

GREEN ECONOMY SCOPING STUDY IN BELARUS

SUMMARY OF RESULTS

EaP GREEN
Partnership for Environment and Growth

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The UN Environment coordination team included Rie Tsutsumi, Nina Schneider, Alex Leshchynskyy.

Andrea M. Bassi, an independent consultant, carried out the scenario analysis and drafted the report (full report and summary of results). Philip Gass, of the International Institute for Sustainable Development, contributed to the preparation of the report.

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¹ The full study could be provided upon request by the UN Environment Europe Office.

INTRODUCTION

This study identifies and assesses the impacts of green investments in key sectors in support of a transition to a green economy. The Government of Belarus has actively sought the implementation of sustainable measures in the energy and renewable energy sectors through various policies and programmes. The government has also pursued a path toward a green economy since 2004, and its newest national direction, *National Strategy for Sustainable Socio-economic Development 2030*, sets out green economy priorities for the country. For the short term (2016-2020), the strategy focuses on structural and institutional investments to support a green economy transition, while for the mid-term (2021-2030) it seeks to foster human development by investing in human capital via knowledge-intensive industries and services. The benefits of shifting to a green economy are well aligned with the country's long-term development goals, as highlighted in a number of Belarus sectoral strategies.

Framing a comprehensive policy and investment context for an inclusive green economy calls for a quantitative assessment of policy options to measure progress towards the goals and objectives (UNCSD, 2012). In light of this, the Government of Belarus requested assistance from the United Nations Environment Programme (UNEP) in identifying options for the country's transition to a resource-efficient green economy within the framework of sustainable development.

The potential benefits for a green economy in Belarus are numerous. Modelling of a Belarusian green economy in 2040 highlights the potential for energy efficiency savings over US \$1.7 billion, avoided thermal capacity investment of nearly US \$2.0 billion, avoided greenhouse gas (GHG) emissions of nearly 29 million tonnes, and employment growth of over 20,000 jobs. With these basic figures the rationale for, and the potential benefits of, a green economy become immediately clear.

MODELLING METHODOLOGY

UNEP provides targeted country support through policy advice, technical assistance and capacity-building that assists countries, including Belarus, in developing and implementing locally tailored green economy approaches (UNEP, n.d.). This is one in a series of studies, and it assesses intervention options and the effects of green economy investments in areas that were identified as priorities among Belarusian stakeholders.

Energy Supply

Green economy modelling examines the impacts of an energy supply scenario where increasing renewable energy is built into the grid at a rate to reach 10 per cent of power generation by 2030 and 14-18 per cent by 2040, with a corresponding reduction in fossil fuel generation.

Energy Demand

The modelling also measures impacts in a scenario with an increase in energy efficiency of 1 per cent per year above business as usual from 2016 to 2040. This improvement would be equal across residential, industrial, transport and other sectors.

This study identifies and examines the challenges and opportunities a green economy approach offers to the Belarus energy and renewable energy sectors, along with the enabling conditions needed for a green economy transition to occur. Overall, the results of this green economy scoping study support the Belarus green transition by providing qualitative and quantitative analyses of the actions that will drive the transition and of the enabling conditions that will strengthen the pathway to a green economy.

SCENARIOS

This study simulates and analyses two main scenarios:

- A Business as Usual (BAU) case that assumes the continuation of historical trends and incorporates all policies and interventions currently active and enforced, but excludes policies not yet implemented
- A set of Green Economy (GE) scenarios that simulate additional interventions that reduce energy intensity across sectors and increase the use of renewable energy for electricity generation

The model runs simulations with each of two economic growth assumptions for the 2014-2020 period. Under a favourable (fav) assumption, GDP grows at 1.9 per cent per year, and under an adverse (adv) assumption, GDP grows at 0.5 per cent per year. The scenarios are identified accordingly as BAU (fav), BAU (adv), GE (fav) and GE (adv).

All of the scenarios assume a 2013-2030 population growth rate of -0.8% per year.

The model holds prices of natural gas and coal constant in real terms, and assumes an annual increase in petroleum prices of 2 per cent per year on average between 2015 and 2020

(accounting for the recent decline in crude oil prices), and a 4.1 per cent annual growth rate after 2020 (in line with the 2011–2013 average annual petroleum price change).

The BAU case simulates an expansion of nuclear capacity with the commissioning of two new units with a total capacity of 2,400 MW progressively operational from 2020 onwards. Under this scenario, no additional investments are made in the expansion of renewable energy capacity, or in energy efficiency improvements.

