NATIONAL POLICIES AND THEIR LINKAGES TO NEGOTIATIONS OVER A FUTURE INTERNATIONAL CLIMATE CHANGE AGREEMENT

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Capacity development for policy makers: addressing climate change in key sectors

The United Nations Development Program (UNDP) "Capacity development for policy makers" project seeks to strengthen the national capacity of developing countries to develop policy options for addressing climate change across different sectors and economic activities, which could serve as inputs to negotiating positions under the United Nations Framework Convention on Climate Change (UNFCCC). The project will run in parallel with the "Bali Action Plan" process – the UNFCCC negotiations on long-term cooperative action on climate change set to conclude in December 2009 in Copenhagen at the fifteenth Conference of the Parties.

This paper is one of a series produced for the project that provides in-depth information on the four thematic building blocks of the Bali Action Plan – mitigation, adaptation, technology and finance – as well as on land-use, land-use change and forestry. The project materials also include executive summaries for policymakers, background briefing documents and workshop presentations. These materials will be used for national awareness-raising workshops in the participating countries.

Disclaimer

The views expressed in this publication are those of the author(s) and do not necessarily represent those of the United Nations, including UNDP, or their Member States.

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CONTENTS

Acronyms

ADB	Asian Development Bank
Annex I	Annex to the Convention listing industrialised and transitioning countries
Annex II	Annex to the Convention, listing mostly OECD countries, with additional commitments to assist developing countries with funding and technology transfer
Annex B	Developed Country Parties to the Kyoto Protocol
ASER	Senegalese Rural Electrification Agency
AWG-KP	Ad Hoc Working Group on further commitments of Annex I Parties under the Kyoto Protocol
CDM	Clean Development Mechanism
CH_4	Methane
CMP	Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol
CNG	Compressed natural gas
CO_2	Carbon dioxide
ENRE	National Electricity Regulatory Board of Brazil
ESCOs	Energy Service Companies
ETS	Emissions Trading Scheme
EU	European Union
GDP	Gross domestic product
GHG	Greenhouses gas
H_20	Water vapor
HFCs	Hydrofluorocarbons
IEA	International Energy Agency
INMETRO	National Institute of Metrology, Standardization and Industrial Quality of Brazil
IPCC	Intergovernmental Panel on Climate Change
KCI	Kenya Ceramic Jiko
KP	Kyoto Protocol
LPG	Liquefied petroleum gas
MDIC	Ministry of Development, Industry and Foreign Trade of Brazil
MNES	Ministry of Non-Conventional Energy Sources
MNRE	Ministry of New and Renewable Energy
N_2O	Nitrous oxide
NDRC	National Development and Reform Commission
NGO	Non Governmental Organization
NGV	Natural gas for vehicles
O_3	Ozone
OECD	Organization for Economic Co-operation and Development
PBE	Brazilian Labelling Program
PFCs	Perfluorocarbons
PPP	Public/private partnership
PROCEL	National Electricity Conservation Program
SELO PROCEL	Sub-program of the National Electricity Conservation Program
SENELEC	National Electricity Company of Senegal
PV	Phovoltaic
R&D	Research and development
RD&D	Research, development and demonstration
SDPAMs	Sustainable development policies and measures
SENELEC	Senegal National Electricity Company
SERCs	State Electricity Regulatory Commission
SEPA	State Environmental Protection Agency
SF6	Sulphur hexafluoride
SSA	Sub-Saharan Africa
TSP	Total suspended particulates
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
UNFCCC	United Nations Framework Convention on Climate Change (the Convention)
WG I	Working Group I (of the IPCC, see above), assesses the literature on the physical science basis of climate change
WG II	Working Group II (of the IPCC, see above), assesses the literature on the impacts, vulnerability and adaptation to climate change
WG III	Working Group III (of the IPCC, see above), assesses the literature on the mitigation of climate change, i.e. reducing GHG emissions

Units and measures

GW	Gigawatts (power measurement) = 109 Watts
GWh	Gigawatt hours
K euros	K = 1,000 euros
kW	Kilowatts (power measurement) = 1,000 Watts
kWh	Kilowatt-hours
MW	Megawatts (power measurement) = 106 Watts
MWh	Megawatt-hours
W	Watt = 1 joule of energy per second

1. SUMMARY FOR POLICY MAKERS

There is a rich array of policy instruments being used by developing countries to achieve national objectives, such as, improving local air pollution and reducing poverty. Most of these policies also reduce emissions of greenhouse gases (GHGs). This paper reviews all policy instruments; in particular, the most commonly used policies in developing countries.

Based on the case studies in this paper, these policies are: *regulations, financial incentives, research and development and information instruments*. Financial incentives are indeed the one policy option used in all but one of the cases. As might be expected, large countries such as China and India use a complex set of policies to achieve objectives, while smaller countries tend to have more focused objectives and less complicated policies. Non-climate change policies in developing countries can have a significant effect on GHG emissions. Therefore, any consideration of ways to limit emissions needs to include such policies. A number of factors, including political will, adequate financing, institutional capacity and information, appear to affect the extent to which developing countries are implementing policies that limit the growth of GHG emissions.

2. INTRODUCTION

The main purpose of this paper is to help policy makers, particularly those in developing countries, think about the national policy instruments needed to contribute to the fight against climate change, how such needs can be articulated in order to seek internal and external financial resources and how these needs may be reflected in negotiations of a future climate change agreement. This paper is an input to a series of workshops which the United Nations Development Program (UNDP) will organize in developing countries with the aim of improving their capacity to respond to climate change.

The paper gives greater weight to instruments and experience with the renewable energy and energy efficiency sub-sectors, but inferences can be drawn for other sectors. It has borrowed heavily from the Intergovernmental Panel on Climate Change (IPCC) Working Group III (WG III) Chapter 13[1], but has been supplemented with case studies that focus on the experiences of developing countries, which for the most part have been implemented for non-climate change reasons. Policies that have been in place for more than a decade are contrasted with cases that are still in the experimental stage. Both success stories and failures are included as they provide lessons for others to consider. Questions are included in different parts of the document to help the reader reflect on the circumstances in his/her country. A final section provides insights about the linkage of national policies to the current negotiations over a future climate change agreement.

The responsibilities of all countries to develop national policies are well grounded in the United Nations Framework Convention on Climate Change (UNFCCC). Article 4 of the UNFCCC commits all Parties, taking into account their common but differentiated responsibilities and their specific national and regional priorities, objectives and circumstances, to formulate, implement, publish and regularly update national and, where appropriate, regional programmes containing measures to mitigate climate change by addressing anthropogenic emissions of GHGs by sources and removals by sinks. Articles 4.3 and 4.5 of the Convention call for developed countries to provide new and additional financial resources to meet the agreed costs of developing countries in complying with their obligations under the UNFCCC. This includes implementing measures to mitigate climate change by addressing anthropogenic emissions by sources, such as fossil fuel combustion and removals by sinks (UNFCCC 1992).

In addition, Article 11.5 stipulates that developing countries may avail themselves of financial resources related to the implementation of the Convention through bilateral, regional and other multilateral channels. The Kyoto Protocol (KP) also sets up a new mechanism, the Clean Development Mechanism (CDM), under Article 12 that is to help developing country Parties achieve their sustainable development objectives and developed country (Annex B) Parties comply with their qualified emission limitations and reduction commitments under the Protocol (UNFCCC 1998).

[1] Gupta, S., D. A. Tirpak, N. Burger, J. Gupta, N. Höhne, A. I. Boncheva, G. M. Kanoan, C. Kolstad, J. A. Kruger, A. Michaelowa, S. Murase, J. Pershing, T. Saijo, A. Sari, 2007: Policies, Instruments and Co-operative Arrangements. In Climate change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [B. Metz, O. R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

3. TYPES OF POLICIES, MEASURES AND INSTRUMENTS

A variety of policies, measures, and instruments are available to national governments to limit the emission of greenhouse gases. These include: regulations and standards, taxes and charges, tradable permits, voluntary agreements, informational instruments, subsidies and incentives, research and development, and trade and development assistance. Box 1 provides a brief definition of each instrument. Depending on the legal frameworks available to countries, these may be implemented nationally, regionally or locally. They may be supplemented with rules, guidelines and other administrative mechanisms to achieve different goals. They may be legally binding or voluntary and they may be fixed or changeable.

Box 1: Definitions of selected greenhouse gas abatement policy instruments

Regulations and Standards:	Specify abatement technologies (technology standard) or minimum requirements for pollution output (performance standard) to reduce emissions.
Taxes and Charges:	A levy imposed on each unit of undesirable activity by a source.
Tradable Permits:	Also known as marketable permits or cap-and-trade systems. This instrument establishes a limit on aggregate emissions by specified sources, requires each source to hold permits equal to its actual emissions, and allows permits to be traded among sources.
Voluntary Agreements:	An agreement between a government authority and one or more private parties to achieve environmental objectives or to improve environmental performance beyond compliance to regulated obligations. Not all voluntary agreements are truly voluntary; some include rewards and/or penalties associated with joining or achieving commitments[2].
Financial Incentives:	Direct payments, tax reductions, price supports, or the equivalent from a government to an entity for implementing a practice or performing a specified action.
Information Instruments:	Required public disclosure of environmentally related information, generally by industry to consumers. Includes labelling programs and rating and certification.
Research and Development (R&D):	Direct government spending and investment to generate innovation on mitigation, or physical and social infrastructure to reduce emissions. Includes prizes and incentives for technological advances.
Non-Climate Policies:	Other policies not specifically directed at emissions reduction but that may have significant climate-related effects.

Note: Instruments are defined above that directly control GHG emissions. Instruments may also be used to manage activities that indirectly lead to GHG emissions, such as energy consumption.

Questions:

- Which policy instruments have been used in your country to achieve environmental, energy, or related objectives? Have they been successful?
- What are the three most important reasons for their success and failure?
- In your opinion, what would it take to ensure more wide spread success?

[2] Voluntary Agreements should not be confused with voluntary actions which are undertaken by sub-national governments, corporations, NGOs and others independent of national government authorities.

4. EVALUATING AND SELECTING POLICY INSTRUMENTS

The policy-making process of most governments involves complex choices involving many stakeholders. These include the potential regulated industry, suppliers, producers of complementary products, labour organizations, consumer groups and environmental organizations. The choice and design of virtually any instrument has the potential to benefit some and to harm others. For example, standards set at a high level may be achievable by large firms, but not by small or new firms entering the market. Voluntary measures, often favoured by industry because of their flexibility and potentially lower costs, are in many cases opposed by environmental groups because of their lack of accountability and enforcement.

In formulating a domestic climate policy program, a combination of policy instruments may work better than relying on a single instrument. Also, the design of instruments may need to consider how they interact with existing institutions and regulations in other sectors of society. When comparing instruments, adjusting for different levels of stringency is important. For all the instruments discussed in this paper stringency may be set at different levels. Over time, all instruments need to be monitored, adjusted and enforced. Furthermore, an instrument that works well in one country may not work well in another country with different economic circumstances, social norms and institutions.

The IPCC identifies four principal criteria by which environmental policy instruments can be evaluated:

- **Environmental effectiveness:** the extent to which a policy meets its intended environmental objective or realizes positive environmental outcomes. The main goal of environmental policy instruments is to reduce the negative impacts of human action on the environment. Policies that achieve specific environmental quality goals better than alternatives can be said to have a higher degree of environmental effectiveness. The environmental effectiveness of policies depends on design, implementation, participation, stringency and compliance. While climate protection may be the main goal, any given policy may have other environmental and societal benefits.
- **Cost-effectiveness:** the extent to which the policy can achieve its objectives at minimum cost to society. There are many components of cost, including the direct costs of administering and implementing the policy, as well as indirect social costs, which are more difficult to measure. Cost-effectiveness can be enhanced by limiting the creation of new institutions and keeping implementation procedures as simple as possible while preserving the integrity of the approach.
- **Distributional considerations:** the extent to which a policy is perceived to be fair and equitable and whether it has distributional consequences. Policies rarely apportion environmental benefits and costs evenly across stakeholders. Even if a policy meets an environmental goal at least cost, it may face political opposition if it disproportionately impacts, or benefits certain groups, within a society or across generations. However, equity and fairness may be perceived differently, depending on the cultural background of the observer.
- **Institutional feasibility:** the extent to which a policy instrument is likely to be viewed as legitimate, gain acceptance, and be adopted and implemented. Environmental policies that are well adapted to existing institutional constraints have a high degree of institutional feasibility; however, institutional realities can constrain environmental policy decisions. Policies that are not acceptable to a wide range of stakeholders and supported by institutions, notably the legal system may not prove successful. Other important considerations include human capital, bureaucratic infrastructure as well as the dominant culture and traditions. The decision-making style of each nation is therefore a function of its unique political heritage.

Governments often use other evaluation criteria, such as *"Does it meet our sustainable development strategy?", "Will it help to reduce poverty?" and "Will it help to provide new jobs or stimulate a new industry?".* Most of such criteria can fit into one of the above four criteria. These criteria can be used in advance to select a policy or afterwards to evaluate the results of a policy.

The case studies in the Annexes provide some insights into the approaches used by governments and the constraints they face, but they do not pretend to assess the criteria that shaped government decisions. However, several of the case studies exemplify situations where explicit multiple policies were (and are being) used successfully to achieve national objectives. For example, in promoting energy efficiency programmes China has used regulations, financial incentives, R&D, and information instruments to achieve its objectives. Kenya, over a long

period, with support from others, has used R&D, financial incentives and information instruments to develop and disseminate improved cook stoves, and India has used a combination of instruments to encourage the deployment of wind power. Several of the case studies relied almost solely on financial incentives, e.g., the promotion of wind power in Argentina and natural gas vehicles in Bolivia. Only one of the case studies, i.e., the case of the energy efficiency labelling programme in Brazil, contains an example of a voluntary agreement with industry. *(For additional information on the interaction of policies see Section 5.8.)*

Questions:

- How are policy decisions made in your country?
- What decision criteria are used and how are they weighted?
- How could the policy-making process be improved and what technical and financial support would be needed to make that happen?
- What institutional arrangements would help to improve policy design and decision making related to climate change?

5. NATIONAL CLIMATE AND RELATED POLICY INSTRUMENTS

Addressing climate change requires actions that range from purely technological (such as fuel switching) to purely behavioral (such as reducing vehicle kilometres travelled) and mixes of technological and behavioral actions. Triggering the implementation of such actions usually requires the adoption of some form of policy instruments which are considered below.

5.1 Regulations and standards

Regulatory standards are the most common form of environmental regulation, covering a wide variety of approaches. A regulatory standard specifies with some precision the action that a firm or individual must take to achieve environmental objectives. This could include specifying technologies or products to use or not use, general standards of performance, as well as dictates on acceptable and unacceptable behaviour. The primary advantage of a regulatory standard is that it may be tailored to an industry or firm, taking into account the specific circumstances of that industry or firm. There is also a more direct connection between the regulatory requirement and the environmental outcome. This can provide some degree of certainty.

Two broad classes of regulatory standards are technology and performance standards. **Technology standards** mandate specific pollution abatement technologies or production methods, while **performance standards** mandate specific environmental outcomes per unit of product.

For example, a technology standard might mandate specific carbon dioxide (CO_2) capture and storage methods on a power plant. Technology standards involve the regulator stipulating the specific technology or equipment that the polluter must use. Technology standards are best used when there are few options open to the polluter for controlling emissions and thus the regulator is able to specify the technological steps that a firm should take to control pollution. The information needs for technology standards are high: the regulator must have good information on the abatement costs and options open to each firm. Losses in cost effectiveness arise when regulators are less well informed. Technology standards may be applied uniformly to a variety of firms, rather than tailoring the standard to the circumstances of the firm. This raises costs without improving environmental effectiveness and is one of the main drawbacks to regulatory standards.

