# Reducing Greenhouse Gas Emissions: The Role of Voluntary Programmes

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# Table of Contents



# List of Tables

# Foreword

Climate change is one of the most pressing environmental issues the world is facing today. Governments and the private sector are beginning to adopt new and innovative policies and strategies to address this challenge. Regulatory reforms, economic incentives, efficient technologies and adequate institutions will be required to catalyse these changes, as required by the United Nations Framework Convention on Climate Change (UNFCCC). Similarly, industry will have to integrate this growing environmental issue in conducting its activities.

At the time when governments gather to agree on next steps to be adopted under the UNFCCC process, there is a growing recognition that numerous opportunities already exist to reduce costs, increase profits and reduce emissions of greenhouse gases (GHGs). These opportunities are frequently referred to as *win-win* solutions.

Numerous governments have implemented national GHG reduction programmes designed to promote and encourage voluntary actions to reduce GHGs. Private sector organisations have made investments, both on their own initiative and as participants in governmental programmes, in technologies and services to reduce costs and enhance productivity while simultaneously reducing GHG emissions. These same governments and industries are at different stages in the development of national plans and strategies to reduce GHGs — some are just beginning to look at policy instruments and measures while others are already taking significant actions.

With this document, the United Nations Environment Programme Industry and Environment Centre and the United States Environmental Protection Agency's Atmospheric Pollution Prevention Division have sought to provide information on voluntary programmes covering a broad range of sectors in a geographically diverse set of countries, and representing a variety of programme types. This was done through the use of a small but representative subset of government and industry case studies. This growing body of international experience with voluntary programmes should be valuable for all countries as they begin, or continue, to evaluate the appropriate steps that need to be taken to reduce GHG emissions. As individual economic, social, and cultural circumstances of countries differ, any recommendations that can be taken from this document should be tailored to the specific needs of the respective country.

This document should be viewed as a first step in disseminating the global experience of implementation of voluntary programmes and cost-effective measures to reduce GHG emissions. It is not meant to be an exhaustive study of all voluntary programmes, but to provide an introduction to the experiences and lessons that have been learned from an illustrative group of programmes and industry efforts.

Voluntary programmes will clearly be just one of the many policies that governments may undertake to address the issue of reducing GHG emissions and implementing the UNFCCC. This publication is intended to generate interest in voluntary programmes and provide motivation to design new initiatives which will contribute to further GHG emissions reductions.

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*The main goal of this report is to provide information about voluntary programmes and related technology initiatives that reduce greenhouse gas emissions. It is intended for three main audiences:*

- *First, it is intended for government policy makers, especially those in developing countries and countries with economies-in-transition, who are designing voluntary programmes.*

- *Second, it is meant for senior decision-makers in industry who may participate in the development of such programmes or who are interested in the benefits of participating in them.*

- *Finally, it will be useful for the range of stakeholders in environmental protection that may have influence on the policy decision-making process.*

# Executive Summary

As an element of an overall strategy to reduce carbon dioxide ($CO_2$) and other greenhouse gas (GHG) emissions, governments and industries are implementing a variety of innovative programmes that promote voluntary actions. Such programmes also contribute to other environmental, economic and social goals. Commonly referred to as *voluntary programmes*, these initiatives encourage individuals, companies, industry groups, or government entities to take advantage of cost-saving technologies[1] and processes that benefit the environment. These programmes are successful because they tap market-based forces to capitalise on existing opportunities where both the environment and the participants can benefit (i.e., *win-win* opportunities).

## Opportunities and Barriers in Reducing GHG Emissions

A variety of win-win opportunities exist in every sector to reduce GHG emissions while reducing costs or providing other benefits for the user. Many of these opportunities are found in the area of energy-efficiency, where newer technologies often provide better quality service while reduced energy use saves money and protects the environment. The United Nations estimates that total global energy consumption in the agricultural, buildings, industrial, and transportation sectors together could be reduced by 35 per cent by the year 2020 through the adoption of energy-efficient technologies (UNDPCSD, 1997). This document summarises some of the opportunities to reduce GHG emissions in the following sectors: commercial/institutional; residential; industrial; electricity generation/energy supply; transportation; solid waste and wastewater disposal; and agriculture (see table).

It might be expected that any cost-effective opportunities would already be implemented; profit-maximising enterprises usually have good incentives to identify and implement technologies or practices that can be used to their economic advantage. One might argue that there should be little need for a formalised programme to support their efforts. However, there are typically numerous market and institutional barriers that impede the use of these technologies. Four main types of barriers include:

- lack of *information* about the existence, availability or reliability of preferable technologies or practices;

1 *Throughout this document, the term "technology" is used in its broadest sense to include equipment, processes, and management practices.*

- lack of *financing* to purchase technologies;
- lack of *access* to technologies or technical support; and
- lack of adequate *motivation* for decision-makers to change behaviour.

Voluntary programmes are designed to reduce or remove one or more of these barriers to increase the use of preferable technologies and practices.

For example, some programmes overcome an information barrier by providing objective, innovative guidance about how new, profitable technologies can be used. Other programmes overcome motivational barriers by offering incentives such as public recognition to decision makers to try new technologies. Many programmes aim to bring about an eventual market transformation — reducing barriers to cause a permanent, self-sustaining change in the market to use the technology.

## Voluntary Programme Types

There are a variety of approaches that voluntary programmes use to overcome barriers to technologies. Although most programmes are tailored to country- and sometimes sector-specific circumstances, programmes usually fall into one of six main categories:

### 1. Technology Upgrade

This type of programme is used to encourage participants to undertake a specific category of technology improvement, such as installing energy-efficient lighting systems in buildings.

### 2. Voluntary Challenge

In a voluntary challenge programme, participants are challenged by government or industry to achieve some environmental goal rather than to use a specific category of technology. For example, participants may commit to reducing GHG emissions by 10 per cent.

### 3. Outreach

An outreach programme uses broad approaches to increase awareness of environmental opportunities among key communities of stakeholders. Unlike Technology Upgrade or Voluntary Challenge programme types, it does not solicit a commitment from participants to upgrade to a particular technology or to achieve a GHG reduction target. Instead, it provides information and motivation to stakeholders to support environmental improvements to reduce GHG emissions. It may also promote new technologies or opportunities to the general public.

## 4. Product Labelling or Promotion

In a labelling programme, products are labelled to designate that they are environmentally friendly, energy-efficient, cost-effective, or a combination of these attributes. This helps consumers easily recognise and choose technologies that benefit the environment.

## 5. Reporting & Monitoring

In a reporting and monitoring programme, participants self-monitor and voluntarily report GHG emissions or energy use to the programme administration. Governments and industries often use these programmes to gather information on best practices and to accumulate data without imposing a regulatory burden on participants.

## 6. Voluntary Codes and Standards

These programmes are often used in the institutional/commercial and residential building sectors to develop high-efficiency building performance standards. They resemble their regulatory counterparts, but allow flexibility in that they do not impose financial or legal penalties for non-compliance.

The following table identifies, by sector, some of the potential cost-effective technologies to reduce GHG emissions, principal barriers to their implementation, and voluntary approaches that help address these barriers. The table is presented in the order in which this document describes the development of a voluntary programme. First, technological opportunities to reduce GHG emissions are identified by sector. Second, the barriers to those opportunities are investigated. And finally, the appropriate voluntary programme type to best overcome those barriers in that sector is applied.

# Opportunities, Barriers, and Voluntary Programme Approaches

| Sector | Technological Opportunities to Reduce GHG Emissions |
|---|---|
| Commercial / Institutional | Buildings energy efficiency<br>• Better envelope (insulation, etc.)<br>• Efficient lighting<br>• HVAC improvements<br>• Efficient office equipment<br>Cogeneration |
| Residential / Consumer Products | Energy efficiency<br>• Efficient lighting<br>• HVAC<br>• Appliances |
| Industrial | Energy-efficient motors<br>Fuel switching<br>Cogeneration<br>Process energy efficiency improvements |
| Electricity Generation / Energy Supply | Energy generation efficiency improvements<br>Coalbed methane recovery<br>Reduced leakage in natural gas transmission and distribution<br>Renewable sources<br>• Wind power<br>• Biomass<br>• Hydroelectric<br>• Solar |
| Transportation | Increased vehicle energy efficiency<br>Improved transportation infrastructure<br>Alternative energy sources |
| Solid Waste and Wastewater Disposal | Source reduction<br>Re-use, recycling<br>Methane recovery |
| Agriculture | Reduced energy use / increased energy efficiency<br>Fertiliser management to reduce $N_2O$<br>Reduced methane emissions |

## Opportunities, Barriers, and Voluntary Programme Approaches (continued)

| Principal Barriers Overcome by Voluntary Programmes | Key Voluntary Programme Strategy or Approach |
|---|---|
| • Lack of awareness of efficient technologies<br>• Lack of unbiased information<br>• Lack of financing<br>• Lack of motivation for decision-makers<br>• Lack of motivation for builders | • Technology Upgrade Programme<br>• Voluntary Building Codes and Standards |
| • Lack of information by consumers about new products<br>• Uncertain demand limits manufacturers' motivation to produce new products<br>• Lack of funds/financing for consumers<br>• Lack of consumer access to new products<br>• Lack of motivation for builders | • Labelling Programme<br>• Voluntary Home Energy Rating Codes and Standards<br>• Outreach Programme |
| • Lack of awareness of efficient technologies<br>• Lack of decision-maker motivation<br>• Lack of research into new "best practices"<br>• Lack of access to new technologies or technological support<br><br>**Other important barriers (not easily overcome by most voluntary programmes)**<br>• Long life of existing inefficient capital equipment | • Voluntary Challenge Programme<br>• Reporting and Monitoring Programme<br>• Technology Upgrade Programme |
| • Lack of decision-maker motivation<br><br>**Other important barriers (not easily overcome by most voluntary programmes)**<br>• Lack of adequate financial return on investments<br>• Lack of regulatory incentives | • Voluntary Challenge Programme<br>• Technology Upgrade Programme |
| • Lack of manufacturer motivation to produce more efficient vehicles<br>• Lack of passengers on public transportation<br>• Lack of public/private co-ordination<br>• Lack of sufficient research into alternative fuel vehicles | • Voluntary Challenge Programme<br>• Outreach Programme |
| • Lack of motivation for waste generators to reduce waste<br>• Lack of information about technologies and regulatory requirements<br>• Lack of access to technical qualifications | • Voluntary Challenge Programme<br>• Technology Upgrade Programme<br>• Outreach Programme |
| • Lack of information about ways to reduce GHGs<br>• Lack of well-tested technologies and methods<br>• Lack of financing | • Outreach Programme<br>• Voluntary Challenge Programme |

## Strengths and Challenges of the Voluntary Approach

Voluntary programmes are only one element of a comprehensive environmental protection strategy that includes a range of policies and programmes. They have important strengths and present particular challenges that should be recognised in order to ensure that they are used most successfully.

Voluntary programmes have several strengths that make them powerful policy instruments. One of the most important strengths is that they use a market-based approach. Because participants act in their own self-interest, the programmes encourage behavioural change that does not need to be mandated through regulation. Another strength of voluntary programmes as a policy tool is that they provide valuable benefits for participants, including access to low-cost unbiased information, reduced operating costs, and public recognition for their environmental accomplishments. In addition, the voluntary approach tends to create partnerships between potential adversaries: government and industry, for example, or corporate competitors within an industry, which leads to improved dialogue and co-operation that can benefit all parties. And finally, voluntary programmes can have wide-reaching effects, influencing behaviour by changing the attitude of the public towards energy efficiency and other environmentally beneficial activities, leading to improvements in a wide variety of activities.

However, because voluntary programmes rely on market forces, they also have limitations and challenges that should be recognised when they are being considered. First, they have limited use. A voluntary programme can be very successful, but only when participants can be persuaded to voluntarily change their actions. Therefore, a careful analysis of opportunities and participant motivations is necessary before choosing a voluntary approach. Second, the results of a programme are not guaranteed since individuals are not required to take action. The programme must be compelling enough to entice participants to change their behaviour. Finally, voluntary programmes need to establish credibility with important stakeholders and develop a credible monitoring and evaluation component to demonstrate results.

## Designing Voluntary Programmes: Critical Elements of Success

This document discusses planning tools that can be used to develop voluntary programmes. It does not prescribe an exact approach for programme design, but instead lists important elements to consider in the planning process. These elements are based on the practical experiences gained by developers of existing voluntary programmes and can provide a good foundation for policy-makers and industry representatives that may be interested in designing similar programmes.

The following summary provides a checklist of elements for developing a successful programme. These are described in more detail in Chapter 3.

## Critical Elements of Success

### Identify a clear opportunity

- Look for under-utilised technologies
- Perform a comprehensive market analysis
- Perform an analysis of barriers

### Develop a communications/ marketing strategy

- Identify the market
- Identify appropriate messages to convey
- Create supporting materials
- Sell the idea to prospects

### Develop an appropriate programme structure

- Select a programme type
- Determine level of commitment from participants
- Determine type of agreement that will be used
- Assess level of resources required
- Design based on customer needs: information, public recognition, and technical support

### Collect and measure results

- Clarify programme goals and objectives
- Identify information required to assess progress toward goals
- Determine data collection technique

# Voluntary Programme Case Studies

Hundreds of voluntary programmes around the world are successfully reducing GHG emissions while increasing the competitiveness and efficiency of businesses and other organisations in the countries in which they operate. This document provides case studies on ten programmes (and brief descriptions of five others) chosen to demonstrate the wide variety of successful programmes and the lessons learned from their implementation. They were chosen to include:

- government and private-sector programmes;
- developing and industrialised countries;
- commercial, industrial, energy supply, waste management and residential sectors;
- a variety of programme types; and
- a variety of technological opportunities.

The table below lists the programmes reviewed in Appendix A.

| Programme Name | Country |
|---|---|
| ENERGY STAR® Buildings/ Green Lights® | United States |
| * Green Buildings for Africa | South Africa |
| * China Green Lights | China |
| Energy 21: Wind Power Initiatives | Denmark |
| Landfill Methane Outreach Programme | United States |
| Long Term Agreements on Energy Efficiency Improvement | Netherlands |
| * French Glass Packaging Agreement | France |
| Canadian Industry Programme for Energy Conservation | Canada |
| * Industrial Energy Efficiency Network | Norway |
| Greenhouse Challenge | Australia |
| Polish Efficient Lighting Project | Poland |
| * Ilumex | Mexico |
| Fluorescent Tube Programme | Thailand |
| PROCEL – Accord with Manufacturers | Brazil |
| ENERGY STAR® Office Equipment | United States, Japan, Thailand, Australia |

* Brief descriptions of programmes included within the ten main case studies

## Industry Case Studies

Companies around the world are taking advantage of technological opportunities to reduce GHG emissions while improving their own competitiveness. As part of a voluntary programme or through their own initiative, these companies are demonstrating that environmental improvements and financial performance can be complementary objectives. The following table lists case studies of ten companies that are successfully reducing GHG emissions. These examples are described fully in Appendix B. They were chosen to demonstrate the range of technologies that are being implemented in a variety of sectors.

| Company Name | Country |
|---|---|
| Norsk Hydro | Norway |
| Mitsubishi Motors Corporation | Japan |
| Thames Water Utilities Ltd. | United Kingdom |
| Pilkington United Kingdom Ltd. | United Kingdom |
| Novotex A/S | Denmark |
| Mo och Domsjo AB (MoDo) | Sweden |
| Blue Circle Southern Cement Ltd. | Australia |
| Noranda Mining & Exploration Inc. | Canada |
| Mobil Corporation | United States |
| KRONOS Canada Inc. / Air Liquide Canada Inc. | Canada |

# Summary

This document describes voluntary programmes and how they can be used in strategies to reduce GHG emissions. It lays a foundation for understanding the strengths and challenges of voluntary programmes, and provides some practical guidelines for those interested in developing them. As shown in this document, voluntary programmes play an important role in mitigating GHG emissions, and the market-based forces on which they rely can be a powerful motivator for encouraging behavioural change. Although voluntary programmes are just one of the many policies that can be undertaken, they can provide a win-win opportunity for all participants as well as foster new partnerships and improve co-operation amongst all parties.

# Introduction to Voluntary Programmes



As an element of an overall strategy to reduce carbon dioxide ($CO_2$) and other greenhouse gas (GHG) emissions, governments and industries are implementing a variety of innovative programmes that promote voluntary actions. Such programs also contribute to other environmental, economic and social goals. Commonly referred to as *voluntary programmes*, these initiatives encourage individuals, companies, industry groups, or goverment entities to use cost-saving, proven technologies[1] and processes that benefit the environment. These programmes are successful because they tap market-based forces to capitalise on existing opportunities where both the environment and the participants can benefit (i.e., *win-win* opportunities).

Many of these win-win opportunities are found in the area of energy efficiency. For example, the Intergovernmental Panel on Climate Change (IPCC) estimates that global energy consumption in the residential, commercial and institutional buildings sector could be reduced by 20 per cent from projected baselines by the year 2010 through cost-effective investments in energy efficiency. This lower energy consumption would reduce GHG emissions by 450 million tons of carbon equivalent while lowering the total cost of energy use (IPCC, 1996). Overall, the United Nations estimates that total global energy consumption in the agricultural, buildings, industrial, and transportation sectors together could be reduced by 35 per cent by the year 2020 through the adoption of energy-efficient technologies (UNDPCSD, 1997).

While these opportunities are important in industrialised countries, they are also valuable to developing and transitional economies. Current projections indicate that by the year 2050 non-Annex I countries[2] will be contributing nearly 50 per cent of energy-related GHG emissions. Cost-effective upgrades in these countries could have a significant impact on global GHG emissions reductions (IPCC, 1996). In addition, the growth in energy use in these countries presents an excellent

***Voluntary programmes tap market-based forces to provide win-win opportunities for participants and the environment.***

*1 Throughout this document, the term "technology" is used in its broadest sense to include equipment, processes, and management practices.*

*2 Countries listed in Annex I of the Framework Convention on Climate Change are committed to adopting national policies to mitigate climate change. They include members of the OECD from 1992, the European Economic Community, and 11 other countries. The list of "Annex I" countries is included in the Glossary.*

***Many cost-effective opportunities exist for reducing GHG emissions.***

opportunity for implementing the most advanced and appropriate technologies at the onset, while in industrialised countries replacement of older technologies may be more common.

In addition to energy efficiency improvements, many other cost-effective opportunities exist for reducing GHG emissions. For example, landfills, coal mines, and other industries have found ways to profitably capture and use methane ($CH_4$), which is 21 times more potent as a GHG than $CO_2$. Better management of ruminant livestock can both reduce and capture $CH_4$ emissions. The US Environmental Protection Agency estimates that economically viable projects in landfills, oil and natural gas systems, coal mining, and ruminant livestock management could reduce global $CH_4$ emissions by 130 to 270 million metric tons of carbon equivalent (as much as 15 per cent of anthropogenic emissions) within 10 years. In the longer term, these reductions could grow to as much as 515 million metric tons of carbon equivalent (US EPA, 1993).

The most potent GHGs, the hydrofluorocarbons (HFCs, such as HFC-134a and HFC-23) and the perfluorocompounds (PFCs, including such chemicals as $CF_4$, $C_2F_6$, $NF_3$, and $SF_6$) can be reduced through optimising the industrial processes in which they are emitted. For example, reductions in emissions of HFC-23 from HCFC-22 manufacturing and reductions of PFC emissions from semiconductor manufacturing have been successfully achieved through industrial process improvements.

In spite of the potential economic benefits, many of these opportunities are not implemented due to market or institutional barriers. Lack of awareness, lack of financing, lack of access to technologies, and lack of motivation for decision-makers all inhibit individuals and companies from taking advantage of these opportunities, even if they are profitable in the long run. Voluntary programmes are designed to reduce or remove one or more of these barriers to increase the use of beneficial technologies.

For example, some programmes overcome an information barrier by providing objective, innovative guidance about how new, profitable technologies can be used. Other programmes overcome motivational barriers by offering incentives such as public recognition to deci-

sion makers to try new technologies. Many programmes aim to bring about an eventual *market transformation* — reducing barriers to cause a permanent, self-sustaining change in the market to use of the technology.

Voluntary programmes can play an important strategic role in the international effort to reduce GHG emissions. They are not meant, however, to displace other important policy measures such as regulations, standards and codes, taxes, research and development, and energy price reform. Instead, they complement those measures and encourage participants to take voluntary actions that go beyond minimum government and industry GHG reduction requirements.

The remainder of this document describes voluntary programmes and their role in overcoming barriers to implementing win-win opportunities to reduce GHG emissions. It provides examples of programmes in industrialised and developing countries that are successful, and describes the methods that they apply to achieve their success. It also provides perspectives of companies that have participated in these programmes or developed their own plans for reducing GHG emissions.

*Chapter 2* describes win-win opportunities to reduce GHG emissions, the barriers to these opportunities, and how voluntary programmes help overcome barriers to accelerate implementation of opportunities. *Chapter 3* provides general guidance on identifying an opportunity for a voluntary programme and designing a programme that meets the needs of the local market. *Appendix A* includes complete summaries of 10 voluntary programmes that have been successful in a variety of circumstances, and *Appendix B* includes case studies of 10 companies that have profitably reduced emissions of GHGs. The other appendices include a *Glossary, Bibliography,* and *Annotated Resource List* for additional information.

***Voluntary programmes can play an important strategic role in efforts to reduce GHG emissions.***

# Opportunities, Barriers, and Voluntary Programmes



*Most successful voluntary programmes are developed with the goal of increasing the use of beneficial technologies that are under-utilised in the market. Therefore, this chapter begins with a discussion of opportunities to profitably reduce GHG emissions. It then describes the barriers that often prevent full implementation of these technologies and the types of voluntary programmes that help overcome these barriers. Finally, it discusses the strengths and challenges of using a voluntary approach to reduce GHG emissions.*

## 2.1 Opportunities for Greenhouse Gas Reductions

There are a variety of opportunities to profitably reduce GHG emissions. Many of these opportunities are found in the area of energy efficiency, where newer technologies often provide better quality service while reduced energy use saves money and protects the environment. This section discusses some of the most promising opportunities to reduce GHG emissions while saving money or providing other benefits for the user.

### Sectors with the Most Opportunities

Most voluntary programmes today promote opportunities in the commercial/institutional, residential, and industrial sectors (IEA, 1997). The opportunities in these sectors are relatively straightforward and the barriers are well suited to voluntary approaches.

## Commercial/ Institutional Sector

One excellent opportunity in the commercial and institutional sector is increasing the energy efficiency of building systems. Efficient technologies in lighting, office equipment, heating, air handling and cooling systems can reduce energy use and its associated environmental impacts and financial costs. In addition, the equipment often provides a more comfortable, better-illuminated office environment.

Many existing buildings contain older, inefficient technologies that can be upgraded. In addition, many buildings being designed and constructed today are being built with the objective of minimising initial capital expenditures (i.e., at the *lowest first cost*), leading to the installation of inefficient technologies that cost more money in the long run. This can be particularly problematic in regions experiencing rapid growth in construction. Voluntary programmes can help overcome this problem by raising the awareness of building owners and operators about the benefits of upgrading old technologies in existing buildings and investing in energy-efficient technologies as new buildings are being built.

Office lighting is one good example of an opportunity to upgrade buildings. Upgrading T-12 fluorescent lamps and magnetic ballasts to T-8 lamps with electronic ballasts can reduce energy use by 30 per cent while maintaining the same level of light and increasing quality (as measured by colour-rendering).

In addition, many new computers, printers, copiers, fax machines, and scanners are now equipped with the capability to use less energy when they are not in active use, a capability referred to as a *power-down feature*. Voluntary programmes have encouraged manufacturers to produce these technologies and encouraged consumers to purchase and use them.

### Commercial/ Institutional Sector Opportunities

Energy-efficient lighting

HVAC improvements to save energy

- More efficient systems, including high-efficiency cooling equipment
- Building adjustments to improve performance of HVAC
- Variable speed drives
- Energy management systems

Energy-efficient office equipment

- Computers
- Copiers, printers
- Fax machines, scanners

Cogeneration

### Major Companies Achieve Savings Through Energy Efficiency Improvements

Mobil Corporation (a US oil and gas company) is saving more than US$ 1.1 million (50 per cent) annually in lighting electricity bills through upgrades to facility lighting. Mobil's original investment of US$ 2.1 million has resulted in a discounted cash flow of 51 per cent while reducing $CO_2$ emissions from energy use. (See Case Study B9.)

## Voluntary Programmes Promote the Manufacture and Purchase of Efficient Equipment

The ENERGY STAR Computers programme worked with computer manufacturers to include a power-down feature in desktop computers. The ENERGY STAR computers use 60–70 per cent less energy in the "power-down" mode, yet are instantly available when the user touches the keyboard. The programme provided a special label that could be used on the efficient computers, and encouraged consumers to buy the labelled products. The United States government then broadened its support by requiring its agencies to show preference for the energy-efficient, environmentally friendly equipment in its own purchases. (See Case Study A10.)

The energy savings from using new technologies often produce sufficient profits to justify replacing older technologies, and they are almost always the best financial choice for new purchases. In many developing countries, the rapid growth of new construction and automation of the office environment will lead to outstanding opportunities for voluntary programmes to influence implementation of efficient technologies in the commercial and institutional sectors.

***Voluntary programmes can raise awareness of the benefits of energy-efficient technologies.***

## Residential Sector

Energy efficiency is also one of the most profitable opportunities in the residential sector. The IPCC estimates that across all countries, by 2010, residential buildings will account for about 60 per cent of energy use in buildings (IPCC, 1996). Efficiency improvements in this sector can therefore substantially reduce emissions of GHGs.

The IPCC reports that the general trends in developing countries are toward increasing electrification, increased market penetration of appliances, and rising use of air conditioning (IPCC, 1996). A variety of opportunities to reduce GHG emissions exist in each of these areas. For example, residential air conditioners can be made as much as 50 per cent more efficient than standard models. In space heating and water heating, improvements can reduce energy use by 10-60 per cent. In residential lighting, compact fluorescents (CFLs) use one-fourth the energy of incandescent bulbs. In the appliances sector, energy-efficient refrigerators represent a good opportunity for achieving savings in energy use. And finally, homes can be made more energy-efficient through improved insulation and other upgrades.

