmental and social challenges. Buildings account for 40% of global energy use and close to 35% of global CO₂ emissions (UNEP, 2007). Most of these impacts occur in the occupancy phase of the building lifetime. In Arab countries, buildings account for an average of 35% of all final energy consumption (MED-ENEC, 2006), as indicated in Figure 1. Studies elsewhere in Europe and North America suggest that buildings are responsible for around 45% of CO₂ emissions over their lifetime, in addition to significant use of water and discharge of wastewater (UNEP, 2007).

While we can expect some differences between

ENERGY EFFICIENCY RETROFIT FOR A HOSPITAL

The Centre Hospitalier du Nord (CHN) is a private hospital with 140 beds, located in Zgharta, North Lebanon. Due to frequent power cuts, 75% of the hospital's electrical energy demand has to be produced by generators. The total energy bill was over €270,000 in 2006. The CHN decided to conduct an energy audit that resulted in the following recommendations:

- Improved maintenance of air-conditioning (AC) equipment
- Energy efficient lighting
- Thermal insulation of the roof
- Demand management system (software for peak shaving and control/monitoring)



After implementing the above measures in 2007, the hospital now saves 20% of its overall energy consumption. This corresponds to an annual saving of €55,000 of energy costs and a yearly reduction of 410 tons of CO₂ emissions. The needed investment did not exceed €60,000. The payback time being estimated at slightly above one year, the used technologies are replicable in most hospitals and similar buildings in Lebanon and in other countries in the region, even without any external financial assistance. CHN has already decided to use the positive experiences of this pilot project for a new hospital building in Jounieh, a coastal city north of Beirut.

Energy in Lebanon

Lebanon is extremely dependent on energy imports—about 97% of all energy had to be imported in 2005. Buildings are the second biggest energy consumers with a share of about 30%, with transport coming in

first place and industry in third place. With the sharp increase in world market prices for energy, and with energy prices subsidized in Lebanon, the national electricity company Électricité Du Liban (EDL) alone absorbed 21% of the state budget in January 2008 (L'Orient Le Jour, 11/03/08). Moreover, people suffer from frequent power cuts due to insufficient and obsolete power plants and distribution lines and have to bear significant additional costs for private generators.

At the same time, a large potential for energy efficiency and for the use of renewable energies stays untapped in Lebanon. The building stock and particularly new buildings usually do not integrate technologies such as thermal insulation of the building envelope, energy efficient lighting, or solar water heaters. The project in Lebanon shows that with additional investments of 10–20%, energy consumption can be reduced dramatically by up to 60%.

low-income and high-income Arab countries, a common challenge will be the sector's significant use of resources and CO₂ emissions. For instance, in high-income Arab countries, with significant water and energy subsidies for households, supply is unable to meet soaring demand⁵ for basic services. Green building practices offer a cost effective strategy to reduce electricity consumption and conserve water, compared with, for instance, expansion of supply capacity. Furthermore, improving the energy performance of buildings is among the most cost-effective way of combating climate change, based on projections for greenhouse gas (GHG) abatement costs for key economic sectors (Enkvist et al., 2007).

Rapid urbanization is further resulting in massive informal settlements and slums in both low and high-income Arab countries, as demonstrated in Table 2. In this context, the scale of low-cost housing is vast. Occupants of these informal settlements face major challenges in accessing basic services, let alone affording conventional housing. The case for affordable green buildings for the poor is equally compelling. A number of studies and experiences have shown that the environmental design features do not have to be more expensive than the conventional features for low-income housing (CBSE, 2010). In this context, green buildings can be a complementary strategy to improving access to basic services and living conditions for the poor (UNEP, 2011b).

DISTRICT S: GREEN NEIGHBORHOOD DEVELOPMENT

Nader Al-Nakib

District S is a neighborhood development project located in Beirut, Lebanon, that employs green planning and design principles in architecture, materials, mobility, and energy and water consumption. The development of the neighborhood adopts the premise that environmentally sustainable communities will offer residents and visitors a better quality of life and health. District S qualifies Lebanon as the fifth country worldwide to apply the Leadership in Energy and Environmental Design (LEED) certification system to neighborhood development (ND), endorsing green living on a lifecycle basis. District S will be the first sustainable neighborhood in Lebanon, the Arab world, and the Mediterranean basin, according to LEED-ND.

District S integrates the principles of new urbanism, green building, and smart growth. It is carefully sited to be in close proximity to basic community services such as schools, convenience stores, places of worship, recreational facilities, and public transportation. These destinations are reachable by foot or bike, hence reducing the carbon footprint of transportation. The neighborhood infrastructure will be green. Street lighting will use energy efficient fixtures, the sewage system will use recycled content, inner roads will be shaded with trees, and a portion of rain water will be harvested. Pedestrian areas will be lined by trees, bushes, and greenery, allowing residents and visitors to walk or ride their bikes to the café, gym, school, or community center. Biking racks will be available for residents, visitors, employees, and shoppers. Hybrid and all-electric cars will have preferred parking spots. All roofs will be green. In summary, District S will exemplify green city development in Beirut.

The developers of District S are collaborating closely with their sustainability consultants to integrate environmentally friendly components in all phases of the project. All buildings will have green roofs that will



decrease the heat island effect caused by the absorption and retention of heat by city building roofs and asphalt. Wood used in construction will be sustainably harvested. Most building materials will have recycled content. Highly efficient heating, ventilation, and air-conditioning systems (HVAC), proper insulation, and building orientation will cut energy usage by around 30% compared with a similar, conventionally-developed neighborhood. Air conditioners will use environmentally friendly gases. Sophisticated air filters and paints with low volatile organic compounds (VOCs) will ensure improved indoor air quality for building occupants. Daylight views are integrated into building design to maximize productivity and reduce the use of artificial lighting. State-of-the-art water conserving fittings and fixtures will decrease water consumption by around 40%. The introduction of waste segregation at source will divert approximately 70% of generated waste from landfills.

District S cannot fight climate change alone, but it can contribute to protecting Beirut's heritage and environment, hoping that many others will follow and undertake similar initiatives to preserve the environment (or what's left of it.)

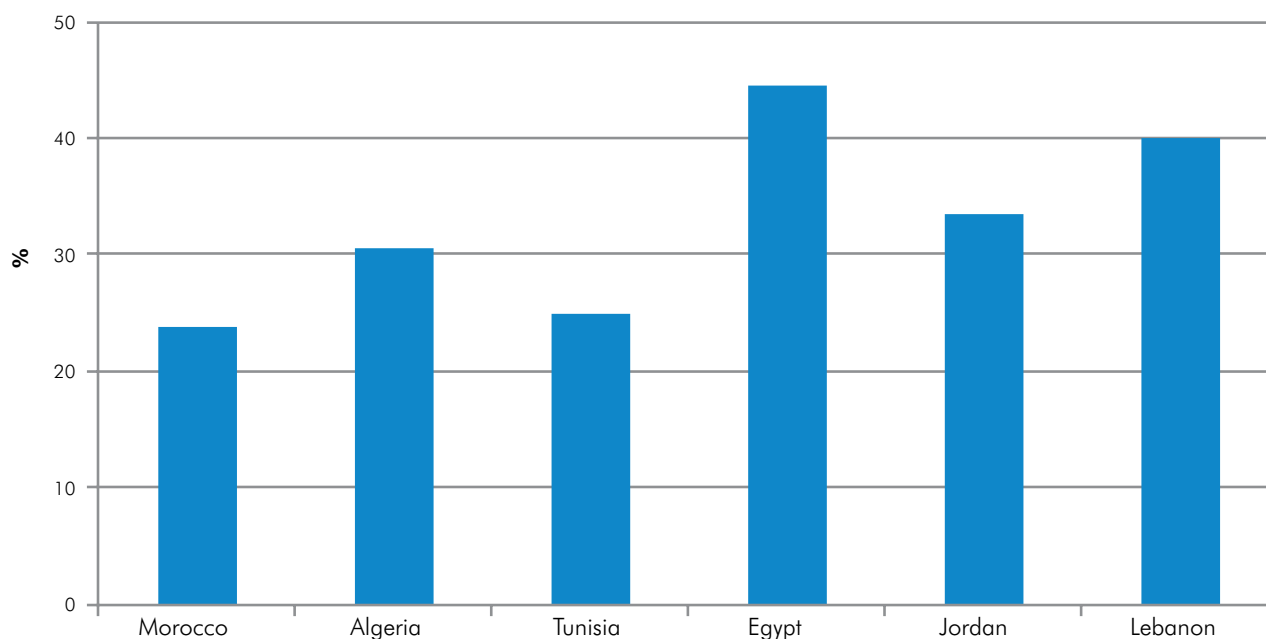
Nader Al-Nakib, is Co-founder, G Lebanon.

II. CURRENT PRACTICES AND THEIR IMPLICATIONS

A. Existing stock of buildings

Assessing the performance characteristics of the existing building stock in Arab countries requires collecting data on annual energy end use per square

meter for the different categories of buildings (e.g., apartment blocks, detached homes, commercial buildings). Consistent and comprehensive data on the performance characteristics of the existing building stock in Arab countries do not exist. Anecdotal and case study data point to alarming inefficiencies in the energy and water use in the existing building stock across the region, and in

FIGURE 1 SHARE OF BUILDING SECTOR IN THE FINAL ENERGY CONSUMPTION IN SELECTED ARAB COUNTRIES


Source: MED-ENEC, 2006

particular in commercial and public buildings. According to a study undertaken in 2007, five star hotels in Dubai on average use between 650 and 1,250 liters of water per guest and consume 275-325 kilowatt-hours (kWh) of power per square meter. In stark contrast, similar hotels in Germany use only 350 liters and 100 kWh per square meter, a difference of 225% (Gulf News, 2007). As a result, Dubai has instated higher tariffs for electricity and water as well as a fuel surcharge in 2011 with the expectation that such measures will create incentives for consumers to improve efficiency measures (Gulf News, 2010).

In the residential sector, the costs of heating and cooling in inefficiently designed and constructed buildings are putting an increasing financial burden on occupants, especially in those countries where fuel and electricity subsidies are gradually being removed. A study conducted in 2007 in the city of Aqaba, south of Jordan, showed that the average household pays up to 30% of monthly income on air-conditioning during the summer months (Biggs, 2005). On the other hand, a considerable percentage of the building stock in Arab cities is without adequate access to basic services in terms of water and sanitation,

especially for informal settlements in and around cities like Cairo and Jeddah. Large income differences also affect energy use intensity at the household level. Because of the uneven access and distribution of basic services for households in Arab cities, the average performance will most likely be a misleading baseline indicator

TABLE 1
EMPLOYMENT IN CONSTRUCTION* AS A PERCENTAGE OF TOTAL EMPLOYMENT IN SELECTED ARAB COUNTRIES (2008)

Country	%
Egypt	10.08
Iraq	10.83
Kuwait**	14.21
Morocco	8.87
Saudi Arabia	11.09
Syria***	14.88
United Arab Emirates (UAE)	12.35
West Bank and Gaza	10.97

* Defined according to the United Nations (UN) International Standards Industrial Classification (ISIC) of all economic activities, and includes construction of buildings, civil engineering, and specialized construction activities

** statistics from 2005

*** statistics from 2007

Source: Data derived from ILO, 2008

TABLE 3 INTERVENTION AREAS FOR GREENING OF BUILDINGS

Intervention Level	Selected examples
Design & engineering	<ul style="list-style-type: none"> • Climatic design taking into consideration, for instance, location, building orientation, sizing of windows and shading. • Design influencing material choices, behavior, and use patterns. • Integrated energy design and performance modeling of buildings.
Construction and materials	<ul style="list-style-type: none"> • Wall and roof systems and materials. • Glazing choices. • Procurement criteria for materials and their origin, e.g., local sourcing, ban on certain chemicals, and manufacturing conditions. • Water efficiency in landscaping.
Installations	<ul style="list-style-type: none"> • Sound choices with regards to energy using devices such as lighting systems, appliances, and use patterns • Water using devices, such as water saving shower taps and faucets. • Energy efficient heating and cooling systems. • Active systems for zero emissions and renewable energy production.
Systems for the provision of basic services	<ul style="list-style-type: none"> • Delivered energy. • Delivered water & wastewater services. • Mobility services.

for setting national performance targets for the building sector.

The prevailing pattern in the region is of a building sector that has evolved without taking the environmental and social considerations into

account. Old and new buildings are without adequate insulations for walls, windows, or roofs (FFEM and ANME, 2010). In commercial buildings, the currently installed systems for heating, ventilation, and air-conditioning (HVAC) have the lowest energy efficiency performance among available options, because of preferences for low cost systems over more efficient ones, aided by the prevalence of large subsidies for electricity in most countries of the region. With many countries in the region heavily dependent on air-conditioning systems, up to 70% of the peak power load is consumed by cooling systems (MENA Infrastructure, 2011).

B. New buildings

Early design stages offer the greatest opportunities for influencing the environmental performance of new buildings at low costs (WBCSD, 2009; UNEP, 2011b). Traditional design approaches in Arab architecture were much

TABLE 2 POPULATION IN SLUMS IN SELECTED ARAB COUNTRIES (2005)

Country	(% of urban population)
Egypt	17.1
Iraq	52.8
Jordan	15.7
Lebanon	53.1
Morocco	13.1
Saudi Arabia	17.9
Syria	10.5
Yemen	67.2

Source: UN-Habitat, 2008

ESTIDAMA AND THE PEARL RATING SYSTEM

The Abu Dhabi Urban Planning Council (UPC) is recognized internationally for large-scale sustainable urban planning and for rapid growth. Plan Abu Dhabi 2030 urban master plan addresses sustainability as a core principle. Estidama, which is the Arabic word for sustainability, is an initiative developed and promoted by the UPC. Estidama is the intellectual legacy of the late Sheikh Zayed bin Sultan Al Nahyan and a manifestation of visionary governance promoting thoughtful and responsible development while creating a balanced society on four equal pillars of sustainability: environmental, economic, social, and cultural. The goal of Estidama is to preserve and enrich Abu Dhabi's physical and cultural identity, while creating a better quality of life for its residents.

The early foundations and aspirations of Estidama are incorporated into Plan 2030 and other UPC policies such as the Development Code. Estidama is the first program of its kind that is tailored to the Middle East region. In the immediate term, Estidama is focused on the rapidly changing built environment. It is in this area that the UPC is making significant strides to influence projects under design, development or construction within the Emirate of Abu Dhabi. An essential tool to advance Estidama is the Pearl Rating System.

The Pearl Rating System for Estidama is a framework for sustainable design, construction and operation of communities, buildings and villas. The Pearl Rating System is unique in the world and is specifically tailored to the hot climate and arid environment of Abu Dhabi. The extreme summer temperatures of Abu Dhabi reach 48°C and humidity levels can be near 100%. Air conditioning consumes large amounts of energy. Water is a precious resource due to its scarcity, high evaporation rates, infrequent rainfall averaging less than 100mm/year and the environmental impacts of potable water production through desalination techniques.

The Pearl Rating System is part of the government wide collaborative initiative to improve the lives of all citizens living in the Abu Dhabi Emirate, by supporting the social and cultural traditions and values of Abu Dhabi. It reinforces what this unique place has been in the past and hopes to be long into the future.

All new projects must achieve a minimum 1 Pearl rating to receive approval from the planning and permitting authorities. Government funded buildings must achieve a minimum 2 Pearl rating.

Source: Estidama <http://www.estidama.org/estidama-and-pearl-rating-system.aspx?lang=en-US>

more responsive to environmental elements. These approaches incorporate much of today's knowledge about climatic design - as a process of identifying, understanding, and controlling climatic influences at the building site - for achieving comfortable and healthy environment for inhabitants (see Traditional Architecture supplement). However the adoption of internationalized and formalized approaches to architecture and construction engineering in educational curriculums across the Arab world has relegated much of this traditional knowledge forgotten or ignored by mainstream architects (Elgendy, 2010). Traditional design approaches in Arab architecture remains consigned to niche practices. Today, there are few Arab architects who can work with the full potential of climatic design and fewer construction engineers who can work with thermal performance modeling of buildings. As a result, the dominant design approaches are insufficiently tuned to the climatic conditions of the region.

In terms of construction work and building materials, building codes and standards are the main institutional levers for influencing construction practices and material selection. Most Arab countries have, or are in the process of introducing, energy efficiency requirements for new construction (Gelil, 2009). According to recent observations⁶, the current initiatives and measures have yet to create a noticeable shift in construction practices. Reform in building regulations and codes to incorporate environmental aspects are still in the early stages of development in most Arab countries. Even in countries such as Egypt and Jordan, where energy efficiency requirements have been in place for a while, enforcement of those aspects of the building code has not been taken up (Gelil, 2009). Among the challenges facing these initiatives are the lack of a sufficient knowledge base within the industry, weak innovative capacity within local building supply chains to meet the demand for better materials and

ECO-FRIENDLY STADIUMS IN QATAR

Qatar won its bid to host the 2022 World Cup Finals, but will players and spectators be able to endure the scorching Doha summer? And who will later, in this tiny country, make use of stadiums built to accommodate tens of thousands of spectators? And what will the magnitude of this tournament's ecological footprint be? Qatar pledged to have a carbon-free tournament but the question is whether it will be able to fulfill its promise.

Qatar undertook to use and develop eco-friendly technologies that could later be adopted by other countries. After the end of the finals, the stadiums will be contracted by dismantling some parts and shipping them to, and reassembling them in, other Asian countries. This will help keep the spirit of Qatar 2022 alive across the continent. Visitors from all over the world will enjoy Arabian hospitality and leave Qatar with a new understanding of the region.

The main challenge facing the organizers is to overcome the extreme desert heat in summer when the finals are taking place. Providing a comfortable environment inside the stadiums requires too much energy, especially for cooling. Two solar energy technologies shall be applied simultaneously to guarantee a convenient and carbon-neutral environment for all players, fans, administrators, and the media. The first technology is the photovoltaic system that converts sunlight into electricity. The second is the solar thermal system that uses heat captured from the

sunrays. The system's collectors transmit and store energy to be used on the days of the matches to cool the water which, in turn, cools the air down to 27° C. Cold air shall be carried, through tubes, to the ground of playing fields and under seats to cool players and watchers alike. Though these two systems are not new, it is the first time they are used in combination with each other.

The roofs of the stadiums shall be retractable to comply with the FIFA regulations which might require matches to be played in open air. Roofs shall be closed during the days before the matches to keep the temperature in the stadiums at 27° C. When there are no matches in the stadiums, the solar equipment shall transmit electricity to Qatar's main grid, and receive its power from the same grid during matches, making the stadiums carbon neutral.

These cooling technologies shall be made available to other countries that have hot weather, so that they may also host major sports events.

Engineers at Qatar University's Mechanical and Industrial Engineering Department produced a design for an artificial cloud that is remotely controlled, so that its location may be changed depending on the position of the sun. Such a cloud shall hover above the stadium and overshadow all fans sitting to watch the game. The cloud consists of a mixture of light carbon and helium, and the

components, and weak institutional capacity within public agencies for the monitoring and enforcement of environmental requirements.

In addition to design and construction technology, buildings' environmental performance can be improved through the choice of installations and components such as heating and cooling systems, lighting, appliances, and water fixtures. The potential savings from promoting energy saving appliances and light fixtures in buildings in the Arab world is substantial. According to some estimates, economically feasible potential savings run in the range of 60% of current consumption (ESMAP, 2009). Similar water saving potentials can be realized by switching to water efficient taps and faucets. The chapters on energy and water in this report give a more detailed review of current green practices in Arab countries.

The overall assessment is that the scope and effect of current measures for promoting energy and water efficient installations, or renewable energy ones, fall short of the economically and technically feasible potential. One primary barrier cited by a recent World Bank assessment report is related to subsidies for conventional energy resources prevalent in most Arab countries (ESMAP, 2009). Energy subsidies exceeded 7.1% of the region's GDP in 2006, according to the same report. One exception has been the wide scale adoption of solar water heating systems (SHW) in several Arab countries, notably Algeria, Egypt, Jordan, Palestine, and Tunisia. This success is the result of an extended period of technical and institutional support for the industry and favorable market conditions for SHW technologies for the low to medium income housing markets (Kordab, 2009). Even in those markets, diffusion of solar thermal



solar energy will keep it floating in the air.

Qatar's pledge to adopt the green building standard was part of its national 2020 vision, and not solely to support its World Cup bid. If the Green Building Council and construction companies succeed in implementing

environmental principles during the next few years, Qatar might witness, by 2022, the development of highly-advanced building technologies. Yet the great challenge will be to shift these technologies from sports spectacles to everyday life.

Al-Bia wal-Tamnia (Environment & Development) magazine

technology for heating at favorable economic returns for users could have been higher (Kordab, 2009).

iii. Policies and initiatives

Encouraging signs are in the horizon. Regionally based trade and professional publications in construction, architecture, building materials, and engineering are increasingly profiling and making the case for greener solutions in buildings (The Big Project, 2010). In parallel, going green has been a focus theme within the leading construction markets of the Arab world, mainly in the UAE and Qatar (Deloitte, 2010). On January 1, 2010, Abu Dhabi enforced a new building code that makes sustainability compulsory in all new buildings and major retrofits of existing buildings. The code addresses energy efficiency, water use, and the

wider environmental impacts of construction. In Qatar, a new assessment system for buildings, the Qatar Sustainable Assessment System (QSAS), was devised and launched in April, 2009 (Deloitte, 2010). The QSAS stipulates new compulsory standards to be incorporated into the Qatar building code. Thermal standards and/or energy efficiency building codes are enforced in Algeria, Egypt, Jordan, and Tunisia (Mourtada, 2008). Other Arab countries, namely Lebanon, Morocco, Palestine, and Syria, are in the process of revising their building codes to include thermal standards or have introduced voluntary standards. However, the scope can be expanded, for instance, by consideration of simple measures such as solar shading and thermal bridges. Furthermore, the implementation and control of the application of the thermal standards need to be improved (Mourtada, 2008).

GREENING CAMPUSES AND CURRICULA

Université Saint-Esprit De Kaslik (USEK) has launched the Carbon Neutral Challenge Project, aspiring to achieve a net zero carbon footprint or emissions on its 67,000 m² campus by the year 2025.

Located in Kaslik, to the north of Beirut, USEK estimated its own production of carbon emissions in 2010 at more than 8,911,000 kg of CO₂ (8,911 metric tons) divided as follows: 800 Kg/day from the consumption of 60,000 kWh of public electricity, 615 Kg/day from the consumption of 40,000 kWh of electricity provided by private diesel generators, and 16,000 Kg/day generated by approximately 2700 cars entering its premises, in addition to other sources of lower carbon emissions generated by other activities on campus.

The project adopted a master plan with a priority on new construction satisfying green building certification by the Leadership in Energy and Environmental Design (LEED) rating system. The estimated total cost of construction is US\$81.3 million, excluding the renovation of existing buildings, transportation, renewable energy production, and landscaping.

USEK is planning to adopt other major initiatives by 2012 to push the campus closer to becoming carbon neutral. The university plans to switch to Energy Star certified efficient appliances or their equivalent, encourage car pooling, and begin a shift to generate renewable power on site using solar and wind power.

Between 2012-2018, USEK plans to move towards a car-free campus, roll out a green fleet hybrid shuttle bus system, and apply water treatment and recycling technologies on campus. François Bassil Medical Building will be constructed with the goal of qualifying for a Platinum LEED certification. An environmentally friendly sport complex is also planned. Furthermore, an underground multi-story car park will be built that will provide 17,000 m² of green roof park space accessible to students and community residents. Landscaping on campus will be recreated using water efficient Xeriscaping principles, including soil amendments, appropriate plant selection, efficient irrigation, use of mulches, and proper maintenance.

USEK's plan over the 2017-2025 period involves the green retrofitting of existing buildings to meet the carbon neutrality goal. A designated task force will evaluate the progress achieved.

The physical green transformations of the USEK campus will be accompanied by new educational and research programs that reflect the goals and means for achieving sustainable development. Innovative learning experiences will be offered to students, including planning sustainability campaigns, creating an organic garden on-campus, and choosing sustainability-related themes to focus on for a semester or on a yearly basis. Moreover, new environmental sustainability courses will be introduced, and related research programs initiated. USEK is seeking to expand the university's efforts beyond its own campus and reach out to local communities in order to raise public awareness about actions we can take to promote green city living.

At the Lebanese American University (LAU), a commitment to green the curricula as well as the campus has been incorporated as an integral part of the university's strategic plan for the period 2011-2015. LAU will continue to integrate energy efficiency, conservation, and the use of renewable materials in new construction and renovation projects on campus. The university's purchasing guidelines will be revised to promote the purchase of products that have minimal environmental impact over their entire lifecycle. LAU has also decided to conduct a campus sustainability audit to identify relevant environmental sustainability initiatives prioritized according to their return on investment. The audit results will be used to select three sustainability pilot projects for implementation by 2016. To create a smoke-free campus, the university will implement programs and activities, such as offering smoking cessation classes and creating designated smoking areas.

In addition, the following action steps will be taken to develop green content in the university's academic educational and research programs:

- Promote enrollment in classes that satisfy the new Environmental Science Minor.
- Study the feasibility of offering undergraduate and graduate courses of study (majors) in environmental sustainability (e.g., Environmental Sciences, Environmental Engineering, and Environmental Design), and develop new program offerings based on the results of the feasibility study.
- Introduce green sustainability topics and courses into existing curricula in the School of Engineering, School of Architecture and Design, the Business School, and the Department of Natural Sciences.



- Create internships related to environment sustainability at LAU facilities, local non-governmental organizations, area industries, and municipalities.
- Identify, target, and build relationships with funding agencies, foundations, and prospective donors who are committed to environmental sustainability, to secure financial support for student scholarships/fellowships, development of new programs, and sustainability research
- Conduct seminars, workshops, training programs, exhibitions, and service learning to increase awareness of environmental sustainability-related education for LAU's students, alumni, and the local communities.

AQABA RESIDENCE ENERGY EFFICIENCY (AREE)

Florentine Visser

The initiative to build a pilot scale energy efficient residence in Aqaba aimed to demonstrate the advantages of sustainable building in Jordan. The Aqaba Residence Energy Efficiency (AREE) design was selected to inspire improvements in the environmental performance of buildings. The building design addresses the efficient use of resources in building construction and in water and energy consumption.

AREE is a three-floor, 420 m² building that includes a living room, a kitchen, a study room, a family room, six bedrooms, three bathrooms, a car garage, and a basement.

The summer temperatures in Aqaba rise above 40° C, and with hardly a need for heating during the winter, the design was focused on adopting passive cooling strategies. By design, heat accumulation is prevented in the summer and heat gain is optimized in winter. The architectural concept was formed by sun angle analysis, wind conditions, Red Sea views, and Jordan's common construction practices (plastered block work and stone cladding).

The architectural design is the first step to get to efficient use of energy, water, and materials. The orientation and layout of AREE optimize passive cooling. Spaces that are generally used for short periods (bathrooms, garage, corridors) are located on the southwest side, the hottest side of the house, creating a buffer that helps keep the main spaces cooler. To minimize the internal cooling load, the bedrooms face northeast. The main part of



the building is finished in regular plasterwork mixed with straw to decrease heat transfer and reduce the use of cement. The use of plasterwork provides a nice texture that improves with ageing.

Natural ventilation is improved by carefully positioning the windows, doors, and ventilation openings below the ceiling and the main staircase, designed to work as a 'wind tower'. Movable shades prevent solar warming in the summer time, but allow for solar heat to enter during the winter to minimize the need for heating.

Exterior and interior space is connected by a zone with recessed glass doors for optimal day lighting. This zone, housing the kitchen and dining area, connects both building volumes. The lower volume is clad with recycled stone procured from local stone companies. The roof

On the regional scale, the Arab League issued in December 2010 the first Pan Arab energy efficiency guidelines. These guidelines stipulate the development of national energy efficiency action plans (NEEAP) and provide recommendations for energy conservation in buildings (Arab League, 2010). Voluntary green building standards and labels offer another way of encouraging green building practices through market incentives. In 2009, Abu Dhabi launched PEARL, the first voluntary regional standards for green buildings. At the same time, the Egyptian Green Building Council has developed a national building rating system called the Green Pyramid Rating System (GPRS) (EGBC, 2009).

Lebanon Green Building Council has developed a green building rating system called ARZ. Other international labeling systems such as the Leadership in Energy and Environmental Design (LEED) and the Building Research Establishment Environmental Assessment Method (BREEAM) have gained an increasing number of promoters within the professional community through local and regional green building councils in Egypt, Jordan, Qatar, Saudi Arabia, and the UAE. While these standards do help raise the environmental benchmark for large-scale building projects, their relevance and applicability to the largest segment of the housing market, low to medium income, is still unclear. In fact, the use of international

garden on top of the lower volume contributes also to a lower internal cooling load achieved by the heat accumulation capacity of the 40-cm garden soil. This roof garden provides shading and has a beautiful view of the Red Sea.

The building envelope is the second step for environmental design and passive cooling strategy. Interior spaces are protected from solar heat through the use of improved insulation. The blocks of the cavity walls have a better insulation value because of the volcanic and perlite aggregates. The cavity is filled with insulation material. The most exposed building surface is the roof, and therefore it is also insulated, which is not a common practice in Jordan. Another new practice introduced is the insulation of the 'heat bridges' at the floor-wall connections. The sand filling of the north cavity wall and natural stonewall finishing increase the heat accumulation capacity of the building.

The building design and construction save 30% on the cooling load, compared to a conventional building. To ensure significant savings on electricity bills, efficient lighting systems have been installed as well.

The 'solar cooling' concept is based on hot water from solar panels providing thermal energy to the adsorption chiller, which provides chilled water to cool the interior. This is the first application of solar cooling in Jordan, and therefore there are challenges in achieving optimal performance. The local supplier is working on a second prototype. In the meantime, an imported adsorption chiller has been installed and is currently being tested.

The solar cooling system brings the total potential savings

of electricity costs to 72%, compared to a conventional design. Taking in consideration additional investment costs, the expected payback time is less than nine years. To make AREE almost self-sufficient in energy supply, the option of photovoltaic (PV) panels for electricity generation was considered. However, the long payback time of around 14 years rendered this option uneconomical.

Reducing water consumption is essential for Jordan, a country with a very low annual per capita share of freshwater. AREE is the first project in Aqaba equipped with a dual plumbing system, separating grey and black wastewater. The grey water from showers and sinks is filtered by a constructed wetland and used for garden irrigation. Water-efficient plants and trees that are well adapted to Aqaba's climate were selected, minimizing the need for irrigation. Together with water-saving taps, toilets, and showerheads, the total estimated water saving is 51%.

All design and construction elements were easy to plan on the drawing board, but required a lot of discussion with the engineers and contractors on site. The biggest challenge for sustainable building in Jordan is the use of materials and the reduction of construction waste. Environmentally friendly materials are scarce and local suppliers are often unfamiliar with material specifications. Moreover, Jordanian contractors were not familiar with passive cooling strategies. The opportunities for learning have been immense, which bodes well for the dissemination of more sustainable building practices in Jordan.

