OTHER INTERNATIONAL DEVELOPMENTS

Legal Structures in Use for Climate Change Mitigation

by Richard L. Ottinger*

Many legal structures have been successfully used around the world for realizing clean energy solutions for climate change. The legal instruments discussed include economic and market mechanisms, standards, utility programmes and regulatory requirements, government-sponsored programmes, voluntary programmes and financing mechanisms.

A remarkably large number of successful programmes to significantly reduce greenhouse gas emissions have been undertaken, by countries large and small, industrial and developing, as well as by municipalities, businesses and non-profit institutions. Indeed, many developing countries have undertaken more far-reaching programmes than the industrialized countries, achieving greater emissions reductions.

Getting the Prices Right

Subsidy removal. By far the most significant economic measure for alleviating carbon dioxide emissions is removal of fossil fuel subsidies. Subsidy removal not only is a costless measure, but by definition, it is a revenue-enhancing one. In many countries fossil fuel subsidies amount to tens or more millions of dollars. Global annual energy subsidies were estimated at about $250-300 billion in the mid-1990s, and that does not count the huge US subsidies required to secure the supply of oil. Revenues saved from the removal of subsidies can be used to promote clean energy alternatives internally.

The problem in achieving subsidy removal is political – recipients of subsidies are usually large, politically powerful enterprises. They get addicted to the subsidies and feel they cannot survive without them. But these subsidies encourage an increased use of fossil fuels and discourage the use of clean alternatives by making them less economically competitive. The political difficulties of eliminating subsidies and the transition problems for local economies in fossil-producing countries cannot be minimized. Nevertheless, countries such as Brazil, China, the Czech Republic, India, the Netherlands, Poland, the USSR and the UK have reduced or eliminated fossil subsidies successfully.

Thus, between 1990 and 1997, annual fossil fuel subsidies in China were reduced from $24.5 billion to just $10 billion. Poland has decreased its fossil fuel subsidies by $3 billion per year, resulting in an overall 30 per cent decrease in the amount of coal used between 1987 and 1994. Since 1990, the USSR has lowered fuel subsidies by more than 50 per cent, decreasing its carbon emissions by 30 per cent. The UK decreased coal subsidies from $7 billion in 1989 to zero in 1995.

Eliminating fossil subsidies really is a *sine qua non* of reducing carbon dioxide emissions.

Externalities. A legislative or regulatory requirement for consideration of externality costs can materially promote clean energy use. When the costs of fossil fuel use are compared to the costs of clean energy resources, the costs to society from fossil fuel emissions are generally ignored, thus effectively placing a zero value on these costs. Numerous studies have now shown that these external costs are substantial, especially with respect to the increased threat to human health and early mortality. Some of these studies calculate that the externality costs of burning coal for electricity can be greater than the generation costs. No accurate assessment can be made of the comparative costs of clean energy without including externality costs.

Life cycle costing. Another economic measure important for promoting clean energy is the use of life cycle costing. The costs of introducing clean energy resources often entail substantial first cost investments, but the savings over the life of these resources make them cheaper over time than fossil fuel alternatives. This phenomenon is particularly evident with efficiency measures and with solar, hydroelectric and wind energy resources. The first cost of equipment acquisition for these resources can be considerable, but the total absence of fuel costs and very low maintenance costs result in their being much more economically competitive than fossil fuels over their anticipated lifetime. The costs of fossil fuels should always be compared to efficiency and renewable resource costs on a life cycle basis.

Economic Measures

Pollution taxes. Taxing pollutants or polluting fuels can be an effective way of promoting emission reductions in the marketplace. Such taxes make the polluters pay the externality costs of the damages to society from their pollution. They raise the price of emissions-intensive processes and goods and lower profits for fossil fuel use, thus allowing market forces to reduce emissions.