Residential consumers often lack information about the most efficient technologies for their needs, and are often likely to choose appliances and equipment based on the lowest first cost, or choose standard technologies that are seen as more reliable. Public outreach and labelling programmes can help educate consumers about products that are both reliable and minimise long-term costs.

### Residential/ Consumer Products Sector Opportunities

Energy-efficient lighting

HVAC improvements to save energy

- Efficient air-conditioners
- Efficient space and water heating
- Improved insulation and windows

Energy-efficient appliances

- Efficient refrigerators

## Industrial Sector

Industrial energy use produces 47 per cent of global $CO_2$ emissions. Because the energy intensity[1] in many developing and transition economies is two to four times greater than in OECD countries (IPCC, 1996), there is significant potential for energy efficiency improvements.

Much of the energy-related emissions in the industrial sector can be reduced through efficiency gains and fuel switching as demonstrated by the industrial process improvements underway in several countries. These improvements include:

- increased efficiency of motor technologies;
- better heat storage and use;
- fuel switching to less carbon-intensive fuels; and
- cogeneration.

For example, MoDo, a Swedish paper and pulp producer, expanded paper production by 60 per cent in a plant in Braviken with no net increases in emissions by implementing a variety of energy efficiency improvements. Some of the largest efficiency gains in OECD countries have occurred in chemicals, steel, aluminium, cement manufacturing, paper, and petroleum refining.

In addition to energy use, industrial process-related gases contribute additional GHG emissions, including:

- $CO_2$ from the production of lime and cement, steel, and aluminium;
- $CH_4$ from iron, steel, ammonia and hydrogen production; and
- PFCs and HFCs from chemical manufacturing, magnesium and aluminium production, and semiconductor fabrication.

A number of opportunities exist to reduce these emissions as well, and are often specific to the technical requirements of each industry. Some examples follow:

- Blue Circle Southern Cement in Australia is working to reduce $CO_2$ emissions in its cement production by changing processes to reduce the amount of lime required. (See Case Study B7.)
- A voluntary initiative in the United States encourages manufacturers of personal care products to purchase propellants with low global warming potential (GWP).[2]
- Hydro Aluminium, a Norwegian aluminium and magnesium producer, reduced GHG emissions from aluminium production by approximately 11 per cent in one year through a combination of measures, including reducing energy use and improving the electrolysis process. (See Case Study B1.)

### Industrial Sector Opportunities

Energy-efficient motors

Fuel switching

Cogeneration

Reducing GHG emissions by using different raw materials or processes

Specific process-related energy use reductions in energy-intensive industries

Capture/recovery and recycling of PFC/HFC emissions from industrial uses



*1 Energy intensity: energy consumption per unit of product.*

*2 Global Warming Potential: ratio of global warming, or radiative forcing, from one kilogram of a GHG to the radiative forcing from one kilogram of $CO_2$ over a period of time.*

## Carbon Dioxide Reductions in Glass Manufacturing

Pilkington United Kingdom Ltd, a UK glass manufacturer, has reduced energy consumption by 80 per cent since 1960, and has consequently achieved a reduction of $CO_2$ emissions from 1.26 tons to 0.32 tons per ton of glass produced. Most of these reductions have been achieved through increasing furnace size, redesigning the furnace, and improving furnace insulation. In addition, Pilkington improved heat recovery through proprietary technologies. Since glass manufacturing is typically very energy-intensive, improvements in efficiency can have significant cost savings and reductions in GHG emissions. (See Case Study B4.)

## *Other Sectors to Consider*

There are currently fewer voluntary programmes in the transportation, energy supply, waste, and agricultural sectors than in the commercial/institutional, residential, and industrial sectors (IEA, 1997). However, a number of win-win opportunities do exist in these sectors.

## *Transportation Sector*

Opportunities for reducing GHGs originating in the transportation sector range from increasing public transportation to increasing the efficiency of vehicles. According to the IPCC, until 2050, cars and other light-duty vehicles will likely remain the largest sources of GHG emissions in transportation (IPCC, 1996), so reducing their use and/or increasing their efficiency will be important.

Several countries are reducing energy use in vehicles. For example, a voluntary programme in Japan has encouraged automobile manufacturers to reduce energy use through a variety of technical improvements. Other programmes are reducing emissions by improving transportation infrastructure and promoting use of public transportation. Some programmes have successfully promoted alternative fuels, such as ethanol or electric vehicles.

### Transportation Sector Opportunities

- Reduced vehicle energy use
- Improved transportation infrastructure
- Alternative energy sources

### Reducing Energy Use in Auto Manufacturing

Under Japan's industry-wide Voluntary Environmental Action Plans, the Japanese auto manufacturing industry is reducing energy consumption through three initiatives: 1) improving vehicle fuel consumption; 2) improving energy efficiency in manufacturing; and 3) educating the public about energy-efficient driving methods. In one effort under this programme, Mitsubishi developed a new Gasoline Direct Injection engine that reduces fuel consumption by 20 per cent. (See Case Study B2.)

## Energy Supply Sector Opportunities

Energy generation efficiency improvements, including transformers

Coalbed methane recovery

Reduced leakage in natural gas transmission and distribution

Renewable sources

- Wind power
- Biomass
- Hydroelectric
- Solar

### *Electricity Generation / Energy Supply Sector*

Opportunities for cost-effective improvements in the energy supply sector are available in three main areas: 1) obtaining energy resources; 2) generating electricity; and 3) distributing natural gas. First, there are opportunities to reduce GHG emissions in obtaining energy resources. For example, coal mines have profitably captured $CH_4$ for use as an energy source. In generating electricity, excellent opportunities exist in changing from fossil fuels to renewable sources of energy, such as hydropower, solar, biomass, and wind, where such technologies are cost competitive and provide an adequate degree of reliability. In addition, newer energy-efficient transformers can significantly increase efficiency. Since transformers can last for 30 years or more, these technologies are generally most cost-effective for new installations rather than retrofits. In the distribution of natural gas, reducing pipeline leaks has proven to be a cost-effective and successful method of reducing emissions.

## Wind Power Development

In Denmark, the Energy 21 Windpower Initiatives aimed to reduce dependence on foreign oil and help the environment by increasing the use of windpower as an energy source. The government worked co-operatively with Denmark's energy sector to enhance research and development of windpower projects. The project successfully increased windpower to more than 3,800 wind turbines with a total capacity of about 600 MW (about 3.5 per cent of total national electricity demand). In 1995, the industry generated US$ 522 million in exports and provided more than 9,000 jobs to the economy. (See Case Study A2.)

## *Solid Waste and Wastewater Disposal Sector*

Solid waste and wastewater contribute about 20 per cent of global anthropogenic $CH_4$ emissions. The IPCC estimates that the majority of solid waste-related emissions of GHGs come from industrialised countries, while most of the wastewater-related GHG emissions come from countries where the domestic sewage and industrial waste streams are unmanaged or maintained under anaerobic conditions without controlling $CH_4$ (IPCC, 1996). In each of these areas, substantial opportunities can exist to reduce GHG emissions while improving the quality of the local environment.

Opportunities for reducing GHG emissions in solid waste begin with source reduction, re-use of materials, and recycling. These measures are appealing because they increase the inherent efficiencies of the production process while reducing the end stream of solid waste. Beyond reducing the waste stream, GHG emissions from existing solid waste disposal sites can be reduced by capturing the emitted methane and flaring it or using it as an energy source. The three primary uses for recovered methane are as a fuel for electricity generation, as a medium-Btu fuel for boiler or industrial process use, or (after extensive clean-up and compression) for injection into natural gas pipelines.

The profitability of methane energy recovery varies greatly depending on the landfill source, the technologies already in place, and the local cost of energy. However, these recovery projects provide additional benefits including improved local air quality and reduced public health hazards. In wastewater treatment, methane emissions can also be controlled and used as an energy source, often costing less than natural gas. Of course, opportunities will again vary by region, energy costs and technological approach already in place.

### Solid Waste/ Wastewater Disposal Sector Opportunities

Source reduction

Re-use, recycling

Methane recovery

### Reducing GHG Emissions from Wastewater

As part of the United Kingdom's *Making a Corporate Commitment Campaign*, Thames Water Utilities Limited began a series of environmental initiatives to reduce energy use and GHG emissions. As part of their improvements, they generated combined heat and power from the methane rich gas generated from the anaerobic digestion of sewage sludge. Half of the total energy was used on-site to power the digestion process, while the other half is sold to regional electricity companies for more than US$ 10 million. (See Case Study B3.)

## Agricultural Sector

The agricultural sector produces over 50 per cent of all anthropogenic $CH_4$ emissions, 70 per cent of $N_2O$ emissions, and 5 per cent of $CO_2$ emissions (IPCC, 1996). Large regional variations in agricultural methods and practices lead to significant differences in opportunities for reducing these emissions cost-effectively.

One of the important areas for reducing emissions is in decreasing energy use in agricultural activities. This can be accomplished by changing land and crop management practices to reduce tilling requirements, reducing energy use in irrigation, and using solar drying of crops. Another opportunity is to modify fertiliser management to reduce $N_2O$ emissions. For example, the IPCC estimates that $N_2O$ emissions could be reduced by 17 per cent through improved fertiliser management practices (IPCC, 1996). In addition, there are a variety of opportunities for cost-effective reductions in $CH_4$ emissions produced from agriculture. For example, $CH_4$ emissions from ruminant animals can be reduced by improving livestock productivity. Other reductions can be achieved by using manure to produce biogas as an on-farm energy supply. Rice cultivation produces significant $CH_4$ emissions, and processes are currently being developed to improve management practices and reduce emissions.

Some voluntary programmes have begun to explore these opportunities in the United States. For example, the US EPA Ruminant Livestock Efficiency Programme and the AgSTAR Programme work co-operatively with the agricultural sector to reduce methane emissions.

### Agricultural Sector Opportunities

Reduced energy use
- Reductions in tillage
- Irrigation planning
- Solar drying

Fertiliser management to reduce $N_2O$

Reduced methane emissions
- Improving productivity of ruminant animals
- Improved rice cultivation
- Manure management

# 2.2 Barriers Addressed by Voluntary Programmes

It might be expected that any cost-effective opportunities described in Section 2.1 would already be implemented; profit-maximising enterprises usually have good incentives to identify and implement technologies that can be used to their economic advantage. One might argue that there should be little need for a formalised programme to support their efforts. However, there are typically numerous market and institutional barriers that impede the use of these technologies. Four main types of barriers include:

- lack of information about the existence, availability or reliability of preferable technologies;
- lack of financing to purchase technologies;
- lack of access to technologies or technical support; and
- lack of adequate motivation for decision-makers to change behaviour.

These barriers can often be overcome by voluntary programmes.

## Information Barrier

One fundamental barrier to optimal use of technologies is lack of information; both businesses and consumers have limited time that can be spent gathering information and evaluating choices. In addition, they may be sceptical of claims by manufacturers and vendors. A voluntary programme can simplify the information-gathering process and make choices easier by providing an independent and objective source of information. The programme can therefore encourage broader use of technologies that may otherwise have been overlooked or ignored.

***Voluntary programmes can overcome market and institutional barriers that impede the use of beneficial technologies.***

## Overcoming Information Barriers

The Canadian Industry Programme for Energy Conservation (CIPEC) was introduced in 1975 as one of the first modern voluntary programmes to increase energy efficiency. In 1990, the programme's goals were expanded to include GHG emissions reductions. The programme has been successful by sharing information about best practices for energy efficiency improvements throughout industries, and training individual companies on technologies that can reduce energy use in a cost-effective manner. Participants receive technical assistance, employee awareness support, and training on the latest in energy-efficient technologies. Between 1990 and 1994, the programme helped reduce industrial energy intensity by 0.3 per cent, and reduced $CO_2$ emissions by 30 million metric tons. (See Case Study A5.)

*Some voluntary programmes overcome a financial barrier by demonstrating the long-term financial benefits of the new technology.*

### Financial Barrier

Even if consumers and businesses know about a new technology, they often lack the funds to purchase it. They may be forced to choose the less efficient alternative because they lack capital even if they would save money in total operating costs over the long run. In some voluntary programmes, the government or industry sponsor helps overcome this barrier by facilitating financing arrangements or identifying financing sources through which the user pays for the cost of the equipment over time, as savings from the new technology are realised. Other voluntary programmes overcome the challenges of a higher first cost by demonstrating the long-term financial benefits of the new technology.

## Overcoming a Financial Barrier

In Mexico, the Ilumex programme helped consumers purchase CFLs without offering rebates. Instead, the programme used an innovative financing scheme that allowed consumers to purchase the lamps with a loan that could be repaid from electricity bill savings. The consumers thus received the net savings without having a large up-front cost. The programme has been very successful, already selling more than 600,000 lamps. (See box in Case Study A7.)

### Access Barrier

Users may lack access to a new technology. Some countries do not produce the latest technologies, and imports may be prohibitively expensive. Even if the product itself is available, a user may not have access to technicians and the necessary maintenance support. Voluntary programmes can serve a role in facilitating access to a new technology. For example, they can help generate or aggregate demand for products, so that manufacturers have the motivation to overcome access barriers. Some programmes have worked specifically with domestic manufacturers to help them begin producing new technologies, or have trained technicians to support those technologies.

***Voluntary programmes can facilitate access to a new technology.***

## Overcoming an Access Barrier

The Electricity Generating Authority of Thailand (EGAT) works to reduce Thailand's rapidly growing energy use. Since lighting accounts for 20 per cent of Thailand's energy consumption, EGAT recognised that replacing 40-watt "T-12" fluorescent lamps with efficient 36-watt "T-8" technologies could have a significant impact on total energy use. However, the domestic production and market share of T-8s was initially less than 30 per cent. EGAT encouraged Thailand's lamp manufacturers to convert production to T-8s, and labelled and promoted the products to consumers. In 18 months, the market share of T-8s increased to 90 per cent. (See Case Study A8.)

*A voluntary programme can offer additional motivations beyond cost savings.*

### Motivational Barrier

Various motivational barriers exist. One type occurs when a company does not feel the cost savings of changing technologies are worth the effort or that limited human resources should be spent solving other business problems. Many organisations have simply never realised that upgrading their own facilities can be one of the most cost-effective components of their overall business plan. To overcome this barrier, a voluntary programme can offer additional incentives beyond the cost savings found in the specific technological opportunity, such as offering public recognition for actions companies have taken to protect the environment. Public opinion is an important motivator for businesses; the chance to improve their image has been compelling enough for many companies to change business practices in areas that may otherwise have been given low priority.

Another motivational barrier can occur at the manager level; businesses do not always offer the right incentives for managers to choose the best long-term solutions for the company. For example, managers may have incentives to reduce up-front costs to demonstrate higher profits during their tenure, even though those choices do not lead to the lowest long-term costs for the company. Many businesses do not have automatic mechanisms to reward managers for profits or cost savings that will be generated in the future. Voluntary programmes can use their role as a third party expert to demonstrate and verify expected future cost savings. This can help a company recognise managers for profitable long-term decisions.

## Overcoming Motivational Barriers

Australia's Greenhouse Challenge programme helps overcome motivational barriers by publicising the initiatives that companies undertake to reduce GHG emissions. There is no penalty if companies do not participate, but there is positive publicity if they do. The programme was introduced in 1995, and expects to reduce aggregate GHG emissions by 16 million metric tons of $CO_2$ through actions taken by initial participants. (See case study A6.)

## 2.3 Voluntary Programme Approaches

There are a variety of approaches that voluntary programmes use to overcome barriers to technologies. Although most programmes are tailored to country- and sometimes sector-specific circumstances, programmes usually fall into one of six main categories:

1. Technology Upgrade
2. Voluntary Challenge
3. Outreach
4. Product Labelling or Promotion
5. Reporting and Monitoring
6. Voluntary Codes and Standards

Some programmes combine elements from several categories. The type of approach chosen usually depends on the sector that is targeted and the key barriers found in that sector.

### 1. Technology Upgrade

This type of programme is used to encourage participants to undertake a specific category of technology improvement, such as installing energy-efficient lighting systems in buildings, and is often found in the commercial/institutional sector. It is most appropriate when a very specific opportunity has been identified that provides significant cost savings, but has not been implemented due to an identified barrier. If the programme can easily overcome the barrier, it can be very successful.

This type of programme is designed to accomplish several goals. First, it achieves direct reductions in GHG emissions from using the new technology. Second, it demonstrates that environmental improvements can generate cost savings. Third, it can increase the demand for the technology so that production increases and product prices fall, leading to greater demand for the product and an eventual market transformation.

***A technology upgrade programme encourages participants to undertake a specific technology improvement.***

#### Technology Upgrade

In 1991, the United States founded the Green Lights® programme to improve the efficiency of lighting in organisations around the country. Although cost-effective, efficient lighting technologies had been on the market for several years, they were not fully implemented due to informational and motivational barriers, including lack of confidence in vendors and low priority given to energy cost considerations. The programme acted as an unbiased information source to verify claims made by vendors. Programme publicity campaigns increased the motivation of companies to increase their energy efficiency. (See Case Study A1.)

## 2. Voluntary Challenge

In a voluntary challenge programme, participants are challenged by government or their industry to achieve some environmental goal rather than to use a specific category of technology. For example, participants may commit to reducing GHG emissions by 10 per cent. The participants, however, decide the way in which they will meet that goal. Often, lessons learned or new opportunities identified by one participant are shared as suggested best practices with others in the industry.

These programmes are most common in the industrial sector. They are used when the programme does not necessarily have a specific opportunity to promote, but desires instead to motivate industries to identify and/or choose their own opportunities. The programme becomes a motivator and facilitator and encourages co-operation and information-sharing among competitors.

***A voluntary challenge programme allows participants to decide how to meet an environmental goal.***

### Voluntary Challenge

The Industrial Energy Efficiency Network in Norway challenges industries to reduce emissions through energy efficiency upgrades. The 500 companies participating from 13 industrial sectors receive publications, seminars, and energy consultant support to learn about improving energy efficiency. The opportunities for improvements are identified and implemented by the industries rather than the programme. (See box in Case Study A5.)

## 3. Outreach

An outreach programme uses broad approaches to increase awareness of environmental opportunities among key communities of stakeholders. Unlike *technology upgrade* or *voluntary challenge* programme types, it does not solicit a commitment from participants to upgrade to a particular technology or to achieve a GHG reduction target.

Instead, it provides information and motivation to stakeholders to support environmental improvements. It may also promote new technologies or opportunities to the general public. This type of programme is particularly effective when success in implementing an opportunity depends on the co-operative action of a diverse group of stakeholders to remove key barriers.

***An outreach programme provides information and motivation to stakeholders to support environmental improvements.***

### Outreach

The US EPA Landfill Methane Outreach Program works with key stakeholders in promoting the capture and use of $CH_4$ from US landfill sites. The programme encourages utilities to consider using energy from landfill methane recovery projects as a fuel source for electricity generation. It works with states to simplify permitting procedures for energy recovery projects. It also supports industry groups involved in energy recovery projects by providing programme specific information about landfill methane projects and experiences. (See Case Study A3.)

*A labelling or product promotion programme helps consumers choose technologies that benefit the environment.*

### 4. Product Labelling or Promotion

In a labelling programme, products are labelled to designate that they are environmentally friendly, energy-efficient, cost-effective, or a combination of these attributes. This helps consumers easily recognise and choose technologies that benefit the environment. These programmes are most often used to overcome information barriers in the residential and consumer products sector. They can also help overcome motivational barriers in manufacturers that are reluctant to produce more environmentally friendly products.

### 5. Reporting and Monitoring

In a reporting and monitoring programme, participants self-monitor and voluntarily report GHG emissions or energy use to the programme administration. Governments and industries often use these programmes to gather information on best practices and to accumulate data without imposing a regulatory burden on participants. In return, participants often receive information from which they can benchmark their own performance or receive third-party publicity for their environmental achievements. Although the case studies profiled in this document do not include any of the programmes that are only designed for reporting and monitoring, several (such as Norway's Industrial Energy Efficiency Network and the Netherlands' Long Term Agreements) include important reporting and monitoring components.

## Product Promotion

In 1985, Brazil established a national electricity conservation program, PROCEL, to help reduce electricity demand. One of the largest and most successful of PROCEL's projects has focused on improving the efficiency of household refrigerators and freezers. In this project, PROCEL worked with manufacturers to increase efficiency and promote efficient models to consumers. Today, there are a total of 15 one-door and 10 two-door efficient models manufactured in Brazil. Electricity savings are estimated to be 2,560 GWh annually — equivalent to about one per cent of national energy consumption. (See Case Study A9.)

## 6. Voluntary Codes and Standards

These programmes are often used in the Institutional/Commercial and Residential building sectors to develop high-efficiency building performance standards. They resemble their regulatory counterparts, but allow flexibility in that they do not impose financial or legal penalties for non-compliance. Participants may receive a variety of benefits, including governmental certification of their equipment or buildings, information sharing about industry achievements, the chance to contribute to the regulatory process, and public recognition of measures they have taken to help the environment.

The following table identifies, by sector, some of the potential cost-effective technologies to reduce GHG emissions, principal barriers to their implementation, and voluntary approaches that help address these barriers. The table is presented in the order in which this document describes the development of a voluntary programme. First, technological opportunities to reduce GHG emissions are identified by sector. Second, the barriers to those opportunities are investigated. And finally, the appropriate voluntary programme type to best overcome those barriers in that sector is applied.

***A reporting and monitoring programme is used to gather information on best practices.***

# Opportunities, Barriers, and Voluntary Programme Approaches

| Sector | Technological Opportunities to Reduce GHG Emissions |
|---|---|
| Commercial / Institutional | Buildings energy efficiency<br>• Better envelope (insulation, etc.)<br>• Efficient lighting<br>• HVAC improvements<br>• Efficient office equipment<br>Cogeneration |
| Residential / Consumer Products | Energy efficiency<br>• Efficient lighting<br>• HVAC<br>• Appliances |
| Industrial | Energy-efficient motors<br>Fuel switching<br>Cogeneration<br>Process energy efficiency improvements |
| Electricity Generation / Energy Supply | Energy generation efficiency improvements<br>Coalbed methane recovery<br>Reduced leakage in natural gas transmission and distribution<br>Renewable sources<br>• Wind power<br>• Biomass<br>• Hydroelectric<br>• Solar |
| Transportation | Increased vehicle energy efficiency<br>Improved transportation infrastructure<br>Alternative energy sources |
| Solid Waste and Wastewater Disposal | Source reduction<br>Re-use, recycling<br>Methane recovery |
| Agriculture | Reduced energy use / increased energy efficiency<br>Fertiliser management to reduce $N_2O$<br>Reduced methane emissions |

## Opportunities, Barriers, and Voluntary Programme Approaches (continued)

| Principal Barriers Overcome by Voluntary Programmes | Key Voluntary Programme Strategy or Approach |
|---|---|
| • Lack of awareness of efficient technologies<br>• Lack of unbiased information<br>• Lack of financing<br>• Lack of motivation for decision-makers<br>• Lack of motivation for builders | • Technology Upgrade Programme<br>• Voluntary Building Codes and Standards |
| • Lack of information by consumers about new products<br>• Uncertain demand limits manufacturers motivation to produce new products<br>• Lack of funds/financing for consumers<br>• Lack of consumer access to new products<br>• Lack of motivation for builders | • Labelling Programme<br>• Voluntary Home Energy Rating Codes and Standards<br>• Outreach Programme |
| • Lack of awareness of efficient technologies<br>• Lack of decision-maker motivation<br>• Lack of research into new "best practices"<br>• Lack of access to new technologies or technological support<br><br>**Other important barriers (not easily overcome by most voluntary programmes)**<br>• Long life of existing inefficient capital equipment | • Voluntary Challenge Programme<br>• Reporting and Monitoring Programme<br>• Technology Upgrade Programme |
| • Lack of decision-maker motivation<br><br>**Other important barriers (not easily overcome by most voluntary programmes)**<br>• Lack of adequate financial return on investments<br>• Lack of regulatory incentives | • Voluntary Challenge Programme<br>• Technology Upgrade Programme |
| • Lack of manufacturer motivation to produce more efficient vehicles<br>• Lack of passengers on public transportation<br>• Lack of public/private co-ordination<br>• Lack of sufficient research into alternative fuel vehicles | • Voluntary Challenge Programme<br>• Outreach Programme |
| • Lack of motivation for waste generators to reduce waste<br>• Lack of information about technologies and regulatory requirements<br>• Lack of access to technical qualifications | • Voluntary Challenge Programme<br>• Technology Upgrade Programme<br>• Outreach Programme |
| • Lack of information about ways to reduce GHGs<br>• Lack of well-tested technologies and methods<br>• Lack of financing | • Outreach Programme<br>• Voluntary Challenge Programme |

# 2.4 Strengths and Challenges of the Voluntary Approach

*Voluntary programmes work best when a win-win opportunity can be identified and barriers can be reduced by the programme.*

Voluntary programmes function most effectively as a part of a comprehensive environmental protection strategy that includes a range of policies and programmes. They have important strengths and present particular challenges that should be recognised in order to ensure that they are used most successfully.

## Strengths of the Voluntary Approach

Voluntary programmes work best when a win-win opportunity can be identified and the market and institutional barriers to the opportunity can be reduced by the programme. When the barriers can be overcome by a voluntary programme, it can be a powerful tool in reducing GHG emissions and achieving environmental protection. Some of the strengths of using voluntary programmes follow.

### 1. Market-based Approach

One of the most powerful strengths of voluntary programmes is that they use the market to encourage actions that help the environment. Because participants act in their own self-interest, the programmes encourage behavioural change that does not need to be mandated through regulation.

### 2. Benefits for Participants

Participants receive a variety of important benefits from participating in voluntary programmes, including access to low-cost unbiased information, reduced operating costs, public recognition for their environmental accomplishments, and potentially fewer burdensome regulations. In many cases, participants will be excited as they learn about opportunities for profitable investments.

### 3. Valuable Partnerships

Voluntary programmes tend to create partnerships between potential adversaries: government and industry, for example, or corporate competitors within an industry. The result is improved dialogue and trust between parties, which creates an opportunity for collaboration that can benefit all involved.

### 4. Flexibility

Voluntary programmes usually encourage flexibility in making environmental improvements. This flexibility can allow companies to reduce GHG emissions by choosing the technologies and practices that are most appropriate for their particular needs.