Florentine Visser is Dutch architect and sustainable building consultant, was AREE Project Architect

labeling schemes has so far been limited to a few upper end luxury buildings, and often used as a public relations tactic. Instead, efforts should be directed toward developing national and regional green building standards adapted to local climatic and cultural conditions. The Regional Center for Renewable Energy and Energy Efficiency (RCREEE) is one actor working at the regional level spearheading a process of harmonizing energy efficiency standards across the Arab World.

These efforts are moving in parallel with increased interest in institutional reforms to promote and create incentives for renewable energy and energy efficiency in buildings (Gelil, 2009). Several Arab

countries have or in the process of completing their national renewable energy strategies (RCREEE, 2010). These will have wider implications on the environmental performance of the building sector.

III. OPPORTUNITIES FOR GREEN TRANSFORMATION IN THE BUILDING SECTOR

Broadly speaking there are four levels where green transformation in buildings takes place: 1) design and engineering choices, 2) construction processes and materials, 3) installations, and 4) systems for the provision of basic services such as

THE DUTCH EMBASSY IN AMMAN: FIRST LEED CERTIFIED BUILDING IN JORDAN

Florentine Visser

Sustainable building is high on the agenda of the Dutch government and has been exemplified in the design and operation of the country's embassy in Amman, Jordan. The embassy, which was officially inaugurated in December 2010, was awarded the Silver Certification of the Leadership in Energy and Environmental Design (LEED).

Beside featuring high environmental performance standards, a challenging assignment for architect Rudy Uytenhaak, a Dutch Sustainability Award winner, and the Jordanian counterpart, Consolidated Consultants, was to incorporate in the new design an existing villa, earthquake risk protection, high insulation standards, shading, and operational security features.

The environmental measures of the design have included high standards of energy efficiency, water conservation and recycling, and material selection. All products and materials of construction used had to be locally sourced to the extent possible. The architectural design had to minimize the heating and cooling loads. Daylight had to be the main source of illumination in the office space. However, reducing thermal bridges turned out to be quite difficult to achieve during construction.

The first sustainable aspect in the development process was the preservation of the existing villa on the new embassy site. To provide enough space for the embassy's needs, the existing villa was 'topped' with an additional floor. This new upper floor is larger than the existing ground floor and thus provides shading for the existing southern façade.

Structural analysis revealed that, according to building seismic regulations in Jordan, the existing villa was at an unacceptable risk due to the attachment of a new upper floor. Therefore, additional columns were needed to add structural strength, which resulted in an impressive front elevation in the form of a modern stone-clad colonnade. This reflects the rich architectural history of Jordan, which bears traces left by the Greeks, Romans, and Nabataeans. The colonnade is also an elegant representation of hospitality, an important element of Jordanian society. In addition, the colonnade provides a pleasantly shaded space in front of the building.

The roof is covered by sunshades, made of cloth in a

reference to the local tradition of Bedouin tents. 'Sails in the wind' would be another legitimate metaphor, a poetic integration of cultures in a highly functional and energy saving element. The lightness of the sunshades provides a counterbalance to the heavy stone. The shading of the front and side elevation and on the roof significantly reduce direct solar heat gain in the hot Amman summer. In addition, the shades are designed in such a way that in the colder winters, when the sun is at a lower angle, the sun warms the building's interior. This generates remarkable savings in heating energy consumption. Thanks to the shading, the façade of the new first floor is translucent. The offices behind the curtain walls enjoy transparent views and daylight, which further reduces the energy demand for artificial illumination.

To provide daylight in the core of the building, the centre of the existing villa has been hollowed out. The resulting central hall connects the old and new floors with abundant daylight from the skylight. The skylight can open on hot days to release excess heat and contributes to the natural ventilation in the building. This courtyard is not a new concept but can be found in traditional Arab houses. The architect of the Dutch Embassy succeeded in combining a traditional concept with contemporary design and functionality.

The construction approach adopted is similar to common Jordanian building methods. The façades are clad in Jerusalem stone to produce unity between the existing and new building. The elegant stone detailing is based on the craftsmanship of making a building, a trademark of Rudy Uytenhaak's architecture. The mechanical fixtures allow the stone to be reused once the building is no longer needed. This was a new concept for the Jordanian contractor.

To accommodate the ductwork and fan coils of the heating, ventilation, and air-conditioning (HVAC) system, space was created between the existing structure and the new 'floating' first floor, providing the opportunity to use night ventilation. The elevation of this 'intermediary' space was furnished with grills that allow the cool night breeze to pass through, releasing the heat gain of the day and, in the process, reducing the cooling load.

The detailed design of the HVAC system is the last step in reducing the energy demand of the building.



Front elevation with colonnade and shading. Solar hot water panels on the carport (left).

Photo: Pieter Kers

Solar hot-water panels are integrated into the carport to provide hot water for heating the building in the wintertime. The swimming pool of the existing villa was covered and reused as an underground 'heat-sink' to store the heating or cooling energy. The heat pump of the former embassy building was transferred to the new building and used to generate cold water at night. This water is stored in the underground pool for daytime use. During the day a ventilation system is used with energy recovery to minimize the energy requirements for a comfortable indoor climate.

The photovoltaic (PV) panels on the roof generate power to meet about 12% of all electricity needs, which is enough energy to power computer use in the building. Moreover, the PV panels provide shade for the roof. Sustainability goals have been pursued right down to the choice of furniture. The Dutch firm Gispem supplied furniture certified by the Eco-Management and Audit Scheme (EMAS), an environmental standard developed

by the European Commission. The desk illumination is designed to meet local lighting levels.

As one of the water-poorest countries in the world, Jordan places great importance on saving water. Compared with a conventionally designed building, potable water consumption has been reduced by 32% using water-saving fixtures. Garden irrigation hardly uses any potable water (4% of baseline). Rainwater is harvested on site at a rate of 48%, and used in irrigation. Native plants that are well adapted to a scarce water environment have been selected. Existing trees were retained wherever possible.

The overall result is an impressive new embassy building with comfortable office space and sophisticated architecture. The balanced sustainability measures have created Jordan's first LEED-certified building.

Florentine Visser is Dutch architect and sustainable building consultant.

energy, water, and mobility. The latter dimension concerns more the urban or district scale but in some cases can be tightly linked to or influenced by project developers. Examples of each intervention type are provided in Table 3. Environmental performance improvements can be achieved at every level. However, the greatest opportunities with the lowest costs can be found at the early stages of design and engineering. A holistic design approach, incorporating environmental principles in the various design stages including building form, orientation, components, and other architectural aspects, yields the highest results (WBCSD, 2009).

Various demonstration projects in selected Arab countries have demonstrated the economic feasibility of integrated energy efficiency in design and construction of new buildings. In Tunisia for instance, the Project for Energy Efficiency in Buildings, which started in 1999, has demonstrated energy savings of 33% on average through the use of simple and locally manageable techniques in 43 demonstration buildings with additional investment costs that are considered acceptable at about 4% for 'affordable' housing and 2% for high-end housing (FFEM and ANME, 2010).

Similarly, an analysis from the European Union (EU) funded project MED-ENEC, which implemented pilot energy efficiency building projects in eight Arab countries, found that the cost to benefit ratio of passive design elements were much more rewarding than the 'active' approach that uses newer technology such as solar heating and cooling, photovoltaic (PV) solar systems, and other devices found in state-of-the-art high technology buildings. Using the cost of primary energy saved compared to international market price indicates that measures introduced in the Jordanian pilot project were profitable at a price of \$40 per barrel of crude oil. For the pilot project in Morocco, the energy efficiency measures were profitable to the country at a price of \$80 per barrel of crude oil (Missaoui, 2009).

Major opportunities can also be found in the maintenance and retrofitting of existing buildings. In Jordan, for example, potential energy savings of 20% have been estimated through cost-effective retrofitting of existing commercial buildings, with a payback of less than 1.6 years on required investments (Shahin,

2006). In the residential sector, simple measures such as the upgrading of lighting and water fixtures and energy and water leakage inspections can yield on average 30% savings.

Finally, adapting behavioral patterns constitute a key element of achieving the full potential of green buildings at nearly no cost. User behavior can make a substantial difference in a building's consumption of energy and water. A recent World Business Council for Sustainable Development (WBCSD, 2009) analysis concluded that wasteful behavior can add one-third to a building's energy performance, while conservation behavior can save a third.

IV. ENABLING CONDITIONS AND POLICIES

While the environmental and socioeconomic case of greening the building sector is strong, recent international and regional studies of the sector point to industry and market barriers for the widespread adoption of green building practices (El Andaloussi et al., 2010; UNEP, 2007; UNEP, 2011b; WBCSD, 2009). These include barriers related to the structure of industry, financial constraints, and misplaced incentives among others (UNEP, 2007; UNEP, 2011b). Overcoming these constraints in the Arab world will require a proactive green building policy at national and regional levels. Recent global assessment studies of the sector have identified a variety of administrative, regulatory, and financing tools (El Andaloussi et al., 2010; UNEP, 2007; UNEP, 2011b; WBCSD, 2009). Governments can create policies for procurement, contract specifications, building performance, and building codes regulating municipal standards. Municipalities can also enact regulations and develop training and education programs that focus attention on sustainable design in building.

A. Regulatory and administrative tools

Mandatory energy efficiency requirements through building codes have been acknowledged for their effectiveness in many countries (Liu et al., 2010). However, the success of implementation was subject to the institutional capacity within implementing agencies at municipal and national

SHARJAH FUTURE ARCHITECTS FOR “GREEN” MOSQUES

Ahmed Hanafi Mokhtar

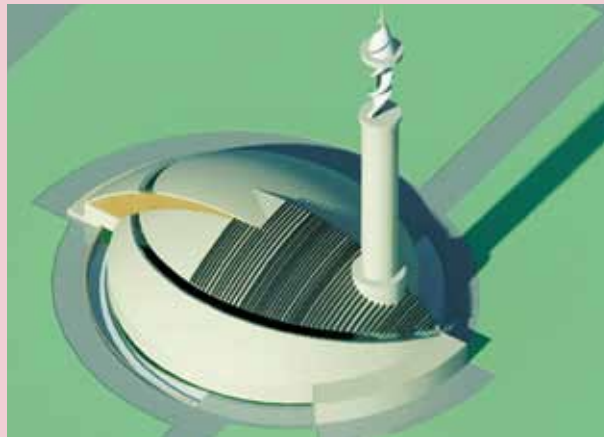
There are verses in the Holy Qoran that forbid extravagance in eating and drinking. So if man is required to be moderate in consuming such life necessities, this should also hold true for the consumption of energy in buildings, with mosques at the top of the list.

Unfortunately this is not the case in the countries of the Gulf Cooperation Council (GCC), where mosques generally tend to be liberal in the use of electricity, since air-conditioning is a necessity. Having their electricity supply free of charge, usually, mosques have little or no motive to use it efficiently, whether in design or operation. It is therefore not uncommon to find a mosque with full internal lights on at midday with the air-conditioning units fully operating almost round-the-clock to have excessively low temperatures inside, despite the presence of a few people off prayer times.

Mosque patrons are partly to blame for this extravagance, in spite of the fact that most of them are unaware of the impact of over-consumption. Yet, the responsibility falls heavily on mosque designers who can address this lack of awareness, because the design of the existing mosques does not respond even to the intentions of those who are willing to conserve energy.

During a course I taught to architecture students at the American University of Sharjah, I urged future architects to consider seriously saving energy through a standard design as a first step towards controlling extravagant consumption of energy in mosques. I asked them to apply the principles of environment-friendly design which they had learned in order to come up with an architectural design adapted to the weather of Abu Dhabi city, which was chosen due to the availability of weather data all-year-round.

The students conducted an analytical review of Abu Dhabi’s weather using computer software of the capital’s meteorological data. Consequently they defined the ecological strategies to address this weather which has two seasons: temperate climate during the months of November through April, and the hot and humid climate the rest of the year. Accordingly, it was decided to apply the natural aeration strategy during temperate months, whereas the use of air conditioners was found inevitable during the hot and humid season. This should be guided by two principles: First, minimizing thermal



loads by choosing adequate architectural designs, and hence minimizing the size and power requirement of air-conditioning units. Second, whenever possible, using the natural energy on-site derived from sunlight to power these units.

To achieve this it was decided to use absorption chillers that basically need heat (not electricity) to cool the air. Such heat can be absorbed from the sun rays that fall on the roof of the building through evacuated tubes or other water heating methods. The resulting hot water is to be used to operate the absorption chillers.

The main challenge facing the students was how to develop an architectural design for a mosque to reflect these strategic decisions that were based on environmental requirements. I instructed the students to discard, in their designs, traditional architectural features such as domes and arches, except for the minaret which is essential for the building’s orientation.

Students variably rose up to the challenge. The efficient concepts they developed included using the minaret as an air duct during the temperate climate. The design strategies also involved making large vents in the mosque that help natural aeration during the winter season and work also – like the minaret – for wind capture. Moreover, the students developed the shape and orientation of the mosques’ roofing to make optimum use of natural lighting and enable the absorption of solar energy through collectors that power absorption chillers during the summer.

Dr. Ahmed Hanafi Mokhtar, Associate Professor of Architecture, American University of Sharjah –Al-Bia wal-Tanmia.

DESIGN AND CONSTRUCTION OF ENERGY EFFICIENT RURAL HOUSE PILOT PROJECT, ALGERIA

Hamid Afra
Abdelkarim Chenak

As part of the Energy Efficiency in the Construction Sector in the Mediterranean (MED-ENEC), a European Union funded project, pilot projects were established to demonstrate the best practices and integrative approaches for efficient energy use and the use of renewable energy in the building sector.

The pilot project in Algeria is a rural low-energy house with 80 m² floor space; 3 bedrooms, 1 kitchen, 1 bathroom, and lavatories, all on ground level. Energy efficiency measures include the use of local building materials and solar energy.

The main purpose of this pilot project is to build a residential rural house suitable for replication within the framework of Algeria's rural housing program. The program entails the construction of 500,000 rural houses during the period 2010-2014 in order to minimize rural-to-urban migration and to encourage the return of rural populations from urban areas and centers.

The energy concept used in this project is based on optimal insulation of the envelope, the use of solar energy, and the utilization of earth stabilized bricks. The objective is to reduce energy consumption during the entire lifetime of the house including the construction phase. Therefore, local building materials, e.g. adobe bricks (compressed earth with a low content of cement),



were used. This reduces building costs as well as energy consumption for the production and transport of the construction materials. In addition, the bricks have good insulation and acoustic and bio-climatic properties.

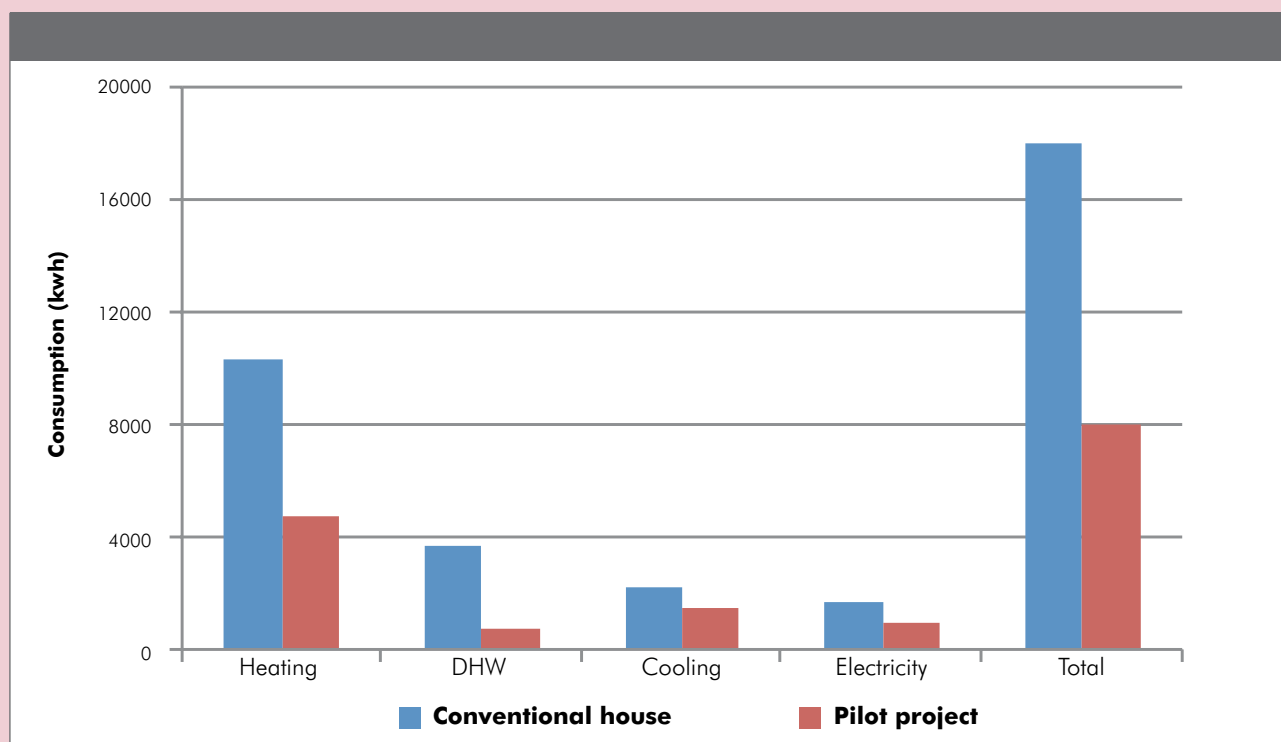
The following measures have been adopted to improve the environmental performance of the house:

- Optimal orientation.
- Thermal insulation of the envelope.
- Use of earth stabilized bricks (adobe).
- Double glazed windows.
- Use of natural light.
- Summer shading.
- Natural ventilation in summer.

levels, and technological capacity within the national building supply chain to meet the requirements without considerable increase in costs. The general consensus from past experiences is that the process of transforming a country's building supply chain takes time and requires continuous government intervention as well as uniformly enforced and regularly updated building energy efficiency codes (Liu et al., 2010).

Mandatory procurement regulations at the city level were found to be quite effective in emerging economies, e.g., Ghana, Kenya, Mexico, and South Africa (UNEP, 2011b). In the Arab world, only the government of Abu Dhabi seems to be moving in this direction, where all publicly commissioned

buildings are required to achieve at least a 2 Pearl rating. Other types of regulatory measures that can be used in the building sector include mandatory energy audits for commercial or large development projects and issuance of mandatory energy certificates upon a sale or a lease transaction of a building. Mandatory audits and performance certificates, however, can be difficult to implement in countries with limited qualified personnel and accredited facilities to perform such audits. The case of Egypt illustrates how long it can take to put these elements in place if policies are not conceived in a comprehensive manner. In 1998, Egypt developed the energy efficiency criteria for room air-conditioners and refrigerators. The Ministry of Industry, then issued a regulatory decree to enforce



- Solar thermal with gas back-up boiler for domestic hot water.
- Solar thermal system also supports space heating.

The project allows annual reduction in energy consumption by 54%, compared with the baseline scenario. The project negates the annual generation of 3-4 tons of greenhouse gas emissions.

The investment required for the pilot project exceeds

the costs of the conventional baseline case by 10%. The payback period is 12 years. The payback period will be reduced with greater economies of scale and increased learning, and by incorporating the real rather than the subsidized cost of energy.

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the program, but enforcement in practice was undermined by the absence of a testing laboratory for appliances (RCREEE, 2010).

Negotiated performance agreements are another type of administrative tool available for municipalities to advance green building targets for selected urban zones or districts. However, these agreements are difficult to institutionalize and protect against powerful interests in the absence of decision making powers for urban planning and zoning at the local and municipal levels. There is a great potential for these agreements in the newly created development zones and districts in, for example, countries of the Gulf Cooperation Council (GCC), Egypt, and Jordan. Although

these countries have declared their commitment to the environment, developers have scaled down their commitments, particularly after the financial crisis of 2008. In such cases, negotiated agreements will have provided an effective governance framework for the implementation of these environmental commitments within the mega development zones.

B. Market Enabling Initiatives

Regulations need to be complemented with market enabling measures in order to foster the emergence of a sustainable market for green buildings. These include economic, fiscal, and public awareness tools (RCREEE, 2010; Iwaro and Mwasha, 2010).

Efficiency certificate schemes and energy performance contracting are two examples of measures that have been used in developed countries. There is a good potential for energy performance contracting in Arab countries within the commercial buildings sector, and especially in countries where energy prices reflect real cost, e.g., Jordan, Morocco, Palestine, and Tunisia.

Examples of fiscal and economic instruments and incentives include tax exemptions, subsidies, soft loans, and grants. Tax exemptions are efficient in stimulating initial sales of clean technologies, e.g., solar heating systems, solar electric, insulation materials, energy and water efficient appliances, and electricity-saving lighting fixtures. Grants and subsidies are well suited to low-income households, which according to UNEP (2011b) “tend not to make investments in energy efficiency even if they have access to capital.” In Tunisia, for example, the Technical Center for Building, a specialized agency under the Ministry of Industry and Technology, introduced a PRO-SOL program offering financial incentives for the use of solar hot water (SHW) systems and a PRO-ISOL program offering financial incentives for thermal insulations of existing roofs and dwellings. These programs have had a remarkable effect on the uptake and spread of SHW systems in the country, the development of a competitive supply market of SHW, and a significant 40-50% drop in the costs of insulation products (RCREEE, 2010).

Soft loans work well in combination with performance standards to encourage households to carry out energy-efficiency improvements. These can be granted through a third party, in which government agencies or donors provide financial incentives to banks, which in turn establish low interest rates for their customers (UNEP, 2011b). In Lebanon, for example, with support from the Central Bank, commercial banks are offering soft loans to individuals and developers for the implementation of renewable and energy efficiency measures in both existing and new buildings.

Public awareness encompasses a broad range of measures for creating spontaneous demand through targeted communication campaigns. For example, capacity building and training programs can be offered for designers and engineers to foster the development of a local, responsive supply

chain. Other initiatives in this area may include public recognition for voluntary labeling schemes and public leadership programs and awards.

Focusing on voluntary labeling schemes, the potential is rather promising in the Arab region. Increasingly locally adapted schemes are emerging in several Arab countries such as the Istdama Pearl system in Abu Dhabi, and the ARZ standard in Lebanon. The experience from the internationally known LEED and BREEAM certification schemes, have shown increased compliance with these schemes in their respective markets, inducing healthy competition among leading construction companies, to use green building strategies for winning large scale projects such as hospitals and schools. On the other hand, the use of green requirements in the commissioning of public buildings should not only target high profile projects, but also low income housing projects, with conditions for cost control. These initiatives typically spur the kind of innovations that are needed to enhance the knowledge base within local construction supply chains, including architects, engineers, material suppliers, and builders.

C. Addressing structural barriers

Buildings seen purely in a narrow end-product perspective are often perceived as low technology products, but in practice they are the outcome of complex product systems (Gann and Salter, 2000), involving diverse knowledge areas, a wide range of physical resources, and a disparate network of actors. The network of actors is dissolved after the completion of a building project and a new network is created with the initiation of a new project (Manseau and Seaden, 2001), not often with the same constellation of actors. The project-based form of organization and the fragmented nature of the construction industry have been widely cited as presenting challenges and barriers for the green transformation of the sector. In this context, addressing the structural barriers will be essential for the success of greening efforts.

There are important differences in the structure and knowledge pool of the construction industry across the Arab region with potential implications for green building strategies. For instance, the considerable construction activities and large-scale projects of some of the GCC countries

have attracted top firms from all over the world with considerable architectural and engineering expertise. It will not be difficult for these firms to pool in the necessary knowledge and expertise to implement high profile green building initiatives, although it will most likely be at considerable additional costs. In low to medium income Arab countries, on the other hand, the industry remains localized, fragmented, and based on small scale contractors and entrepreneurs. Promoting transformation in the practices of the sector within those countries will require considerable efforts in capacity building among builders, architects, engineers, and private developers.

With regard to the knowledge base sector, introducing changes to the curriculums in colleges of architecture and engineering and to vocational training institutions have been cited as key transformational measures of the building sector in the Nordic experiences (Emtairah, 2008). Changes in the academic curriculum included methodologies for incorporating environmental design considerations in all aspects of building design and construction work. There are promising developments in this area with the recent introduction of higher education programs in selected Arab universities in the area of renewable energy and energy efficiency⁷ in the built environment. These however need to be complemented with further changes to core curriculums at the basic level of professional training in all phases of the building supply chain.

V. IMPLICATIONS FOR TRANSFORMATION TO GREEN BUILDINGS

A comprehensive macro analysis of the costs and benefits of green buildings would investigate the effects of implementing the range of measures discussed earlier based on a life cycle analysis. Greening of the building sector in the Arab world will require investments in design and engineering, sustainable materials, and clean technologies. According to some estimates this will increase the upfront capital cost of building construction relative to the 'business-as-usual' scenario (UNEP 2011b). However, for a correct evaluation of the benefits the total cost of ownership over the lifetime of a building needs to be incorporated. There will also be the transition costs associated

with the implementation of the above enabling measures, including governmental support schemes and market incentives to stimulate these transformative changes in the building sector. Furthermore, in countries with limited public resources, the analysis must highlight the case for redirecting investment into green buildings that would have otherwise been invested elsewhere in the economy. On the other hand, the benefits of investing in green buildings go beyond achieving improved environmental performance to bringing about positive social and economic changes.

A. Economic implications

The primary economic benefits from green buildings occur at the household level in terms of realized savings in energy and water bills. While there are contrasting views on the upfront costs, construction costs need not increase substantially as a result of added improvements in the building's energy and water efficiency. Experience from elsewhere suggests that typically construction costs increase by 3-5% due to the introduction of energy efficient solutions, although this figure may vary according to the type of construction. Lowering the overall energy and water consumption has a direct positive impact on life cycle costs. Analytical studies from the United States (US) report that a minimal upfront investment of about 2% of construction costs typically yields life-cycle savings of over ten times the initial investment. The cost data used in the study include energy, water, waste, emissions, operations and maintenance, and productivity and health (Kats, 2003).

Other important benefits of pursuing green building practices include the creation of new jobs and new industries⁸. In terms of retrofitting of the existing building stock, in one estimate, 10-14 direct jobs and 3-4 indirect jobs would be created for every US\$1 million invested in building-efficiency retrofits (UNEP, 2011b). While these figures are based on US housing market, we can expect doubling or tripling of this rate of job creation, considering the average labor productivity and cost factors in the sector in the Arab region. Using a value of 40 direct and indirect jobs per US\$1 million invested in retrofitting activities, close to two million jobs would be created over the next 10 years by investing an average of US\$5,000 per building

for energy and water efficiency retrofitting of the prime 10 million buildings (20% of building stock) in the Arab world.

B. Social implications

Arab countries are urbanizing at a fast rate, resulting in massive informal settlements and slums. In the majority of those countries, the scale of informal and low-cost housing is vast. In this context, providing affordable green housing for the poor is a considerable challenge when so many already face major economic barriers to afford conventional housing. Analysis for social housing, however, does not lead to clear results whether green social housing is more expensive at the point of construction; environmental design features may be, but do not have to be, more expensive than conventional housing (UNEP, 2011b). For example, the results from a recent design competition for social housing organized by the Center for the Study of the Built Environment (CBSE) in Jordan produced consistent cost estimates for upfront construction costs of greener buildings that were comparable to conventional ones (CBSE, 2010). Incorporating life cycle costing into the analysis of greener buildings clearly demonstrates a reduction in monthly ownership and maintenance costs by up to 30% (CBSE, 2010), making them an even more attractive option in social housing schemes.

C. Environmental sustainability

Greening of buildings will have major positive implications in response to the key environmental challenges facing the region such as water scarcity, climate change, land use, waste, and sanitation. Focusing specifically on the water challenge, water efficiency measures for households can result in significant water savings, with fraction of the investments required on the supply side.

VI. CONCLUSION AND RECOMMENDATIONS

The rapid growth in construction work and the significant environmental impacts associated with current and future growth in building stocks make a strong case for promoting green building practices in Arab countries. First, current building practices are still promoting inefficient

building stock characterized by poorly designed and insulated building envelopes and inefficient installations for heating, cooling, and appliances. Green building practices are expected to reduce electricity consumption and conserve water at a time of soaring power demand and limited water resources in most Arab countries. Furthermore, improving the energy performance of buildings is among the most cost-effective ways of reducing climate change emissions.

Second, the case for green transformation of the building sector is also an economic and social one. A key benefit of pursuing green building practices includes increased value creation in terms of new jobs and new industries⁸. Removing water and energy subsidies and directing a portion of these savings towards green social housing will help reduce the cost burden on low income households for basic services (through efficiency gains). At the same time this shift in subsidies removes one of the key market distortions and provides an economic justification for green buildings in the housing market. Consequently, promoting green building practices will have far reaching implications for sustainable urban transformation and for economic growth in a region experiencing rapid urbanization and high unemployment rates.

Meanwhile, current initiatives and policy efforts are fragmented; they target selected parts of the value chain without considering the interactions within the building industry, and they have had limited success in creating real and effective transformation of the construction sector towards building resource efficient buildings. Greening of buildings and achieving sustainable urban transformation in Arab cities will require comprehensive, long-term strategies taking into consideration the particular urban context, the structure of the construction industry, and the target segment in buildings markets. For effective transformation of the building sector, these strategies need to be developed in coordination with other green actions and interventions at the urban scale and in other sectors, namely transport, energy, water, and waste management. Finally, an effective intervention strategy necessitates the identification of current performance levels and setting of clear and realistic targets in terms of energy and water performance for different types and uses of buildings.

SPECIAL SUPPLEMENT SECTION
WAEEL AL-MASRI

ENVIRONMENTAL SUSTAINABILITY IN TRADITIONAL ARAB ARCHITECTURE

Traditional architecture is place-specific, and strongly influenced and shaped by environmental forces in addition to socioeconomic factors. It has evolved through the interaction of man with a particular environment over time, using the available building technologies. Architectural typologies, forms, and details reflect the outcome of this interaction. An adequate understanding of the evolution and logic behind such elements should inform a more rational approach to their adoption and interpretation today as elements of sustainable design, rather than the present reference to such elements in general as iconic or attractive and romantic visual devices.

For example, the courtyard house type was adopted as a “green” device to provide a favorable microclimate in the harsh heat of the desert and represented a true environment-friendly building. The size of the courtyard and its proportions varied considerably from one region to another, reflecting the specific environmental conditions in each region as well as the social, economic, and urban factors. The courtyards of the old houses in Cairo were compact and dense with minimum or no ground floor arcades, acting as cooling wells, while courtyards in the Gulf region were generally spacious with shading arcades, with proportions that helped in the protection from sand storms. Where land was not restricted, multiple courtyards were adopted in houses to accommodate the various family needs. Other examples include a two courtyard arrangement allowing the creation of cross ventilation between the adjacent courtyards. Different levels in dwellings were used interchangeably as living and sleeping quarters at different times of the day and night, and throughout the different seasons. The old houses of Baghdad utilize this creative vertical use of the house around the central courtyard.