The GE scenario simulates additional investments for expanding renewable energy capacity (in addition to the expansion of nuclear power) and for reducing electricity demand through energy efficiency improvements. It simulates an increase in renewables up to 10 per cent of power generation by 2030 and up to 14-18 per cent by 2040, with a corresponding reduction in fossil fuel capacity. Moreover, the GE scenario simulates an increase in energy efficiency of 1 per cent per year above BAU from 2016 until 2040. The improvement would occur equally across key sectors, including residential, industrial, transport and others. Table 1 summarizes the assumptions for the two basic scenarios.

Table 1: Main assumptions used in the BAU and GE scenarios.

GDP growth (2014-2020)	
Favourable	Average annual growth of 1.9 per cent
Adverse	Average annual growth of 0.5 per cent
Population growth (2013-2030)	Average annual growth of -0.8 per cent
Energy prices:	
Natural gas and coal	Constant
Petroleum (2015-2020)	Growth of 2 per cent per year on average
Petroleum (after 2020)	Growth of 4.1 per cent per year on average
Energy efficiency employment	Method 1: Job years per GWh: 0.59* Method 2: Job years per M US\$: 7.61**
Renewables construction cost	US \$1.79 M per MW (IEA, 2014)
Renewables maintenance cost	US \$46,000 per MW (IEA, 2014)
Hydro construction cost	US \$2.3 M per MW (IEA, 2014)
Hydro maintenance cost	US \$53,000 per MW (IEA, 2014)
Fossil fuels construction cost	US \$2.0 M per MW (IEA, 2014)
Fossil fuels maintenance cost	US \$60,000 per MW (IEA, 2014)
Nuclear construction cost	US \$6.60 M per MW (IEA, 2014)
Nuclear maintenance cost	US \$198,000 per MW (IEA, 2014)
Energy efficiency investment	US \$50 per avoided tonne of CO ₂ emissions from electricity generation. (IEA, 2013)
Average emissions from fossil fuel electricity generation	Based on power source and technology used. Highly influenced by the commissioning of nuclear power. From 150 tonne/TJ in 2014 to 90 tonne/TJ in 2025.

*Source: Wei et al., 2010

**Source: ITUC, Millennium Institute, 2012

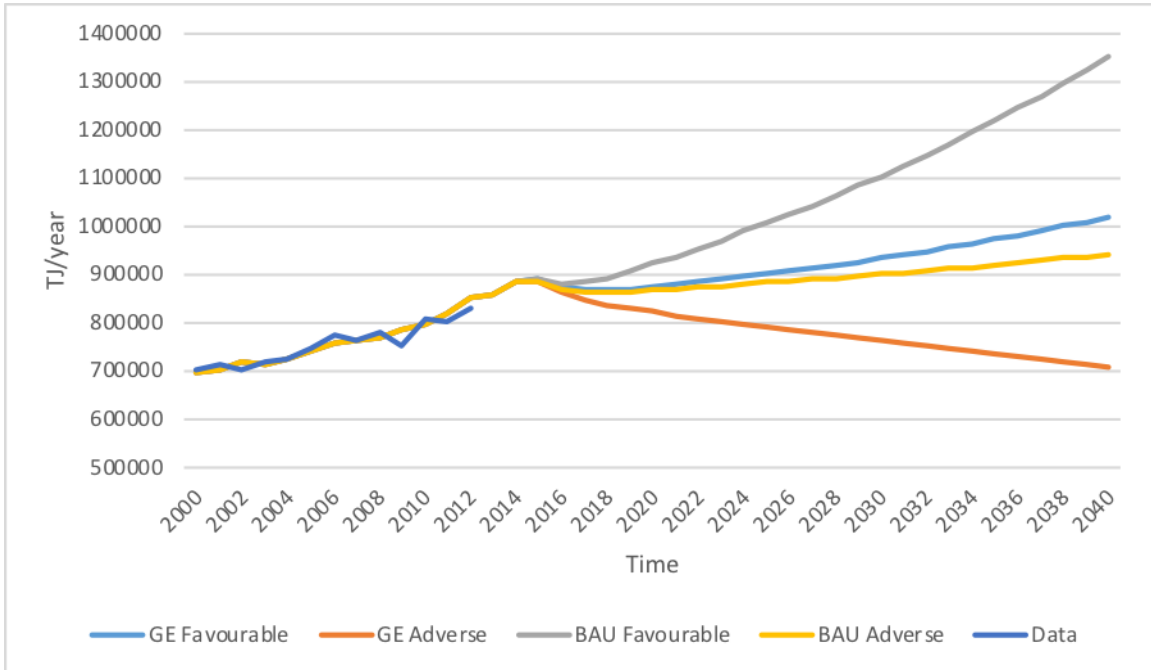
MAIN RESULTS

Simulations of the favourable and adverse BAU and GE scenarios included interventions on energy efficiency (EE) and renewable energy (RE) in various combinations. The following sections present the findings, and emphasize the differences in results between scenarios with favourable versus adverse external macroeconomic conditions. Energy demand estimates for the residential, commercial, industrial and transportation sectors include coal, petroleum products, natural gas, biomass and electricity. Electricity supply estimates include thermal (coal, petroleum and natural gas), nuclear, hydropower and other renewable sources (wind and solar).