### 5. Spillover Effects

The promotional messages of voluntary programmes can change the attitude of the public towards energy efficiency and other environmentally beneficial activities. This may lead companies and individuals to change behaviour toward economic and environmental sustainability in a wide variety of activities.

### 6. Opportunity for Ambitious Environmental Results

While regulations require all companies to comply with minimum required standards, voluntary programmes provide public recognition and other benefits to encourage companies to excel in environmental achievements. Therefore, accomplishments by programme participants can be more ambitious than what is required by regulation.

### 7. Potentially Lower Cost Than Regulations

Voluntary programmes can be less costly to monitor and enforce than regulations. Where there is a barrier that can be clearly overcome by a voluntary programme, policy makers may consider choosing a voluntary programme in place of a comparable, more expensive regulatory programme.

## Challenges When Implementing Voluntary Programmes

Because voluntary programmes rely on market forces, they have limitations and challenges that should be recognised when they are being considered as a policy measure. Understanding these challenges is important to guarantee successful programmes.

### 1. Limited Use

One of the challenges with promoting voluntary programmes is that they might be used in inappropriate situations. A voluntary programme can be very successful, but only when participants can be persuaded to voluntarily change their actions. This most often occurs when there is a win-win opportunity. Voluntary programmes have limited use when there is no individual benefit to the participants, because it is then much more difficult to change their behaviour. Therefore, a careful analysis of opportunities and participant motivations is necessary before choosing to use a voluntary approach.

*One of the most important challenges is ensuring that results are achieved.*

## 2. Uncertainty of Results

One of the most important challenges of a voluntary programme is ensuring that results are achieved. Since individuals are not required to take action, there is no guarantee that the programme will reach its goals. A successful programme, therefore, should be carefully designed with the following considerations: 1) it should be based on a good opportunity; 2) the programme should identify and address the key market and institutional barriers to the identified opportunity; and 3) the motivational aspects of the programme should be compelling enough to get individuals to take action. The design suggestions to be discussed in Chapter 3 can help ensure that a new programme achieves its desired results.

## 3. Establishing Credibility

Another challenge of voluntary programmes is achieving credibility with important stakeholders, including taxpayers, environmental groups, industry, and international audiences. In order to ensure that the programme is achieving real results, it should include a credible monitoring and evaluation component. Again, Chapter 3 discusses methods for evaluating programme results.

## Chapter 3

# Designing Voluntary Programmes: Four Critical Elements of Success

*This chapter discusses programme planning tools that can be used in developing voluntary programmes. It does not prescribe an exact approach for programme design, but instead lists important elements to consider in the planning process. These elements are based on the practical experiences gained by developers of existing voluntary programmes and can provide a good foundation for policy-makers and industry decision-makers who may be interested in designing similar programmes.*

*The chapter discusses four elements of programme design that have been common to many of the most successful voluntary programmes:*

- *Identifying a clear opportunity*
- *Developing an appropriate programme structure*
- *Developing a communications/marketing strategy*
- *Collecting and measuring results*

*Following these elements in order can make it easier to recognise good opportunities for a technological improvement and design a successful programme. A checklist of these points is included at the end of this chapter.*

# 3.1 Identifying a Clear Opportunity

The first step in designing a successful programme is identifying and characterising an opportunity that provides benefits for both the participant and the environment.

## Look for Under-Utilised Technologies

Most voluntary programmes have promoted under-utilised technical equipment, processes, and/or management practices that can improve performance and benefit the environment. These technological opportunities are very different from the "do-with-less" approaches to environmental protection and energy conservation that were common after the "oil shock" in the 1970s. A good opportunity, for example, would be to save energy in a building while maintaining comfortable temperatures by applying better heating and cooling technologies. A "do-with-less" approach might have suggested instead adjusting the thermostat to save energy and causing discomfort for occupants as a result.

It is common to see commercially available, proven technologies used successfully in one company, region, or country and not in another due to lack of awareness of these opportunities. These differences in use of technologies are not surprising since technologies in both local and international markets are changing so quickly. An important role for developers of voluntary programmes is to look creatively for these differences.

Many of the best opportunities that are at the core of voluntary programmes relate to energy use and energy efficiency. As outlined in Chapter 2, most energy efficiency improvements reduce emissions of GHGs, achieve economic benefits, and do not compromise product performance or quality.

Even at this early stage of investigating the programme, it is important to look at technological options that are likely to capture the power of market-based forces. If the technologies under consideration can be used profitably so that prospective programme participants will want to use them, a voluntary approach can be successful. The voluntary efforts described in the case studies have been designed around a diverse set of opportunities from changing lightbulbs to using wind power.

## Perform a Comprehensive Market Analysis

When a technological option is found, the next step is to learn more about the market conditions that will affect whether that option can result in profitable investments and significant reductions in emissions of GHGs. A programme developer could start by asking:

- How is the technology being used today?
- Who buys it and where? (to know which markets are not yet penetrated)
- Who sells it? Is it widely available in the market?
- Why do they buy it? (to learn ways to motivate participants in undeveloped markets)
- How much can be saved using the new technology compared to common practice?
- What are the likely returns of the investment?
- How much would it cost to implement the new idea?
- Are there local manufacturers, suppliers, engineers and contractors needed to implement the idea?
- Is there a significant potential to reduce or prevent emissions of GHGs?

To evaluate the impact on GHGs, it is often helpful to review the sectors that use the most energy or produce the most emissions of GHGs. This information is identified when preparing a country's *National Inventory of GHG Emissions*, which is part of the national communication that all countries that are Parties to the UNFCCC must prepare. Improvements in these sectors can have a significant impact on GHGs because even small percentage improvements can result in large net reductions in emissions. Many countries have successfully directed their voluntary programmes at the largest energy-consuming industries. For example, the Netherlands' LTAs, Canada's CIPEC program, and Norway's IEEN concentrated first on the energy-intensive sectors, such as mining and manufacturing.

However, programme designers should not ignore the sectors that generate relatively lower emissions because they might have significant untapped potential. For example, in less energy-intensive sectors such as service industries, companies are likely to be less knowledgeable about energy-saving opportunities because energy use does not contribute a large portion of total operating costs. Consequently, some voluntary programmes have had a tremendous positive environmental impact when directed toward less energy-intensive industries.

## Perform an Analysis of Barriers

Once a cost-effective technology has been identified and its potential for significantly reducing GHG emissions has been determined, it is helpful to deter-

***It is important to look at technological options that are likely to capture the power of market-based forces.***

***Find out what the specifics of the barrier are, rather than only identifying its generalities.***

mine the specific reasons why the technology is not already in use. What are the key market and institutional barriers for buyers and sellers that exist to pursuing the opportunity? As explained in Chapter 2, most barriers are likely to be one of four kinds: inadequate information; lack of available capital; lack of access to the new technologies; or inadequate motivation.

Whatever the barriers are for a particular technological option, it is important to find out what the specifics of the barrier are rather than only identifying its generalities. For example, if most organisations lack information about a beneficial technology but would choose to use it if they had more complete information, one can determine exactly what kinds of information are needed: product data; best practices for efficient operation; experience with combining multiple technologies in new ways; engineering examples with profitable results; experience on how to overcome perceived side effects, or others. Speaking with producers and consumers themselves can be very important for identifying the specific barriers.

When the barriers are well understood, it is possible to effectively identify mechanisms for overcoming those barriers. Often those mechanisms will be an inherent part of the commonly used programme strategies identified in Chapter 2. If care was taken at the onset to ensure that the technological options under consideration are proven, profitable options, there are usually applicable approaches that will capture market-based forces under the voluntary programme. For example, if consumers do not demand a highly efficient technology because they do not understand that it is cost effective, then both the consumers and the manufacturers would face a motivational barrier to request or to manufacture the high-efficiency equipment. A labelling programme in this case could help to change the way consumers make purchasing decisions and give manufacturers a way to highlight energy-efficient products and expand their market share. It is common for voluntary programmes to overcome barriers in this way by affecting a market with "push-pull" actions that create consumer demand and better access to technological solutions at the same time.

## 3.2 Developing an Appropriate Programme Structure

Once the opportunity has been fully characterised, the next element in designing a voluntary programme is to develop a programme structure that will yield the greatest results at the lowest cost. At this stage programme developers need to have clear policy objectives and have an understanding of what defines success in overcoming barriers. From these goals, the programme type can be selected.

### Select a Programme Type

The market analysis of the opportunity can guide the identification of a programme type that is likely to be most successful. Different voluntary programme types have different strengths in overcoming barriers. The programme may fall into one of the six categories discussed in Chapter 2, or may be a combination of several of these categories. While there is no uniform solution that can be replicated in every case, the search for a good match between programme type and common/typical barriers for particular sectors can be helped by reviewing the dominant voluntary programme strategies that have emerged to date to solve similar problems.

The following table can help identify which programme type (of those identified in Chapter 2.3) is likely to be most appropriate.

# Types of Voluntary Programmes

| Programme Type | Description | Strengths |
|---|---|---|
| Technology Upgrade | Encourages participants to undertake a specific category of technology improvement, such as installing energy-efficient lighting systems in buildings. | • Focuses on specific opportunities.<br>• Can concentrate attention on a particular industry sector.<br>• Good at overcoming informational, financial, access and motivational barriers. |
| Voluntary Challenge | Challenges participants to achieve some environmental goal rather than to use a specific category of technology. For example, participants may commit to reducing GHG emissions by 10 per cent. | • Can lead to new ideas generated by industry participants.<br>• Encourages sharing of best practices among all participants in industry.<br>• Good at overcoming informational and motivational barriers. |
| Outreach | Uses broad approaches to increase awareness of environmental opportunities among key communities of stakeholders. It provides information and motivation to stakeholders to support environmental improvements, and may promote new technologies or opportunities to the general public. | • Can reach a broad audience.<br>• Good for obtaining co-operation from diverse stakeholders in reducing barriers.<br>• Can promote a specific technology or a general environmental message.<br>• Good at overcoming informational and motivational barriers. |
| Product Labelling or Promotion | Labels products to designate that they are environmentally friendly, energy-efficient, cost-effective, or a combination of these attributes. This helps consumers easily recognise and choose technologies that benefit the environment. May also promote product categories without a specific label. | • Provides motiviation to both consumers and producers of technologies.<br>• Labels overcome information barriers and help consumers assess products.<br>• Can encourage manufacturers to make products more environmentally friendly.<br>• Can involve a limited number of manufacturers rather than a large number of participants.<br>• Promotional messages are sometimes persuasive enough to change behaviour even at a cost to the individual; they work well beyond the "win-win" scenario. |
| Reporting and Monitoring | Asks participants to self-monitor and voluntarily report GHG emissions or energy use to the programme administration. Governments and industries often use these programmes to gather information on best practices and to accumulate data without imposing a regulatory burden on participants. | • Publicising results often encourages better performance.<br>• Benchmarking and information-sharing can be useful to industry.<br>• Can help overcome informational barriers. |
| Voluntary Codes and Standards | Often used in the Institutional/Commercial and Residential building sectors to develop high-efficiency building performance standards. They resemble their regulatory counterparts, but allow flexibility in that they do not impose financial or legal penalties for non-compliance. | • Setting standards can encourage better performance.<br>• Can help overcome motivational barriers. |

## Types of Voluntary Programmes (continued)

| Considerations | Examples |
|---|---|
| • Does not promote innovation or other technologies beyond those covered by the programme. | • ENERGY STAR Buildings and Green Lights (United States)<br>• Green Buildings for Africa (South Africa) |
| • Does not require a specific activity; may be difficult for companies to know where to start.<br>• Rigorous reporting is usually required to ensure that companies are making improvements well beyond baseline plans. | • Long Term Agreements (Netherlands)<br>• CIPEC (Canada)<br>• French Glass Packaging Agreement (France)<br>• Industrial Energy Efficiency Network (Norway)<br>• Greenhouse Challenge (Australia) |
| • Absence of formal agreements from those who would implement the new technologies may reduce achievements.<br>• Results are often difficult to measure. | • Landfill Methane Outreach Program (United States) |
| • Requires intensive product review.<br>• Difficult for one label to fully capture information about a product's environmental qualities. | • ENERGY STAR Office Equipment (United States)<br>• Polish Efficient Lighting Project (Poland)<br>• EGAT Fluorescent Tube Programme (Thailand)<br>• PROCEL — Energy-efficient refrigerators and freezers (Brazil) |
| • Programmes usually do not directly encourage any improvements.<br>• Industry members may be concerned that information will be used to establish new regulations, leading to inaccurate baseline projections. | • Industrial Energy Efficiency Network (Norway)<br>• Long Term Agreements (Netherlands)<br>• CIPEC (Canada)<br>• Greenhouse Challenge (Australia) |
| • Lack of formal commitment may reduce effectiveness of programme. | |

*Programmes that offer the highest benefits will be able to command the highest level of commitment.*

## Determine Level of Commitment

Once the general programme type is identified, the next step is to determine the level of commitment that will be expected of participants. The degree of commitment varies greatly among the programmes reviewed in this document.

- Some programmes require no commitment from participants. For example, many programmes that work with residential consumers, such as the Poland Efficient Lighting Project, operate this way.
- Others have a minimum level of commitment, requiring participants to agree to environmental principles to obtain any benefits conferred by the programme. Many voluntary programmes around the world include this sort of environmental pledge.
- Other programmes have a medium level of commitment, asking participants to commit to specific support, but not setting targets for the level of this support. For example, the US Landfill Methane Outreach Program asks utilities, states, and industries to support landfill methane recovery projects, but does not set any specific targets for the level of support committed.
- Some programmes have a high level of commitment, requiring participants to commit to specific upgrades or specific reductions in GHG emissions. For example, the Canadian CIPEC programme requires industries to commit to specific GHG emissions reductions targets.
- Finally, some programmes have very strict requirements. For example, the Netherlands Long Term Agreements Programme requires participants to sign a formal, binding agreement that outlines their commitments and includes penalties for non-compliance.

The level of commitment will vary according to the needs of the programme. In general, the programmes that offer the highest benefits for participating will be able to command the highest level of commitment from participants.

## Determine Type of Agreement

Once the level of commitment is identified, the next step is to determine how those commitments will be made. Some programmes are based on formal agreements that are signed by executives from the programme and the participant organisation and that outline the responsibilities of each party. Others include agreements signed only by the participant. For example, Australia's Greenhouse Challenge programme asks programme participants to sign a "letter of intent" outlining their commitments for reducing GHG emissions. In general, signing a formal agreement can ensure that the top levels of an organisation are committed to the issue, and it can encourage the ongoing implementation of the programme even when other priorities interfere.

## Many Programmes Include a Formal Agreement

In the US ENERGY STAR Buildings programme, programme developers used a bilateral "Memorandum of Understanding" (MOU) to outline the commitments of the participant and the programme. The MOU was important to formalise the commitment that participants make to complete all building energy upgrades that are profitable, and to help them maintain their focus on improving energy efficiency in their buildings throughout the 7-year agreement cycle. (See Case Study A1.)

Other programmes require no formal commitments from participants. In particular, many programmes targeted at consumers or individuals include no formal agreements. Other programmes that expect to have difficulty convincing potential participants to sign a formal agreement may also decide to operate without one. Programmes both with and without formal agreements have been successful.

## Pros and Cons of Using a Formal Agreement

***Pros:***

- clarifies and formalises responsibilities of programme and participant
- enhances commitment from participants
- is credible and more transparent to the general public

***Cons:***

- can be time-consuming to obtain agreements from participants
- can deter those who are wary of signing a document

*Because these programmes are voluntary, it is important to focus on the needs of the expected participants.*

## Assess Level of Resources Required

Before proceeding with the development of the programme structure, it is valuable to begin to consider how the scope of the proposed programme affects resource requirements. Depending on the type of programme and services offered, funds will be required for:

- obtaining and disseminating information;
- public recognition;
- consulting support;
- technical assistance;
- technical analysis;
- monitoring and evaluation; and
- administrative services.

Depending on the scope of the programme, these funding needs can range substantially, from a part-time administrator to dozens of full-time staff and consultants.

A voluntary programme often has limited funding during its start-up phase. It is usually most effective, therefore, to limit the scope of the programme during its early stages. To get the largest impact during its start-up at the lowest cost, the following options may be used:

- Concentrate on just a few industries or a specific region of the country.
- Focus initially on entities that represent the largest potential to reduce emissions of GHGs.
- Offer more support services to a limited clientele instead of offering only nominal services to a great number of constituents.

## Design for Customer Needs

Because these programmes are voluntary, it is important to focus on the needs of the expected participants (i.e., "customers"). Since participants in voluntary programmes typically act in their own best interests, a programme developer should identify and design into the programme key benefits that the customers see as valuable and that will help them overcome the barriers identified previously. Some of these benefits can be identified by asking the participants themselves. Others can be identified by looking for ways that the programme agency can fulfill a unique role not already being offered in the private market. Such a role could be providing unbiased information or offering third-party publicity for participants' environmental achievements. Finally, it helps to clarify what can and should be done by the government versus industry, associations, and others.

The main programme benefits usually include information, public recognition, and technical support.

## Providing Information on Participants

In Norway's Industrial Energy Efficiency Network, the programme offers a communications link between industry, consultants, suppliers, and authorities. The programme provides a "toolbox" of information on energy efficiency, which is disseminated to all participants. (See box in Case Study A5.)

### *Information*

Almost every voluntary programme includes an important "information" benefit. To be useful, the information must be :

- credible, unbiased and objective;
- written using language that business people understand and that emphasises the economic benefits of the technology;
- timely; and
- not readily available from another source.

### *Public Recognition*

Many voluntary programmes also publicise the environmental achievements of participants. Publicity can range from award ceremonies to advertising provided by the programme. It can be a powerful incentive to businesses who want to show consumers that they are the kind of "green" organisation consumers should appreciate. In the programme planning stages, potential participants should be consulted to determine what type of public recognition would be most important for them.

## Working with Participants to Identify the Best Types of Public Recognition

In Australia's Greenhouse Challenge programme, the programme office conducted market research to determine the most desirable public recognition for their participating companies. As a result of the research, the programme placed public service advertisements in national magazines and conducted signing ceremonies for the media with each new participant. These efforts reward current participants and attract new participants to join the programme. (See Case Study A6.)

*The level of customer service to be provided is determined by the specific needs to overcome the target barriers.*

### Technical Support

In addition to information and publicity, many participants need support in actually implementing the new technical opportunities. Several programmes offer access to technical staff to answer questions, guidebooks, free training, or other services to assist participants in the implementation process. This type of support is usually well received by participants, but will expand the cost of administering a voluntary programme. Therefore, it is important to determine where and how it can best be used to ensure the greatest impact for the lowest cost.

The level of customer service to be provided by a programme is determined, in part, by the specific needs to overcome the target barriers. Also, any burden the programme places on participants must be offset by the benefits of participation. Some programmes may not need to provide many additional benefits. In general, the greater the economic benefit to the participants, and the lower the burden of participating, the fewer programme benefits will be needed to encourage participation.

# 3.3 Developing a Communications/ Marketing Strategy

Unlike regulatory actions, a voluntary programme must *entice* industry or consumers to participate. In essence, these programmes must be promoted, or marketed. They therefore devote more of their resources to developing persuasive materials and messages.

Voluntary programmes require a well-planned marketing approach. However, many government agencies that have relied on regulation to accomplish goals may be unfamiliar with implementing marketing strategies. To overcome this lack of experience, government planners can learn from the private sector. The experience of several government voluntary programmes shows that much of what has been successful for private enterprise is directly applicable to voluntary programmes. Just as private enterprise uses a combination of *marketing* (persuading a buyer that the product is valuable) and *sales* (convincing a buyer to purchase the product), successful voluntary programmes break down their programme work into distinct marketing and sales efforts. The approach can be summarised as follows.

First, identify the potential participants of a voluntary programme: companies, industries, or individuals. These participants become the "market" for a particular programme. These markets can then be divided into sectors, such as vertical sectors or geographic sectors. (Vertical sectors indicate organisational function, such as hospitals, schools, banking, retail, etc.) A separate marketing strategy can be developed for each sector, if necessary.

Next, develop the message that will be conveyed to participants. The message will show audiences how they will benefit from the programme, for example:

- The costs they will save with the under-utilised technology.
- The public recognition they will gain from participating and helping the environment.
- The increased output/productivity they will gain by applying the best practices or new technologies.

Again, the message should be market-specific, because the benefits of participating will be market-specific.

## Targeting a Message

In promoting its Green Lights programme to hospitals, the US EPA recognised that the single most important issue for health care providers in the US was limiting the rise in costs. EPA developed a targeted message for hospital trade publications that emphasised the cost-saving benefits of upgrading lighting. The advertising showed a surgery scene with glaring lights in a hospital, with the message, "If you want to reduce your overhead, maybe you should look at what's over your head." Messages to other audiences emphasized other benefits. For example, advertising to major corporations emphasized the public recognition benefits of the program.

Third, once the message has been developed, create supporting materials—brochures, flyers, television and radio clips, posters, videos, and other materials—that describe the programme. Each of these promotional pieces can emphasize the special needs and concerns of targeted potential participants. To project a powerful and credible message, it is often critical to draw data from a solid track record of achievements and cost savings during the programme's start-up period. Sharing case studies and overall achievements can be an important part of convincing prospective participants that joining the programme will help them to achieve real economic benefits.

Finally, "sell" the programme by convincing participants to actually join the programme or implement the technological change. Many voluntary programmes have used sales representatives who use direct mail, telemarketing, and presentations to senior executives to persuade companies to participate. This is an important step. Even if the programme has been successfully "marketed" so its value is understood, it will not be successful until individuals and companies actually take the step to participate.

## 3.4 Collecting and Measuring Results

In any voluntary programme, it is critical to measure and track results. First, an objective evaluation of the programme will determine whether it is making an impact and help demonstrate results to the public and key stakeholders. Second, evaluation is important to help refine the programme to meet participant needs. Many successful voluntary programmes evolve over time to respond to successes and problems identified in the evaluation process. It is especially helpful to monitor the programme closely during its start-up.

It is important to remember the fundamentals during this last part of programme design. The key objectives for programme developers and participants should be clear before developing ways to measure results. For example, key objectives may include: enlisting the participation of a specific number of participants; achieving specific targets for reducing emissions of GHGs; increasing demand for a technology by a specific amount; or other milestones.

After these objectives are reviewed and agreed upon, programme developers can determine which data are best to assess programme progress. Sometimes a proxy can be used for the data desired, rather than trying to collect the actual data. For example, if an energy efficiency programme needs data on reducing emissions of GHGs, it might collect data on kWh savings from participants' utility bills instead. These data can then be used to approximate GHG reductions from power plants. Similarly, if information about sales and implementation of the new technology is desired, a programme could collect information about purchasing practices from all participants, or it may be much easier to collect total sales data from relatively few manufacturers.

When programme developers have determined what should be measured, the final part of programme design is deciding how to collect the data. A variety of good options exist, ranging from overall industry analysis to statistical sampling of participants to individual participant reports. Reliability of the data depends more on the rigour with which the method is applied than on the method itself. For example, strong industry associations may have the best success at obtaining data from their member companies. Canada's CIPEC programme and the Netherlands LTAs both rely on industry reporting. Alternatively, individual company

***The key objectives for programme developers and participants should be clear before developing ways to measure results.***

reports can be very accurate, though time-consuming to collect. The US EPA Green Lights programme collects individual facility reports detailing every lighting upgrade that happens under the programme. The third alternative, statistical sampling, can be very accurate if properly applied. A sampling data collection method may increase the accuracy of results if it is suspected that participants are not completing all of their reports.

As a final consideration, while reporting and evaluations are important, the reporting burden on participants should be kept to the minimum that is sufficient to obtain useful data. Large reporting requirements can be costly and can deter potential participants from joining a programme, and therefore possibly limit programme accomplishments.

The elements discussed in this chapter set a good foundation for understanding the principles of successful voluntary programme design. These guidelines, with expert advice obtained directly from programme developers, can be used to plan new programmes.

## Summary of Elements in Successful Programme Design

**Identify a clear opportunity**

- Look for under-utilised technologies
- Perform a comprehensive market analysis
- Perform an analysis of barriers

**Develop an appropriate programme structure**

- Select a programme type
- Determine level of commitment from participants
- Determine type of agreement that will be used
- Assess level of resources required
- Design based on customer needs: information, public recognition, technical support

**Develop a communications/marketing strategy**

- Identify the market
- Identify appropriate messages to convey
- Create supporting materials
- Sell the idea to prospects

**Collect and measure results**

- Clarify programme goals and objectives
- Identify information required to assess progress toward goals
- Determine data collection technique

*The preceding chapters have described voluntary programmes and how they can be used in strategies to reduce greenhouse gas emissions. They are an introduction to some of the principles of designing a policy that relies on voluntary co-operation, but are not intended to be a rigorous or comprehensive analysis of all voluntary programmes. It is hoped that this document may instead lay a foundation for understanding the strengths and challenges of voluntary programmes as a policy approach, and provide some practical guidelines for those interested in developing them.*

*The examples of programmes and industry achievements included in the appendices will share some of the practical experiences of programme developers and industries making improvements around the globe. While limited in number, these examples demonstrate the broad scope of technological opportunities and market-based programmes that can be successful. They are not meant necessarily to be examples to replicate, but rather to provide an overview of a wide range of successful programme strategies.*

APPENDIX A

# Appendix A:

# Voluntary Programme Case Studies

Hundreds of voluntary programmes around the world are successfully reducing greenhouse gas (GHG) emissions while increasing the competitiveness and efficiency of businesses and individuals in the countries in which they operate. The International Energy Agency (IEA) has identified more than 350 governmental voluntary approaches in operation today (IEA, 1997). These programmes do not only exist to reduce GHGs. In fact, many have the primary goal of increasing the competitiveness of industry or reducing energy use and reliance on foreign energy supplies.

The voluntary programmes in action today vary greatly in their objectives, targeted sectors, participants, and commitments. Collectively, they have demonstrated success in nearly every economic climate and in every type of sector. In this appendix, a selection of these programmes has been chosen to demonstrate the wide variety of successful programmes and the lessons learned from their implementation. These are only a limited sampling of the many successful programmes around the world. They were chosen to include:

- government and private-sector programmes;
- developing and industrialised countries;
- commercial, industrial, energy supply, and residential sectors;
- a variety of programme types; and
- a variety of technological opportunities.