Arcades, pergolas, and screens or mashrabiyyas were among several devices used in buildings to shade living areas, or to filter the strong sunlight into these spaces. Wind catchers or towers were utilized in various forms in many places throughout the region to overcome humidity resulting from stagnation of air in living spaces. For example, the wind towers in old Dubai, which were brought in from Iran, became the subject of recent scientific studies and lab tests to evaluate their environmental performance. The wind catchers of

the houses of Cairo were carefully studied in the mid-twentieth century by Hassan Fathi, who illustrated their valuable contribution to environmental comfort in the famous Cairene Qa’a.

Water cascades and fountains, as well as vegetation, were introduced in private and public spaces to lower the temperature and to modify the microclimate in these spaces. The use of vegetation served both aesthetic, symbolic, and entertainment purposes in the elaborate and intricate layouts of courtyard gardens from Iran to Arab Spain. Inspired by a landscape culture that draws its symbolism from the Quranic depictions of paradise gardens, the nature of such gardens is also a reflection of the delicate harsh environmental conditions in the region and the scarcity of water – the essential ingredient for such gardens.

Throughout history and across the Arab/Islamic region, water devices were creatively used in houses, and can particularly be seen in Cairo, Damascus, Iranian cities, and the cities of Morocco and Andalusia. The fountain is more effective than a still pool of the same size and has the additional advantage that it does not only cool the air, but also “cleanse” it. In some old Arab houses the fountain is replaced by the *salsabil* which flows from one side hall (*iwan*) into a pool in the center of the court. The *salsabil* is constructed of a slab of marble carved with a wave pattern, with water trickling down from it, thus producing evaporative cooling. The fountains and water channels that have survived in the gardens of Al-Hambra Palaces are testimony to the advanced engineering knowledge and technologies developed and adopted by Arab architects and engineers. In the Generalife, water channels still bring in crystal clear chilled water from the far away Sierra Nevada Mountains. The aesthetic of the trickling water fountains in the courtyard gardens of Al-Hambra and the region is a reflection of a sensitive environmental awareness, and is expressive of the value of water in this part of the world.

Water has more direct functional use in some courtyards; in the *Sahn* of many old mosques in Fez and Istanbul for example, water fountains are still being used for ablution and drinking as can also be observed in Al-Qarawieen Mosque in Fez. At a smaller scale, drinking water pots were placed inside the typical *mashrabiyyah* in Cairene

houses to humidify air as it passes through, and to cool air in the drinking pot – hence the name *mashrabiya*. At the urban scale, drinking water fountains, *asbilah* (pl. of *Sabil*), used to be the subject of much architectural and urban celebration in old Cairo, often associated with a school for teaching Quran to young students (*kuttab*). A typical example of this association between water and culture is represented by the famous *Sabil Kuttab Katkhuda* in old Cairo. Drinking water fountains also have important functional, aesthetic, and social features in the urban landscape of Moroccan cities and villages. Great efforts were made to harness, conserve, and channel this precious natural resource in the cities and in the countryside, for domestic consumption, irrigation, and manufacturing. The use of water in these buildings, cities, and farmlands is a product of a culture that respects and values this precious national resource.

Traditional architecture was not only influenced by environmental, but also by socio-cultural and religious practices. For example, the general inward orientation of Arab/Islamic architecture worked well, not just from the climatic points of view, but also in the way it satisfied the conservative nature of Arab Muslim societies. Privacy, emphasis on community and neighborhood solidarity, and respect for neighbors, called for by the teachings of Islam, all found their formal expression in the close knit clusters of traditional Arab urbanization, with their narrow alleys, courtyards, and clear distinction between the public and private realms. The social structure and extended family relationships and growth promoted the general organic character of such urban clusters, while the nature of the relationship between the individual and the community influenced the form of public and private space in the city, and shaped the human aspects of the public experience in the urban context, exemplified by the concept of *fireej*, or *hara* (neighborhood), for example. Cultural values, combined with environmental considerations strongly shaped the character of these cities with emphasis on the strong relationship between nature and the built form, human scale, tight urban grain, inward orientation, and focus on living spaces rather than objects or individual buildings. For example, the dense urbanization resulted in narrow alleys between clusters of buildings, which helped keep pedestrian movement networks in Arab cities largely shaded and protected from the harsh sun. An example of such environments can still be seen in many historic living Arab cities such as the Moroccan cities of Fez and Marrakech. The dense urbanization of these cities also means that circulation and transportation networks are minimized, and that people can live, work,



shop, and perform congregational prayers within walking distance, thus reducing the consumption of energy needed for transportation, minimizing the need for mechanical systems, and saving on valuable time, stress, and effort in communicating between these places. It is worth mentioning that the city of Marrakech, for example, has attracted people to move into the city to live there, not just to visit as tourists, and promoted the real estate market in this ancient city to thrive in the twenty-first century, helping towards its sustainability and economic viability, when other old similar cities are suffering from decay and general neglect, and from the escalating threats and pressures of modern urbanization.

Traditional architectural forms evolved through trials and experimentation with materials and structural systems and technologies. Logic and the economy of materials and technologies influenced the development of roofing and support systems and the associated formal aesthetics. Throughout Islamic history, the interaction with other cultures through conquest and trade resulted in the borrowing of technologies and the importation of materials and builders, and led to the emergence of hybrid architectural styles and forms, which gave diversity and vitality to traditional architecture in different geographic locations.

Control of temperature is achieved in traditional architecture by careful selection of materials. Juxtaposition of materials with different reflective capacities generates

heat gradients which cause enhanced convection. The first line of heat control lies at the surface. The surface temperature of a sunlit material will be higher than that of the air. Air movement over an exposed surface will therefore reduce the impact of external heat. Corrugated uneven surfaces, such as the domed roofs of old Jerusalem, or the alternating recessed brick layers, or elaborate stone carving, or even decorative stucco will also simultaneously increase the rate of convection heat transfer and hence create a cooling effect.

The selective absorption and emission characteristics of materials are also very effective defenses against radiation impacts and are especially important in overheated conditions. Materials which reflect rather than absorb radiation, and which more readily release the absorbed quantity as thermal radiation, will cause lower temperatures within the building. The ceramic lining of the walls of the courtyards as seen in the houses of Iran, Iraq, North Africa, and Spain as well as the marble paving found in most of the sophisticated town houses of the region, are directly related to the absorption and emissive qualities of these "cool" materials.

Symbolism evolved in traditional architecture due to the close interaction between man, culture, and nature. Such symbolism has helped create a strong bond between societies and their physical environment, resulting in a sense of belonging and identity. The expressions of this symbolism in Islamic architecture is manifest in the use of geometry in structural forms and in decorative surface applications, the use of Arabic calligraphy, and in the use of muqarnas, for example, the symbolic aspects of colors and surface textures, as well as the use of water and gardens inspired by quranic description of paradise. Due to the nature of fast changing and moving contemporary cultures, such symbolism has largely disappeared from the contemporary dwelling and city. Understanding of the symbolic aspects of traditional architecture, and their effect on the wellbeing of individuals and the identity of communities, can inform the current practices of architecture and add valuable layers of richness and purpose to these practices.

Conclusion

The environmental lessons to be learned from traditional architecture can be of significant value and relevance. Devices such as wind towers, the use of courtyards, and the various means of dealing with passive energy in traditional architecture, are appropriate and typical examples of green design. The rich architectural heritage of the region should

be carefully analyzed and understood in its own historic and physical context. Its human, cultural, and environmental values should be considered, adapted, and applied where relevant and appropriate in the context of contemporary conditions and technologies. It must be understood, however, that this is not a call for the adoption of traditional solutions to solve more complex and contemporary problems of different nature. Rather it is about the use of such concepts and devices in similar situations where the reintroduction and reinforcement of traditional values can contribute to the general environmental and cultural sustainability in a particular locality. It is also about the critical questioning of the appropriateness of those current modern practices in planning, urbanism, and architecture that have contributed to the deterioration of the quality of living environment in the Arab region and its general alienation.

Although this typology does not offer solutions to the general problem of housing in congested urban centers in the Arab region, it nevertheless can offer a higher density, and a more environmentally and culturally appropriate approach to current planning practices for similar dwelling units. The project has generated interest in the courtyard as a viable practical alternative to the villa type in Kuwait. It is hoped that, as more people learn about the courtyard house, this interest will lead to further research into its affordable adaptation, supported by adjustments to building regulations, and a will to change patterns of living.

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Further reading

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CASE 1: BEIT AL-SUHAYMI, CAIRO

Beit Al-Suhaymi, a historic merchant's (1648-1796) house, is located in old (Fatimid) Cairo, and is approached through a narrow street off the main spine of Al-Mu'iz Street. The complex planning of the house and its compact design reflect its gradual growth over time. It includes a rectangular courtyard at its center, with a backyard garden to the north side. The main central courtyard is approached through the typical "bent" entrance leading to this lush bright space, which is preserved in its original outline.

The two-courtyard arrangement increases the available range of thermal zones so that people can select the microclimate most suited to their needs. Seasonal and daily thermal variations generate patterns of movement within the house, which became habitual and ultimately form part of a culture. Beit Al-Suhaymi includes several places around the central courtyard with thermal comfort qualities such as the various qa'as, the takhtabosh, al-maq'ad, and the built-in seats inside the masharabiyas.

The courtyard acts as a well into which the cooler air from the roof sinks, and so the downstairs rooms cool more rapidly during the night. This cool air is preserved as long as possible and the "bent" entrance leading to the courtyard from the street not only protects its privacy, but also helps preserve this cool air of the well. The thermal forces acting on the courtyard's walls and floor consist of solar radiation and radiant heat exchange. The use of high walls around the courtyard, together with vegetation and water, helps to cut down solar heat through shading, and hence contributes to the preservation of this cool air well. The high walls define the courtyard limits and concentrate the sense of its coolness.

Cool breeze generated by differential pressures between the courtyard and the surrounding rooms, flows at intervals, while the positioning of ventilators and wind catchers in the various halls – qa'as – assists this flow within the house. This breeze is also assisted by the two courtyard arrangement in this house. Opposite the main entrance to the courtyard is a covered terrace - takhtabosh with its fine transparent screen which gives an additional dimension to the courtyard by extending views into the back garden. This is a favorable sitting place because of the breeze generated between the two courts. Air flows from the shaded courtyard garden, over evaporative coolers such as porous pots, to the larger warm courtyard. There is a special sense of comfort being experienced through the alternating warmth and coolness



of this "courtyard breeze," which is very different from the constant temperature and humidity in a mechanically air-conditioned environment.

Al-Ma'ad is one of the "socio-thermal" spaces in this type of houses, which overlooks the main courtyard on the first floor. It is always cool and refreshing and enjoys the best view and breeze of the courtyard and a favorite place for the family to socialize. The mashrabiyya, which is employed here in abundance, is a complex environmental, cultural, and architectural device. This elaborate window usually has a small compartment where a water-filled porous pot is placed. Air from outside is cooled by evaporation as it passes over the surface of the pot. Water inside the pot is eventually cooled and is used for drinking, thus the Arabic name mashrabiyya (a drinking place). This window type reduces solar and light penetration into the room but still allows the cool air of the courtyard to filter through. The deep recesses of these windows were used as favorite sitting sofas, enjoying cool breezes, filtered light and views to outside without encroaching on privacy.

This building is an example of the environmental success of the courtyard house concept and remains today as a testimony to the ingenious sustainable approaches adopted by this traditional society. It has in the past few years been restored to its former glory, and remains an important example of traditional building ingenuity offering timeless lessons for a green sustainable architecture.

CASE 2: AD-DALALIAH, KUWAIT

Ad-Dalaliah houses sit on four adjacent plots, adopting the courtyard house type. The size of each house and the functional program are relatively modest compared to similar houses in Kuwait, with a total built up area of about 600 square meters. The size of the courtyard seems ideal for a family of a small or medium size—around 6 x 6 meters—big enough to have a small family and guest gathering as an extension of the inside living rooms.

The character of this project is in sharp contrast with the mainstream architecture in Kuwait today, where housing types such as the villa and the apartment represent values and socio-cultural behavioral patterns that differ from those represented by the traditional courtyard house.

During the 1950s, the Municipality of Kuwait adopted new building regulations based on Western models, the appropriation of which has resulted in a proliferation of architectural forms that seem to be incompatible with local environmental and regional heritage. At the environmental level, the adoption of the villa house type increased the external surfaces and the size of windows, and the resulting heat penetration, and hence increased the reliance on mechanical cooling systems.

On the other hand, the setbacks around the villa house would not allow freedom of movement between indoor and outdoor spaces, unless the boundary walls are high enough to prevent visual intrusion. Balconies in apartment buildings do not work well for similar reasons, and due to the harsh weather conditions in Kuwait. The application of such regulations, together with the adoption of western design ideas and the use of advanced mechanical technology to provide the desired environmental comfort, have all led to the near disappearance of the courtyard house from the architectural vocabulary of modern Kuwait.

In this project, setbacks between the four units were cancelled to have them completely attached to one another, which allowed for the creation of a central courtyard, so that the two-story high walls of one house form the fourth wall of the courtyard of the neighboring house. This was made possible through negotiation with the municipality to obtain exemptions from the local regulations. At the functional level, the courtyards had to satisfy contemporary living patterns for Kuwaiti families who have become accustomed to the comforts



of mechanical cooling and ventilation systems within indoor settings. These houses provide for the option of moving from one part of the house to the other within a completely enclosed circulation system centered round the courtyard. Nevertheless, the courtyard allows for its extended use to enjoy the temperate microclimate it creates and may also be viewed as a functional spatial element; an additional outdoor room that is protected and contained.

The courtyard includes a fountain and a water channel, potted plants, and is surrounded by an arcade at ground level, first floor loggia, 'maq'ad' and a screen 'mashrabiyya' window. Such elements further enhance the favorable microclimate created by shading and the 'cool well' effect, allowing the courtyard's extended use and helping to conserve energy consumption and reduce reliance on mechanical systems. The courtyard also serves as a "light well," bringing subdued, filtered light into the inner parts of the house, which helps cut down electricity consumption.

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NOTES

1. For preliminary information on the population of those cities, see the web site of the United Nations Department of Economic and Social Affairs Population Division.
2. Some expert opinions even accept much higher density levels, reaching 300 persons per 1,000 square meters.
3. For a more detailed discussion of the themes presented in this section, see the Urban Crossroads articles written for the Jordan Times by Mohammad al-Asad (2004 – present). The articles are available on the web site of the Center for the Study of the Built Environment (CSBE), Amman: http://csbe.org/urban_crossroads/introduction.htm
4. Drawn from statistics for the following countries: 12% Jordan (2010), 12% Lebanon (2008), 6% Palestine (2009), 5.7% Qatar (2005), 10% Saudi Arabia - non-oil GDP (2010).
5. Riyadh and Jeddah (2009) both experienced an electric power blackout due to increased demand for air-conditioning.
6. Even in this area, there is a lack of policy evaluation studies, highlighting

the need for proper evaluation studies with regards to the MENA building and construction sector.

7. Masdar Institute in Abu Dhabi is leading with a technology focused Master program in renewable energy and energy efficiency. Other universities in Jordan, Egypt, Lebanon and Palestine have participated in curriculum development projects with European partners in the area of energy efficiency in buildings and renewable energy.
8. For instance, between 50,000 to 80,000 new jobs will be created from 2010 to 2020 in Nordic countries as a result of the drive to meet national targets for energy efficiency in new buildings and retrofitting of old ones. For more details, see: Andresen, I., Engelund Thomson, K., and Wahlstrøm, A. (2010). Nordic Analysis of Climate Friendly Buildings: summary report. Nordic Council of Ministers (NORDEN), Copenhagen.

Waste Management

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I. INTRODUCTION

A green economy is characterized by public and private investments that result in improved economic returns, a healthier environment, and social development. The process of greening any sector has been defined as “the process of configuring businesses and infrastructure to deliver better returns on natural, human, and economic capital investments, while at the same time reducing greenhouse gas emissions, extracting and using less natural resources, creating less waste, and reducing social disparities” (Gueye, 2010). Policies in green economies are often formulated to stimulate investment in green initiatives. Thus, making the transition to a green economy requires a political environment that holds the long-term wellbeing of individuals as the highest priority and manages resources as assets for future generations. This political environment can only develop in a democracy. It is therefore our strong belief that democracy is a prerequisite for a green economy.

Economic activities in general drive the production, distribution, and consumption of goods and services, which lead to waste generation. Public health and wellbeing can be severely affected by the quality and standards of waste management. Waste exists in solid, liquid, and gaseous forms. Solid waste in turn varies by content and has many sources, as indicated in Figure 1. Solid waste may be classified by source as municipal, industrial, agricultural, or medical. It can also be classified by content as non-hazardous, hazardous, bulky, or biogenic.

Discarded waste is often perceived as a liability. However, in a green economy it is considered a resource because of the ability to alter this waste and make it reusable. Solid waste management is the term used to describe all activities related to the collection, sorting, processing, and disposing of solid waste. The goal of a green solid waste management is to manage waste in a manner that meets public health and environmental concerns, while conserving resources through reuse and recycling of the waste materials.

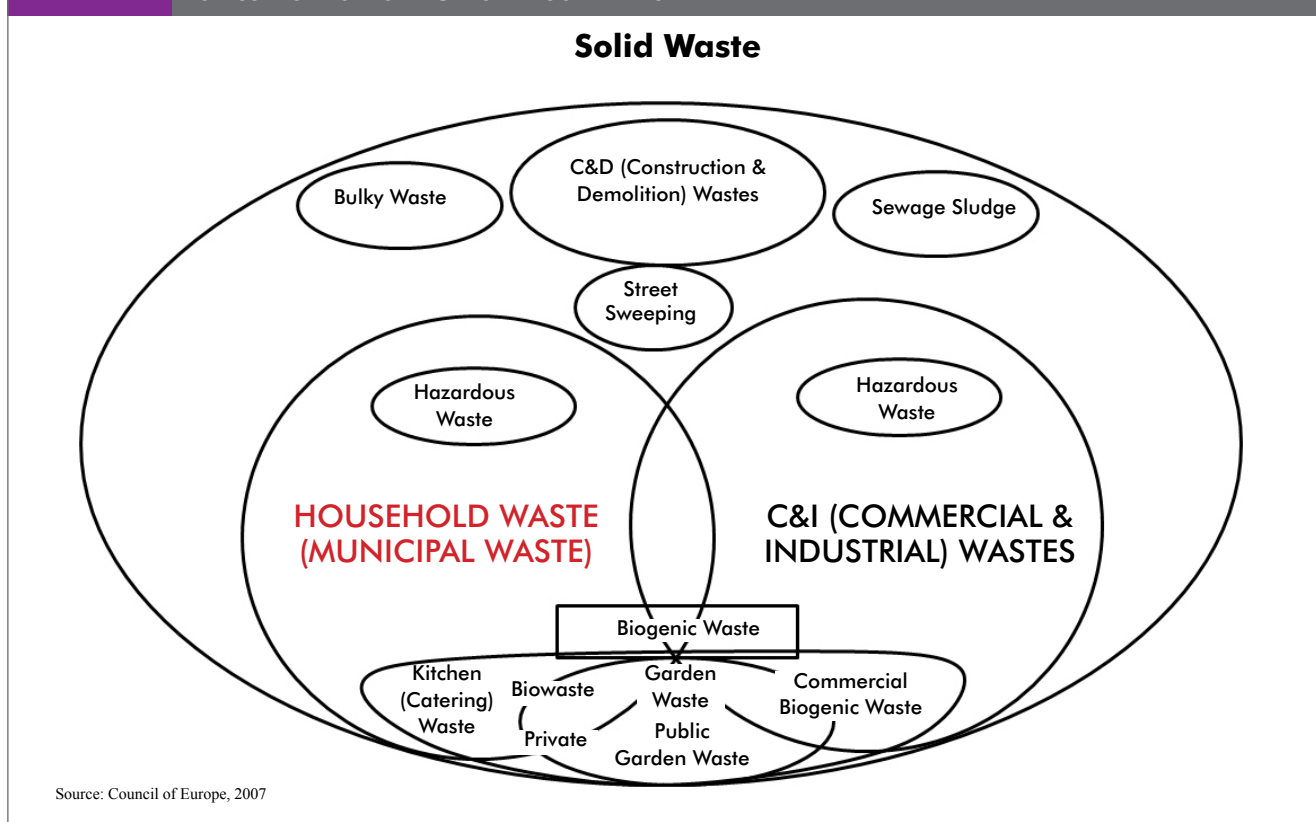
Municipal waste is often generated in greater quantities relative to other forms of solid waste. Therefore, the value of municipal waste as a resource as well as its impact on the functioning



of cities makes it one of the most important components of solid waste. Municipal solid waste (MSW) management directly stimulates the economy because it is labor-intensive and requires investments in machinery and equipment for handling, transport, and processing. In addition, MSW management stimulates multiple economic activities such as recycling, composting, and energy production. This chapter provides an overview of municipal solid waste management in Arab countries and proposes strategies to promote more sustainable patterns of waste management. The chapter seeks to:

- a. Present and evaluate current trends in the waste management sector in Arab countries.
- b. Provide an overview of the best green practices in MSW management.
- c. Discuss the enabling conditions needed to shift to more environmentally sustainable forms of waste management in Arab countries.
- d. Propose policy measures to catalyze the shift to a green waste management sector.

FIGURE 1 CLASSIFICATION OF MUNICIPAL SOLID WASTE



II. DEFINING THE SECTOR AND ITS SUBSECTORS

There is no published definition available in Arab countries for the solid waste sector. For the time being, we may adopt an international or a well agreed upon definition of the sector. The United Kingdom (UK) government, for example, defines waste management, recovery, and recycling as “products, systems and services for the minimization, collection, treatment, segregation, recovery, recycling and disposal of waste that may include paper, organics, metals, glass, plastics, demolition and construction wastes, electrical and white goods” (UK, 2006).

III. CURRENT PRACTICES

The generation of solid waste in Arab countries has recently been growing due to population and economic growth, accelerated rate of urbanization, rapid industrialization, rising standards of living, changing consumption patterns, and the lack of public awareness. The growing volume of

waste has been accompanied by changes in waste composition and characteristics due to changes in lifestyle. It is predicted that the amount of municipal solid waste generated in Arab countries in 2020 will exceed 200 million tons per year (LAS, 2009), with higher waste generation correlated to a higher gross domestic product (GDP). On average, organic matter accounts for approximately 50 to 60% of municipal solid waste, while paper, plastic, glass, metals, and textiles account for about 30 to 40% (LAS, 2009). Thus close to 80% of total municipal solid waste generated in Arab countries is decomposable and recyclable. However, the recycling rate is lower than 5% (AFED, 2008).

The concept of integrated municipal solid waste management and utilizing waste as a resource has been spreading in the Arab region. However, the solid waste sector in many Arab countries can be characterized as a disorganized sector with sporadic service coverage. In most cities of the Arab world, municipal solid waste management is undertaken by municipalities. Subcontractors are commonly brought in to handle specific activities

EXAMPLES OF SOLID WASTE SUBSECTORS (PRODUCTS, SYSTEMS AND SERVICES)

- Advice on waste minimization, landfill, mechanical and biological treatment, and regulatory consulting.
- Technologies such as specialized containment, shredders, compactors, and waste management vehicles.
- Collection and transport of solid wastes.
- Construction of landfills/incinerators (without energy recovery).
- Manufacture of equipment/vehicles for storage/collection/transport of solid waste.
- Research and development of new waste treatment technologies and technologies that minimize waste production.
- Treatment of waste prior to landfill/incineration.
- Vitrification.
- Construction of energy and material recovery facilities/equipment.
- Manufacture and supply of specialist equipment for collection, sorting, and processing of materials.
- Materials collection and reprocessing.
- Operation of material and energy recovery facilities, including composting, anaerobic digestion, and waste-to-energy.
- Segregation, treatment, and supply of recyclables and untreated waste materials.
- Research and development and production of cleaner technologies & processes.

Source: UK, 2006

such as collection and transportation. Private sector participation has been increasing over the past decade but the volume of waste handled is still limited. An informal waste management sector exists in a few Arab countries, living off earnings made from the recycling of waste. Many Arab countries lack a national strategy for solid waste management while regulations to govern the sector do not exist. In Arab countries, the political commitment to waste management is limited.

Current MSW management practices in the Arab world vary drastically from one region to the other. The wide spectrum of practices in all stages of waste management varies from very poor in some countries to state-of-the-art in others.

For example, waste collection efficiency in Egypt is 65% on average, with uncollected waste accounting for up to 50% of all waste generated in some regions (EEAA, 2008).

Even in urban areas, waste collection is more regular in more affluent neighborhoods. This section presents an overview of current practices in Arab countries followed by a discussion of cross-cutting issues.

A. Variation in current practices

Solid waste management practices in the Arab world include waste collection, transport, transfer, sorting, treatment, and final disposal. These practices vary widely from country to country, and even within a country or region. The variation in current waste management practices in the Arab world is depicted in Table 1. For example, man pulled carts and donkey carts are still used in transporting waste. However, open bed, covered, and compactor vehicles are predominantly used in urban areas. Transfer stations are not used in many regions of the Arab world. In some regions, transfer station practices involve labor-intensive handling activities at curbside locations. Vehicle to vehicle transfer, open lot, and formal state-of-the-art transfer stations are also utilized in other regions.

Waste generation rates in Arab countries vary widely, between 0.5 and 2.7 kg/capita-day (AFED, 2008). The amount of total waste generated by country depends on population size and GDP. For example, Bahrain and Egypt generate 1 million and 16 million tons of waste annually, respectively (AFED, 2008). In Egypt, Iraq, Jordan, Sudan, Syria, Tunisia, and Yemen, the rate of MSW generation is 0.5-0.9 kg/capita-day. In these countries, MSW is managed by the local public authorities with some private sector participation.

Waste management in Arab countries is characterized by a high percentage of uncollected waste, with most of the waste directed to open or controlled dumpsites. Sorting and composting facilities are being operated with limited capacity. Waste management operations in many Arab countries are strained by limited budgets due to inadequate cost recovery and low service fees. Although countries of the Gulf Cooperation Council (GCC) have higher waste generation rates of 1.2-2.7 kg/capita-day (AFED, 2008), they are able to provide better waste management services with coverage extending to remote or low density population areas, as indicated in Figure 2. The GCC countries have also begun operating sanitary landfills, albeit with a lesser

degrees of success. Waste recycling and treatment operations are still not widely adopted.

Recycling, reuse, and recovery are still at their infancy in Arab countries, although they are gaining increased consideration. Waste sorting and recycling are driven by an active informal sector. Such recycling activities are mostly manual and labor intensive. Composting is also gaining increased interest due to the high organic content of MSW. Composting has been adopted increasingly in some countries as a strategic choice for processing the organic content of waste. Some countries have deployed waste-to-energy technologies using incineration and anaerobic digestion on a prototype scale. However, such practices have not been scaled up yet.

Still, recycling rates remain low with most waste ending up in dumpsites. Waste disposal along curbsides and in uncontrolled dumps is still practiced in many parts of the Arab region. Open-air burning is often used where these dumpsites exist. In addition, MSW is commonly mixed with industrial and medical wastes during waste disposal. The most commonly used method of disposal is in “controlled” dumpsites. Disposal in sanitary landfills is increasingly being adopted, particularly where there is a strong sense of environmental awareness. Yet only a small percentage of waste is disposed in such landfills. Contamination of old landfill sites and intrusions of waste into residential areas have prompted remediation and rehabilitation efforts in several countries.

Judging by the size of the recycling industry in other nations, the inability of Arab countries to recycle municipal solid waste is a lost economic opportunity. In addition, the mismanagement of municipal solid waste causes significant



TABLE 1

SPECTRUM OF CURRENT WASTE MANAGEMENT PRACTICES IN ARAB COUNTRIES

Spectrum of Practices					
Collection	Curbside	Street Bins	Door to door	Chutes	Underground collection
Transport	Man pulled cart	Donkey cart	Open bed/Covered vehicles	Compactor vehicle	Container carrier
Transfer	None	Curbside	Vehicle to vehicle	Open lot	Transfer station
Sorting & treatment	None	Recycling	Recycling and composting	Waste-to-energy/ Incineration	Anaerobic digestion
Disposal	Open burning	Curbside dumping	Uncontrolled dumpsite	Controlled dumpsite	Sanitary landfilling

FIGURE 2 PICTURES DEPICTING VARIATION IN LEVEL OF SERVICE WITHIN ARAB COUNTRIES



degradation to the environment, with direct negative consequences for human health and standards of living. Improper handling of solid waste can result in the spread of parasites, insects, and diseases. Uncollected waste is an eyesore and bad odors are a continuous source of nuisance to nearby communities. Improper dumping of solid waste allows decomposed waste products to pollute the air, ground and surface water, and the soil. These pollutants may then find their way to the air we breathe or may enter the food chain through the water we drink or the produce we consume, causing direct health hazards and significant health care costs.

B. Cross Cutting Issues

Current waste management practices and policies in Arab countries are not economically sustainable. These practices are often driven by the availability or unavailability of financing, rather than by long-term economic and environmental benefits. Given the sector's underdeveloped condition and unsustainable practice, there is an urgent need to adopt a different strategic approach to create the conditions for more sustainable patterns of waste management practices.

Based on various discussions about MSW management in the region with relevant stakeholders combined with our own observations of the sector in a number of Arab countries, including Bahrain, Egypt, Kuwait, Oman, and Qatar, we have identified a number of key trends and issues that require immediate attention as follows:

1. There is a lack of national policies and strategies for waste management.
2. Arab countries do not have integrated MSW management plans locally or regionally.
3. The region has weak waste disposal standards.
4. Waste management in the region is not adequately financed and levels of cost recovery are low.
5. The volume of solid waste generated is alarmingly increasing.
6. Proper waste collection and transport systems are lacking and coverage is inadequate.
7. Environmental monitoring at MSW facilities is lacking.
8. The sector is plagued by insufficient MSW regulations and enforcement.
9. Reliable data for monitoring and planning purposes is lacking.
10. The sector suffers from a shortage of well-trained staff in MSW management.
11. There is considerable lack of public awareness about MSW management.

The solutions that are commonly proposed to address the problems in municipal solid waste management in Arab countries often have the following features:

1. Centralized and undiversified – solutions that do not distinguish among the different needs and heterogeneity of neighborhoods within each city, and between cities.
2. Bureaucratic – top-down solutions, usually reached without or with little community participation.
3. Capital-intensive approaches – involving advanced technology and equipment,

frequently imported from industrialized countries.

4. Formal – conventional solutions only consider the formal sector, neglecting the existence and possible contribution from the informal sector, despite its experience in waste collection and recycling.

In summary, municipal solid waste management is one of the most underdeveloped sectors in most Arab countries. It needs far more government attention and conceptual development than it has been assigned, if it is to become a sustainable economy driver rather than a source of burden and shame to society.

IV. BEST PRACTICES WITHIN GREENER ECONOMIES

Best practices in industrialized countries have arisen through the development of new concepts and technologies focused on pollution abatement and resource productivity. Considerations of the interaction between the economy, society and the environment have generated a number of significant developments in green concepts and technologies over the past few decades (Bass et al., 2009) that are briefly discussed below.

A. Development of Concepts

The development of a continuous stream of new concepts over the past few decades has marked a new approach seeking to set alternative frameworks for environmental protection and resource conservation. Below is a summary of the main concepts that have been introduced.