ENERGY DEMAND

In 2012, total annual energy demand reached 827,200 TJ/year. Under the BAU scenario, total annual energy demand is projected to reach 865,500 TJ/year by 2020; 899,000 TJ/year by 2030; and 940,500 TJ/year by 2040. In the GE scenario, energy efficiency improvements lead to a reduction in total energy consumption of 5.2 per cent in 2020, 15.5 per cent in 2030 and 24.7 per cent in 2040 relative to the BAU case. Energy demand is lower in the GE (adv) scenario due to the smaller projected GDP growth rate. (See Figure 1.)

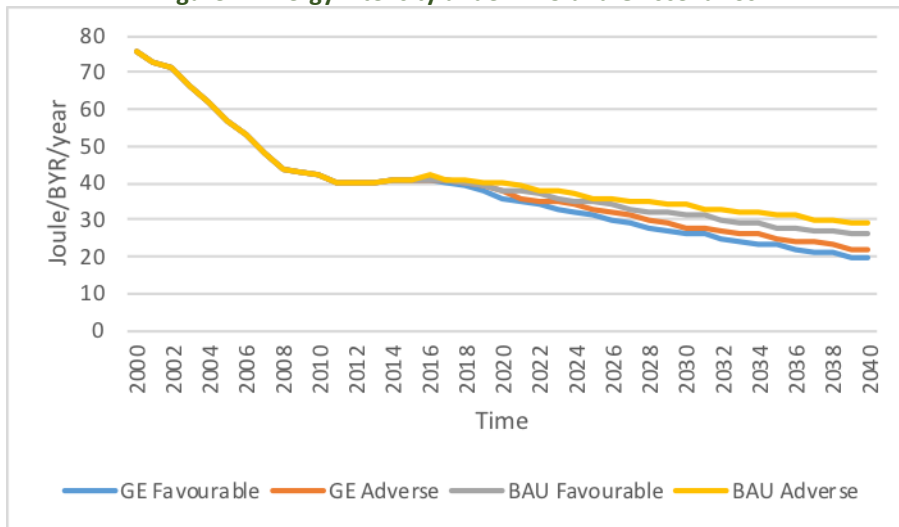
Figure 1: Historical trends and future projections of total energy consumption, under BAU and GE scenarios



The improvement in energy efficiency leads to a reduction in energy intensity (energy consumption per unit of GDP) of 36.6 per cent for the GE (fav) scenario and 31.7 per cent for the GE (adv) scenario relative to 2015 (Figure 2.). The difference between the two scenarios is attributable to a higher GDP and consequently

higher energy demand in the GE (fav) scenario, while the same percentage of investments in efficiency measures, relative to GDP, is applied in both scenarios. That means that greater overall efforts and investments are implemented in the GE (fav) case.

Figure 2: Energy intensity under BAU and GE scenarios



The results further show that the national goal to reduce energy intensity by 35.3 per cent by 2030 will be achieved under the GE (fav) scenario, while more aggressive energy efficiency interventions would be necessary in the GE (adv) scenario. The BAU scenarios also show improvements in energy intensity relative to 2015 levels – 24.4 per cent in the BAU (fav) and 17.1 per cent in the BAU (adv) case. Thus, the net contribution of GE interventions on top of BAU is approximately 12 per cent in the GE (fav) and 14.5 per cent in the GE (adv) case.

According to the results, energy efficiency improvements in the residential sector would lead to a reduction in energy consumption per square metre ranging from 5.5 per cent in the GE (fav) scenario to 24.4 per cent in the GE (adv) scenario in 2030 relative to 2015. This difference is due to the strong correlation between GDP growth and residential energy consumption, and indicates that stronger GDP growth requires higher energy efficiency investments in order to reach the national target.

Investment

The annual investment required to reach the energy efficiency targets assumed for the GE (fav) and GE (adv) scenarios adds up to about US \$124.6 million and US \$120.5 million per year on average between 2015 and 2030, and US \$226.6 million and US \$206.2 million per year on average between 2015 and 2040. The total (cumulative) investment in energy efficiency would amount to US \$1.9 to US \$2.0 billion for the period between 2015 and 2030, and to US \$5.3 to US \$5.9 billion for the period between 2015 and 2040 for the GE (adv) and GE (fav) scenarios, respectively.