The table that follows is a summary of the programme examples included in this appendix.

# Summary of Voluntary Programme Case Studies

| | Sector | Programme Type | Programme Name |
|---|---|---|---|
| 1 | Commercial/ Institutional | Technology Upgrade | ENERGY STAR® Buildings/ Green Lights® |
| (box) | Commercial/ Institutional | Technology Upgrade | Green Buildings for Africa |
| (box) | Commercial/ Institutional | Government Technology Initiative | China Green Lights |
| 2 | Electricity Generation/ Energy Supply | Technology Upgrade | Energy 21: Wind Power Initiatives |
| 3 | Solid Waste Management | Outreach | Landfill Methane Outreach Program |
| 4 | Industrial | Voluntary Challenge | Long Term Agreements on Energy Efficiency Improvement |
| (box) | Industrial | Voluntary Challenge | French Glass Packaging Agreement |
| 5 | Industrial | Voluntary Challenge | Canadian Industry Programme for Energy Conservation |
| (box) | Industrial | Voluntary Challenge and Reporting & Monitoring | Industrial Energy Efficiency Network |
| 6 | Industrial | Voluntary Challenge and Reporting & Monitoring | Greenhouse Challenge |
| 7 | Residential/ Consumer Products | Product Promotion | Polish Efficient Lighting Project |
| (box) | Residential/ Consumer Products | Labelling | Ilumex |
| 8 | Residential/ Consumer Products | Labelling/ Promotion to Manufacturers | Fluorescent Tube Programme |
| 9 | Residential/ Consumer Products | Labelling | PROCEL - Accord with Manufacturers |
| 10 | Industrial | Labelling | ENERGY STAR® Office Equipment Program |

# APPENDIX A

| Country | Sponsor | Technology/ Opportunity |
|---|---|---|
| United States | Government | Energy-efficient lighting and HVAC |
| South Africa | CSIR (scientific R&D organisation) | Energy-efficient lighting and HVAC |
| China | Government and UNDP | Energy-efficient lighting |
| Denmark | Government | Wind turbines (including off-shore) |
| United States | Government | Landfill methane capture & use as energy source |
| Netherlands | Government | Energy efficiency |
| France | Government | $CO_2$ reduction measures, reducing packaging, and recycling |
| Canada | Government | Energy efficiency and other measures |
| Norway | Government | Energy efficiency |
| Australia | Government (w/ industry initiative) | Energy efficiency and other measures |
| Poland | IFC and GEF | Compact Fluorescent Lighting (CFL) |
| Mexico | Government and GEF | Compact Fluorescent Lighting (CFL) |
| Thailand | Electricity Generating Authority of Thailand (EGAT) | Efficient fluorescent tube lighting |
| Brazil | Electrobras (national utility holding and co-ordinating company) | Energy-efficient refrigerators and freezers |
| United States, Japan, Thailand, Australia | Governments | Energy-efficient office equipment (computers, printers, fax machines, and copiers) |

# ENERGY STAR® Buildings and Green Lights®

## Programme Overview

In 1991, the US Environmental Protection Agency (EPA) introduced Green Lights® as a part of the United States' commitment to reduce greenhouse gas (GHG) emissions under the Climate Change Action Plan. The programme encouraged companies and other organisations to reduce energy use by upgrading lighting to energy-efficient technologies in all of their facilities across the country. However, it did not ask for sacrifice; organisations were encouraged to upgrade only where it was cost effective and maintained lighting quality. The programme offered technical information and public recognition to support the efforts of participants.

Initial estimates were that lighting energy use could be reduced by 50-75 per cent through such upgrades. Some participants achieved cost-effective energy reductions of as much as 60 per cent. Based on the success of Green Lights, EPA introduced ENERGY STAR® Buildings (ESB) in 1994 to encourage efficiency in all commercial building systems, including lighting; heating, ventilation, and air conditioning (HVAC); and office equipment. The programmes are now combined as ENERGY STAR Buildings and Green Lights.

## Opportunities and Barriers

In 1990, lighting accounted for 30 per cent of total electricity use in a typical office building in the United States. Inefficient lighting was common, although reliable, high-quality, efficient lighting technologies had been on the market for several years. For example, energy saving 32-watt "T-8" fluorescent lamps and electronic ballasts can reduce electricity use by up to 30 per cent while improving lighting quality. Motion sensors can automatically turn off lights when rooms are vacant, and compact fluorescent task lights can reduce electricity use by 80 per cent when used instead of their incandescent counterparts.

In addition, better lighting design and maintenance could better target correct light levels to the task being performed while reducing energy use. In total building energy use, the opportunities were even greater, including improved insulation and building maintenance, better energy management systems, energy-efficient office equipment, and more efficient fans, motors, and chillers. EPA estimates that most buildings can reduce energy use by as much as 30 per cent through technology upgrades that provide a 20 per cent or greater return on investment through reduced energy costs.

These technologies represented a significant opportunity for improved energy efficiency, but were not widely used. The principal barrier to implementing efficient lighting and building technologies was inadequate information–many facility managers were not fully aware of available technologies, or lacked confidence in claims made

CASE STUDY

# A1

**COUNTRY**
United States

**SECTOR**
Commercial/
Institutional/Industrial

**PROGRAMME TYPE**
Technology Upgrade:
commercial building upgrades
to improve energy efficiency

**DATE FOUNDED**
1991

**PARTICIPATION LEVEL**
2,487 organisations, committing 510 million square meters of facility space to be upgraded (approximately 10 per cent of the national total)

**ESTIMATED ANNUAL COST SAVINGS TO PARTICIPANTS**
US$ 334 million

**ESTIMATED ANNUAL GHG EMISSIONS REDUCTIONS**
0.8 million metric tons of carbon equivalent (the equivalent of removing 634,000 cars from the roads)

**PROGRAMME FUNDING SOURCE**
US Environmental Protection Agency (EPA)

**PROGRAMME AND ADMINISTRATIVE COSTS**
US$ 10,000,000 annually

by vendors. Even if facility managers were convinced of the opportunity, information about the potential for cost savings and pollution prevention often failed to reach administrative decision-makers. Another barrier to implementation of these opportunities was the low priority typically given to energy use. In many office environments, energy use may be less than 1 per cent of total operating costs, and is often overlooked when cost-cutting opportunities are identified. A final barrier was the high first cost of efficient technologies. The new equipment often was more expensive than conventional technologies, even though the energy savings made it very cost-effective in the long run.

## Goal

The original pollution prevention goal of Green Lights was to reduce GHG emissions by 5 million metric tons of carbon equivalent annually by the year 2000. With additional pollution prevention gains through ENERGY STAR Buildings efforts, EPA hopes to reduce US GHG emissions by an additional 3.1 million metric tons. The programme is aimed at market transformation, so that energy efficient technologies (and decision-making based on life-cycle costs, rather than initial costs) will become the standard of the future marketplace.

## Programme Structure

To join the programme, companies and other organisations sign a Memorandum of Understanding (MOU) with EPA in which they commit to upgrade all of their facilities across the country to efficient technologies, wherever those upgrades are cost-effective and maintain quality. An organisation can either join Green Lights and agree to complete lighting upgrades within 5 years, or join ESB and agree to complete building-wide upgrades within 7 years. To support these commitments, EPA provides technical assistance and public recognition to participants.

The programme is targeted at companies, hospitals, schools, state and local governments, and other organisations of all sizes. The majority of programme members are *Partners*, organisations of any type that agree to implement efficient technologies in all of their US facilities. Companies in the energy industry (utilities, manufacturers, suppliers, and contractors) join as *Allies* and commit to upgrade their own facilities as well as promote energy efficiency to their customers.

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## Motivation for Participation

**Lower costs.**
By making the upgrades recommended by the programme, participants save money on their utility bills. Since efficient technologies are often more durable, especially in lighting, participants also save in replacement costs.

**Improved comfort and quality.**
Both ESB and Green Lights help participants select and use efficient products to enhance the comfort of a building, by avoiding extremes of temperature and light levels.

**Technical assistance and training.**
Participants receive one-on-one technical support from an assigned Account Manager and a programme services hotline. Through these resources, participants can obtain information on lighting and building technologies, software programmes to assist in upgrade planning, and case studies detailing the successes of other participants. EPA also offers free training workshops around the country which provide a basic understanding of energy-efficient technologies and address topics such as new lighting and building advances and financing options for upgrade projects.

**Public recognition.**
EPA has developed a public recognition campaign for the ENERGY STAR Buildings and Green Lights programme, which incorporates advertisements, a recognisable logo for participant use, and public service announcements highlighting successful partners. The annual awards competition promotes participants' achievements through national acknowledgement.

## Results

As of August 1997, over 2,400 Green Lights participants had upgraded 175 million square meters of facility space, reducing electricity usage by 4.5 billion kWh per year and saving US$ 334 million annually. The overall level of energy savings is projected to reduce atmospheric pollution by more than 800,000 metric tons of carbon equivalent. More than 300 companies have been recruited into the ENERGY STAR Buildings programme to date; since the programme is in its early stages, the savings have yet to be compiled. Overall, the average energy savings from lighting upgrades has been more than 40 per cent, and the average energy savings from complete building upgrades has been 26 per cent.

## Relevance to Other Countries

These technologies are likely to be viable and cost-effective opportunities in many other countries, especially in urban areas and office environments.

## Future Directions

Recruiting efforts continue to bring Green Lights participants under the more comprehensive focus of ESB. ENERGY STAR Buildings is also expanding its scope; programmes to address the specific needs of private homes, small businesses, and real estate management firms are currently being developed.

# Lessons Learned

• EPA discovered that participants joined the programme for different reasons. Although the principal motivating factor for most programme participants is cost savings, some participants joined for the technical information and training, the opportunity to network with other partners, and for public recognition.

• A major barrier to efficiency upgrades was convincing the top decision-makers to fund the improvements. EPA found that requiring that the MOU be signed by a top company official was extremely helpful in keeping energy efficiency as a top company priority.

• Rather than being a static programme, ENERGY STAR Buildings and Green Lights has evolved to meet the needs of its partners. Reporting forms have been modified, training topics have changed, and support mechanisms have been phased out or added as required. This ability to evolve has been critical to keeping the programme useful for participants.

# Green Buildings for Africa

The Green Buildings for Africa programme was officially launched in June of 1997 by CSIR, Africa's largest scientific research and development organisation. In part modelled after the ENERGY STAR Buildings programme of the US, Green Buildings for Africa will encourage building owners to voluntarily implement profitable energy-efficiency improvements, minimise damage to the environment, and provide comfortable indoor conditions. The programme also contains elements of the Building Research Establishment Environmental Assessment Method (BREEAM) system of the UK and the Green Building Rating System developed by the United States Green Building Council.

To join the programme, building owners sign a Memorandum of Understanding (MOU) with CSIR that commits them to building upgrades over a three-year period. Participants agree to survey their buildings and analyse the potential for cost-effective upgrades within six months of signing the MOU. They agree to upgrade and improve the energy efficiency of 80 per cent of the building's floor area with cost-effective measures within three years of signing, and are encouraged to purchase office equipment labelled ENERGY STAR.

As part of the programme, participants submit annual reports on their progress. The building can be officially assessed using BEARS, an environmental impact assessment system. Based on the assessment, a classification level is awarded, ranging from fair to excellent.

CSIR provides a variety of support services, including technical and financial guides. Participants also receive public recognition for their environmental improvements. For example, the building owner gains the right to use the Green Buildings for Africa logo for marketing purposes. The top 20 Partners will receive a certificate and be publicised in local newspapers on World Environmental Day.

The programme has just begun. However, CSIR expects that Green Buildings Partners will reduce their total building energy consumption by 30 per cent, on average, over the three-year period.

CASE STUDY
A1

# China Green Lights

Lighting accounts for 10 per cent of total electric power consumption in China. However, low-efficiency products, such as incandescent lamps, dominate China's lighting sector. Efficient lighting products in China are typically of inconsistent quality and have short life spans compared to international standards.

The China Green Lights programme was designed to increase the market penetration of high-quality, efficient lighting goods and services in China. Introduced in 1993 after Chinese officials visited the US Green Lights Lights programme, China Green Lights plans to reduce lighting electricity use in China by 25 per cent by the year 2000. This would reduce $CO_2$ emissions by 7.4 million tons and $SO_2$ emissions by 200,000 tons. The programme is supported by the Chinese Government and the United Nations Development Programme (UNDP). Various government Ministries and Commissions co-operated in its design, organisation and implementation. In 1996, UNDP agreed to provide substantial financial and technical support (US$ 995,000).

The planning stages of the programme are nearly complete, and the implementation phase is just beginning. The programme plans to improve policies and regulations governing energy-efficient lighting products, establish a National Green Lights Information System, and increase quality assurance measures for efficient lighting products. Some of these plans are underway. Under the programme, the Beijing Green Lights Exhibition Centre was established to enhance public awareness of energy conservation. More than 15,000 individuals have already visited it. In November of 1996, participating agencies such as the National Energy Management Standardisation Technical Committee and the China Lighting Society signed sub-contracts with the government to formulate energy-saving standards for building lighting systems, to complete surveys of production enterprises and consumers, to operate the Beijing Green Lights Exhibition Centre, and to research efficient lighting policies and standards.

# Energy 21: Denmark Wind Power Initiatives

## Programme Overview

Denmark is a relatively small country in terms of area, but it has one of the world's highest levels of greenhouse gas (GHG) emissions per capita. Until the oil shocks of the 1970s, the energy sector of this heavily industrialised country was centred around non-renewable, imported fuel sources, a situation which had harmful effects on the environment and posed a threat to Denmark's economic and national security. During the winter of 1973-1974, Denmark was 99 per cent dependent on imported oil products. Through the national energy plans of 1976, 1981, 1990, and 1996, the Danish government has been transforming its energy sector toward diversification of supplies, self sufficiency, and an overall sustainable energy future based on increased energy efficiency and renewable energy.

Denmark's commitment to the environment and sustainable development is strongly reflected in its two most recent energy policies: Energy 2000 and Energy 21. Energy 2000, released in 1990, aimed to reduce $CO_2$ emissions 20 per cent from 1988 levels by the year 2005. Energy 21, which replaced Energy 2000 in the Spring of 1996, goes a step further by committing Denmark to reduce $CO_2$ emissions by 50 per cent before the year 2030. To accomplish these objectives, the Danish government intends to satisfy 12-14 per cent of Denmark's energy demand with renewable energy sources by 2005, and 35 per cent by 2030. Of these renewable sources, wind power is expected to comprise 50 per cent (biomass and solar will comprise the other 50 per cent).

## Opportunities and Barriers

Wind can be used to generate electricity without emitting GHGs. As a renewable resource, it is attractive as a primary energy supply source. The largest barrier to wind power is the higher cost of electricity production as compared to fossil-fuel sources. Currently, IPCC estimates that the present average cost of energy from wind power is US$ 0.10 /kWh (IPCC, 1996). This cost is expected to decline as research into wind power technologies continues.

The Danish programme has overcome financial barriers by offering subsidies; the sharing of costs between the government and the investors has led to more rapid development of wind farms than would otherwise have been possible. Other barriers to wind power include public resistance to the noise of turbines, the visual impact on the landscape, the disturbance to wildlife, and finding suitable sites. Denmark has developed pilot off-shore wind farms that have resulted in increased power generation capacity.

## Goal

Energy 21, Denmark's fourth energy policy, supports the goals of Energy 2000 (i.e., to reduce $CO_2$ emissions 20 per cent from 1988 levels by the year 2005) and also focuses on longer term goals to reduce $CO_2$ emissions by 50 per cent by the year 2030. Specifically, Energy 21 intends to increase the use of renewable energy, increasing the capacity of wind turbines to 1,500 MW by 2005, and to 5,500 MW by 2030.

CASE STUDY

# A2

**COUNTRY**
Denmark

**SECTOR**
Electricity Generation/ Energy Supply

**PROGRAMME TYPE**
Outreach/Technology Upgrade

**DATE FOUNDED**
1986

**PARTICIPATION LEVEL**
Agreements to produce more than 3000 wind turbines

**ESTIMATED ANNUAL GHG EMISSIONS REDUCTIONS**
N/A

**PROGRAMME FUNDING SOURCE**
Ministry of Environment and Energy

## Programme Structure

Energy 21 is administered through the Ministry of Environment and Energy (MEE) and the Danish Energy Agency (DEA), an agency within the Ministry. DEA is responsible for overseeing the development programme for renewable energy and for administering subsidies for development projects, demonstration plants, test stations, centres of expertise, and information activities.

In order to meet the objectives of Energy 21, a number of agreements to construct wind farms have been negotiated between the MEE and Danish electric utility companies as well as private investors. Each agreement is different, based on the project's merits and total costs.

## Motivation for Participation

**Research and development support.** Since the 1970s, the Danish government has been granting financial support to energy sector research and development through the Energy Research Programme (ERP). Energy 2000 and Energy 21 support access to ERP grants for greater research activity in such areas as renewable energy sources.

**Subsidies.**
The Danish government offers various types of subsidies to developers of renewable energy sources including a guaranteed purchase price of 85 per cent of the retail cost of electricity, a rebate of the energy tax, and a rebate of the $CO_2$ tax.

## The Velling Maersk Wind Farm

The Velling Maersk wind farm, owned by VESTKRAFT (a Danish utility) and one of the largest wind farms in Denmark, was part of an agreement between the Ministry of Energy and the Danish utilities to install 100 MW of wind turbine power in Denmark by the end of 1990. The 65 wind turbines at the Velling Maersk wind farm, with a total capacity of 9,985 kW, are situated in an area with excellent wind conditions and are installed to allow unattended operation. By the year 2005, the installed capacity is expected to be 1,500 MW.

The total investment in 1989 for the Velling Maersk wind farm was US$ 12.5 million. The total annual production in 1995 was 21.1 GWh. Compared to the energy production at a traditional coal-fired electricity plant, this production represents annual emissions reductions of about 15,000 metric tons of $CO_2$, 45 metric tons of $SO_2$, and 22 metric tons of $N_2O$.

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## Results

In 1985 Danish wind turbines provided 0.2 per cent of the country's electricity production. By 1995, this share had increased to approximately four per cent. In 1996, Denmark had more than 3,800 wind turbines with a total capacity of about 600 MW. Much of the growth in capacity has been undertaken by electric utilities, which have established about 200 MW in wind farms since 1986. In addition, hundreds of smaller wind farms have been developed by wind power guilds and co-operatives.

For Denmark, producing electricity from large wind turbines has become a cost-effective means by which to reduce $CO_2$ emissions. Wind turbines with a rated power of 500-600 kW are now able to produce electricity at prices that can compete with the most efficient coal-fired power plants. The Danish wind turbine industry is currently the largest in the world. In 1995, the industry generated approximately US$ 522 million in exports and provided more than 9,000 jobs.

## Relevance to Other Countries

The use of wind power will vary in applicability to other countries. Some countries may have the geographic characteristics that are well-suited to wind farms. Except in countries where electricity costs are very high, in the near future it is likely that wind power investments will require subsidies or other financial support.

CASE STUDY
A2

# Off-shore Wind Farm

In June of 1989, ELKRAFT Power Company decided to construct the world's first off-shore wind farm off the coast of the island of Vindeby. The project, which was completed in June of 1991, was prepared as a demonstration. The wind farm consists of 11 wind turbines, sited in two rows, located 1.5-3 km north of the coast.

This demonstration project is now generating electricity on average at the rate of 12 million kWh per year, 20 per cent higher than the production at an equivalent on-shore installation. The table below compares the Vindeby off-shore farm with an average on-shore wind farm.

| | Average on-shore | Vindeby off-shore |
|---|---|---|
| **Investment:** | US$ 6.2 million | US$ 11 million |
| **Yearly production of energy:** | 10 GWh | 12 GWh |
| **Annual depreciation & interest:** | US$ 500,000 | US$ 900,000 |
| **Operation & maintenance:** | US$ 0.006/kWh | US$ 0.012/kWh |
| **Energy price:** | US$ 0.055/kWh | US$ 0.088/kWh |

While the cost of off-shore wind farms is higher than on-shore sites, off-shore options can provide enormous capacity for energy production and the ability to overcome objections to landscape disruptions. Off-shore sites are expected to make a significant contribution to meeting Denmark's demand for energy. The Vindeby project is considered a success for two reasons: it demonstrates that off-shore wind farms are feasible and that the technologies are applicable and not cost-prohibitive.

# Landfill Methane Outreach Program (LMOP)

## Programme Overview

The Landfill Methane Outreach Program (LMOP), launched in 1994 by the US Environmental Protection Agency (EPA), promotes projects that recover methane from landfills for use as an energy source. The programme promotes the projects to electric utilities and encourages them to purchase power generated by methane recovery. The LMOP also assists with individual project development by providing programme participants with technical information, permitting assistance, and analytic tools.

## Opportunities and Barriers

Methane gas ($CH_4$) is produced during the decomposition of landfilled waste. As a greenhouse gas (GHG), $CH_4$ is 21 times more potent than $CO_2$. Landfills are the single largest source of human-generated $CH_4$ emissions in the United States, accounting for 36 per cent of emissions. Although available technologies allow the $CH_4$ emitted from landfills to be captured and used as a fuel source, these technologies have not been widely utilised due to several market barriers. The barriers include the falling price of electricity in the United States (which makes it more difficult to find a buyer for landfill methane-generated electricity), lack of information, and difficulty obtaining the necessary environmental permits.

## Goal

The LMOP was established under the US Climate Change Action Plan with a target of achieving 1.1 million metric tons of reductions in carbon equivalent. This projection assumed that the programme would facilitate profitable projects resulting in the capture of 30 per cent of landfill $CH_4$.

# CASE STUDY A3

**COUNTRY**
United States

**SECTOR**
Solid Waste Management

**PROGRAMME TYPE**
Outreach

**DATE FOUNDED**
1994

**PARTICIPATION LEVEL**
93 Industry Allies, 17 Utility Allies, 19 State Allies, 5 Endorsers

**ESTIMATED ANNUAL GHG EMISSIONS REDUCTIONS**
When fully implemented, the 33 projects assisted by LMOP will result in a 0.33 million metric ton decrease in annual $CH_4$ emissions, or 1.9 million metric tons of carbon equivalent.

**PROGRAMME FUNDING SOURCE**
US Environmental Protection Agency (EPA)

**PROGRAMME AND ADMINISTRATIVE COSTS**
US$ 1.6 million/year

## Programme Structure

Under the LMOP, EPA has established voluntary partnerships with three types of organisations: utilities, state agencies, and companies involved in landfill methane energy recovery projects.

Organisations that sign a Memorandum of Understanding (MOU) with EPA are referred to as *Allies*. The programme has three distinct Ally groups — Utility Allies, State Allies, and Industry Allies — each of which agrees to undertake specific activities (see text box). The programme does not include any formal agreements with individual landfill sites that operate energy recovery projects.

EPA estimates that energy recovery is viable at approximately 700 landfills throughout the US, 150 of which currently have projects in place. EPA has compiled a list of top candidate landfills for the programme. Agency staff actively encourage these landfills to develop methane energy recovery projects. The agency provides potential participants with various forms of assistance, which may include technical information, permitting assistance, and possibly preliminary site assessment work.

The LMOP also works to build public awareness of landfill methane recovery projects. Because energy generated from landfill recovery projects may be more expensive than current wholesale rates, utilities need to identify methods for selling this power to their customers. The LMOP helps utilities establish programmes to sell electricity from energy recovery projects to customers interested in supporting renewable energy sources.

## Motivation for Participation

**Public recognition.**
The programme develops outreach strategies that Allies can use to promote their activities. Allies gain recognition as environmental leaders.

**Permitting assistance.**
At the request of programme Allies, the LMOP provides information about the benefits of projects to state permit writers to facilitate the rapid completion of the permitting process.

**Programme involvement.**
Programme Allies are invited to participate in steering committees to help provide direction for the future activities of the programme, such as suggesting useful documents and other informational tools that the programme could develop.

**Networking.**
Through workshops and programme newsletters, Allies are able to meet other organisations that have expertise or interest in pursuing landfill gas development.

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## Results

Approximately 150 landfills throughout the US already have operational energy recovery projects. As of September 1997, programme Allies have credited the LMOP with assisting 33 projects. When fully implemented, these projects will result in a 0.33 million metric ton decrease in annual $CH_4$ emissions, which is equivalent to 1.9 million metric tons of carbon equivalent.

## Relevance to Other Countries

The profitability of landfill methane recovery projects varies greatly depending on the landfill source, technologies already in place, and the cost of energy. One consideration in planning for methane use is that many countries and regions where natural gas is not used extensively may have limited infrastructure and experience for methane use. However, electricity generation can be a promising option.

CASE STUDY

# A3

## LMOP Allies

**Utility Allies:** Participating utilities agree to consider using energy from landfill methane recovery projects as a fuel source for electricity generation. They are not required to pledge specific targets for purchasing energy from these projects, but instead agree to investigate the feasibility of project involvement and report on these activities. Allies also agree to provide public education on the benefits of landfill methane energy recovery.

**State Allies:** State agencies agree to help increase opportunities for landfill energy recovery projects in their state. They develop a primer describing the procedure required to obtain environmental permits for landfill gas projects. They also create a state Task Force to share information and co-ordinate state activities. Each Task Force presents a workshop to bring together organisations interested in promoting landfill methane energy recovery. Finally, State Allies work with the LMOP to investigate innovative financing and energy purchase options to encourage landfill methane energy recovery projects.

**Industry Allies:** Companies engaged in energy recovery projects, including developers, equipment suppliers, financiers, consultants, and energy purchasers, provide expert assistance to the LMOP. They give the programme specific information about their landfill methane project experience and project development activities, which allows the programme to focus its project facilitation activities at key landfills. They also participate in a committee that assists with ongoing programme development and monitoring.

# Long Term Agreements (LTAs) on Energy Efficiency Improvement

## Programme Overview

Fossil fuels provide most of the energy used to produce electricity in the Netherlands. Promoting energy efficiency is, therefore, an important strategy for reducing national greenhouse gas (GHG) emissions. Because the industrial sector consumes most of the country's electricity, the government has focused on the need to improve the efficiency of energy use at industrial facilities.