A performance standard would limit emissions to a certain number of grams of CO_2 per kWh of electricity generated or require, for example, refrigerators to operate at a specified level of efficiency. A technology-forcing standard would involve setting the refrigerator efficiency requirement slightly beyond technological feasibility, but announcing that the efficiency requirement will not go into effect until a number of years after announcement. Performance standards often provide more flexibility than technology standards. Costs can generally be lower whenever a firm is given some discretion in how it meets an environmental target. Performance standards expand compliance options beyond a single mandated technology and may include process changes, reducing output, changes in fuels or other inputs, and selecting alternative technologies. Despite this increased flexibility, performance standards also require well-informed and responsive regulators.

One problem with regulatory standards is that they do not give polluters incentives to develop more effective technologies. Moreover, firms may be discouraged from finding more effective technologies out of fear that standards will be subsequently tightened. Finally, although it may be possible to force some technological change through technology mandates, it is difficult for regulators because they often do not have access to corporate data to determine the amount of change that is possible at a reasonable economic cost. This raises the possibility of either costly, overly stringent requirements or weak, unambitious requirements.

Although relatively few regulatory standards have been adopted solely to reduce GHG emissions, standards have been adopted that reduce these gases as a co-benefit. For example, there has been extensive use of standards to increase energy efficiency in over 50 nations (IPCC 2001b). Energy efficiency applications include fuel economy standards for automobiles, appliance standards, and building codes[3]. Standards to reduce methane and other emissions from solid waste landfills have been adopted in Europe, the United States, and other countries. These standards are often driven by multiple factors,

[3] See China case study (Annex 1.2) for examples.

including the reduction of volatile organic compound emissions, improved safety by reducing the potential for explosions, and reduced odours for local communities.

In many cases, countries simply pass laws that mandate industry to do certain things.[4] For example, targets for future shares or amounts of renewables exist in 58 countries, of which 13 are developing countries. Thirty-six countries have developed feed-in tariff polices; 44 countries, states and provinces have enacted renewable performance standards; and mandates for blending bio-fuels have been enacted in 11 developing countries in Latin America and Asia (UNEP 2007).

Whether regulatory standards or economic instruments are preferable for developing countries is a matter of some discussion. One common view is that technology standards may be more appropriate for building initial capacity for emissions reduction because economic incentive programs require more specific and greater institutional capacity, have more stringent monitoring requirements, and may require fully developed market economies to be effective (IPCC 2001). Some authors suggest that a transitional strategy is appropriate for developing countries, whereby technology standards are introduced first, followed by performance standards and then experimentation with economic instruments.

The case studies in the Annexes demonstrate the complex array of approaches used by developing country governments. In some cases, laws stipulate both the goal and the means to achieve the goal. In other cases, government ministries are empowered to implement the law by designing and issuing regulations. Interestingly, all of the case studies used some form of financial incentives to motivate industry or consumers to change behaviour. Where incentives have been poorly designed – either because of limited information and/or when they have not been evaluated/revised – the results have been poor. It is difficult to draw conclusions about whether countries with fully developed market economies are better or worse in employing financial instruments or regulations as both situations are represented by the cases.

Questions:

- Does your country have regulations or standards to promote energy efficiency or renewable energy?
- In the case of renewable energy, what combination of national, state and local laws would be required?
- Do your country's investment policies encourage or limit investments in renewable energy or energy efficiency measures?
- What specifically has to change or what new actions are needed to promote energy efficiency or renewables?
- What type of assistance would be necessary to expand or introduce energy efficiency measures and renewable energy?

5.2 Taxes and charges

Taxes are usually imposed by governments to raise revenue for the common good or to discourage the consumption of things that are perceived to be bad or lead to long-term societal costs. An emission tax on GHG emissions requires individual emitters to pay a fee, charge, or tax[5] for every tonne of GHG released into the atmosphere. An emitter must pay this per-unit tax or fee regardless of how much of an emission reduction it undertakes. Each emitter weighs the cost of emissions control against the cost of emitting and paying the tax; in the end, polluters undertake emission reductions that are cheaper than paying the tax, but do not undertake those that are more expensive (*IPCC 2001, Section 6.2.2.2*). Taxes and charges are commonly leveled on commodities that are closely related to emissions, such as energy or road use.

Taxes and fees levied on imports and exports can also affect emissions by limiting the availability of GHG friendly products and equipment in different countries. Trade ministers from a number of countries met for the first time in Bali in 2007 to discuss what could be done to support the UNFCCC thorough efforts to remove import duties that restrict the flow of goods that could reduce GHG emissions.

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[4] China, in an attempt to mitigate GHG emissions, has set mandatory quantified targets for 2010 (See Annex 1.2 for additional details): reduce the consumption of energy for every 10,000-yuan of gross domestic product from 1.22 tons of standard coal equivalent in 2005 to below one ton – a reduction of 20%; raise the share of renewable energy in the primary energy supply to 10% (from 7% in 2005); extract 10 billion m^3 of coal-bed methane; cap nitrous oxide emissions from industrial processes at the 2005 level; increase the forest coverage rate to 20%; and increase the carbon sink by 50 million tons over the 2005 level.

[5] No distinction is made here among the terms taxes, fees, and charges. In actuality, the revenue from taxes may go into the general government coffers whereas the revenue from fees or charges may be earmarked for specific purposes.

An **emissions tax** provides some assurance regarding the marginal cost of pollution control, but it does not ensure a particular level of emissions. Over time, an emissions tax needs to be adjusted for changes in circumstances, like an international treaty, inflation, technological progress, and new emissions sources. Fixed emissions charges in the transition economies of Eastern Europe, for example, have been significantly eroded by the high inflation of the past decade. Innovation and invention generally has the opposite effect, reducing the cost of emissions reductions and increasing the level of reductions made. If the tax is intended to achieve a given overall emissions limit, the tax rate will need to be increased to offset the impact of new sources.

Most **environmentally related taxes** with implications for GHG emissions in OECD countries are levied on energy products (150 taxes) and on motor vehicles (125 taxes), rather than on CO_2 emission directly. There is also a significant number of waste-related taxes in many countries (about 50 taxes in all), levied either on particular products that can cause particular problems for waste management (about 35 taxes), or on various forms of final waste disposal, i.e., on incineration and/or land-filling (15 taxes in all).

A very significant share of all the revenues from environmentally related taxes arises from taxes on motor fuels. Such taxes were introduced many decades ago, primarily as a means to raise revenue or to pay for road construction programmes. Regardless of that, they do impact prices car users face, and thus they do have environmental and social impacts. They may affect the size of the cars and how extensively they are used by consumers, but may have disproportionately negative financial impacts on some drivers, such as, those in rural areas and with low incomes who depend on cars to travel to work. In some countries, subsidized gasoline and diesel encourage consumer's choice of cars and driving habits, often to the detriment of the environment. One example of the use of a tax is that of Bolivia, which has a policy of maintaining a fixed differential price (based on tax reduction) between gasoline and natural gas for vehicles (NGV). Since 1992 the NGV price has been linked to the price of gasoline at around 50% of the retail price as a means to encourage consumers to modify their vehicles to use natural gas. *(See Annex 2.1 for more details.)*

There is some experience with **CO_2 taxes** in a number of OECD countries, e.g., Norway and the United Kingdom. To implement a domestic emissions tax, governments must consider a number of issues, such as the level the tax should be set, particularly in the case of pre-existing taxes (e.g., taxes which already exist on energy) or other distortions (e.g., subsidies to certain industries or fuels). Consideration must also be given to how the tax is used, i.e., whether it goes directly into general government coffers, is used to offset other taxes (i.e., the double-dividend effect), is transferred across national boundaries to an international body, is earmarked for specific abatement projects like renewable energy, or is allocated to those most adversely impacted by either the costs of emission reduction or damage from climate change. Another important issue is the point at which the tax is levied. A tax on gasoline may be levied at the pump and collected directly from consumers or it may be levied on wholesale gasoline production and collected from oil companies. Emissions or energy taxes often fall disproportionately on the poor, creating negative distributional consequences. In developing countries, institutions may be insufficiently developed for collection of emission fees from a wide variety of dispersed sources. *(See, for example, the discussion of institutions in China in Annex 1, Section 1.2.)*

Questions:

- Does your country have a tax on energy, including gasoline? Why was it established? Has it been changed since it was introduced? How is it collected and what use is made of the revenue?
- Does your country have a tax on cars or tolls on roads? Why was it established and how was the tax determined?
- What information and assistance would be required if your country wanted to establish a tax on energy or products that use energy?

5.3 Financial incentives

Direct and indirect subsidies can be important environmental policy instruments, but they have strong market implications and may increase or decrease emissions, depending on their nature. Financial incentives to reduce emissions can take different forms ranging from support for R&D, investment tax credits, low interest loans, rebate programmes and price supports, e.g., feed-in tariffs for renewable electricity. Subsidies that increase emissions typically involve support for fossil fuel production and

consumption. They tend to expand the subsidized industry, relative to the non-subsidy case. If the subsidized industry is a source of greenhouse gas emissions, subsidies may result in higher emissions. Subsidies to the fossil fuel sector result in over-use of these fuels with resulting higher emissions; subsidies to agriculture can result in expansion of agriculture into marginal lands and corresponding increases in emissions. Conversely, incentives to encourage the diffusion of new technologies, such as for renewables or nuclear power, may promote emissions reductions.

One of the significant advantages of subsidies is that they have politically positive distributional consequences *(see, for example, the case of Senegal in Annex 3, Section 3.2, which is subsidizing the distribution of compact fluorescent lights in rural villages)*. The costs of subsidies are often spread broadly through an economy whereas the benefits are more concentrated. This means that subsidies may be easier to implement politically than many other forms of regulatory instruments. However, subsidies do tend to take on a life of their own, making it difficult to eliminate or reduce them, should that be desired.

One of the most effective incentives for fostering GHG reductions are the **price supports associated with production of renewable electricity**[6]. These price supports tend to be set at attractive levels and have resulted in significant expansion of renewable energy in OECD countries. They require electric power producers to purchase such electricity at favourable prices. In Europe, specific prices have been set at which utilities must purchase renewable electricity—these are referred to as **"feed-in tariffs"**[7]. These tariffs have been effective at promoting the development of renewable sources of electricity, expansion of the industry and creation of new jobs. As long as renewables remain a relatively small portion of overall electricity production, consumers see only a small increase in their electricity rates as in the case of Germany. Incentives, therefore, have attractive properties in terms of environmental effectiveness, distributional implications and institutional feasibility.

In India (*see the case study in Annex 1.1*), incentives provided by the government include:

- 80% accelerated depreciation of project costs for wind power projects (in the initial stages 100% accelerated depreciation was allowed);
- Concessions or full exemption on customs duties of certain imported components of wind turbines;
- Tax holiday for a maximum of 10 consecutive years within 15 years of commissioning; and
- Concessional loans available through Government-owned agencies.

The Indian Electricity Act, 2003 requires all state-level energy regulatory commissions to ensure that electricity distributors procure a specified minimum percentage of power generation from renewable energy sources. The result of these and other measures has enabled India to develop an industry that competes with the largest companies in the world. The main problem with some financial incentives is cost-effectiveness as there are often energy efficiency savings available at a far lower cost to society. Also, if the feed-in tariff (or subsidy) is set too low by a national law as described in the case study of wind power in Argentina (See Annex 2, Section 2.2), it will be ineffective instrument for encouraging the installation of wind turbines.

The level of subsidies in developing and transition economy countries is generally considered to be higher than in member countries of the Organisation for Economic Co-operation and Development (OECD). One example is low domestic energy prices that are intended to benefit the poor, but which often benefit high users of energy. The result is increased consumption and delayed investments in energy efficient technologies. In India kerosene and LPG subsidies are generally intended to shift consumption from biomass to modern fuels, reduce deforestation and to improve indoor air quality, particularly in poor rural areas. In reality, these subsidies are largely used by higher expenditure groups in urban areas, thus having little effect on the use of biomass. In the Dominican Republic subsidies intended for cooking gas

[6] Based on personal communications from the UNEP office in Paris, the renewable industry is estimated to have grown to $150 billion in 2007, largely as a result of regulatory and financial measures in some countries.

[7] The "Feed-in Law" in Germany permits customers to receive preferential tariffs for solar generated electricity depending on the nature and size of the installation. Under the new tariff structure introduced in 2004, the base level of compensation for ground-mounted systems can be up to 45.7 euro cents/kWh. Photovoltaic (PV) installations on buildings receive higher rates of up to 57.4 euro cents/kWh. In May 2008, the government agreed that subsidies for roof top solar PV systems will be reduced annually by 8% from 2009 to 2010 and then by 9% annually from 2011 onwards. Currently these subsidies are subject to reductions of 5% per year.

go in practice to owners of cars that run on natural gas.[8]

More recently, high global oil prices have led some countries to reconsider their national energy policies, including the subsidies for gasoline. Some developed countries have faced strikes by truckers and other groups calling for governments to reduce taxes or compensate high consumption groups. Some developing countries who are attempting to reduce subsidies for gasoline have also faced protests. Attempts to remove/increase subsidies need to be done cautiously, in the absence of substitutes and a long-term energy plan.

Questions:

- Are fossil fuels subsidized in your country?
- Have attempts been made to reduce subsidies and what was the result? What lessons might be applied from this experience?
- Would information on the experience of others be helpful to your government?
- Does your government provide any financial incentives to promote renewable energy? What form of financial incentives would be most likely to succeed? What would your government need to make a programme of financial incentives a success?

5.4 Voluntary Agreements

Voluntary agreements are agreements between a government authority and one or more private parties to achieve environmental objectives or to improve environmental performance beyond compliance to regulated obligations. They tend to be popular with industry and can be used when other instruments face strong political opposition. Voluntary agreements can take on many forms with varying levels of stringency andm while all voluntary agreements are "voluntary", some may involve incentives (rewards or penalties) for participation. Firms may agree to direct emissions reductions or to indirect reductions through changes in product design.

The benefits of voluntary agreements for individual companies and for society may be significant. Firms may enjoy lower legal costs, can enhance their reputation, and may improve their relationships with society and shareholders. Societies gain to the extent that firms translate goals into concrete business practices and persuade other firms to follow their example. Often, negotiations to develop Voluntary agreements raise awareness of climate change issues and potential mitigative actions within industry to establish a dialog between industry and government, and help to move industries towards best practices.

There are widely differing views as to the environmental effectiveness of voluntary agreements. Some governments, as well as industry, believe voluntary agreements are effective in reducing GHG emissions. Agreements in the Netherlands have resulted in improvements in energy efficiency beyond what would have occurred in the absence of such agreements; that is on average, between a quarter and a half of the energy savings in the Dutch manufacturing industry can be attributed to the policy mix of the agreements and supporting measures.

Others are more sceptical about the efficacy of voluntary agreements in reducing emissions. Independent assessments of voluntary agreements, while acknowledging that there have been absolute emission improvements brought about by investments in cleaner technologies, indicate that there is little improvement over business-as-usual scenarios, as these investments would have probably happened anyway.

The best voluntary agreements include a clear goal and baseline scenario; third party participation in the design of the agreement; description of the parties and their obligations; a defined relationship with the legal and regulatory framework; formal provision for monitoring, reporting, and independent verification of results at the plant level; a clear statement of the responsibilities expected to be self-financed by industry; commitments in terms of individual companies, rather than as sectoral commitments; and references to sanctions or incentives in the case of non-compliance. While imposing lower costs on industry they require dedicated government resources to be effective. It is the case that voluntary agreements fit into the cultural traditions of some countries better than others. Japan, for instance, has a history of cooperation between government and industry which facilitates the operation of "voluntary" programs.

The Brazilian labelling programme (PBE) *described in Annex 2, Section 2.3* represents both a voluntary agreement and an information instrument. It aims to provide

[8] According to Marino Inchaustegui, the former Finance Minister of Dominican Republic.

information to consumers to facilitate optimizing consumption of electricity in domestic appliances, choose more efficient appliances in terms of energy consumption and improve use of those appliances allowing the saving of energy costs. Participation in the programme is voluntary and testing of the appliances is only on products made by manufacturers and facilities that are willing to participate in the PBE. On the basis of the outcome of the tests made a scale was created to classify appliances and those tests are repeated periodically to update the scale. Those appliances that are tested and labelled showing the best performance in their class may also receive an energy efficiency endorsement (SELO PROCEL), given to the best products on the basis of specific energy consumption. The SELO PROCEL program also contributed for the implementation of the PBE by creating measurement infrastructure.

