RENEWABLE ENERGY SOURCES IN LATIN AMERICA AND THE CARIBBEAN

SITUATION AND POLICY PROPOSALS

UNITED NATIONS

ECLAC

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SUMMARY

The World Summit on Sustainable Development, held in Johannesburg, August 2002, responded to a new cycle of global meetings that began with the Millennium Summit. The main characteristic of this new cycle is that the focus of the debate has moved away from declarations of principle toward identifying objectives and areas of concrete action, with quantitative commitments and deadlines for compliance.

Debates about energy held an important position in Johannesburg. The positive links between access to energy, eliminating poverty and improving people's health and quality of life were emphasized. Although there was agreement on the need to expand the use of renewable energy resources and increase the percentage of energy produced from renewable sources, unlike other areas of debate, it was not possible to establish global targets and deadlines. Nonetheless, some regions, among them Latin America and the Caribbean through the Latin American and Caribbean Initiative for Sustainable Development, did agree on concrete targets.

The Brasilia Regional Conference on Renewable Energy (Brasilia, October 2003), represented not only one of the first efforts to concretize the target agreed upon on at Johannesburg, but also the first joint meeting of authorities and representatives of Latin American and Caribbean Ministries of the Environment and Energy. This instance of convergence approved the Brasilia Platform on Renewable Energies, which establishes among its main points: "To further efforts to achieve the goal set forth in the Latin American and Caribbean Initiative for Sustainable Development of ensuring that by the year 2010 the use of renewable energy by the region, taken as a whole, amounts to at least 10% of its total energy consumption on the basis of voluntary efforts and taking into account the diversity of national situations. This percentage may be increased by those countries or subregions that voluntarily wish to do so."

As this paper reveals, in late 2002, Latin America and the Caribbean had already met the targets established in Brasilia, with renewable sources contributing more than one quarter of the Total Energy Supply[1] (25.7%), led by hydro-electric energy accounting for almost 15%, sustainable fuelwood with 5.8%, and cane products with 4.1%. The rest of renewables, such as other biomass (0.5%) and geothermal (0.7%) are marginal, while wind and solar energy, although used, are yet not counted as part of energy supply.

The region has an important store of both fossil and renewable resources. The reserve to production ratio stands at more than 35 years for oil and more than 40 years for natural gas, while hydroelectric power potential that is economically feasible stands at more than 500 GW, of which just 22% is being used. Despite the resources available, no suitable development of geothermal energy is apparent and, at the same time, it would seem that the contributions of other technologies such as solar and wind power are not duly counted, as we will see below in the subregional analysis.

In preparing this paper, ECLAC has sought to achieve the balanced integration of sustainable development's many components as its referential framework, so this study covers the economic, social, energy and environmental spheres using an integrated perspective. From this perspective, the target achieved by the region as a whole must be carefully analysed, since there are clear differences between subregions and countries within subregions:

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[1] Note that while the Brasilia platform sets the target as 10% of consumption, this calculation used supply, due to the problems and methodological limits detailed in chapter 3.

- In terms of the store of natural resources and energy supply and consumption structures;
- In terms of the institutions and baseline conditions for encouraging policies to promote and ensure the use of renewable sources.

An analysis of the renewability of the total supply shows that Caribbean subregion “1” (including Barbados, Grenada, Guyana, Jamaica, Suriname and Trinidad and Tobago) is well below the 10% line, while Mexico is just slightly above it; this means these countries must make a significant effort if they want to achieve the target for renewables’ share over total supply, in the case of the former, and to sustain it, in the case of the latter. Those subregions that have achieved the 20% to 30% range (the case of the Caribbean 2 subregion countries, Dominican Republic, Haiti and Cuba, and the Andean Community) should act decisively in both political terms and in promoting renewable energy. Moreover, in certain Central American countries, Guatemala, El Salvador, Honduras, Nicaragua, the role of forest energy (woodfuel) is very important and if, on one hand, in terms of sustainable development this is positive, since it points to weak use of fossil fuels, on the other it is clearly negative, due to the strong impact on national forestry resources and the quality of users’ lives.

In contrast, in countries where the use of biomass for energy purposes is virtually non-existent, as in Argentina, Mexico, Venezuela and Ecuador, problems of sustainability could exist due to the heavy use of fossil fuels at the final industrial and residential level, and intermediate consumption in generating electric power. In these countries, hydrocarbons account for 80% to 90% of total energy supply.

Apart from this general positioning of the subregions and certain countries in terms of this initiative, other points of analysis arise that should be explored, due to both the medium-term implications of this positioning and the composition and structure of sustainability of the energy supply.

The Residential Sustainability Index (RSI) reveals the importance of fuelwood in supplying families’ basic calorie requirements, mainly for cooking, heat, and hot water. A high RSI means that the country is heavily dependent on fuelwood to satisfy the population’s needs. This study has revealed a wide range of technologies using fuelwood combustion and conditions of use throughout the region, which are relevant in terms of energy efficiency and negative health effects.

The RSI can also be read in terms of social liabilities, with reference to the general population’s poverty levels and the access that people in marginal urban and rural areas have to better quality energy sources. Thus better quality sources are generally associated with a higher monetary cost, but also to greater efficiency and higher yields, to less time spent gathering fuel and to lower levels of household pollution.

The subregions most dependent on fossil fuels (Caribbean 1 and Mexico) are below the RSI line of 20%, as they are heavy users of secondary liquid hydrocarbons. In this case, they could post a consumption of useful energy and therefore a higher level of satisfaction of the basic requirements for caloric use, than the other subregions. At the opposite extreme are the Central American countries, with a ratio that is over 1.4 times, which indicates not only an excessive dependence on fuelwood in both rural and marginal urban areas, but also an insufficient supply of the necessary basic calories, in terms of both access and quality.

Another indicator that to some degree measures the sustainability of energy systems is the Polluting Electric Power Generation benchmark (*Generación Eléctrica Contaminante*), measured by the amount of CO_2 emitted as compared to total electric power production (tons CO_2/GWh). Generation in the Caribbean subregions “1” and “2”, and Mexico, is particularly polluting in terms of CO_2 emissions. In

Mexico's case, this reflects the dominant role of fossil fuels in generation (almost 70% of the total is thermal). In the case of the Caribbean countries this role is clearly associated with a less efficient generation process with low yields in terms of thermal generation.

As expressed above, the specific objective of this document has been to analyse the sustainability of energy supply to 2002. That is, we have attempted to portray the situation up to the year 2002, obtaining positive conclusions in some cases and questions in others.

The application of a more dynamic, rather than static, analysis, remains pending. This would involve proposing a set of possible scenarios for the progress of Latin American and Caribbean countries and identifying the national, subregional and regional conditions that prevent those countries or subregions that do not meet the Latin American Initiative target from approaching these goals. Likewise, it could suggest ways for those that meet them, but run the risk of slipping below them, to redirect trends and policies toward the more sustainable development of their energy sector.

The detection of specific barriers along with other actions should become the basis for public policies in favour of renewable energies. The barriers to implementing energy efficiency and renewable energy measures are well documented and generally fall into five categories: technical, regulatory, economic, financial and institutional. This document includes an analysis of these barriers and adds a new type of obstacle detected, which has to do with specific social behaviour in the region.

From the diagnosis included in this study comes the need to develop and modernize institutional structures to truly integrate public policies and, moreover, encourage synergies with international financing and private investment. Thus, just as the most important task of the past decade was to build environmental institutions, the fundamental task for the coming decade must be to ensure that the environmental theme fully penetrates the economic and social agenda. An essential element in making the transition to the full incorporation of environmental sustainability into the economic agenda requires treating it as an opportunity and not merely a restriction on economic development.

Similarly, it is necessary to reduce the room for multiple governmental errors that appears during the complex process of managing, formulating, articulating and coordinating public interventions. The quality of and interactions among an important set of organizations, institutions and public policies must also be improved; these are often considered separately, as if they were bodies with a life of their own, autonomous from each other. This is common in several of the cases examined, in which programmes attempted to achieve wide penetration of renewable sources, but later proved to provide insufficient information and incentives to ensure the necessary integration, coherency and coordination of sectoral policies with each other and in relation to the general objectives of energy policy. Moreover, this was compounded by the fact that all subregions experience the presence of multiple, isolated international actors, governmental and intergovernmental, regional and extraregional bodies, NGOs, etc., which get involved in different policy spheres (generally speaking, project design and implementation).

As a result, in the case of renewable sources, it is clear that political authorities and instances must be defined to establish the necessary mechanisms, as occurred with the process of reforming the energy system. Countries should therefore explicitly include in their strategic efforts a greater penetration of renewable sources that contribute to achieving greater energy security, and a more efficient energization in the framework of anti-poverty programmes; mitigate environmental problems; and, given the greater use of external sources, permit foreign currency savings. This implies that alliances must be built with local groups, within the framework of international cooperation.

Essentially this strategy proposes reproducing the conditions on which the changes arising from reforms depended. If these processes were accompanied by actions aiming to change the institutional organization, regulatory principles and coordination modes, then these same elements should be involved in renewable sources (i) to ensure stronger institutions, more in line with the proposal; (ii) to introduce fundamental modifications to existing regulatory frameworks; and (iii) to change market organization, the degree of jurisdictional decentralization, access conditions, and areas for the State to provide subsidies.

This therefore assumes that in these three planes the State's role will be inevitable, as coordinator of the space created to ensure policy viability, intervening directly in investment implementation (rural electrification, for example), or through development tools, which make the participation of private investors attractive. Among the development instruments, taxes and subsidies that act on energy prices could be considered, along with a tax on the substitution of sources and/or on the penetration of cleaner sources, to encourage the rational use of energy, environmentally oriented objectives, and others. Undoubtedly, the dose of public intervention and the nature of incentives will depend on conditions in each country.

Today, the issue of renewable energies is placed on the public agenda by those within the authorities or civil society who are concerned with the environment. This is useful for stimulating initiatives for their use, but is not consistent enough in the framework of energy policies, which have tended to give priority to conventional sources, because upon approaching energy from an essentially economic perspective, renewable energies end up in the background due to their higher entry costs.

This situation is slowly changing, however, since other issues on the public agenda, linked one way or another with the use of renewable energies, today hold a prominent place in the concerns of national and in some cases sub-national governments, in most of the region's countries.

The different initiatives apparent in the region's countries should be incorporated into a vision of the energy sector as a whole, making the demands of sustainable development a condition for their evolution. From this perspective certain strategic lines should arise that guide public policy formulation. These should suitably weigh the role that renewable energies could play in economic growth, employment, the environment, rural development, universal energization, and the governability of resources, in particular water.

Based on this integrated vision, this study puts forward four relevant issues and initiatives with concrete proposals for Latin America and the Caribbean:

- A revaluation from an environmental and social perspective of hydro power according to the demands of sustainable development;
- The contribution of renewable sources to the integrated development of rural communities;
- The rational use of fuelwood;
- The role of biomass and biofuels.

These challenges must be dealt with considering the opportunities contained in the new European linking directive on emissions (EuroKyoto), which offers the region the chance to enter a global mechanism trading in emissions, which will attempt to create an institutionalized system as a function of projects already identified in the pilot phase of the Kyoto Protocol; and evaluating the possibility of applying guaranteed buying modes or "Feed-In", which in Europe have enjoyed significant success.

Chapter I

BACKGROUND

Many international, regional and intergovernmental initiatives and instances today support renewable energy sources' entry into energy markets, in both industrialized and developing countries.

A. INTERNATIONAL INITIATIVES

Although it did not achieve concrete objectives and results, there is no doubt that the World Summit on Sustainable Development (WSSD) in Johannesburg, August 2002, represented a major breakthrough, as it put the issue of renewable energy sources (RES) on countries' political agendas.

In terms of "sustainable energies", the Johannesburg meeting generated a series of national, regional and worldwide initiatives with different plans and interests, but all with the same objective: to substantially increase renewable sources' participation and contribution to energy supply. The initiatives generated at this meeting include:

1. Johannesburg Renewable Energy Coalition (JREC)

Led by the European Union, in March 2003 this initiative already had the formal support of 78 countries (among them: Chile, Argentina, Brazil and the countries of the Caribbean). The JREC has not established specific targets, but is currently completing preparation of its definitive Plan of Action.

The JREC Declaration states that its members are committed to cooperating "on the further development and promotion of renewable energy technologies …on the basis of clear and ambitious time bound targets set at the national, regional and hopefully at the global level. We have adopted, or will adopt, such targets for the increase of renewable energy and we encourage others to do likewise."[2] It also expresses the need to report on progress and results in time for the World Conference on Renewable Energies, Bonn 2004.

2. Renewable Energy & Energy Efficiency Partnership (REEEP)

Led by the United Kingdom and proposed in Johannesburg on the occasion of the WWSD, mentioned above, by July 2003, this initiative had organized nine regional meetings of experts in Central Europe, Southeast Asian, Central Asia, East Asia, Western Africa, Eastern and South Africa, North America and finally Latin America. REEEP's official launching took place in London, in October 2003.

REEEP's Plan of Action states that this is "a coalition of progressive governments, businesses and organisations committed to accelerating the development of renewable and energy efficiency systems (REES)." It formed to advise those who are developing energy policies and the business sector on how to

[2] From the official JREC website: www.jrec.org.

provide innovative policies, regulatory and financial mechanisms to accelerate the development of sustainable energy. The process of forming this association will also assist the German proposal for the World Conference on Renewable Energies, to take place in Bonn, June 2004.[3]

3. World Renewable Energy Conference, 2004

The main priorities of this World Conference, organized by the Government of Germany, are to highlight the important role of renewable energy in the context of sustainable development, to bring attention to the concept of establishing national, regional and global shares of renewable energy, and to achieve an international agreement on a Global Plan of Action for the successful implementation of renewable energies.

Reading these different declarations reveals two main principles shared by these initiatives:

(a) The joint definition of concrete numerical targets for renewables share of country's energy matrixes;
(b) The establishment of a target deadline (June 2004, the world meeting in Bonn) as the culminating moment for the presentation of concrete actions in this sense.

B. INTERGOVERNMENTAL INITIATIVES

1. European Union

(a) Directive 2001/77/EC

On 4 July 2001, the European Parliament approved this Directive on the "promotion of electricity produced from renewable energy sources in the internal electricity market". The Directive is intended to contribute to compliance with Kyoto commitments and achieving the goal of doubling renewable energy's share of the European Union's gross national energy consumption, from its current level of 6% to 12% in 2010.

With this new regulation, the member states committed themselves to respecting national objectives for future consumption of electricity produced using renewable energy sources and to create a "green tag" guarantee system. Similarly, States must adopt parallel measures that create equitable conditions and make it easier for renewable energy sources to enter the European market, at the same time as they respect the rules of competition.

(b) Intelligent Energy Europe (EIE)

More recently, in May 2003, the European Parliament approved a multi-year community programme called Intelligent Energy Europe, with a €200 million budget, €80 million of which will go to promoting renewable energy sources in the countries of the Union and €17 million to cooperation with developing countries to develop energy efficiency and renewables. The programme includes and replaces three old programmes: SAVE, Altener and COOPENER.

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[3] From the official REEEP website, at http://www.reeep.org.

(c) Directive 2003/87/EC

On 13 October 2003, European Directive 2003/87/EC on greenhouse gas (GHG) emissions allowance trading was published in the Official Journal of the European Union, thus making the Directive EU law.

According to that Directive, member states must decide on the amount of GHG emission allowances (EUAs) to be allocated for 2005-2007 to large fixed sources of CO_2 by March 2004 (a second phase is scheduled for 2008-2012.) More than 12,000 fixed sources, representing about 45% of the EU25 total GHG emissions, will be covered.[4]

(d) Draft Directive 2003/0173

In addition to the above mentioned EU Directive on greenhouse gas emission allowance trading within the Community, a linking directive will eventually govern the relationships between the European Trading Scheme (EU-ETS) and the Kyoto Protocol. In its current form (it had yet to be approved by the European Council and by the European Parliament at time of writing), it allows for the import of Emission Reduction Units (ERUs) and Certified Emission Reductions (CERs) into the ETS (through conversion in EUA), though only after 2008.

On 16 March 2004, the European Parliament's Environment Committee adopted its report on the Directive to link the EU emissions trading scheme to the Kyoto Protocol project-based mechanisms. The vote marked another step toward turning the linking Directive proposal into law. The report sets out the Parliament's position and will be passed along to the EU Environment Council. The two bodies must agree on all outstanding issues in the coming weeks if they are to meet their 20-23 April target date for adoption.

Following the 16 March vote, both bodies seemed to agree that the link should not depend on ratification of the Kyoto Protocol. They also agreed that the link should start on 1 January 2005 for Clean Development Mechanism (CDM) projects and 2008 for Joint Implementation (JI) projects. Many analysts actually refer to this Directive as the "*EuroKyoto,*" meaning that a wide range of trading opportunities will be offered soon to countries identified as "Non-Annex 1" (as is the case with Latin American countries) in the Kyoto Protocol.

In preparation for the EU-ETS, several companies have engaged in demonstration trades of EUA. Because EUAs have not yet been allocated to any private entities, all transactions at time of writing have been forward trades in which EUAs will be transferred from the seller to the buyer at a future date.

Some 20 deals took place in the first three quarters of 2003, for a volume probably superior to 500,000 tons of CO_2e (carbon dioxide equivalent). Most of these deals are small (below 50,000 tons), and involve only vintages from 2005, 2006 and/or 2007.

Although price information is sketchy, transaction prices have apparently increased from around €6/tCO_2e in May 2003 to €12/tCO_2e in November 2003. These prices, however, do not necessarily reflect the long-term equilibrium between supply and demand, since the market is still so thin, and there is still so much uncertainty about the final allowance allocations.

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[4] EU25 refers to the current 15 EU member countries plus the 10 countries that will join Europe in 2004.

2. International Energy Agency (IEA)

In their official news release (2001), the Ministers of the OECD countries declared that “We intend that renewable energy should play an increasing role… ”.[5]

Within the International Energy Agency, the body responsible for this specific area is the “Renewable Energy Working Party” (REWP), which in preparing “World Energy Outlook 2000”, has proposed some basic guidelines to rapidly increase renewable sources in the Total Primary Energy Supply (TPES).

A recent IEA’s document is one entitled “Renewable Energy... Into the Mainstream” (October 2002), prepared by the Agency’s Renewables Unit. The document deepens the discussion of the five basic steps to increase renewable use:

- (a) Speed up technological development
- (b) Reinforce national policies
- (c) Reduce market barriers and start-up manufacturing costs
- (d) Mobilize investment based on market mechanisms
- (e) Promote international cooperation

C. REGIONAL INITIATIVES: THE CASE OF LATIN AMERICA AND THE CARIBBEAN

1. Latin American and Caribbean Initiative for Sustainable Development (ILACDS)

This initiative was presented to and approved by the first special meeting of the Forum of Ministers of the Environment of Latin America and the Caribbean, in Johannesburg (August 2002). Among others, one of its most ambitious goals is to increase renewable sources’ share of national and regional energy matrixes by 2010, bringing renewables’ share to 10% of Total Primary Energy Supply (TPES).

The ILACDS declaration calls for it to work to ensure that developed countries meet their commitment of assigning 0.7% of GDP to official development aid, promote the implementation of the Kyoto Protocol, strengthen or correct sustainability indicator systems, develop South-South cooperation actions, and, among other guiding targets, increase the region’s use of renewable energy to 10% of total energy by 2010.[6]

2. Brasilia Platform

The regional follow-up meeting to the WSSD, organized by the Government of Brazil in Brasilia, 29-30 October 2003, brought together representatives of Ministries of the Environment and Energy of Latin America and the Caribbean.[7]

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[5] Meeting of IEA Governing Board at Ministerial Level–Communiqué. At http://library.iea.org/dbtw-wpd/Textbase/press/pressdetail.asp?PRESS_REL_ID=35.

[6] First special meeting of the Forum of Ministers of the Environment of Latin America and the Caribbean. Distribution UNEP/LAC-SMIG.I/2. August 2002. Regional Office for Latin America of the United Nations Environmental Programme (UNEP), at http://www.rolac.unep.mx/ilc_esp.pdf.

[7] As follow-up to the Latin American and Caribbean Initiative for Sustainable Development, ILACDS.

The purpose of the Brasilia event was to create an opportunity to bring together initiatives and focus discussion on the problems and opportunities specific to the countries of Latin America, to define a common regional position before the Bonn meeting.

As the event ended, government representatives from 21 of the region's countries approved the Brasilia Platform, whose main commitments are summaries in box I.1.

Box I.1

THE BRASILIA PLATFORM'S MAIN COMMITMENTS

- To further efforts to achieve the goal set forth in the Latin American and Caribbean Initiative for Sustainable Development of ensuring that by the year 2010 the use of renewable energy by the region, taken as a whole, amounts to at least 10% of its total energy consumption on the basis of voluntary efforts and taking into account the diversity of national situations. This percentage may be increased by those countries or subregions that voluntarily wish to do so;

- To strengthen cooperation between the countries of the region and the developed countries in promoting economic growth, environmental protection and social...;

- To foster the formulation of the long-term public policies needed to further the development of renewable energy sources, in accordance with the regulatory frameworks in place in each country...;

- To promote, at the level of each country, cooperation with the production sector in order to form alliances and gain more in-depth knowledge of the renewable energy sector;

- To foster the adoption of regulatory and institutional frameworks that incorporate instruments which internalize the social and environmental benefits of renewable energy;

- To facilitate the training of human resources for, inter alia, the diffusion of technology...;

- To undertake, with the support of the Economic Commission and other international agencies, an exchange of experiences regarding applicable regulatory frameworks for the development of renewable energy sources with a view to the following objectives:

  (a) Development of a comparative table on regulatory frameworks in the region…;
  (b) Formulation of proposals for strengthening the sustainability of existing regulatory frameworks, in accordance with the situation in each country, and for promoting greater energy efficiency;

- To express strong support at the International Conference for Renewable Energies, to be held in Bonn, Germany, in 2004, for the creation of a technical and financial cooperation fund to … permit the reduction of existing costs and to increase investment…;

- To urge financial institutions to finance national, subregional and regional renewable energy projects...;

- To encourage the development of renewable energy projects and the creation of markets for green tags and carbon emission credits and the execution of tax incentive programmes...;

- To formulate public policies that encourage the development of renewable energy markets;
- To take into account the social needs of the lowest-income sectors in the countries of the region when developing renewable energy markets;

- To request the Executive Secretary of the Economic Commission for Latin America and the Caribbean to prepare a document on the status of renewable energy in Latin America and the Caribbean for presentation at the International Conference for Renewable Energies and… to provide support to the countries of the region at the International Conference and in the follow-up and implementation of the agreements reached at that event, including the convening of a regional follow-up conference within the framework of the United Nations;

- To declare that this platform for action constitutes a Latin American and Caribbean contribution to the International Conference for Renewable Energies and to instruct the Chairperson to present it at that Conference.

The Brasilia event made it possible to jointly and synergically discuss the opportunities and benefits available to the Region in the framework of the different world future scenarios in favour of renewables, whether Kyoto is ratified or not.