The Long Term Agreements (LTA) programme is a partnership between government and industry associations, and some individual companies, to increase energy efficiency. LTAs offer industries the opportunity to design their own plans for achieving efficiency goals, instead of being subject to government regulations.

## Opportunities and Barriers

The LTAs capitalise on a wide variety of opportunities (most involving energy efficiency upgrades) to reduce GHG emissions. Each industrial sector is responsible for identifying opportunities and encouraging their implementation among member companies.

Before the LTAs were introduced, the primary barriers were organisational, informational, and motivational. First, not all industries were organised to implement technological changes throughout their sectors. Second, companies within sectors were not aware of all the opportunities that existed. Third, companies did not always have substantial incentives to implement opportunities or share information with others in their sector.

The LTAs helped overcome these barriers by providing a structure for sector participation and encouraging co-operation among companies to strive for a common goal. Since the entire sector must succeed to receive the incentives of the programme, companies are motivated to ensure their competitors receive information and implement technologies.

## Goal

The Netherlands' *National Environmental Policy Plan* aims to reduce $CO_2$ emissions in the year 2000 by 3-5 per cent from 1989 levels. To help achieve this goal, the government established a 20 per cent energy efficiency improvement target for industry by the year 2000.

## Programme Structure

Under an LTA, the government and the industry association agree on energy efficiency improvement targets for the entire sector. Individual companies within a sector can vary their improvements, as long as the sector-wide goal is achieved. The programme is administered by the Netherlands Agency for Energy and the Environment (Novem), a third party executive agency.

CASE STUDY

# A4

Each participating company is required to develop an Energy Savings Plan, which includes research and development on new technologies as well as projects to implement energy efficiency measures. The government supports a detailed audit of each company's facilities. This helps companies identify cost-effective investments.

Participants report annually to the Ministry of Economic Affairs on their Energy Efficiency Index (EEI), amount of energy purchased, and net primary energy used. The industry association uses the information to create an annual sector monitoring report. An LTA can be terminated if a company fails to develop an Energy Savings Plan or provide an annual monitoring report. If targets are not achieved, the government can introduce additional regulation or modify government subsidies to be less supportive of LTA sectors.

## *Motivation for Participation*

**Reduced administrative burden.**
All industries in the Netherlands are required to have environmental permits. LTA participants receive their permits in a simplified, streamlined manner. In addition, these companies do not have to conform to the energy use standards specified in the permits, as long as they remain in the programme.

**Reduced risk.**
Companies within a sector work together to reach the efficiency target for that sector through information sharing and technology transfer. This helps companies overcome uncertainties about new technologies and share the risks associated with implementing those technologies.

**Subsidies and tax incentives.**
Participating companies receive a tax reduction for investing in specified clean or energy-efficient technologies, as well as accelerated depreciation of energy-saving investments.

## The Energy Efficiency Index (EEI)

LTA achievements are measured using the Energy Efficiency Index (EEI). The EEI compares the amount of energy consumed in a given year to the amount that would have been consumed at the 1989 level of energy efficiency. Therefore, a net increase in production (and consequent increase in total GHG emissions) does not affect the evaluation of a company's performance under an LTA — the target is not an absolute reduction in $CO_2$ emissions, but rather an overall improvement in energy efficiency.

**COUNTRY**
Netherlands

**SECTOR**
Manufacturing industry (primarily)

**PROGRAMME TYPE**
*Voluntary Challenge*

**DATE FOUNDED**
1990; (first agreement signed in May 1992)

**PARTICIPATION LEVEL**
30 LTAs with industry associations, involving about 1000 industrial companies that represent more than 90 per cent of industrial primary energy consumption; 6 LTAs with groups of users in service sectors

**ESTIMATED ANNUAL COST SAVINGS TO PARTICIPANTS**
US$ 700 million each year from the year 2000 onwards; these savings build up gradually over the years 1990-2000

**ESTIMATED ANNUAL GHG EMISSIONS REDUCTIONS**
Estimated 1.9 million metric tons of carbon equivalent in 1995, expected to be 3.8 million metric tons in 2000

**PROGRAMME FUNDING SOURCE**
Dutch Ministry of Economic Affairs

**PROGRAMME AND ADMINISTRATIVE COSTS**
US$ 290 million over the period from 1990-2000

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## Results

The existing LTAs are expected to reduce the amount of $CO_2$ emitted in the year 2000 by 13.8 million metric tons. Expected energy savings from the year 2000 onward for participating companies are estimated at 169 petajoules (PJ) per year. Most sectors are on target to achieve a 20 per cent improvement in energy efficiency by 2000. As of January 1, 1997, the average EEI of 22 industrial LTAs had improved by 10 per cent. However, due to overall increases in production, absolute $CO_2$ emissions of the industrial sector in 1997 had increased by seven per cent over 1990 levels.

# Other Industries LTAs

Individual companies that are not members of an association that has signed an LTA can sign an Other Industries LTA (a company must have a minimum annual energy consumption of 0.1 PJ). Participating companies must submit an energy conservation plan approved by Novem and aim for an *individual* conservation target of 20 per cent by the year 2000 (not a sector target). Philips, a company that manufactures electrical products, has demonstrated notable success with its individual LTA–by 1996, the company had improved energy efficiency in its Dutch plants by 25 per cent and saved a total of US$ 100 million over a seven-year period. The company plans to increase its target for 2000 to 35 per cent, which will produce US$ 28 million per year in energy cost savings.

CASE STUDY
A4

# French Glass Packaging Agreement

Through an initiative of the French Ministry of the Environment, the French glass packaging industry signed a voluntary agreement on February 26, 1997. The agreement commits seven participating companies to make drastic cuts in various forms of pollution. As in the Long Term Agreements, the agreement was signed with the glass packaging industry association, and the targets were established on a sector-wide basis. Under the agreement, which covers the period from 1990-2005, the industry agrees to do the following:

- cut $CO_2$ emissions by 25 per cent per quantity packaged (this suggests a 10 per cent reduction in $CO_2$ emissions by 2005, given the market growth forecasts);

- cut emissions of $NO_x$ by 60 per cent and emissions of $SO_x$ by 65 per cent per quantity packaged;

- produce annual reports on pollution emissions for the communities surrounding manufacturing plants, beginning in 1998;

- lighten glass packaging weight by an average of eight per cent;

- recycle waste generated and reduce the quantity of waste going to landfills by 50 per cent; and

- implement environmental management activities with the eventual goal of bringing all production plants into compliance with the ISO 14000 standard.

The industry and the Ministry of the Environment will jointly evaluate overall progress every three years.

# Canadian Industry Programme for Energy Conservation (CIPEC)

## Programme Overview

In 1975, in response to energy security concerns and rising energy prices, what came to be known as the Canadian Industry Programme for Energy Conservation (CIPEC) was founded jointly by Natural Resources Canada (NRCan) and Canadian industry as one of the first voluntary energy efficiency programmes in the world. The programme was designed to support industrial competitiveness at the sector level through the promotion of energy efficiency and the reduction of fossil-fuel use.

At the Rio Earth Summit in 1992, Canada committed to stabilise net greenhouse gas (GHG) emissions to 1990 levels by the year 2000. In 1995, the Climate Change Voluntary Challenge and Registry (VCR) was developed as a challenge to companies to voluntarily limit GHG emissions, and to provide a public record of organisations' commitments and progress. To support these efforts, CIPEC's mission was redefined "to support industrial competitiveness through the more efficient use of energy and through the economic management of industrial environmental energy efficiency problems."

Programme participation includes 30 associations representing more than 3,000 companies and over 85 per cent of industrial energy use.

In 1995, the Industrial Energy Innovators (IEI) Initiative was established to allow individual companies to make energy efficiency commitments beyond their sector-level commitments. To date, more than 240 industrial companies are participating in the IEI Initiative.

## Opportunities and Barriers

As a voluntary programme, CIPEC capitalises on a wide variety of opportunities to reduce industrial energy use. Each opportunity is sector-specific, ranging from such actions as reducing energy use in pulp and paper manufacturing by increasing the recycled content of newsprint, to energy efficiency process changes in the steel industry.

CIPEC provides a focus for industry to identify energy efficiency barriers and opportunities, to set energy efficiency improvement targets, and to develop and implement strategies to achieve these targets.

CASE STUDY

# A5

**COUNTRY**
Canada

**SECTOR**
Industrial

**PROGRAMME TYPE**
Voluntary Challenge, Reporting & Monitoring

**DATE FOUNDED**
1975

**PARTICIPATION LEVEL**
3000 companies represented by sector-level agreements with 30 associations

**ESTIMATED ANNUAL GHG EMISSIONS REDUCTIONS**
More than 8 million metric tons of carbon equivalent

**PROGRAMME FUNDING SOURCES**
Natural Resources Canada (NRCan) and Industry Representatives

**PROGRAMME AND ADMINISTRATIVE COSTS**
US$ 360,000 in 1994 (NRCan) and US$ 1.1 million (estimated) in-kind support of time and effort by industry representatives

## Goal

CIPEC's mission is "to promote effective voluntary action which enhances industrial energy efficiency and economic performance while participating in meeting Canada's carbon dioxide stabilisation objectives." Through a network of 19 voluntary sector task forces, CIPEC co-ordinates the establishment of energy efficiency targets, and tracks efficiency improvements and emissions reductions to achieve these targets.

## Programme Structure

CIPEC is governed by an Executive Board, comprised of 18 industrial sector CEOs who meet approximately four times a year to set industrial energy efficiency strategy. The strategies are then implemented through the individual sector task forces. The Task Force Council, which represents associations and companies from the key industrial sectors, explores opportunities in energy efficiency and assists individual companies within the sectors.

At the sector level, the appropriate task force develops an energy efficiency improvement target and an action plan to reduce industrial energy use. The task forces also track and report on industrial energy intensity that is based on energy per unit of output data. At the individual company level, IEI participants implement their own action plan for economically viable energy efficiency measures and provide an annual review of their energy efficiency performance.

One of the most important elements of the programme is the data collection and tracking process. Information about industrial energy efficiency and $CO_2$ emission reductions is gathered through both the Industrial Consumption of Energy Survey of Statistics Canada, which collects industrial energy consumption data, and through the Climate Change Voluntary Challenge and Registry (VCR), which records company and association action plans.

CIPEC task forces and NRCan have worked with industry associations, Statistics Canada, and the Canadian Industrial Energy End-Use Data and Analysis Centre to construct a database to track industrial energy use. Reports of energy use are made annually, and the information is published in a report from the CIPEC Executive Board to the Minister of Natural Resources.

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## Motivation for Participation

**Targets and benchmarking.**
Programme participants set energy efficiency targets; encourages action plans to decrease industrial energy use; and
co-ordinates with statistical organisations to track and monitor efficiency improvements and GHG emissions reductions.

**Technical assistance and training.**
The programme provides companies with energy efficiency information; disseminates information on best practices of participant companies; develops training and programme techniques; and prepares case studies and operations manuals.

**Administrative support.**
The programme provides administrative support to the industry sector task forces.

## Results

From 1975 to 1990, 700 companies in the programme reduced energy consumption by 1.6 per cent annually, for a total reduction in energy use of 8 million metric tons of carbon equivalent annually.

Between 1990 and 1994, the CIPEC Annual Report indicates the following additional improvements:

- industry's share of total Canadian energy use fell by 1.25 per cent, even though industrial Gross Domestic Product (GDP) grew by 4.8 per cent;
- industrial energy consumption grew only 3.1 per cent, while total Canadian energy consumption grew by 9.2 per cent;
- industrial energy intensity (industrial energy use divided by industrial GDP) fell by 0.3 per cent;
- industrial $CO_2$ intensity ($CO_2$ emissions divided by industrial GDP) fell by 5.9 per cent, an average of 1.5 per cent a year; and
- $CO_2$ emissions dropped by 1.4 per cent (1,350 kilotons of $CO_2$ were avoided) primarily because of improved energy efficiency and fuel switching from coal to natural gas and biomass. By contrast, Canada's overall emissions increased by 4.7 per cent over this period.

In 1994, industry made a further commitment to the Minister of Natural Resources Canada to reduce its energy intensity by one per cent per year from 1995 to 2000 to achieve 1990 levels of $CO_2$ emissions by the year 2000, providing that average industrial growth does not exceed two per cent per year.

CASE STUDY

A5

# Industrial Energy Efficiency Network (IEEN)

When the Norwegian government made plans to involve industries in a programme to promote energy efficiency, it identified the Canadian Industry Programme for Energy Conservation (CIPEC) as a possible programme model. Representatives from the Norwegian government and Norwegian industrial associations met with CIPEC officials, and in 1989 they established the Industrial Energy Efficiency Network (IEEN).

IEEN incorporated many ideas from CIPEC; the structure, administration, and focus of the two programmes are similar. However, IEEN adopted a more individual company-targeted approach than CIPEC's sector programme, enabling IEEN to provide detailed and specific energy efficiency information for individual companies. CIPEC adopted a similar company-specific approach under its Industrial Energy Innovators Initiative in 1995.

IEEN is financed by the Norwegian Water Resources and Energy Administration. It is run independently under the Operating Agent for Industry and is partially managed by the industry itself through an Executive Committee. The Institute for Energy Technology administers the daily activities of the programme.

Five hundred companies, representing 13 industrial sectors, are members of IEEN. The programme supports its participants by disseminating information about energy efficiency measures to industries and by encouraging the implementation of these measures. Through publications, seminars tailored to individual industries, and energy consultants (who charge a small fee for their services), IEEN provides up-to-date technical data on new technologies. IEEN also compiles statistics for members on specific energy consumption, demonstration projects, and technology studies.

IEEN has demonstrated good sector-wide results in reducing energy consumption thus far in the programme. For instance, energy consumption per unit of product in the fishing industry declined between 1995 and 1996, with some companies realising as much as a 50 per cent decrease in energy consumption. The baking industry reduced energy intensity by 10 per cent between 1994 and 1996. The 13 represented sectors are expected to make additional energy efficiency improvements in the coming years and will add additional companies to the agreements. In addition, IEEN expects to expand the programme to additional industrial sectors.

# Greenhouse Challenge

## Programme Overview

Australian industries prompted the creation of the Greenhouse Challenge programme. The industries were interested in developing jointly with the Australian Commonwealth Government a voluntary co-operative agreement programme to demonstrate their increasing energy efficiency and progress toward achieving greenhouse gas (GHG) emissions reductions. In October of 1995, the Greenhouse Challenge was announced as an important component of Australia's National Greenhouse Response Strategy.

The Greenhouse Challenge promotes cost-effective, voluntary, "no-regrets" actions to reduce GHG emissions through improving energy- and process-efficiency and by enhancing greenhouse sinks. The programme has three main objectives: to maximise industry's contribution to Australia's GHG reduction strategies; to encourage companies to achieve the highest possible energy efficiency standards; and to help companies demonstrate how they are reducing their GHG emissions.

## Opportunities and Barriers

There are a large variety of opportunities for companies to reduce their GHG emissions in Australia. Some companies were successfully implementing these measures, but their efforts were not being recognised. The barriers to further implementation were informational, in that not all companies were aware of the opportunities, and motivational, in that some companies were reluctant to implement changes without a mechanism for tracking industry improvements.

## Goal

The Greenhouse Challenge aims to enlist 200 of the largest GHG emitters/energy consumers and industry associations through co-operative agreements by mid-1999. The Commonwealth also plans to recruit 300 of the country's medium sized emitters to participate through team-based co-operative agreements. No long-term GHG emissions reduction targets are set in the programme.

CASE STUDY

# A6

## Programme Structure

The Greenhouse Challenge is a joint endeavour between the Australian Commonwealth's Departments of Primary Industries and Energy; Industry, Science and Tourism; and Environment, Sport and Territories. The Department of Primary Industries and Energy is responsible for administering the programme. The programme is overseen by a steering committee made up of representatives from the above three governmental departments as well as the Department of Prime Minister and Cabinet. Development of the programme's implementation plan, guidelines and activities are undertaken in consultation with industry. This is achieved through ongoing consultation with companies, industry associations and the Australian Industry Greenhouse Network, a group established by the Business Council of Australia.

Companies that are interested in joining the Greenhouse Challenge submit a letter of intent to the Greenhouse Challenge Office (GCO). After submitting the letter of intent, a company is asked to (1) develop an inventory of emissions for certain reference years; (2) assess opportunities for reductions; (3) estimate the company's probable GHG emissions in the year 2000; (4) officially enrol in the programme by signing a co-operative agreement; (5) develop a system to monitor their future GHG emissions; and (6) make annual reports to the Commonwealth. The co-operative agreement must be signed by the CEO of the company in order to ensure full commitment to the programme.

Information submitted by participants on GHG reductions is consolidated and published in an annual report produced by the GCO. The Commonwealth may independently verify agreement inventories, action plans, and achievements. Although all companies are expected to fulfil all of their action plans, there are no penalties for the companies if they do not.

## Motivation for Participation

**Publicity and awards.**
The GCO hosts a signing ceremony when companies join the programme. The ceremony attracts significant media attention and generates publicity for participating companies. In addition, the programme's annual progress report includes public statements from GCO about industry achievements in improving GHG reduction performance.

**Technical Assistance.**
GCO provides a case worker allocated by sector to assist in the preparation of the agreements and to help companies overcome organisational barriers. GCO also organises technical workshops and disseminates technical material to educate participants about opportunities to reduce GHG emissions. The quarterly *Greenhouse Challenge Update* provides a forum in which companies can receive and exchange information.

## Results

According to preliminary estimates, the 30 companies that have signed co-operative agreements will reduce their aggregate emissions by 4.4 million metric tons of carbon (17 per cent) from baseline expectations were no actions taken by 2000. Moreover, one-third of the companies are expected to reduce emissions below 1995 levels by 2000.

## Relevance to Other Countries

This type of programme could work well for countries that wish to identify and implement voluntary abatement measures in their industrial sectors.

**COUNTRY**
Australia

**SECTOR**
Industrial

**PROGRAMME TYPE**
Voluntary Challenge

**DATE FOUNDED**
October 1995

**PARTICIPATION LEVEL**
133 companies have signed letters of intent, 30 companies and 12 industry associations have signed co-operative agreements

**ESTIMATED ANNUAL GHG EMISSIONS REDUCTIONS**
Actions by the 30 companies and 12 industry associations that have signed co-operative agreements are expected to reduce aggregate emissions by 4.4 million metric tons of carbon from baseline expectations were no actions taken by year 2000

**PROGRAMME FUNDING SOURCE**
Commonwealth Government

**PROGRAMME AND ADMINISTRATIVE COSTS**
US$ 7 million over a four-year period

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# Poland Efficient Lighting Project (PELP)

## Programme Overview

Poland is a major contributor to global greenhouse gas (GHG) emissions. An inefficient energy sector, coupled with heavy reliance upon indigenous supplies of coal, made Poland the world's twelfth largest $CO_2$ emitting nation in 1995. Consequently, Poland suffers from extensive environmental damage, and its total primary energy requirements per unit of gross domestic product are about twice the average of Western Europe. Major energy efficiency opportunities exist in Poland to help lower the cost of providing energy services, reduce pollution, and defer the need for new generation, transmission, and distribution capacity.

In 1992, Philips Lighting Poland (PLP) was launched as a private joint venture between Poland's largest state-owned lighting manufacturer, Polam Pila, and the Netherlands' Philips Lighting B.V., with debt financing from the International Finance Corporation (IFC). The company began manufacturing a variety of lighting products including two lines of compact fluorescent lamps (CFLs), most of which were exported to Western countries. It was recognised that there was a tremendous opportunity to use these and other domestic manufacturers' CFLs in Poland to cost-effectively reduce GHG emissions. The IFC's Technical and Environment Department, with assistance from the International Institute for Energy Conservation (IIEC) and US$ 5 million from the Global Environment Facility (GEF), created the Poland Efficient Lighting Project (PELP) to encourage greater CFL use.

## Opportunities and Barriers

CFLs use less than one fourth the electricity of incandescent lamps for the same light output, and last up to ten times longer. However, in Poland the cost of CFLs was up to 35 times more expensive than incandescent bulbs, a major barrier to consumer purchase. Although the energy savings of the CFLs more than pay for the initial investment, consumers were reluctant to pay the higher price. PELP helped to overcome this barrier by providing subsidies to manufacturers, which lowered the retail costs to consumers.

## Goal

PELP's main goal was to reduce GHG emissions from the Polish electricity sector by stimulating the demand for CFLs.

## Programme Structure

PELP is a market transformation programme that combines financial incentives with market education using a utility demand-side management (DSM) programme template (manufacturers' wholesale cost reduction approach pioneered by Southern California Edison).

The Environment Division of IFC is responsible for managing the implementation of PELP. A local agent, the Netherlands Energy Company B.V. (NECO), administers the project. Netherlands' Energy Efficient Lighting B.V. (NECEL), a subsidiary of NECO with an office in Warsaw, is responsible for the day-to-day administration of PELP. The Polish

# CASE STUDY A7

**COUNTRY**
Poland

**SECTOR**
Residential

**PROGRAMME TYPE**
Labelling and demand-side management

**DATE FOUNDED**
May 1995

**PARTICIPATION LEVEL**
Five lighting manufacturers

**ESTIMATED ELECTRICITY SAVINGS**
694 GWh (cumulative)

**ESTIMATED GHG EMISSIONS REDUCTIONS**
0.19 million metric tons carbon equivalent (cumulative)

**PROGRAMME FUNDING SOURCE**
Global Environment Facility (GEF)

**PROGRAMME AND ADMINISTRATIVE COSTS**
US$ 5 million

Foundation for Energy Efficiency (FEWE) is a major partner of NECEL in carrying out the programme and also participated in PELP's initial design. NECEL and FEWE meet regularly with an Advisory Committee made up of Polish non-government organisations, the National Energy Conservation Agency, Association of Polish Electric Utilities, Polish Power Grid Company, and the Polish Ministry of Foreign Affairs, all of whom have an interest in PELP.

Of the US$ 5 million GEF grant, US$ 2.7 million was spent over a two-year period (1995-1997) on subsidies to reduce the cost of 1.2 million CFLs in the market. CFL manufacturers interested in receiving PELP subsidies had to meet certain basic requirements to be eligible for participation. First, the CFLs had to be substantially manufactured in Poland and meet specified technical standards. Second, the full value of the subsidies had to be passed on in the form of lower wholesale prices. Third, manufacturers had to help ensure that the lower wholesale prices translated into lower CFL retail prices for consumers. This was done by controlling excessive rent capture throughout the distribution chain.

Manufacturers' proposals were evaluated competitively, and NECEL signed contracts with those manufacturers who qualified for subsidies. The contracts entitled manufacturers to apply for a certain amount of subsidies contingent on the quantity of CFLs that they were able to sell at the agreed-upon price. They were also required to provide "proof of performance" documentation. Four manufacturers qualified for the first round of PELP CFL subsidies during the winter of 1995/96, and two manufacturers qualified for the second and final round of subsidies during the winter of 1996/97.

In addition to the CFL subsidy activity, PELP has four other components: (1) a CFL luminaire subsidy programme; (2) a pilot DSM activity; (3) a public education programme; and (4) a monitoring and evaluation activity. The luminaire programme (US$ 505,000) includes a school lighting retrofit programme, a luminaire subsidy initiative, and a voluntary programme to reduce residential peak electricity demand by installing CFLs in three target cities. As far as is known by IFC, this was the first demonstration of the distributed utility concept outside of North America. Peak electricity demand in the target area was reduced by 15 per cent. The public education component of PELP (US$ 570,000) is designed to raise consumer awareness of the economic and environmental benefits associated with the use of CFLs. The PELP logo helps consumers identify energy efficient lighting products. PELPs monitoring and evaluation are carried out by an independent contractor and will consider the market transformation impacts of the overall project.

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## Motivation for Participation

**Manufacturer subsidy.**
Participating manufacturers were eligible to receive subsidies on a competitive basis which translated into lower wholesale prices and ultimately lower retail prices of CFLs. Lower retail prices led to increased sales of the CFLs.

**Education/labelling.**
PELP has been publicised through posters, newspaper articles, and press conferences. Manufacturers are allowed to affix the PELP programme logo to their product.

**Lower consumer prices.**
Consumers benefit from lower retail prices of CFLs and receive the additional financial benefit of lower energy costs for lighting.

**Environmental benefits.**
Environmental non-governmental organizations (NGOs), consumers and other organizations have supported the project due to its environmental benefits.

## Results

Under PELP approximately 1.2 million CFLs were sold over a two-year period from 1995-1997, up 50 per cent from previous sales levels. The PELP CFL subsidy was considered to be a major factor in observed sales increases.

The installation of the CFLs sold under the programme lowered the demand for electricity by 694 GWh in Poland's residential sector and reduced GHG emissions by an estimated 0.19 million metric tons carbon equivalent (total). It is also estimated to reduce bills by US$ 40 million during the life of the installed CFLs and to provide other important local and regional environmental and economic benefits from reduced air pollution. Official results of the PELP programme will be available from IFC in the Fall of 1998.

A GEF Public Project Document that further describes the programme is available from the GEF Secretariat.

## Relevance to Other Countries

CFLs are a basic technology used as an alternative to incandescent lamps. Most other countries could effectively use CFL technology.

# Consumer Awareness and Satisfaction

Preliminary evaluations of PELP suggest that it was very successful in raising consumer awareness of energy efficient lighting products for residential applications. A total of 73.9 per cent of consumers purchasing a PELP-subsidised CFL said that they were "very satisfied" and an additional 24.6 per cent said they were "satisfied" with their purchase. Moreover, after the first lighting season, 79.5 per cent of consumers said that they intend to buy more CFLs in the second lighting season.

CASE STUDY

A7

# Ilumex - Proyecto de Uso Racional de Illuminacion en Mexico

In 1991, officials from Mexico and the US drafted a proposal to the Global Environment Facility (GEF) of the World Bank for a project to reduce $CO_2$ emissions in Mexico through the use of energy efficient technologies. With US$ 23 million in funding from the GEF, the Government of Mexico, the Mexican public utility company Comision Federal de Electricidad (CFE), and the Government of Norway initiated the Ilumex programme in 1994.