The impact of human activities on the planet was investigated by Paul Ehrlich and John Holdren through the “Questioning Consumption” concept in which they arithmetically modeled the impacts of each dollar spent on the planet (Bass et al., 2009). Understanding the implications of human activities has led to the concept of “sustainable development” which was defined by the Brundtland Commission in 1989 as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs.” The concept advocates preserving a resource base for future generations, integrating environmental



management, setting social and economic objectives, and making informed trade-offs when needed. These principles remain valid and are very relevant to MSW management activities.

Daly and Cobb called for an index of sustainable economic welfare that measures wellbeing in financial terms that subtracts negatives such as pollution, disease, and the depletion of natural resources (Bass et al., 2009). The above concepts have gradually built pressure for new initiatives towards the green economy.

Of particular relevance to waste management are zero waste initiatives that are now being adopted by cities and some corporations. With the emergence of new technologies in recycling and recovery, in parallel with waste reduction and reuse initiatives, the concept of “zero waste” that targets the prevention of waste by-product formation and advocates putting an end to landfill activities, has gathered steam. It has been suggested that “zero waste reflects a shared global vision where resources are used sparingly, efficiently, and optimally with systems in place to ensure that waste is effectively managed without significant negative impacts on the health of citizens and the quality of the environment. It represents an aspiration to both minimize the use of resources in the manufacture, distribution, and use of products consumed by society and maximize the capture, reuse, recycling, and recovery of the intrinsic resource value within the waste generated by society” (CSD, 2011). Germany and Japan have launched initiatives with set targets and schedules to end landfills. However, there is yet to be an initiative achieving zero waste in absolute sense.

B. Development of Technologies

The conceptual development in resource management over the past few decades has been accompanied by a fundamental shift in the approach to solid waste management from “getting rid” of waste to a resource management approach seeking to capture value from waste material through reuse, recycling, and recovery (Chandak, 2010). A combination of waste management practices and technologies are therefore being employed to divert waste away from landfill disposal and make use of otherwise wasted resources. Green economies tend to stimulate increased investment in waste management to accommodate increased waste generation rates associated with economic development. Investments are directed towards developing means for waste diversion and resource conservation to reduce the amount of garbage going to landfills.

Waste diversion is fundamentally based on minimizing waste going to final disposal. Strange (2002) argued that “while some consider the diversion of waste materials into recycling to be waste minimization, the original intent of the term was to reduce to a minimum the amount of waste being generated” in the first place.

The broader definition of minimization encompasses the three elements in order of desirability beginning with avoiding or reducing waste generation and increasing waste quality at the source, followed by material recovery through reuse and recycling (Strange, 2002). Successful implementation of material recovery may achieve approximately 70% waste diversion. However, material recovery is not the only measure for waste diversion. Additional treatment and processing is applied to manage the remainder of the waste stream in order to recover energy. It is however unavoidable that some waste residuals remain at the end of the pipeline.

The waste management hierarchy from a desirability perspective is illustrated in Figure 3 (European Parliament, 2008). The hierarchy has little scientific or technical basis but can be used as a reminder of the waste management options available to decision makers. For example, the hierarchy does not factor in costs, nor is it of use when comparing a combination of options. The greener the economy, the higher up the diversion targets are on the waste hierarchy. The so-called 5-Rs of solid waste management

(Reduce, Reuse, Recycle, Recover, and Residue management) are further discussed in the following sections.

1. Reduce

Reducing waste is the most important element of waste minimization and is considered the most desirable. It is often achieved through judicious process and input design. Waste reduction avoids the unnecessary use of materials, energy, and water. In addition, avoided waste has no environmental impact and requires no management. The aim of waste reduction is to eliminate waste before it is produced and to reduce both the quantity and toxicity of waste. This should be achieved through resource optimization, in which an integrated system-wide approach is taken.

There are a number of practices that can be adopted by stakeholders to achieve waste minimization. Households can contribute to waste minimization by moderating and monitoring their consumption habits, focusing on their needs rather than wants. Good household strategies include purchasing longer life products and repairing items whenever possible.

Manufacturers have the dual responsibility of reducing waste associated with their operations, as well as making products with longer lifetimes. Extending the product life contributes directly to resource optimization. In addition, designing products that are amenable to re-manufacturability, reparability, and recyclability are effective strategies. Government authorities need to promote waste minimization through mandatory regulations, incentives, and public awareness campaigns. Therefore, political engagement and public participation are necessary.

2. Reuse & Recycling

Reuse obviates the need to make purchases, thus reducing the consumption of energy and virgin materials that would have been used to make new products. Reuse and recycling prevent waste from reaching a landfill. Recycling often involves the reprocessing of waste materials to produce other products. Examples include the recycling of plastic bottles to make buckets or the conversion of organic waste into compost. Wastewater is sometimes treated for reuse in landscape irrigation.

AL-AZHAR PARK: FROM WASTE-DUMP TO CAIRO'S GREEN LUNG

Nidaa Hilal

For 500 years, the 30-hectare (74 acre) derelict Darassa site in Cairo had been used as a waste dump. It is adjacent to Darb al-Ahmar, one of the Egyptian capital's poorest districts and one of the world's most congested sites, ironically featuring one of the world's richest concentrations of Islamic architecture.

Working in over 30 countries on development, the Aga Khan Trust for Culture (AKTC) undertook to restore the whole area to become a "green lung" for inhabitants of the city and a powerful catalyst for urban renewal, now known as Al-Azhar Park.



The story dates back to 1984 when AKTC decided to finance the construction of a \$30 million park, which now attracts over one million visitors a year. The project included excavating a 12th Century Ayyubid wall to a depth of 15 meters after being buried up to its battlements. Having undergone extensive restoration, a 1.5 km section of the wall, with several towers and battlements almost intact, appeared in its entire splendor. Other landmark monuments and buildings in the Historic City were restored: the 14th Century Umm Sultan Shaban Mosque, the Khayrbek complex (encompassing a 13th century palace, a mosque, and an Ottoman house), and the Darb Shoughlan School.

The multidisciplinary project presented complex technical issues, including incorporating three large fresh water reservoirs for Cairo, each 80 meters in diameter and 14 meters deep. Hundreds of families have benefited from the improvement of the water supply network and the reparation of the electrical systems that began in 2007. Parts of the sewage network have been upgraded and expanded into alleys previously not served by these facilities. New drainage works are preventing the pooling of water, thereby reducing the potential for water-borne disease.

The horticultural challenges, such as the highly saline soil, were formidable. To overcome this challenge, over two million plants and trees have been planted after

creating specialized nurseries to identify and grow the best plants and trees for the soil, terrain, and climate.

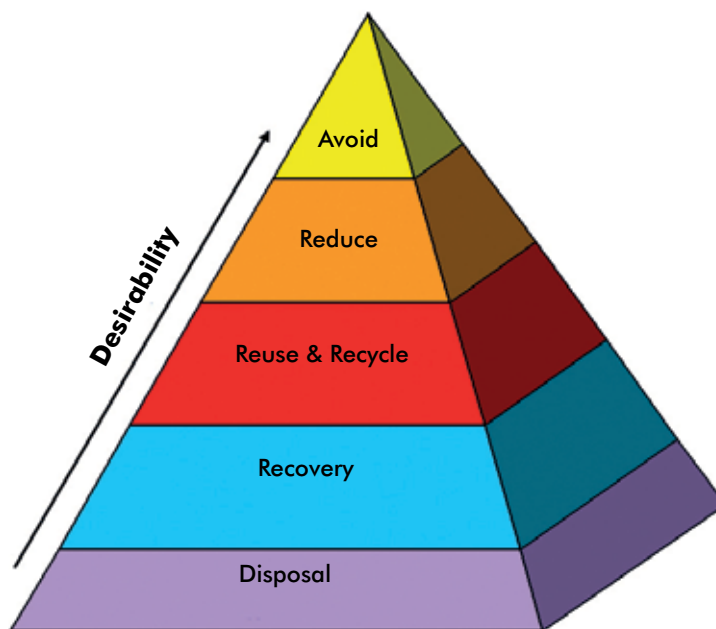
Environmental programs stressed general awareness, focusing specifically on green solid waste disposal practices. A program to remove the trash and rubble strewn across most roofs and replace them with vegetable gardens was undertaken. Additionally, a pilot project for affordable solar water heating systems was started, addressing the lack of heating in 25 percent of the area's homes.

The Agha Khan vision also encompassed extensive social development programs. Job training and employment opportunities are being offered in different sectors such as shoemaking, furniture manufacturing, and tourist goods production. Apprenticeships are available for automobile electronics, mobile phones, computers, masonry, carpentry, and office skills. Micro-credit loans have enabled residents to open small businesses.

In short, AKTC has worked with the locals on identifying priorities before taking practical steps to address their needs. Such an approach has stimulated rehabilitation without displacing residents, ensuring that they have a stake in the future of their community and helping to create viable businesses.

Nidaa Hilal is writer at Al-Bia Wal-Tanmia (Environment & Development) magazine

FIGURE 3 WASTE MANAGEMENT HIERARCHY



Source: adopted from European Parliament, 2008

Waste recycling can be hindered when market conditions are unfavorable. Sources of waste need to be in proximity to secondary materials dealers and processors. Barriers to waste recycling include changing demand caused by gaps between perceived and actual performance of the recycled products, cross contamination, and limited public participation. The most effective strategy for improving recycling is by promoting source segregation. Developing separate collection systems and improving coverage of collection at curbsides, while increasing the density of recycling centers are all factors that make recycling more effective.

3. Recovery

Energy or materials can be recovered from wastes that are not reused or recycled. A number of technologies are used to recover energy from waste. Waste combustion is one of the methods used where waste is incinerated after the removal of bulky items. In the past, waste was incinerated as a treatment process but today incineration is used to recover energy. Fluidized bed combustion is a second method of waste incineration where a fire bed of sand or ash is used. When air is

blown through the bed the material behaves as a fluid, enhancing mixing and process efficiency. Fluidized bed incinerators reduce air emissions, which results in lower-cost air pollution control equipment. This technology requires uniform size waste, which is accomplished by pre-processing before injection into the fluidized bed reactor.

Another method of energy recovery from waste is refuse derived fuel (RDF), which is produced by processing waste to produce palletized fuel that can be sold, transported, and combusted as a source of energy.

Waste-to-energy through direct combustion of municipal solid waste (MSW) or through the production of refuse derived fuel (RDF) may be considered a waste diversion system. Some analysts, though, view waste-to-energy as a waste of resources because the energy recovered is only a small fraction of the energy that goes into producing the waste (Morris, 2009). However, waste may be separated at the source into combustible and non-combustible portions before sending the combustible portions to incinerators. The combustible portions would naturally have the highest possible calorific value,

PROCESSING OF OLIVE MILLS WASTEWATER

Fuad Hashwa

Olive oil making, one of the oldest agricultural industries, has traditionally been a hallmark throughout the Mediterranean basin. It is an economically significant product for many countries and a major source of income for olive growers in Arab countries. However, high organic content process water from olive oil manufacturing is a significant environmental problem.

Olive oil is produced by extraction from olives under pressure. The oil content of olives varies between 15-22% by weight. The process waste generated, making up the remaining 78-85% of olives, is made up of olive cake and organically rich wastewater called Zibar. Many countries restrict olive mills wastewater (OMW) dumping into city sewers, streams, or rivers. Technologically and economically feasible technologies for the safe disposal of OMW have not been available till now.

The small, mostly family owned olive oil processors in Lebanon are of fundamental economic importance due to the high nutritional value of their products. However, a huge waste of agricultural potential and natural resources accompany their trade. During the annual olive-harvesting season (October-January), Zibar is generated in large quantities from olive mills, adversely impacting the environment in different parts of Lebanon.

There are few technologies available to alleviate the adverse effects of wastewater effluents in general, and none have been applied to the problems associated with Zibar in Lebanon. Since there is no disposal system, OMW is dumped on land without treatment,

thus becoming a major pollutant to surface water, groundwater, and soils. Zibar is known to be toxic to plants, inhibiting their growth. The untreated olive cake doesn't decompose at a high rate, accumulating over time as a persistent environmental pollutant. However, its nutritional value after composting permits its use as a significant feed source for animals. Proper recycling of these wastes would alleviate the annual water shortage and would reduce economic dependency resulting from the import of human food and animal feed.

To address these problems, the Lebanese American University (LAU) Biotechnology Labs in Byblos initiated a research project to develop a process for the safe treatment of OMW. The main objective of the project was to develop a low cost OMW bio-treatment technology that can reduce the high organic load of OMW and minimize its toxic impacts on the environment. The technology had to be also affordable to olive mills owners. Bio-processing of OMW is viewed as desirable because of the capability to convert toxic compounds to potentially commercial products such as proteins, fertilizers, phenols, and biogas (methane).

The low cost OMW bio-treatment process developed at LAU achieved significant organic matter reduction rates, and has proven to be suitable for deployment in small rural olive mills in Lebanon and in the Middle East. The bioprocess can also be exploited to produce additional valuable products such as phenols and biogas, thus bringing additional benefits to improve the socioeconomic status of the farmers and protect the environment.

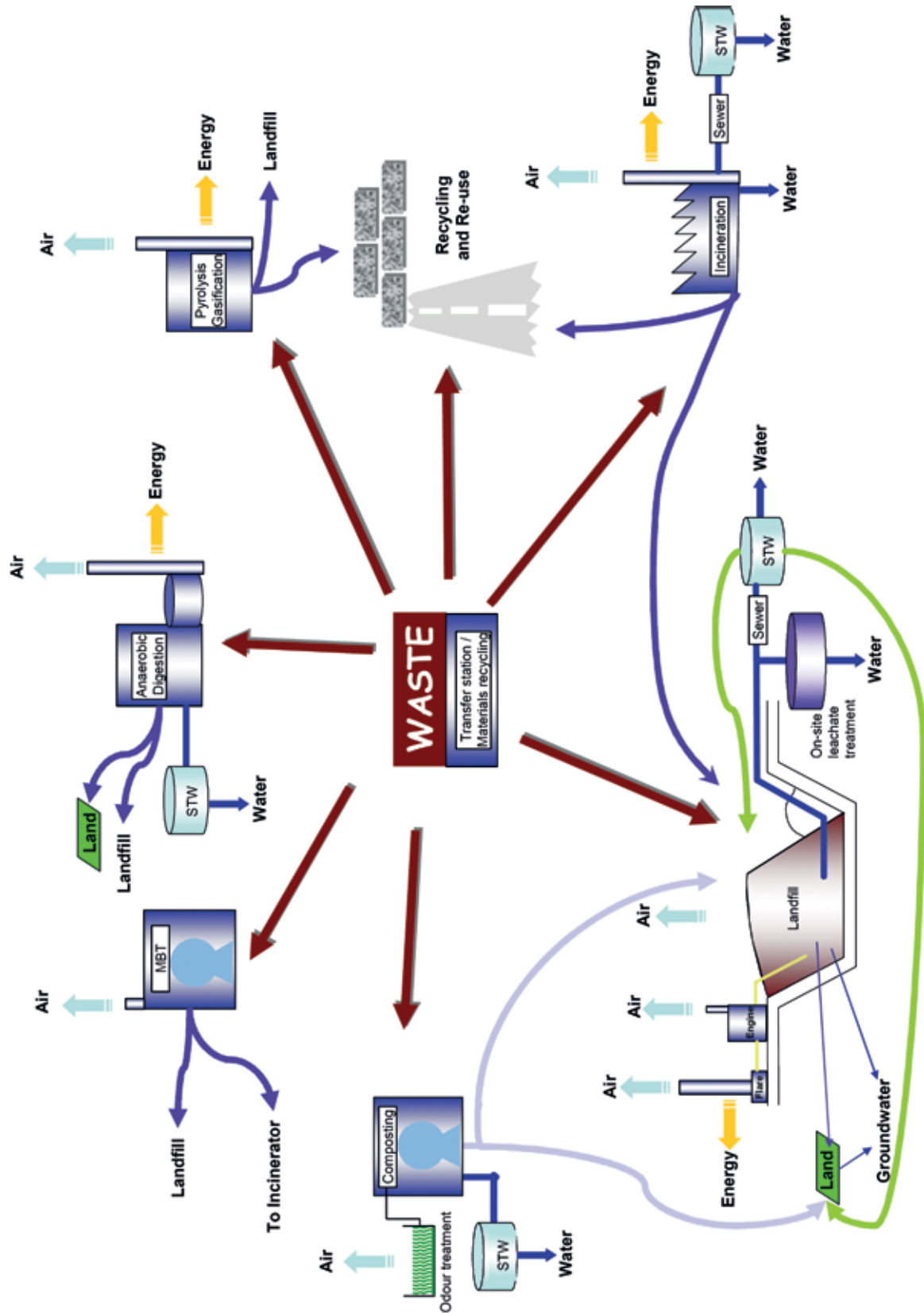
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which could preclude the use of auxiliary fuel. Many of the cities that achieve high diversion rates rely on waste incineration to generate heat and electricity (Vancouver, 2009). In addition, incineration is the option of choice in communities where it is difficult to secure land for landfills.

The beneficial conversion of landfill gas into energy evolved in order to address the potential of explosive gas leaking from landfills. Anaerobic decomposition of organic waste in landfills generates methane gas, which can then be

collected and burned for energy recovery. Methane is a greenhouse gas with higher global warming potency than carbon dioxide. Therefore, the combustion of methane gas for energy recovery has the further benefit of reducing the net potential for global warming. Anaerobic digestion of organic waste provides a higher recovery rate than landfill gas recovery. In anaerobic digesters, only organic waste is introduced to the reactor where it is mixed with sewage sludge. Gas emissions from anaerobic digesters are used for energy recovery while the remaining residue can be used as a fertilizer.

FIGURE 4 OVERVIEW OF A WASTE MANAGEMENT SYSTEM



Source: Whiting, 2006

Waste-to-energy gasification is the process of reacting waste with steam at a high temperature without combustion to produce synthesis gas or syngas, a mixture of hydrogen and carbon monoxide, which is often used as a fuel. Pyrolysis is a complex series of reactions initiated when the waste material is heated (to around 400-800°C) in the absence of oxygen to produce condensable and non-condensable vapors and solid residues. The heat breaks down the molecular structure of waste, yielding gas, liquid, and a solid char, all of which can be used as fuels. Gasification and Pyrolysis have primarily been used for single, unmixed waste streams such as tires and plastics, or to process RDF. Neither pyrolysis nor gasification is generally considered suitable for handling mixed, untreated MSW in large volumes at the present.

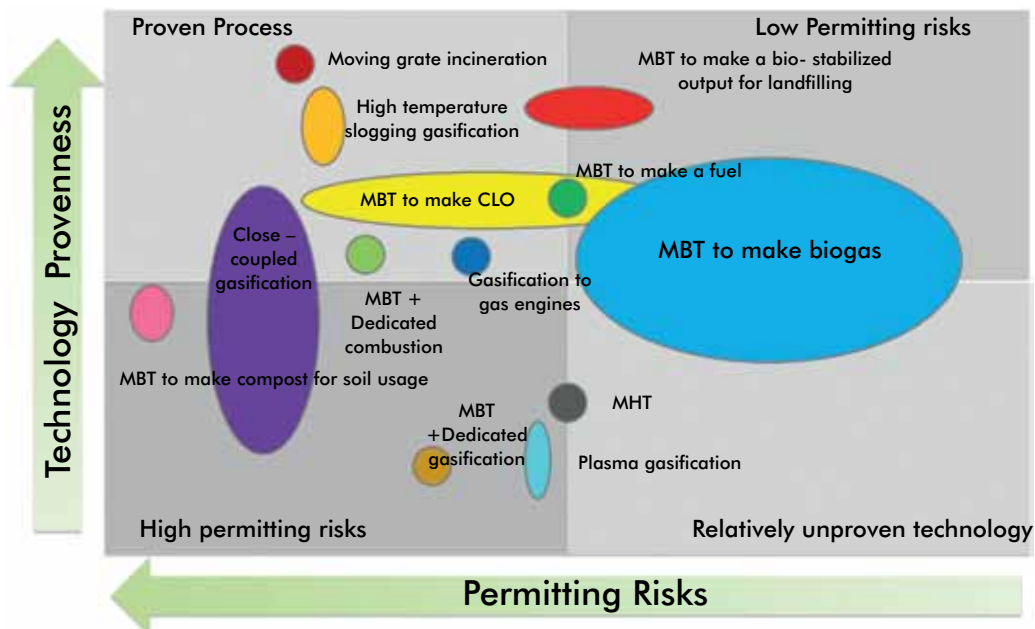
4. Residual management

Source reduction, reuse, recycling, and recovery should be considered in that order for managing solid waste. But even with best efforts and practices, there may still be a need to dispose of some residual waste. Residual waste management is the final disposal of waste materials that cannot be used in any other way.

It was common decades ago to dispose of waste in open dumps. With growing environmental awareness and the development of new concepts, open dumps have been phased out and replaced with sanitary landfills which are designed to fully contain gas and leachate. Modern landfills are also equipped with gas and leachate monitoring systems to monitor any leaking emissions to the environment. As discussed earlier, new trends in waste management tend to gradually decrease the reliance on landfills through waste diversion.

Figure 4 is an overview of the methods and technologies used in a modern waste management system. The combination of methods used in municipal solid waste management in a given city is highly dependent on the composition of waste and the economics of each method. Recycling and recovery activities may not always be financially justified, unless the costs of environmental degradation and natural resource depletion are internalized. Investment in waste reduction, reuse, and recovery can therefore be catalyzed only through government public policies, public-private partnerships, and/or innovative financing and cost recovery schemes.

FIGURE 5 WASTE DIVERSION TECHNOLOGIES: RISK VS. DEMONSTRABILITY



MBT: Mechanical biological treatment
 MHT: Mechanical heat treatment
 CLO: Compost-like-output
 Source: Whiting, 2006

STOCKHOLM – EUROPEAN GREEN CAPITAL

Adapted from: Stockholm, 2011

The City of Stockholm has a 100-year old tradition in waste incineration and waste-to-energy management experience. In 2007, the total amount of waste per capita in Stockholm was 597 kg/person-year. The city has a unique waste management system and uses innovative methods such as vacuum controlled underground transportation of solid waste.

Waste management is regulated at both national and municipal levels. Ordinances on producer responsibility, regulation of specific types of waste, waste transport, waste treatment, and other relevant areas are regulated at the national level. Waste collection and disposal for Stockholm municipality, and waste collection fees are regulated by the local bylaws.

The city of Stockholm diverts 100% of its waste as follows:

- **Recycling:** 25% of the waste produced by the citizens in Stockholm is recycled. Packaging materials are collected for material recycling by the contractors for the producer's collection system. Bulky waste from households is collected directly from houses and buildings, or delivered to the recycling centers.
- **Recovery:** 73.5% of the waste is recovered for production of district heating (energy recovery by incineration). Today, more than 70% of the households in Stockholm have access to district heating, partly produced by energy recovered from households' waste. Domestic waste is used for energy recovery at the Högdalen plant in southern Stockholm. The combustion process produces both heat and electricity. The residual products of the combustion process are slag, which is recycled and

ash, which is disposed of at a landfill site.

- **Biological treatment:** 1.5% of the waste is biologically treated. Swedish legislation does not allow organic waste to be sent to landfills. In Stockholm, all separately collected food waste is recycled as biogas and fertilizer. The city promotes source segregation of organic waste by providing bins for food waste intended for biological treatment and cornstarch bags available to individual households.

Stockholm finances waste management through a waste collection fee, which has been approved by the Stockholm City Council. The waste collection fee covers the collection and treatment of domestic waste and the administration of waste management in the city. The fee also covers the drop off of bulky waste, electrical, electronic, hazardous, and other wastes at the recycling centers and at other permanent and mobile collection points for hazardous and non-hazardous waste.

The Swedish government has introduced a producer responsibility program for the packaging and newspapers industries because they constitute a major proportion of municipal solid waste that is relatively easy to separate. The responsibility of collection and recycling of packaging lies on every company that produces, imports, fills or sells packaging or packaged goods. Similarly, producers or importers of newsprint and those who print or import newspapers and magazines have responsibility for the collection and recycling of newspapers. The producers of packaging and newspapers have created a cooperative under the name "The Packaging and Newspaper Collection Service" (FTIAB) for managing collection and recycling on a non-profit basis.

Green economies often promulgate policies to promote more sustainable patterns of municipal solid waste management. These green policies can take the form of economic incentives, mandates for extended producer responsibility, regulations in favor of green solid waste management, and cost recovery using, for example, linear garbage rates. The effectiveness of these policies can be significantly increased by sustained campaigns for public awareness, mass education, and social marketing.

When choosing between alternatives for waste

diversion, decision makers are faced with a number of questions as to which technology or group of technologies to utilize. Among the key factors are cost, technology risks, and whether the technology is proven. Figure 5 displays a 2-dimensional matrix of waste diversion technologies based on risk and whether the technology is proven. The currently underdeveloped condition of municipal solid waste management in Arab countries requires adherence to proven technologies having low risk. Arab countries cannot afford to take risks or

make trials at this stage. Proven technologies are needed in order to achieve the minimum level of waste management reliably. As authorities acquire and/or develop more capabilities, they can invest in more sophisticated waste management practices.

Having trailed other nations in sustainable development, Arab countries have been on the recipient end of MSW concepts and technologies, utilizing obsolete methods. The Arab world had little to contribute to the field. We see the political changes in the region as a prerequisite for ushering a green agenda. Accountable governments are generally more motivated by the wellbeing of their citizens, which gives hope that sustainable development will become a priority for Arab countries in the near future.

5. Spotlights on selected best practices

Two cities were selected to shed light on best practices from different perspectives. Vancouver, Canada, was selected to demonstrate best practices in waste reduction, reuse, and recycling. Stockholm, Sweden was selected because of the success the city has achieved in diverting its municipal solid waste with heavy dependence on waste-to-energy technologies. Both approaches have been adopted by different countries, depending on their own needs and goals. (See boxes on p 218-219)

6. Gains and opportunities

Significant opportunities exist for economic diversification in Arab countries by developing the solid waste sector, which will contribute to job creation and stimulate demand for products, systems, and services in other industries and sectors. Examples of related industries and sectors that can benefit from the development of the solid waste sector are provided below:

- *Manufacturing and after-sale services:* Waste handling, treatment, and disposal require vehicles, equipment, bins, and construction supplies. Additional supplies of specialized equipment are also needed for collection, sorting, and processing of materials. Supplies are also needed for the other service sectors associated with MSW management. Demand for these products and associated maintenance services will escalate with increased service coverage and

VANCOUVER 2020: A BRIGHT GREEN FUTURE **Adapted from: Vancouver, 2009**

Vancouver views the low carbon economy of the future as a great opportunity and is planning to build and boost the market for green products, services, and jobs. Vancouver produces over 1.5 tons of waste per capita annually, of which 55% is either recycled or composted. In April 2009, Vancouver issued an action plan for becoming the world's greenest city by 2020. As part of the greener communities plan, the city aspires to divert at least 70% of solid waste from going to landfills by 2015 with a long-term goal of achieving zero waste to landfills. The first step in this direction is to change mindsets so that waste materials are identified as a resource.

The plan prepared by the city of Vancouver is based on reducing the sources of solid waste, gradually moving towards a cradle-to-cradle economy where everything can be re-used, recycled or composted. From an economic perspective, reducing solid waste creates a comparative advantage as scarce resources are freed up for investment, compared to the high capital cost of building incinerators and the difficulties in finding suitable locations for new landfills.

The City of Vancouver decided to prioritize waste reduction through by-laws, education, and expansion of extended producer responsibility programs, and by taxing plastic bags, polystyrene foam food containers, cups, and utensils.

The second priority for Vancouver was to implement city-wide composting programs that include all residents, all businesses, and other institutions, such as schools and hospitals. Work is underway, and should include support for backyard composting, neighborhood-scale pilot projects, and participation in Metro Vancouver's planned regional composting program. The third priority is to improve the recycling program for businesses and multi-unit residential buildings. Vancouver is considering adopting a comprehensive recycling and composting bylaw requiring everyone—single-family residents, multi-family residents, and businesses—to sort their waste into containers designated for recycling, composting, and garbage. Building owners are required to educate tenants, employees and contractors, including janitors, on how to separate materials.

The city of Vancouver plans to build partnerships with industry and other key institutions in a joint zero waste initiative that would share learning and costs, and have a larger, more visible impact. The city is also planning to create new Low-Carbon Economic Development Zones, featuring green infrastructure and financial incentives for entrepreneurs interested in green business models.

MAKING PRODUCTS FROM WASTE PROFITABLY

Boghos Ghougassian

Cedar Environmental, an engineering firm in Lebanon, has eschewed landfills for the disposing of waste and has pioneered innovative processes for recycling municipal solid waste (MSW) since 1999 using its own locally developed methods. The company builds its own composting rotating drums, which ferment organic waste aerobically and reduce the odors to a minimum.

Controlling odors enables Cedar Environmental to operate composting and recycling facilities closer to the communities it serves where waste originates, thus reducing transportation costs and avoiding the logistics of hauling waste over long distances to a landfill.

Cedar Environmental operates waste management and treatment facilities in a closed area, whereby 95% of the received municipal solid waste is recycled into commercially sellable products. The company's goal is to reach "zero waste".

After sorting, approximately 25% of the waste is sorted by weight and is collected for direct marketing as recyclable materials such as metals, paper, cardboard, glass, and some types of plastic. The organic matter, accounting for about 55% of the total waste, is digested aerobically in rotating drums and converted into a marketable organic fertilizer product. The remaining 15% of materials, such as cloth, shoes, and low quality plastic are separated and recycled, or utilized in specific applications. Only 5% of the original waste remains and is sent to a landfill for safe disposal.



The marketable products made by composting the organic components of the waste include:

- Certified organic compost, which is sifted and homogenized to bring it to a uniform structure. It is 99% free of foreign matter. The compost is then matured and packed in 20-liter bags, labeled, and sold in supermarkets and flower shops. Revenues from compost sales allow the company to charge municipalities less for the transport and treatment of their solid waste.
- In 2005, the company adapted its Dynamic Composting Technology to slaughterhouse waste. About 6 tons of digestive tracts, horns, hoofs, and bones of slaughtered animals used to be dumped in rivers or burned in the backyard of the slaughterhouse daily. The company uses composting drums to mix slaughterhouse waste with fish waste, tobacco waste, and coffee roasting waste (which were all land-filled). The waste mixture is then processed to generate a

volume of waste. The rising demand for these products and services will stimulate investments in manufacturing and services to meet the needs of green MSW management.

- *Processing:* Growth in green patterns of waste management will require the development of recovery facilities to produce higher quality final materials for recycling and reuse. The value of recoverable materials can only be fully realized if they can be processed (i.e., segregated, graded, shredded, and cleaned) uniformly, allowing a high-quality bulk material to be produced. These processing needs will create additional investment and employment opportunities.

- *Waste-to-Energy:* Waste incineration has the potential of producing energy that can be converted to electricity. Anaerobic digestion of the organic fraction of municipal solid waste has the potential to produce bio-methane, which can be used as a fuel source. The development of the waste-to-energy sector creates opportunities for companies to provide ancillary services and equipment to the waste management operators.