Avoided cost

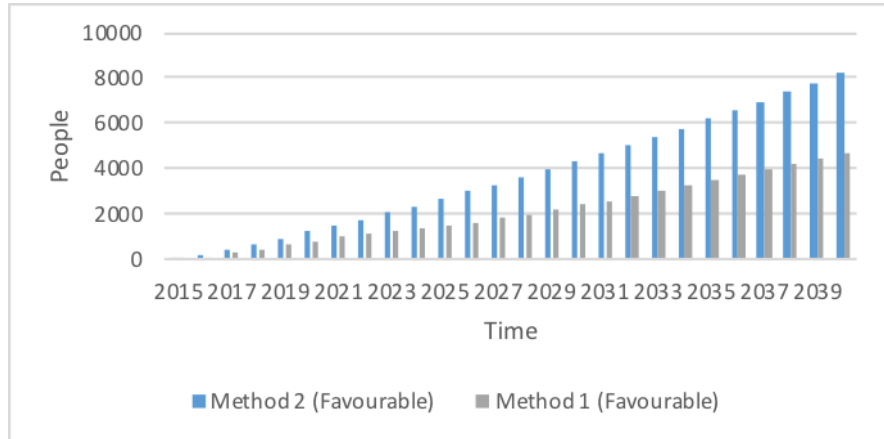
The improvements in energy efficiency are projected to generate cumulative savings on energy consumption of about US \$6.2 to US \$7.0 billion between 2015 and 2030, and US \$17.3 to US \$20.7 billion by 2040, with a yearly average of approximately US \$388 to US \$432 million between 2015 and 2030, and US \$667 to US \$800 million by 2040 for the GE (adv) and GE (fav) scenarios, respectively. The energy efficiency investments range from US \$120.5 to US \$124.6 million per year on average between 2015 and 2030, and US \$206.2 to US \$226.6 million per year on average between 2015 and 2040 in the GE (adv) and GE (fav) scenarios, respectively. The higher avoided costs compared to the investments indicate that this intervention is highly likely to generate consistent positive economic returns. In addition, avoided costs are also expected from the reduced use of fossil fuels (primarily natural gas) for thermal power generation.

Employment

Two methods were used to estimate the potential for job creation under the simulated energy efficiency investments. In method 1, new jobs are calculated based on the annual avoided energy consumption (jobs/year/GWh). In method 2, estimates are based on annual financial resources invested (jobs/year/million US\$).

The method 1 modelling results show that under the energy efficiency GE scenarios a total of 1,140-1,200 full time direct jobs would be created by 2020, a total of 3,700-4,300 by 2030, and a maximum of 8,200 by 2040. Under method 2, a total of 750-780 full time direct jobs would be created by 2020, a total of 2,200-2,400 by 2030, and a maximum of 4,600 by 2040. The lower numbers in the ranges are for the GE (adv) scenario, and the higher numbers for the GE (fav) scenario. (See Figure 3.)

**Figure 3: Additional jobs resulting from Energy efficiency investments
Methods 1 and 2, GE (fav) scenarios**



ELECTRICITY SUPPLY

Power generation capacity

Under the BAU scenario, electricity is almost entirely generated from fossil fuels, particularly natural gas.² The commissioning of nuclear power plants, however, is expected to considerably change the electricity generation mix starting in 2020. At that time (2020), nuclear power will represent 27.2 per cent of electricity generation capacity, while thermal power generation capacity will decline to 72.3 per cent and hydropower will drop to 0.5 per cent. Projections for the GE scenario show a marked increase of power generation capacity from renewable energy sources (especially wind and solar), which would comprise 9.7 per cent of the national power capacity mix by 2020, 29.2 per cent by 2030 and 41.2 per cent by 2040.