Ilumex promotes the replacement of incandescent bulbs with compact fluorescent lamps (CFLs) in Mexican households. CFE implements the programme by providing loans to help its customers purchase CFLs. CFE created a revolving fund that extends credit to customers to buy the CFLs, then permits them to repay the loans over time in their electricity bills. The value of the energy saved by the CFL is consistently larger than the monthly payments, thereby effectively reducing a customer's energy bills. A public information campaign ensures that lamps are installed correctly and households know where to buy them.

CFL sales to customers began in April of 1995, and by the following April the programme had sold 600,000 lamps. By 2000, some 1.8 million CFLs are expected to have been sold under the programme. Overall, the sale of these lamps will result in an estimated annual energy savings of 169 GWh, estimated total fuel savings of 311,000 barrels of oil equivalent, carbon savings of 34,400 tons, $SO_2$ savings of 2,510 tons, and $N_2O$ savings of 205 tons. The programme also permits CFE to avoid the construction of 78 MW of new peak generating capacity. The estimated cost of the programme, including programme execution and evaluation, is US$ 1.64 per CFL lamp.

# Electricity Generating Authority of Thailand (EGAT) Fluorescent Tube Programme

## Programme Overview

Thailand's electricity demand grew rapidly during the 1980s. In response, the Electricity Generating Authority of Thailand (EGAT), a nationally owned corporation that produces and transmits power, created the Demand Side Management Office. This office works to improve energy efficiency through demand-side management (DSM) programmes involving lighting, refrigeration, air conditioning, buildings, and motors. EGAT launched the High-Efficiency Fluorescent Tube Programme as its first DSM programme, because the lighting sector offered a relatively straightforward means to achieve considerable energy savings.

The programme has worked with the five major fluorescent tube manufacturers over a five-year period to convert production of 40-watt "T-12" fluorescent lamps to more efficient 36-watt "T-8" lamps and has encouraged consumers to purchase and use the new products.

## Opportunities and Barriers

Lighting accounts for 20 per cent of Thailand's energy consumption. Before the programme was initiated, 80 per cent of commercial lighting fixtures and 40 per cent of residential fixtures consisted of 40-watt T-12 fluorescent tube lamps. Replacing these lamps with high-efficiency 36-watt T-8 lamps represented an opportunity to make a significant impact on total energy use. However, T-8s were not being produced in Thailand, and the market share of these technologies was low. The primary barriers to developing domestic production were a lack of consumer interest in energy efficiency and a perception that reduced wattage lamps provided dimmer and lower quality light.

## Goal

The Fluorescent Tube Programme planned to convert the production of 40-watt fluorescent tube lamps to 36-watt lamps within a two-year period. EGAT's broad objectives in developing DSM programmes were to demonstrate non-regulatory energy-saving alternatives to reduce fossil-fuel power generation and to encourage other Asian utilities to pursue similar ventures.

## Programme Structure

The government developed this voluntary initiative through close collaboration with manufacturers, since a primary goal was to move away from regulatory measures and toward self-sustaining actions. After extensive negotiations, the government signed a Memorandum of Understanding (MOU) in September of 1993 with the five existing Thai lamp manufacturers. The MOU obligated the manufacturers to convert their production from standard-efficiency T-12 lamps to high-efficiency T-8 lamps.
The increase in production costs of the new lamps was negligible.

The manufacturers were initially reluctant to convert to the new technology because of the public's widespread misconception that T-8 lamps provide lower quality and dimmer light. To overcome these concerns, EGAT agreed to undertake a massive US$ 3.5 million advertising and energy awareness campaign through posters, TV, radio, and newspaper advertisements to dispel false information and highlight the manufacturers' efforts. As part of this campaign, the MOU signing ceremony was televised nationally and was attended by the Thai Prime Minister, the Governor of EGAT, and the presidents of the manufacturing companies.

CASE STUDY

# A8

## Motivation for Participation

**Thai public.**
Consumers reduce their energy use for lighting by 10 per cent. This leads to a cost savings for the consumer and serves the nation's interest by minimising the need to expand power generation and by reducing environmental impact.

**Lamp manufacturers.**
The government-sponsored advertising campaign educates the public about energy efficiency, encourages consumers to use the new lamps, and brings positive publicity to the manufacturers. The programme was dedicated to the revered King Bhumipol and is endorsed by local celebrities in advertisements.

## Results

The Fluorescent Tube Campaign succeeded in creating a complete market transformation of the Thai fluorescent tube industry. In the first 18 months after the campaign was launched, the market share for T-8 lamps increased from 30 per cent to 90 per cent. Since then, 40-watt lamps have become obsolete. An EGAT national survey found that 97 per cent of Thais were aware of the new technology and its benefits as a result of the broad national media campaign.

As of July of 1997, more than 120 million T-8 lamps had been sold in Thailand, resulting in a cumulative demand savings of 109 MW and energy savings of 929 GWh. This electricity reduction also translates into 0.19 million metric tons of carbon equivalent emissions avoided. The economic effects of the campaign were also evident in savings for consumers in their energy bills, with a 10 per cent reduction in energy used for lighting.

## Relevance to Other Countries

Lighting is often an important source of energy consumption in any country, especially in urban areas. By converting to energy-efficient fluorescent lamps, electricity use can be reduced accordingly. EGAT's programme was targeted at manufacturers, which would not be appropriate for countries without domestic lamp production. However, the public awareness campaign EGAT used could be effective everywhere.

## Future Directions

EGAT is also leveraging its experience by promoting low-loss ballasts, a refrigerator and air conditioner labelling programme, and an energy-efficient motors programme.

**COUNTRY**
Thailand

**SECTOR**
Residential/Consumer Products

**PROGRAMME TYPE**
Labelling/Promotion to Manufacturers

**DATE FOUNDED**
1993 (pilot), launched in 1994

**PARTICIPATION LEVEL**
Five major Thai fluorescent tube manufacturers

**ESTIMATED GHG EMISSIONS REDUCTIONS**
Approximately 0.19 million metric tons of carbon equivalent avoided to date

**PROGRAMME FUNDING SOURCE**
Electricity Generating Authority of Thailand

**PROGRAMME AND ADMINISTRATIVE COSTS**
US$ 8.6 million over a five-year period

Appendix A

## Lessons Learned

EGAT found that three elements supported the success of the programme. First, focusing on a commonly-used and straightforward technology made implementation easier. Second, extensive negotiations with manufacturers at the onset led to full co-operation later in converting production facilities. Third, the intense media and public education campaign was critical to encouraging consumers to adopt the new technology.

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# PROCEL - Accord with Manufacturers: Refrigerator and Freezer Project

## Programme Overview

Between 1970 and 1996, annual electricity consumption in Brazil grew at the rate of 7.9 per cent, increasing from 38 TWh to 270 TWh. This situation caused concern about the risk of energy shortages, as demand for power threatened to exceed the supply. To avoid the cost of building additional generating capacity, the government planned instead to reduce the demand for energy.

In 1985, Brazil established a national electricity conservation programme, PROCEL, to help reduce electricity demand. PROCEL is managed by Electrobras, the national utility holding and co-ordinating company. Over the past decade, PROCEL has organised more than 100 projects to improve energy conservation. One of the largest and most successful projects has focused on improving the efficiency of household refrigerators and freezers through a voluntary agreement with the manufacturers.

## Opportunities and Barriers

In 1986, energy-efficient refrigerators and freezers were being manufactured in world markets, but were not being produced in Brazil. The main barrier to production was lack of demand from consumers for efficient products.

## Goal

The programme aimed to reduce the energy consumption of refrigerators and freezers manufactured by each participant by an average of 10 per cent.

## Programme Structure

More than 90 per cent of refrigerators and freezers manufactured in Brazil are produced by four companies. In 1986, these companies signed an accord with PROCEL and INMETRO, a Brazilian standards organisation, to improve the energy efficiency of these products. Under the accord, the manufacturers agreed to reduce the energy consumption of their appliances by an average of 10 per cent. PROCEL is responsible for setting energy consumption standards and testing the new models annually. PROCEL also administers the labelling programme and publicises the efficient models.

The parties to the accord worked together to design the programme and develop strategies to upgrade domestic refrigerator and freezer models to international standards. Ongoing development of the programme is also carried out collaboratively. While there are no legal repercussions if manufacturers do not fulfil their commitments, PROCEL will inform the public about inefficient models and withhold rebates from those models.

# CASE STUDY A9

**COUNTRY**
Brazil

**SECTOR**
Residential/Consumer Products

**PROGRAMME TYPE**
Labelling

**DATE FOUNDED**
PROCEL: 1985; Refrigerator and Freezer Project: 1986

**PARTICIPATION LEVEL**
Four refrigerator and freezer manufacturers

**ESTIMATED ANNUAL ENERGY CONSUMPTION REDUCTIONS**
1,026 GWh per year of electricity savings (one per cent of total national electricity use)

**ESTIMATED ANNUAL GHG EMISSIONS REDUCTIONS**
N/A

**PROGRAMME FUNDING SOURCE**
Electrobras

**PROGRAMME AND ADMINISTRATIVE COSTS**
US$ 1.5 million total from 1986 to 1996

## Motivation for Participation

**International competitiveness.**
The programme helps Brazilian manufacturers improve their energy efficiency standards and compete more effectively both domestically and abroad with efficient international models.

**Publicity.**
In 1995, PROCEL initiated a labelling project that awards a seal of approval to the top-rated refrigerator and freezer models. PROCEL has also done extensive advertising to persuade consumers to buy the new models.

**Rebates.**
During a six-month pilot rebate programme in the city of Manaus, PROCEL provided rebates worth a total of US$ 400,000 to consumers for 6,700 refrigerators and freezers.

## Results

Today there are a total of 15 one-door and 10 two-door energy efficient refrigerator and freezer models manufactured in Brazil. Average energy savings per model reached 90 kWh per year in 1993 — a 15 per cent reduction from the baseline consumption rate for new models in 1985. Some manufacturers have achieved even higher gains, producing models with energy savings of up to 40 per cent. By 1996, average savings per model were expected to reach 135 kWh, resulting in total annual electricity savings of 2,560 GWh. These savings are equivalent to one per cent of national electricity consumption in 1996. PROCEL has estimated that 40 per cent of these reductions can be directly attributed to the programme.

## Relevance to Other Countries

The UNDP has indicated a trend of increasing use of refrigerators and freezers in non-OECD countries (UNDP, 1997), representing a significant opportunity for efficient products.

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# ENERGY STAR® Office Equipment Program

## Programme Overview

The ENERGY STAR® Office Equipment Program is a voluntary partnership effort with the office equipment industry to promote energy-efficient products. These products, which qualify for the ENERGY STAR label, conserve energy when idle by entering a low-power or auto-off mode. The programme has grown to include energy efficiency specifications for computers, monitors, printers, fax machines, copiers, scanners, and multifunction devices.

## Opportunities and Barriers

Office equipment is the fastest growing electric load in the business world. However, energy is often wasted in this area because equipment is left on, even when people are not in their offices or actively using the equipment. Before the ENERGY STAR Office Equipment Program was introduced, equipment models that conserved energy during periods of inactivity were not widely in use, except in cases where energy use was critical (such as battery-operated laptop computers). The primary barrier to production of efficient models was lack of consumer demand. The technology existed, but the relatively inexpensive cost of electricity made energy use a low-priority item and decision-makers lacked awareness of the opportunity to save money by using more efficient office equipment. The ENERGY STAR Office Equipment Program was designed to raise awareness of the significant cumulative cost of wasted energy, encourage consumers to purchase and use energy-efficient products, and to encourage manufacturers to produce energy-efficient products.

## Goal

The programme aims to reduce greenhouse gas emissions by 6 million metric tons carbon equivalent per year in the United States alone by the year 2000. This reduction would be equivalent to removing more than 500,000 cars from the road.

## Programme Structure

Manufacturers participating in the programme agree to produce products that meet US Environmental Protection Agency (EPA) energy efficiency criteria, primarily through adding technology to put the equipment in a low-power state when it is not being used. All product models are self-certified by manufacturers, based on EPA-approved testing methods. When they join the programme, each manufacturer receives an electronic copy of the ENERGY STAR label to include on qualified products and other materials. Manufacturers are also involved in all aspects of the development process for product specifications.

In August of 1997, EPA launched a nation-wide consumer awareness campaign to achieve greater recognition of the ENERGY STAR label and to explain that efficient use of energy protects the environment. Manufacturers have been encouraged to incorporate the campaign into their marketing activities and to provide ENERGY STAR training to all their employees who are involved in the development, marketing, sales, and service of ENERGY STAR-labelled models.

# CASE STUDY A10

**COUNTRY**
United States/International

**SECTOR**
Commercial/Industrial/Residential

**PROGRAMME TYPE**
Labelling

**DATE FOUNDED**
1992

**PARTICIPATION LEVEL**
More than 600 manufacturers and resellers/integrators in the United States and around the world

**ESTIMATED ANNUAL GHG EMISSIONS REDUCTIONS**
N/A

**PROGRAMME FUNDING SOURCE**
US Environmental Protection Agency (EPA)

**PROGRAMME AND ADMINISTRATIVE COSTS**
N/A

## Motivation for Participation

**Market for products.**
In the United States, both the EPA and the manufacturers promote ENERGY STAR-labelled products to consumers through advertising and web sites. The US government has committed to buying only ENERGY STAR-labelled computers, printers, and monitors when they are available and cost no more than comparable products. Since the US government is the largest purchaser of computer equipment in the world, this is a compelling incentive.

**Publicity and awards.**
EPA has presented awards to outstanding participants, which they then use to promote their products. EPA also provides lists of qualifying products to consumers.

## Results

More than 2,000 products bearing the ENERGY STAR label are currently available. Some manufacturers have converted an entire product line (e.g., monitors, printers, or fax machines) to meet the ENERGY STAR guidelines. More than 90 per cent of monitors, printers, and fax machines, approximately 70 per cent of computers, and approximately 70 per cent of black and white copiers meet the ENERGY STAR criteria (Source: Dataquest).

## Future Directions

EPA is working with large organisations to demonstrate that purchasing energy-efficient products is a smart business practice that saves money while also reducing air pollution. In addition, the computer and monitor specifications will be revised to reflect changing technologies in this fast-paced industry.

Based on the success of the ENERGY STAR Office Equipment Program, manufacturers are working with EPA to develop another voluntary programme for televisions and videocassette recorders, which will be launched in January of 1998. Together, EPA and the US Department of Energy (DOE) have already introduced energy efficiency specifications for office equipment, residential heating and cooling equipment, appliances, and other products.

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# International Impact

The ENERGY STAR message and label have been adopted by other countries and appear likely to become an internationally recognised specification for energy efficiency.

Japan: In late 1995, EPA and the Japanese Ministry of International Trade and Industry (MITI) signed an agreement allowing Japan to adopt the ENERGY STAR specifications and label and promote the program to consumers. Since then, MITI and EPA have worked together to develop the ENERGY STAR Scanner and Multifunction Device Programs and to amend the Copier and Computer Program.

European Union (EU): The EU has proposed that EPA, Japan, and the EU enter into an intergovernmental agreement regarding the ENERGY STAR Office Equipment Program. This agreement would allow the EU to also promote the programme to consumers in Europe. This agreement would emulate in many ways the existing programme with Japan.

New Zealand: The Energy Efficiency and Conservation Authority (EECA) endorses the ENERGY STAR Office Equipment Program. The EECA is allowed to use the ENERGY STAR logo to educate consumers about the environmental and financial benefits of ENERGY STAR-labelled office equipment.

Thailand: The Thailand Environment Institute has recently decided to include computers and monitors in its Green Label Programme for Thai consumer products. Manufacturers in the programme must ship products with the power management features activated, which is also a requirement in the ENERGY STAR Office Equipment Program.

Australia: In New South Wales, the Sustainable Energy Development Authority (SEDA) has used ENERGY STAR as a model for developing its office equipment energy efficiency programme.

Other countries: Several other countries have inquired about participating in the ENERGY STAR programme in an effort to encourage energy efficiency in office equipment in their markets.

# Lessons Learned

The ENERGY STAR Office Equipment Program had outstanding success in recruiting virtually all office equipment manufacturers to design and market ENERGY STAR-compliant products. This success can be attributed to working closely with manufacturers before the programme was launched. Office equipment manufacturers met extensively with EPA to discuss the implementation of new and existing technologies to make products more energy-efficient and remove the barriers to their implementation. This co-operation with the manufacturers was critical to understanding the industry and ensuring that the new products were technically and economically feasible. In addition, the programme was able to guarantee a substantial market for the qualifying products. Since the new computers would cost no more than standard technologies, the government and consumers could easily be persuaded to purchase them.

APPENDIX B

# Appendix B:

# Industry Case Studies

The following ten in-depth case studies are of companies engaged in innovative processes to reduce GHG emissions. In some cases, the companies are making improvements as part of a commitment under a voluntary programme. In other cases, they are making unilateral improvements based on their desire to reduce costs or fulfil other company objectives.

These case studies were chosen to demonstrate the range of technologies that are successfully being implemented around the world. In some examples, proprietary information is withheld about technologies or total savings achieved. In general, however, the examples provide a sense of the variety of opportunities available for industries that are among the largest generators of GHGs.

# Summary of Industry Case Studies

| | Sector | Strategy/ Approach | Company Name |
|---|---|---|---|
| 1 | Aluminium & Magnesium Production | Changes in production processes, use of renewable energy | Norsk Hydro |
| 2 | Automobile Manufacturing | Development of new type of engine (and production process improvements) | Mitsubishi Motors Corporation |
| 3 | Water Utility | Biogenic gas by-product used to generate power for on-site use and sale to electricity companies, energy efficiency improvements | Thames Water Utilities Ltd. |
| 4 | Glass Manufacturing | Changes in manufacturing equipment & processes | Pilkington United Kingdom Ltd. |
| 5 | Cotton Textiles Manufacturing | Use of renewable energy sources, heat exchange technologies, and energy conservation | Novotex A/S |
| 6 | Paper & Pulp | Energy efficiency improvements, biofuel use, and wood exchange program with other mills to reduce transport energy use | Mo och Domsjo AB (MoDo) |
| 7 | Cement | Improved cement mixture to reduce energy use, researching ways to minimise $CO_2$ emissions, increased energy efficiency in kilns | Blue Circle Southern Cement Ltd. |
| 8 | Mining Company | Reductions in energy use through new technologies and employee-sponsored initiatives, use of recycled materials, $SO_2$ reductions | Noranda Mining & Exploration Inc. |
| 9 | Oil Industry | Energy-efficient lighting | Mobil Corporation |
| 10 | Pigments and Industrial Gas | Sale of $CO_2$ for use in secondary industries | KRONOS Canada Inc. / Air Liquide Canada Inc. |

# APPENDIX B

| Country | Voluntary Programme Link | Achievements |
|---|---|---|
| Norway | Business Charter for Sustainable Development | Total GHG reductions of 11%, including CF gases and $SF_6$ |
| Japan | Japan's Voluntary Environmental Action Plans | 20% savings in fuel consumption in new engine, additional energy savings in production |
| United Kingdom | UK "Making a Corporate Commitment Campaign" | Energy efficiency improvements of 10%, £6.9 million earned from sale of electricity |
| United Kingdom | Company's own initiative | Since 1960, 80% energy savings & $CO_2$ emissions reduced 75% |
| Denmark | Company's own initiative | Various, including 20% reduction in energy use from heat exchange technologies |
| Sweden | Company's own initiative | Biofuels used for 74% of fuel needs, energy efficiency improvements as much as 60% in some plants, estimated 6,900 tons $CO_2$ reductions through transport savings |
| Australia | Greenhouse Challenge | Various. Reduced energy use in drying kilns by 15% |
| Canada | Company's own commitment and Canadian Climate Change Challenge programme | Energy use reductions of 12%, $SO_2$ significantly reduced |
| United States | US EPA Green Lights® programme | Upgraded 7.4 million square feet of facility space, saving US$ 1.13 million in annual energy costs |
| Canada | Canadian Climate Change Challenge | N/A (just beginning) |

# Norsk Hydro

## Introduction

Norsk Hydro was founded 90 years ago to capitalise on Norway's vast energy resources. One of the group's core activities is light metal production, undertaken by Hydro Aluminium. The breakdown of Hydro Aluminium output is approximately 90 per cent aluminium and 10 per cent magnesium.

Norsk Hydro was the first European company to produce an Environmental Report (1989) and to have it verified (1990). The company made a firm public statement in 1993 on its environmental principles, for which it won an award.

## Goal

Norsk Hydro, the parent company, has made public commitments to continuous improvement and reducing emissions in general.

## Opportunity/Motivation for Participation

Aluminium and magnesium production are big energy users and release extremely potent GHGs. Primary aluminium is produced through a reduction process from its raw material alumina ($Al_2O_3$), a white powder, itself refined from bauxite. The refining and reduction processes are high energy, electrolytic processes that result in the release of significant quantities of several different GHGs.

By making commitments to continuous improvement, the company is achieving cost savings related to reduced fuel consumption and is preparing in advance for possible future regulation.

## Programme Design

The electricity requirement for Hydro's production process comes from hydroelectric power generation which releases no $CO_2$. Additional energy requirements for transportation and production are met using fossil fuels which release the following amounts of $CO_2$:

| | |
|---|---|
| Bauxite mining | 0.2kg $CO_2$ per kg Al |
| Alumina production (refining) | 2.2kg $CO_2$ per kg Al |
| Aluminium production (reduction) | 2.0kg $CO_2$ per kg Al |
| TOTAL emissions | 4.4kg $CO_2$ per kg Al |

Coal-fired power generation would generate an extra 13.4kg of $CO_2$ per kg of aluminium, oil-fired an extra 10.8kg and gas-fired an extra 6.4kg. Across the industry 57 per cent of the electricity used today to produce aluminium worldwide comes from hydroelectric power stations and 33 per cent from coal.

Carbon anodes are consumed during the electrolytic production process, releasing $CO_2$ (included in the 2.0kg tabulated above), carbon tetrafluoride ($CF_4$) and carbon hexafluorethane ($C_2F_6$). The latter are both potent GHGs. One kg of $CF_4$ is equivalent to 5,100kg of $CO_2$ and 1kg of $C_2F_6$ to 10,000kg of $CO_2$ over a hundred-year time span (IPCC, 1995). Although these gases are released only in small quantities across the whole industrial sector, they account for around one per cent of the total man-made (anthropogenic) impact of GHG emissions.

CASE STUDY
# B1

Emissions of greenhouse gases from Hydro's production activities in 1995
***All figures in tonnes of $CO_2$ equivalent (except total metal output)***

| | $CO_2$ | $CF_4$ + $C_2F_6$ | $SF_6$ | Total emissions | Total metal output (tonnes) | Emissions per tonne of metal produced |
|---|---|---|---|---|---|---|
| Aluminium | 1,037,000 | 1,196,000 | 86,000 | 2,319,000 | 606,000 | 3.83 |
| Magnesium | 323,000 | | 1,749,000 | 2,072,000 | 69,600 | 29.77 |
| $GWP_{100yrs}$ factor | 1 | 6,600 | 23,900 | | | |

GWP = Global Warming Potential, factor used for converting the various greenhouse gases into $CO_2$ equivalents (Source: IPCC, 1995).

In addition, sulphur hexaflouride ($SF_6$) is used as a shielding gas in the casting of magnesium and to a lesser extent in the casting of special aluminium alloys. $SF_6$ is an extremely potent GHG, 23,900 times more potent than $CO_2$ (see table above). The company believes that in the near future, release of this gas will become a very serious issue for the industry worldwide.

## Results

Between 1983 and 1990, energy consumption in Hydro's primary aluminium production fell from 15.9 to 15.1 kWh per kilo of aluminium due to increased operating efficiency, process improvements, and technological advances. Based on the total production figures for 1990, this represents 530 million kWh of energy conserved annually, or five per cent of total energy consumption. Hydro's emissions of GHGs from aluminium production in 1995 were roughly 11 per cent lower than in the previous year.

The company's emissions of CF gases produced in the electrolysis process fell by 10 per cent between 1994 and 1995, amounting to a 50 per cent reduction since 1989.

Emissions of $SF_6$ in 1995 were 60 per cent lower than in the previous year.

## Lessons Learned

Hydro Aluminium has initiated a research project, supported by the Royal Norwegian Council for Scientific and Industrial Research (NTNF), to examine which conditions influence the formation of CF gases. Preliminary results suggest that emissions are higher from the older facilities, which make up around 40 per cent of Hydro Aluminium's production capacity in Norway. Emissions from modern production facilities are below 60 grams per tonne of aluminium produced, while the emissions from older facilities are 1,000-3,000 grams per tonne.

## Transferability to Other Countries

To meet the huge energy requirement for aluminium production, countries are likely to find hydroelectric power to be the most viable source of energy under current technology. Adapting existing processes is not as effective in reducing CF gas emissions as implementing new processes in new plants.

## Future Directions

Work is proceeding in all areas to continue to reduce emissions using various production process changes (in the case of $SF_6$ through trials using alternative shielding gases).

**COUNTRY**
Norway

**SECTOR**
Aluminium and magnesium production

**STRATEGY/APPROACH**
$CO_2$ reduction through use of renewable energy, reduction of CF gases and $SF_6$ (sulphur hexaflouride) through changes in the production process

**DATE COMMENCED**
1989

**ESTIMATED ANNUAL COSTS AND COST SAVINGS**
N/A

**CONTRIBUTION TO GHG EMISSIONS REDUCTIONS**
Reductions in 1995 were approximately 11 per cent lower than in the previous year

**FUNDING SOURCE**
Norsk Hydro together with research support from the Royal Norwegian Council for Scientific and Industrial Research (NTNF)

**LINK TO VOLUNTARY PROGRAMME**
Norsk Hydro is a signatory to ICC's "Business Charter for Sustainable Development" and takes part in the European chemical industry's Responsible Care programme.

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# Mitsubishi Motors Corporation

## Introduction

Mitsubishi Motors Corporation, established in 1970, is one of Japan's newest automobile manufacturers. The company produces a full line of automotive products, from 660cc mini cars to passenger cars, light commercial vehicles and heavy-duty trucks and buses. Mitsubishi has around a five per cent share of the global vehicle market and employs more than 28,000 people.