- *Construction:* Solid waste management requires construction of facilities such as transfer stations, energy and material recovery facilities, incinerators, and landfills. Thus, expanding solid



final compost product that qualifies as a high-grade organic fertilizer. This product is now sold primarily to organic certified farmers at half the price of imported certified organic fertilizers.

- During the composting cycle of the combined slaughterhouse-fish-tobacco-coffee waste, the leachate is collected into fermentation tanks, oxidized, and aerobically fermented for two weeks. When it was originally analyzed in the laboratory it proved to be loaded with 30 different micronutrients, while meeting heavy metal specification standards. This new product is marketed as a liquid fertilizer concentrate to farmers, who can dilute by 100 times with water. The diluted liquid can then be used in drip irrigation or by spraying directly on plants' foliar structure.
- For home and small garden use, the company introduced a 1.5-liter liquid fertilizer bottle. The liquid fertilizer concentrate, produced from the



slaughterhouse waste process, is diluted to safe usage levels, bottled, labeled, and marketed along with the organic fertilizer in supermarkets and flower shops.

- Aside from organic products, Cedar Environmental has been involved in research to recycle plastic bags and other plastics that are not currently being recycled such as plastic cups, plastic dishes, cutlery, compact disks (CDs), toothbrushes, and toothpaste tubes. The company has developed a process in which all plastic materials are shredded and turned into a thick flat board, which is dubbed "eco-board." The eco-board is used in the making of fencing for outdoor construction sites, shelves, and outdoor furniture such as benches and tables. The company is currently scaling up this process to be able to produce these boards on an industrial scale for commercial sale.

Boghos Ghougassian is president, Lebanese Appropriate Technology Association (LATA)

waste management services provides opportunities for the construction industry.

- *Transportation:* Waste collection and transfer requires transportation of labor, vehicles, fuel, and equipment. In addition, products and by-products of material and energy recovery facilities also require transportation. The waste management sector needs to be served by an efficient transportation sector, whether by truck, train, or ship and the associated infrastructure of roads, railways, and ports.

- *Agriculture:* The recycling of organic waste through composting is a key growth area given the

high organic content of waste in Arab countries. High quality compost at an affordable cost can have positive effects on the agriculture sector. Composting creates opportunities for companies providing systems, equipment, and services in this area.

- *Waste consultancy:* More stringent environmental regulations regarding the handling, transport, storage, treatment, and disposal of waste requires the development of an advisory service sector to provide technical assistance to waste companies who must meet these regulations and fulfill the specific terms of their operating contracts. Advisory consulting companies are also becoming

RESTORATION OF WADI HANIFA WETLANDS

Based on on-site review reports by Mohammad Al-Asad and Wael Al-Samhuri

The Wadi Hanifa watershed is an oasis located in the heart of the Najd Plateau in the Kingdom of Saudi Arabia. It is a natural water drainage course for an area of over 4,000 square kilometers and a unique geographical feature in this dry region. Its basin and many tributaries form a unique 120-kilometre-long ecological zone that descends from the Tuwaiq escarpment in the northwest to the open desert southeast of Riyadh. For centuries, the Wadi Hanifa watershed system provided sustenance for communities along its length, where a balance prevailed between the wadi's resources, natural processes, and human interventions. The Wadi Hanifa is inextricably linked to Riyadh's history.

In the late 18th century, the first Saudi state strategically located its capital at Addiriyah on the west bank of Wadi Hanifa, taking advantage of water and arable land. Subsequently, Riyadh (or in Arabic, Arriyadh), the new capital of the modern Saudi state, developed to the east of Wadi Hanifa, which was used as a sustainable source of water and food for the city. Beginning in the early 1970s, Riyadh expanded westward towards Wadi Hanifa, after which it was overexploited to satisfy the increasing demand for water and mineral resources to meet the massive construction needs arising from rapid growth.

By the 1980s, Riyadh's explosive growth towards Wadi Hanifa led to the rise of ground water, dumping, environmental degradation, and loss of natural functioning and ecosystem productivity. Illegal building, flooding, and wastewater and industrial dumping led to further deterioration exacerbated by increased

urbanization and encroachment. In response, the Arriyadh Development Authority (ADA) began the implementation of a comprehensive long-term strategy in 2004 to develop Wadi Hanifa into an environmental, recreational, and tourist resource, restore its natural beauty, and rehabilitate and harness its water resources.

The reclamation project has included the introduction of landscaping, conservation of the natural environment, enhancement of agricultural land in the valley, managing water quality, restoring flood performance, the construction of dams to regulate water flow, and the planting of reed to further purify water from contaminants. An environmentally sensitive wastewater treatment facility was constructed, providing additional water resources for the rural and urban inhabitants of the region. The works involved the removal of almost 1.25 million cubic metres of construction waste, along with inert and non-inert waste that had been dumped in the wadi over many years. Another component of the wadi development was the restoration of the wadi channel as preparation for a 20-year flood plan. Prior to this, there had been widespread flooding due to the rubble and illegal building within the wadi.

The bio-remediation facility is one of the most impressive features of the project. The facility incorporates a series of weirs, riffles, pools, aerating pumps, bio-remediation cells, artificial periphyton and benthic substrates, and riparian planting. Together, the elements of this design have developed the appropriate aquatic and riparian conditions to assimilate contaminants and further purify the water through a community of natural organisms that aggregate to form a food web. This has contributed to the improvement of the environmental quality of the wadi and has greatly enhanced public perception and recreational use.

involved at the design stage of waste management. As waste management operators begin to adopt greener and more innovative waste treatment, processing, and recovery technologies, there will also be an increasing demand for research and development services in the sector.

Hence, waste management provides business opportunities in many service sectors of an economy such as construction, manufacturing, transportation, retailing, professional services, and administrative services. It also provides an opportunity to revive stagnating economies

with the potential for creating jobs. The solid waste sector in Arab countries offers significant investment opportunities.

The Arab world has an existing practice of material reuse due to cultural beliefs and social practices that can be promoted on a larger scale. Recyclables have an existing market that can grow with increasing recycling rates, and can catalyze associated processing and manufacturing industries. Organic waste accounts for 40-70% of all municipal solid waste in Arab countries (AFED, 2008; GTZ et al., 2003). Composting



Today Wadi Hanifa is a “living valley” recovered and fully integrated into the life of Riyadh. The restoration project has regenerated a clean, green, safe, and healthy environment, providing continuous parkland that connects city and wadi. Combined residential development, farming, recreation, cultural activities, and tourism inhabit an oasis that extends the full length of Riyadh and beyond, into the surrounding rural areas.

Preservation of the wetlands of the Wadi Hanifa has resulted in restoring the productive capacity of the ecosystem to provide multiple services including purifying contaminated water, restoring flood performance, providing habitat for biodiversity, and creating opportunities for recreational, educational, and aesthetic experiences. Wadi Hanifa has become a popular destination for recreational activities

such as fishing and picnicking and has also become a stop for migratory birds. Use of the parks for recreation, farming, and tourism generate income and support regional employment.

The Wadi Hanifa Wetlands reclamation project offers an alternative model for urban development. It demonstrates that the productive resources of an ecosystem can be balanced with the socio-economic needs of the people living around it to create a sustainable relationship.

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The text was edited by Melissa Vaughn.

segregated organic waste to produce manure (for agricultural use) and/or anaerobic digestion to produce biogas (to replace fossil fuels) present outstanding investment opportunities. Recovery of energy from waste is still in its infancy in the Arab world with a significant potential for expansion. Providing incentives for green solid waste management practices is needed to attract investment in the sector. These green initiatives in MSW management can generate saleable emission reduction credits, which can be traded through the Clean Development Mechanism (CDM).

V. CHANGE FROM CURRENT PRACTICES TO BEST PRACTICES

It is often said in Japan that it took one generation to change people’s habits on MSW management and that the awareness should start with school children. Change in Arab countries can be brought about provided there is a political commitment on the part of policy makers to do so, a public awareness program is in place, and concerned stakeholders are cooperating. With these catalysts in place, we can expect to see green waste management



practices expand as waste minimization takes root in Arab societies.

A. The Objective

In the modern world of high competitiveness, the elements that make a community healthy also make it wealthy. There is no doubt that solid waste management has direct impact on human health, the environment, and the economy. Therefore, embracing investment in green waste management practices is essential for achieving welfare as well as socioeconomic sustainability in Arab societies. The ultimate objective should be to develop a sustainable solid waste management strategy that relies on waste minimization and diversion as well as resource conservation, and catalyzes investment in a green economy transition. This can only be achieved by regarding waste not as a costly liability but as a resource, and building business models to capture its value economically and environmentally.

B. Routes for Change

Many developed countries realized that along with technologies and sophisticated treatment processes, there are other necessary aspects to a sound MSW management system, particularly the 3 R's of waste minimization, namely, reduction, reuse, and recovery.

As the examples of best practices in Stockholm and Vancouver illustrate, there may be several routes to transform waste management. One approach is through capital investment utilizing advanced technologies to maximize waste diversion while gradually implementing 3R policies. This has been the model adopted by Stockholm where much of the investment is directed towards waste-to-energy diversion. The other alternative is to start with the 3R policies to gradually divert waste away from landfills. This option may be more suitable for developing economies where the availability of capital is limited. It also utilizes more desirable alternatives of waste diversion. There is not a single solution for waste diversion. A hybrid approach combining features from these two models may be more suitable in some circumstances. The chosen route towards a green waste management sector needs to be customized to suit the circumstances of individual municipalities and communities. It is however very important to learn from the experiences of cities that have gone through this transition.

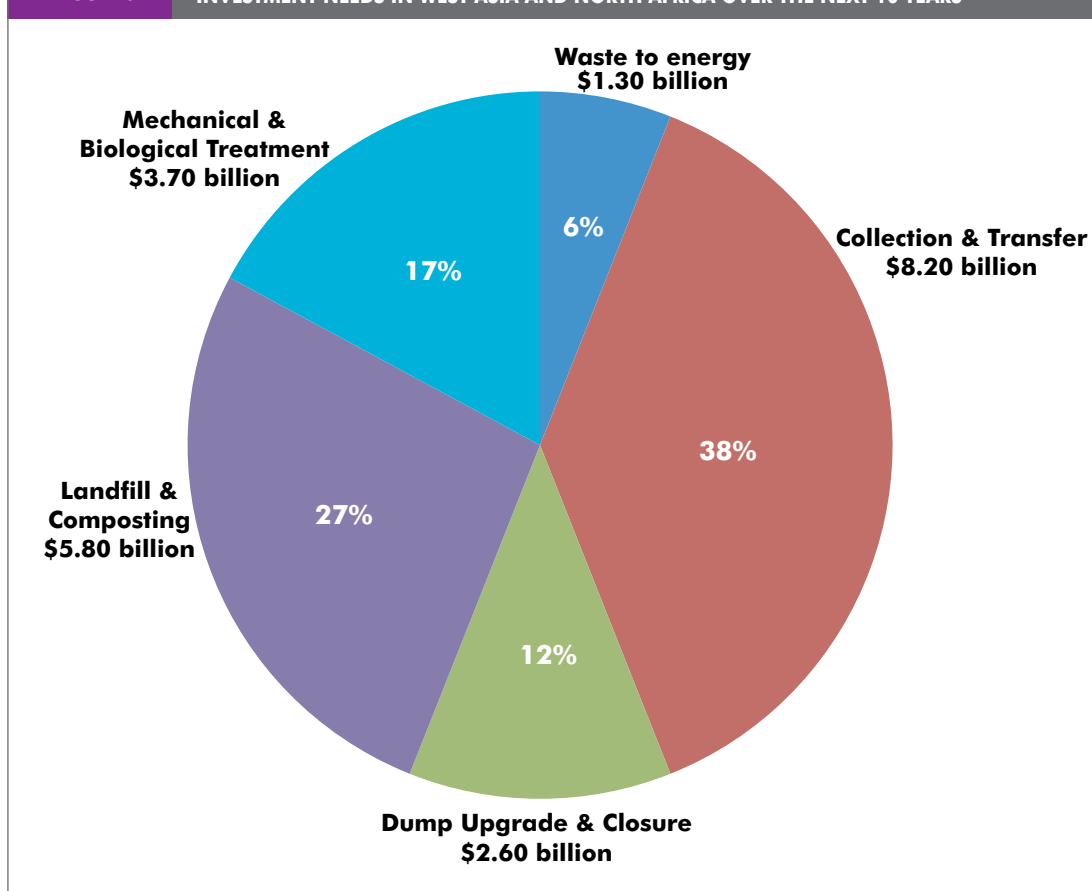
Lessons learned from other countries

1. MSW management: Vision, strategy, guidelines and plans

While MSW management remains mostly

FIGURE 6

INVESTMENT NEEDS IN WEST ASIA AND NORTH AFRICA OVER THE NEXT 10 YEARS



the responsibility of local authorities, it is the responsibility of the central government to determine the overall quality of MSW services, and to safeguard public health and the natural environment at the national level. These goals should be enshrined in the vision statement for MSW management as well as in the sector's strategic and master plans.

In the developed world, many countries have adopted national policies and national strategic plans solely for MSW management. Japan has called for a Sound Material-Cycle Society, and the New Zealand Waste Strategy raises the challenge of moving towards a zero waste and a sustainable New Zealand. Hong Kong, Malaysia, Singapore, and the UK all have similar MSW strategy documents.

Many Arab countries have adopted visions and strategic plans to guide their economic development. Some examples are Bahrain - Vision 2030, Qatar National Vision 2030, Abu Dhabi 2030, and

Oman - Vision 2020, in addition to national 5-year plans. These development plans have incorporated environmental issues to a large degree but are very sparse concerning the MSW sector.

It is recommended for Arab governments to:

- Make a strong visionary statement about waste minimization and recycling.
- Prepare technical guidelines and standards to guide and monitor private operators.
- Prepare integrated SWM master plans and action plans.

2. MSW institutions and legal frameworks

This component deals with the administration and legislation related to MSW management. Privatization of MSW services is a common strategy for improving the services provided in the GCC countries as well as in other developed countries. But it should be noted that privatization should not relieve the central government and

FIRST SECURITY GROUP – DUBAI

When the management of First Security Group's staff accommodation realized that they were spending more than AED 4 million a year on sewage tankers, they knew something had to be done, and fast.

For one, it was a fairly expensive endeavor to have twenty sewage tankers haul sewage away every day. Secondly, organizing the logistics of these tankers was proving to be tedious. Finally, since this problem surfaced at the peak of Dubai's construction (and traffic) boom, oftentimes, tankers would not arrive at all, resulting in leakage, spillage, and septic sewage.

All of this could easily be managed by installing an onsite sewage treatment plant, aside for small issue: space. The staff accommodation was situated in an industrial area in Dubai, and comprised of many buildings which left little room for a sewage treatment plant, however necessary.

The problem was solved using a packaged sewage treatment technology, with a somewhat unconventional mode of installation: the modules of the sewage treatment plants were installed in an empty walkway between the site buildings, thus making good use of existing space.

The treated water is being currently used for irrigation within the facility and also for vehicles washing, resulting in reduced water consumption.

Averda water using package sewage treatment solutions, like the one at First Security Group, can



provide financial as well as environmental benefits to its clients.

THE BENEFITS

- Major savings on sewage disposal and transportation
- Major savings on water consumption bill
- Leasing opportunities of packaged STP's
- Low maintenance costs (no mechanical parts)
- Low operation costs (no sludge, no chemicals)
- Quick return on investment
- Preservation of water resources through reuse
- Reduce of groundwater contamination from illegal dumping
- Elimination of health hazards caused by sewage odors
- Decrease of fuel emissions, traffic jam and noise pollution caused by sewage tankers

Area	Amount Spent for Water Consumption, before STP (AED per year)	Amount Spent for Water Consumption, after STP (AED per year)
Toilets	875,448	0
Laundry	125,064	125,064
Irrigation	156,330	0
Kitchens & Shower	2,219,886	2,219,886
Discharge of wastewater by Suction Tanker	4,380,000	0
Discharge of treated water	0	1,022,000
Total consumed per year	7,756,728	3,366,950
Savings	AED 4,389,778	
ROI	0.7	



local authorities of their responsibilities towards public health and environmental protection.

Most countries that went down the path of privatizing MSW services have first laid the institutional foundation necessary to govern the privatization of these services. Responsibilities of all stakeholders were properly defined. Waste types and categories have been classified and those responsible for their management clarified.

Arab countries need laws pertaining to various MSW subsectors to be enacted, including:

- a. Containers and packaging recycling law.
- b. Home appliance recycling law.
- c. Construction and demolition materials recycling law.
- d. Food recycling law.

- e. End-of-life vehicle recycling law.
- f. Laws regulating green public purchasing.

In order to bring about legal and institutional reforms, Arab countries need to:

- a. Define waste categories.
- b. Define stakeholders' responsibilities.
- c. Promulgate laws that encourage waste minimization.
- d. Set in place an accounting system for MSW management.
- e. Combat illegal waste dumping.

3. Financial sustainability

Financial sustainability of MSW management is a major issue for cities all over the world. Unlike other service sectors, it is difficult to recover the

cost of waste management services. Consumers are willing to pay for essential services such as water and electricity, but solid waste management services are not necessarily regarded as worth paying for, particularly in low and middle income countries. Although solid waste may account for a high proportion of the recurrent budget of a municipality, in the range of 20-50%, collection service coverage remains low and disposal standards are generally poor in such countries.

In order to achieve financial sustainability, the important first step is to develop an understanding of the actual cost of MSW services. Once the cost is defined, the financial gap can be calculated and target revenue levels can be defined.

Revenues can generally be raised from local taxes, special solid waste management tariffs on service bills, or charges by the service provider. Tariffs and charges can recover some of the cost of service. Thus, much of the full cost may still have to be covered by the central government. Most developed countries have introduced alternative sources of funding to close the gap. These include

carbon financing through CDM, landfill taxes, and producer responsibility schemes. These financial tools along with additional financial incentives can be used as leverage for changing consumption patterns.

It is important to determine the available resources and financial demands in order to prioritize investments. With a clear vision of costs and revenues, policy makers can take decisions based on what is affordable, particularly pertaining to deploying technologies with high capital or running costs.

4. Public awareness

While the public has a right to demand effective and efficient MSW services, it is also necessary for the public to have an understanding of MSW management and share in the responsibility of reducing waste generation. The starting point is to provide role models and education to school children. In many countries children participate in recycling activities and in campaigns to clean their schools and public beaches and parks.



In Arab countries, public awareness about MSW management is limited to a few billboards and signs stressing the need to keep cities clean. While these are welcome signs, much more needs to be done. Public awareness about MSW management should be oriented towards:

- a. Explaining and promoting waste minimization.
- b. Introducing source separation of waste materials.
- c. Collecting MSW service charges.
- d. Understanding MSW management rules and regulations and decreasing illegal practices.

5. Human resources development

More recently, the capabilities of officials responsible for MSW management in Arab countries have seen improvement. Waste management services could be further improved by developing in-house expertise and/or acquiring skills in the following areas:

- a. Monitoring the growing number of private MSW service providers.
- b. Developing better understanding of more sophisticated MSW treatment systems.
- c. Formulating MSW management laws to regulate the sector.
- d. Promoting public awareness.
- e. Operating more cost effective services.

6. Information management systems

Solid waste management is not an exact science. The waste is not homogeneous and there are daily and seasonal variations in the quantity of waste generated and its composition. But these two characteristics, the amount and composition of waste, are the data points upon which the planning and administration of waste management services depend from waste collection and transport to facilities design and budget setting. Therefore, it is necessary to develop a data information system for data storage, retrieval, and analysis.

MSW service providers in the developed countries maintain operation records and monitoring systems for environmental pollution. Financial data is also properly recorded and categorized by cost item.



C. Realistic Objectives

The development of a green MSW management sector in Arab countries will require the implementation of both soft and hard measures. The hard components will entail the implementation of capital investment projects and operation of intermediate treatment facilities as well as improved industrial processes. This

in turn will require larger budgets for MSW management. It needs to be stressed that the implementation of the 3R concepts will provide some revenue, but in most cases it will be difficult to cover all the capital and operating costs.

As for soft measures, Arab governments will need to set objectives based on the priorities of each individual municipality. This can be realized by articulating a national MSW management policy, based on which a national MSW strategic plan and regional level MSW master plans should be prepared. National policies as well as strategic and master plans should all be consistent and based on the waste management hierarchy (Figure 3) introduced earlier. The target of these plans is to change consumption and production patterns towards waste minimization and reduction as per the 3 R's concept.

It is often said that the privatization of MSW services may lead governments to take a hands-off approach to the sector. In fact, the introduction of privatization to the MSW management sector should not be considered as a substitute to government coordination, monitoring, and

regulation. The proper role for governments is to develop the institutional framework for MSW management that would inform the actions of concerned stakeholders.

D. Proposed Route for Arab Countries

For Arab countries to develop a green MSW management sector within the wider context of a green economy, a set of proposed actions is needed as follows:

1. Vision and strategy

- a. Develop a vision statement for MSW management as well as a strategic plan for making this vision a reality, recognizing waste as a resource and emphasizing waste minimization.
- b. Include the MSW sector in the country's national development plan.
- c. Generate "National Guidelines" for MSW management.
- d. Prepare the MSW master plans for the country's capital city and for other municipalities.
- e. Establish a National MSW Task Force



to oversee implementation of the above activities.

2. Institutional and legal frameworks

- a. Entrust the central government authority responsible for the environment in each country with the portfolio for MSW management at the national level.
- b. Identify the shortcomings of existing laws and regulations for MSW management.
- c. Prepare a law on the management of construction and demolition waste.
- d. Review trade agreements in order to extend the responsibility of foreign producers to manage the packaging and waste of electronic and electrical equipment (WEEE) generated from their goods exported to Arab countries.

3. Financial sustainability

- a. Separate waste management budget to identify the actual cost of MSW management.
- b. Prepare a sustainable financial plan for waste management.
- c. Negotiate compromises with different stakeholders to balance budget limitations and spending needs.
- d. Consider financial resources through extended producer responsibility, carbon credit, and landfill taxing.

4. Public awareness

- a. Develop and implement a sustained public awareness campaign.
- b. Promote a Clean Week where the public, service providers, and government officials participate in MSW management activities.
- c. Promote a Clean City competition with financial rewards, to motivate municipalities to act.
- d. Introduce educational content about MSW management in elementary school curriculums.
- e. Promote awareness about MSW management at the work place of large waste generators such as shopping malls and office buildings by setting up MSW plans at these locations by facilities managements.

5. Human resources development

- a. Develop training and executive education programs about MSW management and



- governance targeting officials from central and regional governments.
- b. Organize information exchange trips for MSW officials in Arab countries to share experiences, coordinate policies, and learn about new green policies and processes.
- c. Introduce MSW management in educational and research programs of universities.

- d. Allocate funds for capacity building in MSW.

6. Information management system

- a. Set up mechanisms for collecting information on solid waste quantities and compositions nationally.
- b. Establish an operational and environmental monitoring program in each MSW facility.
- c. Unify the practices for collecting MSW data among the various solid waste facilities within the country, and among Arab countries.
- d. Set up a government-run MSW web site and upload MSW data on a regular basis.

E. Policies and responsibilities to support the change

There is a major need for investment in municipal solid waste management in the region for environmental sustainability as well as economic growth. Policies and incentives

need to be developed to promote profitable investment initiatives in the waste management sector. However, weaknesses in the framework of municipal solid waste management in the region increasingly constrain investment in the sector. The following section discusses existing constraints in the sector.

1. Constraints

Policy makers in Arab countries need to be aware of existing weaknesses in the waste management sector that constrain a shift to green practices. Such constraints need to be addressed when planning for the transition to a green economy. The most important barriers in the region are summarized as follows:

- a. Increased quantities and changing composition of MSW.
- b. Increasing cost of waste management.
- c. Inadequate financing and weak cost recovery.
- d. Limited waste management policy framework.
- e. Undefined roles and responsibilities in solid waste management.
- f. Lack of political priority.
- g. Lack of reliable data for planning purposes.
- h. Shortage of well-trained staff and technical expertise in MSW management.
- i. Lack of public awareness about MSW.

2. Proposed policies for change

The following policy changes are proposed to overcome these constraints:

- a. Promoting the adoption of sustainable integrated solid waste management (ISWM) strategies with emphasis on a preventative waste management hierarchy.
- b. Developing policy, legal, and institutional frameworks supportive of ISWM.
- c. Developing financial frameworks to reflect full cost accounting.
- d. Using market incentives to develop a recycling industry.
- e. Promoting waste avoidance, reduction, reuse, and recycling (3Rs) by waste generators and consumers.
- f. Building institutional capacity of municipalities for improved management of



the MSW sector.

- g. Encouraging private sector participation and stewardship in ISWM activities.
- h. Promoting sustainable production practices in manufacturing and other industries.
- i. Raising public awareness about sustainable consumption and production and the economic, social, and environmental consequences of inadequate solid waste management.
- j. Developing effective capacity for safe and sound management of hazardous waste.
- k. Promoting on-site sorting and separation of various waste streams.
- l. Fostering regional cooperation in research and development and the sharing of experience in the fields of MSW management and hazardous waste management.

F. MSW management economy

The solid waste management sector is an important service sector with a significant economic weight compared to other utilities and service sectors. The size of the world's waste management industry in 2010 was estimated to be approximately \$433 billion compared to \$1,715 billion for the electric utilities industry and \$515 billion for the water utilities sector in 2008 (Whiteman, 2011). These estimates indicate the economic significance of the waste management sector. At the local level, MSW management consumes a large portion of municipalities' budgets. It is common for developing and transitional country cities to spend 20-50% of their available recurrent budget on solid waste management (UN-HABITAT, 2010). Yet it is also common for one half of the urban solid waste to remain uncollected and one half of the city population to be unserved.

In Arab countries, more investment is needed in the sector to expand coverage and improve health and environmental standards. Estimating investment requirements is difficult because waste management is one of the industries with the fewest pieces of available hard data to allow modeling of market needs. However, Whiteman and Soos (2011) extrapolated limited existing data to assess the indicative investment needs of the world's countries for municipal waste management only. They estimated that the worldwide investment needs in MSW management over the next 10 years

is between \$214 and \$499 billion. Municipal solid waste management investment needs over the next 10 years in West Asia and North Africa (mostly Arab countries) was estimated at over \$21.6 billion. These investment needs are related to the waste management chain and broken down as follows: collection and transfer (38%), dump upgrade or closure (12%), landfilling and composting (27%), mechanical & biological treatment (17%), and waste-to-energy (6%), as indicated in Figure 6. The estimated investment needs for some Arab countries (Algeria, Egypt, Jordan, Lebanon, Mauritania, Morocco, Palestinian Territories, Syria, Tunisia, and Yemen) is \$6.5 to \$9.3 billion (Whiteman, 2011).

The estimated investment projections are based on assumptions on the potential infrastructure requirements and investment expenditures of a notional unit urban population using different investment projection scenarios for different countries at different stages of development. Investments are also required for other (special) waste streams not included in the estimates including hazardous waste, healthcare waste, waste of electronic and electrical equipment (WEEE), tires, and other waste streams. Investments in downstream processing of collected recyclable materials are also not included. Therefore, these are considered rough estimates, which need to be revaluated on a country-by-country basis to account for local special conditions.

VI. CONCLUSION

The main recipe for success in improving waste management in Arab countries is the political will. It is much needed to rearrange the priorities and take the actions needed to provide an enabling environment for green investment in the sector. If actions are taken to develop a framework for municipal solid waste management with clearly defined roles and responsibilities, a foundation platform can be in place to support more sustainable practices in the sector. Such actions will trigger the development of policies and strategies, legal and regulatory reforms, financial plans, the development of regional or local master plans, the prioritization of investments, and stakeholder interactions. Such reform should foster investors' confidence in the sector and stimulate green transformations in the economy.

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Tourism

HEBA AZIZ
EDITH SZIVAS



I. INTRODUCTION

The tourism economy is one of the largest economic sectors in the world; it ranks fourth in terms of global exports after fuel, chemicals, and automotive products, with an industry value of US\$1 trillion a year (UNEP, 2011). The tourism economy generates 5% of world gross domestic product (GDP), and it makes up 6-7% of total employment. International tourism accounts for 30% of the world's exports of commercial services or 6% of total exports; 935 million international tourists were recorded in 2010. In over 150 countries, tourism is one of the top five export earners, and in 60 it is the number one. It is the main source of foreign exchange for one-third of the developing countries and one-half of the less developed countries (UNWTO, 2010).

In the 1950s, tourism was the preferred sector of the world economy – termed the ‘smokeless industry’ and considered to be the most environmentally sensitive when compared to manufacturing and mining at the time. This favourable position did not last long and by the mid 1990s, policy and academic discussions focused on the impact of tourism on the environment, society, culture, and the economy. The rapid growth in both international and domestic travel coupled with trends to travel further and over shorter periods of time have led to the excessive use of energy intensive transportation, excessive consumption of water, and excessive generation of waste, making the tourism sector a target of heavy criticism.

According to a 2008 report by the United Nations World Tourism Organization (UNWTO) and the United Nations Environment Program (UNEP) on climate change and tourism, the sector's contribution to global greenhouse gas (GHG) emissions is almost 5%. Given tourism's contribution to global GDP and employment, questions are being raised about promoting more sustainable forms of tourism economically, culturally, and environmentally. Tourism contributes positively to diversifying and revitalizing local economies. Through tourism, cultural and natural assets become a source of financial gain, which provides a strong motivation for conservation. However, these benefits are overshadowed in many cases by poor economic, environmental, and social concerns.



The concept of a green economy introduced by UNEP does not replace sustainable development. In fact, there is now a growing recognition that achieving sustainable patterns of development rests almost entirely on greening the economy. Therefore, we view sustainable tourism development as a by-product of green tourism.

Discussions on sustainable or green tourism have often presented ecotourism and small-scale, low-intensity tourism as the way forward. By extension, there was a significant silence imposed on the effects of large-scale resorts and mass tourism, which continue to dominate the international travel and tourism industry.

Therefore, a clear distinction should be made between the concepts of ecotourism and sustainable tourism. According to UNEP (2011), “the term ecotourism refers to a segment within the tourism sector with a focus on environmental activities; while sustainability principles should apply to all types of tourism activities; operations, establishments and projects, including conventional and alternative forms.”