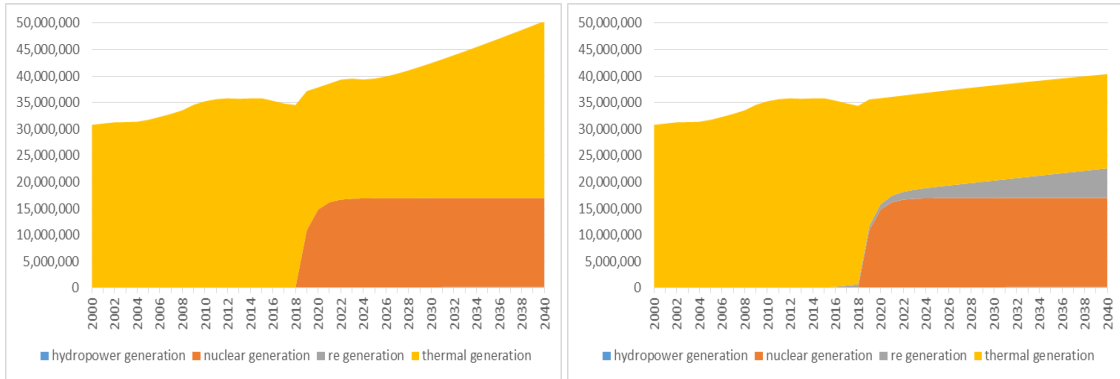
Electricity generation

Figure 4 presents historical and projected electricity generation under the BAU (fav) and GE (fav) scenarios (2000-2040); Figure 5 presents the share of electricity generation by technology in the year 2030 under the same two scenarios. The total amount of generated electricity would be lower under the GE (fav) scenario due to lower electricity demand as a result of energy efficiency improvements. The BAU (adv) scenario generates 37,818 GWh and the BAU (fav) scenario 42,466 GWh. The GE (adv) scenario generates 32,740 GWh in 2030 and the GE (fav) scenario 38,260 GWh. This corresponds to a 12 per cent reduction in total electricity generated in the adverse case and a 10 per cent reduction in the favourable case.

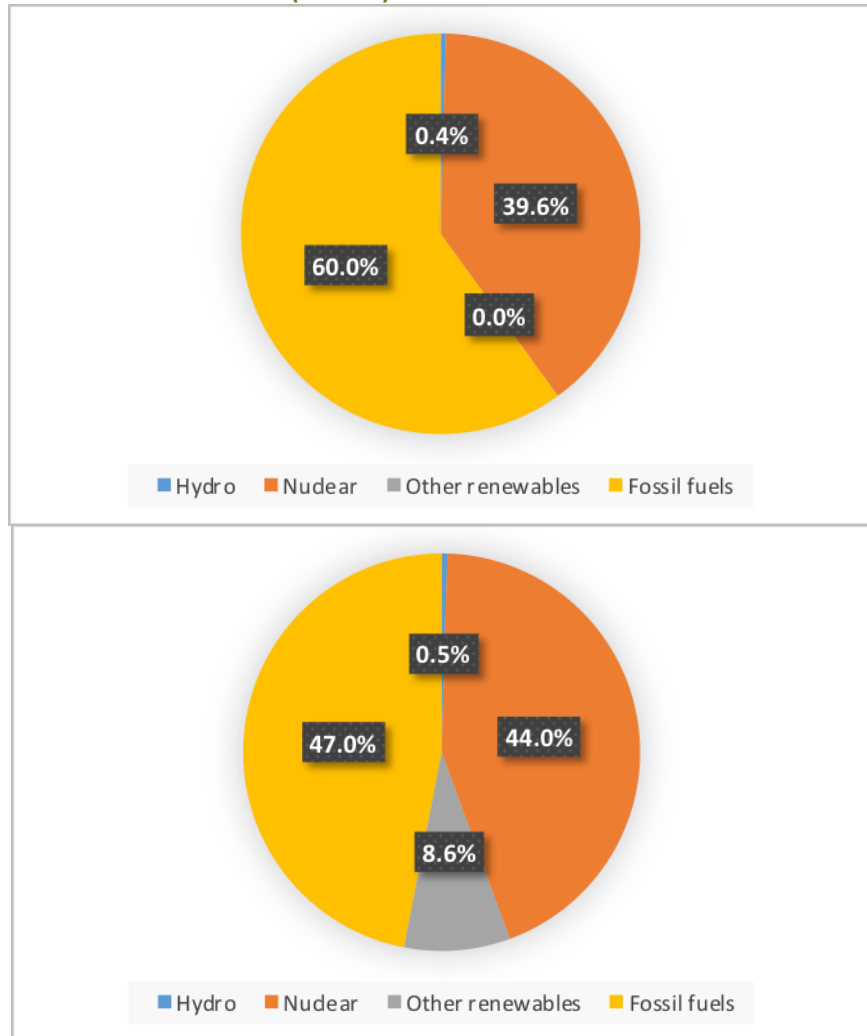
Projections for the GE scenario show that electricity supply from fossil fuels and nuclear power would remain almost unchanged between 2020 and 2030, while additional electricity would be produced from renewables.

² The planned installation of wind generators in Belarus under the EU financing Agreement ENPI/2012/023-517 has not been taken into account in this modelling.

**Figure 4: Electricity generation by energy source (in million MWh)
Historical trends and future projections, BAU (fav) and GE (fav) scenarios**



**Figure 5: Share of electricity generation by 2030 under BAU (top) and
GE (bottom) Favourable scenarios**



As energy efficiency interventions lower energy demand and thus reduce the required generation capacity, a lower level of investment in renewable energy is required to reach the stated penetration target if energy efficiency gains are achieved. This shows that investments in energy efficiency advance progress towards three national targets – expanding the use of renewable energy as a share of total energy supply; reducing energy intensity; and, as a result of these two interventions, lowering CO₂ and GHG emissions.