## Goal

Japan's industry-wide Voluntary Environmental Action Plans cross 29 industrial sectors. The Japanese auto manufacturing industry is taking measures which will reduce emissions of GHGs and local air pollution and require less reliance on imported fossil fuel supplies — a goal resulting from the fuel shortage crisis in the 1970s.

## Opportunity/Motivation for Participation

The government has set fuel efficiency targets for large, medium, and small cars. To ensure that no manufacturer gets a competitive advantage by not complying, complex formulas are used so that all manufacturers have to make roughly similar efforts.

The Japanese Ministry of Transport publishes results of manufacturers who do not meet the targets. Being singled out in this way is very undesirable for a Japanese company and thus this strategy ensures compliance. There are no legal penalties for non-compliance. Mitsubishi is also responding to consumer attitudes to respect the environment.

## Programme Design

**Energy efficiency.**
Mitsubishi has developed a new Gasoline Direct Injection engine (GDI) incorporating diesel engine technology but using petroleum fuel. Under optimum driving conditions (steady 120km/hr), a 20 per cent saving in fuel consumption can be achieved over equivalent conventional petrol engines. Savings fall with increasing speed, with loss of advantage at around 200km/hr. In addition to greater fuel efficiency, the GDI engine also runs more smoothly and more quietly than diesel engines.

GDI engines were developed by Mitsubishi in Japan and launched there in August of 1996. The new engine was launched in Europe in October of 1997.

GDI engines combine a series of different technological developments. The main advance over current petrol engines is that a fuel/air mixture is injected directly into the combustion chamber of the cylinder instead of into the intake portion via computer-controlled engine management. A new 'swirl' fuel injector has been designed to cope with the high cylinder temperatures and to more precisely control the proportion of air and fuel in the mixture, ensuring that no fuel is wasted. Finally a new 'concave-top' piston has been designed to improve the 'tumble' or turbulence dynamics within the cylinder and hence concentrate, and more accurately direct, the fuel spray towards the spark.

# CASE STUDY B2

**COUNTRY**
Japan

**SECTOR**
Automobile manufacturing

**STRATEGY/APPROACH**
Engine redesign, consumer information, and substitution of HFC134a for CFCs

**DATE COMMENCED**
Varies

**ESTIMATED ANNUAL COSTS AND COST SAVINGS**
N/A

**CONTRIBUTION TO GHG EMISSIONS REDUCTIONS**
Various, including 20 per cent reduction in energy use of newly developed engines

**FUNDING SOURCE**
Mitsubishi Motors

**LINK TO VOLUNTARY PROGRAMME**
Japan's Industry-wide Voluntary Environmental Action Plans

**Coolant gases.**
Until recently CFC12 had been the standard coolant used in vehicle air conditioning systems across the industry. It is a potent GHG and a powerful ozone destroyer. To combat ozone destruction it is being replaced by HFC134a, which is harmless to the ozone layer and has only about 40 per cent the greenhouse potential of CFC12. Japanese manufacturers, including Mitsubishi, were the first in the world to introduce the HFC134a air conditioners, and they have completed the switch for all cars manufactured in Japan.

**Information.**
Efforts are also being made to enhance fuel efficiency by labelling to inform customers when they are choosing fuel efficient cars. Mitsubishi's advertising strategy promotes the fuel savings achievable with the GDI engine, appealing to customers who want to both protect the environment and save money. Figures are produced to substantiate the claims, and customers are advised how to adjust their driving habits to optimise fuel efficiency.

## Results

The new engine generates a 20 per cent savings in fuel consumption over equivalent conventional petrol engines under optimum driving conditions (steady 120km/hr).

## Future Directions

The company intends to introduce the new engine into all of its models during the next 20 years. The design will be sold to other manufacturers, and Mitsubishi is confident that it will become the industry norm worldwide in the future. Several other manufacturers are currently developing engines along similar lines, but Mitsubishi is the first to have produced them commercially.

Appendix B

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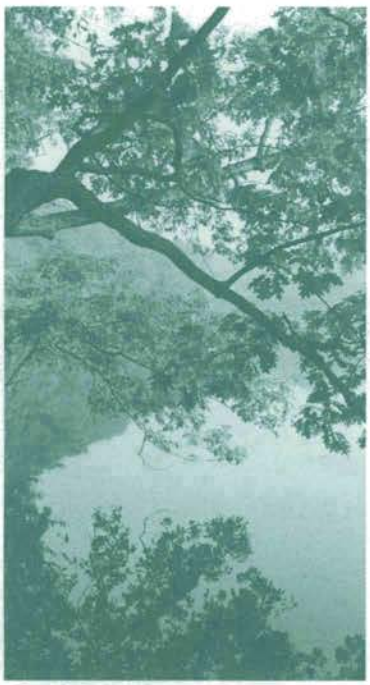
# Thames Water Utilities Limited



## Introduction

Thames Water Utilities Limited is the core water and sewage company of the Thames Water Group, operating in London and the Thames Valley. It supplies drinking water to more than seven million customers and collects and treats sewage from more than 11 million people.

Thames Water recognises that the natural environment is the central element of its business, providing both water supplies for customers and disposal routes for treated sewage. The company is proactively involved in many environmental initiatives such as water conservation (reducing leakage, customer education) and lobbying to reduce the use of pesticides with residues that contaminate water supplies.

The water industry is one of the most regulated industries in the UK. The Environment Agency regulates the company's effluent and waste discharge and water abstraction levels, the Drinking Water Inspectorate monitors water supply quality, and various other regulators are responsible for regulating other elements of its business.

## Goal

Thames Water's energy policy target was to achieve a 10 per cent improvement in energy efficiency by 1996, based on projected levels from its 1992 baseline.

## Opportunity/Motivation for Participation

Thames Water is committed to continuous improvement of its environmental record and published its first Environmental Policy statement in 1991. The company supports a series of environmental initiatives including the environmental campaign 'Going for Green' whose aims are based on Agenda 21. It won eight environmental awards in 1996 for achievements in nature conservation, energy efficiency, effluent quality improvement, aesthetic building design, and community access schemes. In 1992, Thames Water Utilities Limited joined the Department of the Environment's initiative "Making a Corporate Commitment Campaign."

## Programme Design

Combined heat and power (CHP) is generated from methane-rich gas generated from anaerobic digestion of sewage sludge at 23 Thames Water sites.

Half of the total energy generated is used on site to power the digestion process. The other half is sold to regional electricity companies, making more than £6.9 million for the business.

The new technology focuses on recycling the putrescible fraction of municipal solid waste by co-digestion with sewage sludge. First, the biodegradable fraction of household waste is mechanically separated. This is then slurried with sewage sludge and submitted to anaerobic digestion. The output is fertiliser/soil improver and renewable energy. This technology will also help local authorities to meet their 25 per cent recycling target set by the UK government and is seen as a truly sustainable approach to disposal of these organic wastes.

# CASE STUDY B3

**COUNTRY**
United Kingdom

**SECTOR**
UK water utility

**STRATEGY/APPROACH**
Energy savings through use of biogenic gas by-product as heat generator in anaerobic digestion process

**DATE COMMENCED**
N/A

**ESTIMATED ANNUAL COSTS AND COST SAVINGS**
N/A

**CONTRIBUTION TO GHG EMISSIONS REDUCTIONS**
11 per cent reduction through energy efficiency

**FUNDING SOURCE**
Thames Water Utilities Limited

**LINK TO VOLUNTARY PROGRAMME**
UK DOE "Making a Corporate Commitment Campaign"

## Results

Energy efficiency improved by 10.8 per cent by 1994/95 (audited figure) against the 1992 baseline consumption.

ENERGY EFFICIENCY

| Fuel usage | 1994/95 (Gwh) | 1995/96 (Gwh) |
|---|---|---|
| Electricity | 916.9 | 880.3 |
| Gas | 22.1 | 15.9 |
| Fuel oil | 184.7 | 193.2 |
| Kerosene | 0.4 | 0.3 |
| TOTAL | 1,124.1 | 1,089.7 |

RENEWABLE ENERGY GENERATED

| Year | Electricity generated (Gwh) | % increase from 1991/92 baseline |
|---|---|---|
| 1991/92 | 159.8 | N/A |
| 1992/93 | 182.4 | 14.1 % |
| 1993/94 | 205.7 | 28.7 % |
| 1994/95 | 206.5 | 29.2 % |
| 1995/96 | 203.9 | 27.6 % |

In December of 1996, Thames Water was the first water company to be awarded the UK's Energy Accreditation Certificate. This certification is accredited by the Institute of Energy and co-sponsored by the Department of the Environment.

## Transferability to Other Countries

The CHP plant is a fairly transferable technology as long as anaerobic digestion is an appropriate and viable option. The critical factor that would determine the applicability and financial viability of this solution is a sufficiently large and densely concentrated population. This results in a large quantity of sewage being produced in a small area, thereby minimising the high costs of pumping the sewage and producing large quantities of methane gas. In London and the Thames Valley, the 23 sites which have CHP facilities treat waste from 80 per cent of the region's population, whereas an additional 338 smaller sites, which do not have CHP, treat the remaining 20 per cent.

## Future Directions

Thames Water is continuing to develop ways to recover more renewable energy from its sewage treatment processes. A large-scale demonstration plant has been completed at Mogden sewage treatment works. It is designed to double the amount of renewable energy that can be produced at the site.

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# Pilkington United Kingdom Ltd.

## Introduction

Pilkington manufactures flat glass products in 21 countries for the building (52 per cent) and transport (41 per cent) markets with a growing range of products for the solar energy and electronics markets (seven per cent). Sales centres and manufacturing plants are distributed approximately equally between Europe and the rest of the world (North and South America, China, Australia, and New Zealand), with 85 per cent of the group's business outside the UK.

Many of Pilkington's glass products are for the energy efficiency market, including a range of double glazing, solar control, and photovoltaic products. The Pilkington Solar International subsidiary business is currently increasing its production capacity for photovoltaic panels for use on roofs and building facades to generate electricity. This subsidiary won a European Solar prize for the second time for an installation in an Italian research centre. Solar panels are mainly supplied to Europe, US, and Asia.

## Goal

Pilkington aims to continue improvements in energy savings and to encourage the wide expansion of installation of double glazing across the European Union.

## Opportunity/Motivation for Participation

The glass manufacturing industry has always been a large energy user and has a history of constantly improving energy efficiency over the last 150 years. With constantly rising energy prices and a now intensely competitive market, cost savings have been the major motivation for energy efficiency measures.

The industry is very conscious of the fact that, as a big energy user, it is under pressure to reduce its consumption. However, at one of its plants, Pilkington is already approaching the theoretical minimum energy requirement beyond which there is no scope for further reductions.

## Programme Design

There is a theoretical minimum energy input required to liquefy the various silica, aluminium, calcium, sodium, and other oxides that are used in glass production. This is being rapidly approached across the industry through a collection of energy efficiency measures. The majority of these energy efficiency improvements have come about through fuel switching from wood to coal to oil to natural gas. The current level of energy consumption for making glass is only three per cent of that required in 1850, and the amount of heat required to make a tonne of glass has halved over the last 30 years.

# CASE STUDY B4

Today 87 per cent of the energy input is required for two steps in the manufacturing process, a total of 10.39 GJ per tonne of glass. These are:

- the refractory process, requiring high furnace temperatures (1600°C) to melt the raw materials
- the annealing process, which creates flawless glass by gradually reducing temperatures during cooling, requiring a continuing energy input.

## Results

Since 1960, Pilkington has reduced energy consumption by about 80 per cent and has consequently achieved a reduction of $CO_2$ emissions from 1.26 tonnes to around 0.32 tonnes per tonne of glass during this time. At St. Helens in Merseyside, the amount of fuel required to produce a tonne of glass has been reduced by 40 per cent since the current plant was built in the early 1970s. A reduction of 50 per cent is seen as being technically feasible while the theoretical limit is a reduction of 60 per cent, dependant on fixed thermodynamic temperature requirements and the most advanced insulation materials. Simultaneous reductions in $NO_X$ (30 per cent), $SO_X$ (55 per cent), HCl (80 per cent) and $CO_2$ (40 per cent) since 1974 are related to the same energy efficiency measures.

## Lessons Learned

Competition in the glass manufacturing industry is intense, and Pilkington has not released details of its energy efficiency measures into the public domain. In general terms, recent energy efficiency measures have consisted of increasing furnace size, partial redesign of the furnace, and improved furnace insulation using newly advanced and thicker refractory materials. Improvements in the annealing process have included the improved application of proprietary heat recovery technologies.

## Transferability to Other Countries

Pilkington has sold and licensed the 'float process,' which it developed, to manufacturers around the world. Operations are run at similar levels of productivity, quality, energy efficiency, and to some extent environmental standards regardless of location because the plants are built and run according to similar guidelines.

## Future Directions

Pilkington is part of a consortium of European flat glass manufacturers (GEPVP) which has researched the potential benefits of high performance glazing in existing dwellings across the European Union. Results show that if all of the remaining 60 per cent of single glazed dwellings were fitted with double glazing, annual $CO_2$ emissions would be reduced by 94 million tonnes. This is equivalent to 16 per cent of the total $CO_2$ emissions associated with dwellings. Retro-fitting existing dwellings would produce economic benefits as well from reduced energy costs.

**COUNTRY**
UK, Europe, North and South America, China, Australia, and New Zealand

**SECTOR**
Glass manufacturing

**STRATEGY/APPROACH**
Energy savings through changes in manufacturing equipment and processes. Promotion of double-glazing in dwellings.

**DATE COMMENCED**
1974

**ESTIMATED ANNUAL COSTS AND COST SAVINGS**
N/A

**CONTRIBUTION TO GHG EMISSIONS REDUCTIONS**
$NO_x$ (30%), $SO_x$ (55%), and $CO_2$ (40%)

**FUNDING SOURCE**
Pilkington United Kingdom Ltd.

**LINK TO VOLUNTARY PROGRAMME**
Company's own initiative

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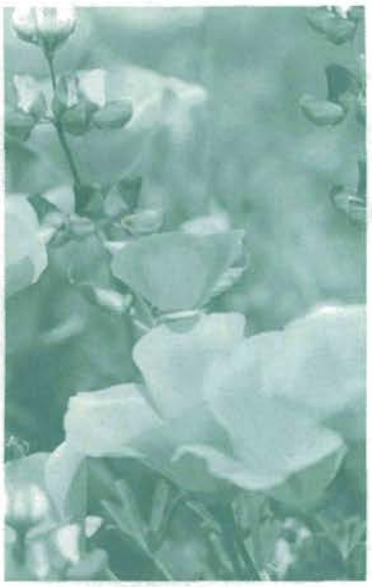

# Novotex A/S

## Introduction

Novotex A/S was founded in 1983 and today has a turnover of DKK 95 million and a staff of around 80 people. It produces cotton fabric, clothing, and other cotton items, most of which are exported.

All the company's final products are made from its intermediate product, Green Cotton, which is produced according to two standards: Green Cotton Organic and Green Cotton Sustainable. Green Cotton Organic is the world's first textile product made from certified organic cotton, grown and certified according to current EEC regulations, Council regulation (EEC) No. 2092/91. Green Cotton Sustainable is the world's first textile product produced according to the Brundtland Commission's definition of sustainability. The cotton is hand-picked, and no chemical exfoliates are used. Every new lot of cotton is tested for its content of pesticide remains. Novotex also requires specific environmental standards to be reached by its suppliers.

## Goal

The company is committed to continued environmental improvement and aims to approach sustainable production in the long term. Its environmental performance to date has been recognised through a variety of international awards including: the American Fashion and Ecology Award in co-operation with UNEP (1994); European Better Environment Awards for Industry —"Green Products" (1988) and "Good Environmental Management Award" (1994); and IFOAM "The International Organic Cotton Prize" (1993).

## Opportunity/Motivation for Participation

Additional motivation comes from very tight Danish government environmental regulations covering all aspects of manufacturing operations. Green taxes have been introduced to control emissions of GHGs and other emissions to water and air and to encourage a move away from heavy fuels and towards natural gas and renewable energy. There is currently some disquiet from industry over the relatively low level of government reinvestment in industry with funds raised from green taxes.

In the textile industry, dye mills are highly energy-intensive, so any energy conservation measures can additionally deliver large cost savings. Novotex says that avoiding green taxation through tight control of its own processes is a voluntary measure that supports its whole philosophy of moving towards sustainable production. The company is guided by the principle that using environmental resources has costs attached which have to be paid either now or later, by this or future generations.

## Programme Design

The company has in place comprehensive environmental management systems applying to all stages of its operations and had its activities and associated services certified according to BS 7750 in 1995.

CASE STUDY
# B5

## Results

**Heat generation.**
Novotex uses only natural gas for primary heat generation in its dyeing mills. It is also committed to increasing its use of renewable energy sources, particularly the use of wood chips. Across large parts of Denmark there is a large surplus of wood from local forest plantations, mainly thinnings made 15 years into the growth cycle. This is due to the collapse of the Swedish market for virgin paper pulp following increases in transport costs.

**Energy recovery.**
Waste water temperatures leaving the dyeing process reach 140°C while fresh water enters the plant at only 9°C. A large proportion of energy is recovered from the hot water using a commercially available heat exchanger. This works by passing outgoing and incoming water flows in close proximity to each other so that energy can switch across from one flow to the other. Transfer is maximised by having a large surface area of the two flows in contact with one another. This is achieved by passing the water three or four times through closely parallel capillary tubes. Novotex estimates it has gained an energy saving of more than 20 per cent from the installation of its heat exchange technology.

**Reducing energy requirements.**
Over the last five years, Novotex has installed commercially available heat controlling technology, called energy equalisers, on its dyeing machines. Equalisers combat or 'equalise' the fluctuating supply of energy from the electricity grid by only accepting the level of power required by the equipment and refusing to absorb any slight surges in supply. This is expected to produce a 20 per cent energy savings.

**Energy conservation.**
All processes involving high temperatures are heavily insulated, thereby cutting down on energy loss through heat radiation. Apart from the obvious incentive of cost savings for the manufacturer, commercial and domestic energy conservation measures are strongly regulated by the Danish government.

## Lessons Learned

Novotex has found that including all staff in decision making on environmental improvements has led to greater sharing of the company's commitment to environmental responsibility. At all levels in the company, great emphasis is placed on an integrated approach to resource use and energy conservation. In its offices and plant, for example, energy savings of up to 50 per cent have been made in lighting requirements by removing one of two bulbs from each unit of strip lights and inserting a reflective strip behind the remaining bulb, resulting in no net change to the light level.

## Transferability to Other Countries

All the measures outlined above are applicable to other countries, with the use of water heat exchangers perhaps delivering the greatest benefits. Novotex's managing director Leif Noergaard strongly feels, however, that it is much more important to consider the needs, resources, and culture of the country in question before applying standard technological solutions. In particular, the potential use of solar and wind energy is enormous in many countries. A combination of renewable energy resources and appropriate technology may well provide the best solution to other countries' needs.

## Future Directions

Novotex will seek to continuously improve its environmental performance in the future. The company will consider using wind energy as a power source in the future as it is seen as an important future source of energy and has a high profile in Denmark.

**COUNTRY**
Denmark

**SECTOR**
Cotton textiles manufacturing

**STRATEGY/APPROACH**
Energy savings through implementing heat exchange technologies

**DATE COMMENCED**
Varies

**ESTIMATED ANNUAL COSTS AND COST SAVINGS**
N/A

**CONTRIBUTION TO GHG EMISSIONS REDUCTIONS**
N/A

**FUNDING SOURCE**
Novotex

**LINK TO VOLUNTARY PROGRAMME**
Company's own initiative

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# Mo och Domsjo AB (MoDo)

## Introduction

Mo och Domsjo AB (MoDo) is one of Sweden's top ten exporters, employing around 7,500 people in Sweden and 2,500 in other parts of Europe. It produces fine paper, wood-containing printing paper, paperboard (which together comprise around 80 per cent of total sales), as well as sawn timber and pulp. The group has its own production facilities in Sweden (eight), France (two), and Great Britain (one), and its main markets are in Europe. The group is involved in all aspects of paper production, and its main raw material, virgin wood, is sustainably harvested from its own forests in Sweden.

## Goal

MoDo began its environmental activities in the 1960s, and the environment has since steadily become one of the most important development areas within the group. Investments of billions of kroners have resulted in a dramatic reduction in emissions of all types to water and air since operations began. Since 1990, the group has published a comprehensive environmental report covering all aspects of its production. Policy statements include the following: "MoDo's business operations will be managed in a manner which ensures the protection of the environment, the efficient use of raw materials and energy, and the promotion of sustainable development." Its intention to achieve sound environmental standards through investment in continuous process improvement is supported by internationally competitive products and healthy profitability.

Environmental auditing has been carried out at least once on all of MoDo's pulp and paper mills, sawmills, and forest regions within Sweden and abroad. In the UK, its Workington production plant complies with the UK's standard BS 7750. Of its Swedish plants, Husum completed the process of certification in accordance with the ISO 14001 environmental management standard in February of 1997, and two others, at Iggesund and Braviken, are now aiming for this standard.

## Opportunity/Motivation for Participation

MoDo sees maintaining a low environmental impact as important to its market position. The achievement of the various environmental management standards gives the company a competitive edge in terms of efficiency and satisfies demand for more sustainably-produced products. Sweden is working towards reducing its reliance on oil for energy production. This is due to a desire to minimise its dependence on oil imports and because of the damaging effects of acidification in Sweden caused by $SO_2$ and $NO_2$ emissions from fossil fuels.

## Programme Design

What makes MoDo stand out in its attempts to reduce $CO_2$ emissions is the broad mix of energy efficiency, biofuel use, and transport efficiency measures that it has taken in addition to a vast range of other environmentally responsible measures incorporated into its production practices. Like the rest of the paper industry, MoDo consumes large amounts of energy to produce pulp and to dry paper, pulp, and sawn timber. It is committed to minimising its use of fossil fuels and consequently reducing emissions of $CO_2$.

## Results

**Increasing use of biofuels– reusing a waste product.**
MoDo publishes the $CO_2$ emissions from each plant and splits the total into $CO_2$ derived from fossil fuels

and from biofuels. Biofuels are $CO_2$ neutral. In 1996 biofuels accounted for around 74 per cent of the group's total fuel requirement for producing heat and electricity. The biofuel comprises mainly by-products of the production process (bark, wood residues, sawdust, and de-inking sludge from the reprocessing of recycled fibres). More than half of the total weight of waste and by-products generated are reused as biofuel. The biofuel is used to produce steam for the paper making process. The steam is at a higher pressure than required so first it is passed through a turbine which produces electricity by reducing the pressure and temperature of the steam (counter-pressure power). Counter-pressure power accounts for 17 per cent of MoDo's electricity requirement. Hydroelectric power generated from power stations run by partnership-financed companies accounts for the remaining 15 per cent of MoDo's additional energy requirements.

**An example of energy efficiency measures in one plant.**
In the early 1990s, MoDo made requests to the Swedish National Franchise Board for Environmental Protection to expand paper production by 60 per cent at a MoDo plant at Braviken. Expansion was agreed to on the basis of no net increases in emissions to water or air. A package of energy efficiency measures was implemented to meet these requirements including: 35 per cent electricity savings using a 50/50 pulp mixture composed of recycled (DIP — de-inked pulp) and virgin (TMP — thermo-mechanical pulp) pulps compared with just using virgin pulp. Using 100 per cent virgin pulp increases the electricity requirement because the pulp is produced by grinding the wood fibres. However, this creates a large amount of heat that can be recovered and then used to heat the pulp in the paper-making process itself, reducing the energy requirement at that stage of the process. The choice of process, in terms of optimum use of energy is not a simple one and is very much based on the energy sources available.

Low-energy equipment on the TMP line saves 15-20 per cent electricity over previous technology. Steam and heat are recovered from burning the waste products derived from pulping the recycled paper using commercially available heat-exchange technology. Fifty per cent of this material is reusable as paper pulp and the other 50 per cent comprises brown liquor and other waste materials. These products are then burnt in a boiler, producing steam that can be converted into electricity if preferred. MoDo's engineers are continuously improving the application of this technology.

**Transport efficiencies.**
Fuel efficiencies in the transportation of raw materials have been maximised over the years as a result of co-operation between Swedish forestry industry companies. Each owns a geographically dispersed mosaic of forest areas, many of which are closer to the production plants of other companies than to its own. To minimise the distance wood is carried between forest and mill, MoDo and two other companies, SCA and Assi Domäin, exchange wood with one another so that wood is generally delivered to the closest production plant. Theoretical reductions in emissions of $CO_2$ equal 6,900 tonnes through reduction in diesel consumption by 2,500,000 litres.

## Lessons Learned

MoDo has found that energy savings are best maximised through the application of a variety of integrated measures and attempts to do this across its whole operation rather than focusing on just the core manufacturing element of its business.

## Transferability to Other Countries

The use of biofuels comprised of waste materials from the production process to generate energy for production has clear applicability in other countries.

## Future Directions

The company is committed to continuously improving its energy efficiency and overall environmental performance in all areas of its business with new emphasis being placed on transport efficiencies.

**COUNTRY**
Sweden

**SECTOR**
Paper and pulp producer

**STRATEGY/APPROACH**
Use of biofuels and energy savings through process and transport efficiencies

**DATE COMMENCED**
1990

**ESTIMATED ANNUAL COSTS AND COST SAVINGS**
N/A

**CONTRIBUTION TO GHG EMISSIONS REDUCTIONS**
Various, including 6,900 tons reduction in $CO_2$ due to transport efficiencies

**FUNDING SOURCE**
MoDo

**LINK TO VOLUNTARY PROGRAMME**
Company's own initiative

**CONTACT INFORMATION**

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# Blue Circle Southern Cement Limited

## Introduction

Blue Circle Southern Cement, owned by Boral, is one of the largest cement manufacturers in Australia. With three plants in New South Wales and one in Victoria, annual production exceeds 2 million tonnes.

The Greenhouse Challenge is a government-led initiative launched two years ago in response to recommendations agreed to at the Earth Summit in Rio, 1992. The cement industry was a particular target for the government because it both is a big energy user and emits large quantities of $CO_2$ as a product of chemical reactions during the production of cement. The programme was set up through negotiations between industry and the government to implement systems and to investigate alternatives to current energy use practices. All of the five major cement companies are signatories.