Although in this document governments make no specific political-institutional commitment, the Platform has nonetheless been an important step for the region's countries, since it represents the first concrete effort to coordinate and make consistent Latin American countries' different focuses and interests in terms of sustainable renewable energy.

In fact, Brasilia has represented an important opportunity to concentrate and consolidate the regional discussion agenda on renewable sources and to guide it toward initiatives that include designing a joint Latin American proposal, to position Latin America strategically in terms of the different future scenarios for the development of renewable sources and the world carbon market.

According to the specific requirement contained in the Platform, ECLAC is the regional institution in charge of follow-up and implementation of its agreements, including the invitation, within the framework of the UN, of a regional conference to follow-up on the World Conference in Bonn (see box I.1).

3. Declaration of the Latin American Parliament

The parliamentarian delegations from 10 of the region's countries, attending the seventeenth meeting of the Energy and Mining Commission of the Latin American Parliament (Parlatino), held in Santiago Chile in late April 2004 at ECLAC headquarters, agreed on the following points, among others:

- Promote judicial-regulatory frameworks that encourage not only the growth and greater competitiveness of markets, but also the efficient use of the natural resources involved, the protection of societies' heritage as an integral whole, the rights of users and consumers, and harmonic and economically rewarding relationships for local communities involved in resource exploitation.

- To encourage a broad debate to improve energy sector regulation, considering among others: (i) the goals of sustainable development; (ii) the ongoing effectiveness of genuinely competitive markets; (iii) prices that reflect externalities; (iv) supply security; etc.

- Improve judicial and regulatory norms according to each country's reality, to guarantee the rights of users and to ensure that more renewable energy sources and improved energy efficiency lead to an increase in the competitiveness of our economies.

- To jointly foster with parliamentarians and countries belonging to the European Union an extensive cooperation programme to harmonize legislative practices favourable to protecting the environment.

- To promote draft laws that favour sustainable development of the energy sector through legislative initiatives on renewable sources and efficient energy use.

- To foster Europe-Latin American Parliamentarian dialogues through the Commission of Mining and Energy of the Latin American Parliament and the Committee on Industry, External Trade, Research and Energy of the European Parliament, to promote the development of sustainable energy.

Like the Brasilia Platform, the Declaration of Santiago, while a document with no specific political-institutional commitment on the part of national congresses, nonetheless became a significant step for the region's countries, since it is the first effort to coordinate Latin American parliamentarians in terms of sustainable renewable energy.

Chapter II

THE CURRENT STATE OF RENEWABLES IN THE REGION

The grouping of countries into the subregions considered in this paper reflects the information available (as established by the Latin American Energy Organization (OLADE) Energy Economic Information System, SIEE) and their geo-economic proximity. Thus, the following subregions have been defined:

- **Central America**: Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Panama
- **Caribbean "1"**: Suriname , Guyana, Barbados, Trinidad & Tobago, Jamaica, Grenada
- **Caribbean "2"**: Haiti, Cuba, Dominican Republic
- **Andean Community**: Venezuela, Colombia, Ecuador, Peru, Bolivia
- **Expanded MERCOSUR**: Brazil, Argentina, Paraguay, Uruguay + Chile

Moreover, given the size and specific characteristics of their energy systems, Mexico and Brazil will be analysed separately on some occasions.

In the case of the Caribbean subregion, two aspects were considered: (a) all the countries analysed provide information to OLADE's SIEE, thus guaranteeing that comparable information has received a similar treatment; and (b) the Caribbean has been separated into two units for analysis (Caribbean 1 and 2) given the differences in the availability of natural resources and in the socio-economic conditions.

A. THE INSTITUTIONAL FRAMEWORKS GOVERNING RENEWABLE ENERGIES

Generally speaking, the agency responsible for renewable energy sources should come under the institution in charge of the energy sector, which in different countries may be dealt with by a Ministry, Secretariat or Commission. However, given the multisectoral nature and extent of the issue, in the case of almost all renewable technologies, other state, non-governmental and private instances can be identified that are directly or indirectly handling renewable energy sources (RES), mainly those involved in managing biomass and water resources, whose perspectives or primary lines of action are not energy.

Several agencies participate on behalf of the public sector. At their upper levels these involve the institutions responsible for a country's energy policy, depending on the degree of participation established in their central mandate with regard to RES. Similarly, environmental ministries, secretariats or authorities also participate, as they must ensure the sustainable use of the country's natural resources (mainly forestry and hydro) and moreover constitute the country level counterpart involved in international protocols and conventions on climate change, and therefore are responsible for monitoring progress on greenhouse gas reduction commitments.

Of the specific subsectors, the most significant are forestry, hydro and electricity. In the case of the first, the forestry authorities have a mandate to ensure the conservation and sustainable use of forests. Generally these institutions have close ties with environmental authorities, but their links to energy authorities are less solid. Forestry authorities have worked mainly on some specific aspects of this resource, quantifying the production of fuelwood, while the ministries in charge of the energy sector focus their efforts on preparing statistics on consumption and developing measures to reduce it.

In most of the subregion's countries, both the national forestry agency and the ministry responsible for the energy deal with the issue of fuelwood, but not necessarily through close cooperation. The laws governing the bodies responsible for forests usually do not refer specifically to fuelwood, which is treated as a subproduct of logging activities.

Institutions in charge of water resources usually handle hydroenergy, but these are generally not very developed, focus more on the subsector, and are more interested in issues related to human consumption and the quality of public water utilities, with the participation of several ministries, municipal governments and other bodies. Many laws include the concept of integrated basin management, but institutionalizing basin management is still in its early stages.

The third subsector is very important due to the participation of hydroelectric power (and to a lesser degree geothermal energy and wind power) in countries' electric power supply. Thus, even in cases where the electrical industry has been liberalized, public electrical utilities remain very important. In this subsector it is also necessary to refer to regulatory bodies, which generally must grant permits, licenses and /or concessions for RES use.

In the case of the private sector, the main agents are the companies involved in developing and running electric generation projects with renewable energies. In several countries these firms have come together to represent their collective interests. In these cases, there are at least three categories that should be recognized, depending on their current or projected installed capacity: small, medium-sized and large firms.

The first belong to local investors and face the most difficulties and barriers to developing their projects. Depending on their location and their closeness to electric distribution grids, they consist of two sub-groups: those connected to the grid and those dedicated to isolated systems and communities. The second group (generally with installed capacities ranging from 10 to 50 MW) is also associated with local investors, but larger ones, with access to international capital (in some cases through joint ventures with regional corporations) and easier access to national and even international electricity markets. The third group includes the large hydroelectric companies.[8]

It is important to mention the NGOs, generally associated with development processes, which have in some cases proposed and developed energization projects using RES, in isolated communities. Some NGOs and firms deserve special mention for their dedication to the sustainable use of fuelwood, promoting energy efficient stoves (Guatemala) and in some cases conducting their own research to develop unique prototypes, some already being sold in the region. Thus cooperatives, rural community organizations and the isolated rural population without electric coverage, with limited capacity to pay, and difficulties obtaining financing can nonetheless play an important role.

Another very important group of players are the workshops, equipment suppliers, installers, maintenance people and local technical bodies that must be trained and encouraged to provide solid, reliable service, essential if the use of renewable sources is to meet its objectives.

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[8] This is the case of a privatized firm, present only in Panama, but supported by multinational corporations.

Research centres and universities, which aside from training human resources are important to monitoring, evaluating and analysing projects, also contribute to adjusting and developing appropriate technologies. In every country there are research groups working on renewable energies, dealing with constant financial difficulties, but often developing work of high academic quality and with good potential for application.

Brazil is the region's country with the most renewable energy research reference centres; these take advantage of governmental support but also develop projects for the private sector. They include:

- CBEE - Brazilian Center for Wind Energy at the Federal University of Pernambuco
- CENBIO - National Reference Center for Biomass at the University of São Paulo
- CENEH - National Reference Center for Hydrogen at the University of Campinas
- CERPCH - Reference Center for Small Hydropower at the Itajubá Federal Engineering School
- CRESESB - Reference Center for Solar and Wind Energy at the Electric Energy Research Center, CEPEL
- GREEN SOLAR - Brazilian Center for the Development of Thermo-Solar Energy at the Catholic University of Minas Gerais, PUC-MG
- CERBIO - Reference Center for Biofuels at Paraná Institute of Technology, TECPAR
- NAPER - Support Center for Renewable Energy Projects at the Federal University of Pernambuco, UFPE
- GEDAE - Development of Alternative Energies Studies Group at the Federal University of Pará, UFPA

Multilateral and international cooperation agencies, present in most renewable energy projects, are significant players given the role played by their expertise, economic aid for evaluating natural resources and project financing, often associated with equipment sales.

In the Caribbean, for example, many international players are developing energy projects, programmes and initiatives, currently underway or planned for the near future (see table II.1). They aim to improve the competitiveness of renewable energies and increase energy efficiency.

Nonetheless, the presence of so many similar programmes in a small territory, such as the West Indies for example, often with overlapping issues and locations, should give rise to international concern and an effort to ensure better coordination, in order to achieve more efficient cooperation and more visible, synergetic results.

Table II.1
ENERGY PROGRAMMES/ONGOING PROJECTS IN THE CARIBBEAN
(Status, as per 3/2004)

International donor organizations	**National/ regional counterparts**	**Name of programme**	**Description**	**Remarks/ stage**
GEF/ UNDP Guyana	CARICOM	CREDP/UNDP	Barrier removal for RE projects in the Caribbean	extended PDF B Stage
BMZ/GTZ Germany	CARICOM	CREDP/GTZ	Barrier removal for RE projects in the Caribbean (Parallel project to CREDP/UNDP in selected Caribbean Countries)	project agreement still pending, Implementation stage
OAS/Climate Instit./Winrock (GSEII)	Governments of Saint Lucia, SVG, Dominica	GSEII	Development of Sustainable Energy Policy in selected Countries	Implementation
World Bank/ ESMAP	OESC Secretariat, St. Lucia, NRMU	ESMAP Sector Study: Sector Development in Small Islands		Application/ negotiation stage
European Union	Regional EU Delegations and NAO of Caribbean Countries	Energy Initiative for Poverty Eradication and Sustainable Development	Financing of studies, analysis, project preparation, applications, workshops	Preparatory phase
USAID	CAST	Energy Efficiency in the Tourism Sector		
GEF/UNDP	OLADE/CEIS	Energy Efficiency Project		PDF B Stadium
EU/ Insula	Ministry of Physical Planning, Saint Lucia	EURO-CARIBBEAN Forum RES	Export Promotion programme for European Energy Sector	Kick-off Conference in Saint Lucia in May 2002
Governments. France, UK, USA, Japan, and Canada	CARICOM	Sustainable Energy for Sustainable Development in the Caribbean	Main objectives of the Partnership/Initiative: - Accelerate the transfer and adoption renewable energy - Implementing pilot energy efficiency projects - Build capacity for the training of energy sector professionals	
BMZ/GTZ	CARILEC CAST	working title: Sustainable use of Energy in the Tourism Sector (Energy Efficiency in the Caribbean)	energy efficiency in Hotels, efficient water supply, water recycling, solar water heating Also: EE in Industry and Commerce	preparatory phase Desk Study initiated in September 2003, final date: middle of November 2003

B. CARIBBEAN "1"

1. General and policy aspects

The countries in the Caribbean are heavily dependent on fossil fuels. More than 97% of the region's commercial energy consumption is based on oil products. Aside from Trinidad and Tobago, which is a net exporter of oil products, and Barbados, which partly covers its own oil and natural gas requirements, no other country has significant proven fossil fuel resources.

Electric power generation is provided mostly by medium- and high-speed diesel generators of different sizes. Jamaica is the only country with coal-fired power plants and a few countries use hydro power plants or biomass from sugar cane to generate some electricity.

The main characteristics common to these Caribbean countries and energy are:

- They have small-scale economies and small energy markets;
- They are mainly isolated islands (except Guyana and Suriname);
- They have relative high GDPs (e.g., Trinidad, Barbados, Grenada);
- They have extensive electric power coverage, up to 99% (except Guyana and Suriname);
- Longstanding private electrical utility monopolies handle generation, transmission, distribution;
- They are extremely dependent on oil imports (except TT);
- Their electric power supply system is very centralized with no isolated systems (except Guyana and Suriname);
- They have readily available, but mainly untapped renewable energy potential, mainly wind power, hydropower and solar-thermal energy.

Because most of the affected countries are net importers of oil products, their balance of trade and domestic economies are highly vulnerable to fluctuations in the international oil market. Moreover, the high proportion of oil products used to produce electricity makes production costs high and brings with it relatively high levels of local and global environmental degradation. As a result, for each kilowatt-hour of energy produced, carbon dioxide emissions are about 30% to 40 % more than levels in Western Europe.

The main challenges confronting the energy sector in the Caribbean are therefore:

- energy security;
- economic growth; and
- sustainable development

Many Caribbean countries spend up to 50% of their export earnings, including revenues from tourism, to import oil products. Moreover, given the location of the Caribbean islands, the region will also be heavily affected by the consequences of global climate change, particularly rising sea levels and the increased danger of hurricanes.

The utilization of renewable energies (RE) addresses these issues and other key aspects of sustainable energy, specifically energy efficiency and energy conservation. Nevertheless, despite the region's sizeable renewable energy resources (e.g., wind and solar energy, hydropower and biomass) and investors' interest, just 2% of these resources contribute to energy supply.

In the past, regional and international private investors have often offered to invest in attractive RE projects in the English Caribbean countries, such as wind parks, hydropower schemes or geothermal energy power plants. However, these initiatives were turned down due to restrictive energy legislation not allowing for independent power producers.

The energy policy pursued most widely by Caribbean governments in recent years has been the privatization of formerly state-owned electrical utilities. Among other reasons, privatization responds to budgetary pressures, the need to improve efficiency, and a desire to attract private capital. Usually, privatization has brought restructuring and cost reductions and reduced government subsidies to the energy sector. It was also expected to increase competition.

The status of privatization varies from country to country: from being an integrated department of the ministry (Saint Kitts) without a separate budget to fully privatized utilities, in which the government is a minority shareholder. Each country has its own rules regarding sales and privatization, but normally electrical tariffs cover the full costs of generation.

The general tariff rate ranges from around 15 cents/kWh (US$) in Barbados, Jamaica and Guyana to nearly 30 cents/kWh in Antigua. The exception is Trinidad & Tobago, which thanks to its own resources still enjoys the region's lowest electrical rates.

In countries where utilities have been privatized, such as Grenada, Santa Lucia or Dominica, the governments have agreed on a guaranteed fixed return on the utility's assets as the basis for their operation. Often governments have also permitted an electrical law with its respective regulation, granting sole rights to the utility to generate and distribute electricity.

This creates a very comfortable situation for companies. The Saint Lucia utility, for example, enjoys a minimum 15% return on assets guaranteed by the government until 2045 through tariff adjustments. In Guyana, the guaranteed return on assets is 23% and the government also guarantees the company currently managing the utility payment of the utility's debts.

This situation is typical among most Caribbean countries and has led to several initiatives financed by international donors.

In recent years, the general conditions surrounding the use of renewable energies have changed. The heavy economic burden of gasoline imports, political dependency, and renewable energy sources' enormous untapped potential, combined with falling investment costs for RE projects, have made governments and, increasingly, electrical utilities, more inclined to consider using renewable energy sources.

2. Baseline conditions

The potential for renewable energy throughout the Caribbean region is vast and includes all the 'classic' RE technologies, 'old' (hydropower) and 'new' (wind, solar, biomass, geothermal energy). Organized according to their potential impact on electric power generation in the near future, these are wind power, micro- and mini-hydropower systems (MHP), biomass (including bagasse, rice husks, wood waste products and landfill gas) and solar energy (photovoltaic systems for remote rural sites).

There are also important opportunities for the use of solar thermal energy, namely solar water heating systems (SWH). In addition, in the medium to long run the use of geothermal energy may constitute an opportunity.

(a) Wind Power

The largest wind power facility on a Caribbean island to date is on Curacao, where a 3 MW wind farm was installed by the KODELA utility company in 1993. A new 9 MW wind farm was commissioned in mid-2000 and is run by a private firm. Other wind turbines providing energy to the grid operate in Guadeloupe. A number of Caribbean islands such as Barbados, Antigua and Montserrat had some individual wind turbines installed in the 1980s, but most are no longer working.

In May 2004 a 20 MW wind farm will be commissioned in Jamaica. This will be the largest wind farm in the Caribbean and a step toward the larger scale use of wind power in the Caribbean. Presently, the following countries are either planning wind farms or researching their feasibility for their territory: Barbados, Dominica, Grenada, Guyana, Jamaica, Saint Lucia, Saint Vincent and the Grenadines.

(b) Hydroenergy

In the Caribbean, hydropower is used in Guyana (0.5 MW), Suriname (189 MW), Belize (25.2 MW), Dominica (7.6 MW), Saint Vincent (5.6 MW), Cuba (56.2 MW) and Jamaica (23.8 MW).

In Suriname and Guyana big hydropower potential in the range of thousands of MW exists. In Jamaica, a potential hydropower site of about 50 MW has been identified and some run-of-the-river schemes add up to 6 MW. On some smaller islands, such as Dominica and Saint Vincent, some run-of-the-river schemes already exist and their increased use is under consideration.

(c) Biomass

Biomass sources in the Caribbean include:

- agricultural by-products e.g., bagasse and sugar cane tops;
- agro-industrial waste, e.g., vinasse (dunder) from the sugar industry;
- aquatic biomass e.g., spirulina, water hyacinth;
- wood and woody materials, including wood chips from the lumber industry;
- landfill gas from closed waste disposals.

Barbados, Saint Lucia and Jamaica have made requests for landfill gas projects. A common example of biomass conversion into electricity in some Caribbean countries is the burning of bagasse (sugar cane residue) in a conventional steam boiler plant.

As a matter of fact, bagasse is an important biomass fuel in the Caribbean. Sugar factories in all Caribbean countries use bagasse as a heat source for raising steam; mostly they burn it inefficiently to avoid accumulating too much waste. Most Caribbean sugar factories also produce electricity from bagasse for their own needs, but only a few (Cuba and Puerto Rico) can feed electricity to the grid because of contractual and operational difficulties in selling power only during the one-crop per year growing season. About 5.7% of the electricity produced in Jamaica comes from bagasse. This could be increased if the sugar cane industry had two crops per year.

(d) Photovoltaic

Photovoltaic (PV) applications in the Caribbean are primarily for security lighting and stand-alone systems in areas far from the grid. PV has developed a market niche in telecommunications, signalling, leisure, water pumping and stand-alone rural electrification. In the Caribbean, stand-alone PV systems assist social and economic development in some remote areas, such as rural areas in Guyana and Suriname.

(e) Solar water heaters

The most frequent use of this technology in the Caribbean is as solar water heaters (SWH) for domestic and industrial use, in hotels and hospitals. SWH are cost effective in the areas with high exposure to sunlight in the Caribbean and have enjoyed significant success in countries such as Barbados and Saint Lucia. In Barbados, growth was driven by fiscal incentives. Nevertheless, there is still enormous potential for SWH application on other islands and particularly in the hotel and tourism sector.

(f) Geothermal energy

Geothermal energy resources can be found in areas of high volcanic activity in many parts of the world. Geothermal energy resources may be categorized as hydrothermal, geopressured, hot dry rock and magma. Presently all commercial operations are based on hydrothermal systems where wells are about 2,000 meters deep, with reservoir temperatures ranging from 180^{o} to 270^{o}C.

Geothermal energy resources are used to generate power in Guadeloupe. Some Caribbean islands such as Saint Lucia, Dominica, and Montserrat have considerable potential. A major drawback to the development of geothermal energy resources, however, is capital. Companies in developing countries are usually not large or diversified enough to assume the high investment risks and the high upfront costs associated with geothermal energy exploration.

The magnitude of technical and financial assistance required to develop the region’s geothermal energy potential goes far beyond the capabilities of a technical assistance project. Therefore support of geothermal energy as well as larger hydropower schemes will not be considered within the current project design.

C. CARIBBEAN “2”

1. General and policy aspects

Given the availability of information, in the case of this subregion it was only possible to analyse the cases of Cuba and the Dominican Republic. Table II.2 summarizes the main laws making up the regulatory framework governing RES in these two countries.

(a) Cuba

No specific law governs new and renewable sources in the Republic of Cuba. However, in May 1993, the Executive Committee of the Council of Ministers approved a "Programme for Developing Domestic Energy Sources" (*Programa de Desarrollo de las Fuentes Nacionales de Energía*), prepared by the then National Energy Commission, after a lengthy consultation process at the national level. In June of the same year, the National Assembly invited all of the country's institutions and the population to participate in improving and implementing this programme. It included developing all domestic energy sources, but gave priority to biomass from sugar cane in a first stage, and left other renewable sources, such as hydroenergy, fuelwood, coal, solar and wind power, in a second stage.

Table II.2

Scope of the law	**Cuba**	**Dominican Republic**[a]
Energy	--	
Environment	Law 81 governing the environment, July 1997	General Law on the Environment and Natural Resources No. 64-00
Forestry	The forestry law (Law #85, 31 August 1998)	General Law on the Environment and Natural Resources No. 64-00
Water		General Law on the Environment and Natural Resources No. 64-00
Public utilities		General Law on Electricity No. 15-01
Electricity		General Law on Electricity No. 125-01
RES	Programme to Develop Domestic Energy Sources (1993)	Law 112-00
Specific to any RES	N/a	N/a

[a] The regulations accompanying these laws are not included. Nor are regulations referring to electric power market operations that function in the Dominican Republic.

Later, in October 2002, the Executive Secretariat of the Council of Ministers ordered the creation of the Renewable Energies Front (*Frente de Energías Renovables*), a state agency specializing in coordinating and supervising the different State bodies involved in the issue. Its objectives are: to provide the country with an instrument that supports, promotes and proposes to the government policy on RES use, gives priority to their use and favours the cohesion and integration of the different institutions and ministries most involved and most influential in this strategic activity.

Environmental Law No. 81 was approved in 1997, and lists the instruments committed to applying Cuba's environmental policy, including: the National Environmental Strategy, the National Environmental and Development Programme, the Economic and Social Development Plan. Moreover, it created the National Environmental Fund (*Fondo Nacional de Medio Ambiente*), to fully or partially finance projects and activities that aim to protect nature and ensure its rational use.

For forestry resources, in August 1998 Law No. 85 was approved, establishing general principles and regulations on protecting, increasing and sustainably developing the country's forestry heritage, and promoting the rational use of non-wood forestry products. It assigned the ministries of Agriculture, Science, Technology and the Environment, and the Interior, with different forest-related functions.

Meanwhile, the Foreign Investment Law, approved in September 1995, approves fiscal exemptions for all foreign investment, including energy, and therefore sugar cane biomass and other renewable energy sources.