Taxation of carbon dioxide emissions or polluting fuels is one of the most direct ways of addressing global warming and raising revenues for clean energy. Carbon taxes have been imposed in Brazil, Denmark, Finland,

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Italy, Latvia, Lithuania and Sweden. Pollution taxes are politically difficult since inevitably some energy-intensive industries and jobs are affected and adverse competitive effects are feared. However, If the pollution taxes are offset by reductions in other business taxes, they can produce a net economic benefit. The competitive effects of carbon taxes can be ameliorated with border tariffs and rebates.

Emissions trading. An interesting innovation in reducing the costs of sulphur dioxide and No_x emissions in the US has been to provide for emission trading rights. Polluters may accumulate trading rights by reducing their emissions below adopted standards and then sell these rights to other polluters for whom pollution reduction is more expensive. The advantage of emission trading rights over pollution tax is that the pollution cap underlying trading rights assures specified carbon dioxide emission reductions, whereas the emissions reductions from taxes are somewhat speculative. The Norwegian government, therefore, has just decided to consider replacing its carbon tax, which has not resulted in sufficient carbon reduction to meet its goals, with an emissions cap and emission trading rights. Some environmental groups object to the grant of a legal right to pollute. International emission trading rights for carbon dioxide are now being debated as a means of reducing the costs of climate change mitigation measures in the Kyoto Protocol conferences of the parties' negotiations.

Technology subsidies. Enactment of temporary subsidies to introduce new technologies into the marketplace has been used effectively in many countries. While long-term subsidization of any fuel, technology or product distorts the market and is therefore theoretically undesirable, temporary subsidies to bring new technologies into the marketplace can be effective to accelerate their market acceptance. Also, where fossil fuel subsidies persist, non-fossil fuel subsidies are justifiable to level the playing field for them.

Standards

Standards are a particularly effective way of assuring that emission reductions will be achieved. Countries have adopted very effective standards for emissions of pollutants, for the energy efficiency of buildings and appliances and for emissions and miles per gallon (mpg) performance of vehicles. Standards require minimal government outlays (for monitoring and enforcement), but they may result in increased costs for the goods involved; though these cost increases have proved to be inconsequential.

Pollution standards. Legislated standards for air polluting emissions from power plants and exhaust emissions from vehicles can be very effective in promoting clean energy. The US (through its Clean Air Act), most European countries and many developing countries have already adopted such standards. Legislated standards for electric power plant and industrial emissions have proven effective; while they are usually addressed to sulphur and nitrogen oxide emissions, there are resultant reductions in carbon dioxide emissions. Vehicle pollution standards place numerical limits on exhaust emissions. These standards account for environmental externalities. By making it more expensive to use fossil fuels, they encourage the use of cleaner alternatives. Of course, the standards also reduce the health, mortality and environmental effects of air pollutants, so there is a double dividend. The costs in terms of more expensive electricity, industrial products or vehicles have been slight.

Building codes. Most countries have adopted standards for the construction of new buildings. Many have now included energy requirements in these building standards. All the International Energy Agency (IEA) countries have energy requirements as a part of their building codes. Experience in the US has shown that building codes can reduce space conditioning energy use in new buildings by 25 per cent or more.

Existing buildings account for approximately two-thirds of the energy used in the buildings sector. Emissions from existing buildings can also be substantially reduced through standards, requiring or granting incentives for cost-effective retrofits. Retrofits of 15 office buildings as a part of the US Environmental Protection Agency (EPA)'s Energy Start Showcase Buildings partnership reduced energy consumption by an average of 30 per cent. The technologies that can be used to upgrade efficiency include: adding insulation to walls and attics; replacing older windows with energy efficient windows**;** sealing leaky heating and cooling air ducts; sealing air leaks in the building envelope; upgrading heating and cooling systems; replacing inefficient lighting; installing control systems; using light colours for buildings; and planting trees to shade them from the sun.

One measure worth pursuing is a law, adopted in some US states, requiring that homes or commercial buildings be inspected at the time of resale, with a retrofit requirement for buildings that are found not to be up to standards.