Investment

The average annual investment required to expand renewable energy power supply is projected to be approximately US \$394 million between 2015 and 2030, or a cumulative total of US \$6.3 billion by 2030. Additional investments between 2031 and 2040 bring the cumulative total to US \$11.8 billion by 2040. While this investment may seem high, the total investment for electricity supply is actually lower in the GE scenarios than in the BAU cases. This is due to the reduced energy demand as a result of energy efficiency interventions in the GE scenarios, which subsequently require lower investments for the expansion of the energy supply.

Avoided cost and net investment

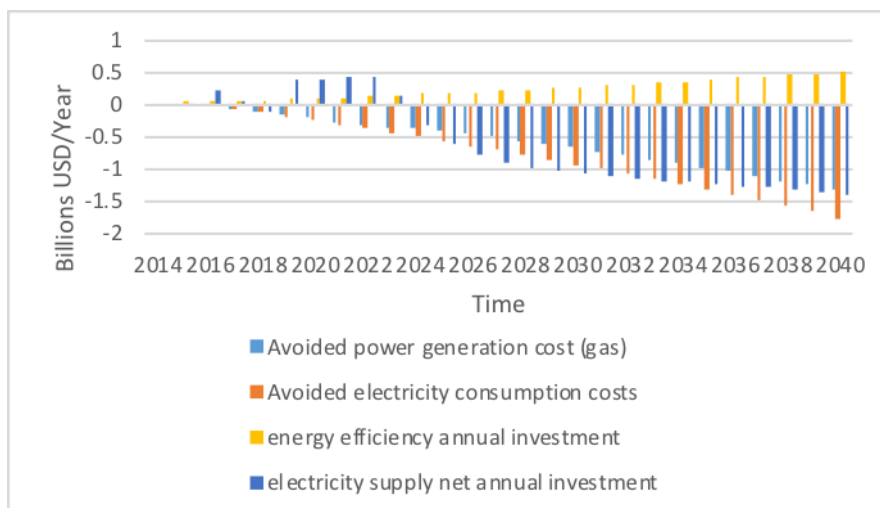
While the upfront investment required for the

expansion of renewable energy power generation capacity is comparatively high, it contributes to the reduction of capital costs for building thermal power plants, allows savings on energy imports (e.g. natural gas), and creates jobs.

Between 2015 and 2040, the avoided annual cost for fossil fuel capacity expansion would amount to US \$150-620 million on average in the GE (adv) and GE (fav) scenarios, or US \$3.6-15.7 billion cumulatively. The total investment in the power sector until 2040 will therefore be 6.7 per cent and 23.9 per cent lower in the GE (adv) and GE (fav) scenarios through the end of the simulation. Figure 6 shows that investments in renewable energy are higher than the avoided cost of thermal generation in the first years. From 2024 onwards, the savings on thermal capacity expansion are higher than the investment required to increase renewable energy generation.

The GE (fav) scenario produces savings before 2030, but extra investments are required in the GE (adv) scenario because of the initial upfront investment required and the shorter time frame considered for the avoided costs. By 2030, the total savings in the GE (fav) scenario will reach US \$3.2 billion while the additional investment required in the GE (adv) case amounts to US \$977 million.

Figure 6: Annual investment (energy efficiency and renewable energy) and avoided costs* GE (fav) scenario



* Avoided energy consumption and fuel consumption for power generation

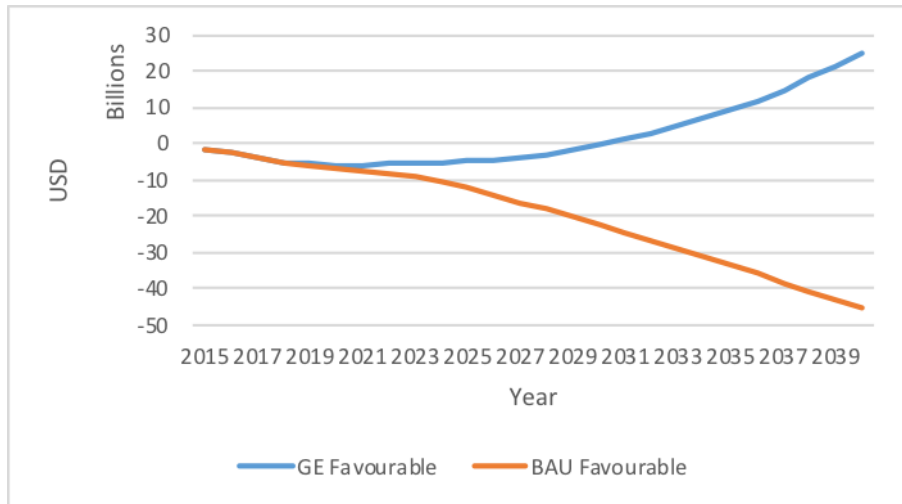
Reduced capacity expansion and generation from natural gas also generate savings from the corresponding reductions in imports of this fossil fuel. These projected savings reach US \$815 million per year on average between 2015 and 2030 (totaling US \$13 billion cumulatively) and US \$1.5 billion per year on average between 2015 and 2040 (totaling US \$39 billion cumulatively) in the GE scenarios relative to the BAU cases.