The Brazilian programme contained a number of elements listed above for a good voluntary agreement, i.e., there was an adequate regulatory framework, appropriate institutional arrangements between governmental institutions and the companies, economic and technical resources, including investment in laboratories to measure performance and compliance with required standards and a dissemination plan and capacity building.

Questions:

- Would voluntary agreements fit with the current policy environment in your country and be a means of educating industry about climate change and opportunities for energy efficiency?
- If so, which industry is likely to be a test case for a voluntary agreement? What would be the main elements of such an agreement?
- What would it take to launch and maintain such an activity in your country?

5.5 Information instruments

There is an array of instruments (television, newspapers, internet, workshops and educational forums) that can inform the public about climate change, the local benefits of different actions and possible ways they can help to reduce emissions. More specific information instruments – such as public disclosure requirements and awareness/education campaigns – may help consumers to make choices that may lead to improved environmental quality or reductions in energy use. Examples of information instruments include labelling programs for consumer products, information disclosure programs for firms, or public awareness campaigns. Some of the most frequently used instruments are labels denoting the automobile gas consumption and labels denoting the consumption of energy and its cost for different electrical appliances.

Information instruments can be used to improve the effectiveness of other instruments. They are popular with industry because they do not impose penalties for environmentally harmful behavior per se. They may also be less expensive than other instruments. However, it is difficult to measure the environmental effectiveness or cost effectiveness of information instruments *(See the case studies on Brazil, Kenya and China in the Annexes for examples of how different countries are using information instruments.).*

Questions:

- Have information instruments been used in your country to educate and inform the public about the environmental consequences or energy consumption and costs?
- Do you think a labelling programme for some sectors would be useful in your country?
- What assistance would you need to make that happen?

5.6 Tradable permits

Tradable permit systems have been or are being implemented in a number of OECD countries. This paper does not go into depth with regard to such systems because relatively few developing countries are currently contemplating such an instrument. However, if such systems allow for the introduction of emission offsets, such as those from CDM projects in developing countries, their design features may be of interest to developing countries.

Briefly, a number of analyses as documented in IPCC 2007 have found that economy-wide approaches are superior to sectoral coverage because they equalize marginal costs across the entire economy. They find significant cost savings to an economy-wide program when compared to a sectoral program coupled with non-market-based policies in the United States and the European Union.

Permits may be allocated directly to emitters, such as energy-using industrial facilities (**downstream**) or to producers or processors of fuels (**upstream**), or to some combination of the two (**a "hybrid system"**). There are two basic options for the initial distribution of permits:

free distribution of permits to existing polluters or auctions. Auctions provide a source of revenue that could potentially address inequities brought about by a carbon policy, creating equal opportunity for new entrants, and avoiding the potential for "windfall profits" that might accrue to emissions sources if allowances are allocated at no charge. Government revenues from auctions may be used to address equity issues through reductions in taxes or other distributions to poor households. Recently, Germany has indicated that it will use a portion of its auction proceeds to fund adaptation projects in developing countries.

Although a tradable permits approach can ensure that a certain quantity of emissions will be reduced, it does not provide certainty of price. **Price uncertainty** may be addressed by a "price cap" or "safety valve" mechanism, which guarantees that the government will sell additional permits if the market price of allowances hits a certain price. The reasoning is that GHGs are of concern as they accumulate over an extended period in the atmosphere. There may therefore be less concern about short-term increases in CO_2 as long as the overall trajectory of CO_2 emissions is downward over an extended period. While no current emissions trading scheme (ETS) has initiated a price cap, such an approach could have long-term implications for the price of emission offsets. *(For a more expansive consideration of emission trading systems, including different types of targets, banking and borrowing provisions, enforcement requirements and the European Union's ETS, see the IPCC 2007 report.).*

There have been several experiments with tradable permits for conventional pollution control in developing countries and economies in transition. For example, there was an experiment with tradable permits for total suspended particulates in Santiago, Chile, which revealed that the permit market was underdeveloped due to high transaction costs, uncertainty, and poor enforcement, but that such a system improved documentation of historic emissions inventories and increased flexibility to address changing market conditions. Several analysts have suggested that strengthening the monitoring and enforcement capacity that would be required to implement conventional pollution trading programs in most developing countries.

The tradable permit systems developed or under construction in OECD countries all permit some form of offsets for credits generated through either domestic projects or the international mechanisms such as CDM of the Kyoto Protocol. Under the **CDM**, more than 3,000 projects are in the pipeline of which 1,090 are registered.[9] However, there is an uneven distribution of CDM projects by type, gas and country as documented in IPCC 2007. Ellis and Kamel (2007) have identified a number of barriers to CDM projects, including:

- *National-level barriers not related specifically to the CDM*, such as the policy or legislative framework within which a CDM project operates, e.g. electricity-related regulations that constrain generation by independent power producers;
- *National-level CDM-related barriers* such as institutional capability/effectiveness or lack of awareness about CDM potential. For example, delays in host country approval of CDM projects can dampen interest in CDM project development;
- *Project-related issues* including availability (or not) of underlying project finance, or other country or project-related risks that render the performance of the project uncertain;
- *International-level barriers* such as constraints on project eligibility (e.g., on land use and forestry projects), available guidance and decisions (e.g. with respect to the inclusion of carbon capture and storage projects).

Barriers to CDM development can arise at different parts of the CDM project cycle. The relative importance of particular barriers varies between countries as well as over time. A combination of factors is needed to drive growth in a country's CDM activity. This includes the presence of attractive CDM opportunities, a positive investment climate, and an enabling policy and legislative framework (in general, as well as CDM-specific). Some barriers to CDM development can be reduced relatively simply and cheaply. These include CDM-specific actions such as establishing a simple, timely and transparent CDM project approval process and a clear policy on CDM-relevant issues such as ownership of CDM credits or the national-level eligibility of certain project types. Other, more general, actions can also help to reduce barriers. These include reducing participation/ownership

[9] As of June 24, 2008. See: www.unfccc.int.

restrictions on foreign investment and ownership in sectors liable to CDM investments.

Questions:
- Does your country have a clear legal framework and process for CDM projects?
- If your country has not been able to develop a CDM project, what are the main domestic issues that need to be clarified?
- Are there specific 'immediate' actions that the CDM Executive Board could take to facilitate the development of CDM projects in your country?
- What additional steps might be addressed through the negotiations to facilitate the development of projects?

5.7 Research and development

The need for R&D in changing the trajectory of the energy emissions is unquestionable. The IPCC (2007) notes that the range of stabilization levels assessed can be achieved by deployment of a portfolio of technologies that are currently available and those that are expected to be commercialized in coming decades. However, it also notes that investments in and world-wide deployment of l**ow-GHG emission technologies**, as well as technology improvements through public and private research, development & demonstration (RD&D) would be required for achieving stabilization targets as well as cost reduction. The lower the stabilization levels are, especially those of 550 ppm CO_2-eq or lower, the greater the need for more efficient RD&D efforts and investment in new technologies during the next few decades will be. For some high risk technologies government support will clearly be needed.

Governments in OECD countries, which account for most energy research, use a number of tools to support R&D, such as grants, contracts, tax credits and allowances, and public/private partnerships. Total public funding for energy technologies in IEA countries in the period 1987-2002 was $291 billion, with 50% allocated to nuclear fission and fusion, 12.3% to fossil fuels and 7.7% to renewable energy technologies. Funding has dropped after the initial interest created through the oil shock in the 1970s and has stayed constant, even after the UNFCCC was ratified. The capacity of developing countries to pursue R&D programmes in the main depends on the size of their economies and status of their institutions, but is generally more limited.

Many countries pursue technological R&D as a national policy to foster the development of innovative technologies or help domestic industries to be competitive. Countries chose to cooperate with each other in order to share costs, spread risks, avoid duplication, access facilities, enhance domestic capabilities, support specific economic and political objectives, harmonize standards, accelerate market learning and create goodwill. Cooperation, however, may increase transaction costs, require extensive coordination, raise concerns over intellectual property rights (IPRs) and foreclose other technology pathways. It may also be a path to reducing tension over IPRs if developing countries participate from the beginning as equal partners in an R&D programme.

Analysts have examined several policy options to promote renewables. They indicate that research subsidies are an expensive way to achieve emission reductions, in the absence of higher prices. A specific example arises from the Danish experience with wind technologies. In that case, despite significant support for wind energy R&D during the 1980s, wind power only boomed in Denmark when favourable feed-in tariffs were introduced, procedures for construction were simplified and priority was given for green electricity. Others have found that the ability to raise capital and take risks has played a much larger role in the recent expansion of the photovoltaic industry than other factors such as learning by experience.

Questions:
- Does your government support any R&D programmes that aim to develop or deploy GHG mitigation technologies? If so, what sectors or technologies are of particular interest?
- What means does it use to share information and results with other governments?
- What would be necessary to enable your government to participate in a cooperative international programme?

5.8 Non-climate change policies and other national priorities

A number of non-climate national priorities and policies can have an important influence on GHG emissions. These include: policies that focus on poverty, land use and land use change, energy supply and security; international trade, air pollution, structural reforms, and population policies. These non-climate policies could offer countries

an opportunity to assess and develop synergistic sustainable development strategies at a time of limited financial and human resources in developing countries.

For example, **poverty** reduces the resilience of vulnerable populations and makes them more at risk to the potential impacts of climate change, but it also leads communities to take measures that may increase emissions. If poverty can be reduced without raising emissions, a strategy to reduce poverty will be seen as a way to reduce emissions as well as enhance resilience. Typical areas of synergy included small-scale renewables and community forestry. The case study of efficient cook stoves in Kenya *(Annex 3.1)* is an example of how the climate may benefit from efforts to improve the lives of the poor, reduce local air pollution, and reduce wood consumption.

Land use policies (or lack thereof), whether terrestrial (agriculture, forestry, nature), aquatic (wetlands) or urban, can lead to enhanced emissions. Policies that aim to integrate climate change concerns with those of local people may yield major synergies. For example, within the Netherlands, a major programme is currently underway to understand how spatial planning and climate change policy can be effectively linked. Regional (acid rain abatement), local and indoor air pollution policies can also have climate change co-benefits.

Consumption of natural resources is ultimately one of the major drivers of global emissions. The global population and income levels affect the consumption of natural resources, particularly energy, food and fiber, and hence can also affect GHG emissions. Consumption patterns vary significantly between developed and developing countries. The IPCC 2007 notes that changes in lifestyle and behavior patterns can contribute to climate change mitigation across all sectors and lifestyles and that consumption patterns that emphasize resource conservation can contribute to developing a low-carbon economy that is both equitable and sustainable. It further notes, among several examples that management practices, education and training programmes, and industrial management tools can affect consumption patterns.

5.8.1. National policy interactions/ linkages and packages

Single instruments are unlikely to be sufficient for many environmental problems, including climate change mitigation; rather it is likely to take a portfolio of policies *(see IPCC, 2001)*. However, the application of two or more overlapping instruments could diminish economic efficiency while increasing administrative costs. In practice, however, there are market failures that make a mix of instruments desirable. We note for example, that the rapid increase in renewable investments has come about largely because of a combination of regulations and financial incentives shown in Box 2. Also to be noted, the lists in Box 2 contain a combination of regulations, standards, and rules at different levels of government. Vertical policy integration is an important requirement to overcome many implementation barriers as demonstrated by the developing countries with multiple policies in Table 1 and by the case studies.

Box 2: Examples of standards, regulations, rules and financial incentives used in some countries to promote the deployment of renewable technologies

Regulations, standards and rules:
Renewable Performance Standards
Performance standards for new facilities
Green power purchasing requirements
Interconnection standards
Net metering rules
Generation disclosure rules
Contractor licensing
Equipment certification
(Solar) access laws/guidelines/zoning codes/building permits

Financial incentives:
Feed in tariffs
Rebates
Grant programmes
Loan programmes
Bonds
Production incentives
Government purchasing programmes
Equity investments, including venture capital
Insurance programmes

Source: Adapted from DSIRE website http://dsireusa.org/Index.cfm?EE=0&RE=1

Table 1: Examples of renewable energy promotion policies in selected developing countries

Country	Feed-in tariff	Renew-able portfolio stan dard-	Capital sub-sidies, grants, or rebates	Invest-ment excise, or other tax credits	Sales tax, energy tax, or VAT reduc-tion	Trad-able renew-able energy certifi-cates	Energy produc-tion pay-ments or tax credits	Net Mete-ring	Public invest-ment, loans, or finan-cing	Public compe-titive bidding
Argentina			X				X			
Brazil	X								X	
China	X		X	X	X				X	X
Guatemala				X						
India	(*)	(*)	X	X	X				X	X
Indonesia	X									
Mexico								X	X	
Morocco										
Nicaragua	X			X						
Philippines				X	X				X	
Sri Lanka	X									
Thailand	X	X	X					X		
Turkey	X		X							
Vietnam										

Source: Erik Martinot

There are several requirements for applying an environmentally and economically effective instrument mix. First, there is a need to have a good understanding of the environmental issues to be addressed. In practice, many environmental issues can be complex. A tax can affect the total demand for a product and the choice between different product varieties, but is less suited to address, for example, how a given product is used and when it is used. Hence, other instruments could be needed. A second requirement is to have a good understanding of the links with other policy areas. In addition to coordinating different environmental policies, co-ordination with other related policies and consistency among policy goals is needed. A third requirement is to have a good understanding of the interactions between the different instruments in the mix. In this regard, depending on their designs, modelling tools can provide some insights into policy interactions. Finally, the exchange of information among ministries is essential to the implementation of good policies. *(See IPCC 2007 for a more elaborate discussion of when a combination of policies may be desirable.)*

5.8.2. Institutions

A number of the case studies in the Annexes point to the need for well-functioning institutions and/or, when none are present, for reforms. Such was the case of Senegal, which, when faced with the need to provide greater access to electricity for the poor, passed new laws that liberalized the electricity sector, set up a commission to develop regulations, created the Senegalese Rural Electrification Agency dedicated to the implementation the rural electrification policy, and allowed the creation of Public/Private Partnerships. Other countries such as China, with its heavily centralized institutions, are reorganizing, downsizing, and decentralizing over-burdened institutions. In China's case, the institutional capacities at the provincial and county level are very weak. China recognizes this issue. To strengthen the system, the energy bureau within the National Development and Reform Commission was upgraded to a State Bureau of Energy in March 2008.

The lessons from these and other case studies is that if national policies are to be well designed and implemented

effectively, strong institutions are needed. The cases demonstrate that there are still substantive needs for institutional capacity building at both central and local levels in most developing countries for the smooth implementation of policies.

Questions:

- Can you identify the non-climate national policies that are likely to have the greatest impact on GHG emissions in your country?
- Is there a way to quantify the effects of a possible change in policy over the next 10-20 years? What would it take to implement such a policy?
- Given your knowledge of the policies in your country and reflecting on the case studies in the Annexes, what additional local, state or national policies, institutions, financing and/or other arrangements are needed to promote renewable/energy efficiency in your country?

6. ASSESSING POLICY INSTRUMENTS

Evaluating instruments based on the criteria we have discussed is challenging for two reasons. First, practitioners must be able to compare potential instruments based on each of the evaluative criteria. However, in many cases it can be difficult to rank instruments in an objective manner. For example, ranking environmental policy instruments based on their technology-stimulating effects is particularly difficult, as is assessing distributional considerations in some cases. Second, policymakers must determine how much weight to assign each of the evaluative criteria. Consider two instruments that are equally environmentally effective and both institutionally feasible, but one has unfavourable distributional implications while the other is less cost-effective. To choose one instrument over the other one must assess the relative importance of distribution vs. cost-effectiveness. Determining these weights is a subjective question, left to policy makers to decide.