Appliance efficiency standards. Legislated standards for appliance efficiency are particularly useful because most appliances are bought, not by bill payers, but by landlords, individual homebuilders and public housing authorities that have no economic interest in saving energy in selecting them**.** On the contrary, they are more likely to purchase the appliances that have the lowest first cost regardless of energy consumption. While incentives and appliance labelling for energy efficiency (which is required in the US and many other countries) can be helpful in exceeding standards, only standards can assure that at least the most inefficient models will be removed from the market. Standards have been adopted effectively for minimum efficiency performance of products such as appliances, light fixtures, ballasts and motors. Standards for computers and televisions, requiring that power use be reduced or eliminated when not in use, are currently being adopted in the US. ➨

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The US has adopted a broad range of appliance efficiency standards, estimated cumulatively to reduce electricity use by 2.7 per cent in 2000 and 6 per cent by 2015. A US Energy Information Administration study finds that a 10-20 per cent increase in these standards would lead to a reduction of carbon emissions of eight million metric tons in 2010 and would further reduce carbon emissions by 20-23 million metric tons by 2020.

A number of other countries have also adopted appliance efficiency standards. For example, the European Union (EU) has adopted directives for its members to create energy efficiency standards for hot water heaters and boilers, refrigerators, freezers, washing machines and tumble dryers. Argentina has adopted home electrical appliance efficiency standards for refrigerators and freezers, with labelling commencing in mid-2000, with standards and labelling for washing machines in progress.

Renewable portfolio standards. In the US and other countries, renewable portfolio standards have been adopted or are being considered. These standards require electric utilities to purchase a certain percentage of their power from renewable resources. Legislation has been proposed to create a national renewable portfolio standard of 7.5 per cent non-hydro renewables by 2010 and 20 per cent by 2020 (compared to 2.3 per cent of US electricity supply today). The US Energy Information Administration estimates that this standard would reduce US carbon emissions by 19 million metric tons by 2010. If such standards were to be widely adopted, they would allow mass production of renewable energy generation equipment, substantially reducing their costs.

The UK has enacted a similar Non-Fossil Fuel Obligation (NFFO) with renewable resources required to be purchased through auctions, five of which have now taken place. These auctions were so successful that 3,271 MW of non-fossil power has been purchased at the auctions, far in excess of the 1,500 MW requirement. The auction device has driven renewable prices down to about 4.3 cents/kWh (very close to the electricity pool price of 4.2 cents). Argentina, Denmark, the Netherlands and Germany also have adopted utility renewable requirements.

Vehicle standards. Legislation regulating the vehicle miles per gallon standards for all vehicles sold can also impact strongly on pollution reduction, thus promoting cleaner energy policies. The US Congress enacted Corporate Average Fuel Economy (CAFE) standards during the energy crisis in 1975, and Canada adopted a similar Motor Vehicle Fuel Efficiency Programme with voluntary standards. The US CAFE standards provide that the passenger vehicles produced by each manufacturer must average a prescribed miles per gallon, with a lesser standard for light trucks. As a result, the average miles per gallon of the US passenger automobile fleet was increased from 17 mpg in the 1970s to a high of 25.9 mpg in 1988, now reduced to 23.8 mpg because of the promotion of large, inefficient "sports utility vehicles."

Other vehicle efficiency standards adopted include HOV limited access lanes on highways, car-pooling incentives including company-provided van-pools, the elimination of free parking by business establishments and parking fees. These measures have been adopted in a good number of US states. France and Italy have even gone so far as to limit parking in the city to alternate days for odd and even licence numbers and have created "No Car Days."

Enforcement. Effective enforcement is critical to the success of any standards programme. In practice governments and regulatory agencies often come to identify with the industries or companies that they regulate. Also, political pressures often prevent effective government enforcement. Citizen enforcement, adopted in the US in the Clean Air Act and other environmental statutes has been found to be a highly effective enforcement mechanism. Non-governmental organizations (NGOs) in the US are able to hold regulators' feet to the fire very effectively by filing suit to enforce standards, with the award of attorneys' fees to pay for such litigation; the very presence of citizen suit provisions enables the NGOs to influence government enforcement policies.