The programme relies on companies themselves deciding how to achieve reductions in $CO_2$ emissions based on their own particular circumstances and processes. They are free to evaluate opportunities within the boundaries of commercial realities, their internal financial goals, and company policies. The companies report the changes to their processes and outcomes achieved. The national government audits the reports.

## Goal

To reduce energy consumption during cement manufacture and to minimise $CO_2$ emissions released from the manufacturing process itself.

## Opportunity/Motivation for Participation

The cement industry is energy intensive so there are immediate financial benefits to the companies from energy reductions. In addition, it is in the industry's interest to support this approach in preference to the introduction of punitive fiscal measures such as a carbon tax which would increase its vulnerability to competition from Indonesia and China. Emissions reductions are achieved through voluntary arrangements since there are no mandatory targets in the programme.

## Programme Design

Manufacture of cement involves the transformation of limestone and other minerals through the application of large amounts of heat in a kiln. The resulting product, called clinker, is ground and mixed with gypsum to make cement. Fuel is used to heat the kiln and electricity is used to grind the clinker and run fans, motors, and drives.

In the 1960s, the manufacturing system in common use involved processing a slurry of limestone, clay, silicon dioxide, and iron in a wet kiln operating at 1450°C. Subsequently, dry kilns have taken over, resulting in a reduction in fuel consumption by around one third.

The dry kiln cement manufacture involves the following processes:

CASE STUDY
# B7

The ground raw materials are fed into a drying kiln at 300°C, driving off remaining moisture in the clays, shales, or a 'wet' limestone with heat captured from cooling clinker. The dried feed is fed into a pre-calcining kiln at 800-900°C, which drives off $CO_2$ from the limestone (decarbonation) and water from the chemical structure of the clays (dehydroxination). The pre-calciner is used to reduce the carbonate content of the mixture before it enters the main kiln which increases the capacity of the main kiln, reduces radiation losses, and permits more efficient heat transfer. The pre-calcining process uses around 55 per cent of the total fuel requirement of the whole manufacturing process but its introduction as part of the new dry kiln method has reduced overall fuel consumption by 15 per cent.

The decalcined feed is fed into the main rotary kiln where it melts and reacts to form clinker containing calcium silicate, the main component of cement, plus many other compounds. Hot exhaust gases released as the clinker cools are captured and fed back into the drying kiln. The clinker is finally ground with gypsum to produce cement.

Because the amount of $CO_2$ given off from decarbonating limestone during the manufacture is actually greater than that released from burning fossil fuels, any measures to reduce the proportion of limestone in the original feed would reduce $CO_2$ emissions. Blue Circle is developing several approaches to achieve this.

Like all manufacturers, the company is attempting to change the ratio that different calcium silicates form in the clinker. $Ca_3Si$ generally makes up 55-60 per cent of the clinker and $Ca_2Si$ comprises up to 20 per cent. $Ca_2Si$ is the less reactive and needs less lime to make it, resulting in a lowering of $CO_2$ emissions. No company has successfully achieved changing the ratio to date, but it continues to be actively pursued.

## Results

Blue Circle's New South Wales plants have focused on their product mix to achieve energy savings. The plants are now producing a range of cements that incorporate granulated blast furnace slag from iron smelting and pulverised fuel ash coal-fired power stations. Less energy is required to produce a given amount of cement. The amount of slag that can be used in cement is determined by the end performance required. Conventional cements can contain up to 60 per cent slag, which represents dramatic energy savings in cement production.

## Transferability to Other Countries

Since most countries that are making cement are using modern processes, all of the above measures are applicable. Countries in hotter climates often have the advantage that their raw materials are drier which reduces energy consumption.

## Future Directions

The company will continue to experiment with its product mixtures to make further energy savings in the future.

**COUNTRY**
Australia

**SECTOR**
Cement manufacturer

**STRATEGY/APPROACH**
Energy savings from improving cement mixtures

**DATE COMMENCED**
1994

**ESTIMATED ANNUAL COSTS AND COST SAVINGS**
N/A

**CONTRIBUTION TO GHG EMISSIONS REDUCTIONS**
N/A

**FUNDING SOURCE**
Blue Circle Southern Cement Limited

**LINK TO VOLUNTARY PROGRAMME**
The Australian Government's "Greenhouse Challenge"

Appendix B

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Mr. Longman
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# Noranda Mining and Exploration, Inc.

## Introduction

One of the largest zinc producers in the world, Noranda Mining and Exploration Inc., operates five mines and two smelters and owns a major share of Novicourt Inc., a publicly-traded company. Noranda Mining and Exploration has 11 exploration offices in Canada, the United States, and Latin America. The company employs about 2,900 people.

Noranda Metallurgy Inc. is one of the largest refiners of copper and precious metals in the world and an important producer of zinc. The company employs 2,600 people at seven production plants and three commercial offices.

## Goal

Noranda had an internal commitment to achieve a 10 per cent reduction of energy consumption by 1995 from 1990 levels. This was consistent with the Canadian Government's Climate Change Challenge programme, which Noranda supported.

## Opportunity/ Motivation for Participation

Reducing energy consumption is a key factor in a broader commitment, made by Noranda in 1990, to lower operating costs by 10 per cent in real terms. Electricity consumption is a significant concern for Noranda. Although it represents only half of the energy the company uses, it constitutes three-quarters of the company's energy costs. In addition to this economic benefit, reduced consumption of electricity and fossil fuels has an environmental benefit.

## Programme Design

While some of the dramatic reductions in energy use at Noranda have been the result of sophisticated and technically advanced measures, others are simple, ingenious, and the product of employee creativity. Brunswick Mining (a division of Noranda that operates a zinc-lead mine and mill) began to shut off all electrical power to the mine at the end of each work shift. After one minute, power was restored. Vital equipment such as essential fans and pumps were equipped with automatic starters to re-engage them at once. Other, less important equipment, such as auxiliary fans stayed off until the next morning when arriving workers would start them on an as-needed basis.

At a more technically advanced level, Noranda's Horne copper smelter in northwestern Quebec uses recycled materials for up to 15 per cent of the feed ore (the rest coming from virgin ore). An important source of recyclable copper and other valuable metals is electronic equipment (obsolete computers, telephones, televisions, and other telecommunications equipment). Recovering copper from recyclable electronic materials takes much less energy and generates 98 per cent less process waste than using virgin ore. Noranda is also investing $ 53 million in new sulphur fixation technology at the Horne smelter. This process involves capturing $SO_2$ molecules from the flue gases and binding them with other molecules to create a new, benign solid substance. Ultimately, use of recycled copper and fixation of the sulphur from virgin ore will almost totally eliminate $SO_2$ emissions from the site.

# CASE STUDY B8

**COUNTRY**
Canada

**SECTOR**
Mining

**STRATEGY/APPROACH**
Reduced electricity consumption through energy stewardship and the design and implementation of new technology, innovation to reduce $SO_2$

**DATE COMMENCED**
1990

**ESTIMATED ANNUAL COSTS AND COST SAVINGS**
Electricity represents half of the energy that the company uses, and constitutes three-quarters of the company's energy costs. One facility produced savings of $ 250,000 in electrical costs per year. Overall energy consumption was down 12.4 per cent within the first three years of the programme

**CONTRIBUTION TO GHG EMISSIONS REDUCTIONS**
N/A

**LINK TO VOLUNTARY PROGRAMME**
Internal Company Commitment to achieve 10 per cent reduction from 1990 levels by year 1995 through Canadian Climate Change Challenge programme

## Results

The simple steps taken at Brunswick Mining resulted in a saving of $ 250,000 in electricity costs per year. As a result of all energy reduction initiatives at the mine, specific energy consumption was down 12.4 per cent by 1993. In addition, since the recyclable material used contains little to no sulphur, sulphur dioxide ($SO_2$) emissions are significantly reduced.

## Lessons Learned

While Noranda recognises the crucial role of sophisticated technology in reducing energy consumption and will continue to make major investments in this area, it has also found that, in many instances, simple changes in practices or processes requiring little or no financial investment can achieve dramatic results. As well, it has confirmed its belief that employees are an important creative resource.

## Transferability to Other Countries

Using recyclable copper as well as sulphur fixation requires the latest smelting technology. A site with older technology would not be able to take advantage of these approaches. The technology involved requires a major investment, though the payback makes it worth considering.

Obviously, it would make sense for a plant being built from the ground up to put in the latest technology. The recycled portion of the process would require a reliable source of obsolete electronic equipment. Simple ideas that require little or no financial investment should be easily transferable to any country. Whether or not employees are seen as a potential source of ideas would depend on the local culture and management style.

## Future Directions

The major breakthrough in $SO_2$ emissions reduction will be the new converter technology developed by the Noranda Technology Centre, which will allow the smelter to achieve a minimum 70 per cent sulphur fixation by 1998. A second stage of the project will bring the smelter up to a 90 per cent fixation rate by the year 2002.

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# Mobil Corporation

## Introduction

Mobil Corporation is a Fortune 100 company involved in oil and petrochemicals with facilities around the world, including refineries, chemical plants, and service stations.

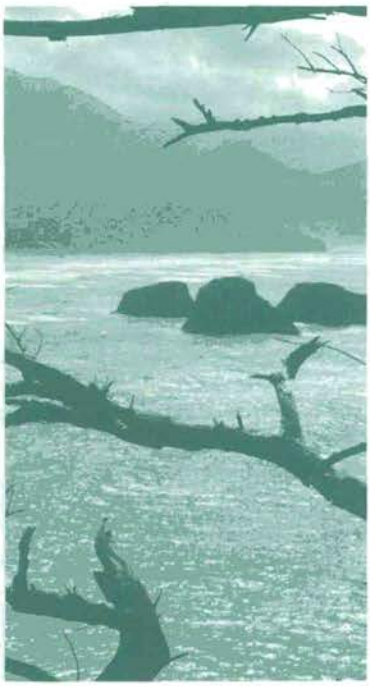
## Goal

Continuous improvement in energy efficiency.

## Opportunity/Motivation for Participation

In 1991, Mobil's facility management network identified the Environmental Protection Agency's (EPA's) Green Lights® programme as a natural fit with the company's own voluntary efforts to provide energy-efficient work environments. The Green Lights programme is a voluntary programme designed to reduce energy consumption through the use of energy-efficient lighting technologies. Following successful testing of the proposed technologies at several Mobil sites, the decision was made to join Green Lights.

Mobil's continued commitment to energy efficiency stems from their philosophy that reductions in energy make both economic and environmental sense.



## Programme Design

Mobil invested US$ 2.17 million in lighting upgrades, upgrading in excess of 7.4 million square feet of building space.

## Results

Mobil successfully completed Green Lights within three years of its commitment to the programme, two years ahead of schedule. The 90 per cent completion target established by the EPA was surpassed in November of 1994. By March of 1995, Mobil had fulfilled its corporate pledge of attaining 100 per cent completion at domestic offices and laboratories. Lighting energy consumption was reduced by 54 per cent, saving US$ 1.13 million in annual energy costs and a discounted cash flow of 51 per cent.

Mobil was recognized for its achievements with receipt of the EPA's first Green Lights "Partner of the Year" award in 1994. In 1995, Mobil was honoured with the EPA's "Sustained Excellence by a Green Lights Partner or Ally" award. The company continues to share the results of its programme and its successes through national advocacy advertising, speaking engagements, site visits, publications, and video tape.

# CASE STUDY B9

**COUNTRY**
United States

**SECTOR**
Oil industry

**STRATEGY/APPROACH**
Energy reduction through energy efficient lighting

**DATE COMMENCED**
1991

**ESTIMATED ANNUAL COSTS AND COST SAVINGS**
US$ 1.13 million in annual energy costs on an initial investment of US$ 2.17 million

**CONTRIBUTION TO GHG EMISSIONS REDUCTIONS**
N/A

**FUNDING SOURCE**
Company resources

**LINK TO VOLUNTARY PROGRAMME**
Green Lights programme (EPA)

## Lessons Learned

The results at Mobil suggest that the private sector has a strong interest in voluntary initiatives that make economic sense and that government can greatly influence private industries by drawing their attention to such potential benefits. For example, an EPA-sponsored workshop was important in helping to turn Mobil managers onto the energy efficiency path. There is also a government role in providing advice and information to companies as they implement programmes. Mobil found EPA "extremely helpful" during the implementation of the Green Lights programme.

In accepting the "Partner of the Year" award in 1994, Mobil's senior vice president, Robert O. Swanson, said: "The EPA's Green Lights programme is an outstanding voluntary initiative to save energy and protect the environment, based on sound business principles that every investment must have an appropriate return. It also proves that co-operation and consultation work better than adversarial and regulatory approaches."

Another lesson learned is that the success of one programme can heighten management awareness and encourage investment in other environmentally-oriented programmes.

## Future Directions

The energy management plan at Mobil is now being extended to all company facilities, and the corporation has also joined the ENERGY STAR® Buildings programme. In 1996, Mobil won an award from the Association of Energy Engineers for its overall energy programme.

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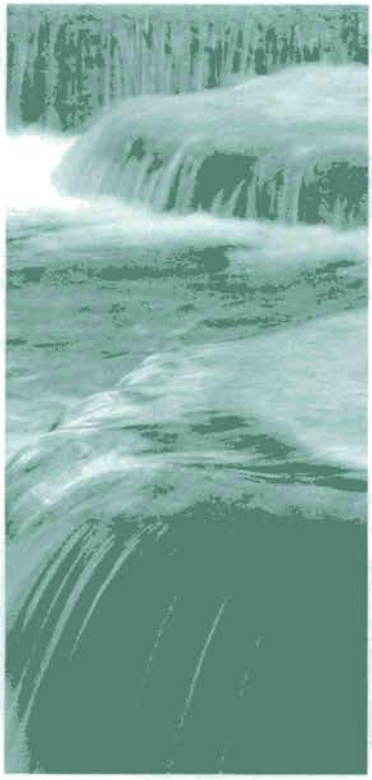
# KRONOS Canada Inc.
# Air Liquide Canada Inc.



## Introduction

In operation since 1936, and located in Varennes since 1957, KRONOS is the only Canadian producer of white titanium dioxide pigments, which are used primarily in paint, paper, and plastic. The company has expanded several times, increasing its production capacity to 71,000 tonnes per year by 1996. The company now employs 425 people. Sales exceeded $150 million in 1995. KRONOS is a division of NL Industries of Houston, Texas, which has six plants throughout the world.

Air Liquide Canada, a long-term partner with Canadian and Quebec industry, is a member of the Air Liquide Group, headed by Air Liquide S.A. of France. Present in over 60 countries on five continents, the Air Liquide group is a world leader in the production of industrial gases, with 1995 consolidated sales in excess of $8.6 billion (Canadian). Air Liquide Canada, which was founded in 1911, employs more than 1,500 people in Canada. The company, which has its head office in Montreal, produces and distributes a complete line of industrial, medical, and specialty gases, as well as welding equipment. Sales exceeded $470 million in 1995.

## Goal

The goal of the effort is to reduce $CO_2$ emissions and provide a useful product for industrial application.

## Programme Design

In an agreement signed in March of 1997, KRONOS Canada will sell $CO_2$ to Air Liquide Canada. Relatively pure $CO_2$ is a by-product generated by KRONOS at Varennes. A pipeline will link the two companies. The gas is used in several industries, such as the agri-food industry, for quick freezing, in the production of soft drinks, and as an effluent treatment.

# CASE STUDY B10

**COUNTRY**
Canada

**SECTOR**
Pigments and industrial gas

**STRATEGY/APPROACH**
Sale of $CO_2$ for use in secondary industries

**DATE COMMENCED**
1997

**ESTIMATED ANNUAL COSTS AND COST SAVINGS**
N/A

**CONTRIBUTION TO GHG EMISSIONS REDUCTIONS**
N/A

**FUNDING SOURCE**
Joint company resources

**LINK TO VOLUNTARY PROGRAMME**
Canadian Climate Change Challenge programme

## Opportunity/Motivation for Participation

The agreement will enable KRONOS Canada to pursue the ambitious programme it initiated several years ago to reduce emissions into both water and air. Emissions into the water were reduced by 99.8 per cent between 1992 and 1995 and those into the air have been reduced by 40 per cent since 1992. It is anticipated that the new recycling programme will significantly reduce $CO_2$ emissions from the Varennes plant. KRONOS will be selling the $CO_2$ to Air Liquide for a nominal price. In addition to helping to meet the Canadian Climate Change Challenge, reducing $CO_2$ and other emissions fits in with the company's commitment to Responsible Care®, a voluntary initiative involving high standards and continuous improvement in the areas of environment, health, and safety.

For Air Liquide, the agreement represents both economic and environmental benefits. It creates a new Quebec supply of $CO_2$ for the company, close to Quebec and Atlantic markets; and it reduces the cost of shipping $CO_2$ which is currently supplied by ALC's plant in Courtright, Ontario. Air Liquide will invest more than $ 4 million to build a $CO_2$ liquefaction and purification plant with a capacity of 75 tonnes per day by September of 1997. This new production capacity will reinforce Air Liquide's leadership in the Quebec and Canadian markets and will optimize ALC's production and distribution facilities in Varennes.

## Results

While this recycling programme is just beginning, significant environmental and economic results are anticipated. A major lesson learned is the importance of partnerships in reducing GHGs, partnerships between government and industry, and within industries.

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APPENDIX C

# Appendix C:

# Glossary of Terms

**Abatement**
Limiting, reducing, avoiding, or sequestering greenhouse gas emissions through source reduction or sink enhancement (abatement measures may not necessarily result in net emission reduction when compounded with changes in production or activity level).

**Annex I Parties**
Countries that are listed in Annex I to the UNFCCC: Australia, Austria, Belarus, Belgium, Bulgaria, Canada, Czechoslovakia (now Czech Republic and Slovakia), Denmark, the EU, Estonia, Finland, France, Germany, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Lithuania, Luxembourg, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Russian Federation, Spain, Sweden, Switzerland, Turkey, Ukraine, United Kingdom, and United States.

**Best Practices**
Measures or processes that represent the highest level of efficiency, based on economic, environmental, or other standards.

**CFL - Compact Fluorescent Lamp**
A small fluorescent lamp that is often used as an alternative to an incandescent lamp; CFLs usually last 8-10 times longer than incandescent lamps (8,000-10,000 hours) and consume approximately 25 per cent of the electricity required by incandescent lamps for comparable lumen output.

**Cogeneration**
The combined production of two derived energy sources from one primary input. For example, using "waste heat" in electricity production.

**Energy Efficiency**
Receiving the same performance from a product or process with less energy input, or receiving higher performance with the same energy input.

**Energy Intensity**
The amount of energy used per unit of activity (energy use divided by unit of production).

**Energy Policy Act, 1992**
A United States Act which requires Federal agencies to reduce energy consumption per gross square foot 20 per cent by the year 2000, compared to 1985 levels. The Act also requires that agencies install energy conservation measures with less than 10 year payback periods, and prohibits new production of certain highly inefficient lamps.

**Environmentally Friendly**
A phrase often used in labelling programmes to help consumers identify products which have a less harmful effect on the environment than competing products in the same category.

**GDP - Gross Domestic Product**
The total output of goods and services produced by labour and capital within a particular country.

**Global Climate Change**
A phenomenon used to describe the altering of the Earth's climate due to an increase in atmospheric concentrations of greenhouse gases from natural and anthropogenic activities.

**GHGs - Greenhouse Gases**
Defined in the UNFCCC as "... those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and re-emit infrared radiation" (Article 1). The GHGs that are affected by human activities include carbon dioxide ($CO_2$), methane ($CH_4$), nitrous oxide ($N_2O$), non-methane volatile organic compounds (NMVOCs), chlorofluorocarbons (CFCs), hydrofluorocarbons (HFCs), and perfluorocompounds (PFCs). Other gases, such as nitrogen oxides ($NO_x$) and carbon monoxide (CO), while not GHGs, are precursors to GHGs.

**GWh - Giga Watt Hour**
The commercial unit of electric energy equivalent to $1x10^9$ watt hours. Can be visualised as the electricity required to power approximately 67 average-sized US homes for one year.

**GWP - Global Warming Potential**
Factor used for converting the various greenhouse gases into $CO_2$ equivalents.

**HVAC**
Heating, Ventilation and Air-Conditioning Systems.

**Market Transformation**
The process of altering market forces from one product towards another (for example, away from incandescent lamps and toward CFLs).

**MOU - Memorandum of Understanding**
A document signed by two or more parties that represents an agreement between them. It may include commitments from the parties, and is a common form of agreement in voluntary programmes.

**No-regrets Policies**
Greenhouse gas abatement policies that have net economic benefits (or at least no net cost) to the economy. Compare to "win-win".

**PJ - Petajoule**
$1 X 10^{15}$ joules (measure of energy).

**Stakeholders**
Parties with an invested interest in a particular company/issue.

**TWh - Tera Watt Hour**
The commercial unit of electric energy equivalent to $1x10^{12}$ watt hours. Can be visualised as the electricity required to power approximately 67,000 average-sized US homes for one year.

**UNFCCC - United Nations Framework Convention on Climate Change**
An international agreement whose ultimate objective is to stabilise greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous human interference with the climate system.

**Voluntary Programme**
An initiative, undertaken by government, industry or another entity, that encourages participants to take a voluntary action with a desirable social outcome.

**Win-Win**
A situation in which both parties of an agreement or transaction achieve benefits; both "win." Contrast to "win-lose" where only one party gains, and "lose-lose" in which both parties suffer losses.

APPENDIX D

# Appendix D:

# Bibliography


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APPENDIX E

# Appendix E:

# International Annotated Resource List

*The resources listed on the following pages were helpful in compiling information for this document. This list is not meant to be a comprehensive listing.*

## *Banks, Funding Agencies, and Development Organisations*

African Development Bank
01 BP 1387 Abidjan 01
Cote d'Ivoire, AFRICA
Tel: +22-52-04-118
Fax: +22-52-04-006

Asian Development Bank
Office of the Environment and Social Development
6 ADB Avenue, 1501 Mandaluyong City
0401 Metro Manila, PHILIPPINES
Tel: +63-28-13-2148
Fax: +63-27-41-7961
http://www.asiandev.org/

GEF Secretariat
1818 H Street, NW
Washington, DC 20433 USA
Tel: +1-202-473-0508
Fax: +1-202-477-0551

Inter-American Development Bank
1300 New York Avenue, NW
Washington, DC 20577 USA
Tel: +1-202-623-1000
Fax: +1-202-623-3096

International Finance Corporation
1850 I (Eye) Street, NW
Washington, DC 20433 USA
Tel: +1-202-477-1234
Fax: +1-202-477-6391

US AID: Office of Energy, Environment and Technology
Ronald Reagan Building,
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Fax: +1-202-216-3230

The World Bank
1818 H Street, NW
Washington, DC 20433 USA
Tel: +1-202- 477-1234
Fax: +1-202-477-6391
http://www.worldbank.org/

## Energy Efficiency Resources

The Alliance to Save Energy
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American Council for an
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Fax: +1-202-429-2248
http://crest.org/aceee

International Energy Agency
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Fax: +33-1-40-57-6559
http://www.iea.org/

International Institute for
Energy Conservation
750 First Street, NE
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Washington, DC 20002 USA
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World Energy Efficiency Association
910 17th Street NW
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Washington, DC 20006 USA
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http://www.weea.org/

## Programme/Government Energy and Environmental Contacts

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Energy Efficiency and
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Wellington, NEW ZEALAND
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European Bank for Reconstruction
and Development
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# APPENDIX E

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# About UNEP Industry and Environment Centre

The United Nations Environment Programme's Industry and Environment Centre (UNEP IE) was established by UNEP in 1975 to bring industry and government together to promote environmentally sound industrial development. The mission of UNEP IE is to "encourage the development and implementation of industrial policies, strategies, technologies and management practices that contribute to sustainable development by making efficient use of natural resources as well as by reducing industrial pollution and risk."

The goals of UNEP IE are to:

- build consensus for preventive environmental protection through cleaner and safer industrial production and consumption;
- help formulate policies and strategies to achieve cleaner and safer production and consumption patterns, and facilitate their implementation;
- define and encourage the incorporation of environmental criteria in industrial production; and
- stimulate the exchange of information on environmentally sound technologies and forms of industrial development.

To achieve these goals, UNEP IE has developed seven work programme areas: Cleaner Production, Safer Production (Awareness and Preparedness for Emergencies at the Local Level — APELL), Industrial Pollution Management, Environmental Technology Assessment (EnTA), Energy, Tourism, and Protection of the Ozone Layer (OzonAction).

UNEP IE organizes conferences and seminars, undertakes training activities and demonstration projects, and produces practical supporting publications, such as the *Industry and Environment* quarterly review and the technical report series, as well as other handbooks and training materials which provide practical information to decision-makers throughout the world. UNEP IE also uses new delivery mechanisms (diskettes, WWW) to render the information more accessible.

UNEP IE develops partnerships with industry, government, non-governmental, and other international organizations and organizes consultative meetings between industry, NGOs and other partners on issues of mutual interest.

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# About the US Environmental Protection Agency

## Atmospheric Pollution Prevention Division

The United States Environmental Protection Agency (US EPA) was created in 1970 to provide leadership in the nation's environmental efforts and a comprehensive approach to environmental planning. The US EPA's mission is to protect human health and to safeguard the environment. The Atmospheric Pollution Prevention Division (APPD) is part of the US EPA's Office of Atmospheric Programs in the Office of Air and Radiation. APPD works with businesses, governments, and consumers to build partnerships that achieve complementary goals of economic growth and environmental protection. The partnerships strive to stimulate demand for energy-efficient products as these products lower energy bills for homes and businesses and prevent needless air pollution from the burning of fossil fuels.

APPD focuses on overcoming the barriers to investing in energy-efficient/low carbon emitting technologies. The Division's programmes are based on agreements (or voluntary contracts) that members sign. By providing clear, reliable and unbiased information, technical guidance and motivation for organisations to invest wisely, APPD's programmes are helping to transform markets by stimulating demand for energy-efficient products.

APPD's programmes currently have over 3,000 partners, have catalysed over $1 billion in energy-efficient investments and have prevented the emissions of six million tons of greenhouse gases (i.e., six million metric tons of carbon equivalent). In 1996, programme partners and consumers had saved over $750 million on their energy bills due to these programmes.

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