The UNWTO ecotourism summit in 2002 has caused a controversy as supporters of sustainable development believed that it was important to address sustainable tourism as opposed to ecotourism solely. Those who were wary of addressing large-scale tourism argued that bringing all large industry

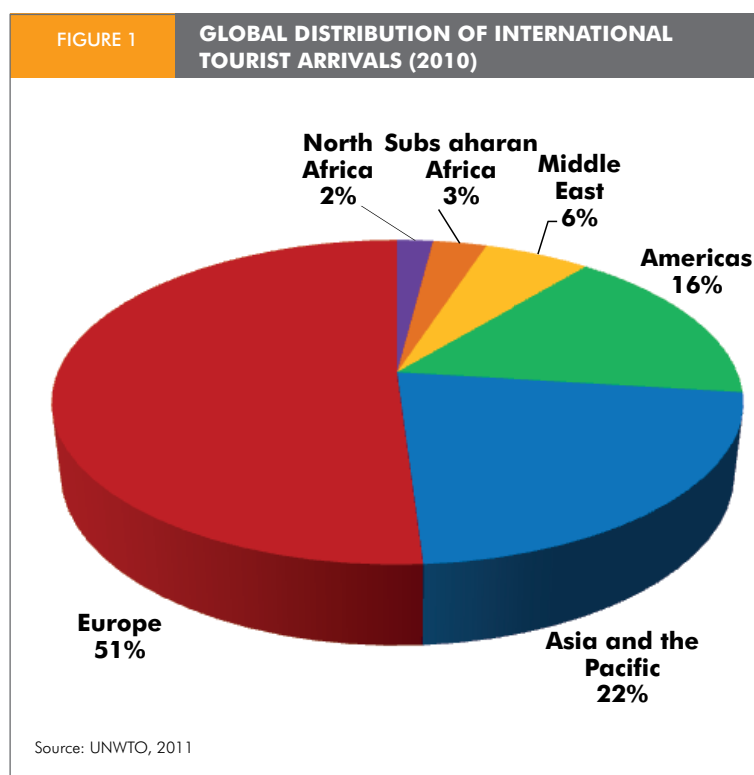
players to the table was not practical, while small-scale ecotourism was an easy target.

The Earth Summit Rio +20 is to be held in Brazil in June 2012. Government departments in charge of the environmental portfolio are currently drafting reports highlighting the progress achieved in sustainable development over the past 20 years.

The two main themes of Rio+20 are: (1) the green economy in the context of poverty eradication and sustainable development, and (2) the institutional framework for sustainable development focusing mainly on the role of UNEP and the World Commission on Sustainable Development. These two issues are of relevance to the tourism sector. Sustainability and poverty eradication have been discussed since Rio 1992 and Johannesburg 2002; in the last decade or more the green economy has also been a subject of numerous discussions and debates at conferences, workshops, and seminars. The array of terminology and concepts introduced has left the tourism sector as well as government environmental agencies unclear as to what to adopt and how.

There is currently a growing trend in many countries to set up separate ministries or departments of tourism within government cabinets, charged with ensuring that the social, cultural, and environmental effects of tourism are positive. These tourism ministries however do not have the authority to regulate the use of energy, water, or construction since these matters fall under the jurisdiction of other government agencies. Therefore, tourism ministries remain unable for the most part to effectively deploy relevant policy measures to ensure the sustainability of tourism. The political and organizational framework for institutionalizing green tourism presents a challenge on the national as well as the international level.

This report was drafted during exceptional times in the Arab world, which was inspirational at times and limiting at others in terms of accessing data and case studies from different countries. This chapter addresses policy makers and seeks to highlight areas of concern and needed action relevant to the greening of the tourism economy. It draws on a number of case studies from the region and reflects views of a number of industry leaders.



II. CURRENT TRENDS IN TOURISM

According to UNWTO (2011), the Middle East and North Africa (MENA) in 2010 received 6% and 2% of all international tourist arrivals, respectively, as indicated in Figure 1.

According to UNWTO, the Middle East received 60 million international tourist arrivals in 2010. The region experienced rapid growth (14.2%), albeit on depressed figures in 2009. International tourist arrivals were supported by strong intra-regional travel, which was boosted by high oil prices. Africa received 49 million international tourist arrivals in 2010, which corresponds to a 6.4% growth. Tourism there was boosted by the exposure created by the FIFA World Football Cup in South Africa.

International tourist arrivals to North Africa in 2010 grew by 6.2% relative to 2009. To put it in context, globally international tourist arrivals grew by almost 7%, following the exceptional decline of 4% in 2009. This indicates particularly strong growth for the MENA region. According to UNWTO, the 2009 share of international tourism to GDP ranged from 25.7% in Lebanon to 0.2% in Algeria. The contribution of tourism to GDP is also high in the case of Jordan (16.7%),

BASATA ECO-LODGE: A WIN-WIN-WIN MODEL FOR PEOPLE, THE ENVIRONMENT, AND TOURISM

Basata is one of the first eco-lodges in Egypt, located on the eastern coast of the Sinai Peninsula between the cities of Taba and Nuweiba on the Red Sea's Gulf of Aqaba. Basata offers its own brand of eco-tourism by creating harmony among people, the environment, and tourism. For 25 years, Basata has evolved and adapted to the needs of its guests, while staying true to its mission of protecting the environment and contributing to local community development.

Environmental sustainability practices have been built into the development and operation of Basata, encompassing construction, energy and water use, solid waste management, food production, and ecosystem protection. The owners of Basata have made a conscious choice to adopt ecological architectural design and the use of natural building materials in harmony with the Sinai landscape. Guest houses and buildings are designed and constructed using indigenous building materials by Egyptian architects and workers using traditional methods and reflecting traditional architecture. Only materials that are biodegradable such as bamboo, clay, and natural stones, are utilized. Higher cost construction that relies on heavy construction equipment and the import of materials over long distances has been avoided. Energy consumption is kept to a minimum; Air conditioning is not used, nor is any other form of artificial cooling. Natural

wind patterns provide cooling. Landscaping is kept to a minimum and restricted to native flora, if any, to preserve the character of the desert, reduce water consumption, and prevent agrochemicals pollution.

There are several aspects to efficient water use and management. The water cycle is explained to guests so that they may become partners in water conservation. Water-saving taps are used. On average, each Basata guest uses 70 liters of water per day, compared to an average of 500 liters per guest per day at most conventional hotels. Organic waste and excess food are fed to animals in Basata's farm. Waste from the animals is then used as a natural fertilizer for the plants in Basata's greenhouse and it is also a component in building material. The greenhouse employs organic method to grow tomatoes, eggplants, cucumbers, melons, and peppers. When harvest is abundant, fresh produce is sold to local hotels. All recyclable, non-organic waste materials are picked up by Hemaya, a local non-governmental organization founded by Basata's owner, and then taken to the solid waste transfer station in Nuweiba, where it is further sorted and sent to Cairo for recycling. To minimize power consumption, energy-saving lighting is used. Solar thermal heaters provide hot water. Electricity is only used in public areas and in some guest houses to meet basic needs. Refrigerators are not used in guest houses, nor are television sets, air conditioners, or

Morocco (9.8%), Tunisia (9.6%), and Bahrain (9.0%). The share of international tourism receipts in total exports in 2009 was highest in Lebanon (33%), followed by Jordan (28.5%), Morocco (26.3%), Egypt (22.1%), and Syria (19%). The lowest contribution of tourism to export earnings in 2009 was reported by Libya (0.2%). In terms of employment, tourism is estimated to have contributed 3% and 6% of total employment in the Middle East and North Africa, respectively, in 2010 (WTTC, 2011).

Tourism development trajectory

The Arab world is blessed with rich cultural and natural attractions and a favourable climate for most parts of the year. The region has been well known as a destination for cultural tourism for centuries. In recent times, countries in the region have embarked on the diversification of their

tourism to include various other forms. In Arab countries today, tourism spans meetings, incentives, conferences, and events (MICE), medicine and wellness, sports and adventure, and ecotourism.

As a region known primarily for its cultural heritage, tourism has since the middle of the last century been focused primarily on cultural heritage particularly in destinations such as Egypt, Jordan, Lebanon, Morocco, Syria, and Tunisia. Today, tourism in the Arab world is split between traditional and cultural destinations that have long formed the backbone of the tourism industry in terms of arrivals, market share, and development projects, and new tourism products and services, primarily in destinations such as Abu Dhabi, Dubai, Oman, Qatar, and Saudi Arabia. The region is also witnessing the growth of cruise tourism with new destinations to Oman, for example, being added to cruise ship routes.



electric entertainment devices.

To facilitate its integration with the local Bedouin communities in Sinai, Basata opened its doors for local commerce, social services, and education. This is accomplished through Hemaya, the non-governmental organization. Hemaya has initiated environmental projects for solid waste management system, ocean preservation, and renewable energy for local communities in Nuweiba and other towns, which have generated sustainable income and employment opportunities. In addition, Hemaya continues to contribute to socio-economic

development through educational, cultural, and health care projects, some of which target women.

The NGO Hemaya has succeeded, through Basata, in developing community projects that protect the culture and the environment throughout the region on a larger scale by collaborating with various authorities and local communities. Basata would not have become a model for economic, social, and environmental sustainability, had it not been for its enduring green philosophy of maintaining respect for the local culture and natural environment.

Al-Bia Wal-Tanmia (Environment & Development) magazine

The need for economic diversification, job creation, and foreign exchange made tourism a prime economic sector for many Arab countries. A significant change towards a more mass based tourism development approach was also instigated by political developments in the region. Egypt, for example, has sought after the return of Sinai to maintain a permanent presence in the peninsula and has thus encouraged the development of coastal towns like Sharm el Sheikh and Taba. Similar types of developments started also in Aqaba and in the Dead Sea region in Jordan.

The majority of tourism infrastructure in countries of the Gulf Cooperation Council (GCC) depends on large-scale iconic, resort-based projects such as the Jumeirah properties with its flagship Burj Al Arab and Madinat Jumeirah, the Palm, Downtown Dubai with its flagship property Burj Khalifa, and Dubai Land (pending). Many of

them are mixed use projects but they are still a pull factor for the growing tourism industry in the region. Qatar has coined itself as the Meetings, Incentives, Conventions and Exhibitions (MICE) destination, now expecting mega growth in preparation for the FIFA 2022 tournament. Abu Dhabi has positioned itself as the capital of culture in the GCC, with its flagship project Saadiyat Island becoming an integrated tourism complex (ITC) offering unique collection of world class museums. There are also some unique projects based on natural desert landscapes. Oman is another destination with a rich natural and cultural heritage and is now expecting the completion of major resort projects by 2012, including Jebel Sefa in the greater Muscat area, Salalah Beach, and an eco-resort in the Soda Island.

The current trend of tourism development in a number of leading destinations in Arab countries

is focused on integrated tourism centers (ITC), with conventional large-scale grouping of hotels, second homes, marinas, and golf courses. ITCs are large-scale 200,000 m² developments usually located on coastal areas and dedicated to tourism and real estate development. ITCs are popular forms of development in countries of the GCC, along the Red Sea in Egypt, in the Gulf of Aqaba in Jordan, and along the southern Mediterranean coast of Morocco and Tunisia. Oman and Bahrain have also adopted this model. Governments have allowed foreign ownership within these models of development in either a freehold or a usufruct mode. The preference for this type of development is supported by the need to provide nodes of development that spearhead regional development and create employment opportunities for the large number of unemployed youth. Due to their large scale, ITCs act as catalysts for regional development; some of them have their own schools, workers' accommodation, and service centers.

An integrated tourism center would often contain marinas, golf courses, real estate, hotels, and retail stores. For example, in the Sultanate of Oman, the regulations for development restrict building to no more 30% of the total area and do not permit the residential component to exceed 50% of the total built up area. Oman has a number of ITCs, including the Wave Project, Jebel Seef, Salalah Beach Resort, Bar al Jissah Resort. Popular ITC destinations in Egypt include El Gouna, Port

Ghaleb, and Marsa Alam in Egypt along the coast of the Red Sea.

ITCs are developed by major investment corporations and in many cases in partnerships with governments. These types of large-scale developments have become the subject of much criticism because of their impacts on the environment and society. ITCs are large consumers of energy and water and large generators of waste, and they seldom invest in alternative energy or in carbon neutral projects. Their effects on marine ecosystems are not fully assessed. What is lacking is the commitment of governments to impose environmental regulations and green business models that would encourage ITCs to invest in green infrastructure. Large-scale tourism developments have the economies of scale and the resources to invest in alternative energy, waste recycling, and other green initiatives, if a business case or incentive scheme were presented.

One of the main concerns of ITCs or other similar large-scale developments in Arab countries is golf courses, whose maintenance requires significant amounts of water. Golf destinations are resource-intensive, requiring labor and significant amounts of natural resources to maintain them. It is estimated that 9.5 billion litres of water are used to irrigate the world's golf courses per day, equivalent to the daily needs of 80% of the global population (UNEP, 2011). In addition, golf courses use excessive amounts of pesticides that



cause toxic contamination of ground water and the environment.

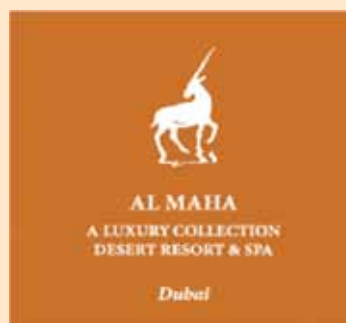
According to a 2008 report by the consultancy KPMG, the golf industry across Europe, the Middle East, and Africa (EMA) has generated US\$76 billion in revenue in 2006, supporting almost half a million jobs. The golf economy consists of six key segments, namely, golf facility operations, golf course capital investment, golf supplies, golf tournaments and endorsements, golf tourism, and golf real estate. Golf tourism accounts for 12.9% of the direct revenue from the golf economy and 13.4% of total employment in the golf economy in the EMA region.

The Arab region is known for its scarce water resources and rising water demand to meet the needs of rapid economic growth. In drawing attention to this scarce resource, a 2008 report by the Arab Forum for Environment and Development (AFED) has stated that “a particularly striking example of the conflict that exists between rapid economic development and scarce water resources is the recent boom in the construction of golf courses in certain parts of the region. In fact, most of the current and planned golf courses are in Egypt and the Gulf region, particularly the United Arab Emirates, where water resources are already low, even by regional standards. Expansion of water-intensive projects like grass golf courses cannot go on unchecked, especially with meager investments to develop sustainable desalination technologies. There are plans to increase the sixteen golf courses operating in the GCC countries now to 40 in the near future. In most cases, golf courses in the region are irrigated with desalinated seawater, treated effluent or a combination of both. A 2008 report released by the international consultants KPMG estimated the use of water for each golf course in the region at an average of 1.16 million cubic meters per year, reaching 1.3 million cubic meters in Dubai, enough to cover the water consumption of 15,000 inhabitants.”

III. BARRIERS TO GREEN TOURISM

A. Lack of governmental coordination

Promoting more sustainable patterns of tourism requires a sophisticated level of coordination on political, regulatory and operational levels,



Al Maha Resort and Spa in Dubai is an example of a private sector green initiative as outlined on the resort's website. Located on the Dubai Desert Conservation Reserve, the hotel is a unique luxury destination. However, given its proximity to protected land, the resort has gone

beyond the usual green measures. “Since its inception and its opening in 1999, Al Maha has led the region's conservation efforts. With large scale habitat rehabilitation programs, including the propagation of over 6,000 indigenous trees, shrubs, and grass, and the re-introduction of the regions' first free-roaming herds of endangered Oryx and many other indigenous wildlife species, Al Maha is an ever-growing haven of protection for the many large and small mammal and bird species of Arabia.”

Source: Al Maha—Dubai Conservation, 2011 (<http://www.al-maha.com/dubaiconservation>)

among government authorities, particularly given the multiple linkages with transportation, water, energy, and waste management sectors. Unfortunately, the commitment to intra-governmental cooperation and coordination is lacking in Arab countries. Given that tourism is a cross cutting sector, integrated policymaking is a necessary requirement for coordinated policies that promote the development and implementation of sustainable and green tourism.

B. Weak institutional capacity

A key challenge within the tourism sector is to improve the institutional capacity of governments to ensure the adoption of appropriate strategies and plans. It is the role of governments to develop the institutional framework for tourism by introducing the right regulations, coordination mechanisms, and incentive measures, disseminating best practices, and promoting public-private partnerships. Tourism authorities are left to coordinate not only with other government agencies, but also with multiple operators and providers of tourism products and services. This requires cooperation and coordination between government agencies, the private sector, industry associations, and non-governmental organizations. It is a challenging task for tourism authorities to

DUBAI FESTIVAL CITY HOTELS: ENERGY EFFICIENT LANDMARK

InterContinental & Crowne Plaza hotels in Dubai Festival City comprise 814 rooms, with over 2 kilometers of static external façade lights and more than 35,000 indoor light points. The existing lighting installation was inefficient, causing high maintenance costs, high rates of heat release from lit lamps, and high energy consumption.

To identify opportunities for switching to energy saving solutions, Philips performed a lighting audit at the premises. The audit results have revealed that the old installation could be replaced with a more efficient lighting system that would ensure long term safety, while preserving the ambience of the rooms and corridors by using the appropriate lamp for the right application.

For interior lighting, a direct replacement with light-emitted diode (LED), CFL I, and energy saving halogen lamps was offered based on the application requirements and location (burning hours, light levels, and dimming needs). This solution has reduced heat generation, which in turn reduced the cooling load, and has improved the quality of light especially in the corridors. Maintenance costs have become minimal due to the long lifetime of the new lighting installation, particularly the LED technology.

Likewise, a feasibility study of outdoor lighting demonstrated that maintenance-free LED I Color Accent is the perfect alternative to the cold cathode tubes. Flexibility of control, provided via an easy plug & play



system, allows playing any color-changing effect in line with the type of event taking place on the premises.

InterContinental and Crowne Plaza in Dubai Festival City are setting the benchmark for one of the region's best practices in green technology. Aiming to reduce their carbon footprint, the hotels are expected to cut down their CO₂ emission by almost 2 million kg/year and achieve an 80% reduction in the energy costs incurred by lighting.

http://test.lighting.philips.com/me_en/projects/intercontinentalandcrowneplazahotels.wpd

manage and organize operations efficiently when the institutional capacity is lacking.

C. Lack of regulations and monitoring

The absence of binding regulations and the lack of monitoring are principal barriers to making a transition to a green tourism sector. Green initiatives in the Arab tourism sector are currently almost entirely voluntary because Arab governments are unable or unwilling to promulgate necessary regulatory standards to make this transition.

D. Ineffective environmental impact assessment

Environmental impact assessment (EIA) studies

are an important tool available for governments to evaluate the environmental effects of tourism. However, the manner in which EIA studies are administered in the Arab region diminishes their effectiveness. Currently, EIA studies are conducted on a project-by-project basis, making it difficult to actually assess the cumulative impacts of tourism activities on the environment and the economy. EIAs for tourism projects are often commissioned by developers and conducted by environmental consultancy firms. Such firms are often licensed and qualified by the government environmental agency, which also sets the terms of reference for the EIA study. There is however an obvious case of a conflict of interest as the investor is the party responsible for making the consultancy fee payments. In addition, there is often a lack of expertise within government agencies entrusted

with reviewing the EIAs and making further recommendations for action, if any. It is important to review the process of commissioning EIAs and to adopt a more comprehensive regional approach for areas earmarked for tourism development.

E. Private sector domination

Tourism is predominantly a private sector activity. Government agencies are not effectively involved in tourism operations, i.e. bringing tourists into the country, accommodating them, or organising their destination tours except on a rather limited scale. Therefore, a compelling business case needs to be made for green tourism, supported by government incentives. The absence of incentives and business case arguments makes the greening of the tourism sector rather difficult. Moreover, the commitment made to green the economy on both national and international levels should be reflective of the will and the ability of the private sector to implement them.

F. Lack of incentives

In order to support regulations, market incentives can play a critical part in greening tourism. In Arab countries there are limited investment incentives that favour developers who adopt green practices such as alternative energy solutions or advanced waste management systems. Investment incentives are focused on cheap rental value for land or usufruct, tax holidays, rights of profit repatriation, and rights of ownership. Conditions for development rarely stipulate any environmental measures and are mainly focused on completion periods, proportion of real estate to hotels, and built up areas versus open space. Governments not only fail to provide incentives for tourism developers to green the sector, but in many cases subsidise electricity, water, and fuel, leading to overuse and unchecked behaviour.

G. Industry practices

The tourism industry faces a number of environmental challenges, namely, high rates of greenhouse gas (GHG) emissions, water consumption, waste generation, ecosystem degradation, and related social implications. A globally averaged tourist journey generates an estimated 0.25 ton of CO₂ (UNWTO and

UNEP, 2008). It is estimated that the industry currently contributes 5% of total global GHG emissions, 75% of which originates from tourist transport and 21% from accommodation. GHG emissions from tourism are expected to grow by a factor of 2-3 under a “business-as-usual” scenario. Water consumption in tourism is another area of concern, particularly in regions characterised by water scarcity. Direct water use in tourism varies between 100 and 2000 litres per guest per night with a tendency for larger resort star hotels to use more water than smaller scale accommodation establishments. For example, luxury tourists in Europe consume 880 litres of freshwater per day while average tourists consume 300 litres per day compared to 241 litres per day in residential consumption (UNEP, 2011). In terms of solid waste an international tourist is responsible for generating approximately 1 kg of solid waste per day.



Green Globe is frequently cited as one of the most widely applied for-profit, global certification schemes. Green Globe is a “structured assessment of the sustainability performance of travel and tourism businesses and their supply chain partners.”

Green Globe sustainability criteria consist of “337 compliance indicators applied to 41 individual sustainability criteria. The applicable indicators vary by type of certification, geographical area as well as local factors.” These standards are reviewed and updated twice annually. They cover the following areas: sustainable management, socioeconomic, cultural heritage, and environmental categories. Green Globe also supplies its own accredited auditors who include “professional environmental or sustainability consultants who have undergone Green Globe Certification training,” although a “third-party independent auditor is appointed to work with clients on-site” during the process. The Green Globe seal has been applied to more than 100 properties in all regions of the world. A Green Globe certified business has the rights to display its logo as well as access to marketing and promotional services.

Source: Green Globe, 2011 (<http://www.greenglobe.com/introduction>)

LEBANON MOUNTAIN TRAIL



The Lebanon Mountain Trail (LMT) provides a unique hiking experience combining walking, exploration and adventure. LMT extends from Qbaiyat in the north to Marjaayoun in the south — a 400 km trek through pathways and rural tracks across more than 70 mountain villages and towns. Hikers can either cover any part of the trail for one, two or more days, or thread their way through the whole trail, north to south.

Funded by the U.S. Agency for International Development (USAID) and implemented by ECODIT, the project started in 2007. The LMT involves environmental, economic, and social aspects that showcase Lebanon as a new destination for alternative tourism. It also contributes to the preservation of the natural heritage of Lebanon's countryside, helps discover villages marked by scenic settings and unrivalled traditions, and supports nature reserve management because it passes through three reserves: Al Shouf Cedar Nature Reserve, Ehden Cedar Reserve, and Tannourine Cedar Reserve .

On the other hand, the Trail shall help to expand economic opportunities in villages and create jobs for local inhabitants. Hikers will need the services of local guides, lodge in guesthouses owned by villagers and purchase country products, thus supporting light artisanal handicrafts. The Trail traverses some villages known for being the birthplaces of renowned poets and writers. It further promotes awareness of heritage sites and the need to preserve them.

At the onset of an LMT journey, hikers gathered in the

northern town of Qbaiyat to start their adventure towards Tachea village, some twenty km away from Qbaiyat. They were equipped with all the necessary gear, snacks and water supply. They relied on a schedule specifying the timing and locations of start, rest and arrival.

They set on their long journey which was to take them from one village to another across green mountains, stretching planes, and forests scented with flower fragrance. The whole trail through the mountains of Lebanon abounds with captivating landscape with rivers, brooks, springs, plants, migratory birds, and wild animals, let alone historic ruins including temples and castles.

They go on until they reach the guesthouse where they spend the night. The family in the house chats with them about their day's adventure. They enjoy the hospitality that characterizes the Lebanese, and sit to a table full of savory traditional Lebanese dishes and home-made sweets that give them some calories after a long active day.

Reaching Tachea village the following day, the group had completed one of the 24 sections of the hike through the Lebanon Mountain Trail. It is a fascinating adventure which is necessary for the completion of the work which started in 2006 to map out the course and set its activities. The work is still in place and is expected to eventually place LMT in a prominent position on the international ecotourism map.

Al-Bia wal-Tanmia (Environment & Development) magazine
www.lebanontrail.org

H. Consumer demand

Tourists' demand for sustainable practices appears to have increased in recent years, although data does not suggest that consumers are actively seeking information on sustainable practices. Studies reveal that consumers have a level of awareness and willingness to support green initiatives, although this does not necessarily indicate serious commitment. In a survey of 1,000 users of the travel site Trip Advisor, 38% reported that "environmentally friendliness" played a role in their travel decisions, and 34% were willing to pay more for an environmentally responsible hotel. While perhaps willing to pay more, 62% of respondents in the CMI survey did not pay extra in order to decrease their 'footprint' on their most recent trip. While environmental sustainability was listed as an important criteria in selecting a travel destination, 53% of the respondents listed "desirability to explore" as the top criteria, followed by location, price, and proximity to family and friends; sustainability ranked 6th (CMI, 2011).

It is quite obvious that it would be insufficient to leave the greening of the tourism sector solely in the hands of tourists. Luxury hotel group practices related to procurement and the provision of services lead to exuberant amounts of waste. Importing water bottles, fresh flowers, in-room amenities, are justified by hotel operators on grounds of consumer expectations. Therefore, understanding the behaviour of high net worth individuals (HNWI) will play a major role in the successful implementation of green initiatives.

IV. ENABLING CONDITIONS FOR GREENING THE TOURISM SECTOR

A. Ecotourism

The green tourist economy has often been championed through ecotourism. The International Ecotourism Society (TIES) defines eco-tourism as: "Responsible travel to natural areas that conserves the environment and improves the wellbeing of local people" (TIES, 1990). Ecotourism plays a significant role in nature conservation and in supporting local economies by stabilizing communities in their locality and halting internal migration from rural

to urban centres, hence contributing positively to the eradication of poverty. The Royal Society for the Conservation of Nature (RSCN) in Jordan exemplifies this trend by marrying local economic development, tourism ventures, and nature conservation.

However, ecotourism currently accounts for only a relatively small proportion of the tourism industry. UNWTO (2010) estimates that ecotourism represents 3-7% of the global tourism market. Ecotourism is promoted through small and medium sized locally owned organizations, and exists in remote rural or environmentally sensitive areas. By virtue of its dependence on the physical environment, it is committed to the preservation of the environment. The main factor constraining ecotourism development is the lack of access to capital (UNEP, 2011). It is therefore important for international organizations and governments to facilitate financial flows to this small but important market niche.

B. Quality assurance

The existing quality assurance and licensing schemes are sufficiently broad to accommodate greening regulations. A good example is the hotel classification system in the Emirate of Abu Dhabi, where points are awarded for environmental measures. According to the point system currently adopted by the Abu Dhabi Tourism Authority, carrying out a minimum of four activities that have a positive impact on the environment such as the reduction in GHG emissions, energy efficiency, waste management (recycling), water management,





and noise pollution reduction earns the hotel 5 points towards their classification. Similarly, licensing schemes could also incorporate alternative energy sources for hotels or similar establishments.

C. Finance

The availability of capital to finance green tourism initiatives is the key to successful introduction and implementation of a green tourism economy. This includes investment in infrastructure, including alternative energy sources, waste management, and water efficiency, which are needed to spearhead private sector investment in sustainable green tourism. This could take the shape of a public-private partnership (PPP) where the government joins forces with the private sector to provide such infrastructure facilities. In many developing countries, investment in green projects is classified as “non-productive assets” resulting in higher interest rates and lower investments (UNEP, 2011). An investment of 0.2% of global GDP in green initiatives for the tourism industry between now and 2050 will ensure significant benefits such as the reduction in water consumption by 18%, energy use by 44%, and CO₂ emissions by 52% compared to the business as usual scenario (UNEP, 2011). These findings by UNEP confirm that successful implementation of green initiatives requires government intervention and should not be left to voluntary corporate programs.

D. Government initiatives and recognition schemes

A number of Arab countries have established environmental awards to encourage research and

to recognize efforts in environmental protection. The Zayed Prize for the environment (recognized as one of the most valuable environmental awards), and the Sultan Qaboos Prize for Environmental Preservation awarded through the United Nations Educational, Scientific, and Cultural Organization (UNESCO) are notable examples. A number of initiatives focusing on hospitality and tourism were recently launched in the region. The Dubai Green Tourism Award granted by the Dubai Department for Tourism and Commerce Marketing (DTCM) is designed to encourage investment in sustainable management practices among its members - the hotels of Dubai. The award recognizes tourism establishment that observe green practices: increasing resource efficiencies, reducing and reusing treated wastewater, preventing waste from the source, influencing the supply chain to reduce unnecessary packaging, using double-sided paper when printing or copying, and avoiding the use of products that have hazardous properties.

E. International organizations

International organizations including the United Nations Environment Program (UNEP), the United Nations World Tourism Organization (UNWTO), and the United States Agency for International Development (USAID), among others, offer opportunities for nation states to push forward the green tourism agenda by spearheading green projects and offering capacity building and consulting. For example, a number of government agencies in Egypt, including the Tourism Development Authority and the Egyptian Environmental Affairs Authority, have partnered with USAID in the design of a

green tourism policy for the Red Sea. The Red Sea program is aimed at expanding educational opportunities, redefining zoning regulations, and promoting environmentally sound practices among the different stakeholders (USAID, 2006). Another global initiative is the launch by UNWTO of the hotel energy solutions project, including a portal that shares techniques for improving energy efficiency.

F. Commitment by industry

The wide range of private operators that form the backbone of the tourism industry are now showing more commitment to make significant green changes in their operations. They are driven by the need to fulfill international obligations, meet consumer expectations, and above all to reap financial gains. The growing awareness of the demand for green tourism products and services, whether in the form of modes of transportation, hospitality, or leisure and recreation, has forced large corporations to take practical measures to improve their environmental performance and also to disclose their sustainability policies. Whatever the motives are, it offers governments a vehicle to secure private sector commitment to transitioning to a green tourism sector. Nakheel, the real estate developer in Dubai, is the force behind Dubai's most iconic building projects including the Palm Islands, The World, and The Universe Islands. Some of these developments off the coast of Dubai are human-made islands and have thus raised serious environmental concerns because of the significant amount of sea dredging and the resulting disruption to marine habitats and species. In response, Nakheel has launched a sustainability initiative known as Blue Communities with a budget of US\$136 million (500 million Emirati Dirham or AED) to enhance the coastal ecosystem. This initiative, however, was one of the first victims of the economic downturn, and initially lacked concrete focus on solving specific problems created by the local coastal developments.

G. Corporate social responsibility (CSR) and supply chain

Corporate social responsibility (CSR) is a management and organizational tool in corporate structure used to assist corporations in taking sustainability actions. The World Bank defines

CSR as “the commitment of businesses to contribute to sustainable economic development—working with employees, their families, the local community, and society at large to improve the quality of life, in ways that are good for business and good for development” (World Bank, 2004). The hope is that CSR and the underlying commitment it embodies will forge tighter bonds between stakeholders and make otherwise altruistic behaviors part of corporate standard operational practices.

The potential for utilizing CSR to bridge the gap between small-scale ecotourism projects and large-scale sustainable developments is yet to be explored. Aziz and Bontenbal (2011) recommended a twining scheme between large corporations on one hand, be they developers or management corporations, and small and medium-size enterprises (SME) on the other hand, be they community tourism projects, ecotourism enterprises, farms, or handicrafts providers. The goal of the twining scheme is to allow technology transfer and training that facilitate the application and cross-fertilization of green tourism principles. This kind of partnership could also be a way forward for ensuring the implementation of green tourism projects across the supply chain. Twining could take place not only within the hospitality and tourism sectors, but may also include farms and handicrafts centers.