Utility Regulations and Programmes

Until recently, utilities in many US states were required by regulatory commissions to undertake integrated resource planning (IRP), including energy efficiency "demand-side management" (DSM) and renewable resources. They were required to provide incentives to their customers to purchase energy efficient lighting and appliances and to provide free or low cost energy audits to residential, commercial and industrial customers to help them identify efficiency opportunities. Utility spending on energy efficiency programmes has declined from about $1.4 billion in 1992 to about $1.2 billion in 1996, however, because of the prospect of deregulation.

Utilities in other countries have imposed extensive efficiency requirements. In Brazil, for example, a new federal utility regulatory agency in July, 1998, required all distribution utilities to spend at least one per cent of their revenues on energy efficiency improvements, with at least a quarter of this amount (about $50 million per year) to be spent on end-use efficiency projects. Utilities in Australia, Austria, Belgium, Canada, Germany and Ireland also have IRP and DSM requirements.

Where US states have deregulated their utility generation, environmental advocates have been successful in getting utility regulators or legislators to impose a "systems' benefit charge" on the monopoly distribution company to fund efficiency, renewable and other public benefit investments.

The revenues from these charges are often placed in independently administered public benefit funds. The US Congress has introduced a national public benefits trust fund of 0.2 cents/kWh (which would cost the typical residential customer only about one dollar per month).

The UK has established an Energy Savings Trust as a private limited company, funded by a small charge on distribution services, to promote energy efficiency for small customers. Norway adopted a small transmission tax ear-

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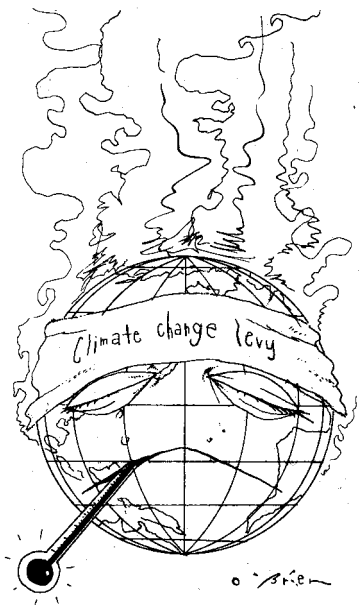
marked for energy efficiency information, and created and funded independent regional conservation centres to provide energy efficiency services. New Zealand set up an Energy Saver Fund as a part of its restructuring legislation to support residential programmes funded by an $18 million appropriation for an initial three-year period.

Combined heat and power. Utilization of the waste heat from electricity generation for industrial or district heating purposes converts as much as 90 per cent of fuel input into useful energy, compared to 30-35 per cent for a conventional power plant, thus saving significant amounts of fuel and avoiding pollution. Conversely, some manufacturing facilities that produce substantial high temperature fluid or steam wastes have used this waste heat for electricity production. Roughly 52 GW of combined heat and power (CHP) was installed in the US by 1998, providing about 9 per cent of total electricity production. Europe is far ahead of the US in CHP installation, which exceeds 30 per cent in the Scandinavian countries and is widely used in the climate strategies of the UK, Denmark, Sweden, the Netherlands and Germany.



Courtesy: Financial Times

There is enormous potential to expand the use of CHP. For example, the chemicals industry uses only about 30 per cent of its CHP potential and has used only 10 per cent of useable sites. A CHP plant in Stockholm has a net overall efficiency of 86 per cent compared to an average efficiency of just 36 per cent for non-CHP plants in the European Union. Legislation to promote the use of CHP could save vast amounts of wasted energy and corresponding emissions of carbon dioxide.

District heating. District heating involves the use of a single heating generator to warm and cool multiple homes in a community. Considerable energy can be saved in defined or newly planned communities by using district heating instead of less efficient heating units for each building or dwelling unit in the community. District heating is widely used in Europe, particularly in Scandinavian countries. Legislation to promote district heating also has a large carbon dioxide saving potential.