(b) Dominican Republic

The constitution of the Dominican Republic makes no specific references to natural resources or energy. Law 112-00, however, specifically refers to a tax on fossil fuel and oil derivative consumption, and creates a special fund to encourage RES programmes and an energy saving programme. According to this law, “the fund will consist of … two percent of income received as part of the application of this law, rising annually by one percent to reach a total of five percent of these revenues.”

2. Baseline conditions

(a) Cuba

(i) Fuelwood

With regard to fuelwood and the loss of forested areas, Cuba was the only country posting favourable trends, with reforestation amounting to 1.3% from 1990 to 2000. The country has potential for using bagasse and agricultural sugarcane wastes to produce 9,500 GWh annually. In terms of electricity from wind, 23 locations in the north have the potential to produce an estimated 1,300 GWh. This is the same as the amount of potential energy that could be produced using hydro. For biogas, the potential is 0.18 million tons of oil equivalent (toeb). Finally, considering the sustainable use of fuelwood, potential is estimated at 3.5 mn m^3 annually (0.5 mn toeb).

(ii) Hydroenergy

Cuba has 175 hydroelectric power plants with a total capacity of 54.7 MW, which generate 90 GWh.

(iii) Wind and solar energy

On wind, 6767 windmills exist to pump water, which replaced almost 10,000 toeb in 2002. Similarly, three facilities exist to produce electricity using wind, with a capacity of 0.46 MW. This country also has 7000 photovoltaic systems up and running, with a capacity of 1.5 MW, including 350 medical offices, 5 rural hospitals, 2364 primary schools, 1864 rural television rooms, 150 social circles. Finally, more than 1800 facilities for heating water using solar energy and 50 using biogas are reported.

The Cuban government’s plans establish the goal of extending electrification to 100% of the population over the next five years, using new and renewable sources.

(b) The Dominican Republic

(i) Biomass

Forests cover 28.9% of the country’s total surface area. No figures are available on changes in the forested surface area. Meanwhile, this country’s biomass potential has been estimated for different sources. For biomass from sugar cane, this reaches 575 GWh/year; for organic wastes, 1,644 Tera Joules (TJ) of residual energy in rice husks and 1.6 tons per day of manure from cows and pigs; and for urban waste, more than 3 500 tons of garbage per day for the cities of Santo Domingo and Santiago de los Caballeros. In terms of fuelwood biomass, local production of fuelwood and charcoal is estimated to reach 1.8 million metric tons per year, in the context of an industry considered informal.

(ii) Hydroenergy

Although the country is thought to have made substantial progress in terms of making the most of large-scale hydroelectric potential, its mini-hydro potential has not been completely identified and has not been used much. According to information gathered, the most significant contribution from RES comes from conventional hydro sources, with installed generating capacity standing at 452 MW, while for mini-plants the aggregate capacity is 0.93 MW.

(iii) Wind power

The potential for wind power use in the Dominican Republic has been estimated at more than 10,000 MW, mostly located on the northern (oriented toward the north-east) and the south-eastern (oriented toward the south-east) coasts. There are almost 30 small facilities that use wind power. Finally there is a registry of a relatively small number (no more than 80) photovoltaic solar facilities for community and private use. Of these, 29 are used in computer laboratories in the country's border regions.

In the Dominican Republic there are several projects using the RES analysed here. Most outstanding is a set of eight wind power projects, with capacities ranging from 2 to 100 MW, which altogether total more than 300 MW, and concessions in place already for half thiscapacity.[9] A project for producing 83.4 GWh using sugar cane bagasse has also been reported. At the same time, 41 drinking water pumping systems that use photovoltaic systems are planned for border military posts.[10]

D. CENTRAL AMERICA

1. General and policy aspects

Central America is one of the few Latin American subregions to have regulations regarding the development of RES at both national and subregional levels. Table II.3 provides a list of treaties, conventions and subregional institutions in this sense, summarizing the main initiatives in this area involving Central American Countries, which form part of the Central American Integration System (SICA).

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[9] Draft "*Estudio Básico sobre Potenciales, Proyectos y Actores en el Área de Energías Renovables de la República Dominicana*" (Basic study on potencial, projects and players in the renewable energy area in the Dominican Republic), prepared by the German Technical Cooperation (GTZ) for the State Ministry of Manufacturing and Commerce, December 2003.

[10] *Energías Renovables en Acción* magazine. October 2003. Published by the Ministry of Manufacturing and Commerce.

Table II.3

MAIN SUBREGIONAL INITIATIVES AND INSTITUTIONS LINKED TO RENEWABLE SOURCES

Initiatives and institutions	**Description**
Central American Commission for Environment and Development (CCAD)	Set up by agreement during the Presidential Summit held in Costa Rica in February 1989, this came into effect on 14 June 1990. The CCAD seeks to establish a regime of cooperation for the optimum and rational use of the area's natural resources, pollution control, and re-establishing the ecological balance, to guarantee the population of the Central American isthmus a better quality of life.
Central American Electrification Council (CEAC)	Created in 1985, this institution seeks to improve regional cooperation, coordination and integration. Its main end is to ensure the best use of member states' energy resources, through the efficient, rational and appropriate generation, transmission and distribution of electrical energy by the countries of the Central American isthmus. Its objectives include: promoting bilateral or multilateral interconnection agreements and contributing to the analysis of production projects' technical and economic feasibility, with an emphasis on those projects that benefit two or more countries.
Central American Alliance for Sustainable Development (ALIDES)	Set up by agreement during the Presidential Summit in October 1994. This is an initiative that integrates political, moral, economic, social and ecological elements. It creates the Central American Council for Sustainable Development, formed by the Presidents of Central America and the Prime Minister of Belize, which functions like any other organization within SICA. It is based on sustainable development as an ongoing process of change in the quality of life of the human being, whom it places at the centre as the primordial subject of development, through economic growth with social equity and the transformation of production methods and consumption patterns, and which is based on the ecological balance and the vital support of the region. This process involves respect for regional, national and local cultural and ethnic diversity, as well as strengthening and ensuring full citizens' participation, in peace and harmony with nature, without compromise, and guaranteeing the quality of life of future generations.
Central American Region Environmental Plan (PARCA)	PARCA was approved in 1994. It seeks greater regional integration around environmental policies and their management. This Plan deals with four strategic areas in the medium and long terms: forests and biodiversity, water, clean production and environmental management, considering both extraregional and intraregional levels.
CONCAUSA	A joint declaration by Central American countries and the United States' government, signed during the Americas Summit (1994). Its main objective is the commitment to strengthen Central America's ability to prevent and manage natural disasters, as well as adapt to the impacts of climate change. It includes an action plan using matrixes, with several points of interest for signatory countries, such as strengthening the distribution and generation of energy using renewable sources in the area.
Johannesburg Commitments	In 2002, during the World Summit on Sustainable Development held in Johannesburg, Costa Rica's Minister of Energy and the Environment, as President of the CCAD, presented the environmental commitment of Central America to work for the principles and agreements of that summit in six key areas: water and sanitation, biodiversity, energy, health care, agriculture and general policies for sustainable development. In the energy section, the Central American countries committed themselves to fostering the diversification of energy supply and developing energy efficiency, evaluating the potential of conventional sources and improving the share of renewable sources. By establishing long-term synergies between Central America' s energy and environmental policies to achieve greater efficiency, reduce greenhouse emission gases and promote the use of clean technologies.
Puebla – Panama Plan (PPP)	Plan supported by eight of the Middle-American region's governments to strengthen the region's human and ecological richness, in a framework of sustainable development that respects cultural and ethnic diversity. An integral strategy is proposed for the region, which includes a set of Meso-American initiatives and projects, including energy interconnection, to unify and interconnect electrical markets, to promote a rise in sector investment and a reduction in the price of electricity. In June 2002, the eight countries signed a Memorandum of Understanding for the coordination of the Mesoamerican Initiative for Sustainable Development, to ensure that all projects, programmes and initiatives incorporate a suitable level of environmental management and promote the conservation and sustainable management of natural resources. During the Sixth Summit of the Tuxtla Mechanism (Managua, Nicaragua, 12 March 2003), the presidents instructed the PPP Commissioners to promote the implementation of rural electrification programmes, renewable energy and biofuels.

In terms of national laws and upper level administration, legislation and the regulatory framework affecting renewable energy sources (RES) is general and focuses on conserving, protecting and sustainably using countries' natural resources, principles that are dealt with in their respective constitutions and environmental laws.

Direct references or mandates concerning RES, in general or in terms of specific sources are found in laws creating ministries, secretariats or energy commissions and in laws governing the electrical industry. These last include not only electricity laws, but also statutes governing regulatory bodies, laws concerning electrification institutions and in some cases special laws for promoting RES in general or some resource in particular (for example, encouraging hydro- and geothermal energy use).

Likewise, laws regarding the electrical industry are directed at transforming RES into electric power, to be sold through interconnected grids or to function as stand-alone systems. Similarly, own consumption and where appropriate the sale of surpluses to third parties through electrical distribution grids are also considered.

Fuelwood and water are the main renewable resources among countries' self-produced energy resources. For both there are laws that govern their rational use and the conservation of forest and water resources, which in some cases include clauses and articles that refer to energy uses. Some countries have new judicial frameworks dealing specifically with forestry; this is not the case with water, in which most countries are discussing initiatives to update the corresponding legislation. Note the necessary and convenient links that should exist between both sets of norms, especially in terms of integrated basin management, an issue that has not yet been fully included in the respective laws. One important aspect involves international basins, whose management is based on old treaties governing international limits, with no recent protocols or accords that refer to resource management and administration.

A summary of the main laws making up the judicial and regulatory framework governing RES follows for each country, highlighting the particular conditions and incentives to support and promote these sources, which mostly refer to the electrical industry.

(a) Costa Rica

This is undoubtedly the country with the broadest most coherent regulatory and legal framework regarding RES. The four main precepts contained in national laws are: (i) The Organic Environmental Law, which establishes that energy resources are essential factors for the country's sustainable development, indicates that the State will retain control of them, being able to dictate general and specific measures, regarding research, exploration, operation and the development of these resources, based on dispositions contained in the National Development Plan (article 56, Organic Environmental Law 7554). Moreover the State must evaluate and promote exploration for and the use of alternative energy sources that are renewable and environmentally healthy, to contribute to sustainable economic development (article 58 of the same Law); (ii) The Law creating the Costa Rican Electricity Institute (*Ley de Creación del Instituto Costarricense de Electricidad, ICE*) charges this agency with the rational development of the sources producing physical energy that the Nation possesses, especially hydro resources (article 1, Law 449, 1949); (iii) Executive Decree N° 30480 from the Ministry of the Environment and Energy (MINAE), establishes that the management of water resources is governed by a series of principles that must be incorporated in public institutions' work plans, including the promotion of alternative renewable energy sources that reduce or eliminate the impact of this activity on water resources, which is in line with the general policy of the Government of the Republic to implement environmental conservation policies through encouraging alternative and renewable sources for electrical energy generation, such as wind, biomass, solar energy, as established in both the Third National Energy Plan and the National Development Plan 2002-2006, and (iv) Directive 22 (D22-26389, 25 March 2003), instructs members of the electrical subsector to encourage the use of new technologies that employ new and renewable sources, when these are environmentally friendly and technically and economically feasible, as established in the Third National Energy Plan and the National Development Plan.

In terms of forestry resources, the Organic Environmental Law establishes that the State is required to conserve, protect and administer forestry resources. The Forestry Law, in its first article, adds that it is an essential and priority function of the State to ensure the conservation, protection and administration of natural forests and the production, good use, industrialization and development of the country's forestry resources for this end, according to the principle of the suitable and sustainable use of renewable natural resources, and assigns supervision of this sector to the MINAE. This law also defines the environmental services of forests and forest plantations according to their direct impact on protecting and improving the environment. These services include protecting water for urban, rural or hydroelectric use.[11]

On water resources, the Environmental Law sets criteria for conserving and sustainably using water. One of the priorities is modernizing the current regime (which dates from 1942). To do so, the Assembly and the Executive are analysing a proposal for a new water law.

In terms of specific laws concerning RES, these are found in the electrical industry area. They consist of two parallel autonomous generation laws and a law on participation in cooperatives and municipalities, which have been fundamental to private sector participation and that of other public and social institutions in developing RES. These refer to limited capacity electrical generation stations (small and medium-scale).

The first two laws (on parallel autonomous generation) authorize the ICE to hire private bodies, cooperatives and municipalities, under different systems, to produce the equivalent of up to 30% of the installed capacity of the national interconnected electrical system, provided that generation is based on RES. The third law establishes the legal regulatory framework for concessions granting the use of public domain waters to rural electrification cooperatives, consortia formed by same, and municipal public utility companies. It also establishes the conditions for the same parties to generate electrical energy using renewable and non-renewable energy resources. In every case, the projects developed must be compatible with the National Energy Plan.

The state company acts as the sole buyer through a regulated price scheme. Exchange tariffs are regulated according to the alternative cost principle, applied to investment in and operation of the national interconnected system. In the case of electric power plants with a capacity of over 20 MW, contracts can last up to 20 years and energy must be purchased through a competitive regime or at public auction. Moreover, the law promotes and protects local investors, who must contribute at least 35% of the total investment.

[11] The environmental services defined by the Law are the following: mitigation of greenhouse gases (through fixing, reducing, capturing, storing and absorbing), protection of water for urban, rural or hydroelectric use, protection of biodiversity to conserve it and for sustainable, scientific, pharmaceutical use, genetic improvement and research, protection of ecosystems, forms of life, natural scenic beauty for tourism and scientific ends.

(b) El Salvador

The environmental law states that the sustainability of renewable natural resources must be ensured (Environmental Law, Decree No. 233, 4 May 1998). In terms of the sustainable management of forests, it delegates to the Ministries of the Environment and Natural Resources (MMARN) and Agriculture and Ranching (MAG) responsibility for preparing the market mechanisms that will facilitate and promote reforestation, keeping in mind the forests' economic value and considering non-loggable resources, environmental services (protection of water resources, soil, biological diversity, energy and carbon fixation).

The forestry law was recently passed (Legislative Decree 852, 22-3-2002) and establishes regulations for promoting the sustainable management and use of forestry resources and the development of the logging industry, declaring the country's development of its forestry sector to be of economic interest (from plantations to the final use and including every form of added value).

For water resources, it is the MMARN's responsibility to prepare a draft law and regulation for the administration, use, protection and management of water, according to criteria established in the environmental law. Currently a draft general waters law is being debated, which proposed creating a regulatory agency and considers the participation of users (institutions involved in sanitation, culverts and sewer systems, such as municipalities, private companies and NGOs).

On RES, the main laws have dealt with their use to produce electricity. In 1945, the Lempa River Executive Commission (*Commission Ejecutiva del Río Lempa*, CEL) was set up as an autonomous public service institution to develop, conserve, administer and use the country's energy resources and sources of energy (Decree No. 130, 3-10-1945). In 1996, the general electrical law was approved; its main purpose is to develop a competitive electrical market in every one of the subsector's activities (Decree No. 93-96, 13-11-1996). This Law and its regulations establish the principles governing the development and incorporation of new generation, including RES-based projects, through private initiative and their sale within the electrical system. With reforms to the electrical industry, the CEL was restructured and has remained basically in charge of hydro-electrical production. The regulatory agency (the Superintendent of Communications and Electricity (*Superintendencia de Comunicaciones y Electricidad*, SIGET) has issued several rulings regarding the granting of geothermal energy and hydroelectric power concessions, eliminating red tape and facilitating permits for small-scale renewable projects.

(c) Guatemala

The constitution makes several indirect references to RES: reforestation and forest conservation have been declared matters of national urgency and social interest; waters are declared public domain goods and their use is granted according to social interest, with a specific law to regulate this area upcoming, and electrification is also declared a matter of national urgency.

In terms of forestry, the respective law establishes that these resources can and should form the fundamental basis of the country's economic and social development. It recognizes that the sustainable use of forestry resources can help to satisfy needs in energy, housing, food, and mentions carbon fixation as one of the services that will improve the population's quality of life (Forestry law, Decree 101-96).

The environmental law establishes the government's obligation to conserve water resources, maintain the quantity and quality of water for human use, ensure the integrated use and rational management of water basins, springs and other sources of water supply, and the conservation of the flora, mainly forests, to maintain and balance the water system (Law for Protecting and Improving the Environment (*Ley de Protección y mejoramiento del medio ambiente*, Decree 68-86). Since 1989, a national commission for managing water basins (*Comisión Nacional de Manejo de Cuencas Hidrográficas,* CONAMCUEN) has existed, to cover the concepts referred to in this initiative. Today, a draft general waters law is under consideration, which would establish a general and institutional framework governing water.

The direct legislation dealing with RES is limited to the framework of the electric power industry. The national electrification institute (*Instituto Nacional de Electrificación,* INDE), a semi-autonomous, decentralized government agency, was created in 1959 to electrify the country and develop energy sources (Decree No. 1287, 1959, and amendments). Electrical industry reforms have made it possible for the private sector to produce electricity, using fossil fuels and renewables, since the early 1990s. In 1986 the first law to foster RES use was approved and remained in effect until the end of 2003, when congress approved an incentive law to develop renewable energy projects, which establishes the following with regard to RES: it declares the urgent need to ensure their rational development; it instructs the Ministry of Energy and Mines (MEM) to inventory these resources, study the respective pre-investment, and award incentives (exemptions from customs tariff and value-added tax, income tax and tax on mercantile and farming firms during the first ten years of commercial operation).

(d) Honduras

The constitution declares the usefulness of and the public need to ensure the technical and rational use of the country's natural resources, reforestation and forest conservation.

Legislation specific to RES started with the creation of the national electric power company (*Empresa Nacional de Energía Eléctrica*, ENEE) set up in 1957, as an autonomous public utility, to promote the development of electrification. Reforms to Honduras' electric power industry were formalized with the approval of the so-called electric power subsector framework law (1994), and its regulations (1998). This law ordered the vertical and horizontal dismantling of the ENEE and established an incentive to use RES, whose energy could be acquired by the state firm at 10% over the short-term marginal cost.

Since then, several other RES-related incentives have been approved, including exemption from income tax during the first five years of commercial operation, import duties and the tax on sales of goods acquired during the construction period, including temporary machinery imports (Decrees 95-98 and 267-98). Moreover, decrees have been issued for a private wind power project and to guarantee the state-owned firm will buy all the production from renewable projects with an installed capacity of less than 50 MW (Decree 9-2001). A decree was also passed to reduce the red tape faced by renewable projects, among them an initiative reducing the number of legislative steps for approval to a single debate, thus solving problems related to charging municipal rates (Decree 103-2003).

In the forestry sector, a law to modernize and develop the farming sector (*Ley de Modernización y Desarrollo del Sector Agrícola*, 1992) makes the government responsible for regulating, protecting and managing protected areas and the country's forests. Similarly, it revokes the 1974 forestry law and returns forest property rights to land owners. Currently a new forestry law is being debated, which would provide a simple interpretative and administrative framework to facilitate decision-making and stimulate private investment.

In terms of water resources, the Ministry of Energy, Natural Resources and the Environment (*Secretaría de Energía, Recursos Naturales y Medio Ambiente*, SERNA), through the water bureau (*Dirección General de Recursos Hídricos,* DGRH), administers and regulates the use of the country's waters. The current water law (1927) includes charging royalties on water use. A new framework is being discussed, based on a new law governing drinking water and waste water utilities and three draft laws (basins, territorial organization and forestry).

(e) Nicaragua

The constitution establishes that natural resources are part of the national heritage, with the State responsible for preserving the environment and conserving, developing and ensuring the rational use of natural resources. The State is required to promote, facilitate and regulate the services provided by basic public utilities, among them water and energy. It is also required to preserve, conserve and rescue the environment and natural resources.

The National Energy Commission (*Comisión Nacional de Energía*, CNE) is the agency responsible for the country's energy sector and its main function is to formulate the objectives, policies, strategies and general guidelines for the whole energy sector, as well as the required planning, to ensure the development and optimum use of the country's energy resources. This commission was created based on mandates in the Electrical Industry Law (*Ley de la Industria Eléctrica*, Decree Law 272, 1998). The CNE also has special attributes to develop rural electrification.

On the forestry issue, in late 2003 the forestry law (Law 462) was approved, which establishes the legal regime governing conservation, care and sustainable development of the forestry sector. Other aspects covered by this law include: (i) recognizing the land owner's right to the forest land and the associated benefits; (ii) creating the national forestry commission (*Comisión Nacional Forestal*, CONAFOR), as the maximum forest sector instance, whose functions include approving the forestry policy prepared by the agriculture and forestry ministry (*Ministerio Agropecuario y Forestal*, MAGFOR), and (iii) mandating the national forestry institute (*Instituto Nacional Forestal,* INAFOR) to ensure compliance with the forestry regime throughout the country.

In terms of forestry development policy, Decree 50-2001 remains in effect; its purpose has been to guide consistent actions of all forest sector actors, to guarantee the protection, conservation and sustainable use of forestry resources. To guarantee a balance between forest-energy sources (fuelwood and charcoal), specific policies will be proposed that consider both supply and demand, and also include: the management of secondary forests and energy plantations; the suitable transformation and use of by-products, farm and forestry industrial waste as an energy source; promoting electric power generation using forest biomass; the more efficient use of fuelwood and/or charcoal by improving stoves and the use of stoves that use low-environmental impact fuels that replace fuelwood.

The general environmental law establishes that water resources are in the public domain and the State is required to protect and conserve aquatic ecosystems, guaranteeing their sustainability. It also establishes that the priority for water will be human consumption and public utilities. Specific laws and regulations exist governing drinking water provision. In December 2001 an executive decree was approved that establishes the national policy on water resources. There is also a draft general water law.

In terms of hydroelectric and geothermal use, their initial development was carried out by a state firm, created in 1958, and then from 1979 on, the Nicaraguan Energy Institute (*Instituto Nicaragüense de Energía*, INE), which in the early 1980s became a publicly owned, vertically integrated monopoly. Restructuring the electric industry in the 1990s turned the INE into an energy sector regulatory body, with the electrical monopoly exercised by an electric power company (*Empresa Nicaragüense de Electricidad*, ENEL), which later, with approval of the electrical industry law (*Ley de la Industria Eléctrica*, 1998), was dismantled vertically and horizontally. This law regulates industry activities to ensure the best use of resources for the benefit of the whole. The State is required to ensure the country's electrical supply, creating conditions for economic agents to increase the energy supply. The law makes no specific reference to developing RES.

A presidential agreement (*Acuerdo Presidencial* 279-2002) establishes the policy for developing wind and non-dam hydroelectric power initiatives and defines different incentives for these resources. The purpose of Law 467, on promoting the hydroelectric subsector, is to encourage the use of water resources within a sustainable framework, offering incentives for up to 15 years, which include exemptions from: customs tariffs on imports and the general sales tax (IGV) during project construction; income tax during the first ten years of commercial operation; royalties on water use; and municipal real estate taxes.