Table 2: National environmental policy instruments and evaluative criteria

	CRITERIA			
Instrument	Environmental effectiveness	Cost-effectiveness	Meets distributional considerations	Institutional feasibility
Regulations and Standards	Emissions level set directly, though subject to exceptions. Depends on deferrals and compliance.	Depends on design, uniform application often leads to higher overall compliance costs.	Depends on level playing field. Small/new actors may be disadvantaged.	Depends on technical capacity. Popular with regulators, in countries with weak functioning markets.
Taxes and Charges	Depends on ability to set tax at a level that induces behavioural change.	Better with broad application. Higher administrative costs where institutions are weak.	Regressive. Can be ameliorated with revenue recycling.	Often politically unpopular. May be difficult to enforce with underdeveloped institutions.
Tradable Permits	Depends on emissions cap, participation and compliance.	Decreases with limited participation and fewer sectors.	Depends on initial permit allocation. May pose difficulties for small emitters.	Requires well functioning markets and complementary institutions.
Voluntary Agreements	Depends on programme design, including clear targets, a baseline scenario, third party involvement in design and review, and monitoring provisions.	Depends on flexibility and extent of government incentives, rewards and penalties.	Benefits accrue only to participants.	Often politically popular. Requires significant number of administrative staff.
Subsidies and Other Incentives	Depends on programme design. Less certain than regulations/standards.	Depends on level and programme design. Can be market distorting.	Benefits selected participants, possibly some that do not need it.	Popular with recipients; potential resistance from vested interests. Can be difficult to phase out.
Research and Development	Depends on consistent funding, when technologies are developed, and polices for diffusion. May have high benefits in long-term.	Depends on programme design and the degree of risk.	Benefits initially selected participants. Potentially easy for funds to be misallocated.	Requires many separate decisions. Depends on research capacity and long-term funding.
Information Policies	Depends on how consumers use the information. Most effective in combination with other policies.	Potentially low cost, but depends on programme design.	May be less effective for groups (e.g., low-income) that lack access to information.	Depends on cooperation from special interest groups.

Note: Evaluations are predicated on assumptions that instruments are representative of best practice rather than theoretically perfect. This assessment is based primarily on experiences and literature from developed countries, as peer reviewed articles on the effectiveness of instruments in other countries was limited. Applicability in specific countries, sectors and circumstances – particularly developing countries and economies in transition – may differ greatly. Environmental and cost effectiveness may be enhanced when instruments are strategically combined and adapted to local circumstances.
Source: IPCC 2007

Nevertheless, it is possible to make general statements about each instrument according to the criteria we have selected. For instance, it is generally believed that market-based instruments will be more cost effective than regulations and standards. However, this belief implicitly assumes that a country has well-functioning institutions, the lack of which can make market-based instrument more costly to implement. Table 2 (*previous page*), taken from the IPCC 2007, summarizes the seven climate-related instruments presented in this chapter for each of the four criteria.

7. RELATIONSHIP OF NATIONAL POLICIES TO A FUTURE INTERNATIONAL CLIMATE CHANGE AGREEMENT

The reasons for an international agreement are well covered in the IPCC 2001 and 2007, in particular, the global nature of the problem and the fact that no single country has more than approximately 20% of global emissions. This means that successful solutions will need to engage multiple countries. Similarly, the fact that no one sector is responsible for more than about 25% of global emissions (the largest sector is that of electricity generation and heat production at 24% of the global, six-gas total) implies that no single sector will be uniquely required to act.

Recent literature has noted the limitations of existing international agreements to address climate change. In fact, there are no authoritative assessments of the UNFCCC or its Kyoto Protocol that assert that these agreements have succeeded – or will succeed without changes – in fully solving the climate problem. As its name implies, the UNFCCC was designed as a broad framework and the Kyoto Protocol's first commitment period for 2008 to 2012 only as a first detailed step. Both the Convention and the Kyoto Protocol include provisions for further steps as necessary.

A number of limitations and gaps in existing agreements are cited, namely:

- The lack of an explicit long-term goal means countries do not have a clear direction for national and international policy[10];
- The targets are not sufficiently stringent;
- The agreements do not engage an adequate complement of developed and developing countries;
- The agreements are too expensive;
- The agreements do not have adequately robust compliance provisions; and
- The agreements do not adequately promote the development and/or transfer of technology.

To address these limitations in the post 2012 period, Parties to the UNFCCC and to the Kyoto Protocol met in Bali, Indonesia, from December 3 to 14, 2007. Negotiators agreed on a two year process to finalize a post 2012 regime by December[11], 2009. The key elements are contained in UNFCCC decision 1/CP.13 on the Bali Action Plan, adopted by consensus on December 15 (UNFCCC 2007).

The Bali Plan of Action seems to provide an opportunity to foster a global response to climate change. The Plan retains distinctions between the responsibilities of developed and developing countries with respect to their mitigation actions[13]. Actions by developed countries may include measurable, reportable and verifiable nationally appropriate mitigation commitments, or actions including quantified emission limitation and reduction objectives, while ensuring the comparability of efforts among them, taking into account differences in their national circumstances; while those of developing countries are to include nationally appropriate mitigation actions in the context of sustainable development, supported and enabled by technology, financing and capacity-building, in a measurable, reportable and verifiable manner.

Each of the **Bali Action Plan building blocks** (i.e., mitigation, adaptation, technology transfer, and financing) will represent a special challenge for the negotiators over the next several years, but finding a means to reduce the level and growth rates of emissions and to improve the cost-effectiveness of, and generate sufficient, predictable and sustainable financial resources for mitigation will be a particularly crucial task.

An analysis of the financial resources and investment that would be required for mitigation and adaptation undertaken by the UNFCCC secretariat indicates that significant changes in the existing patterns of public and private investment and financial flows will be required (UNFCCC 2007b). Additional investment and financial flows in 2030 to address climate change amounts to 0.3-0.5% of global domestic product and 1.1-1.7% of global investment. This is a small amount in overall global GDP, but large compared to the currently available public and

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[10] The IPCC report notes that under regime designs for low and medium concentration stabilization levels, i.e. 450 ppm CO_2-eq, GHG emissions from developed countries would need to be reduced substantially during this century, i.e., 25 to 40% by 2020 and that, substantial deviation from baseline would be required in Latin America, Middle East, East Asia and Centrally-Planned Asia by 2020.

[11] This process will build on the work of the Ad Hoc Working Group on Further Commitments of Annex I Parties under the Kyoto Protocol (AWG-KP) and a "Dialogue" to consider long-term cooperation under the Convention as initiated at COP11 in Montreal in December 2005. The main purpose of both processes was to exchange information and ideas regarding a follow-up to the Kyoto Protocol.

[12] See the paper by Harald Winkler that is part of this series titled *Climate change mitigation negotiations, with an emphasis on options for developing countries*.

[13] See decision 1/CP.13 for full text (UNFCCC, 2007a).

private financial resources for climate change. Total investment in new physical assets is projected to triple between 2000 and 2030. Due to rapid economic growth, a large share of these investments will occur in developing countries using internally generated funds, through foreign direct investment, the carbon market and through other financial mechanisms related to the Convention. As with any such global analysis, the circumstances of any individual country will differ.[14]

There is little doubt that additional investments are needed. Yet, a dilemma that has faced climate change negotiations since 1992 has been how to separate out development needs from the extra cost of addressing climate change. What should the international community pay for versus developing countries because it is in their national development and economic interest? One way to overcome this dilemma is for developing country negotiators to articulate how they will contribute to the global effort by changing the trajectory of their emissions as noted in IPCC 2007 through the adoption/modification of national policies, if additional technological and financial assistance is forth coming. Moreover, careful consideration of the state of national policies in developing countries would seem to be a useful step even without any consideration of how such information might be applied in the context of the negotiations.

Finally, one additional concept needs consideration, that is, the concept of sustainable development policies and measures (SDPAMs) as a contribution to the global effort. The basic idea behind this concept is that in many cases addressing the sustainable development goals of developing countries may also be the most effective way of stimulating reductions in greenhouse gas emissions. In most cases, these SDPAMs do not need to be based on emission limits or on a carbon price. They can be aimed directly and wholly at meeting the sustainable development goals of the host country. Critics have noted the difficulty of quantifying the benefits of such actions, however, if the link between the two can be made clearer, a hurdle in the negotiations may be overcome.[15]

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[14] See the paper by Erik Haites that is part of this series titled *Negotiations on additional investment and financial flows to address climate change in developing countries* for additional details on investment needs and options to increase funding to developing countries.

[15] See the paper by Harald Winkler that is part of this series titled *Climate change mitigation negotiations, with an emphasis on options for developing countries* for more details.

8. THE POLICY MAKING PROCESS

Each country has a policy making process, that regardless of the form government, is complex and unique. It is often the case that while individuals may be aware of the benefits of actions that have both local and climate change benefits, that awareness is not always extended to the whole set of governmental decision makers. Hence, in terms of mitigation policies and measures, an essential first step may entail enhancing awareness within ministries and across the government to ensure consistency and synergies in policy making and implementation.

Secondly, even if a problem is recognized, information may be insufficient for adequate policy design, for example developing marginal abatement cost curves. Trying to assess the benefits of a policy and the costs of inaction may be hindered or impeded by fragmentary information. Overcoming this barrier may require competing for budgetary resources with other programmes, and national priorities or finding funding from other sources and governments.

Third, national capacity to elaborate scenarios – economic, energy and climate, and to model future trends and the evolution of key variables, is sometimes limited in developing countries. This can impair the quality of decision making, or reducing the scope of policy options being considered. At worst, that capacity may be missing and the necessary analysis that informs policy design may consequently be missing.

While acknowledging that these constraints are inherent to policy making in developing countries, it is recognized that climate change intensifies the effect of such constraints as it creates new challenges. Climate change adds an additional dimension to efforts to promote sustainable development. On the one hand, because resources otherwise needed to alleviate poverty or enhance income distribution, among other goals may need to be channelled to address climate change impacts or to facilitate mitigation policies that may be initially be more expensive such as, the deployment of the some renewable energies technologies. On the other hand, uncertainty on the nature, intensity, frequency and timing of impacts may artificially enlarge the magnitude of resources needed to tackle the problems of adaptation thereby creating additional financial constraints and diminishing economic efficiency. Finding synergies between sustainable development goals and responses to climate change is therefore important.

More broadly, there are dynamic tensions in developing countries between economic growth, development, environmental preservation, poverty alleviation, or energy security, among other critical goals. In that regard mitigation policies might be seen as improving the overall efficiency and security of an economy, e.g., by reducing the need for imported oil. However, this is not always the case as they may be viewed as an unnecessary diversion of key resources.

Questions:

- Are the institutional arrangements and policy making processes in your country adequate in the short term (the next couple of years) to tackle the broad set of issues that need to be addressed?
- How can the constraints noted above be measured and needs quantified in order to justify funding and capacity building?
- What are the effects of these constraints when defining national positions at the negotiations?
- What are the effects of those constraints in terms of prioritization of sectors/planning/policy development/ opportunities?
- What can you personally do to overcome them?

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Internet websites with information on national policies

International Energy Agency
http://www.iea.org/textbase/pm/index_effi.asp

World Resources Institute
http://cait.wri.org/sdpams/search.php

ANNEXES

Annex 1. Asia

1.1 Renewable/wind policy in India

1.1.1. Background

India is endowed with abundant renewable energy sources – solar, wind, biomass, and small hydroelectric – and the government is working proactively to develop them. Under the "Power for All by 2012" initiative, the government has envisaged universal electricity supply by 2012. So far only 56% of the households have access to electricity.

India is the third largest electricity consumer in Asia behind China and Japan. As of 31 December 2006, installed power generation capacity in India was 127,753 MW. Thermal power plants, mostly coal-fired, provide 66% of the installed capacity. Hydropower accounts for 26% of the capacity, with gas and oil fired thermal plants, renewable energy plants, and nuclear plants providing the remaining 8%.[16]

As the Indian power sector has grown, India has become increasingly dependent on fossil fuels. With continued and sustained hikes in oil and gas prices in recent years, as well as the expected fossil fuel shortages in the future, the security of energy supply in India has generated increasing concern. The environmental concern over excess use of fossil fuels is also on the rise. In this context, India urgently needs to explore sustainable energy development, and the government has been working proactively to promote the use of renewable energy sources.

Among the renewable power resources available in India, wind energy is a promising source for further development. India has over 45,000 MW of gross potential and 13,000 MW of technical potential for wind power. As of September 2007, India had over 7,200 MW of installed wind power capacity, ranking the country fourth in the world after Germany, United States, and Spain. While the 10th Five Year Plan (2002-2007) targeted a 2,200 MW increase of installed wind power capacity, over 5,400 MW was actually installed.[17]

The government has provided support measures to increase renewable energy contributions in the country. It has also issued policy guidelines for the state governments to establish and maintain state-specific policies to promote renewable power projects. The promotional measures available to renewable energy projects comprise a wide range of fiscal and financial incentives, including soft loans, concessional customs duties, exemption from excise duty, tax holidays, and accelerated depreciation benefits.

1.1.2. Objective of the policy

To support the development of renewable energy, the government has stipulated a national objective of achieving 10% of the capacity additions for the period 2002-2012 from renewable energy sources.

1.1.3. What policy instruments were used/had to be passed to achieve the objective?

The government is proactively encouraging development of renewable energy sources. The government's efforts to promote renewable energy started in the early 1980s after the first and second global oil price shocks. The government created the Commission for Additional Sources of Energy in 1981 and Department of Non-Conventional Energy Sources in 1982. The Department of Non-Conventional Energy Sources was transformed into the Ministry of Non-Conventional Energy Sources (MNES) in 1992, and then was renamed the Ministry of New and Renewable Energy (MNRE) in 2006. The National Electricity Policy, issued by the Ministry of Power in 2005, contains a major thrust toward the development of renewable energy sources. MNRE is the nodal ministry in the government for all matters relating to new and renewable energy. Its main functions include:

- Policymaking and planning;
- Program formulation and implementation;
- Research and development;
- Technology development and commercialization;
- Promotion of demonstration and pilot projects; and
- Implementation of fiscal and financial incentives.

The MNES (now MNRE) established the Centre for Wind Energy Technologies at Chennai as an autonomous R&D institution of the government and as a technical focal point for India's wind power development. The

[16] Ministry of Power. 2007. Report of the Working Group on Power for Eleventh Plan (2007–2012). New Delhi.
[17] Ministry of New and Renewable Energy Annual Report 2006–2007. New Delhi.

centre provides developers with technical services, including wind resource assessment for project sites, testing and certification services for equipment, and training and capacity-building services. Technological advancements are gradually increasing the commercial viability of wind power projects.

Fiscal and financial incentives provided by the national and state governments have traditionally driven the development of wind power projects in India. The incentives being provided by the government include:

- 80% accelerated depreciation of project costs for wind power projects (in the initial stages 100% accelerated depreciation was allowed);
- Concessions or full exemption on customs duties of certain imported components of wind turbines;
- Tax holiday for a maximum of 10 consecutive years within 15 years of commissioning, which is available for infrastructure projects;
- Concessional loans available through Government-owned agencies, including Indian Renewable Energy Development Agency Limited, Power Finance Corporation Limited, and Rural Electrification Corporation Limited.

The Electricity Act, 2003 requires all state-level energy regulatory commissions to ensure that electricity distributors procure a specified minimum percentage of power generation from renewable energy sources. The midterm appraisal of the 10th Five Year Plan by Planning Commission included the following recommendations for the renewable energy sector:

- Explore alternative subsidy structures that encourage utilities to integrate wind, small hydroelectric, cogeneration, etc., into their systems;
- Phase out capital subsidies linked to the creation of renewable capacity in favour of subsidies linked to renewable energy generated;
- State electricity regulatory commissions should mandate the purchase of energy from renewable sources, as per the provisions of the Electricity Act;
- Improve coordination and synergize the programs of MNRE with similar programs of other central ministries and state governments.

1.1.4. Key factors needed to make something happen

Several factors supported the development of the wind-based electricity generation in India. On the technical side, the government undertook extensive wind mapping studies in the mid-80s. Besides providing policy support it also established the India Renewable Energy Development Agency to channel concessional finance into renewable energy projects. Wind energy projects capitalized on this facility in a significant manner. The government further set up the Centre for Wind Energy Technologies to cover R&D, technology upgrading, testing, certification and standardization in association with the wind turbine industry. The technological support and the fast growth in the sector as a result of the various policies encouraged local industry to collaborate with foreign firms and establish local manufacturing capacity.