H. Environmental certification schemes

Environmental certification has become a widely implemented tool for regulating the environmental impacts of many industries. An effective certification scheme could act as a guide, directing organizations to use their resources more efficiently while exercising minimum impact on the environment. Leadership in Energy and Environmental Design (LEED), a widely used certification scheme, is an internationally recognized green building certification system, providing third-party verification of the environmental performance of buildings across important metrics including energy and water consumption, CO₂ emissions, indoor air quality, and resource use.

The LEED hotel program provides benchmarks for water and energy use, environmentally preferred products and practices for cleaning, sustainable purchasing policies, waste management, and

ongoing indoor environmental quality. In many countries, LEED certification is backed by tax incentives for both private and public projects, which help to defray some of the cost of LEED-certified construction and renovation. In that context, LEED has managed to provide financial incentives for developers to adopt green building practices. It is hoped that this model can also be followed in Arab countries, whereby such certification schemes can be tied to financial incentives.

Certification brings together government regulatory agencies, developers, financial institutions, architects, and other stakeholders in the tourism value chain, which often provides significant opportunities for exchanging knowledge and experience. Certification schemes should ideally make themselves attainable to the entire spectrum of tourism enterprises ranging from small hotels to large corporations. Governments should take an active role in promoting them; the Estidama initiative, developed and promoted by the Abu Dhabi Urban Planning Council (UPC), is a good role model to be followed and emulated in the Arab region.

V. CONCLUSION AND RECOMMENDATIONS

Tourism is a fast-growth, leading industry in the economy of most Arab countries. It is an



important and significant contributor to economic diversification and job creation. The shift to a green tourism economy will become a reality once governments, tourists and tour operators realize the gains from adopting green practices and measures and become more committed to applying sound and sustainable environmental principles.

It is important to point out that almost all direct and indirect activities in the tourism sector can contribute to green tourism. This includes operation by both small-scale enterprises as well as integrated tourism centers (ITC). Arguably, large-scale tourism developers and ITCs are more capable of adopting more sustainable patterns of tourism due to the availability of funds, resources, and economies of scale, which may not be available to small-scale players. The transition to environmentally sustainable tourism for both large and small scale industry players will take place only if there is a compelling business case and a set of both regulations and incentive measures that encourages investments in energy and water efficiency, renewable and clean energy sources, waste reduction and recycling, green buildings, biodiversity protection, the conservation of cultural heritage, and community development.

Although tourism is dominated by private sector developers as well as small and medium-sized enterprises, the role of the government is crucial in creating a pro-green investment environment. Arab governments have the power to license, regulate, and penalize, while at the same time providing incentives that support investment in green infrastructure development projects. What is needed is commitment and the political will to do so.

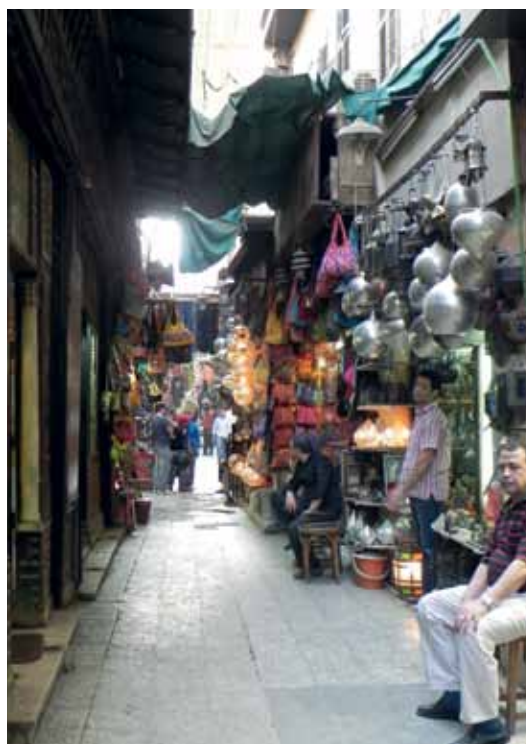
In the short term, governments should be able to reform existing rules and regulations to accommodate green economy principles, linking quality assurance schemes such as hotel certification, to energy and water efficiency measures, renewable sources of energy, and waste reduction and recycling. Linking investment incentives in tourism to green performance standards is often crucial to winning investors over and creating a win-win scenario. To further support the greening of the tourism sector, Arab governments should bring all relevant stakeholders together in order to consolidate efforts, encourage

the sharing of experience, and to disseminate best practices.

According to UNEP (2011), global growth in tourism up to 2050 under a “business-as-usual” (BAU) scenario will result in increased energy consumption by 111%, GHG emissions by 105%, water consumption by 150%, and solid waste disposal by 252%. Alternatively, with investments in green tourism equal to 0.2% of current global GDP, the growth rate in the tourism market will exceed the BAU scenario by 7%, while expecting to “undercut the corresponding BAU scenario by 18% for water consumption, 44% for energy supply and demand, and 52% for CO₂ emissions” (UNEP, 2011). This highlights the necessity of allocating capital to enable a stable transition to a more environmentally sustainable tourism industry. While corporate voluntary programs and international donor agencies can provide some funding, there is no alternative to governments taking responsibility for providing finance in partnership with the private sector and with incentives offered by financial institutions in the form of green credit. Public-private partnership (PPP) schemes can provide an attractive vehicle to encourage investors and developers to adopt green tourism and provide the necessary finance. Green capital can be used to invest in green design and construction, solar thermal water heating units, waste recycling equipment, water efficiency fixtures, and energy efficiency appliances.

Effective implementation of green tourism strategies requires high levels of institutional cooperation and coordination. The government agency in charge of tourism should provide the institutional framework, while working with other government ministries that have responsibility in water, energy, waste management, and transport sectors, as well as with local government authorities and chambers of commerce, to coordinate implementation and compliance.

Effective implementation of green economy requires capacity building for both the public and private sectors. It is important to highlight the necessity of training for two target groups: environmental inspectors and frontline hospitality staff. Inspectors need to be able to inspire confidence and transfer knowledge when inspecting private sector projects for environmental compliance. Frontline staffs are



the ones directly in contact with the physical environment surrounding them, and their decisions can make a big difference.

Ecotourism as well as community-based cultural tourism should especially be promoted and supported by Arab governments. They are important sources of funding for conservation projects. To raise funding for biodiversity protection and cultural preservation of heritage sites, a small portion of the proceeds should be allocated for such activities. Because they tend to be located in environmentally sensitive areas or in remote sites, they contribute to poverty reduction, community development, and employment. It is key to ensure community involvement in all aspects of project development.

Research and innovation are crucial to enhancing green economy practices. Although research and innovation have targeted energy efficiency in the transport and construction sectors, more innovation is needed in the hospitality and leisure sectors and in services and products that cater for customers' tastes and needs. Research in artificial green golf courses, for example, would be highly relevant to reducing water consumption, together with a better understanding of high net worth individuals' needs and expectations.

TOURISM FOR NATURE - THE JORDANIAN EXPERIENCE

Royal Society for the Conservation of Nature (RSCN)

For most travelers, Jordan's image is still branded by the historical sites of Petra and Jerash, and to a lesser extent by the desert landscape of Wadi Rum. These have been the mainstay of its tourism industry for decades. But Jordan is now trying to diversify its tourism base within the framework of the National Tourism Strategy, and eco-tourism is beginning to play a significant role in creating new attractions for visitors.

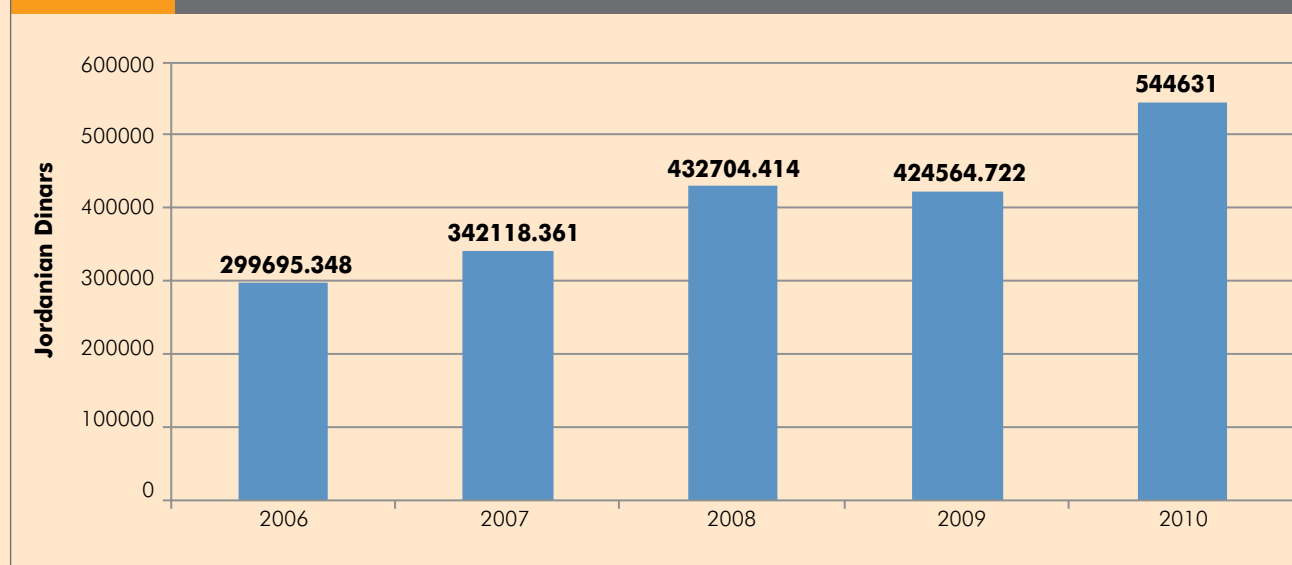
Remarkably, the development of the eco-tourism sector is being spearheaded by a long-established non-governmental organization (NGO), the Royal Society for the Conservation of Nature (RSCN), which has been developing eco-tourism ventures over the last 15 years as a tool to sustain its nature conservation areas. Through its separately branded business arm, 'Wild Jordan' - and in partnership with the government and private sector - it has developed tourism operations in six major protected areas, including several uniquely designed lodges and campsites. Its flagship site is the Dana Nature Reserve, which has won four international awards for sustainable tourism since it was established in 1994. The number of tourists to RSCN sites exceeded 137,000 in 2010, generating 1 million Jordanian Dinars (JD) in revenue. Over 16,000 people from poor rural communities have been supported by this tourism for nature conservation scheme in 2010. This revenue stream has also covered over 50% of annual conservation costs in the same year.

The graph for the Dana Nature Reserve in Figure B1 shows the amount of money that has gone to the Dana communities from tourism, employment, and handicraft initiatives over a period of 5 years.

A new era in conservation thinking

The RSCN is entrusted by the government with the protection and management of Jordan's special ecosystems. It is one of the few non-governmental organizations in the world given such a national mandate. For several decades, RSCN managed its protected areas as isolated sanctuaries, fenced and guarded from the general public and with little involvement of local communities.¹ This all changed in 1992 with the Rio Summit and the Biodiversity Convention. As a signatory of the Convention, Jordan was the first country in the Middle East to be awarded a multi-million dollar pilot project under the Global Environment Facility (GEF) to develop a regional model of integrated conservation and development. The project was focused on the Dana Nature Reserve in southern Jordan, where for the first time in the Arab world, the creation of a protected area was linked to the socio-economic development for local community. This pioneering initiative ushered in a new era in conservation thinking, which the RSCN continues to spearhead today. In particular, it kick-started the development of eco-tourism as a principal tool for sustaining the management of protected areas and for

FIGURE B1 LOCAL BENEFITS IN JORDANIAN DINARS FOR THE DANA NATURE RESERVE 2006-2010



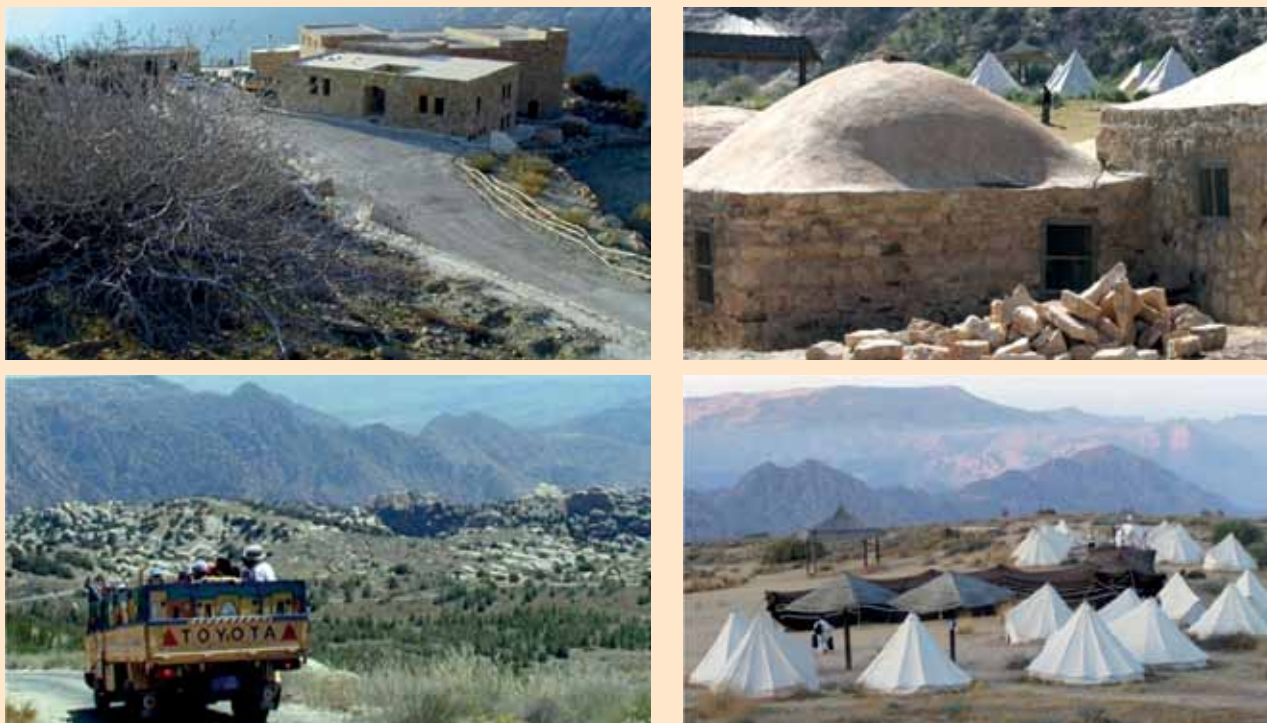


Figure B2: the Dana Reserve tourist facilities: top left, the Guesthouse; top right the campsite kitchen and store, bottom left the “Dana shuttle”, taking visitors to the camp and one of the access controls; bottom left, the campsite tents against the mountain backdrop.

engaging local communities in nature-based livelihoods. Figure B2 shows images of the Dana Nature Reserve.

Using the accumulated experience gained from the ‘Dana model,’ RSCN has developed eco-tourism facilities and operations in all the protected areas under its jurisdiction. It now operates five permanent lodges/guesthouses, three campsites, three visitor centres, and many hiking and activity trails, as shown in Figures B3 and B4. With this extensive portfolio of projects and experiences, RSCN has demonstrated that tourism is an effective vehicle for:

- Generating substantial income for biodiversity protection.
- Creating jobs and revenue for local communities and, thus, more positive attitudes and support from local people towards conservation.
- Helping Jordanians to appreciate and value their natural heritage.
- Ensuring that conservation is seen as part of the “real world,” with a clear economic value that government officials and other decision makers recognize and appreciate.

‘Wild Jordan’

While the benefits of tourism are clear to see, they have not been easily won. Jordan undoubtedly has some spectacular landscapes and a fascinating cultural history, but at the same time, it lies in one of the most politically unstable regions in the world and is at the ‘mercy’ of unpredictable and violent events on its borders (witness the huge drop in tourist numbers during the current wave of unrest sweeping the region). It therefore became apparent to RSCN early on that good marketing was the key to making its tourism ventures viable and sustainable, especially as Jordan was not known as an eco and nature tourism destination.

Initially, RSCN created a tourism unit, embedded in the conservation department, which devoted most of its time to working with established Jordanian tour operators. Initially, however, it was difficult to get local tour operators to support the new eco-tourism opportunities being opened up by RSCN. With their long history of conventional ‘archaeology tours,’ most Jordanian operators were not comfortable with the new product, having little understanding of the philosophy of eco-tourism and what it entails.



Figure B3: Taking influences from ancient caravanserai and Yemeni architecture, the Feynan Eco-lodge provides 26 rooms, all organically shaped and different in layout. It incorporates several environment-friendly features, including solar power, high insulation and passive ventilation systems and, in the absence of mains electricity, it is lit at night by candle light, which gives a very special atmosphere to the building and creates an unusual attraction for tourists. Feynan Lodge is the first RSCN facility to be outsourced to private sector management

Faced with this lethargy and conservatism in the industry, RSCN decided to become more up-front and entrepreneurial itself and developed the idea of 'Wild Jordan': a separately branded division devoted to the development and marketing of its eco-tourism (and other socio-economic) products. This division recruited a team of marketing and public relations staff from the private sector and introduced private sector thinking and performance related incentives. Under the slogan, "helping nature, helping people," the Wild Jordan division has become increasingly effective in putting RSCN's eco-tourism products 'on the map.' It has cultivated the local tour operators through constant interaction and has secured agreements with over 40 companies for bringing clients to RSCN facilities. It has also introduced several innovative marketing initiatives, of which the most pioneering is the Wild Jordan Centre in the heart of the capital city of Amman. This purpose-built centre, perched high above the old city, combines a tourist information focal point with a large nature shop and whole food restaurant to provide a popular city-center showcase for RSCN's tourism and handicraft products.

Issues and lessons learned

Looking back over 15 years of experience, the main problems and issues affecting the development of desert tourism as a conservation tool in Jordan have largely been social and business-related, rather than ecological. Key ecological indicators in the protected areas developed for tourism have not shown (as yet) a negative relationship with increasing tourism activity. The one exception concerns local community livelihoods. It was envisaged that increasing job opportunities in tourism would reduce the dependency of local people on ecologically damaging land use practices, especially goat grazing. So far, however, this does not seem to be the case.

A study conducted in Dana in 2001², five years after tourism began, concluded that RSCN's socio-economic strategy (including eco-tourism) had not significantly reduced the level of goat grazing in the reserve. The author notes, however, that RSCN [its socio-economic strategy] "has been very successful in improving the attitudes of the local population toward conservation and the presence of the reserve."

One of the very visible (and unexpected) impacts of RSCN's tourism ventures has been the response of local entrepreneurs to the influx of eco-tourists to protected areas. This is most evident in Dana Village, where resident cooperatives and business-oriented individuals have created small hotels from the old village houses to exploit the growing reputation of the Dana Biosphere Reserve as a tourist destination. This in itself is not a problem – indeed it would normally be welcomed and fostered by RSCN – but the proprietors have shown little regard for the architectural, historical, and visual quality of the village and the resulting hotels and guest houses have become a visual eye sore. Apart from unsympathetic restoration, they have added intrusive signing, strings of neon lighting, and a host of small 'kitsch' interventions that are seriously affecting the architectural integrity of this Ottoman village. The local hotels have also started employing foreign women for housekeeping and waitressing, undermining the benefits of tourism for local employment. Developments such as these, as well as attempts to compete for customers, have led to rivalries and disputes between owners and families, and to criticism of RSCN for restricting development inside the protected area.

Another issue has been pricing for Jordanians. RSCN has pitched its pricing policy for entrance, accommodation,



Figure B4: The tourist facilities recently completed by RSCN, showing the wide range of ‘styles’ of architecture. Top left: wooden cabin in the Ajloun Forest Reserve; top right, silver-domed chalets at Mujib on the shores of the Dead Sea; below, Azraq Lodge in the Eastern Desert; a converted British military field hospital dating from the 1940’s.

and activity fees according to the need to cover all tourism operational costs and raise revenue for supporting protected area management costs. While the fees are not high by international standards (average rate for a double room is \$70) they are expensive for a large proportion of the Jordanian population and RSCN is sometimes criticized for “pricing out” sections of society. This is an important philosophical issue for an NGO that has been given responsibility for managing natural heritage sites on behalf of the nation, since access to these sites is arguably the birthright of all Jordanian citizens. Indeed, the whole idea of RSCN becoming business-like and commercial in the interests of conservation is not always received favourably and this, ironically, includes a proportion RSCN’s own staff, who feel the Society is losing sight of its conservation and NGO roots. RSCN has tried to reduce the perceived inequalities in pricing by charging

lower fees for Jordanians and by developing more “economy level” facilities. In terms of the business-NGO dilemma, RSCN has started to outsource its Wild Jordan operations to the private sector and enable the Society to concentrate more on its core mandate. It does, however, see tourism as critical to its long term sustainability and it will continue to develop tourism ventures in protected areas through private sector partnerships.

Royal Society for the Conservation of Nature (RSCN)

¹ The exception was the Shaumari Nature Reserve, which had a small animal collection and was open to visitors and school groups.

² *Combining Conservation and Development: An Evaluation of the Socio-economic Strategies of the Royal Society for the Conservation of Nature in Dana, Jordan.* MA thesis, Amberley Knight, Brigham Young University, USA, July 2001.

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ANNEX

POLICY MEASURES FOR TRANSITIONING TO A GREEN ECONOMY

In order to facilitate and enable a transition to a Green Economy, a number of measures need to be introduced. The manner in which these measures are identified, prioritized and implemented is dependant on the policy context, prevailing institutional setup, and specific circumstances in the country in question. In addition to being country specific, the policy package should be developed in such a manner that the various measures and tools support and complement one another.

1. Political economy

In any political system there are always those who resist change and are in favour of maintaining the status quo. These may be individuals in high offices who would see their political power and interests threatened if there is a major change or shift in policy. They may also be large corporations that would see their businesses incur losses due to major policy shifts. Both entities will try to lobby and obstruct any change that will result in them losing power or money even if this shift is in the best interest of the majority of the people and country at large. It is therefore essential that policy makers are fully aware of the playing field, and measures are taken to contain, and/or counter their attempts to obstruct change.

2. Macroeconomic environment

A secure and stable environment is a necessary requirement to attract local and foreign investors and entrepreneurs. This can be achieved by ensuring a transparent, accountable and stable economic climate. In order to attract foreign capital - particularly for new and innovative sectors - it is essential that there is a clear and predictable financial system with a stable exchange rate, regulations pertaining to investments in the different sectors, and transfer of funds. The necessary market incentives should be in place in order to encourage investment. In most countries of the region, for example, the bond market is weak, thus hampering government and private sector involvement in large and long-term projects.¹

3. Integrated approach

Adopting an integrated approach for policy development and implementation will ensure the integration of environmental and social considerations in sectoral and macroeconomic policies. There is a need to depart from dealing with environmental and social consideration in isolation from mainstream economic policies. Financial and short-term economic gains should not be the primary driving force in designing sectoral and macroeconomic policies. Key

considerations such as social justice, poverty reduction, and equitable distribution of wealth, preservation of the environment and human welfare should be at the heart of the policy formulation process for genuine sustainable development to be achieved. Integrated assessment and policymaking for sustainable development should be one of the main tools used and promoted by national institutions to facilitate a transition to a green economy.

4. Regulations

In many countries regulations are the main tools used to regulate and implement policies, including environmental policies. Regulations need to be designed to support other measures, including market incentives.

In order to have an effective regulatory system that supports a transition to a green economy, the following should be taken into account in developing regulations:

- Support research and development and use of environmental technologies.
- Coordinate activities between government bodies with clear lines of responsibilities.
- Local capacity of environmental officers in environment-related issues and capability in tracking environmental pollutants to the source should be enhanced.
- Regulations introduced to provide a code of conduct for the different sectors should be designed to take into account environmental, social, and developmental considerations.
- The full cost of regulations should be accounted for and their implications on the economy, environment and different segments of the population taken into consideration.
- Include clear property and access rights for agricultural land, pastures, fisheries, and forests to encourage their proper use and management.

5. Market incentives

Incentive measures are increasingly being used to influence production and consumption patterns towards green and sustainable practices. Incentive measures include tools such as taxes, subsidies, charges, and fees, tradable permits, eco-labeling, and payments for ecosystem services. The use of a feed-in tariff and metering systems are other incentive tools that encourage investments in renewable technologies, where consumers are credited for surplus electricity generation beyond domestic needs. Such tools need to be designed to complement regulations and address environmental, social and economic considerations. In many instances, green taxes continue to be introduced as distinct from traditional or grey taxes. Taxes need to be designed not simply to generate income for the government, but also to alter behaviors towards more sustainable patterns of consumption and production. Therefore, instead of restricting taxing to income and employment, taxes should be introduced to arrest environmentally damaging behavior. Specific attention should be given to equity considerations and the

distribution of the tax burden among different segments of the society according to their income .

6. Subsidy reform

One of the main causes of market distortions that contribute to the inefficient allocation and use of resources are perverse subsidies. According to the World Bank, subsidies are one of the main barriers for energy and water efficient installations and investment in renewable energy.²

The following should be taken into account in reforming subsidies:

- Define and measure subsidies as some of them may be in the form of direct financial support or reduced tariffs or charges for utilities.
- Identify perverse subsidies as opposed to subsidies that promote sustainable development activities.
- Prepare a strategy for reforming subsidies with full consideration of its implications.
- Monitor the implications of subsidy reform.
- Replace perverse subsidies with green subsidies. These include direct grants, loans, tax rebates or cuts to encourage investments in green sectors.³
- Design as part of a package of incentives and regulatory measures aimed at reducing negative impacts on the poor, and on competitiveness.
- Develop and introduce a social protection mechanism in order to address potential resentment and negative reaction from the general public.

7. Human resource development

Investment in human capital is a crucial and necessary prerequisite for transitioning to a « Green Economy ». Strengthening capacities need to emphasize providing a cadre of professionals capable of designing policy packages aimed at achieving sustainable development. Particular emphasis should be laid on integrating environmental and social considerations, including equity considerations, social justice in the planning and decision making process. Efforts should focus on enhancing capacities to develop policies designed to maximize the benefits from investing in the environmental infrastructure.

Education systems in the Arab world need to be revamped to produce education curricula that meet current and future challenges. Environmental and social considerations need to be integrated in the different disciplines and not taught as separate disciplines. University and vocational curricula should cater for current and future market demands. This includes expertise in renewable and energy efficiency, water efficiency, recycling and water desalination, sustainable agriculture, clean technology and industrial processes and practices, ecotourism, green transport, green cities and buildings. Sustainability tools and methodologies should be introduced and taught at schools, universities and training centers. These include: integrated policy making, integrated/sustainability assessment, life cycle analysis, use of market incentives, economic valuation of the environment,

ecosystem and the services it provides, integrated environmental and economic accounting among other tools. Moreover, education systems should be geared towards encouraging innovative thinking, research and development.

8. Technology and innovation

At the global current level, investment in research and development and deployment of technology is in the range of US\$ 12.5 billion annually both by private and public sector. In order to make the transition to a green energy sector, this figure needs to be increased by a factor of 2 or 3⁴. National capacities to absorb and develop appropriate and environmentally sound technologies are key to making the transition to a green economy and achieving sustainable development. The figure for developing countries is in about 0.15% compared to the world average of 1.4%, and 2.5% in Europe. Adequate budgetary allocations should be made available by Arab countries for research and development (R&D). Governments in the Arab region have to allocate at least 0.5% of GDP to R&D, which amounts to US\$ 9.5 billion annually based on the region's GDP in 2010. The introduction and use of environmentally sound technologies will enhance resource efficiency, reduce waste, and contribute towards creating new market opportunities as well as increasing competitiveness of products in local and international markets.

9. Communication and outreach

It is important to develop communication and outreach packages to make the business case for transitioning to a green economy. These packages should be designed to target different stakeholders and target groups in order to raise awareness about the rationale, benefits, and implications of the proposed policies and enabling conditions for transition to a Green Economy. This will enhance the likelihood of integration of the proposed policies, programmes, and projects in the decision making process. Media has a very important role to play in this regard. Though in some Arab countries media is used as an instrument to propagate government policies, media need to function independently and function as a source of education and knowledge, and to create public awareness.

10. Consultation and participation

It is essential to adopt a consultative and participatory process involving all relevant stakeholders in development and implementation of policies. This will not only ensure that the adopted policies reflect the needs and priorities of the different segments of the population, but will also increase the chances and success of implementation of the proposed policies, particularly if the proposed policies are innovative and non-conventional. Adopting a participatory process further empowers local communities, and increases trust and confidence in government and their policies.

11. Inter-ministerial coordination

Inter-ministerial coordination is essential in order to ensure complementarity of and support for sectoral policies. This will also ensure the integration of environmental, social and economic policies, and increase the net development gains of sectoral and macroeconomic policies. Inter-ministerial coordination is generally lacking, not only in the Arab countries but in many developed countries, as well. It is therefore important that a coordinating mechanism is established at the national level to ensure inter-ministerial coordination. It is advisable that this coordinating entity is under the direct authority or chairmanship of the Prime Minister.

12. Finance

The bulk of funding needed to support the transition to a green economy should be through the private sector and gradual redirecting of public spending from conventional to green and sustainable investment. Moreover, following a green and sustainable development path should result in government savings in the immediate, short and long term. This is due to savings resulting from the phasing out of perverse subsidies and efficiency gains, and reduced cost of medical expenses due to improved health conditions. Moreover, though most of the funding for green investment is expected to come from the private sector, government spending, policies and incentive measures need to be supportive to a transition to a Green Economy.

Investing in green sectors is likely to attract foreign direct investment as opposed to conventional investment. In order to encourage investment along a sustainable path, finance institutions should screen projects and approve loans based on a sustainability assessment. Attempts to include ethics in lending operations should also be considered. Such an assessment should also be applied to loans provided to countries in the region. Moreover, in order to encourage the engagement of small and medium size enterprises in economic activities, governments should encourage micro finance.

13. Trade policy

Trade policies, if properly designed, can be an effective tool to promote green investments. Trade policies can facilitate access to environmental technologies necessary for green transformation. This can be in the form of market access related measures, subsidies, and standards. Due consideration should be given to avoiding or reducing the potential negative impacts of trade policies on the environment, job creation, and poverty reduction in the region.

14. Governance

One of the main obstacles in making a transition to sustainable development in the Arab world is governance and institutional setups. Despite the increase in environmental commitments by most Arab countries, current institutions and practices are inadequate to formulate and implement sustainable development policies. There has been a shift in the understanding of the environment in the Arab world from being confined to sanitary engineering and health related issues to the broader sense of sustainable development. This process has been advanced through the Arab Initiative for Sustainable Development, put forward by the League of Arab States in 2002. In order to assist Arab countries strengthen governance for sustainable development in the Arab region, ESCWA has suggested the creation of a high council for sustainable development to coordinate efforts between member states and national councils supported by a sustainable development advisor to the Prime Minister⁵. What is relevant in this connection is the need to mainstream sustainable development with economic considerations within the planning and decision making process of ministries.