(f) Panama

The constitution establishes that the State will regulate, supervise and opportunely apply the measures necessary to guarantee that the land, river and marine life, as well as forests, lands and waters, are well used and taken advantage of. Concessions granted for the use of soil, subsoil, forests or the use of water, communications media or transportation, and of other public utilities will be based on social welfare and public interest.

The environmental law reaffirms that natural resources belong in the public domain and are of social interest and establishes among its principles the sustainable use of natural resources. The national environmental authority (*Autoridad Nacional del Medio Ambiente*, ANAM) will establish fees for the use of natural resources, which will be set according to the appropriate technical and economic studies.

On forestry resources, institutionally this issue is administered by the ANAM, which is responsible for the State forest heritage inventory. The legislation on forests is covered by the 1994 Forestry Law and the 1992 Reforestation Law. The former is based on the principle of sustainable development and offers an integrated perspective on the set of goods and services provided by forests. The latter provides government incentives for reforestation activities.

On water resources, the Environmental Law establishes that users must carry out the work necessary for their conservation, according to the environmental management plan and the respective concession contract. Law No. 44 (2002) establishes the administrative regime for managing, protecting and conserving water resources. It is based on environmental and territorial organizational plans, along with the plan for managing, developing, protecting and conserving each basin, whose coordination falls under the ANAM. The law institutionalizes hydrographic basin management committees (*Comités de Cuencas Hidrográficas*) to decentralize responsibility for their environmental management.

On energy resources, the regulatory framework for electric power services (*Marco Regulatorio y Institucional para la Prestación del Servicio Público de Electricidad*, Law No. 6, 1997), created the Energy Policy Commission (*Comisión de Política Energética*, COPE), to formulate overall energy sector policy and define its strategy. The environmental law, meanwhile, establishes that the State will promote and give priority to unpolluting energy projects, based on the use of clean, energy efficient technologies and establishes that the policy for developing electrical industry activities will be set by COPE, along with ANAM, in terms of its impact on the environment and natural resources.

The electrical industry reform began with Law No. 6, referred to above, and includes creating an electrical market whose purpose is to: promote competition and efficiency; improve service quality and coverage; regulate electrical industry services; and improve environmental quality. The main legislation regarding RES is contained in article 55 of Law No. 6, which establishes that it is in the State's interest to promote the use of RES, to diversify energy sources, mitigate adverse environmental effects and reduce the country's dependency on traditional fuels. For these effects, a 5% discount on the evaluated price is granted to RES, in each of the competitions or auctions carried out to buy energy and power.

Other efforts to promote RES are to be found in the regulations issued by the regulatory body for energy auctions that distributors must organize regularly. These regulations have included conditions to facilitate the supply of new renewable energy projects, making possible long-term contracts and grace periods of four years, which are necessary given the implementation cycles of these projects.

2. Baseline conditions

As with other subregions, several Central American countries do not have up-to-date information and recent evaluations for several resources, so the RES potential referred to in this study can be considered conservative and lower than reality. Because of this, it was only possible to provide an overview of biomass, hydro, geothermal energy, wind and solar power.

(*i) Biomass*

No detailed inventory of the energy potential associated with this resource exists, but undoubtedly almost all these resources are very underused in the region's countries. What follows are some general references to forests and forest resources, the sugar sector and its relevance to electric cogeneration, and the production of biofuels, and urban organic wastes.

Forests and associated forest resources:[12] The loss of wooded land is a serious problem in the subregion. From 1990-2000, Central American countries reported deforestation rates of 1.6% annually. The main causes included: logging operations, the advance of the agricultural frontier, overgrazing due to livestock, urban sprawl, natural disasters (mainly hurricanes and forest fires), and the irrational use of fuelwood.

There is general agreement that its use in energy production is not the main cause of deforestation. Nonetheless, there are no up-to-date statistics on fuelwood, none of these countries has an up-to-date diagnosis of forest energy resources; nor do they have integral programmes that favour its rational use to produce energy. In 1998, 81% of total wood production in the Central American countries went to fuelwood and charcoal. It is estimated that on average in the Central American countries, 92% of production is used as fuelwood and just 8% goes to industrial uses.[13] This situation reaffirms the high consumption of wood to produce energy.

Cogeneration in agro-industrial processes: Energy-related plantations include both those producing by-products with energy-producing value during an industrial process, as well as those mainly

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[12] Prepared mainly based on information from the FAO and countries' forestry offices.

[13] Figure is for 1996 (See: *Comisión Centroamericana de Ambiente y Desarrollo* (CCAD), *Estrategia Forestal Centroamericana* (SICA, San Salvador, 2003).

grown to produce energy products. They are of major importance to this subregion's countries, given the importance of farming.

The sugar industry has been a pioneer in making good use of sugar cane bagasse to produce heat, both for its own processes and to produce electricity (cogeneration). Since the late 1980s, sugar cane mills have sold surplus electric power production to third parties, through the electric power grid.

In late 2002, countries reported 311 MW installed (equivalent to 4% of total installed capacity and 7.2% of RES installed capacity) in 17 sugar cane mills, which added a total of 774 GWh (gross sales) to the electric grid, about 2.6% of regional electric power demand. Table II.4 presents a summary of the share of sugar cane mill co-generators within their respective electric power industries. It should be noted that of the 58 sugar cane mills operating in the subregion, just 17 participate as co-generators of electric power. Potentially, another 41 sugar can mills could join.

Table II.4
CENTRAL AMERICAN COUNTRIES: SHARE OF CO-GENERATION WITHIN THE ELECTRICAL INDUSTRY, 2002

	Number	**Installed capacity MW**	**Sales to the grid (GWh)**	**Share of the electrical industry (%)**
Total	17	310.9	774.0	2.6
Costa Rica	2	12.0	11.9	0.2
El Salvador	3	47.3	50.7	1.2
Guatemala	7	182.7	621.1	10.0
Honduras	2	18.2	4.2	0.1
Nicaragua	2	10.8	78.9	3.3
Panama	1	9.9	7.3	0.1

Source: ECLAC, based on official figures. In Guatemala, 1% of production is bunker.

The largest share is reported by Guatemala, which has the largest sugar cane mills and plantations. This country took special measures to encourage the development of co-generation, which consisted of favouring long-term electric power purchases within a dual generation scheme (using both bagasse and oil derivatives) that also permitted production outside of the sugar cane season. In other countries, electrical co-generation has essentially been based on cane bagasse; however the case of a sugar cane mill in Nicaragua (San Antonio) should be noted: in recent years it has developed eucalyptus plantations to produce electricity in the off-season. The case of two plants in Honduras, which are using African palm trees in co-generation processes for their own consumption, should also be noted.

Liquid biofuels: Liquid biofuel production could respond to some of the transportation sector's needs. The main biofuels include ethanol, produced from sugar cane or corn, and biodiesel produced from vegetable oil. In the 1980s, Guatemala, El Salvador and Costa Rica tried unsuccessfully to introduce gasohol into commercial use. Currently, these countries export small volumes of this biofuel to the United States.

Central American countries have recently completed talks on a free trade agreement with the USA (US-CAFTA, United States-Central America Free Trade Agreement), which include sugar export quotas on the part of Central American countries.[14] Similarly, in terms of ethanol, the US-CAFTA will allow unlimited exports of ethanol provided the raw material is from these countries. All this suggests stable and predictable conditions for the sugar industry that will favour future biofuel programmes.[15]

Biogas from urban organic wastes*:* Except for Costa Rica, these countries have no estimates for the usable energy potential of biogas from urban organic wastes. In this sense, this energy use is viable only as part of integrated plans for solid waste, garbage dump and sanitary fill management.

To date, only one major project exists, in the construction phase, in Costa Rica. For different reasons, the construction of this generator only began in the early months of 2004. Enough gas to install a 4 MW capacity is expected, providing the additional benefit of reducing accumulated methane gas leaks.

(ii) Hydroenergy

Estimates made on the basis of water basin evaluations, the identification of sites and basic, pre-feasibility and feasibility studies of projects reveal that this subregion's countries have significant unused resources, of about 24.4 Tera Watts (TW), consisting of very small capacity plants, along with small, medium and large ones (see table II.5).

Table II.5

CENTRAL AMERICAN COUNTRIES: HYDROELECTRIC RESOURCE POTENTIAL, 2002

	Total potential		**To be developed**		**Installed**	
	MW	**GWh**	**MW**	**GWh**	**MW**	**GWh**
Central America	27 938	129 142	24 415	112 565	3 523	16 577
Costa Rica	5 802	29 660	4 531	23 163	1 271	6 497
El Salvador	2 165	9 483	1 743	7 633	422	1 850
Guatemala	10 890	47 698	10 332	45 254	558	2 444
Honduras	5 000	26 280	4 534	24 241	466	2 039
Nicaragua	1 740	5 767	1 636	5 403	104	364
Panama	2 341	10 254	1 639	6 873	702	3 381

Source: Official figures and OLADE's SIEE database.

(iii) Geothermal energy

Table II.6 summarizes the geothermal potential of the subregion's countries that could be used to produce electricity (potential and actual), along with a summary of actual and potential geothermal energy installed capacity and an estimate of the energy that could be produced by these plants, according to historic plant factors and re-potentiation and recovery of fields that is currently taking place. Based on

[14] US-CAFTA negotiations drew to a close between December 2003 and January 2004. Ratification by the respective assemblies and congresses is pending. In terms of sugar, the text approved will allow Central America countries to export 97,000 metric tons (mt), a quota that will rise by 2% annually during the first 15 years and then, from the 16th year on, by 2000 mt/year. Currently the US provides the subregion with free access for an annual quota of 126.4 mt of this sweetener, which is part of the Caribbean Basin Initiative (CBI) and will be reviewed upon approval of the US-CAFTA.

[15] See chapter V (d) on biofuel policies.

these figures, values for currently undeveloped or unused geothermal potential have been estimated. Generally speaking, potentials correspond to preliminary evaluations (at the basic study level and pre-feasibility level). Unused geothermal potential amounts to about 2.1 TW, from small, medium- and large capacity stations.

In addition to this data, it should be noted that in the case of Costa Rica, many potential resources located within protected areas have not been included.

Table II.6
CENTRAL AMERICAN COUNTRIES: GEOTHERMAL ENERGY RESOURCE POTENTIAL, 2002

	Total potential		To be developed		Installed	
	MW	**GWh**	**MW**	**GWh**	**MW**	**GWh**
Central America	2 528	15 704	2 112	13 027	416	2 677
Costa Rica	235	1 647	90	633	145	1 014
El Salvador	333	2 039	171	1 050	161	988
Guatemala	800	4 906	767	4 703	33	202
Honduras	120	736	120	736	0	0
Nicaragua	1 000	6 132	923	5 660	77	472
Panama	40	245	40	245	0	0

Source: Official figures and OLADE’s SIEE database.

(iv) Wind power

Only Costa Rica has wind power plants in operation, located on three farms. The first units started up in August and September 1999 (26.2 and 20 MW respectively). At the end of 2002, installed capacity had reached 62.3 MW, with 68% coming from two private plants and 32% from one belonging to the public electric power company. The plant factors obtained have been very attractive. For example, in 2002 this factor stood at 47%. Thus, Costa Rica has positioned itself as the leading country in developing wind power in Latin America.

Figures for potential wind power remain preliminary. On one hand, most countries only have measures and maps pointing to places or sites with the highest velocities, during seasons and months of the year. Four of the region’s countries are involved in SWERA (Solar and Wind Energy Resource Assessment)[16] programme activities, in which, based on global and local information available, and through regional wind circulation models, preliminary maps have been developed that indicate the locations or sites where the highest velocities appear at different times of the year.

Total wind power potential for Costa Rica has been estimated at 600 MW, bringing unused potential to about 538 MW, which could produce energy of about 1,650 GWh annually.

With the existing information and information from SWERA, private investors have applied for licenses and are measuring winds in some locations with the best conditions for interconnection through

[16] With support from the United Nations Environmental Programme (UNEP) and co-financed by the GEF. The programme includes activities in El Salvador, Guatemala, Honduras and Nicaragua.

electric grids (both in terms of distances and voltage). In Honduras, the public electrical company (ENEE) signed a BOO-type (Build, Own, Operate) contract for buying energy with a developer who will build a 50 MW plant (*Ecoeléctrico Honduras 2000* project, on a site known as *Cerro de Hula*). In Nicaragua several sites have been identified, two with potential of over 250 MW (the *Rivas* Isthmus and the *Hato Grande* region). In Panama, preliminary evaluations point to almost 400 MW in potential, located in sites close to the grid, among them the *Hornitos* project (57 MW), which looks attractive. Moreover, other isolated experiences exist, some developed for demonstration purposes.

(v) Solar energy

There is no reliable data or figures on solar energy use in each country in this subregion. However, it is known that existing facilities (solar panels and collectors) represent a very small percentage of the potential for solar energy. Based on this assumption, it can be said that the unused potential of solar energy is 100%. Solar project development will become more viable and/or necessary in countries with less modern energy sources (lower indices for electric power coverage), larger communities and more population in the rural area, and longer social lags.

Almost all countries have some pilot solar applications for pumping water and irrigation systems. As a reference, it should be mentioned that: (i) Costa Rica has around 1000 photovoltaic systems installed by the ICE in households in isolated rural communities, and this institution hopes to install another 1500 systems between 2003-2006; (ii) Guatemala has around 18,000 photovoltaic systems (in use, both in rural communities without electrical service and in urban and semi-urban areas), of which around 20% were installed by the MEM, and the other 80% by private firms and NGOs.

In Nicaragua, its project for connecting isolated areas to the electric power grid (PERZA)[17] contemplates the inclusion of solar panels for around 800 families located in several communities, mainly on the Atlantic coast. This includes the installation of six photovoltaic systems for charging batteries. In Panama, the Social Investment Fund's Office for Rural Electrification (*Oficina de Electrificación Rural*, OER) has installed around 400 solar panels in rural households, schools and health care centres.

E. MEXICO

1. General and policy aspects

Mexican laws mention the use of renewable energy resources on several occasions. Article 27 of the political constitution of the United States of Mexico, establishes that it is the Nation's exclusive right to generate, conduct, transform, distribute and supply electrical energy whose purpose is the provision of a public service. In this sense, no concessions will be granted to private individuals and the Nation will make use of all goods and natural resources required for these ends.

Similarly, the waters of rivers and direct or indirect tributaries belong to the Nation, from the point at which the first permanent, intermittent or flood waters begin all the way to their outlet in the sea, lakes, lagoons, or estuaries. Article 28 states that the functions exercised exclusively by the State in the

[17] A project with financing from the World Bank, carried out by the National Energy Commission, whose purpose is to improve living conditions in remote rural areas, through the sustainable provision of electricity, with its associated economic and social benefits.

following strategic areas will not be considered monopolies: oil and other hydrocarbons; basic petrochemicals; radio-active minerals and nuclear energy generation; electricity and activities expressly mentioned in laws passed by congress.

Similarly, through its public administration law (*Ley Orgánica de la Administración Pública Federal*), the energy ministry is responsible for conducting the country's energy policy, as well as exercising the Nation's rights with regard to making use of goods and natural resources required to generate, conduct, transform, distribute and supply electrical energy for the purposes of providing public service. According to the same law, the ministry of the environment and natural resources (*Secretaría del Medio Ambiente y Recursos Naturales*) is responsible for encouraging the protection, restoration and conservation of ecosystems, natural resources, and environmental goods and services, to ensure their sustainable development and use.

Among its objectives, the Energy Sector Programme (*Programa Sectorial de Energía*), 2001-2006, which forms part of the National Development Plan for the same period, includes increasing the use of renewable energy sources and to do so defines a specific action, creating an annual programme for encouraging electrical generation using renewable energy.

2. Baseline conditions

Wooded lands cover 28.4% of Mexico's total surface area. From 1990-2000, it posted an annual loss of 1.1% of wooded areas.

Estimates for the wind power potential in Mexico range from 5,000 to 50,000 MW. In particular, an evaluation based on satellite images in the area of the Tehuantepec Isthmus revealed a potential of almost 10,000 MW, including possible facilities in the sea. Similarly, hydroelectric generation potential is estimated at more than 11,500 MW. According to the Federal Electric power Commission (*Comisión Federal de Electricidad*, CFE), the potential for electric power generation through mini-hydro plants (less than 5MW) is about 3,000 MW. The CFE has also established that the potential for geothermal energy is over 2,000 MW. In the agro-manufacturing sector, specifically the sugar cane industry, the potential for generation is over 3,000 GWh annually. Finally, general knowledge about solar energy in Mexico indicates that more than half its territory receives an average density of solar radiation of 5 kWh per square metre daily.

Mexico's largest potential for using RES is in hydro and geothermal energy. Electric power generating potential using hydroenergy stands at more than 9,400 MW, while for geothermal energy it has an installed capacity of 960 MW. At the same time, Mexico's installed capacity for generating wind power is 2.2 MW at an experimental CFE station and only one plant runs on gas from the sanitary fill at Monterrey, Nuevo León, with a potential of almost 5 MW.

According to Mexico's Ministry of Energy, expansion plans for the domestic electrical sector over the next ten years include two major hydropower projects with a capacity of almost 1,700 MW and a geothermal energy plant, with a capacity of 107 MW. For applications with photovoltaic systems, the country expects to have 28 MW installed by 2011.[18]

[18] Ministry of Energy (*Secretaría de Energía*), Mexico, *Prospectivas del Sector Eléctrico en México,* 2002-2011.

F. ANDEAN COMMUNITY

1. General and policy aspects

A rather wide range of institutions is responsible for renewable energy in the Andean context. Throughout the region, ministries associated with energy issues treat questions of electricity and hydrocarbons together and almost independently from renewable energy, which is left to a complementary role, typically for supplying electricity to isolated systems, with different levels of attention and institutional connections.

While some countries, such as Colombia and Peru, have a reasonable definition of the institutional attributes and a defined legal framework, in others the administrative structure is still in the early stages of implementation.

In Bolivia, for example, although there is an Undersecretary of Electricity and Alternative Energies within the Ministry of Service and Public Works, the level of coordination, execution and reach of policies is limited compared to other countries. Even with the importance that fossil fuels have for this subregion, generally speaking all countries have some notion of the growing importance of renewable energies, especially oriented to providing electricity in isolated communities and where the idea of renewability is reinforced by the environmental advantages inherent in renewable technologies. Exactly for this reason, a difficulty that must be overcome is establishing appropriate joint action between energy and environmental agencies on the issue of renewable energy.

In this sense, given their results, the situations in Colombia and Peru are described in detail. In Colombia, the mining-energy planning unit (*Unidad de Planeamiento Minero-Energético,* UPME), associated with the Ministry of Mines and Energy, has produced a wide range of information and statistics for consistent decision-making in the energy field, which have been fundamental to developing renewable energy.

This governmental unit has a trained team and has achieved some stability, which is considered very important to give continuity to studies and the resulting policy formulation. A basic UPME product is its National Energy Plan (*Plan Energético Nacional*), which analyses the country's energy sector in detail, setting the foundations for its energy development strategy until 2020; it has encouraged a market-oriented vision and introduced competition in every energy field; it has applied an integrated approach to defining policies, efficiently assigning resources, and ensuring the sector's sustainability, among others. This plan includes a diagnosis of different energy sources and markets, establishing projections, analysing impacts and suggesting lines of action. In legal terms, Law 697/2001 encourages the rational use of energy and promotes the use of alternative energy, along with its regulations, included in Decree MME 3683/2003. The latter places the Ministry of Mines and Energy in charge of defining policies and designing instruments for promoting unconventional energy sources. Similarly, it has created an intersectoral commission for energy efficiency and unconventional energy sources (*Comisión Intersectorial para el Uso Eficiente y Fuentes no Convencionales de Energía,* CIURE), to coordinate policy implementation and programmes, among other attributes. This Decree even establishes a deadline for defining financing mechanisms to support energy programmes.

In Peru, among its other responsibilities the Technical Energy Office (*Oficina Técnica de Energía*, OTERG), an advisory body supporting the Undersecretary of Energy, proposes and evaluates national energy policy in the medium and long term. It used to prepare the Electric Power Reference Plan

(*Plan Referencial de Electricidad),* today prepared by the national electricity bureau, *Dirección General de Electricidad*), but nowadays proposes regulations for energy conservation, prepares the National Energy Report (*Balance Energético Nacional*) and makes projections regarding the country's energy prospects. Of course, because these are not executive bodies, neither Colombia's UPME nor Peru's OTERG are responsible for implementing projects, but they play an essential role in helping to create the environment necessary for investment in renewable energy to occur and be effective.

The growing importance of municipal or district administrations, which have taken on implementation and occasionally the administration of energy projects related to renewable energy sources, should be noted in the Andean context. Although in some ways this creates an additional problem for coordination, it also reinforces local integration within the project. This aspect, related to administrative decentralization, can be found to differing degrees in all the Andean countries.

The regulatory context for renewable energy in the Andean countries is naturally a direct consequence of the institutional context, that is, the countries best structured to deal with this issue also have a more advanced judicial-legal framework. Thus, laws, draft laws and decrees on sustainable energy development have recently appeared in all countries, clearly associated with energy supply, but how their goals are met often depends on questions that go beyond the mere regulatory framework and its intentions, such as the availability of natural resources and the right financing conditions.

On this point, it is interesting to observe that one policy that yielded promising results involved creating rotating funds for rural electrification, based on a surcharge applied to electrical energy companies' profits and eventually contributions from cooperation agencies, which financed projects using renewable energy. This category includes Peru's rural electrification fund (*Fondo de Electrificación Rural*, FER) and Ecuador's rural and marginal urban electrification fund (*Fondo de Electrificación Rural y Urbano Marginal*, FERUM), and has become very important in promoting renewable energy in these countries.

In Colombia the implementation of a biofuels programme based on sugar cane ethanol stands out. Early next year it should start being used in a 10% mix with gasoline (gasohol), initially in some cities and eventually throughout the country. This programme arose from the regulatory and legal framework developed as part of the national energy plan (*Plan Energético Nacional*).

As mentioned, from the environmental point of view, the Andean Community needs to articulate institutions involved in energy and the environment, in the framework of developing renewable energy sources. These energy technologies can and often do contribute to environmental improvements, but there is still little relationship between the bodies evaluating environmental impacts and those responsible for promoting renewable energy, especially in sensitive areas where better coordination is essential, such as hydroenergy and biofuels, to reach a consensus on the requirements for sustainability.

Generally speaking, the basic conditions for formulating policies for the development of renewable energy sources exist, to the degree that there is a minimum legal framework to promote them and some sort of institutional framework, although as mentioned, there are considerable differences among countries. It should also be recognized, however, again generally speaking, that there has been no significant progress consistent with the natural resources available and the shortcomings apparent, which offers the opportunity to develop and implement broader, more integrated and effective energy policies.

In the case of Peru, currently the country is applying the second decade of a rural electrification plan, which is based on a diagnosis of needs and a detailed inventory of resources, with targets, financing needs and priority criteria for activities. This plan places expansion of electric power services as the main aegis of social interests. Colombia also has an energy plan with a vision and strategy for the future designed according to public policy objectives, but in terms of renewable resources it is a rather limited and more discourse-based plan.