Disclosure. Laws requiring environmental disclosure by utilities of their emissions and power generation sources are very helpful in allowing consumers to select clean energy options knowledgeably in deregulated markets. Disclosure also creates public pressure for pollution remediation and legislative action for tighter pollution controls. The US has such disclosure and monitoring requirements.

Green marketing. A number of US utilities offer an option to customers to purchase a package of green generation products at a low cost. Among other countries, the Netherlands has created a similar green pricing programme. The City of Los Angeles, California, has adopted an ingenious programme to have customers voluntarily agree to a 6 per cent rate increase in return for utility-installed efficiency improvements**.** This guarantees the customer no electric bill increases and over 60,000 of its customers have opted for this programme in its first six months of operation.

Government procurement. All governments are major energy users. Legislation or executive orders to require purchase by federal, state and/or municipal governments of clean energy products and processes can do much to reduce green house gas emissions directly. In this way, governments also create markets to bring down green product prices and set an example of the feasibility of their use for the private sector. The US Government, through legislation and executive orders, has required that all US federal agencies must use 30 per cent less energy per square foot in their buildings than they consumed in 1985 and 35 per cent less by 2010. The US Government also includes energy efficiency specifications in its contracting guidelines used for construction and renovation projects.

Australia utilizes best practices in government procurement through performance contracting; Finland has adopted a target to reduce energy and electricity consumption in government buildings; Ireland has a state building energy reduction; and the UK has a five-year programme for reducing energy in government facilities. Canada, through a Federal Building Initiative, has been successful in achieving energy savings by contracting with energy service companies (ESCOs).

In the US, city governments have been very aggressive about reducing their carbon dioxide emissions. Over 100 cities, representing 10 per cent of global emissions, have joined the Cities for Climate Protection programme to reduce carbon emissions by investing in public transportation, building efficiency measures, planting trees and installing solar collectors. Cities in other countries have taken similar action. Thus, Toronto, the first city to announce a climate plan, has undertaken to reduce its carbon emissions by 20 per cent. Saarbrucken in southern Germany has already cut its emissions by 15 per cent by measures including energy efficiency and public education.

Government sponsored competitions also have been used to develop improved energy-efficient technologies. A successful example was the US government's "Golden Carrot" Super-Efficient Refrigerator Programme under which a consortium of government, utilities and NGOs organized a competition to award a total of $30 million to the manufacturer offering the best new refrigerator that exceeded prevailing efficiency standards by at least 30 per

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cent. The goal was met and many participating utilities also offered additional consumer rebates for it. Sweden has a similar, very ingenious programme under which purchasing offices issue requests for proposals guaranteeing to buy a large number of devices at a pre-agreed price if they meet technical standards for improved efficiency.

Technology solutions and R&D. Governments are now the prime investors in research and development of new energy technologies which can enhance efficiency and develop new clean energy processes because global competition has led most corporations and utilities to drastically reduce their R&D budgets.

The US relies heavily on the development of new technology to meet its Kyoto Protocol obligations to reduce carbon dioxide emissions. For example, the US Department of Energy has entered an agreement with motor manufacturers to produce vehicles using hybrid electric and other new low pollution technologies.

For developing countries, technology transfer is a critical factor in enabling them to take advantage of energy efficiency and renewable technologies used in industrialized countries. Technical assistance and education of key energy players is essential to success. There are many such efforts being conducted around the world sponsored by governments and international agencies.

Improved technology offers great potential for developing countries to leapfrog to cleaner energy solutions. They can adopt the cleaner technologies from the start, avoiding the economic and pollution costs of using less efficient technologies and then having to replace them, as was done in the industrialized countries.

One example is China's chlorofluorocarbon (CFC)-free Energy-Efficient Refrigerator Project to develop an energy-efficient CFC-free refrigerator. The final model, completed in 1996, demonstrated a 45 per cent reduction in energy use that would after 10 years reduce China's carbon dioxide emissions by over 100 million tons over the life of these refrigerators. The programme thus leapfrogs to modern efficient refrigerator technology, providing China with a major industrial opportunity with attendant jobs, consumer savings, power load reductions and significant reduction of pollutants.