1.1.5. What has happened as a result of the policy and instruments that were introduced?

The policies and instruments and their constant adaptation and modification have resulted in the commercialization of the wind electricity technology in the country. At present, wind turbines of 1 MW and above are being manufactured in India. A major evolution in the policy was a shift in focus from "capacity additions" to "generation based incentives". The initial growth in capacity was followed by a lull in capacity additions. However, international policy instruments like the CDM added fillip to the growth in wind based power generation in India. The sector continues to benefit from the national and state level policies for promoting renewables. For example, innovative business models are being developed where firms with technical capability develop projects that are sold to the private investors. The technical firms continue to operate and maintain the wind farms through a maintenance contract.

1.1.6. List of relevant laws, regulations and rules

Electricity Act 2003

Section 86. (1): "The State Commission shall discharge the following functions… (e): promote cogeneration and generation of electricity from renewable sources of energy by providing suitable measures for connectivity with the grid and sale of electricity to any person, and also specify, for purchase of electricity from such sources, a percentage of the total consumption of electricity in the area of a distribution licensee".

National Electricity Policy 2005

The National Electricity Policy 2005 stipulates that the

share of electricity from non-conventional sources would need to be progressively increased; with purchase by distribution companies through a competitive bidding process. Considering that it will take some time before non-conventional technologies compete, in terms of cost, with conventional sources, the state commission may determine an appropriate deferential in prices to promote these technologies.

Tariff Policy 2006

The Tariff Policy announced in January 2006 has the following provisions:

- Pursuant to provisions of Section 86 (1) (e) of the Act, the Appropriate Commission shall fix a minimum percentage for purchase of energy from such sources taking into account availability of such resources in the region and its impact on retail tariffs. Such percentages for purchase of energy should be made applicable for the tariffs to be determined by the State Electricity Regulatory Commission (SERC) latest by April 1, 2006.
- It will take some time before non-conventional technologies can compete with conventional sources in terms of cost of electricity. Therefore, procurement by distribution companies shall be done at preferential tariffs determined by the Appropriate Commission.
- Such procurement by Distribution Licensees for future requirements shall be done, as far as possible, through competitive bidding process under Section 63 of the Act within suppliers offering energy from same type of non-conventional sources. In the long-term, these technologies would need to compete with other sources in terms of full costs.
- The Central Commission should lay down guidelines within three months for pricing non-firm power, especially from non-conventional sources, to be followed in cases where such procurement is not through competitive bidding.

National Rural Electrification Policies, 2006

- Goals include provision of access to electricity to all households by 2009, quality and reliable power supply at reasonable rates, and minimum lifeline consumption of 1unit/household/day as a merit good by 2012.
- For villages/habitations where grid connectivity would not be feasible or not cost effective, off-grid solutions based on stand-alone systems may be taken up for supply of electricity. Where these also are not feasible and if only alternative is to use isolated lighting technologies like solar PV, these may be adopted. However, such remote villages may not be designated as electrified.
- State government should, within six months, prepare and notify a rural electrification plan, which should map and detail the electrification delivery mechanism. The plan may be linked to and integrated with district development plans. The plan should also be intimated to the appropriate commission.
- Gramapanchayat shall issue the first certificate at the time of the village becoming eligible for declaration as electrified. Subsequently, the Gramapanchayat shall certify and confirm the electrified status of the village as on 31 March each year.

1.2 Energy efficiency policies in China

1.2.1. Background

China has the largest population in the world and is amongst the highest rate of economic growth. However, many of its people live in poverty. The government's objective is to lift its people out of poverty through continued economic development. China is the second largest consumer of energy in the world and its future growth will increase its energy requirements significantly making it the largest energy consumer by 2015.

China's relative dearth of high-quality energy resources hinders its supply capability. Its imbalanced distribution makes it difficult to secure a continued and steady supply; and the pattern of economic growth, irrational energy structure, unsatisfactory energy technology and relatively poor management have resulted in higher energy consumption per-unit GDP for the major energy-consuming products. Constrained supply is, thus, further intensified by high energy intensity. Consequently, meeting increasing energy demand just by increasing energy supply has its limitations and it is well recognized that action to lower energy intensity is essential.

In recent years, a host of programs have been formulated to address the problem of low energy efficiencies, including: 10 energy conservations, top 1,000 energy-using enterprises, retirement of inefficient power-generation stations and industrial plants, power generation dispatch scheduling based on energy efficiency, demand-side energy efficiency management, clean coal initiative, use of coal-bed methane and waste coal, green light stimulation,

energy efficiency in transportation, urban and rural environment management, and energy-efficient labelling and certification. *(See 1.2.6 for more details.)*

1.2.2. Objective of the policy

China has set itself the goal of quadrupling its GDP by 2020 (from 2000) while only doubling its energy consumption. Although as a non-Annex I country China is not obliged to commit itself to binding quantified emission reduction during the first period of the Kyoto Protocol (2008–2012), in an attempt to mitigate GHG emissions, the national climate change program has set the following mandatory quantified targets for 2010:

- Reduce the consumption of energy for every 10,000-yuan of gross domestic product from 1.22 tons of standard coal equivalent in 2005 to below one ton – a reduction of 20%;
- Raise the share of renewable energy in the primary energy supply to 10% (from 7% in 2005);
- Extract 10 billion m3 of coal-bed methane;
- Cap nitrous oxide emissions from industrial processes at the 2005 level;
- Increase the forest coverage rate to 20%;
- Increase the carbon sink by 50 million tons over the 2005 level.

1.2.3. What policy instruments were used/had to be passed to achieve the objective?

In the early 80s, China adopted the principle of "promoting both development and conservation, but conservation first," making energy and resource conservation a priority in energy and industrial policy. In the late 80s, China began paying more attention to growth patterns and economic structural adjustment with an eye to reducing the consumption of energy and other resources, promoting cleaner production, and reducing industrial pollution. A series of industrial policies were instituted with the goal of accelerating the growth of tertiary industry (normally low energy intensity), improving energy efficiency in secondary industry, and discouraging quick expansion of energy-intensive industries. Since then, the State Council and relevant ministries have issued a series of energy and resource conservation rules. A three-tier energy and resource conservation management system has been set up at the central, local, industrial and enterprise levels. It has also established standards, labelling, and certification of energy efficiency, and included "energy efficiency" in procurement requirements. In 1997, the Energy Conservation Law was issued in support of these efforts. The law was amended in 2007 to strengthen its provisions. Some policies and measures undertaken are listed in the last section.

At the turn of the 21st century, China responded to the stresses on natural resources with a "green strategy," which sought to:

- Improve overall planning for regional economic development, especially with respect to the efficient use of land, water, and energy resources and local environmental absorption capacity;
- Improve technologies and management practices thereby promoting efficient resource use;
- Replace or retrofit old equipment so as to attain higher energy and resource efficiency;
- Explore new sources for resource substitution (e.g., clean and renewable energy, energy-efficient construction materials).

In May 1996, the State Planning Commission, the State Economic and Trade Commission, and the State Science and Technology Commission jointly formulated the Policy Outlines for Energy Conservation Technologies in China, which provided targets for energy saving by the various sectors of the economy. They recommended 106 energy-saving technologies for large-scale adoptation, and introduced policies that promoted market development for technological services on energy conservation, restructuring of corporate energy management systems, and privatization of energy utilities.

In November 2006, the Ministry of Finance increased export taxes on energy-intensive industries. This included a 15% export tax on copper, nickel, aluminium, and other metals, a 10% tax on steel primary products, and a 5% tax on petroleum, coal and coke. Simultaneously, import tariffs on 26 energy and resource products, including coal, petroleum, aluminium, have been cut from their current levels of 3–6% to 0–3%. These tax changes aim to discourage the export of energy-intensive products and to conserve energy. They were triggered when elevated international prices started stimulating large investments in energy-intensive industries, particularly copper, aluminium, and steel.

China recognizes that only with improved energy technologies can it achieve its targets for development and economic growth while avoiding energy shortages and coping with global climate change. In 2006, the Outline

of National Medium- and Long-term Science and Technology Development Plan (2006–2020) were issued. The latter identified innovation as a new national "strategy" for which China will:

- Invest more than 2.5% of its GDP in R&D;
- Ensure that the contribution of science and technology to economic development exceeds 60%; and
- Reduce its dependence on foreign technologies to under 30%.

1.2.4. What has happened as a result of the policy and instruments that were introduced?

Energy intensity has started to decline recently, although less than the annual target of 4%. This was mainly the result of aggressive adjustments made to the structure of the economy, increases in productivity, technological progress, and more efficient ways of using energy.

From 1991 to 2005, China had an annual GDP growth rate of 10.2%, supported by an annual energy consumption growth rate of 5.6%. This resulted in an energy consumption elasticity of 0.55. Other examples of energy efficiency measures include the following. By December 2007, China had shut down 553 small (average capacity 23 MW) and inefficient power generation units, totalling 14.38 GW and 43.8% more than the 2007 target. Electricity generation from the old units has been replaced by larger and more efficient units. New energy efficiency labels, similar to the US ENERGY STAR program, were introduced to encourage consumers to use the more energy efficient appliances. *More examples are listed in Section 1.2.6.*

1.2.5. Key factors needed to make something happen

China has achieved significant improvement in its energy intensity and energy efficiency. However, it is below the stated and ambitious target and there is scope for further improvement in the following areas:

- **Consistency.** Many policies and regulations are developed over several stages, by various government agencies, for different purposes, and with targeted focuses. They may not necessarily consistent with each other. For example, the policy of promoting high efficiency technologies but at the same time reduced dependence on foreign technologies.
- **Coordination.** Fiscal, financial, and environmental policies are formulated by the Ministry of Finance, Central Bank, and State Environmental Protection Agency (SEPA), respectively. Energy sector operations and large project approvals are controlled by the National Development and Reform Commission (NDRC). Relevant line ministries (e.g., Ministry of Construction, Ministry of Science and Technologies, Ministry of Agriculture) have been playing their own roles. Apparently, coordination among these government agencies needs to be further strengthened.
- **Institutional Arrangements.** The central government has been reorganized and downsized and implementation for energy development and conservation has been decentralized and assigned to various agencies, many of which are claiming to be over-burdened. The institutional capacities at the provincial and county level are very weak. China recognizes this issue and to strengthen the system the energy bureau within NDRC was upgraded to a State Bureau of Energy in March 2008. But there are still substantive needs for institutional capacity building at both central and local levels for the smooth implementation of these policies.
- **Implementation Procedures.** Many policies in China have focused on laying out broad guidelines and overall targets. Implementation procedures need to be worked out in detail in order to carry out these polices. For example, the procedure to measure and monitor energy savings and pollution reduction needs to be systematically established to ensure actual award of fiscal incentives (e.g., subsidies, tax privileges, and allowances for accelerated depreciation). Energy efficiency standards and labelling systems need to be put in place to phase out energy-inefficient appliances. Approximately 2 billion m^2 of floor area is being constructed annually in China, accounting for half of the world's total. Based on this trend, China will build another 20-30 billion m^2 of floor space between now and 2020. Despite the issuance of a number of building standards and regulation, so far, among the existing 40 billion m^2 of buildings, only 4% have been considered for energy efficiency improvements, mainly by adopting energy-efficient heating and cooling systems. There is a need for stronger enforcement of existing law, rules and regulations.
- **Support to Market Mechanism Development.** Currently, most policies in China are implemented through administrative means (e.g., allocating energy conservation requirements to provinces and large industrial enterprises, linking results of energy conservation to the performance evaluation of local officials).

Insufficient efforts have been put to inducing enterprises to voluntarily participate in energy conservation and pollution control (that would also enhance long-term competitiveness and profitability), to encourage local financial institutions and banks to invest in energy conservation (even though many energy conservation projects have high returns and relatively short pay-back periods), and to boost development of domestic energy service companies.

1.2.6. List of relevant laws, regulations and rules

Mandatory Reduction of Energy Intensity

The 11th Five-Year Development Plan (2006-10) includes a major program to improve energy efficiency nationwide, including a goal of reducing the energy intensity to 20% below 2005 levels by 2010. This energy intensity reduction target is part of a broader goal of quadrupling per-capita GDP while only doubling energy consumption between 2000 and 2020. The government has allocated the reduction target to provinces and industrial sectors.[18] Energy efficiency improvement is now among the most important criteria used to evaluate the performance of local officials. Progress to date has been slower than the expected annual reduction of 4%.

Ten Energy Conservation Programs

In 2004, the NDRC launched the Medium and Long-term Plan of Energy Conservation, which covers two phases: 2005–2010 and 2010–2020. In this plan, detailed energy conservation targets and implementation plans were set up. Key actions and comprehensive policy measures were put forward. The following ten key programs for energy conservation were stipulated in the plan:

- **Upgrade Coal-Burning Industrial Boilers (kilns).** China has about 500,000 medium- and small-sized boilers, which on an average have an actual efficiency around 65%. Three measures are planned to raise the efficiency by 5 and 2 percentage points respectively:
  - i. Use quality coal;
  - ii. Renovate boilers and kilns employing advanced techniques, like circulating fluidized bed and pulverized coal firing; and
  - iii. Establish a scientific management and operation system.
- **District Co-generation.** Combined heat and power systems, can raise efficiency by 30% over that of separated generation. Centralized heat supply is 50% more efficient than small boilers. In the 11th five-year period, the focus will be on the heat load and measures to be taken, which will include:
  - o Installing high efficiency 300 MW cogeneration units;
  - o Constructing back-pressure units;
  - o Developing centralized heat supply for areas where heat demand is small and mainly for warming;
  - o Developing combined heat and electricity supply systems in medium-sized and small cities;
  - o Transforming existing coal-burning small boilers for decentralized heat supply.
- The goal is to cover 40% of urban centralized heat supply systems by 2010.
- **Residual Heat and Pressure Utilization.** Iron and steel enterprises will apply coke dry quenching and power generation from the waste energy from blast furnaces, renovate all blast furnace gas power generation, and implement converter gas recovery.
- **Petroleum Conservation and Substitution.** Specific steps include: replacing fuel oil (light oil) with clean coal, petroleum coke, and natural gas in the power, petroleum and petrochemical, metallurgy, and construction material industries and in transport; accelerate the development of the west-east power transmission to replace small oil-burning units; implement policies and regulations on fuel use and petroleum conservation measures; implement the policy for clean automobiles; promote hybrid vehicles; popularize compressed natural gas buses and taxis in cities and speed up the promotion of methanol and alcohol as fuels; step up coal-liquefaction projects; and develop alternative fuels.
- **Energy Conservation for Electrical Motor Systems.** Currently, 420 million-kW electrical motors, which consume 60% of the total electricity, operate at an efficiency which is 10-30% lower than that in other countries. In the 11th 5-year period, the country will popularize high efficiency electrical motors and those

[18] ADB is providing advisory technical assistance to NDRC for the exploration of innovative mechanisms that promote energy improvement, as a part of a regional project TA-6392-REG. Supporting the Implementation of the Energy Efficiency Initiative in Developing Member Countries.

that use rare earth permanent magnets, launch systematic renovation to and operation of high-efficiency wind turbines, pumps and compressors and promote variable speed motors and automated system control.

- **Energy System Optimization.** Optimization of energy systems in major industries (mainly metallurgical, petrochemicals, and chemicals) will be launched.
- **Energy Conservation for Buildings.** The country will adopt strict standards that save energy by 50% in residential buildings and public structures, speed up the reform in heat-supply system, and tighten efforts in promoting building energy efficiency technology and related products.
- **Green Lighting.** Thirteen percent of the total power use of the country is in lighting. 70% to 80% of power can be saved by replacing ordinary candescent lamp with high-efficiency energy-saving fluorescent lamp and an additional 20-30% can be saved by replacing traditional electromagnetic ballast with electronic ballast. Ninety percent of power use in traffic lights can be saved by replacing candescent lamps with light emitting diodes.
- **Energy Conservation in Governmental Agencies.** Energy consumption in government and public institutions is increasing rapidly and expenditure on energy is relatively high. Energy efficiency measures include: reconstruction and renovation of the buildings, heating, air-conditioning, and lighting systems according to building energy efficiency standards, procurement of high-efficiency products, and purchase of fuel efficient business vehicles.
- **Energy Conservation Monitoring and Technical Services System.** Establish and improve the capability of the energy-saving monitoring centers in provinces and in major energy-consuming industries through upgrading monitoring equipment, strengthening personnel training, and popularizing contractual energy management. These centers would provide a package of services including diagnosis, design, financing, renovation, operation, and management for enterprises, governmental organs, and schools.