2. Baseline conditions

Renewable energy resources in the Andean region can be considered abundant, although not totally known or evaluated in depth. The region occupies a tropical strip with high levels of exposure to sunlight and, given the presence of some dry or cold climates, most of the surface of Andean Community countries offers ad hoc weather conditions for high productivity bioenergy vectors, such as sugar cane. Similarly, it offers enormous potential for wind power, geothermal and hydroelectric power, which have already been identified in every country. In short, many sources of renewable energy are available in the Andean region.

The Andean subregion is one of the main hydrocarbon producers in Latin America. It possesses an extensive area with hydrocarbon potential, estimated at from 15% to 30% of the explored area in each country, except Venezuela where it stands at over 30%. Proven oil reserves are estimated at 85 billion barrels, with most of this rise occurring in the past decade when the reserves rose 55.5%, with Bolivia and Ecuador multiplying their initial levels fourfold. Keeping in mind that average oil production in recent years was 4.5 million barrels per day, the reserves to production ratio reaches 55 years, the highest in Latin America.

Proven natural gas reserves stand at 5.451 billion cubic metres, of which 77% are in Venezuela. In the past decade, Peru increased its reserves in the Camisea field, while Bolivia increased its reserves fourfold in the past four years. With average production at 56 billion cubic metres, the Andean Community has 97 years of reserves at current production rates.

Despite these magnificent hydrocarbon conditions, in 2002 renewable energy sources accounted for 28% of the total energy supply, with hydroenergy leading the RES. Among the RES it is interesting to note that no other type of modern energy vector appears (solar energy for agricultural drying or the same in photovoltaic systems).

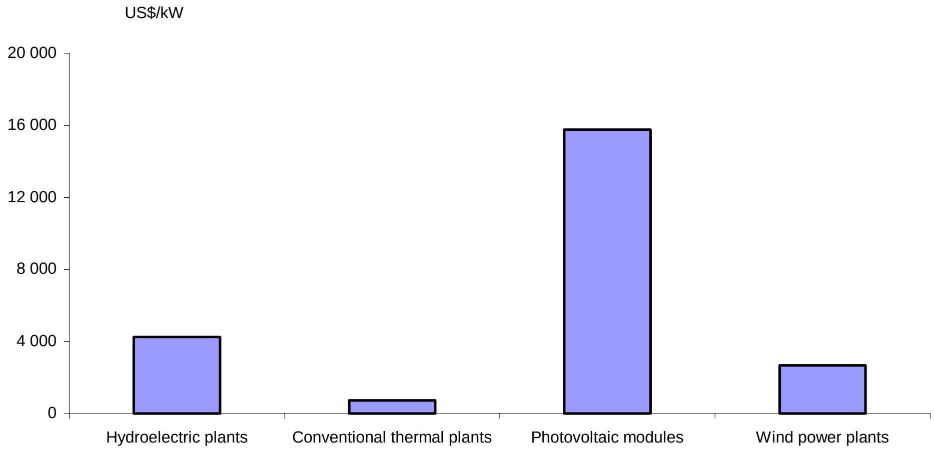
The supply of equipment for converting and using renewable energy sources is limited in the Andean Community, mainly in terms of the more sophisticated or higher capacity technologies, such as wind generators with potentials of 100 KW or higher. The most common technology used in Andean rural programmes, photovoltaic solar cells, is almost entirely imported, except for parts and basic materials. Nonetheless, it is important to note that the region in recent decades has developed a technological and productive capacity of its own in small-scale hydroelectricity, particularly in Colombia, Peru and Bolivia, capable of meeting the typical generation needs of isolated communities at competitive costs, obviously where there is the necessary water supply.

Figure II.1 presents the estimated unit costs, according to Peru's rural electrification plan[19] and adds some interesting information: aside from using locally produced equipment, hydroelectricity costs

[19] Ministry of Energy and Mines, Dirección Ejecutiva de Proyectos, Plan de Electrificación Rural 2003-2012 (PER), Lima, 2003.

less than photovoltaic systems and can thus be employed in households with installed capacities requiring more than a few lamps for a few hours, and contribute to genuine change for users.

Figure II.1
ESTIMATED RURAL ELECTRIFICATION COSTS IN PERU



Source: Ministry of Energy and Mines, Dirección Ejecutiva de Proyectos, Plan de Electrificación Rural 2003-2012 (PER), Lima, 2003.

Current levels of energy demand apparent in the Andean Community vary significantly from country to country and among different social groups, but indicate that there is a significant amount of need that is not covered, particularly among the lowest income strata, when compared to other Latin American countries. One indicator of this is that electrical service coverage in rural areas averages 46% for the region but is less than 25% in Bolivia.

(a) Bolivia

Toward the middle of the past decade and in the framework of a UNDP/World Bank project on rural energy, a map of rural electrification (*Plano Indicativo de Electrificación Rural*) was proposed for Bolivia, with a regional diagnosis and demand studies, which was complemented by a rural electrification investment programme (*Programa de Inversiones para Electrificación Rural*), with a horizon for 2002 and partially implemented.

(i) Solar energy

Currently being implemented, the rural electrification plan proposes the combined implementation of distribution lines, local systems, and decentralized power plants, mainly based on solar energy, with the target being 45% coverage, adding 60 MW of demand toward 2007.

(ii) Hydroenergy

Almost all Bolivia's potential is possible to use and the country is able to design, build most equipment (there are three hydro turbine manufacturers) and implement these plants, at prices that are substantially more competitive than photovoltaic systems. Naturally, hydroelectric plants can be more complicated to manage, requiring a minimum level of community organization for their implementation, but the advantages in terms of local resource use and the integration of production are significant.

For the conditions typical of Cochabamba, a mini-hydroelectric plant of 100 kW costs about US$ 300,000 and can provide household and production-oriented energy to 400 families, while a 200 W unit costs US$ 600 for the electromechanical equipment, plus a similar amount for the civil works. As capacity factors are rather higher than for solar systems, the cost of the energy produced is about 15 times lower than for solar energy.

A project inventory carried out by the national energy ministry, in the middle of the past decade, revealed the possibility of installing 7 MW micro-plants distributed across more than 100 projects and supplying almost 20,000 families.

(iii) Biomass

A 15 MW co-generation unit in the Unagro sugar centre (*Central Azucarera Unagro*), Santa Cruz de la Sierra, is worth mentioning. It uses bagasse as fuel and high performance equipment, such as a boiler producing 170 tons of steam per hour, for an investment of US$ 5.5 million. Reports also reveal a 1 MW plant operating in the Bolivian jungle, using cashew husks from Brazil as fuel, and in Santa Cruz two projects have been implemented using rice husks as fuel for a rice mill (*Ingenio Arrocero Agroincruz*) and bagasse to produce sugar syrup. Initiatives of this kind can increase the competitiveness of Bolivia’s agromanufacturing, and naturally raise the rational way renewable energy is used. In this field, there is plenty of room for opportunity, keeping in mind the potential of Bolivia’s cane and wood agroindustries.

(b) Colombia

From the point of view of the resources available, Colombia has carried out important studies to evaluate its potential for renewable energy sources, as presented in table II.7. It is interesting to note that this potential is also highlighted in a document dealing with the need to increase Colombia’s electricity generating capacity.[20]

Table II.7

RENEWABLE ENERGY RESOURCES IN COLOMBIA

Energy	**Information about the resource**	**Comments**
Solar	Maps of the annual and monthly resource	With potential remaining virtually constant year round, the best regions are in the areas of Magdalena, La Guajira and San Andrés, and Providencia, with annual potentials totalling from 5 to 6 kWh/m^2
Biomass	Map of plant coverage Preliminary estimates	Annual production of cane bagasse is 7.5 million tons and rice husks is 457,000 tons. It is estimated that a sanitary landfill in Bogotá could generate 11 GWh/year
Wind power	Preliminary wind map	The best sites, with normalized speed of over 10 m/s, are found in the country’s far north
Hydro	Map of rainfall (based on a Digital Elevation Model) and flows (based on the hydro balance sheet), classifying the regions among six potential levels	The most potential is located in the eastern and western mountain ranges. Colombia’s potential is estimated at 50 GW in projects with capacity of over > 100 MW and could reach 70 GW when medium and small power projects are included
Geothermal energy	Maps of geothermal resources Preliminary studies in areas of interest	The areas with the greatest potential are on the border with Ecuador (in the Chiles - Cerro Negro volcanoes), in the *departamento* (district) of Nariño (Azufral Volcano), in the national park *Parque Natural Nacional de Los Nevados* and the geothermal energy area of Paipa - Iza in Boyacá
Tidal power	Preliminary study	Some 500 MW should be available along the Pacific coast
Waves	Preliminary study	The potential for the whole coast is 30 GW

20 UPME, *Plan de Expansión de Referencia: Generación y Transmisión – 2002-2011*, Bogotá, 2002.

One sector of renewable energy that looks very promising is sugar cane. With annual production of about 20 million tons of sugar cane, using almost 200,000 hectares, the Colombian cane industry is technologically developed and in agricultural terms, posts high productivity on a world level, averaging 114 tons of cane per hectare. Of the 14 existing mills, 13 produce more than 99% of the total and are located in the fertile Cauca valley, in the Cali region, whose climate permits production year-round. In these conditions, cane could play an important role as a renewable fuel source, as discussed below.

Among the energy plan's strategic objectives, aiming to expand and guarantee the domestic supply of energy with efficient prices and suitable quality, one proposes using ethanol as an oxygenate additive to Colombian gasoline. This should improve air quality in the large cities, as well as stimulating production and creating jobs in many areas around the country, by requiring the cultivation of sugar cane.

(c) Ecuador

Different studies of potential available for renewable energy have been carried out in Ecuador, confirming that the country has significant resources of this kind. Table II.8 provides a summary of the potential identified and adds some comments on facilities existing in the country**.**

Studies of biomass energy potential evaluated agricultural wastes (bagasse, banana, corn leaves, rice husks, palm fruit, fruit peelings) and found these could generate 50% of current electricity demand, while municipal and animal wastes could generate 16% and 42% respectively of electric energy needs.

Table II.8
RENEWABLE ENERGY POTENTIAL IN ECUADOR[a]

Energy	**Knowledge of the resource**	**Comments**
Solar	Maps of the resource per year and local maps	Radiation levels from 3.8 to 6.0 kWh/m2/day (2,000 hours/year of sunlight) Existing facilities: Solar heat: 20,000 collectors for heating water Photovoltaic: almost 400 sites in the Amazon, some in the Galapagos
Wind power	Local studies	Winds located in mountains and sea breezes. Andes from 2.4 to 8.0 m/s, Coast >3.5 m/s
Biomass	Preliminary studies	Forest plantations: 78,000 has Municipal wastes: 1.7 million tons/year Animal wastes: 40.3 million ton/year
Hydro	Specific studies	Many plants were deactivated. 143 sites evaluated, with a capacity reaching up to 5 MW, for a total potential of 47 MW
Geothermal energy	National study and preliminary studies of areas of interest	Generating potential estimated at 4,700 GWh, almost 60% of annual consumption.

[a] See S. Sánchez, *Las Energías Renovables en Ecuador*, Power Point presentation, 2004, and E. Aguillera, *Los Recursos Geotérmicos del Ecuador,* Power Point presentation, 2004.

(i) Geothermal energy

In terms of geothermal energy, since the 1970s, the former electrification institute (*Instituto Ecuatoriano de Electrificación*, INECEL), explored for geothermal resources, with an eye to diversifying the supply of natural resources suitable for electrical generation and reducing the use of fuels from oil derivatives.

With international support (OLADE, Government of Italy) and its own resources, INECEL completed the reconnaissance studies at the national level and three site studies for the regions considered most interesting: Tufiño-Chiles, Chalupas and Chiles-Cerro Negro-Tufiño, this last a binational project with Colombia. This is the geothermal area with the most advanced geological and geochemical studies, for exploration and pre-feasibility. To start using geothermal energy in Ecuador, resources are sought to set up a 15 MW unit in Tufiño, which would be a way of financing the studies still needed to build a larger capacity plant.

(ii) Wind power

An interesting wind power initiative is located in the Loja region, in the south. Here a very high quality potential site was identified, with good, stable, almost unidirectional winds (average speed 10 m/s), which would make it possible to install an almost 110 MW plant. Seeking to leverage future investment and based on an institutional design with strong, effective, leadership from the local community in coordination with the MEM, the first stage will attempt to develop a 15 MW project that should have support from the Andean Development Corporation (as the guarantor) and the Government of Denmark (to finance the wind generators).

(iii) Hydroenergy

With regard to small hydroelectric plants, a portfolio of projects including 3,220 MW plants is reported. These should be preparing for financing, in the framework of existing support mechanisms, such as the FERUM (*Fondo de Electrificación Rural y Urbano Marginal*). On this issue and in discussions about the prospects for renewable energy, the importance of including hydroenergy as a sustainable source was underlined, with its interesting associated advantages. As an example, one project (*Proyecto de Propósito Múltiple Quevedo Vinces*) was mentioned, where the Baba dam will be included in the Río Guayas basin. This project is expected to generate more than 50 MW, avoid flooding downriver, regularize the flow (80% between January and May) and permit irrigation.

(d) Peru

In Peru, a significant and positive step has been the gathering and publication of data included in an integrated energy study (*Estudio Integral de Energía*).[21] Based on this study, table II.9 presents estimated potential for Peru's renewable energy sources, according to studies carried out in the mid-1980s. The resources for each type of renewable energy important to this country are commented upon below.

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[21] *Sistemas Agua & Energía SA, IDEE/FB - Instituto de Economía Energética, Estudio Integral de Energía del Perú, informe para OTERG/MEM*, Lima, November 2001.

Table II.9
RENEWABLE ENERGY SOURCE POTENTIAL IN PERU

Source	Production potential
Hydroenergy	2 852 10^3 (Toe/year)
Fuelwood	66 10^6 (Toe/year)
Agricultural waters	0.53 10^6 (Toe/year)
Livestock wastes	0.15 10^6 (Toe/year)
Agroindustrial wastes	0.395 10^6 (toeb/year)
Urban waste	0.236 10^6 (toeb/year)
Wind power	450-5 000 (kWh/m^2/year)
Solar	4-5 (kWh/m^2)

Source*:* *Sistemas Agua & Energía SA, IDEE/FB - Instituto de Economía Energética, Estudio Integral de Energía del Perú, informe para OTERG/MEM*, Lima, November 2001.

(i) Biomass

Peru is a privileged country in terms of its forest resources, ranking second in Latin America in terms of its forested area. In 1988, the forestry and fauna bureau (*Dirección General Forestal y de Fauna*, DGFF), estimated for Peru's forestry resources a maximum sustainable flow of 66 million de toeb/year,[22] which would be the equivalent of 36 times estimated fuelwood consumption in 1998. If agricultural and agro-industrial wastes are added, the potential for bioenergy is clearly higher than Peru's current oil reserves of 43 million toeb.

(ii) Solar power

As a country with an equatorial area and low fog regions, solar energy is abundant in Peru. On average, solar radiation across a horizontal area of the Sierra is more than 5 kWh/m^2 and in the forest ranges from 4 to 5 kWh/m^2, which represent very high levels of solar energy.[23]

(iii) Wind power

To evaluate wind power, 31 metering stations have been set up in almost all of Peru's districts (*departamentos*), which indicate that the best conditions occur on the coast and border regions between Bolivia and Chile.[24] It should be noted that the Peruvian coast has significant wind power potential with averages reaching 8 m/s in Malabrigo, San Juan de Marcona and Paracas. Likewise, along most of the coast, annual averages reach 6 m/s, which encourage analysing the potential for their use in generating electricity.

(iv) Geothermal energy

Peru has 300 hot springs with temperatures ranging from 49º to 89 ºC located along the western mountain range and to a lesser degree in some of the Andean valleys and the eastern area, which would only be suitable for heating water and providing heat. Based on the available information for the six Peruvian geothermal energy areas, the Ministry of Energy and Mines conducted a geological

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22 L.A. Horta Nogueira, chapter III, *Energía de Biomasa, Propuesta para un Plan Nacional de Desarrollo de las Fuentes Nuevas y Renovables de Energía* – Proyecto PER/86/011, PNUD/CONERG/MEM, Lima, 1988.

23 L.G. Bastos, chapter II, *Energía Solar*, *Propuesta para un Plan Nacional de Desarrollo de las Fuentes Nuevas y Renovables de Energía*, Proyecto PER/86/011, PNUD/CONERG/MEM, Lima, 1988.

24 M.H. Hirata, chapter IV, *Energía Eólica, Propuesta para un Plan Nacional de Desarrollo de las Fuentes Nuevas y Renovables de Energía*, Proyecto PER/86/011, PNUD/CONERG/MEM, Lima, 1988.

interpretation,[25] considering the socio-economic aspects of industrial development and possibilities for replacing oil derivatives in thermal plants, which led it to establish the following order of priorities: (i) chain of volcanic cones, (ii) Puno Cuzco, (iii) Cajamarca and La Libertad, and (iv) Callejón de Huaylas, Churrin and Central.

(v) Hydroenergy

Proven hydroelectric potential is about 6 GW, but if probable and possible potential is included, the total for potential and proven producible energy would reach 74 GW and 316,702 GWh respectively. As a result, Peru must still evaluate another almost 68,000 MW from the technical and financial perspective, which, because of its renewable nature, could turn this resource into the country's most important energy source.

(e) Venezuela

With generous fossil fuel resources and at the same time significant renewable resources, among them its hydroelectric potential, Venezuela is one of the few oil exporting countries with good prospects for development in a sustainable scenario. Nonetheless, it faces a unique challenge, that of suitably defining the role of renewable resources in a diversified and rational fashion.

Renewable energy's current share is contributed almost completely by hydroelectricity, with Venezuela being the Andean country with the most installed capacity (13,215 MW) and the highest development of its potential (26%).

The country is also involved in some specific activities regarding other renewable forms of energy, such as biodigestors installed in Pedraza Barinas, solar systems in the Amazon and Anzoátegui and a wind turbine (Darrieus type) on La Orchila island, but these do not produce significant capacities and instead serve more as tests than for commercial ends. Similarly, in the 1990s some seminars were held on the subject, such as Bioenergy Through Forest Plantations, Geothermal Energy and Development, Planning of Renewable Energy in Venezuela, but without results in energy terms.

The reduced importance of non-hydro renewable energy is clear from the fact that there is virtually no mention of these sources in Venezuela's Energy Balance Sheet, with reports mentioning only diesel oil as the energy source consumed in the agricultural sector.[26]

It should be remembered, however, that this subject matter has been explored since the 1990s through the general energy sector bureau (*Dirección General Sectorial de Energía*), which designed an information system on alternative energy sources (*Sistema de Informaciones de Fuentes Alternas de Energía*, SIFARE) and the national education programme on alternative and renewable energy (*Programa Nacional de Educación en Fuentes Alternas y Renovables de Energía*, PRONDIFARE), always keeping in mind the priority of energizing distant and isolated, rural, island and border areas. Within these programmes and with support from OLADE, eight feasibility studies were carried out for micro-hydrogeneration plants for the state of Bolívar. Also, and very related to microplant potential, it was reported that 60 dams existed for non-energy purposes and without generating electricity, with

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[25] Ministry of Energy and Mines, *Generación Eléctrica a partir de Fuentes Nuevas: Energía Geotérmica, Atlas Minero Energético*, Lima, 2000.

[26] Venezuela, *Balance Energético 1996-2000*, Ministry of Energy and Mines, Caracas, 2000 (economic energy summaries are also available for 1990-1997 and 1995-1999).

heights of over 80 metres and flows of over 1.5 cubic metres per second, that is, with evident potential for use in generation units.[27]

To date, activities are governed by the renewable energies programme (*Programa de Energías Renovables*, PER), run by the Ministry of Energy and Mines. In terms of complementing the country's electrical grid, initial studies are proposed on:

- Setting up a wind park with 80 MW of capacity in the State of Falcón;
- Setting up several wind parks in the Venezuelan Goajira (State of Zulia), with an initial capacity of 50 MW, which could rise to more than 10,000 MW in later phases;
- Study and implementation of high capacity photovoltaic solar plants.

G. EXPANDED MERCOSUR

1. General and policy aspects

(a) Brazil

Despite the high expectations associated with privatization in the 1990s, investment in new generation in Brazil has not followed the rise in consumption. GDP growth's decoupling (Brazil averaged 2% annual growth between 1980-2000) from soaring electric power consumption (which rose an average of 5% annually in the same period) is common in developing countries. In the Brazilian case, new investment in power generation (averaging 4% annually) has not met the increase in demand.

To understand this situation, it is important to examine the behaviour of the primary power fuel in Brazil, water dammed in reservoirs. Projected to accommodate unfavourable climate variations for 4-5 years, the reservoirs suffered excessive depletion amidst rising demand and lack of new generating capacity. These were planned to deal with up to five years of lower-than-average rainfall during the rainy season, but collapsed after two summers (rainfall in the summers of 1999/2000 and 2000/2001 was below the historic average, although this is the traditional rainy season).

The combination of record low rainfalls, the intensive use of the "energy reserves" (corresponding to the useful volume of water in reservoirs), and insufficient generating capacity development (power trends, blackouts and rising consumption), led to energy rationing between July 2001 and February 2002.

To ease the crisis and reduce dependence on hydro generation, the federal government launched a thermoelectric priority plan (*Plano Prioritário de Termelétricas* - PPT) en early 2000, which called for the installation of 47 natural gas-fired power plants. However, several difficulties, mainly related to the environmental licensing process and the scope of regulations, prevented the plan's full development.

Meanwhile, consumers were subject to restrictions: a compulsory 20% cut to average electric power consumption from May to July 2000. As a result, during the second half of 2001 and the beginning of 2002, the cut reached 24.5% of normal "business-as-usual" consumption.

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[27] A. Hichter, Undersecretary of the Environment and Natural Resources, personal communication.

Presently, Brazil again faces a possible energy crisis. Investment has stopped due to regulatory uncertainty and lack of a stable policy for the industry, which has created expectations that new profitable projects will face some limits, thus inhibiting new investment. In this atmosphere, players are looking for prospects and solutions in initiatives involving energy conservation, decentralized energy generation, co-generation, and renewable energy.

The government change at the beginning of 2003 brought the possibility of replacing the power industry model (*Novo Modelo*). The reform is a complete overhaul of Brazil's previous electricity sector model, which failed to prevent an energy crisis in 2001. Two new state entities form the core of the new system:

- The *Câmara de Comercialização de Energia Elétrica* (CCEE), has been designed to function as a sort of auction house for the market's electricity output.
- The *Empresa de Pesquisa Energética* (EPE) will be responsible for planning the sector's future, establishing guidelines for future investment in plants and transmission lines.

Power concessions will be auctioned off by the sector's regulatory agency, the *Agência Nacional de Energia Elétrica* (ANEEL), under the supervision of the Ministry of Mines and Energy. The winners of contracts, which will last 15 to 20 years, will be the companies offering the lowest rates for consumers. The previous auction system awarded concession contracts to the highest bidders.