Some examples of technology R&D currently underway which could drastically reduce carbon dioxide emissions include the following:

– The development of hydrogen fuel cells utilizable in both power plants and vehicles.
– Refinement and reduction of the costs of photovoltaic cell manufacture and of various kinds of central station solar power stations.
– Manufacture of more affordable and efficient electric or hybrid vehicles and lighter, more efficient batteries.
– Coal gasification.
– A new generation of advanced reciprocal engine or micro-turbine engine, particularly well suited for combined heat and power applications.
– Development of carbon dioxide separation processes for hydrogen production and carbon dioxide sinks for storage and reuse. An insulated car has been researched that will reduce heating and cooling loads by 80 and 75 per cent respectively, saving fuel and improving safety by reduced glare and heat.

Recycling programmes. Many countries today have laws providing for the recycling of their waste paper, glass and metal products. For example, in Denmark, half of all waste is recycled and 80 per cent of new paper is made from used paper. Almost every municipality in the US has established a recycling programme for paper, glass, plastic and metal wastes, either with roadside collection or the establishment of a central recycling municipal facility.

Education programmes. Education is vital to let the public know the importance to them of taking the measures necessary to reduce carbon dioxide emissions; to build the political support necessary for enactment of appropriate legislative measures; and to inform them of the options available to them for carbon dioxide reductions.

Such education is particularly important for architects, engineers, builders, commercial enterprise managers, tradespeople and government officials at all levels, to inform them of the requirements of laws adopted to promote carbon dioxide reductions**;** and the costs and benefits of the measures they can take either voluntarily or pursuant to legal requirements. It is important that retail sales staff, contractor installers and maintenance/service personnel understand the benefits of efficient products and processes and can personally benefit from promoting these products to end users.

Labelling programmes. One effective educational measure has been the adoption of energy efficiency product labelling requirements by countries, municipalities and professional associations. Labelling is an inexpensive educational tool. The US, many of its states and cities, and many other countries and their municipalities have adopted such labelling. Appliance labelling has often been an effective precursor to the adoption of efficiency standards. New buildings can also be the subjects of energy efficiency labelling requirements, as required through building certification programmes in Denmark and Canada. The US and various other countries have a miles-per-gallon labelling requirement for all vehicles sold.

Ratings. Ratings of companies on the greenness of their products can also be an effective educational tool. For example, major US environmental organizations, and consumer and industrial allies have established a "Green-E" clean electricity certification programme. This programme permits the display of the Green-E logo if power providers meet very rigorous "green" conditions. With the advent of deregulation in the US, a Power Scorecard also has been developed to rate the greenness of power plants, thus permitting informed consumer choice.

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Industry programmes. A remarkable number of major corporations around the world have publicly recognized the risks of climate change and voluntarily embarked on major emission reduction initiatives. Thus, in 1998, the President of British Petroleum, John Browne, broke ranks with the rest of the oil industry and announced that, recognizing the severe threat of climate change, BP was embarking on a voluntary programme to reduce its carbon emissions to 10 per cent below 1990 levels by 2010, which constituted a 40 per cent reduction from business-as-usual emissions growth. Royal Dutch Shell, the world's biggest oil company, and Enron Corporation, North America's largest natural gas company, have since followed suit.

Whilst this action by members of the petroleum industry is remarkable, major companies in many other fields have taken similar action, finding that producing more efficient products and adopting energy saving processes adds to profits and is therefore good business. Thus, Johnson & Johnson set a goal in 1995 of reducing energy costs by 10 per cent by 2000 in 96 of its US facilities, and has already met 95 per cent of that goal with a payback of three years or less for most of the projects undertaken. Dupont, too, announced in September 1999 that it would reduce greenhouse gas emissions worldwide by 65 per cent from 1990 levels while holding total energy use flat and increasing its use of renewable resources by 10 per cent. This was on top of a previous commitment to reduce energy intensity by 15 per cent by 2000 from 1990 levels, which it is on track towards achieving.