1,000 Enterprise Programs

In 2006, NDRC launched a major program to improve energy efficiency in the 1,000 largest energy-consuming enterprises,[19] which in 2004, accounted for 33% of the total and 47% of the industrial energy use. Each enterprise under the "1,000 Enterprise Program," signed an energy conservation agreement with the local government outlining its 2010 energy-saving target. The enterprise will be monitored and supervised on its energy use. Advanced domestic and international standards are used to set the targets for the energy intensity for products produced. Incentives will be offered to encourage enterprises to exceed their targets. Overall and individual targets for the 1,000 enterprises were established in 2006.

Retiring Inefficient Power Plants

In early 2007, the State Council issued an order to retire 50 GW of small, inefficient power plants, amounting to 8% of China's total generating capacity. Large and more efficient coal-fired generation units can be constructed only when the smaller and older ones are fully decommissioned. Certain compensations (up to 3 years' economic benefits) could be provided to smooth and accelerate the closure processes. By 2010, approximately 40 GW of coal-fired and 10 GW of fuel oil-fired capacities will be retired before the completion of their design life. In addition, all coal-fired plants of less than 50 MW capacity and 50-100 MW capacity plants that have been in operation for more than 20 years will be retired by 2010. Generators with unit coal consumption 10% above the provincial average or 15% above the national average are also targeted for closure.

Energy Efficient Power Generation Dispatch Scheduling

The current power generation scheduling and dispatch system allows about the same utilization hours to large-efficient plants and to small but less efficient coal-fired power generation units, resulting in a large waste of energy. Since the newly installed 300 MW or more coal-based power plants have a designed efficiency close to the international standards, their utilization has to be maximized to reduce coal consumption. NDRC has taken the initiative to implement a new energy-efficient and environment-friendly dispatch system[20] that maximizes the use of renewable energy, gives priority to nuclear energy, and ranks coal-fired units according to their marginal fuel consumption. When fully implemented, it

[19] http://www.iea.org/textbase/pm/?mode=pm&id=3542&action=detail.

will significantly reduce coal consumption and GHG emissions from the rapidly expanding power sector. The implementation guidelines for the new dispatch system were approved in August 2007. Five provinces, namely, Guangdong, Guizhou, Henan, Jiangsu, and Sichuan, have been selected to test the new system.

Closing Inefficient Industrial Plants

NDRC announced in early 2007 that it would close many inefficient industrial plants manufacturing a range of products, including cement, aluminum, ferroalloy, coke, calcium carbide, cement, and steel.

- All cement plants with an annual capacity of less than 200,000 tons are to be closed by the end of 2008, with 250 Mt of outdated cement capacity to be eliminated by 2010.
- In the steel sector, outdated pig iron capacity is to be reduced by 100 Mt, and steel capacity by 55 Mt by 2010.

NDRC has set reduction quotas at the provincial and regional levels, and provincial officials are required to sign agreements with the central government holding them accountable for their targets. Potential disciplinary action is possible for provincial officials failing to comply.

Promoting End-Use Energy Efficiency

The 1997 Energy Conservation Law initiated a range of programs to increase energy efficiency in buildings, industries, and consumer goods. China has established efficiency standards for many energy-consuming appliances and is adopting building energy standards in regions with high heating and cooling demands. China also promotes end-use energy efficiency improvement[21] through government procurement policy. In 2004, the Ministry of Finance, in coordination with NDRC, modified the National Procurement Policy to include the preferential purchase of labelled energy efficient products in public procurement. The program started in 2005 and by the end of 2006 it was rolled out to all levels of government: central, provincial, and local. The State Council ordered in June 2007 that air-conditioning units in most office buildings be set no cooler than 26°C.

Phasing Out Incandescent Bulbs

In 1996, the China Green Lights Program was launched to raise the awareness of available energy efficient lighting technologies. The program has contributed to the increase in production and use of these efficient lighting technologies. By 2017, China will have phased out incandescent bulbs through a program initiated through the Global Environment Facility.

Energy Efficiency in Transportation

The transportation sector is currently not a big consumer of energy in China, but takes an increasingly large share in the longer term. The increase in vehicles has doubled oil consumption in the last 20 years, turning China from a net oil exporting country into a large oil importing country. Measures for improving energy efficiency and reducing emissions in the transport sector include:

- **Investing in Energy-efficient Transportation Infrastructure.** China has implemented a massive plan to build and renovate high-speed railway systems that will be more energy efficient, less polluting, less vulnerable to extreme weather events, and likely to replace many passenger and cargo vehicles on roads.
- **Requiring High Fuel Economy Standards.** China's fuel economy standards are more stringent than those in Australia, Canada, and the US, including California (but less stringent than those in the European Union and Japan). The vehicle standards will be implemented in two phases (2005–2006 and 2008–2009) for all classes of vehicles.
- **Encouraging Use of Public Transport.** The Ministry of Construction held a "no car day" on 22 September 2007 to encourage people to travel by public transportation. In urban areas, light rails and subways are being constructed and tariffs are subsidized to popularize mass transport systems.
- **Use of Alternative Fuels.** Twenty percent ethanol has been introduced in six provinces.
- **Developing New Transport Technologies.** An automobile emission tax is under consideration, which will fund the development of cleaner transport technologies.

[20] ADB is providing advisory technical assistance to NDRC concerning the structuring and implementation of the proposed energy-efficient generation scheduling and dispatch system.

[21] ADB is working on two loan operations, in Guangdong and Shandong, to assist China in improving demand-side energy efficiency.

Efficiency in Urban Housing and District Heating

China has realized that adoption of energy-efficient technologies in buildings is a promising path to ease expanding energy shortages and reduce GHG emissions. It began investigating energy efficiency in buildings in early 1980s. A number of standards, regulations, related incentives, and administrative rules have been issued. The 11th Five-Year Development Plan calls for energy savings of 50% for new buildings nationwide and up to 65% for buildings in four large municipalities (Beijing, Shanghai, Tianjin, and Chongqing). In early 2006, the government issued the Designing Standard for Energy Conservation in Civil Building to encourage contractors to use energy-efficient materials and adopt energy-saving technologies for heating, cooling, ventilating, and lighting in public buildings.

Annex 2. South America

2.1 Natural gas for vehicles in Bolivia

2.1.1. Background

During the past decade, Bolivia has experienced major increases in its gas reserves, production, and exports. In recent years, this process has been followed by a rise in world energy prices of natural gas, as well as, more recently, by a sharp increase in the government's tax take from the hydrocarbons sector. This combination of factors has transformed the Bolivian natural gas sector so that it now constitutes not only the main component of country's exports (43% of total exports in 2006) but also is a large source of revenues for the government (about 27% of total revenues in 2006).

The hydrocarbons sector has thus become increasingly important. In terms of contribution to growth, the key economic sectors in Bolivia since 1990 have been manufacturing, agriculture, and transport and communication.

Despite those positive trends, Bolivia still has an unbalanced availability of fossil fuels. While the country has important reserves of natural gas, 30% of the diesel consumed is imported. Being one of the countries with a lower GDP per capita in South America and currently having per capita income of less than a quarter of the average for the rest of Latin America, the reduction of imports by replacement with local production has been a priority for all Bolivian governments. Furthermore, the aim is to have increased gasoline domestic surplus in order to export gasoline, as value per energy unit traded is far higher (two or three times) for liquid fuels than for natural gas.

The replacement of gasoline by compressed natural gas is a very well known technology in the region. Two neighboring countries (Argentina and Brazil) have the largest NGV fleets in the world (more than 1.3 million cars in each country).

Bolivia is now benefiting from the replacement of gasoline by compressed natural gas in two ways: reducing fuel imports while consuming a fuel that the country is abundantly endowed with and in addition reducing pollution.

There are many actors in the NGV chain: government, dispensing stations, distributors, producers and transporters of natural gas, small facilities to convert vehicles, and consumers.

The Ministry of Energy and Hydrocarbons is the key actor responsible for policy making and implementation while the Superintendencia de Hidrocarburos regulates NGV dispensing stations and replacement facilities.

2.1.2. Objective of the policy

The objective of the policy was to foster the substitution of liquid fuels in mobile applications with natural gas. The only instrument used by government was to fix a different tax and a different price for NGV and for gasoline in 1992. Since that time, there has been no change in the policy or the tax. The policy did not include a quantitative objective, as it was not completely clear in the beginning how ambitious the target could be in terms of effective replacement.

2.1.3. What policy instruments were used/had to be passed to achieve the objective?

The policy was based on a fixed differential price (based on tax reduction) between the gasoline and the NGV. Since 1992, the NGV price has been linked to the price of gasoline at around 50% of the retail price.

There are technical rules that govern how the producers of natural gas, replacement facilities and distributors operate, fixing parameters as pressure level, and standards for security in NGV stations and cars (mainly for the cylinders) and measuring.

Table 3: Relation between NGV price (in std m^3) and gasoline (in liter) at retail level

1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.49	0.44	0.44	0.44

Source: Ministry of Energy and Hydrocarbons

2.1.4. Key factors needed to make something happen

- The difference between NGV and gasoline price is the only incentive car owners have to adapt their cars to NGV. A sustained (through years) difference provides a clear signal to car owners and also to NGV stations owners and requires a delicate balance between demand (cars adapted) and supply (NGV stations).
- An NGV business requires a significant investment in the station. Natural gas is compressed at 250 bars. The difference between the NGV price (paid by cars) and natural gas cost (paid by stations) should be high enough to recover the investment.
- The repayment period of a car conversion is in the order of eight months. Even with this short period, as car owners don't have access to financial institutions (banks, credit cards), a specific credit line should be provided.

On top of that, an additional creative scheme of incentives for adapting cars to consume NGV was implemented by the private sector. Since 2001, an association between private companies including Transredes (gas distribution company), Sergas (distribution) dispensing stations and replacement facilities, under the name Feria del Gas, reimburses up to 80% of the cost of replacement to end users, in kind (NGV). There are no credit or government incentives for distributors. The only government intervention is related to the tax and the price of NGV and gasoline.

2.1.5. What has happened as a result of the policy and instruments that were ntroduced?

- The volume of NGV sold today is equivalent to 40% of the volume of gasoline sold;
- Approximately 90.000 vehicles were converted out of a total fleet of 550.000 vehicles;
- In the short term replacement is mainly from gasoline to NGV, but when consumers buy new vehicles they change from diesel to NGV (e.g., taxi fleet in Santa Cruz which was 95% diesel and is now 95% gasoline converted to NGV). The owner of the car covers the conversion costs.

2.1.6. List of relevant laws, regulations and rules

Ley Nacional de Hidrocarburos, Resolución 120/1992 del Ministerio de Energía (National Hydrocarbons Law, Resolution 120/1992 of the Department of Energy)

- Established the objective of the policy: substitution of liquid fuels by natural gas in mobile applications;
- Approved the rules for NGV stations, including the differential price between NGV and gasoline.

National Law N° 3058

In 2005, the oil and gas institutional framework was completely changed, moving to a system with a high level of government intervention. The general policy indicates that hydrocarbons should be used to promote comprehensive, sustainable and equitable development, ensuring the supply of hydrocarbons to the domestic market, encouraging the expansion of consumption in all sectors of society, developing industrialization in the national territory and promoting the export of surplus in a position favoring the interests of the state. It also has a specific prescription for NGV pertaining to tax exemptions (custom duties and value added) for imports of materials and equipment for the NGV sector.

2.2 Wind power in Argentina

2.2.1. Background

The demand for electricity in Argentina has grown constantly over the last decade despite the economic downturn of the late 1990s as shown in Table 4. The cost of electricity in Argentina, however, is difficult to estimate. Government intervention is extensive: fixing the price of natural gas to producers, importing natural gas and liquid fuels, and finally fixing different rules for electricity prices. There are two price levels. In the first level the price is determined by the cost of the most expensive unit dispatched using natural gas. Hydro, nuclear, wind and thermal units using natural gas are included in this level. The second level applies to units using liquid fuels.

As a result of these government interventions, the price of electricity is low, and as a consequence private investment in generation is small. The production of natural gas is declining. On the other hand, the consumption of gas has grown at 5% per year since 2003. The situation is further complicated because gas supplies from neighboring countries are unstable due to the political issues.

Table 3: Relation between NGV price (in std m3) and gasoline (in liter) at retail level

1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
69.892	72.998	74.137	80.710	88.943	90.088	84.420	91.996	100.261	105.750

Source: Secretariat of Energy

Wind power resources

Argentina has large wind resources. According to the Centro Regional de Energía Eólica (CREE), which has extensively researched wind resources and made inventories at the regional and national level, the technical potential of wind power resources can be estimated at around 500.000 MW.

Some regions, mainly the Patagonia, in the southern part of the country, are among the best locations in the world for wind power production. Data available from existing power units operating in Comodoro Rivadavia (Chubut Province) show that average wind speeds are higher than 11 m/s, and load factors are in the order of 40%.

The national grid

The information provided by the Secretariat of Energy, indicates that total installed power in Argentina was 25,678 MW in 2006. Hydropower represents 39% of the total installed capacity, while thermal facilities (fossil fuel fired) contribute 57% and nuclear approximately 4%. Installed wind power capacity is 27 MW (0.1% of the total).

Relevant institutions

Policies and regulations are determined by the Secretariat of Energy. Ente Nacional Regulador de la Electricidad (ENRE) is in charge of enforcing the regulations and of the supervision of the electric market. CAMMESA is responsible for decisions on the dispatch of the system, determines wholesale prices and administers transactions in the electric markets.

2.2.2. Objective of the policy

The objective of the national policy, enacted through the National Law 25019 (1998), is to promote the installation of additional wind power generation capacity. No quantitative objective (in absolute terms or as a proportion of the total capacity) has been fixed.

2.2.3. What policy instruments were used/had to be passed to achieve the objective?

The above-mentioned law declared that the generation of electricity from wind or solar resources is in the national interest, and established subsidies and specific tax conditions for these activities. The law did not include quantitative targets to be achieved through the application of the new framework.

Further, the National Law 26190 (2006) confirmed the objective of the previous law, expanded its applicability to other renewable sources (e.g. small hydro, landfill gas, biogas, biomass, geothermal) and updated the value of the subsidies. The National Law 26190 established that by 2016, eight percent of the electricity national consumption should be produced from renewable resources.

2.2.4. Key factors needed to make something happen

In this case, four factors can be identified as barriers for the development of a successful wind power program in Argentina:

- Information on resource availability;
- Long term capital recovery;
- Cost of production; and
- Tax framework instability.

The first barrier is related to the nature of the resource itself: renewable and difficult to quantify (high unpredictability). The law should have made provisions to promote research in order to quantify the availability and determine the characteristics of wind resources in Argentina.

The second barrier is common to all renewable energy projects. When compared to fossil fuel power generation projects, capital costs are higher while variable costs are very low. Hence, renewable energy projects in Argentina face constraints, particularly in access to project finance. The period required to recover the investment is higher in renewable projects compared to the period required in fossil fuel projects.

Wind power electricity production costs in 1998 had (and still have) higher costs than the wholesale price of electricity in the national market. The difference was

around $0.03/kWh. The value of subsidies fixed in the National Law 25019 was $0.01/kWh, only around a third of the differential cost. The situation was not improved by the National Law 26190 in 2006. Although the value of the subsidies was increased to $0.015/kWh, the actual value was equivalent to only $0.005/kWh due to the devaluation of the Argentine peso – that is, less than before the adjustment.

The last barrier is related to the second one, as due to longer capital recovery, these types of projects are highly vulnerable to a changing tax and fiscal environment. Both laws granted 15 years of fiscal stability for wind energy projects.