The fuel compensation fund (*Conta de Consumo de Combustíveis*, CCC) policy aims at cooperating to increase access to energy in isolated communities; still, several difficulties remain, among them high extra-diesel consumption for boat transportation of diesel oil; higher costs; difficulties in guaranteeing supply, increased dependency on diesel oil imports, and polluting emissions.

The expansion of the CCC under the *Novo Modelo* policy intends to reduce these difficulties. Renewable energy sources, such as photovoltaic cells, biomass, small hydro, and others, can be provided with local resources, guaranteeing the supply (if they depend on local resources), have fewer environmental impacts, and contribute to energy self-sufficiency, among other advantages (Goldemberg, 2002).

The Ministry of Science and Technology has special programmes aiming to stimulate research and technological innovation involving new sources of electric power generation at lower costs, and to develop the national technology industry and human resources.

Brazil has never implemented financial and tax measures to foster small or medium-sized energy projects, including renewables. An additional drawback to renewables is that investors perceive greater risks, leading financial agents to boldly refuse projects or to require higher interest rates for loan approvals. The Brazilian Development Bank (BNDES) has also launched several programmes, allowing special credits for biomass power plants that will generate electricity and sell surpluses to utilities or sell them directly.

An indirect barrier to the implementation of renewables is the current environmental legislation for stationary sources. To date, legislation for these sources has established emission limits on SO2 and particulate specific emissions only, not NOx. This is significant because the expansion of the power sector is expected to rely on natural gas-fired power plants and NOx emissions must be controlled. If not, conversion systems will be installed with no emission cuts, reflecting lower installation costs. Consequently, this appears to be an indirect subsidy to fossil fuels, mainly outside São Paulo State.

Since the Federal Constitution of 1988, environmental impact assessments (EIA) have been required of almost all energy projects. On energy production, Brazilian environmental legislation requires at least a preliminary environmental assessment to be carried out for all hydroelectric plant projects, thermal plants with installed capacity of 10 MW or more, power transmission lines of 230 kV or more, oil or gas pipelines, new ethanol distilleries (or increases in sugarcane crop areas), flammable product storage areas, and mining activities, among others. Water use must comply with the national water resource plan, respecting watercourse classification and other multiple uses.

(b) Argentina

The role of the State in Argentina has undergone profound changes since the electrical reorganization that began in 1992. The activities of generation, transmission, and distribution are open to the private sector, with ownership of more than one activity within the sector restricted. The law guarantees access to the grid, creates a competitive environment and allows generators to serve customers anywhere in the country.

The importance of the contribution from renewable resources as alternative sources of electrical energy in the rural sector has been developed through the PAEPRA programme, under the guidance of the Ministry of Works and Public Utilities through its bureau, the *Dirección Nacional de Promoción*, in an effort to achieve basic electric power services for lighting and communications, using renewable source technologies (photovoltaic, wind power, biomass and minihydro), which has attracted the interest of new investors.

The Ministry of Energy is about to add a geographic information system (*Sistema de Información Geográfico*, GIS) on renewable energy to its website. This will coincide with the international meeting “Renewables 2004” in Bonn. The product that will be available to the public will be an interactive map of resources and projects involving renewable energy.

Finally, a draft law for fostering renewable energy sources (*Ley sobre Fomento Nacional para el uso de Fuentes Renovables de Energía Destinada a la Producción de Energías Eléctricas*) is currently being debated. It sets the goal of having renewable energy sources contribute 8% of national electrical energy consumption at the end of 2013. Moreover, it would create an investment regime for building renewable-based generation projections and, in this same area, provide a series of benefits that would also affect some existing regimes, such as: (i) tax on profits; (ii) value-added tax; (iii) import duties; (iv) fiscal stability.

(c) Uruguay

In 1997, the electric power sector changed significantly with the passing of the regulatory framework law (*Ley del Marco Regulatorio*), which created the Uruguayan electrical market, separating regulation from business activities. This law, among other elements, guarantees the freedom to generate, as this ceases to be considered a public service, and free access to transmission and distribution grids.

This landmark has brought a change in the general view of the sector and the State’s roles. The public company, *Usinas y Transmisiones Eléctricas* (UTE), was set up as a state monopoly to manage the electrical sector. The UTE participates in the coastal gas pipeline, because it is associated with projects for gas-fired electrical generation plans along the country’s coastline, to satisfy domestic demand and export energy to Brazil.

In future, the business objective is to advance toward integrating Uruguay into the regional electrical market, increasing domestic sales and expanding external markets.

Uruguay has no explicit or implicit policies for using renewable sources, over and beyond the legislation mentioned above and the policy of the UTE, the national electrical company.

In terms of solar-based rural electrification, there are plans in the form of UTE resolutions, at the company level; however, these reflect company rather than country level policy. Other rural electrification plans are based on extending power lines and non-renewable energy sources. There is information on the UTE web site about a call for expressions of interest in the supply and assembly of a future wind park, with a 5/30 MW capacity, in Uruguay.

On its own initiative, the UTE installed solar (photovoltaic) panels for schools, police stations and polyclinics in rural areas (for a total of 70 points distant from the grid). A similar plan is being prepared with World Bank funding, in which people in rural areas without electrical service would have to pay about US$ 3.5 monthly to install a 50W panel. Current, UTE estimates national electric power coverage to be 97%.

(d) Chile

Electrical generation in Chile is based mainly on hydroenergy, coal, natural gas, oil derivatives and fuelwood. Installed capacity in 2003 had reached 10,465 MW, of which 41% came from hydroelectric plants and the rest from thermoelectric plants (mainly coal and natural gas).

Chile’s electrical system, which was the pioneer experience with privatizations and liberalizations in the 1980s in Latin America and the world, is now being redesigned, to be able to make another leap forward in liberalizing markets and, at the same time, guarantee supply and regulatory rigor, which would put it in the vanguard in terms of integration processes and the new economy during this new decade.

The structural changes in the electrical subsector began in 1982, through Decree Law (*Decreto con Fuerza de Ley*) Nº 1-1982, which allowed private participation in electric power generation, transmission and distribution. On 13 March 2003 Law N° 19,940 (known as the short law, or *Ley Corta*) was published in the official gazette, introducing a series of amendments to Decree Law No.1 of 1-1982.

The purpose of these recent amendments to Law N° 19,940 (the short law) is to modernize and make the system more transparent, for investors and consumers, to guarantee the opportune realization of the investment necessary to provide the country with electrical service to appropriate standards of security and quality.

The Short Law, aside from introducing important amendments to how transmission systems are developed and run (these become a public service and a new procedure for determining transmission tolls is set up) and stabilizing the way node prices are determined (by reducing the node price change band is relation to the free segment), this law improves the conditions for the development of small, unconventional energy plants, mainly using renewable energy sources.

This is done by opening electrical markets to this type of plant, establishing the right to transmit this energy along distribution systems and exemption from toll payments for the use of the transmission grid by “renewable” plants whose total capacity is under 9 MW.

In terms of electrification in isolated areas, the national rural electrification programme (*Programa Nacional de Electrificación Rural*, PER), was created by the National Energy Commission in late 1994, with the following objectives: to deal with the lack of energy in some rural areas, reduce the incentives for migration to urban areas, encourage the development of production, and guarantee a stable flow of public investment for this purpose.

The results of the population and housing census, carried out on 24 April 2002, revealed the PER's impact, as in ten years national coverage went from 53.15% to 85.71%. With these figures, Chile has become, along with Costa Rica, the country with the highest rural electrification coverage in Latin America. While from 1982 to 1992 the number of rural households with electricity rose by 14.8%, from 1992 to 2002 this rose by 32.6%, or 193,147 new rural households with access to electricity.

Similarly, the National Energy Commission, in coordination with the Undersecretary of Regional Development, regional and the respective municipal governments, are carrying out technical, financial and design feasibility projects to implement wind power projects that would favour 3,500 families on the 32 islands making up the provinces of Chiloé, Palena and Llanquihue, and 200 families on Robinson Crusoe Island in the Juan Fernández Archipelago. In 2001 a pilot project started up on Tac Island using a hybrid wind-diesel system to provide electricity to the 72 resident families.

The National Energy Commission and regional governments are establishing a programme for micro-hydroelectric power plants for isolated communities in several northern and southern regions.

2. Baseline conditions

(a) Brazil

Brazil is a country rich in renewable energy resources, especially in terms of hydropower and biomass. After the military regime ended, the 1988 Constitution imposed more limitations on projects with significant environmental impacts, such as the large hydro plants in the Amazon rainforest and other sensitive regions. Medium- and small hydro plants are also being built amidst more transparent public debate.

Biomass boomed after the establishment of the national ethanol program in 1975. By early 2004, alcohol was being blended into gasoline at a ratio of 25% and this renewable fuel was available at gas stations throughout the country without subsidies and at very competitive prices. Research is ongoing for other biofuels and carriers, such as biodiesel and hydrogen from ethanol. Innovative end-use technologies (such as gasoline-ethanol flexible fuel vehicles) are already competing in the market. Institutions are also supporting other renewable energy sources (see PROINFA program, Chapter IV) such as landfill gas, agriculture waste and wind power.

On fuelwood, reforestation for energy use is turning into an attractive investment and becoming a more common supplier to industry, while residential use remains a question mark. Uncertainty about fuelwood consumption in residences mainly reflects a lack of information and the rising prices of possible substitutes, especially electricity and liquified oil gas (LPG).

(i) Hydroenergy

Brazil has the world's second largest hydro potential after Canada. Hydro has played a key role in the country's socioeconomic development. The hydro potential is 260 GW, although estimates vary; of this only around 80 GW (31%) is currently used (ANEEL, 2003). A major feature of hydro is the unequal geographical distribution of this resource: 144 GW (44%) is located in the Amazon Basin, far from the main demand centres in the country's southeast.

Thus, the main problem is how (and if) this resource can be fully utilised in an environmentally sustainable manner, and with economically and financially acceptable costs. This is a key issue and therefore hydropower warrants a rethink in Brazil. Much of this technical potential remains largely untapped and thus, despite uncertainties (for example about possible climatic changes, increasing doubts on the potential economic contribution from the Amazon Basin, and the already overwhelming dependence on hydropower), hydro will continue to be a major source of electricity generation in Brazil for decades to come.

(ii) Biomass

The overall theoretical potential of biomass energy (4,500 Exa-Joules, EJ) is huge, although only a small fraction (270 EJ) can be considered available on a sustainable basis and at competitive prices (Hall and Rao, 1999); but this is very likely to change over time. Biomass energy, by its very nature, is far more complex and difficult to measure than most other resources. Most energy scenarios include biomass as an important component of energy supply, ranging from 28 to 450 EJ from 2025 onwards.

Brazil is a world leader in large industrial applications of biomass energy and has one of the world's largest potentials. Brazil has the world's largest reserves of natural forests, at least 400 mt of woodfuel could be exploited on a sustainable annual basis. The country produces an enormous amount of waste, 250-275 mt from commercial crops alone; the potential from bagasse varies from 1.1 to 47 GW (compared with an installed capacity of about 1,000 MW, mostly from bagasse); and around 1,800 MW from pulp and paper (current installed capacity is just over 600 MW); 20.4 M m3 (6.35 mt) of charcoal were used in 2001 in steel making, metallurgy, cement, etc. These resources remain largely unexplored and uncounted; Brazil is in a unique and privileged position to increase biomass energy, offering considerable potential for diversification.

Biomass residues are a large and under exploited potential energy resource, and involve many opportunities for better use as a large proportion are readily available and represent a good opportunity at low costs. The most important residues are agricultural and forestry, manure, and more controversially, municipal solid waste (MSW). There have been many attempts to estimate the global energy potential of agricultural residues, but this is a very difficult task and only rough estimates are available. Brazil produces an enormous amount of waste [e.g., 250-275 mt/year] from commercial crops alone.

(iii) Solar power

The theoretical potential of solar energy is truly large, but with many limitations and uncertainties. In common with the rest of the world, the future role of solar energy in Brazil is hard to foresee. Many technological advances are still required to make solar energy economically viable. Currently, there are approximately 6,000 small projects with peak installed capacity of 3,000 kW in a variety of applications but primarily water pumping and lighting. On average, Brazil receives 230 Wh/m2 of solar radiation, giving the country considerable potential in this area.

(iv) Wind power

Estimates of wind power in Brazil vary from 20 to 140 GW. Unlike solar power, wind is better established, with about 22 MW installed capacity and growing rapidly. The greatest potential is in the Northeast (see table II.10), which incidentally, is one of the poorest regions, as illustrated. Based on investment already committed, it seems wind power may finally take hold in Brazil: ANEEL, for example, has authorized more than 6 GW from wind power.

Table II.10
BRAZIL'S ESTIMATED WIND POWER POTENTIAL, BY REGION

Region	Capacity GW	Potential power generation
North	12.84	36.45
Northeast	75.05	144.29
Mid-west	3.08	5.42
Southeast	29.74	54.93
South	22.76	41.11
Brazil total	**143.47**	**272.20**

Source: Information provided by the Ministry of Mines and Energy of Brazil (2003).

(b) Argentina

(i) Solar energy

Total power installed in the form of photovoltaic solar power energy, as part of public utility services, was estimated at 5MW in 2002. Estimated energy produced by this installed capacity stood at around 7 Mwh/year.

(ii) Wind power

Implementation of Law 25019, has made it possible to develop installed capacity of about 26 MW as of 2003, with production standing at about 75 GWh/year, with the average use factor standing at slightly over 30%.

(iii) Hydroenergy

In terms of renewable energy sources, the government's strategy focuses primarily on the development of small hydropower plants (up to 15 MW), given that for Argentina this type of project represents an opportunity for the sustainable development of several geographical regions.

A catalogue of small hydroelectric uses is available, containing about 120 projects that offer a potential of about 200 MW, and updating and financially evaluating these projects has begun, especially in those cases where fossil fuels are replaced. These projects could ensure more efficient water and energy uses in irrigated areas, expanding possible regional uses and with these, job opportunities.

The installed potential in small hydroelectric plants is estimated at about 160 MW, with energy production reaching 620 Gwh and a use factor of 43%. The percentage of plants under 15 MW of installed power represent 0.8% of Argentina's electrical production for public use.

(iv) Geothermal energy

In terms of installed capacity, the geothermal energy plant at Copahue in the province of Neuquén, with an installed capacity of 600 Kw, is out of service. The provincial authorities are studying the possibilities of rehabilitating the plant and starting up other activities, such as its direct use to heat streets and its potential for developing opportunities in tourism.

Worth noting are recent activities initiated by the Organization of American States (OAS) on the potential for developing the Guaraní Aquifer using GEF financing, with an eye to studying the energy opportunities of this geothermal resource. Seventy one percent of the aquifer, which covers a total area of 1,200,000 km2, is located in Brazil, 19% in Argentina, 6% in Paraguay and 4% in Uruguay.

(c) Uruguay

The national energy matrix for renewable sources includes only fuelwood and biomass wastes (rice husks, sunflower seed husks, bagasse, black liquor). Within final energy consumption by source, in 2002 17.1% came from fuelwood and charcoal (376.2 ktoeb) and 1.8% from biomass wastes (39.1 ktoeb).

(i) Biomass

Biomass wastes are used in the industrial sector (39.1 ktoeb) and for some autogeneration of electricity (2.7 ktoeb). In terms of fuelwood, its final energy consumption in 2002 reached 374.7 ktoeb, with another 1.5 ktoeb for charcoal and 0.5 ktoeb for self-generation of electricity. In terms of final consumption of fuelwood, 301.7 ktoeb went to the residential sector, 3.1 ktoeb went to commercial and 69.9 ktoeb to industrial uses. Industrial consumption stood at 190 ktoeb in 1992 (due to fuel oil being replaced by fuelwood) and has fallen in recent years (reflecting low fuel prices). While the amount for the industrial sector is estimated annually based on industrial sector surveys, the amounts for residential and commercial sector use have been held constant at values obtained using surveys 20 years ago. Real values are probably lower, but the information is not available to check this.

(ii) Hydroenergy

Estimated hydroenergy potential stands at 1815 MW, with 1538 MW already installed (half of the 1890 MW from Salto Grande (Uruguay River) go to Uruguay and 593 MW come from three plants on the Negro River.

A study evaluating wind power potential in Uruguay, carried out by technicians from the renewable energies working group at the faculty of engineering, on the use of electricity from wind power found that it was technically feasible, but its economic feasibility was heavily influenced by how the energy produced would eventually be valued.

(d) Chile

In Chile, the framework in which the development of renewable energy takes place is classified by type of application.

Large scale: For applications of this type, such as for example electrical energy generation projects using renewables and connected to national electrical grids, a neutral regulatory and economic framework is applied that treats these the same as traditional energy sources, and therefore assumes that their use will depend on their competitiveness in terms of price and quality as compared to traditional energy sources. In the electrical generation sector, this approach has stimulated extensive hydroenergy development, while unconventional renewable energy sources are solely represented by a 2 MW wind park in Chile's XI Region.

Although the reasons behind the low use of RES in this type of application are the sum of a series of technological and/or economic factors, the main reason lies in the low private competitiveness that they still yield compared to traditional energy forms. This situation could change in the future given, among other factors, the need to constantly increase electrical supply (a phenomenon typical of a developing country experiencing sustained economic growth) and sustained progress in the technological development of RES in electrical generation encouraged by international policies for environmental protection. These elements could translate into a future scenario more favourable to investment in this kind of project.

Small scale: One of the policy objectives undertaken within rural electrification has been the option of using renewable energies in those small scale projects where the appropriate technology exists and they are competitive with traditional forms of electrical supply. Given this, unconventional renewable energy has found a space within the development of the national electrification programme (*Programa Nacional de Electrificación Rural*, PER), to such an extent that today several applications supply isolated rural communities with electricity through renewable energy use and specific projects to promote its use.

Renewable sources with the greatest potential impact within Chile's central grid (*Sistema Interconectado Central*, SIC) are geothermal energy, wind power and biomass. In the case of the northern grid (*Sistema Interconectado del Norte Grande*, SING) these are geothermal energy and wind power.

(i) Geothermal energy

The national geological and mining service (*Servicio Nacional de Geología y Minería*) maintains a list of thermally active areas in Chile, sites which could have geothermal potential for energy use. Despite estimates that geothermal energy is abundant throughout the country (several hundred usable MW), it has not been explored in depth or used to generate electric power and has solely been used to date for medicinal and tourism-related purposes.

This situation is expected to change given the decline in the costs of technology to turn geothermal energy into electric power that occurred during the 1990s, and the approval, after nine years of debate in congress, of Law Nº 19,657, which establishes that geothermal energy is a good belonging to the State, to be explored and exploited by those holding concessions granted by the State. This law defines the regulations governing private firms' participation in exploring for and exploiting this energy source. The Ministry of Mining is responsible for the application, control, and enforcement of the Law and its regulations. As of March 2004, this Ministry had granted a total of 12 concessions to explore for geothermal energy.

(ii) Wind power

In 1992, most of the information available on wind power to that date was brought together to evaluate the wind resource in places with reliable information (*Evaluación del potencial de energía eólica en Chile*, CORFO). At the same time, the National Energy Commission prepared a preliminary map of wind power potential for the Chiloé Archipelago, to evaluate this resource for use in rural areas not connected to the grid. This map has made it possible to develop some hybrid wind-diesel projects to supply more than 3,100 families on 32 islands within the archipelago.

To date, one of these projects is up and running in Chile: "Alto Baguales". It is a park with three wind generators (660 kW c/u) and a nominal combined capacity of 2 MW. Since November 2001, it has been connected to the Aysén electrical system, which serves 19,000 families in Chile's XI Region. The project's owner is the Aysén electrical company (*Empresa Eléctrica de Aysén*). It should be noted that it was the area's high potential for wind power that made this wind park possible.

(iii) Biomass

Reports from the University of Chile point to a potential of up to 300 MW based on using the wastes from forest plantations. Currently, biomass is used in Chile to produce electricity and add it to the grid, through electrical co-generation plants that use energy wastes (black liquor, bark), from other industrial processes such as pulp production.

Gas extracted from garbage dumps has made a significant contribution to the use of unconventional renewable energy. It is later processed and used commercially, as a component of city gas in Santiago and Valparaíso.

Another interesting application of biomass energy can be found in electricity generation in isolated rural areas. In 1999, the National Energy Commission and the United Nations Development Programme (UNDP) implemented a pilot project to generate electricity from gasifying biomass, as part of the rural electrification programme, to supply 31 families in Metahue, on Butachauques Island in the XI Region, with electric power.

Chapter III

CURRENT STATUS OF RENEWABLES IN THE REGION

1. Sustainability of the energy supply

(a) Background

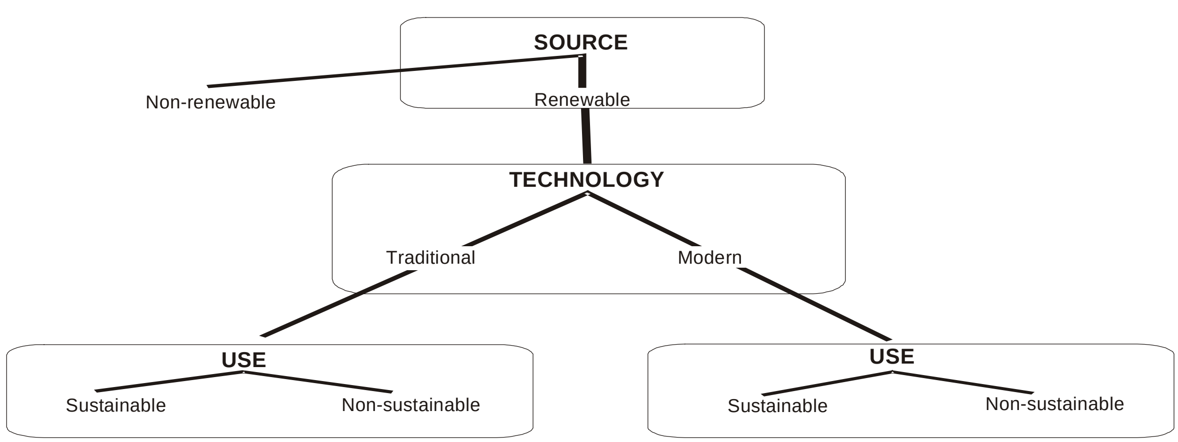
The energy statistics regularly published by international bodies today make no clear distinction between renewable and non-renewable energy. The best reference available to date at the world level is provided by the International Energy Agency (IEA) in its November 2002 study entitled “Renewables in Global Energy Supply”, which accurately describes the fossil fuel and nuclear energy categories. Hydroelectric energy, despite not being broken down into large and small generators, is also satisfactorily characterized. The data for geothermal, wind, solar and tidal power is also clear and easy to identify.

The main problem arises with the category which IEA refers to as “combustibles, renewable & waste, CRW”, which includes both the sustainable and non-sustainable portions of biomass.