Iperiled by floods due to the unseasonal weather in England this spring, deer attempt to swim to safe, dry land. (Courtesy: NZZ)

Government-sponsored voluntary programmes. The US Government has relied heavily on partnerships with industrial companies to achieve energy efficiencies that will reduce pollutants and carbon dioxide emissions. Most notable, is its 1991 "Green Lights" Programme under which companies agree to capture cost-effective lighting energy savings and in turn are allowed to advertise their participation in the programme. As of 1997, the Programme involved more than 2,300 organizations and its retrofits were saving over half the previously used lighting energy with a 30 per cent return on investment**.** The national potential for this effort alone has been estimated to be annual savings of $16 billion with a 12 per cent reduction in utility carbon and other emissions.

In 1996, China began a Green Lights Programme with the goal of increasing the use of high-efficiency lights to 300 million building units by 2000, resulting in electricity savings of 26.8 TWh, along with avoiding the cost of building a new electricity power plant. Pollution savings are estimated at 200,000 metric tons of sulphur and 7.4 million tons of carbon emissions annually by the year 2000.

The US Government has also initiated the "ENERGY STAR" programme to give technical assistance and recognition to companies that market very efficient equipment. This programme has been highly successful in promoting market transformation measures, which establish new energy efficient products in the marketplace. For example, the ENERGY STAR office equipment programme convinced most manufacturers to produce only photocopiers, computers and other office equipment that automatically switch to a low energy consumption mode when not in use.

Canada started a Voluntary Challenge and Registry programme as a part of its National Action Programme on Climate Change in which in its first three years registered approximately 700 companies and organizations. Resulting carbon dioxide emission reductions totalling just over nine metric tons of carbon were reported, about 6.5 per cent of Canada's fossil fuel carbon emissions in 1998.

Agreements between government and industry have resulted in substantial energy intensity reductions in European countries such as the Netherlands, Denmark and Germany, whose companies committed in March 1996 to reduce carbon dioxide emissions by 20 per cent between 1990 and 2005. Belgium, France, Spain and Norway are in the process of negotiating voluntary agreements with their principal energy-intensive industries.

Financing Mechanisms: Internal Resources

As indicated previously, there are a number of financial resources that can be generated internally by any government. The largest of these in most countries is removal of fossil fuel subsidies. Many of the energy efficiency measures described above achieve such large savings over time as to provide very substantial revenue resources. Taxes on pollutants and fossil fuels have been used in many countries to help finance carbon reduction measures. Emission trading rights have been utilized to lower the costs of pollution reduction measures. Governments have supported efficiency and renewable programmes and R&D for new technologies to address climate change. They have also initiated programmes to require the purchase of energy efficient appliances, lighting and buildings for their own use; and they have required their electric utilities to do integrated resource planning and to finance demand

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side management (DSM) and renewable resources.

A major problem with obtaining commercial financing of efficiency and renewable resources is the small size and distributed nature of these resources. A number of financing devices have been used to overcome these obstacles.

Aggregated loans. One way to overcome the problems with small loans for distributed resources is to aggregate the loans in various ways. Thus a bank can lend to an energy service company or government agency funds for efficiency and renewable investments, allowing them to do the retail re-lending to individual consumers.

Installment loans. An innovative credit arrangement to overcome these problems has been adopted by several countries, to make loans to credit-worthy institutions such as local utilities which set up revolving funds to manage installment loans to individuals and small businesses on relatively attractive terms. Such arrangements have been adopted in Indonesia for its Solar Home Systems Project, in India for a solar photovoltaic programme, in Kenya for its wood stove upgrading programme and for off-grid photovoltaic systems, and in Bangladesh, the Dominican Republic and Honduras.