It should be noted that importing the equipment is not a barrier. Duties are not too high, maximum levels are in the order of 15%.

2.2.5. What has happened as a result of the policy and instruments that were introduced?

There is a fundamental inconsistency between the policy and its implementation. As a result, the policy is not effective. The wind power installed capacity increased from 12 MW (1997) to 28 MW (1998). The instruments provided by the law provided non-effective solutions for two of the barriers, while not considering other ones. It is clear that the subsidies provided are not enough to cover the difference between wind power production costs and the market price. It could be concluded that there is no consistency between the objective enunciated and the instruments provided.

2.2.6. List of relevant laws, regulations and rules

National Law 25019

Declares that the generation of electricity from wind or solar resources is in the national interest and provides tax benefits: value-added tax on capital investment could be deferred up to 15 years and 15 years of fiscal stability. It also establishes subsidies: a value of $0.01/kWh produced for 15 years. The resources for the subsidies are obtained from a specific charge in the electricity tariff.

National Law and 26190

This law declares that the generation of electricity from renewable sources, and also the research and manufacturing of renewable energy equipment, is in the national interest. It establishes a quantitative objective: by 2016, eight percent of the electricity national consumption should be produced from renewable resources. Renewable energy sources included in the law regime are defined as: wind power, solar energy, geothermic energy, hydropower (less than 30 MW), tidal power, biomass, landfill gas and biogas. It provides tax benefits for a 10-year period on value added and income taxes. It also established subsidies: for all renewable sources (but solar), a value of $0.005/kWh produced for 15 years. For solar, the value is $0.3/kWh. The procedure to obtain the resources for the subsidies fixed in the Law 25019 is maintained.

2.3 An energy efficiency labelling programme in Brazil

2.3.1. Background

Brazil, with its 190 million inhabitants, has the largest population in Latin America. The country has very important renewable resources, and has been implementing policies in order to increase the participation of renewables in the energy matrix.

The country had limited oil production and reserves in the past. The impact of fuel imports on domestic prices – due to fuel price increases – and trade balances led the country to implement a very extensive bio-ethanol program and to consolidate an electric system based on hydropower in the beginning of the 80s. As a result, the Brazilian energy system is currently one of the most efficient in the world in terms of CO_2 emissions per unit of energy supplied.

Brazil is also one of the largest producers of hydroelectricity in the world: in 2006, Brazil was the third world producer (after China and Canada), with 11.5% of total world hydro-electrical production. Table 5 provides the value of hydro-electrical production in Brazil, per year (1965-2005) in Terawatt hours.

Table 5: The value of hydro-electrical production in Brazil, per year, 1965-2005

1965	1975	1985	1995	2005
24.0	72.3	178.4	253.9	337.5

Source: British Petroleum Statistical Review of World Energy 2007

In 2005, hydroelectricity was 85% of total electricity production. However, due to its characteristics the system became vulnerable to natural events (e.g., droughts). The crises suffered in 2001 and 2002, when the government had to implement very stringent water rationing schemes, is an example of how vulnerable the system is to climate conditions.

Since the early 80s, the Brazilian government has implemented different energy efficiency programmes. The institutions involved in those programmes were:

- Eletrobrás (government is the major share owner);
- INMETRO (National Institute of Metrology, Standardization and Industrial Quality, within the Ministry of Development, Industry and Foreign Trade).

2.3.2. Objective of the policy

The purpose of PROCEL, the National Electricity Conservation Program, was to integrate the energy conservation actions in the country.

The PROCEL Label (a subprogram of PROCEL) was created in order to indicate to consumers the equipment and appliances available in the domestic market that have the highest rates of energy efficiency in each category. The scheme stimulates the production and marketing of more efficient products, in terms of energy efficiency, reducing environmental impacts in Brazil.

2.3.3. What policy instruments were used/had to be passed to achieve the objective?

In 1984, on the basis of a protocol (a voluntary agreement) between the government (MDIC) and the Brazilian Electrical and Electronics Industry Association (ABINEE), the Brazilian Labeling Program (PBE) was created. The program is coordinated by INMETRO. PBE aims to provide information to consumers to facilitate optimization of consumption of electricity in domestic appliances; choose more efficient appliances in terms of energy consumption; and improve use of those appliances allowing the saving of energy costs. Participation in the program is voluntary and testing of the appliances is made only on those products made by those manufacturers and facilities that are willing to participate. On the basis of the outcome of the tests, a scale was created to classify appliances. The tests are repeated periodically to update the scale.

PROCEL, now coordinated by ELETROBRÁS, was created in 1985. PROCEL includes several subprograms of electric energy efficiency: Evaluation of Energy Efficiency Measures, Energy Efficiency in Buildings, Energy Efficiency in Public Facilities, Municipal Energy Management, Industrial Energy Efficiency, Energy Efficiency in Public Lighting, and Energy Efficiency in Environmental Sanitation.

The SELO PROCEL subprogram was created in 1993 and, along with the PBE, is responsible for significant results obtained. Appliances that are tested and labelled showing the best performance in their class can receive an energy efficiency endorsement (SELO PROCEL), given to the best products with respect to specific energy consumption. The SELO PROCEL program also contributed to the implementation of the PBE by creating measurement infrastructure.

Finally in 2001, an important milestone was the Law N° 10.295. The law establishes "maximum levels of specific energy consumption or minimum levels of energy efficiency of machines and energy-consuming devices produced and sold in Brazil". Performance levels have been defined for electric engines and fluorescent lamps. There are advanced proposals for other devices. The law defines compulsory performance levels. Therefore, it is different from the labelling programs (PBE and SELO PROCEL) which are voluntary.

2.3.4. Key factors needed to make something happen

The success of the program was due to a combination of elements that included:

- An adequate regulatory framework;
- Appropriate institutional arrangements:
  - Between governmental institutions and entities (INMETRO, Eletrobras, others);
  - Between the government and industry, which were based on voluntary agreements;
- Economic and technical resources, including investment in laboratories to measure performance and compliance with required standards;
- Dissemination and capacity building.

2.3.5. What has happened as a result of the policy and instruments that were introduced?

The outcomes of the implementation of the PROCEL Label in 2006 were:

- Savings of 2,900 GWh of energy consumption;
- Savings in domestic appliances including also domestic lighting, air conditioning, refrigerators, electric engines and solar energy equipment.

2.3.6. List of relevant laws, regulations and rules

Resolution N° 1877, 1985. Creation of the PROCEL

Decree December 8, 1993. Creation of the Energy Label and Award.

This decree established the Green Label of Energy Efficiency, aiming to identify the equipment that achieves optimal levels of energy efficiency.

Law Nº 10.295, 2001 National Policy of Rational Use of Energy

Established maximum levels of specific consumption of energy, or minimum energy efficiency, for machinery and consumer appliances, energy manufactured or marketed in the country, based on technical indicators relevant. Levels will be established based on values that are technically and economically feasible.

Annex 3. Africa

3.1. Efficient stoves dissemination policy in Kenya

3.1.1. Background

Sub-Saharan Africa countries, except South Africa, still depend heavily on wood to meet their basic energy needs. The share of fuel wood is estimated to be 61%-86% of primary energy consumption, with a major part (74%-97%) consumed by households. Fuel wood is also used to a significant extent in many of these countries in cottage industries such as bread baking, metal smelting operations, and brick kilns. The management of fuel wood resources and demand is a major issue to be accounted for in energy policies and strategies in Africa.

Furthermore, fuel wood production has been identified as one of the causes of forest degradation and deforestation in many African nations, in particular in regions surrounding large towns (e.g., N'Djamena in Chad). Indeed, the most important share of total wood removal is due to fuel wood consumption, which represents around 92% of total African wood consumption, and contributes to GHG emissions. Fuel wood use is therefore a major local and global environmental issue in Africa, and should be fully integrated into forestry management and environmental protection policies.

In Kenya, wood fuel is the dominant primary energy source for most households and small industrial establishments. This was confirmed by a 2000 energy survey, which indicated that biomass accounted for more than 68% of Kenya's total direct primary energy consumption. The survey also revealed that 89% of rural households relied on fuel wood, while 82% of the urban households relied on charcoal for their energy needs.

In most Sub-Saharan Africa countries, women devote most of their time to fuel wood gathering and cooking tasks. Children in rural area are also involved in fuel wood gathering tasks that can take most of their time, depending on the region. In Kenya, a lot of effort has gone into the promotion of fast-growing energy trees for the supply of fuel wood. In 2000, 84% of the fuel wood consumed in rural households was supplied from these farms, as opposed to 47% in the 80s. In 2007, 85% of the households could access fuel wood at close proximity to their homes – within a 4km radius However, as a consequence of continuous urbanization, a change in the use of wood for fuel wood and charcoal is taking place. Charcoal will play a more important role in the achievement of the sustainable development objectives of the country.

In this context, a demand-side, energy-efficiency program was needed to reduce the negative impact of the growing charcoal demand.

Sessional Paper No. 4 of 2004 on Energy in Kenya, which constitutes the government policy on energy, recognizes that fuel wood will continue to be a primary source of energy for years to come. As a consequence, it lays out strategies and policies for biomass development and exploitation, including the promotion of energy-efficient stoves and study and research for additional efficiency improvement of the stoves.

3.1.2. Objective of the policy

The policy aims to promote the dissemination of energy-efficient stoves, mainly through R&D activities that increase the efficiency of stoves and lower their price, thereby facilitating access to urban and rural poor populations. The aim is to increase the adoption of charcoal stoves from 47% to 100% by 2020.

3.1.3. What policy instruments were used to achieve the objective?

R&D activities are the main policy instruments used for the promotion of high-quality, energy-efficient and low-cost stoves. The research activities also encompass the development of appropriate distribution strategies for the stoves. Indeed, the Kenyan Ceramic Efficient Stove is the result of research on stove design, materials, and production processes for the purpose of increasing quality and decreasing costs. The program was initiated in the 70s and continued through the 80s with support from GTZ of Germany.

In Kenya, commercial energy-efficient stove production and dissemination is not directly subsidized. Initially, stoves were expensive (~$15/stove) and quality assurance and control was not established for the production process. As a consequence, the stoves were not attractive to the poorer part of the population. The studies and research initiated since the early 80s, the experience accumulated by the manufacturers, and the competition that has been generated have led to innovations in materials and production processes and, ultimately, to better quality stoves, more choices, and lower costs.

While the program of energy efficient stoves diffusion

has been implemented without direct subsidies, other forms of soft subsidies have been provided. Free training sessions have been provided and research results transferred without fees payment to producers by a number of organizations. Loans with low interest rates have been provided for the acquisition of efficient equipment for stove production and design and to implement communication schemes to raise awareness about stove performance by Winrock International[22]. This support was needed to facilitate the dissemination of the new technology to the portion of the population with low incomes.

3.1.4. Key factors needed to make something happen

The Minister for Energy is empowered under section 103 of the Energy Act N°12 of 2006 to promote the development of renewable energy technologies, including biomass, biodiesel, charcoal, fuel wood, biogas, solar, and wind. This includes providing an enabling framework for the efficient and sustainable production, distribution, and marketing of renewable energy technologies. The Ministry undertook a study of wood fuel in 2000 and plans to undertake another study in 2009/10 to determine the impact of the policy measures implemented over the last 10 years in redressing the balance between supply and demand for fuel wood.

In addition, the inadequate data on the development of markets for efficient stoves will be addressed by doing surveys. Also, the legal and regulatory framework for wood fuel development and an effective mechanism for coordination of different stakeholders, as identified in an Integrated Assessment of the Energy Policy study[23] that was requested by the Kenyan Ministry of Planning and National Development in Household Energy Sector, will be addressed. The assessment identifies gaps in the energy policy for the household sector and provides recommendations, but it does not formulate clear actions relating to the recommendations.

3.1.5. What has happened as a result of the policy and instruments that were introduced?

The Kenyan efficient stove can now be purchased in a variety of sizes and styles. Prices have decreased to roughly $1-$3[24]. This has opened the market for these stoves. More than 13,000 energy efficient stoves are sold each month in Kenya and there are more than 700,000 energy efficient stoves in use in the country.

As a consequence, there are now more than 200 businesses of different sizes, legal entities, or informal sectors that are involved in this production activity. The Kenyan ceramic efficient stove is used in more than 50% of the households in urban area, and more than 15% in rural area.

The charcoal savings of the energy-efficient stoves reduce the energy-related expenditures of users that are generally low income populations.

3.1.6. List of relevant laws, regulations and rules

Parliament passed the Energy Act No.12 in 2006. Section 6 (p) of this Act gives power to the Energy Regulatory Commission. Under the Act, the Commission is empowered to make proposals to the Minister on regulations that are necessary for the energy sector, particularly for charcoal.

3.2 Promotion of energy efficient lighting as part of Senegal's rural electrification

3.2.1. Background

In sub-Saharan Africa, access to modern energy in rural areas remains a complex issue with multiple constraints in relation to the low income of the populations, the dispersion of the habitat, and increases in international energy prices. This situation is particularly exacerbated for the countries that don't have energy resources. The electricity sector conforms to this general rule. With 35.5% of the population electrified in 2002, Africa has the lowest rate of electrification of the world under development.[25] If only sub-Saharan Africa is accounted for, households that have access to electricity are limited to 23.6%. However, the disparities are even more marked within the sub-Saharan Africa countries, between urban and rural areas, where the

[22] Household Energy for Improved Health and Livelihoods: Winrock International. See: http://www.winrock.org/publications.asp.
[23] Kenya: Integrated Assessment of the Energy Policy, UNEP, August, 2006.
[24] Walubengo, D., 1995: Commercialization of improved stoves: the case of the Kenya Ceramic Jiko (KCI). In Stove Images: a Documentation of Improved and Traditional Stoves in Africa.
[25] African Bank of Development and the Center of Development of OECD, Economic Outlooks in Africa, 2005-2006.

latter areas have a rate of electrification that is generally lower than 5%.

In Senegal, the situation that preceded the reform of the energy sector was characterized by:

- Weak rate of rural electrification: 5% in 1998;
- Single player: the government which subsidizes access to electricity;
- Single technical solution of the national operator: connection to the grid;
- Weak commercial interest for the national operator in a tariff context whereby subsidies did not allow the real costs of electricity to be reflected, particularly in rural areas.

At the end of the 90s, catalyzed by the emergence of the fight against poverty and concerns of the international community, new laws with important changes were passed which promoted in-depth reforms of the energy sector. The new laws liberalized the electricity sector, set up a commission to develop regulations, and created the Senegalese Rural Electrification Agency (ASER), dedicated to the implementation of rural electrification policy.

In this new environment, an energy efficiency program has emerged as an important part of the rural electrification strategy of the Senegalese government. It aims to promote the use of energy-efficient devices as compact fluorescent light bulbs to displace incandescent light bulbs in newly electrified households in rural areas. It will be undertaken within a nation-wide rural electrification plan implemented under the supervision of ASER. ASER coordinates and monitors the implementation of the national rural electrification plan which includes a Public/Private Partnership scheme. For the purpose of the plan, the Senegalese territory has been divided in 12 geographical concessions. Each concession will be granted to investors/operators through an international competitive bidding process. Standardized contracts have been drawn up by ASER to provide a framework for the activities of the concessionaires. The concessionaire will purchase and install the compact fluorescent light bulbs, which will be subsidized by ASER.

3.2.2. Objectives of the policy

The demand-side energy efficiency measures aim to reduce energy consumption in newly electrified households in rural areas, for the same service provided by electricity operators. This will lead to an increase of the access of rural population to electricity. The objective is to increase electricity access in Senegalese rural areas from 16% to 50% by 2012.

3.2.3. What policy instruments were used/had to be passed to achieve the objective?

An in-depth change has occurred compared to the traditional tariff models. A new tariff system has been introduced for low-energy consumers based on a fixed price authorized by the Commission of Regulation. Low-energy consumers are the ones that consume electricity mainly through lighting and use a radio as their only appliance. Indeed, for these consumers, the tariff is fixed and based on whether or not they use a radio and on the number of lighting points in the household. Instead of the energy consumed, these clients will pay for a level of service. This promotes the implementation of demand-side, energy-efficiency measures.