The concepts of energy “renewability” and “sustainability” have been a subject of intense debate. In this document, renewability is defined as an attribute of the energy source, whereas sustainability is defined as an attribute of the way the source is used.[28.]

Although this paper does not distinguish between “modern” and “traditional” biomass, these terms are common and reflect both the technology used to extract wood energy and its end use. Thus, energy from biomass used to heat households or prepare food is deemed to be a traditional use of energy (or technology), while biomass used to generate electricity and steam and to produce biofuels is deemed to be a modern use.

The conceptual framework adopted by ECLAC can therefore be presented graphically as follows:



Source: G. Gallopín (2003).

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28 Drawn from: “Energy Sustainability in Latin America and the Caribbean: The Share of Renewable Sources”, M. Coviello, H. Altomonte (LC/L.1966), ECLAC.

The non-sustainable portion of biomass comes essentially from fuelwood derived from deforestation. Sustainable biomass includes animal, vegetable and urban waste, as well as fuelwood obtained in a sustainable manner.

The following are sustainable forms of fuelwood consumption:

- Collecting dry branches or prunings.
- Felling trees at a rate lower than their natural regeneration rate.
- Felling trees and then replanting the felled species.

In the Scandinavian countries, for example, all fuelwood burned for household consumption can be described as sustainable, which is certainly not the case in developing countries, particularly in Latin America, where fuelwood biomass accounts for a major proportion of total energy supply (TES). As mentioned below, in some Central American countries, fuelwood contributes more than 40% of TES.

(b) Methodology applied in the study

The Brasilia Platform sets out how to calculate the share of renewable sources as a proportion of total energy consumption. However, in this study, it has been decided to calculate renewable sources as a proportion of total energy supply, because if the share were calculated as a proportion of consumption, the methodology would in fact fail to:

- Include transformation losses, or at least it would make it very difficult to calculate losses for sources emanating from a prior transformation process (such as charcoal produced from fuelwood), or from more than one transformation process (such as electrical power produced using diesel or fuel oil).

- Take into account losses of nearly 50% of the fuelwood used in charcoal production centres.

- Take into account losses in the systems of electricity transmission and transportation of derivatives (multipurpose pipelines, trucks, etc.) and losses during electricity distribution or marketing of derivatives.

To calculate the shares of renewable sources, the preferred reference is the TOTAL ENERGY SUPPLY (TES), measured as:

TES = Total Primary Energy Suply + Total Secondary Energy Suply – Secondary Energy Production

This calculation method is more in keeping with the objectives set out in the Platform because:

(i) It takes into account the pressure on a country’s non-renewable resources, as well as the real share of renewable resources.

(ii) It incorporates the entire physical flow of the supply system.

(iii) It provides a more realistic method of quantifying the share for countries that import derivatives.

(iv) It takes into account the pressure on the resources of exporting countries, since the pressure exerted by exports on primary energy production is included in the equation for calculating total supply.

As with any form of energy accounting, there is a series of conventions to be followed. In order to complete the supply equation, where necessary, for countries trading electrical power, the trade balance and the corresponding supply variations would also need to be taken into account.

This study therefore adopts the convention that, if the balance is positive (where imports exceed exports), the source is deemed to cause no environmental impact on the importing country. In order to avoid fictitiously inflating the renewable energy shares in the country under study, this balance is added to the other sources. Otherwise the energy balance of each transformation centre and the origin of the electricity output would need to be analysed. For example, 100% of the electricity Paraguay exports is hydroelectric, so it would be appropriate to assign the balance to that source. In cases where thermal power is exported, the balance is assigned proportionately to each fuel used in power generation. This would avoid distorting the share of the different renewable and fossil sources.

(c) Proposed model

Since world energy statistics still make no distinction between the renewable and non-renewable portions of biomass, it is very difficult for a country to estimate how much of the energy available for supply and consumption can be truly considered renewable, particularly when considering the “sustainability” of the fuelwood biomass.

Brazil’s Ministry of Mines and Energy has put forward a model based on sectoral consumption figures in the National Energy Balance Sheet (BEN) and information from the Brazilian Institute of Geography and Statistics (IBGE). Based on these energy consumption statistics, “renewability fractions” were assigned to each fuelwood consumption sector or subsector for the year 2000. According to this method, the percentages of renewable fuelwood used in the various sectors of application in Brazil are as follows:

Percentages of fuelwood renewability

- Agriculture = 74%
- Charcoal = 71%
- Residential = 90%
- Industrial (paper) = 100%
- Industrial (ceramic and food) = 44.5%
- Industrial (other uses) = 0%

In this study, the percentages were initially used as reference points for separating “sustainable” from “non-sustainable” fuelwood biomass. The aim of this first approach was to focus discussion on a “minimum methodology” for the countries of Latin America, taking into account specific local conditions. In keeping with this methodology, the term biomass “fractions of sustainability” will be used from now on.

Conceptually speaking, this methodology is based on crossing data from:

- National balance sheets, based on data from ministries or secretaries of energy in different countries and information from the Latin American Energy Organization (OLADE).

- National sector information (data from national bodies responsible for keeping statistics for various sectors, such as forestry resources, industry and others).

The greater fuelwood’s share of the country’s energy supply, the more important it is to accurately calculate these “sustainability fractions” (in terms of “policy” analysis of the information). So, the figures for the Central American countries and Haiti, whose energy structures depend heavily on fuelwood, will be those more affected by how accurately “sustainable biomass” is calculated. Since this is basically a fuelwood issue, it could be referred to as “sustainable wood energy”.

For a rigorous analysis, Brazil’s proposed methodology should therefore be used, adapting it to the specific conditions of, and information available for, the different countries in the region. The methodology should be applied on the basis of data controls and confirmations from national energy balance sheets and sectoral information for each country. This process has been applied in the current study.

(d) Renewable energy categories

Based on the above-mentioned information and categories, this study proposes to quantify how much the various renewable energy categories contribute to the total energy supply (TES) of each country in the region. The renewable sources considered were:

- Hydroenergy (large- and small-scale) - 100% renewable.

- Geothermal - 100% renewable.

- Sustainable wood energy, the portion of sustainable fuelwood biomass used for residential, industrial, agricultural energy and charcoal - 100% renewable.

- Non-wood related sustainable bioenergy, such as agrofuels (from cane and other biomass residues) and municipal by-products (organic waste) - 100% renewable.

- Other renewable technologies (wind and solar) - 100% renewable.

After removing the renewable energy category, this should leave the non-sustainable biomass or wood energy portion, alongside hydrocarbons, nuclear and coal. This would be the fuelwood portion stemming from deforestation (expansion of the agricultural frontier, illegal logging), which is therefore non-sustainable.

2. Analysis of total energy supply in Latin America and its subregions

Based on the outline and concepts described above, data for the year 2002 was collected and organized for 26 Latin American and Caribbean countries. The disaggregated data for the 26 countries was analysed on both an individual and subregional basis. In this study, the countries have been grouped into subregions based on the available information from the SIEE (the OLADE Energy Economic Information System), as well as on the common geo-economic areas to which the countries belong. This led to the following subregions being defined:

- Central America: Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Panama.
- Caribbean Subregion 1: Suriname, Guyana, Barbados, Trinidad and Tobago, Jamaica, Grenada.
- Caribbean Subregion 2: Haiti, Cuba, Dominican Republic.
- Andean Community: Venezuela, Colombia, Ecuador, Peru, Bolivia.
- Expanded MERCOSUR: Brazil, Argentina, Paraguay, Uruguay, Chile.

In addition, Mexico and Brazil are analysed individually in some instances, on account of the size and special characteristics of their energy systems.

In the case of the Caribbean subregion, it is also useful to note two points: (a) all the countries analysed provide information to the OLADE Energy Economic Information System, which guarantees standardized information comparison; and (b) the subregion has been subdivided into two units of analysis (Caribbean subregions 1 and 2), based on differences in their natural resource wealth and on socioeconomic factors.

Initially the information was broken down into renewable and non-renewable sources, with particular reference to biomass "sustainability fractions", using the method proposed by Brazil. The result of this first calculation was then officially sent to the competent institutions in the countries, to elicit their comments and any numerical amendments based directly on national information.

Twelve countries officially replied to the ECLAC request: Chile, Mexico, Honduras, Uruguay, Paraguay, Peru, Cuba, El Salvador, Guatemala, Brazil, Bolivia and Argentina. The national data was revised and the biomass sustainability fractions recalculated based on the official information received directly from the countries.

The reason for analysing the share of renewable sources by subregion is to show the potential that each group of countries has, and to use this as a basis for viably increasing the share of renewable sources in national and regional energy structures.

This means that, in addition to the efforts individual countries can make to improve their use of renewable energy sources (RES), progress can also be made at regional and subregional levels through joint initiatives in areas such as: technology exchange; cooperation to assist isolated communities; integration of energy structures to achieve minimum targets; and the development of accounting methods and mechanisms for exchanging renewable energy certificates.

The subregions can use the Latin American Initiative as a guide to avoid penalizing countries whose natural conditions are less conducive to energy sustainability, but instead to promote a greater share of renewable sources at the regional and global levels.

The results of the study on the share of renewable sources in each subregion's TES are analysed below. Annex 1 shows the information for the individual countries.

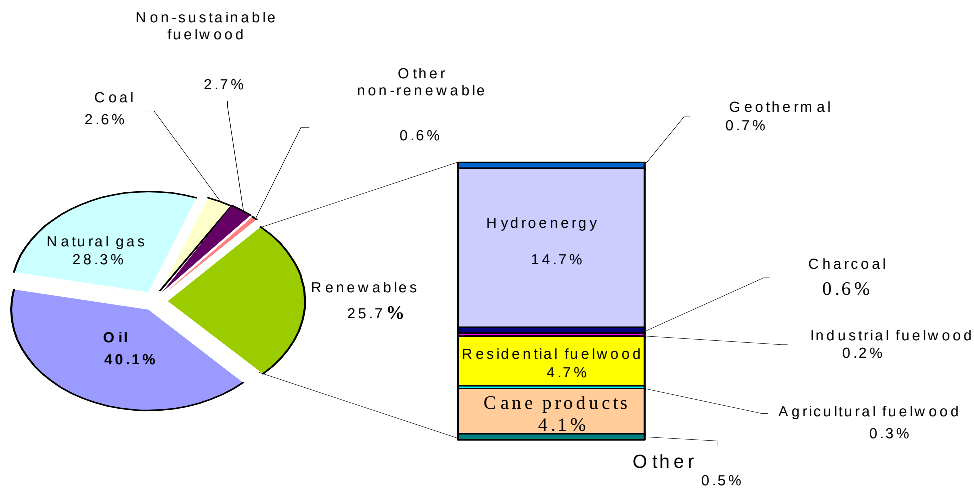
(a) Latin America and the Caribbean

The total energy supply composition of Latin America and the Caribbean (figure III.1) shows that the region enjoys a good balance of natural fossil and renewable resources. Oil reserves (around 122 billion barrels of oil) represent 11.51% of the world's total and are concentrated mainly in Venezuela (65%), Mexico (19%) and Brazil (7%). The average output is around 3,500 million barrels per year, yielding a reserve/production ratio of 35 years.

Natural gas has come to account for a growing share of total supply in recent years, rising to 28.3% by 2002. This is due to the development of natural gas reserves in the region, representing 5.3% of the world total, which are concentrated in Venezuela (52%), Mexico (14%), and Bolivia and Argentina (with almost 10% each).

Of the region's 237 GW of total capacity, 55.3% is hydroelectric, 42.2% thermoelectric and 1.9% nuclear (Mexico, Argentina and Brazil), while barely 0.6% comes from other non-conventional sources, chiefly geothermal power plants. There has been a marked increase in the ratio of hydroelectric capacity to installed thermoelectric capacity, from 1.46 in 1992 to 1.20 in 2002.

Figure III.1
LATIN AMERICA AND THE CARIBBEAN: 2002 ENERGY SUPPLY



Renewable sources contribute more than one quarter of the total energy supply (25.7%), the most important of which is hydroenergy with almost 15%, sustainable fuelwood with 5.8% and cane products with 4.1%. The remaining RES, such as other types of biomass (0.5%) and geothermal energy (0.7%), are negligible.

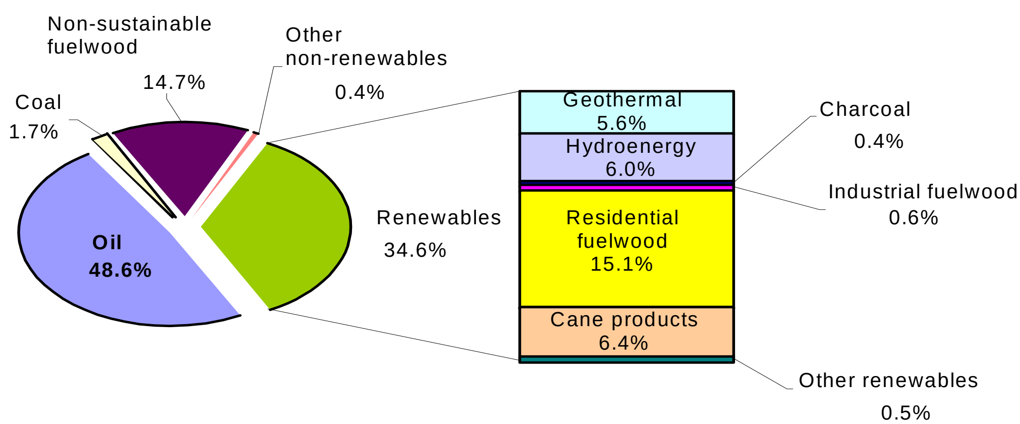
In spite of the wealth of resources available, there has been no notable development of geothermal energy. What is more, it would appear from the following subregional analysis, that the contributions from other technologies, such as solar and wind, are not properly taken into account.

(b) Central America

Oil accounts for almost 50% of TES, showing that total consumption is heavily dependent on imported hydrocarbons, which is especially important since Central American countries are net importers of hydrocarbons. Guatemala alone produces a small amount of oil, most of which is exported. In 2002, more than 30 millions of barrels of crude oil were imported, in addition to 65 millions of barrels/year of derivatives. The sectoral distribution of hydrocarbon consumption shows that 80.8% was used for industrial, transport and domestic end consumption, whilst the remaining 19.2% was used for electricity production.

In 2002, the Central American Isthmus had an installed capacity for electricity generation of 7,898 megawatts (MW), of which 3,897 MW (49.3%) was from thermal power plants, 3,523 MW from hydroelectric power stations (44.6%), 416 MW from geothermal power plants (5.3%) and 62 MW from wind power plants (0.8%). Renewable energies (hydroelectric, wind and geothermal) accounted for 57.4% of total production in 2002.[29]

Figure III.2
CENTRAL AMERICA: 2002 ENERGY SUPPLY



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[29] ECLAC, *Propuesta para una estrategia sustentable del subsector hidrocarburos en Centroamérica* (LC/MEX/L.582), Mexico, November 2003.

In the Central American subregion, renewables account for a major proportion of total energy supply, in excess of one third. The non-sustainable biomass portion is also particularly significant (14.7%), which is causing serious concern about the efficient and sustainable use of fuelwood in the countries of the region, particularly Guatemala.[30] This should encourage the proposal of projects and lines of research in this field to international cooperation partners.

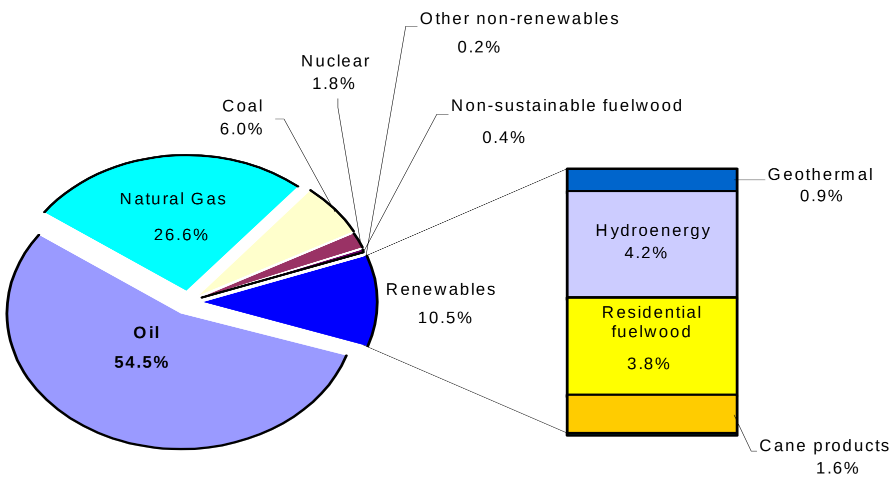
(c) Mexico

Hydrocarbons (oil and natural gas) play a predominant role in Mexico's energy supply, in excess of 80% of TES. Despite being one of the top 10 producers in the world, with an annual production of 3.3 million barrels, Mexico has to resort to importing natural gas to satisfy domestic demand.

In 2002, Mexico's installed capacity for generating electrical power was 43,534 MW, of which 2,200 MW was from autoproduction and co-generation. In the composition or structure of public generation capacity, thermoelectric power accounts for 69.2% and nuclear for 3.5%. The remaining 27.3% comprises hydroenergy (25%) and geothermal energy (2.2%), with a negligible amount of wind power.

Renewable sources as a whole make a very minor contribution to total energy supply, scarcely exceeding the 10% threshold proposed by the Brasilia Platform.

Figure III.3
MEXICO: 2002 ENERGY SUPPLY



In terms of renewable sources, there is a significant hydroenergy supply (4.2%), whilst the shares of geothermal energy (0.9%) and renewable non-fuelwood biomass (1.6% cane products) are negligible.

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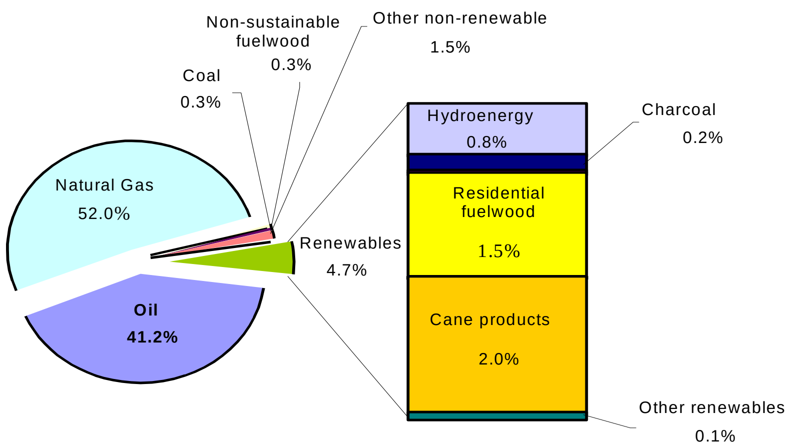
30 The Guatemalan authorities reported a non-sustainability index of 96% for fuelwood.

Renewable fuelwood (3.8%) plays a very small role, being used only for household consumption. In percentage terms, the share of new, renewable technologies, such as solar and wind, is virtually non-existent because efforts and programmes for successfully introducing these RES are still too recent.

(d) Caribbean subregion 1

Caribbean subregion 1 countries depend more heavily on hydrocarbons (93.2%) than any of the other subregions in Latin America and the Caribbean.

Figure III.4
CARIBBEAN SUBREGION 1: 2002 ENERGY SUPPLY
(Grenada, Jamaica, Trinidad and Tobago, Suriname, Guyana, Barbados)



Given their natural resource endowment, and the short time in which “commercial-scale” RES projects have been in operation, renewable energies account for an extremely small share of total energy supply (4.7%). In fact it is the lowest in all of Latin America and the Caribbean, and is below the 10% threshold proposed in the Brasilia Platform.

A notable feature of this subregion is that it is a net importer of hydrocarbons, with the exception of Trinidad and Tobago, which is a net exporter, and Barbados, which partially satisfies its own oil and gas requirements. In addition, electrical power generation is concentrated heavily in thermal power plants, leading to considerable pressure on imported fuels, mainly diesel and fuel oil. This would warrant stepping up the promotion of public policies for enhancing the sustainability of its energy system.

Cane products are the only renewable source of any importance, with 2% of TES.

(e) Caribbean subregion 2

Even though they belong to an area with similar socio-economic characteristics, the Caribbean subregion 2 countries (Cuba, Haiti and the Dominican Republic) differ markedly in terms of their energy trends and situations.

At one end of the scale there is Haiti, where the scarcity of natural sources of energy means that the energy sector has been unable to attract investment, forcing decision makers to adopt a demand management policy. What is more, Haiti's extremely damaged environment makes any effort to improve the quality of life very difficult. Many factors have contributed to this damage. However, the main one is still deforestation, which affects agriculture and hydroenergy production.

At the other end of the scale, the Dominican Republic, through a process of reform and capitalization of state corporations, has succeeded in channelling a large percentage of direct foreign investment into a few non-traditional sectors of the economy, including electricity generation and distribution. In 1999 alone, the country captured more than US$ 600 million in foreign capital, by capitalizing the Dominican Electricity Corporation (CDE). This process mainly favoured thermoelectric plants (steam turbine, gas turbine and diesel), which accounted for 82% of the country's installed capacity (2,464 MW) in 2002. Hydropower made up the remaining 18%, to the exclusion of any other form of renewable energy.

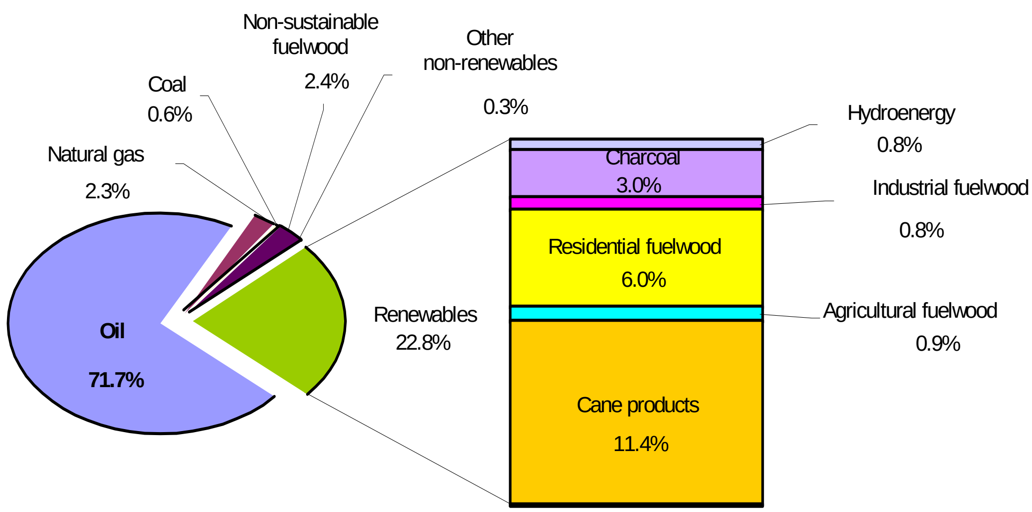
Cuba, which has continued to extend access to commercial energy sources (more than 95% of the population has electricity service), has succeeded in substantially reducing its imported energy coefficient by developing national sources (including renewables) and increasing energy efficiency.