15. Public procurement

Public procurement constitutes a significant share of public spending. Adopting a government policy that promotes green public procurement sends a strong signal to investors and businesses regarding government intentions with respect to its current and future policies to promote green investment. By greening public spending, governments would create demand for green products thus

encouraging green investment. This does not only result in creating new markets, and creating jobs, but also in promoting sustainable production and consumption, and at the same time reducing negative environmental degradation. Green public procurement in a number of countries in Europe (Austria, Denmark, Finland, Germany, the Netherlands, Sweden, and the UK has reduced CO2 footprint of procurement by 25%.⁶

17. Role of private sector

The active involvement of the private sector and promotion of public-private partnership through finance and expertise is critical for transitioning to the green economy. In order to encourage private sector involvement, governments need to provide the right regulatory and market incentive measures to achieve this. Providing the enabling environment in terms of policies, regulations, and incentive measures is therefore necessary in engaging effectively the private sector in supporting government policies aiming at transitioning to a green economy. National capacities are needed to design policies and introduce measures that encourage the involvement of the private sector in support of the green transition. Moreover, in order to enhance the engagement of small business, governments should encourage microfinance.

18. Public-private partnership and guarantees

There has been growing interest in the last several years in promoting private sector engagement through joint public-private activities. Such partnerships have been used in the field of clean energy⁷. Guarantees can take different forms, but the basic principle behind it is to provide necessary funding to cover initial costs of the project whereby the government guarantees credits for that purpose. The International Finance Cooperation (IFC) has been active in this field by establishing partnerships with banks in a number of developing countries. Combining training with the loan has been an effective way of encouraging energy efficient investments⁸

19. Voluntary measures

Voluntary initiatives are also used to influence attitudes towards the environment. This includes the introduction of energy efficiency rating system and eco-labeling schemes. Such tools contribute to raising awareness of the benefits of green and sustainable investments and encouraging the participation of the private sector in environmental and sustainable development initiatives and activities. In order to be effective, such interventions need to be supported by regulations⁹.

20. Integrated environmental and economic accounting

The main measurement for economic growth is the system of national accounts (SNA) currently universally used by governments to provide an assessment for the performance of an economy. It was introduced in the 1930s mainly to measure the value of goods and services produced in a country. However, the SNA is not an accurate indicator for measuring human welfare. The current SNA does not reflect the depletion and degradation of resources. It even provides a distorted picture of the performance of the economy, where for example it calculates as income damage cost, and cost of selling natural assets such as oil and natural gas. Attempts to provide an alternative measurement or indicator started in the early 1980s when the United Nations Environment Programme (UNEP) together with the World Bank launched an initiative exploring the introduction of environmental accounting as a real measurement for the genuine performance of an economy.

*Since then a great deal of work has gone into the development of methodologies for green or environmental accounting or what is referred to by the Statistics Division of the United Nations Division of Economic and Social as **Integrated Environmental and Economic Accounting**.* The need to go beyond the GDP has been further stressed in the Stiglitz Commission Report on the Measurement of Economic Performance and Social Progress established in 2008 to identify the limits to GDP as an indicator for human wellbeing. The proposed system for green accounting is reflected in “The Handbook of National Accounting: Integrated Environmental and Economic Accounting 2003”. The Handbook brings together economic and environmental information in a common framework to measure the impact of the economy on the environment and vice versa. Apart from several developed countries who have developed green accounting systems such as the Netherlands, Germany, and France, developing countries introducing the system include China, Indonesia, and the Philippines¹⁰.

21. Monitoring and evaluation

This should be part and parcel of the planning, decision-making, and implementation processes. It is intended to ensure that the proposed policies have achieving or are in the process of achieving their set objectives through the introduction of necessary corrective measures and actions. Capacities of Arab countries to develop follow up, monitoring, and evaluation tools and techniques are needed to ensure that policies, plans, and programmes are on target and are yielding the desired outcomes.

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Acronyms and Abbreviations

AAID	Arab Authority for Agricultural Investment and Development
AC	Air-conditioning
AC	Alternating current
ABSP	Agricultural Biotechnology Support Programme
ACSAD	Arabic Centre for the Studies of Arid Zones and Drylands
ADA	Arriyadh Development Authority (Riyadh)
ADFD	Abu Dhabi Fund for Development
ADR	Alternative Disputes Resolution
ADWEA	Abu Dhabi Water & Electricity Authority
AED	United Arab Emirates Dirham
AEPC	African Environmental Protection Commission
AEPS	Arctic Environmental Protection Strategy
AEWA	African-Eurasian Waterbird Agreement
AFED	Arab Forum for Environment and Development
AFESD	Arab Fund for Economic and Social Development
AG	Associated gas
AGERI	Agricultural Genetic Engineering Institute
AGU	Arabian Gulf University
AHD	Aswan High Dam
AHDR	Arab Human Development Report
AIA	Advance Informed Agreement
AIDS	Acquired Immunodeficiency Syndrome
AIECGC	Arab Investment and Export Credit Guarantee Corporation
AKTC	Aga Khan Trust for Culture
Al	Aluminum
ALBA	Aluminium Bahrain
ALECSO	Arab League Educational, Cultural, and Scientific Organization
ALOA	Association for Lebanese Organic Agriculture
AMCEN	African Ministerial Conference on the Environment
AMF	Arab Monetary Fund
AMU	Arab Maghreb Union
ANME	National Agency for Energy Management
AoA	Agreement on Agriculture (WTO Uruguay Round)
AOAD	Arab Organization for Agricultural Development
API	Arab Planning Institute
AREE	Aqaba Residence Energy Efficiency
ASABE	American Society of Agricultural and Biological Engineers
ASR	Aquifer storage and recovery
AU	African Union
AUB	American University of Beirut
AUM	American University of Madaba (Jordan)

AWA	Arab Water Academy
AWC	Arab Water Council
AWCUA	Arab Water Countries Utilities Association
BADEA	Arab Bank for Economic Development in Africa
BAU	Business-as-usual
BCH	Biosafety Clearing House
BCWUA	Branch Canal Water User Association
BDL	Central Bank of Lebanon
BGR	German Geological Survey
BMP	Best Management Practices
BMZ	German Federal Ministry of Economic Cooperation and Development
BOD	Biological Oxygen Demand
boe	Barrels of oil equivalent
BREEAM	Building Research Establishment Environmental Assessment Method
BRS	ARZ Building Rating System
BRO	Brackish Water Reverse Osmosis
BU	Boston University
C&D	Construction and demolition
C&I	Commercial and industrial
CA	Conservation agriculture
CAB	Centre for Agriculture and Biosciences
CAIP	Cairo Air Improvement Project
CAN	Competent National Authority
CAMP	Coastal Area Management Project
CAMRE	Council of Arab Ministers Responsible for the Environment
CBC	Community-Based Conservation
CBD	Convention on Biological Diversity
CBO	Community-Based Organization
CBSE	Center for the Study of the Built Environment (Jordan)
CCS	Carbon Capture and Storage
CD	Compact disk
CDM	Clean Development Mechanism
CDRs	Certified Emissions Reductions
CEDRO	Country Energy Efficiency and Renewable Energy Demonstration Project for the Recovery of Lebanon
CEIT	Countries with Economies in Transition
CEDARE	Centre for Environment and Development for the Arab Region and Europe
CEP	Coefficient of performance
CERES	Coalition for Environmentally Responsible Economics
CFA	Cooperative Framework Agreement
CFC	Chloro-Fluoro-Carbon
CFL	Compact Fluorescent Lamp
CGIAR	Consultative Group on International Agricultural Research
CHN	Centre Hospitalier du Nord
CH ₄	Methane
CHP	Combined Heat and Power
CILSS	Permanent Interstate Committee for Drought Control in the Sahel
CIRAD	Agricultural Research for Development
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CIWM	Chartered Institution of Wastes Management
CLO	Compost-like-output
CLRTAP	Convention on Long-Range Transboundary Air Pollution

CIHEAM	International Centre for Advanced Mediterranean Agronomic Studies
CMI	Community Marketing, Inc.
CMS	Convention on the Conservation of Migratory Species of Wild Animals
CNA	Competent National Authority
CNCA	Public Agricultural Bank
CNG	Compressed Natural Gas
CO	Carbon monoxide
CO ₂	Carbon Dioxide
CO ₂ eq	CO ₂ -equivalents
COD	Chemical Oxygen Demand
COP	Conference of the Parties
CPB	Cartagena Protocol on Biosafety
CPC	Calcined petroleum coke
CRS	Center for Remote Sensing
CSD	Commission on Sustainable Development
CSP	Concentrated Solar Power
CSR	Corporate social responsibility
CTAB	Technical Center of Organic Agriculture
cum	Cubic meters
CZIMP	Coastal Zone Integrated Management Plan
DALYs	Disability-Adjusted Life Years
DBO	Design-Build-Operate
DC	Direct current
DED	Dubai Economic Department
DEFRA	Department for Environment, Food and Rural Affairs (UK)
DEM	Digital Elevation Model
DESA	Department of Economic and Social Affairs
DEWA	Dubai Electricity and Water Authority
DFID	UK Department for International Development
DHW	Domestic Hot Water
DII	DESERTEC Industrial Initiative
DMN	Moroccan National Meteorological Office
DNE	Daily News Egypt
DOE	United States Department of Energy
DSIRE	Database of State Incentives for Renewables & Efficiency
DTCM	Dubai Department for Tourism and Commerce Marketing
DTIE	UNEP Division of Technology, Industry, and Economics
DTO	Dublin Transportation Office
DUBAL	Dubai Aluminium Company Limited
E3G	Third Generation Environmentalism
EAD	Environment Agency Abu Dhabi
ECA	Economic Commission for Africa
ECE	Economic Commission for Europe
ED	Electrodialysis
EDF	Environmental Defense Fund
EDL	Electricité du Liban
EE	Energy efficiency
EEAA	Egyptian Environmental Affairs Agency
EGBC	Egyptian Green Building Council
EGPC	Egyptian General Petroleum Corporation
EGS	Environmental Goods and Services
EIA	Energy Information Administration

EIA	Environmental Impact Assessment
EITI	Extractive Industries Transparency Initiative
EMA	Europe, the Middle East, and Africa
EMAL	Emirates Aluminium Company Limited
EMAS	Eco-Management and Audit Scheme
EMS	Environmental Management System
ENPI	European Neighborhood and Partnership Instrument
ENSO	El Niño-Southern Oscillation
EOR	Enhanced oil recovery
EPA	US Environmental Protection Agency
EPD	European Patent Office
EPDRB	Environmental Program for the Danube River Basin
EPSA	Exploration and Production Sharing Agreement
EPI	Environment Performance Index
ESAUN	Department of Economic and Social Affairs
ESBM	Ecosystem-Based Management
ESCSWA	United Nations Economic and Social Commission for Western Asia
ESI	Environment Sustainability Index
ESMAP	World Bank Energy Sector Management Assistance Program
ETM	Enhanced Thematic Mapper
EU	European Union
EU ETS	European Union Emission Trading System
EVI	Environmental Vulnerability Index
EWS	Emirates Wildlife Society
EWRA	Egyptian Water Regulatory Agency
FACE	Free Air Carbon Enrichment
FAO	Food and Agriculture Organization of the United Nations
FDI	Foreign Direct Investment
FFEM	French Fund for Global Environment
FIBL	Research Institute of Organic Agriculture
FIFA	Fédération Internationale de Football Association
FIT	Feed-in-tariff
FOEME	Friends of the Earth Middle East
FTIAB	Packaging and Newspaper Collection Service (Sweden)
G7	Group of Seven: Canada, France, Germany, Italy, Japan, United Kingdom, United States
G8	Group of Eight: Canada, France, Germany, Italy, Japan, Russian Federation, United Kingdom, United States
GAPs	Good Agricultural Practices
GAS	Guarani Aquifer System
GATT	General Agreement on Tariffs and Trade
GERD	Gross Domestic Expenditure on Research and Development
GBC	Green Building Council
GBIF	Global Biodiversity Information Facility
GCC	Gulf Cooperation Council
GCM	General Circulation Model
GCOS	Global Climate Observing System
GDP	Gross Domestic Product
GE	General Electric
GECF	Gas Exporting Countries Forum
GEF	Global Environment Facility
GEMS	Global Environment Monitoring System
GEO	Global Environment Outlook
GFEI	Global Fuel Economy Initiative

GFU	Global Facilitation Unit for Underutilized Species
GHGs	Greenhouse Gases
GIPB	Global Partnership Initiative for Plant Breeding Capacity Building
GIS	Geographical Information Systems
GIWA	Global International Waters Assessment
GLASOD	Global Assessment of Soil Degradation
GLCA	Global Leadership for Climate Action
GM	Genetically Modified
GMEF	Global Ministerial Environment Forum
GMO	Genetically Modified Organism
GNI	Gross National Income
GNP	Gross National Product
GPC	Green petroleum coke
GPRS	Green Pyramid Rating System
GRI	Global Reporting Initiative
GRID	Global Resource Information Database
GSI	IISD Global Subsidies Initiative
GSLAS	General Secretariat of League of Arab States
GSR	Global Status Report
GTZ	German Technical Cooperation (Gesellschaft für Technische Zusamm)
GVC	Civil Volunteers' Group (Italy)
GW	Greywater
GWI	Global Water Intelligence
GWP	Global Water Partnership
ha	Hectares
HACCP	Hazardous Analysis and Critical Control Points
HDI	Human Development Index
HFCs	Hydrofluorocarbons
HIV	Human Immunodeficiency Virus
HNWI	High net worth individuals
HVAC	Heating, ventilation, and air-conditioning
I/M	Inspection and maintenance
IAASTD	International Assessment of Agricultural Knowledge Science and Technology for Development
IAS	Irrigation Advisory Service
IC	Irrigation Council
ICAM	Integrated Coastal Area Management
ICARDA	International Center for Agricultural Research in Dry Areas
ICBA	International Center for Biosaline Agriculture
ICC	International Chamber of Commerce
ICGEB	International Center for Genetic Engineering and Biotechnology
ICM	Integrated Coastal Management
ICPDR	International Commission for the Protection of the Danube River
IDA	International Desalination Association
IDB	Islamic Development Bank
ICT	Information and Communication Technology
ICZM	Integrated Coastal Zone Management
IDRC	International Development Research Center
IDSC	Information and Decision Support Center
IEADSM	International Energy Agency Demand-side Management
IEEE	Institute of Electrical and Electronic Engineers
IFOAM	International Federation of Organic Agriculture Movements

IFPRI	International Food Policy Research Institute
IEA	International Energy Agency
IFA	International Fertilizer Industry Association
IFAD	International Fund for Agricultural Development
IHP	International Hydrology Program
IIED	International Institute for Environment and Development
IIIEE	Lund University International Institute for Industrial Environmental Economics
IIIP	Integrated Irrigation Improvement Project
IIP	Irrigation Improvement Project
IISD	International Institute for Sustainable Development
ILO	International Labour Organization
IMC	Istituto Mediterraneo Di Certificazione
IMF	International Monetary Fund
IMO	International Maritime Organization
InWEnt	Capacity Building International-Germany
IPCC	Intergovernmental Panel on Climate Change
IPF	Intergovernmental Panel on Forests
IPM	Integrated Pest Management
IPP	Independent power producer
IPR	Intellectual Property Rights
IPTRID	International Program for Technology and Research in Irrigation and Drainage
IRENA	International Renewable Energy Agency
IRR	Internal rate of return
ISCC	Integrated solar combined cycle
ISESCO	Islamic Educational, Scientific, and Cultural Organization
ISWM	Integrated solid waste management
ISO	International Organization for Standardization
ISIC	UN International Standard Industrial Classification
ITC	Integrated tourism centers
ITC	International Trade Center
ITSAM	Integrated Transport System in the Arab Mashreq
IUCN	International Union for Conservation of Nature
IUCN	World Conservation Union (International Union for the Conservation of Nature and Natural Resources)
IWRB	International Waterfowl and Wetlands Research Bureau
IWRM	Integrated Water Resources Management
IWMI	International Water Management Institute
IWPP	Independent water and power producer
JBAW	Jordan Business Alliance on Water
JD	Jordanian Dinar
JI	Joint Implementation
JMWI	Jordan Ministry for Water and Irrigation
JVA	Jordan Valley Authority
KA-CARE	King Abdullah City for Atomic and Renewable Energy
KAUST	King Abdullah University of Science and Technology
KFAED	Kuwait Fund for Arab Economic Development
KfW	German Development Bank
KISR	Kuwait Institute for Scientific Research
KSA	Kingdom of Saudi Arabia
kWh	Kilowatt-hours
LADA	Land Degradation Assessment of Drylands
LAS	League of Arab States

LATA	Lebanese Appropriate Technology Association
LAU	Lebanese American University
LBNL	Lawrence Berkeley National Laboratory
LCEC	Lebanese Center for Energy Conservation
LDCs	Least Developed Countries
LED	Light-emitted diode
LEED	Leadership in Environmental Design
LEMA	Suez Lyonnaise des Eaux, Montgomery Watson and Arabtech Jardaneh
LGBC	Lebanon Green Building Council
LNG	Liquefied natural gas
LowCVP	Low Carbon Vehicle Partnership
LMBAs	Land and Marine Based Activities
LMEs	Large Marine Ecosystems
LMG	Like Minded Group
LMO	Living Modified Organism
LPG	Liquefied Petroleum Gas
LRA	Litani River Authority
MAAR	Syrian Ministry of Agriculture and Agrarian Reform
MAD	Moroccan Dirham
MALR	Ministry of Agriculture and Land Reclamation
MAP	UNEP Mediterranean Action Plan
MARPOL	International Convention for the Prevention of Pollution from Ships
MBT	Mechanical-biological treatment
MCM	Million Cubic Meters
MD	Membrane distillation
MDGs	Millennium Development Goals
MEA	Multilateral Environmental Agreement
MECTAT	Middle East Centre for the Transfer of Appropriate Technology
MED	Multiple-Effect Distillation
MED-ENEC	Energy Efficiency in the Construction Sector in the Mediterranean
MED WWR WG	Mediterranean Wastewater Reuse Working Group
MEES	Middle East Economic Survey
MEMAC	Marine Emergency Mutual Aid Centre
MENA	Middle East and North Africa
METAP	UNEP Mediterranean Environmental Technical Assistance Program
MEW	Lebanese Ministry of Energy and Water
MGD	Million gallon per day
MHT	Mechanical heat treatment
MICE	Meetings, incentives, conferences, and events
MIST	Masdar Institute of Science and Technology
MOQ	Maersk Oil Qatar
MOU	Memorandum of Understanding
MPA	Marine Protected Area
MSF	Multi-Stage Flash
MSW	Municipal solid waste
MT	Million ton
MTPY	Metric tons per year
Mt	Megatonnes
MW	Megawatt
MWRI	Ministry of Water Resources and Irrigation
NARI	National agricultural research institutes
NASA	National Aeronautics and Space Administration

NBC	National Biosafety Committee
NBDF	Nile Basin Discourse Forum
NBF	National Biosafety Framework
NBI	Nile Basin Initiative
NBM	Nile Basin Management
NCSR	Lebanese National Council of Scientific Research
ND	Neighborhood development
NDW	Moroccan National Drought Watch
NEEAP	National energy efficiency action plans
NEEREA	National Energy Efficiency and Renewable Energy Action (Lebanon)
NF	Nano-Filtration
NFC	Nile Forecast Center
NGV	Natural gas vehicles
NGWA	Northern Governorates Water Authority (Jordan)
NOAA	National Oceanic and Atmospheric Administration
NOC	National oil company
NOGA	National Oil and Gas Authority (Bahrain)
NORDEN	Nordic Council of Ministers
NOx	Nitrogen oxides
NRC	National Research Council
NREL	National Renewable Energy Laboratory
NRW	non-revenue water
NSAS	Nubian Sandstone Aquifer System
NWRC	National Water Research Center (Egypt)
NWSAS	North Western Sahara Aquifer System
NEAP	National Environmental Action Plan
NFP	National Focal Point
NGO	Non-Governmental Organization
NPK	Nitrogen, Phosphates and Potash
NPP	Net Primary Productivity
NUS	Neglected and underutilized species
O&M	Operation and Maintenance
OAPEC	Organization of Arab Petroleum Exporting Countries
OAU	Organization for African Unity
ODA	Official Development Assistance
ODS	Ozone-Depleting Substance
OECD	Organisation for Economic Co-operation and Development
OFID	OPEC Fund for International Development
OMW	Olive mills wastewater
ONA	Omnium Nord-Africain
ONEP	National Office of Potable Water
OPEC	Organization of Petroleum Exporting Countries
OSS	Sahara and Sahel Observatory (Observatoire du Sahara et du Sahel)
PACD	Plan of Action to Combat Desertification
PC	Personal computer
PCB	Polychlorinated biphenyls
PCFPI	Per Capita Food Production Index
PCFV	Partnership for Clean Fuels and Vehicles
PERSGA	Protection of the Environment of the Red Sea and Gulf of Aden
PFCs	Perfluorocarbons
PICs	Pacific Island Countries
PIM	participatory irrigation management

PM	Particulate matter
PMU	Program Management Unit
PNA	Palestinian National Authority
PNEEI	Tunisian National Program of Irrigation Water Conservation
PPIAF	Public-Private Infrastructure Advisory Facility
PPP	public-private partnership
POPs	Persistent Organic Pollutants
PPM	Parts Per Million
PPM	Process and Production Methods
PRM	Persons with reduced mobility
PRY	Potential researcher year
PTSs	Persistent Toxic Substances
PV	Photovoltaic
PWA	Palestinian Water Authority
QP	Qatar Petroleum
QSAS	Qatar Sustainable Assessment System
R&D	Research and Development
RA	Risk Assessment
RADEEMA	Régie autonome de distribution de l'eau et de l'électricité de Marrakech
RBO	River Basin Organization
RBP	Restrictive Business Practices
RCREEE	Regional Center for Renewable Energy and Energy Efficiency
RCM	Regional Circulation Model
RDF	Refuse derived fuel
RE	Renewable energy
REMPEC	Regional Marine Pollution Emergency Response Centre for the Mediterranean Sea
REN21	Renewable Energy Policy Network for the 21st Century
RO	reverse osmosis
RM	Risk Management
ROPME	Regional Organization for the Protection of the Marine Environment of the sea area surrounded by Bahrain, I.R. Iran, Iraq, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates
RPS	Renewable portfolio standard
RSA	Ropme Sea Area
RSCN	Royal Society for the Conservation of Nature
RSC	Royal Society of Chemistry (UK)
RSGA	Red Sea and Gulf of Aden
S&T	Science and Technology
SAIC	Science Applications International Corporation
SAP	Strategic Action Program
SCP	Sustainable Consumption and Production
SCPI	Sustainable crop production intensification
SD	Sustainable development
SEA	Strategic Environmental Assessment
SFD	Saudi Fund for Development
SHS	Solar home system
SIR	Shuttle Imaging Radar
SIWI	Stockholm International Water Institute
SL	Syrian Pound
SLR	Sea Level Rise
SME	Small and medium-size enterprises
SPM	Suspended Particulate Matter

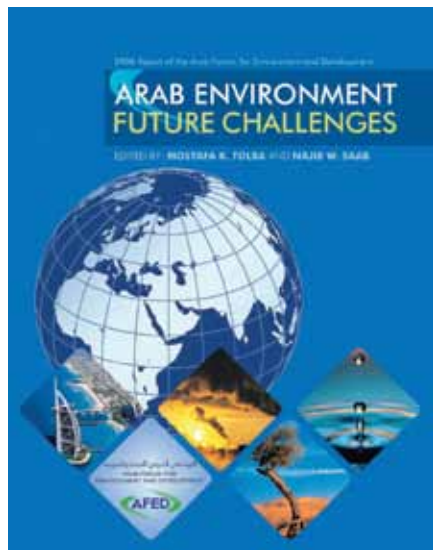
SONEDE	Société Nationale d'Exploitation et de Distribution des Eaux
SoE	State of the Environment
SOx	Sulfur oxides
SRES	Special Report on Emission Scenarios
SRTM	Shuttle Radar Topography Mission
SWCC	Saline Water Conversion Corporation
SWH	solar water heating
SWRO	Seawater Reverse Osmosis
TAC	Technical Advisory Committee
TAR	Third Assessment Report
TDM	Transportation demand management
TDS	Total Dissolved Solids
TFP	Total factor productivity
TIES	The International Ecotourism Society
TOE	Tonnes of Oil Equivalent
TRI	Toxics Release Inventory
TRIPs	Trade-Related Aspects of International Property Rights
TRAFFIC	Trade Records Analysis for Flora and Fauna in International Commerce
TRMM	Tropical Rainfall Measuring Mission
UAE	United Arab Emirates
UCLA	University of California at Los Angeles
UCS	Union of Concerned Scientists
UF	ultrafiltration
UfM	Union for the Mediterranean
UK	United Kingdom
UNCED	United Nations Conference on Environment and Development
UNESCO	United Nations Educational, Scientific, and Cultural Organization
UNESCO-ROSTAS	UNESCO Regional Office for Science and Technology for the Arab States
UIS	UNESCO Institute for Statistics
USA	United States of America
USAID	United States Agency for International Development
USEPA	United States Environmental Protection Agency
USPTO	United States Patent and Trademark Office
UHI	Urban Heat Island
UMA	Union du Maghreb Arabe (Arab Maghreb Union)
UN	United Nations
UNCBD	United Nations Convention on Biological Diversity
UNCCD	United Nations Convention to Combat Desertification
UNCED	United Nations Conference on Environment and Development
UNCHS	United Nations Centre for Human Settlements (now UN-Habitat)
UNCLOS	United Nations Convention on the Law of the Sea
UNCOD	United Nations Conference on Desertification
UNCTAD	United Nations Conference on Trade and Development
UNDAF	United Nations Development Assistance Framework
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNFPA	United Nations Population Fund
UNHCR	United Nations High Commission for Refugees
UNICE	United Nations Children's Fund
UNIDO	United Nations Industrial Development Organization

UNWTO	United Nations World Tourism Organization
UPC	Abu Dhabi Urban Planning Council
UPI	United Press International
USA	United States of America
USCCSP	United States Climate Change Science Program
USAID	United States Agency for International Development
USEK	Université Saint-Esprit De Kaslik
USEPA	United States Environmental Protection Agency
USJ	Saint Joseph University
UV	Ultraviolet (A and B)
VAT	Value-added tax
VC	vapor compression
VCM	Volatile combustible matter
VMT	Vehicle miles traveled
VOC	Volatile organic compounds
VRS	Vapor recovery system
WaDImena	Water Demand Initiative for the Middle East and North Africa
WAJ	Water Authority of Jordan
WALIR	Water Law and Indigenous Rights
WB	West Bank
WDM	Water Demand Management
VOC	Volatile Organic Compound
WBCSD	World Business Council for Sustainable Development
WBGU	German Advisory Council on Global Change
WCED	World Commission on Environment and Development
WCD	World Commission on Dams
WCMC	UNEP World Conservation Monitoring Center
WCP	World Climate Programme
WCS	World Conservation Strategy
WDPA	World Database on Protected Areas
WEEE	Waste of electronic and electrical equipment
WEF	World Economic Forum
WEI	Water Exploitation Index
WFP	World Food Programme
WGP-AS	Water Governance Program in the Arab States
WHO	World Health Organization
WMO	World Meteorological Organization
WNA	World Nuclear Association
Wp	Watt-peak
WRI	World Resources Institute
WSSCC	Water Supply and Sanitation Collaborative Council
WSSD	World Summit on Sustainable Development
WTO	World Trade Organization
WTTC	World Travel and Tourism Council
WWAP	World Water Assessment Programme
WWC	World Water Council
WWF	World Wide Fund for Nature
WUA	water user association
WWAP	World Water Assessment Program
WWF	World Water Forum
WWI	First World War
WWII	Second World War

Arab Environment: Future Challenges

2008 Report

of the Arab Forum for Environment and Development



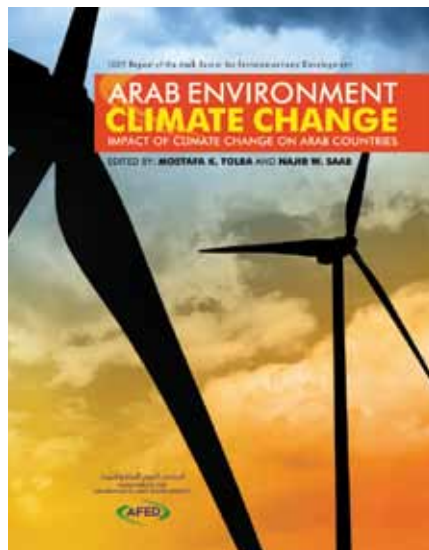
For the first time, a comprehensive independent expert report on Arab environment is released for public debate. Entitled *Arab Environment: Future Challenges*, this ground-breaking report has been commissioned by Arab Forum for Environment and Development (AFED), and written by some of the most prominent Arab experts, including authors, researchers and reviewers. Beyond appraising the state of the environment, based on the most recent data, the policy-oriented report also evaluates the progress towards the realization of sustainable development targets, assesses current policies and examines Arab contribution to global environmental endeavors. Ultimately, the report proposes alternative policies and remedial action.

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Arab Environment: Climate Change

2009 Report

of the Arab Forum for Environment and Development



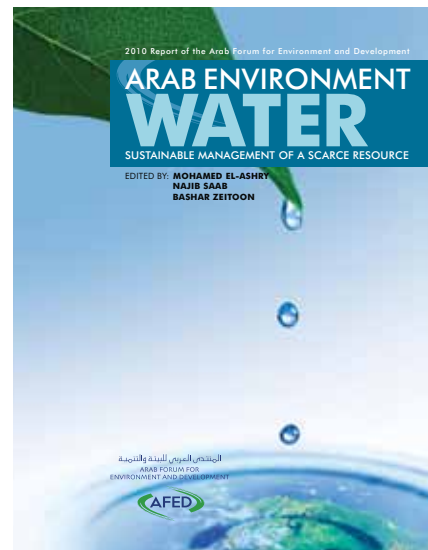
Impact of Climate Change on the Arab Countries is the second of a series of annual reports produced by the Arab Forum for Environment and Development (AFED). The report has been designed to provide information to governments, business, academia and the public about the impact of climate change on the Arab countries, and encourage concrete action to face the challenge.

The report analyzes the Arab response to the urgent need for adaptation measures, and uses the latest research findings to describe the vulnerabilities of natural and human systems in the Arab world to climate change and the impacts on different sectors. In an attempt to help shape adequate policies, the report discusses options for a post-Kyoto regime and outlines the state of international negotiations in this regard.

Arab Environment: Water

2010 Report

of the Arab Forum for Environment and Development



water: sustainable management of a scarce resource is the third of a series of annual reports produced by the arab forum for environment and development (afed). it follows the publication of two reports, arab environment: future challenges in 2008 and impact of climate change on arab countries in 2009.

the 2010 report is designed to contribute to the discourse on the sustainable management of water resources in the arab world and provides critical understanding of water in the region without being overly technical or academic in nature.

the unifying theme is presenting reforms in policies and management to develop a sustainable water sector in arab countries. case studies, with stories of successes and failures, are highlighted to disseminate learning.

this report contributes to the ongoing dialogue on the future of water and catalyzes institutional reforms, leading to determined action for sustainable water policies in arab countries.