Total annual net investment under the GE (fav) scenario is calculated as renewable energy investments plus energy efficiency investments and operation costs minus avoided fossil fuel capacity expansion costs, savings on fuel (for power generation) and electricity consumption. The results of this calculation reveal that a significant upfront investment is required in the first years of policy implementation, and that

added value and avoided costs result in positive and increasing returns (Figure 7). In particular, the net economy-wide annual cash flow would be higher than BAU from year 2022 and would become positive from year 2031 (Figures 6 and 7).

In 2040, net revenues under the GE (fav) scenario would amount to approximately US \$3.7 billion or US \$25.2 billion cumulatively between 2015 and 2040. Compared to the BAU scenarios, which do not show positive returns in the electricity sector, gains under the GE scenarios are much higher. While average net expenditures of US \$1.4 billion per year are incurred under BAU, net savings of US \$35.5 million per year in the same period are generated under the GE scenarios, implying an annual net saving of approximately US \$1.4 billion.

**Figure 7: Cumulative Net Investment in the energy sector (US\$)
Projections under BAU (fav) and GE (fav) scenarios**

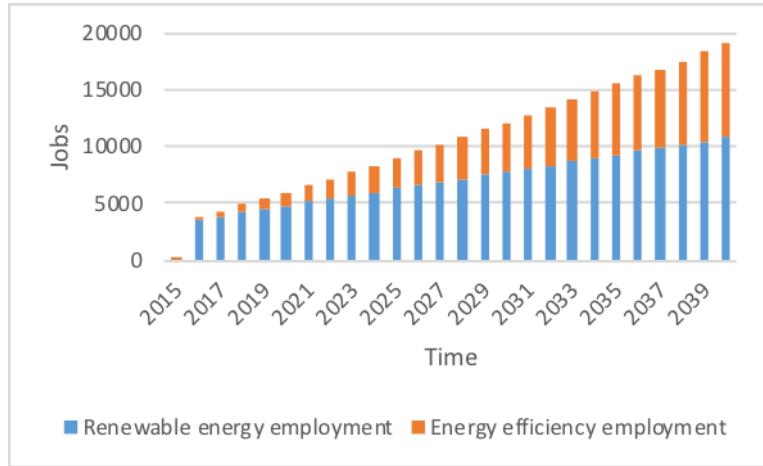


Employment

The expansion of renewable energy capacity is likely to generate employment through the construction, operation and management of new wind turbines, solar panels and new hydropower plants. The share of renewable energy jobs in total energy employment would

increase by approximately 50 per cent between 2015 and 2030, but is projected to remain close to zero under the BAU scenario. The renewable energy jobs together with the projected new jobs related to energy efficiency (up to 4,300 new jobs by 2030) add up to 12,000 total additional jobs by 2030. (See Figure 8.)

**Figure 8: Additional employment (cumulative) in the energy sector under the GE scenario
Projections for energy efficiency and renewable energy sectors**



Emissions

Investments in renewable energy and energy efficiency will reduce CO₂ emissions as a result of reductions in fossil fuel-based electricity generation and in overall energy consumption. The combination of these two interventions in the GE scenarios leads to a reduction of CO₂ emissions of 19.9 per cent under the GE (adv) scenario, and 18.8 per cent under the GE (fav) scenario in 2030 compared to the respective BAU simulations (Figure 9). These reductions lead to per capita emissions below 7 tonnes/person/year in the GE (fav) scenario and

around 5 tonnes/person/year in the GE (adv) scenario in 2030. The lower emissions in the GE (adv) scenario, as compared to the GE (fav) case, result from the lower energy consumption linked to weaker assumed GDP growth.

Through the combination of energy efficiency, renewable energy and nuclear power investments, both GE scenarios reach the national emission reduction target of preserving the absolute level of anthropogenic load on air and water at the 2011-2015 levels.

Figure 5: Total emissions under the BAU and GE scenarios

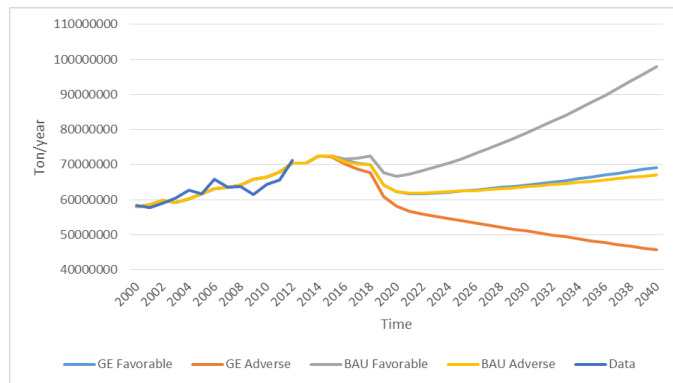


Table 2 summarizes the results of the modelling of the energy efficiency and renewable energy interventions.