3.2.4. Key factors needed to make something happen

The main factor influencing the success of this program is the guarantee that the use of the compact fluorescent light bulbs will be sustainable. For this purpose, power limitation devices calibrated according to the level of service purchased will be installed. The client is discouraged from using incandescent light bulbs or adding other appliances. The electricity operator has the obligation to provide a compact fluorescent light bulb on request to the client after the recovery of the old one.

A local network of distributors is needed to collect, install, and replace the compact fluorescent light bulbs. The light bulbs that are to be installed should be of good quality. A Terms of Reference is to be elaborated for the compact fluorescent light bulbs, with very precise characteristics concerning the life time and the capability to operate in an environment with fluctuating voltage.

Local stakeholders consultations are to be carried out to enhance the awareness of the rural population concerned by the project. Their commitment is needed for the success of the project.

3.2.5. What has happened as a result of the policy and instruments that were introduced?

This demand-side, energy-efficiency programme will facilitate the implementation of the rural electrification program. It will allow more people to be connected to the grid while reducing the need for additional new electricity supplies. One contract has been already signed by an

electricity operator for the electrification of the concession of Saint-Louis/Dagana/Podor. Through this contract, the electricity operator is committed to electrify 16,400 households corresponding to 114,600 compact fluorescent light bulbs. If the rural electrification agency continues to subsidize the installation of the internal equipment as planned, it is foreseen that this program will be a success. Other operators have showed interest in signing for the other concessions. The fact that the purchase of the compact fluorescent light bulbs is subsidized by ASER reduces the electricity operator's investment and has helped to reduce the investment risk for the electricity operator.

3.2.6. List of relevant laws, regulations and rules

The ASER is an autonomous public entity created in 1998 under Senegal's Electricity Reform Law 98-29 to provide technical and financial assistance for rural electrification in Senegal.

3.3 Renewable energy development policy in Senegal

3.3.1. Background

While almost 100% of modern energy generated in Senegal is fossil fuel based, the country is not endowed with conventional energy resources. The import of fossil fuel for modern energy production has had a very negative effect on the availability of hard currency and on national export earnings. This reliance also increases the vulnerability of the country to fuel price increases. As a result, a diversification in modern energy generation is now the key goal of the Senegalese energy strategy.

In Senegal, actual electricity demand growth has been estimated to be higher than 7% per year. The government aims to increase electricity access in rural areas from its current value of 16% to 50% by 2012, as access to modern energy is seen as a human right by the Senegalese population. This will lead to a very significant increase in the demand for electricity, which the government will have difficulties satisfying.

Senegal has a vast potential to generate electricity from renewable sources. There is substantial wind energy potential in the northern coastal areas and significant solar energy and biomass potential. This suggests the need to develop renewable energy as these resources are locally available, secure, and not exposed to exogenous disruptions or higher prices. However, the success of this option depends to a large extend on a policy framework with all the instruments necessary to achieve its objectives. A national renewable energy policy was needed in Senegal to ensure that national energy resources are adequately tapped. In particular, an optimized energy system cascade – in which renewable energy and fossil fuel energy are integrated and utilized efficiently to satisfy the most appropriate demands – was needed to provide the modern energy needed for the country development.

3.3.2. Objective of the policy

The objective of the policy is to strengthen the electricity market and increase access to modern energy, while protecting the global environment and diversifying the sources for electricity generation through the development of public and private investment in electricity production from renewable sources. For that purpose, an attractive regulatory framework has been set up and implemented.

3.3.3. What policy instruments were used to achieve the objective?

The existing laws relating to the purchase and cost of renewable energy in the electricity sector (the 98-29 law of 14 April 1998 and the 2002-01 of 10 January 2002) were updated. The updated law obligates the grid operator – that is, the national electricity company owned by the state – to buy and pay for electricity produced from renewable sources. It guarantees the purchase of electricity from independent power producers using renewable sources and establishes a national system of subsidies to cover the cost differences among different regions. The subsidy does not vary with different renewable sources. The grid is the property of the state. The updated law also established a Ministry for Bio-fuels and Renewable Energy, which is responsible for its implementation.

The elaboration of a law on the purchase and cost of renewable energy is the instrument used by the Senegalese government for the development of renewable energy and its use for electricity sector development. A legal framework consisting of laws and regulations will permit different stakeholders to play their role in a sound and attractive environment. This law defines the obligation of companies that operate the electricity grid to purchase and to pay for electricity produced from renewable sources. It applies to the following renewable sources:

- Micro and mini hydroelectric power plants;
- Wind farms;
- Solar based electricity generation;
- Waste heat recovery; and
- Renewable biomass based electricity generation.

3.3.4. Key factors needed to make something happen

The use of renewable resources is, in most cases, not cost competitive when compared to conventional fossil-based energy generation. There is therefore a need for the Senegalese government to create an attractive environment through the introduction of fiscal and financial support mechanisms within this legal and regulatory framework to allow renewable energy technologies to compete with fossil-based technologies.

For the development and deployment of solar PV in rural electrification projects, an assessment of the most suitable technology for a given region, accounting for the notion of subsidiary, is required. This means that in times of scarce electricity, the most suitable option to satisfy a given energy need should be based on both economical criteria and the availability of the supply. For example, in times of high demand, the satisfaction of energy demand for lighting by low power consumers in villages should be met by off grid sources of electricity, while the needs of industry should be met by the grid as their requirements cannot easily be met by solar PV. This is the first step of an integration that will satisfy each type of demand with the type of sources of quality just required.

The law must be properly enforced so that investors can be confident that they can earn a return on their investment. For that purpose, the Regulatory Commission for Electricity is to be strengthened and supported.

A holistic approach is to be used for policy definition and implementation. Otherwise, if one key factor for the achievement of the policy objective is not accounted for, even if important measures are taken, the result can be mitigated. The key factors and stakeholders needed to ensure implementation must be identified for each step of the process.

To expand the program beyond its current scope, CDM revenues could be used as an incentive to increase the attractiveness of projects using renewable sources of electricity. However, there are still some barriers (e.g., non involvement of the local financial institutions in the CDM capacity building process, the lack of official data publicly available for demonstration projects, and the eligibility assessments of CDM projects) that prevent CDM development in Senegal.

3.3.5. What has happened as a result of the policy and instruments that were introduced?

There are two projects under development as a result of the law. The first is a project to generate electricity using typha biomass, an invasive water plant that is abundant in the Senegal River. This plant colonizes the flood plains, reduces the available cropland in the irrigated areas, impedes river traffic, and provides habitat for carnivorous birds. So, this project will also contribute to sustainable development because the plant must be harvested, thereby providing jobs for local people. In the first phase, the investors aim to implement a 12 MW power plant and add two 12 MW plants in a second phase. The feasibility studies have been done and if the project proponents finalize the contract with the electricity company, the project will be launched.

The second is the development of a wind farm project at Saint-Louis, on the north coastal area of Senegal. The region of Saint-Louis, with a subsidy from the Midi Pyrenees region and the Agence Française de Développement, the French bilateral cooperation agency, is undertaking preliminary studies for a 50 MW wind park. This project will be carried out in two phases: a first pilot of 15MW and a complementary phase of 35MW. The estimated cost of the first phase is about 16,500 K Euros. The annual net producible electricity will be 28,775 MWh. Training will be provided for the operation and the maintenance of the wind park as part of the project activity.

The Saint-Louis region has clearly stated its interest in this wind park. A contract providing a long-term concession of the land to accommodate this park has been signed. The government of Senegal, through the Ministry for Energy, is very interested in implementing the project, which is highly ranked on the list of projects for energy production by the ministry. The project was presented by the national private sector at the employers' national council workshop as an example of a renewable energy project that can be implemented in a short term. A draft contract for the sale of electricity was proposed by SENELEC, the Senegal National Electricity Company.

There was a legal barrier to the implementation of this project that needed to be clarified. The consortium of companies behind this project originally wanted the

electricity for their own use and to pay the electricity company fees for the transport of the electricity in its lines. The concept of self-production does not exist in the laws and regulations in force in Senegal. The project was thus perceived to be selling energy to the companies in the consortium, whereas the electricity company SENELEC has the monopoly for the sale and the distribution – a monopoly which it does not plan to reassign to self producers. The new approach of the independent power producers, in the context of the new regulatory framework for renewable energy production and sale, seems to be more appropriate for SENELEC and will remove the barrier to the implementation of this project. The companies have to sell their entire production to the grid and purchase electricity from the grid.

3.3.6. List of relevant laws, regulations and rules

The 98-29 law of 14 April 1998.

The 2002-01 of 10 January 2002.

Only one law is for the time being identified as instrument for the achievement of this policy. It is the law on the purchase and cost of renewable energy.

Annex 4. Glossary

TERM	DEFINITION
Abatement	Refers to reducing the degree or intensity of greenhouse gas emissions.
Adaptation	Adjustment in natural or human systems to a new or changing environment. Adaptation to climate change refers to adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation.
Anthropogenic emissions	Emissions of greenhouse gases, greenhouse gas precursors, and aerosols associated with human activities. These include burning of fossil fuels for energy, deforestation, and land-use changes that result in net increase in emissions.
Ad Hoc Working Group on Further Commitments of Annex I Parties under the Kyoto Protocol (AWG-KP)	Article 3, paragraph 9 of the Kyoto Protocol provides that the CMP shall initiate consideration of future commitments for Annex I Parties at least seven years before the end of the first commitment period. Pursuant to that provision the CMP at its first session held at Montreal from 28 November to 10 December 2005, established the Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol (AWG-KP).
Bali Action Plan	The United Nations climate change conference in Bali culminated in the adoption of the Bali Road Map, which consists of a number of forward-looking decisions that represent the various tracks that are essential to reaching a secure climate future. The Bali Road Map includes the Bali Action Plan, which charts the course for a new negotiating process designed to tackle climate change, with the aim of completing this by 2009. It also includes the AWG-KP negotiations and their 2009 deadline, the launch of the Adaptation Fund, the scope and content of the Article 9 review of the Kyoto Protocol, as well as decisions on technology transfer and on reducing emissions from deforestation.
Biomass fuels or biofuels	A fuel produced from dry organic matter or combustible oils produced by plants. These fuels are considered renewable as long as the vegetation producing them is maintained or replanted, such as firewood, alcohol fermented from sugar, and combustible oils extracted from soy beans. Their use in place of fossil fuels cuts greenhouse gas emissions because the plants that are the fuel sources capture carbon dioxide from the atmosphere.
Capacity building	Increasing skilled personnel and technical and institutional abilities.
Clean Development Mechanism (CDM)	Defined in Article 12 of the Kyoto Protocol, the CDM is intended to meet two objectives: (1) to assist parties not included in Annex I in achieving sustainable development and in contributing to the ultimate objective of the convention; and (2) to assist parties included in Annex I in achieving compliance with their quantified emission limitation and reduction commitments. Certified Emission Reduction Units from CDM projects undertaken in Non-Annex I countries that limit or reduce GHG emissions, when certified by operational entities designated by COP Meeting of the Parties, can be accrued to the investor (government or industry) from parties in Annex B. A share of the proceeds from certified project activities is used to cover administrative expenses as well as to assist developing country parties that are particularly vulnerable to the adverse effects of climate change to meet the costs of adaptation.
Climate	Climate in a narrow sense is usually defined as the 'average weather', or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years. These quantities are most often surface variables such as temperature, precipitation, and wind. Climate in a wider sense is the state, including a statistical description, of the climate system. The classic period of time is 30 years, as defined by the World Meteorological Organization (WMO).

Climate change	Climate change refers to a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/ or the variability of its properties and that persists for an extended period – typically, decades or longer. Climate change may be due to natural internal processes or external forcings or to persistent anthropogenic changes in the composition of the atmosphere or in land use. Note that UNFCCC, in its Article 1, defines "climate change" as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods". The UNFCCC thus makes a distinction between "climate change" attributable to human activities altering the atmospheric composition, and "climate variability" attributable to natural causes.
Co-generation	The use of waste heat from electric generation, such as exhaust from gas turbines, for either industrial purposes or district heating.
Deforestation	Conversion of forest to non-forest. For a discussion of the term forest and related terms such as afforestation, reforestation, and deforestation, see the IPCC Special Report on Land Use, Land-Use Change, and Forestry (IPCC, 2000).
Demand-side management	Policies and programs designed for a specific purpose to influence consumer demand for goods and/or services. In the energy sector, for instance, it refers to policies and programs designed to reduce consumer demand for electricity and other energy sources. It helps to reduce greenhouse gas emissions.
Emission	In the climate change context, emissions refer to the release of greenhouse gases and/or their precursors and aerosols into the atmosphere over a specified area and period of time.
Energy efficiency	Ratio of energy output of a conversion process or of a system to its energy input.
Fossil fuels	Carbon-based fuels from fossil carbon deposits, including coal, oil, and natural gas.
Greenhouse gas (GHG)	A gas that absorbs radiation at specific wavelengths within the spectrum of radiation (infrared radiation) emitted by the Earth's surface and by clouds. The gas in turn emits infrared radiation from a level where the temperature is colder than the surface. The net effect is a local trapping of part of the absorbed energy and a tendency to warm the planetary surface. Water vapor (H_2O), carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4) and ozone (O_3) are the primary GHGs in the Earth's atmosphere.
Intergovernmental Panel on Climate Change (IPCC)	Established in 1988 by the World Meteorological Organization and the UN Environment Programme, the IPCC surveys world-wide scientific and technical literature and publishes assessment reports that are widely recognized as the most credible existing sources of information on climate change. The IPCC also works on methodologies and responds to specific requests from the Convention's subsidiary bodies. The IPCC is independent of the Convention.
Mitigation	An anthropogenic intervention to reduce the sources or enhance the sinks of greenhouse gases.
Renewables/renewable energy	Energy sources that are, within a short time frame relative to the Earth's natural cycles, sustainable, and include non-carbon technologies such as solar energy, hydropower, and wind, as well as carbon-neutral technologies such as biomass.
Research, development, and demonstration (RD&D)	Scientific and/or technical research and development of new production processes or products, coupled with analysis and measures that provide information to potential users regarding the application of the new product or process; demonstration tests; and feasibility of applying these products processes via pilot plants and other pre-commercial applications.
Renewable energy	Energy sources that are, within a short time frame relative to the Earth's natural cycles, sustainable, and include non-carbon technologies such as solar energy, hydropower, and wind, as well as carbon-neutral technologies such as biomass.
Resources	Resources are those occurrences with less certain geological and/or economic characteristics, but which are considered potentially recoverable with foreseeable technological and economic developments.
Sink	Any process, activity or mechanism that removes a greenhouse gas, an aerosol, or a precursor of a greenhouse gas or aerosol from the atmosphere.

Source	Any process, activity, or mechanism that releases a greenhouse gas, an aerosol, or a precursor of a greenhouse gas or aerosol into the atmosphere.
Subsidy	Direct payment from the government to an entity, or a tax reduction to that entity, for implementing a practice the government wishes to encourage. Greenhouse gas emissions can be reduced by lowering existing subsidies that have the effect of raising emissions, such as subsidies to fossil-fuel use, or by providing subsidies for practices that reduce emissions or enhance sinks (e.g., for insulation of buildings or planting trees).
Sustainable development	Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.
Voluntary measures	Measures to reduce greenhouse gas emissions that are adopted by firms or other actors in the absence of government mandates. Voluntary measures help make climate-friendly products or processes more readily available or encourage consumers to incorporate environmental values in their market choices.
United Nations Framework Convention on Climate Change (the Convention) (UNFCCC)	The Convention was adopted on 9 May 1992, in New York, and signed at the 1992 Earth Summit in Rio de Janeiro by more than 150 countries and the European Community. Its ultimate objective is the 'stabilisation of GHG concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system'. It contains commitments for all Parties. Under the Convention, Parties included in Annex I aim to return greenhouse gas emissions not controlled by the Montreal Protocol to 1990 levels by 2000. The Convention entered in force in March 1994.

Sources: IPCC and UNFCCC glossaries, available at http://www.ipcc.ch/glossary/index.htm and http://unfccc.int/essential_background/glossary/items/3666.php.