Micro utilities. Another innovative mechanism is financing service providers with the creation of renewable energy micro utilities which sell energy services, permitting financing to be aggregated to the service provider, the end-user being required to make payments based on the level of energy services received. This approach has been successfully demonstrated in the Dominican Republic and is now being implemented in a 10,000 solar home system programme by a rural electric cooperative in Bolivia. Mortgage financing, allowing homeowners to incorporate the costs of installing renewable systems into the overall costs of their homes through mortgage financing, is currently being tested in a rural housing/electrification programme in South Africa.

Grameen Bank. A particularly fascinating development is the creation of micro lending organizations in some of the world's poorest countries for their most impoverished populations. Thus, Grameen Bank ("village bank" in Bengali) in Bangladesh has started a lending programme for people earning on average less than $1 a day. Today, Grameen is established in nearly 39,000 villages in Bangladesh, lending to approximately 2.4 million borrowers. Established in 1986, it reached its first $1 billion cumulative loans in 1995. It took only two more years to reach $2 billion. The repayment rate hovers between 96 and 100 per cent. In a typical year, five per cent of Grameen borrowers, representing 125,000 families, rise above the poverty level. The Grameen model has now been applied in 40 countries. In all, about 22 million poor people around the world now have access to small loans. Grameen has now established more than a dozen enterprises, often in partnership with other entrepreneurs. One such enterprise is Grameen Skakti (Energy), which helps to install solar energy systems into village households.

Leasing, vendor financing and performance contracts. Other useful internal financing mechanisms are the following:
- lease clean energy equipment or services, thus avoiding for the user the necessity to raise purchase capital;
- vendor financing which has been undertaken by some equipment suppliers to promote sales of their products; and
- performance contracting by energy service companies (ESCOs) under which the ESCO gets paid out of savings achieved and again, the user avoids capital financing.

External Resources

The World Bank and its sister international lending institutions, which had for many years made wasteful investments in highly capital-intensive, polluting and energy inefficient technologies, have changed direction and are now making major funding available for energy efficiency and renewable technologies. The International Finance Corporation has recently launched a $100 million Renewable Energy and Energy Efficiency Fund; and the Asian Development Bank has approved a $100 million loan to the Indian Renewable Energy Development Agency for biomass cogeneration projects in India. The Global Environmental Facility (GEF) donated $10 million to Argentina to assist Argentinian cooperatives in the removal of barriers to installation of windpower and solar photovoltaic development, including subsidies for equipment investment and technical assistance and studies.

One problem that these international lending facilities have had to overcome is administering small loans because of the small size of many efficiency and renewable projects. They have started to assist in the creation of local and regional lending institutions to manage the smaller loans on their behalf.

Two financing mechanisms emerging from the negotiations of the conferences of the parties to the Kyoto Protocol are Joint Implementation (JI) projects and a Clean Development Mechanism (CDM), both designed to encourage industrial countries and companies to invest in greenhouse gas emission reductions in developing countries. By participating in a clean development mechanism that generates greenhouse gas reductions in a developing country, an industrialized country or its companies could earn carbon emission reduction credits to meet the country's Kyoto Protocol obligations.

However, these mechanisms are highly controversial with many developing countries and environmental organizations – because of doubts about their standards, reliability and enforceability and because of the belief that they are just escape valves by which industrialized countries can avoid reducing their own emissions. These mechanisms are presently key issues being debated by the Conference of the Parties (COP) negotiations.

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Conclusion

There are abundant examples, in both developed and developing countries, of the successful adoption of cost-effective measures to ameliorate carbon dioxide emissions in the electric utility and vehicle sectors. A wide variety of legislative and regulatory programmes have been undertaken and the legal and financial mechanisms employed are many and varied. It is possible to meet the Kyoto Protocol goals, and even to go beyond them to meet what the International Panel on Climate Change (IPCC) scientists find is needed to stabilize global warming. This can even be achieved on the basis of long term profitability; indeed many energy efficiency savings are so compelling that they should be undertaken just to save money, regardless of their utility in reducing the risks of global warming. But achieving these goals will take determined action and political will from governments, corporations and institutions worldwide.