Table 2: Main results of the EE and RE interventions.

Year	2015	2020	2025	2030	2035	2040
ANNUAL INVESTMENT (US\$ Million)						
Energy efficiency						
BAU (adv)	-	-	-	-	-	-
GE (RE+EE) – (adv)	0.9	81.5	160.4	241.6	333.7	427.1
BAU (fav)	-	-	-	-	-	-
GE (RE+EE) – (fav)	0.9	84.4	160.2	259.4	376.0	502.5
Renewable energy (capital)						
BAU (adv)	5.4	6.0	6.8	7.5	8.4	8.9
GE (RE+EE) – (adv)	5.4	396.6	447.9	497.7	545.9	600.8
BAU (fav)	5.4	6.0	6.8	7.5	8.4	8.9
GE (RE+EE) – (fav)	5.4	396.6	447.9	497.7	545.9	600.8
Thermal and nuclear energy (capital)						
BAU (adv)	891.3	1,886.6	493.4	930.7	999.4	1,042.2
GE (RE+EE) – (adv)	876.3	1,886.6	10.1	-	-	-
BAU (fav)	932.1	1,886.6	1,071.2	1,589.2	1,794.0	1,987.5
GE (RE+EE) – (fav)	917.1	1,886.6	10.1	-	-	-
Total annual energy investment and O&M costs						
BAU (adv)	1,442.0	2,668.9	1,218.6	1,637.7	1,698.8	1,762.8
GE (RE+EE) – (adv)	1,427.9	3,145.3	1,343.3	1,447.2	1,569.2	1,729.1
BAU (fav)	1,483.0	2,691.3	1,841.6	2,376.5	2,611.6	2,868.3
GE (RE+EE) – (fav)	1,468.8	3,169.7	1,393.2	1,543.4	1,718.1	1,939.1
EXPENDITURE AND SAVINGS (US\$ Million)						
Electricity expenditure savings						
GE (RE+EE) – (adv)	4.4	246.5	521.6	801.7	1,085.7	1,372.5
GE (RE+EE) – (fav)	4.4	259.7	578.7	936.9	1,335.9	1,777.8
Avoided thermal capacity investment						
GE (RE+EE) – (adv)	15.0	-	483.3	930.6	999.4	1,042.2
GE (RE+EE) – (fav)	15.0	-	1,061.1	1,589.2	1,794.0	1,987.5
Total savings and avoided costs						
GE (RE+EE) – (adv)	19.3	246.5	1,004.8	1,732.4	2,085.1	2,414.7
GE (RE+EE) – (fav)	19.4	259.7	1,639.8	2,526.0	3,129.9	3,765.3
NET INVESTMENT (SAVINGS – INVESTMENT) (US\$ Million)						
Total net annual savings minus investment						
GE (RE+EE) – (adv)	(1,408.5)	(2,898.8)	(338.5)	285.1	515.8	685.7
GE (RE+EE) – (fav)	(1,449.4)	(2,910.0)	246.6	982.7	1,411.8	1,826.2
EMISSIONS (tonnes)						
Avoided annual emissions from fossil fuel-based electricity generation						
GE (RE+EE) - (adv)	65,328	4,220,304	8,468,332	12,671,708	17,027,284	21,367,580

Year	2015	2020	2025	2030	2035	2040
GE (RE+EE) - (fav)	65,504	4,445,056	9,215,372	14,853,320	21,358,556	28,723,256
EMPLOYMENT						
Electricity employment (Person)						
BAU (adv)	4,735	7,917	3,883	4,900	5,155	5,355
GE (RE+EE) - (adv)	4,701	12,523	8,710	10,033	11,384	12,732
BAU (fav)	4,827	8,029	5,395	6,767	7,514	8,260
GE (RE+EE) - (fav)	4,793	12,631	8,961	10,425	11,917	13,405
Energy efficiency employment (Person)						
BAU (adv)	-	-	-	-	-	-
GE (RE+EE) - (adv)	20	1,139	2,410	3,704	5,016	6,341
BAU (fav)	-	-	-	-	-	-
GE (RE+EE) - (fav)	20	1,200	2,674	4,329	6,172	8,214

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United Nations Environment Programme

International Environment House

11-13, Chemin des Anemones

CH-1219 Chatelaine

Switzerland

+41229178279

www.unenvironment.org