An analysis of the total energy supply of Caribbean subregion 2 as a whole in 2002 reveals a very different situation to that of Caribbean subregion 1.

Even though the analysis confirms a high dependency on oil (more than 70%), in this case renewables account for quite a large share, exceeding one fifth of TES (22.5%).

The extremely small contribution from hydroenergy is due to the scarcity of endogenous natural resources. Cane products account for 50% of the total renewable portion and fuelwood and its derivatives, for 47%.

Figure III.5
CARIBBEAN SUBREGION 2: 2002 ENERGY SUPPLY
(Cuba, Dominican Republic, Haiti)



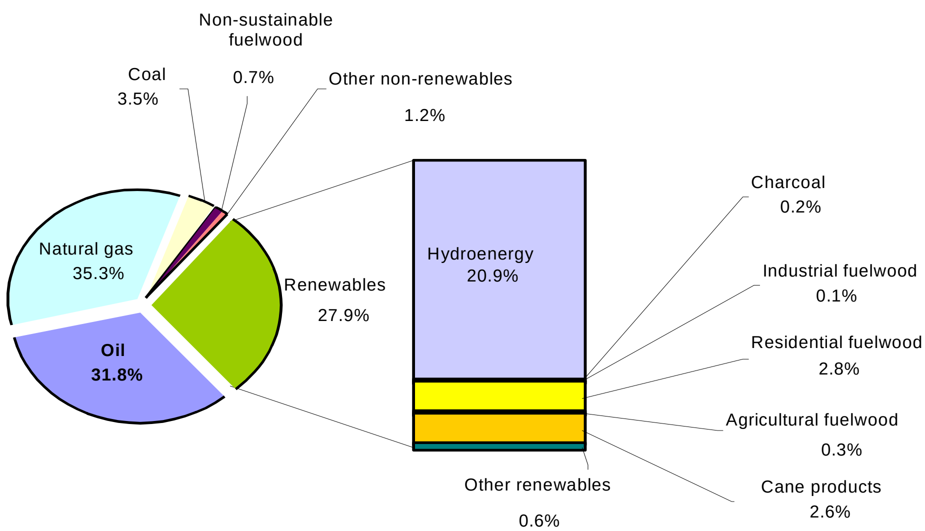
(f) Andean Community

The Andean region is considered to have abundant renewable energy resources, even though they are still not all known and have not yet been thoroughly evaluated.

The supply of renewable energies represents around 28% of TES, with hydroenergy, as one might expect, representing the largest proportion of renewable energies (20.8%). Interestingly, natural gas is the energy source most used in the Andean Community of Nations, mainly due to the supply from Venezuela, followed by oil and hydroelectricity.

Taking into account fuelwood renewability estimates, sustainable fuelwood has a 3.4% share of supply, followed by cane products with 2.6%, and other primaries with 0.6%. Note that no other type of modern energy vector appears in the RES calculation, although it is almost certainly used for certain applications, such as solar energy for agricultural drying or in solar systems. This is either because such modern energies are not included in the conventional energy balance sheets, or because they are significant and interesting, but as yet unexploited, potential sources. This might be the case with wind and geothermal energies, holding out hope in the future for more renewable energies in all the Andean countries. The energy figures under "other non-renewables" refer to flows of non-energy or exported products that have to be deducted from the total in order to keep the calculations consistent.

Figure III.6
ANDEAN COMMUNITY: 2002 ENERGY SUPPLY



(g) Expanded MERCOSUR

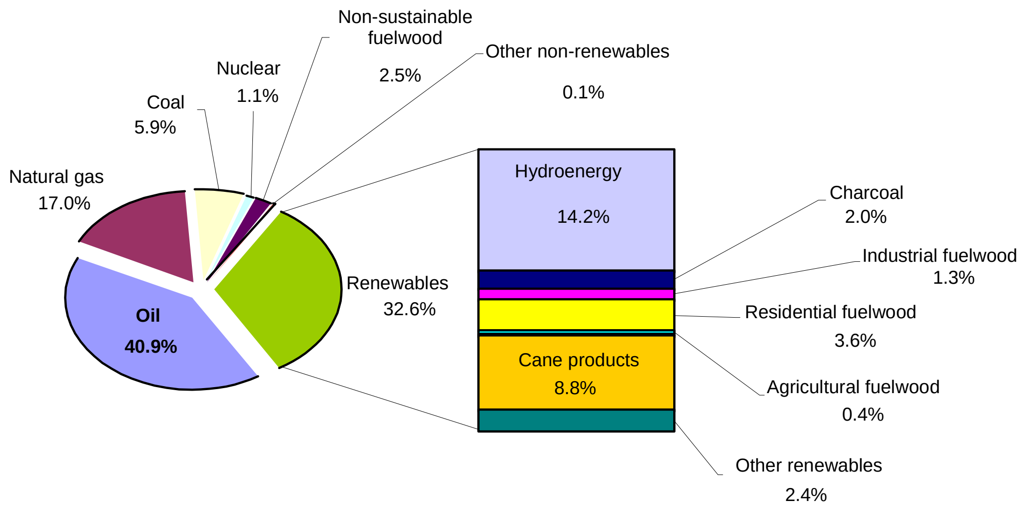
Even though they belong to an area with the same socio-economic characteristics, the MERCOSUR countries differ in terms of their energy trends and situations. This is immediately apparent from the figures on total energy supply in 2002 for the countries of this subregion (Chile, Uruguay, Paraguay, Argentina and Brazil) (see annex).

The overall TES analysis for this block of countries seems quite similar to that of the Andean Community.

It is similar in that: (i) there is a heavy dependency on fossil fuels (57.9%); (ii) renewable energies represent approximately one third of TES; and (iii) a significant proportion of hydroelectric power is generated by large power stations.

It also resembles the countries of the Andean Community of Nations as regards the prospects for modern renewable technologies. Geothermal, small and very small hydroelectric power stations are seen as highly promising, even though they have still not been fully exploited. Since wind energy is only used to a minor degree, it is still not included in the energy balance sheet.

Figure III.7
EXPANDED MERCOSUR: 2002 ENERGY SUPPLY



However, the expanded MERCOSUR subregion differs from the Andean Community of Nations in terms of its fossil resource endowment. In spite of the importance of hydrocarbons in TES, the expanded MERCOSUR subregion has a major trade balance deficit in hydrocarbons.

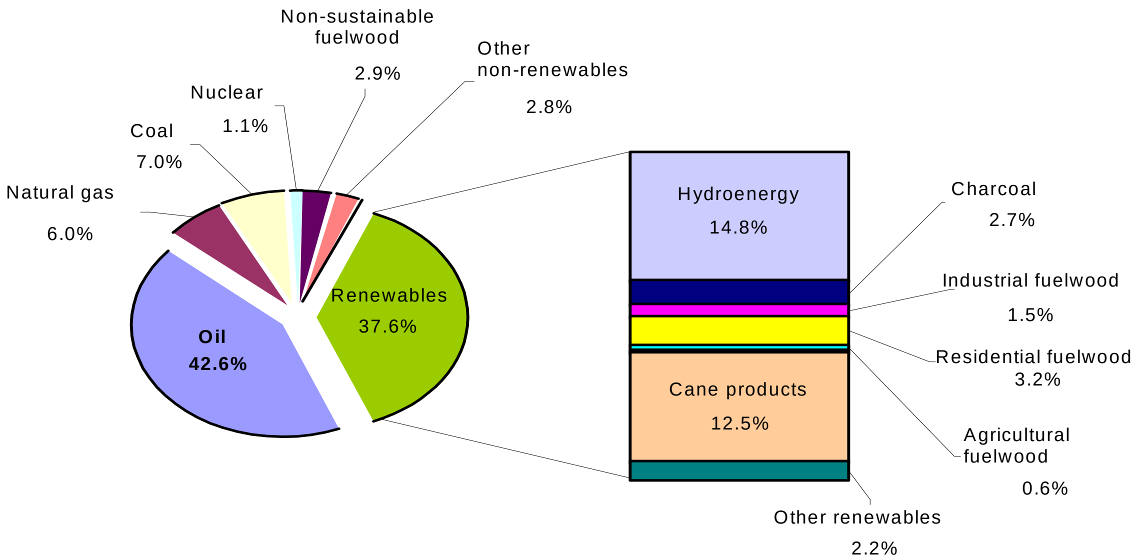
(h) Brazil

Energy use has increased rapidly in Brazil since 1975. Total energy use rose by nearly 200% between 1975 and 2000, while energy use per capita increased 60% and energy use per unit of GDP increased 22% (Geller et al., 2004). Rapid industrialization, including high growth in some energy-intensive industries like aluminium and steel, and increasing residential and commercial energy services, were the main contributing factors to this growing energy use and energy intensity (Tolmasquim et al., 1998).

Energy policy in Brazil in the last three decades has focused mainly on reducing the country's dependence on foreign energy supplies and stimulating the development of domestic energy sources. Natural gas and hydroelectricity increased steadily over the period; the oil share decreased in the first half of the 1980s, only to recover its market share after the oil counter-shock in 1986; coal increased solely on account of the metallurgical sector; while biomass was pushed up by modern sources used in the industrial sector, and down by fuelwood substitution, mainly in the household.

An analysis of Brazil's total energy supply in 2002 shows that the country continues to be highly dependent on oil (42.6%), with a small contribution from natural gas, coal and nuclear energy.

Figure III.8
BRAZIL: 2002 ENERGY SUPPLY



The share of all RES as a whole is significant, exceeding 37% of TES. There are two main renewable sources: hydroenergy (14.8%), with the largest share, and cane products, with a very sizeable percentage (12.5%).

The renewable fuelwood portion and charcoal also play an important role (together representing 8%). The share of other renewable technologies, such as wind and solar, is very low.

3. Comparative analysis of energy indices in the subregion

Table III.1 summarizes the energy and non-energy variables for developing the indices described below.

This information can be used to calculate national performance indices for the energy sector in 2002 relating directly to the role of renewable energies, as well as to take into account local and global environmental issues involving carbon dioxide emissions (CO_2).

Table III.1

LATIN AMERICA AND THE CARIBBEAN (26 COUNTRIES): DATA AND INDICATORS RELATED TO ENERGY SUPPLY AND CONSUMPTION

			TOTAL ENERGY SUPPLY – year 2002						ENERGY CONSUMPTION – year 2002						*BOE = Barrel Oil Equivalent*
	POP	**GNP**	**TES Ren**	**TES woodfuel**	**TES Second. Hydrocar.**	**TES Oil**	**TES Hydro**	**CO_2 from electricity**	**Per Capita Consum.**	**Woodfuel Consum.**	**Secondary Hydrocarb. Consumpt.**	**Total Consum.**	**Electricity Generation**	**T E S**	**Total CO_2**
	Populat. 2002 (thousand)	GNP 2002 (M US$, 1995)	Total Renewable Energy (kBOE)	Total Woodfuel (kBOE)	Secondary Hydrocar. - GLP, Keros, Diesel (kBOE)	Total oil supply (kBOE)	Total hydroenergy (kBOE)	Electric generation emissions (Gg CO2)	Per capita electric. consump. (MWh/hab)	Woodfuel consumpt. (kBOE)	Secondary hydrocarbons consumption (kBOE)	Total final consump. (kBOE)	Electric power production. (GWh)	Total energy supply (kBOE)	Total emissions (Gg CO2)
Argentina	37 944	257 000	48 451.49	4 360.36	-17 960	185 201.2	27 763.2	14 310.39	1.94	1 542.01	7 4621.7	290 041.8	84 430.27	422 450	111 837
Barbados	269		209.90	0.01	623	0.01	0.01	563.72	2.87	0.01	412.09	1 872.34	860	2 813	1 075.86
Bolivia	8 705	8 034	8 927.67	2 414.3	1 628	10 525.77	5 031.15	1 729.34	0.41	2 137.97	5 674.13	18 284.65	4 188.1	29 544	7 621.58
Brazil	175 084	752 600	517 069.78	152 204.24	40 456	580 570.2	203 575.16	16 338.45	1.77	103 689.29	303 206.5	1 168 403	344 559.25	1 373 979	304 516.9
Chile	15 589	81 900	39 152.66	30 928.8	8 361	75 642.74	14 368.78	10 585.35	0.81	27 931.26	46 142.09	144 491.5	43 676.54	188 023	50 334.56
Colombia	43 817	97 900	59 148.95	17 334.11	-3 181	106 423.5	26 251.13	5 787.87	1.49	15 420.49	33 049.01	163 725.6	45 248.55	214 966	54 549.96
Costa Rica	4 200	15 100	10 536.07	387.49	5 227	3 471.55	4 483.95	401.92	0.84	328.59	5988.02	17 604.73	7 477.23	22 780	5 653.47
Cuba	11 273	22 800	16 956.62	1 575.29	10 493	39 375.2	82.41	6 313.99	2.62	2 019.32	13 781.95	72 280.92	15 699.8	82 443	28 953.74
Ecuador	13 112	19 200	10 024.64	3 184.9	8 142	58 437.82	5 180.86	2 970.12	0.75	3 184.9	22 214.94	49 373.04	11 885.36	59 576	19 625.94
El Salvador	6 518	11 250	14 328.92	8 197.91	4 548	6 556.33	877.82	1 504.48	0.64	8 134.05	5 604.02	21 903.66	4 466.49	28 378	5 871.47
Grenada	94		36.68	38.4	314	0.01	0.01	79.13	1.37	32.68	130.94	453.02	153.3	544	214.26
Guatemala	11 995	18 100	8 894.24	23 317.47	8 584	4 546.95	1 307.44	3 130.75	0.47	23 190.36	9 971.06	48 419.19	6 191.1	55 445	10 693.12
Guyana	765		2 880.69	1 683.5	2 257.09	0.01	0.01	192.52	0.92	1 657.57	1 127.39	5 253.78	914	7 052	1 587.54
Haiti	8 668	3 100	9 204.73	10 376	3 058	0.01	404.6	201.34	0.03	7 055.68	2 669.9	12 580.21	469.68	15 195	1 687.09
Honduras	6 828	4 710	10 666.85	8 949.3	6 730	0.01	1 520.51	1 385.76	0.52	8 606.89	6 144.66	22 069.99	4 099.13	25 137	5 730.58
Jamaica	2 621		1 964.28	1 129.95	2 282	8 348.5	212.5	2 666.04	2.41	352.78	4 301.38	17 325.3	6 934.3	26 446	10 628.74
Mexico	101 847	473 000	108 977.09	44 107.48	24 368	547 306.8	43 663.15	98 185.32	1.57	44 107.48	191 382.92	684 663.5	203 362.52	1 035 381	345 611.9
Nicaragua	5 347	2 550	9 610.47	8 688.1	1 444	5 823.91	300.81	1 460.56	0.31	8 527.89	3 252.61	15 850.23	2 553.84	19289	3 819.24
Panama	2 942	9 500	6 676.81	4 412.94	3 617	10 167.25	2 108.49	1 094.88	1.41	4 344.66	6 291.85	18 853.06	5 380.36	23052	6 073.76
Paraguay	5 778	8 700	50 247.40	11 987.03	6 290	690.36	36 542.36	0.41	0.76	9 966.75	6 882.82	26 430.6	48 209.88	61037	3 759.3
Peru	26 749	60 800	30 250.02	12 761.44	6 897	54129	13 974.03	2 216.84	0.72	11 748.96	27 954.78	79 156.4	21 985.18	91104	25 428.04
Dominican Rep.	8 677	17 770	9 265.57	8 274.86	15 170	14 144.11	680.12	5 074.55	1.12	5 055.71	16 344.02	39 234.32	11 510	57777	17 992.68
Suriname	421		1 314.13	313.88	1 137	4 198.88	951.09	136.4	3.16	319.15	1 157.61	4 254.37	1 482.64	6762	2 325.11
Trinidad andTobago	1 306		613.34	0.01	-18 443	55 365.82	0.01	4 089.06	3.79	0	2 628.53	63 710.58	5 643.4	106271	24 152.43
Uruguay	3 385	19 000	9 183.55	2 692.02	1 850	9 249.17	6 633.52	22.66	1.82	2 699.96	5 906.47	16 212.71	9 605.98	18789	4 159.03
Venezuela	25 093	76 800	133 901.74	50.07	-118 156	353 719.6	133 774.95	22 775.75	2.48	20.6	49 099.77	246 279.3	87 405.48	463750	12 6341.9

Source: Based on the National Balance Sheets, the ECLAC Statistical Yearbook and SIEE figures from the Latin American Energy Organization (OLADE) for 2002.

(a) Energy Supply Renewability Index (RI)

The RI expresses the total supply of all renewable energies in relation to total energy supply. It indicates the relative share of a country's renewable sources used to supply domestic energy directly for final consumption sectors and as intermediate sources used in transformation centres.

Note that the target in the Latin American and Caribbean proposal, presented to the Sustainable Development Summit in Johannesburg, is for 10% of primary energy supply to come from renewable sources by the year 2010. A high index rate means that the country or subregion is over quota and therefore meets the target proposed in this initiative for the countries of Latin America.

Figure III.9
ENERGY RENEWABILITY INDEX (RI)
(Supply of renewables/total energy supply)

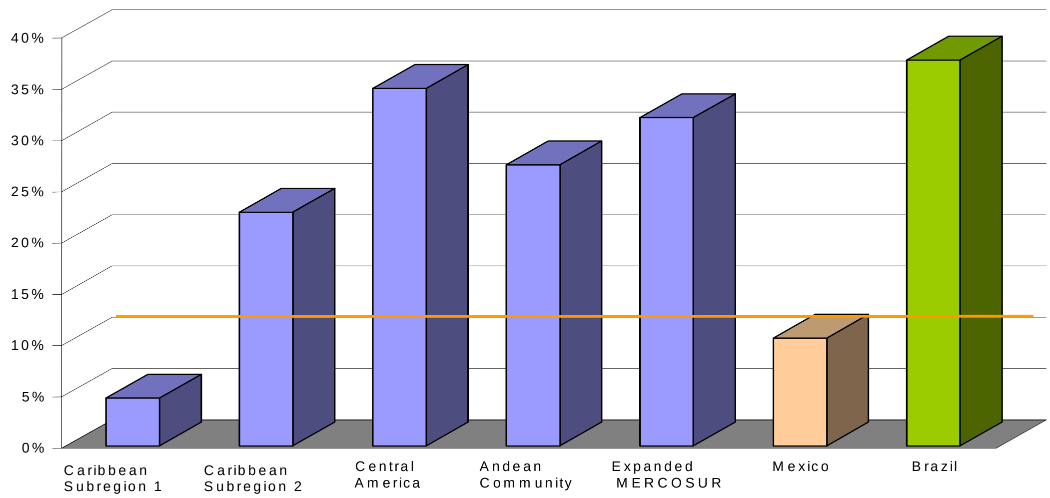


Figure III.9 shows that:

- Caribbean subregion 1 comes well below the 10% threshold, whereas Mexico exceeds the threshold by a mere half a percentage point. This means that the countries of Caribbean subregion 1 and Mexico need to make a major effort if they wish to meet, and then maintain, the target of a 10% share of renewables in TES.

- Those subregions which come within the 20% to 30% range (Caribbean subregion 2 and the Andean Community) need to take decisive action, both in policy terms and by promoting renewable projects, if they wish to maintain their current share of renewables in TES at a level well above the reference threshold.

(b) Per Capita Renewability Index (CRI)

The CRI expresses the energy supply from all renewable sources in relation to the population of a country or subregion (measured in thousands of barrels of oil equivalent per capita). A high index rate means that, qualitatively speaking, there is more per capita “commitment” to energy sustainability, and hence to energy from renewable sources, in that country or subregion.

If a country’s CRI is low and its population growth high, the country is at risk of failing to meet the 2010 target for the renewables share unless it strives to change the type of energy supplied for consumption (less fossil energy and more renewables). This index is also more important for the future since if the renewable energy growth rate is lower than population growth, there is a danger that the country will either fail to meet the target of 10% renewables in TPES, or fail to maintain it over the medium term.

Figure III.10
PER CAPITA RENEWABILITY INDEX (CRI)
(Total supply of renewables/population)

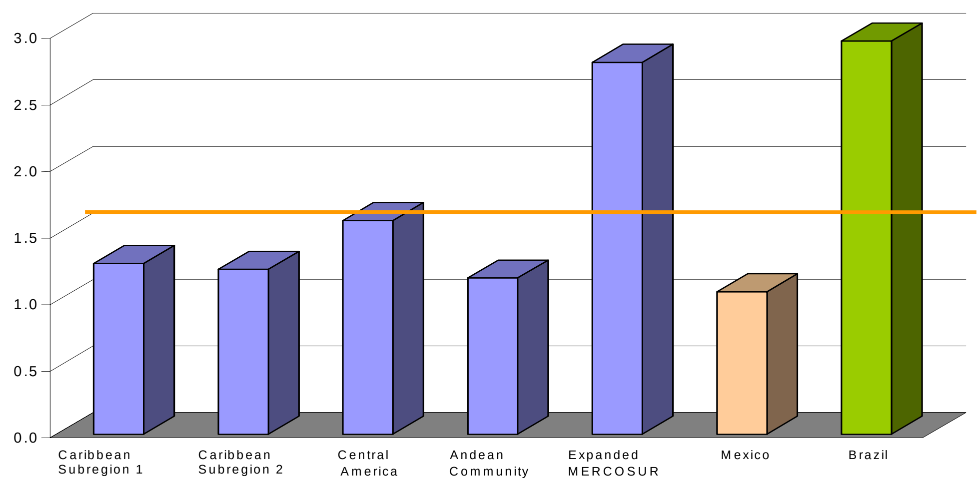


Figure III.10 shows that:

- The MERCOSUR countries (particularly Brazil) have the highest index rate. This is due mainly to their extensive supply of hydropower, and to technologies and renewable sources other than fuelwood.

- The subregions with the heaviest dependence on hydrocarbons (Caribbean subregion 1, Caribbean subregion 2 and Mexico) have low index rates. If this continues in the future, it could jeopardize the long-term aim of sustainable energy development.

(c) Residential Sustainability Index (RSI)

The RSI expresses fuelwood consumption in relation to the consumption of oil derivatives or secondary hydrocarbons (kerosene, diesel, liquefied petroleum gas) in the residential sector. It indicates the importance of fuelwood in meeting energy requirements, mainly for cooking, heating and boiling water.

A high RSI means not only that the country is heavily dependent on fuelwood to satisfy the needs of its population, but also that a specific study is required to analyse the “sustainable fraction” of the fuelwood used. The RSI also reflects certain social factors, such as the poverty level of the population at large and the access of poor urban and rural populations to better quality sources, which tend to cost more but are more efficient and productive and cut the time taken to gather fuel and indoor pollution levels.

Figure III.11
RESIDENTIAL SUSTAINABILITY INDEX (RSI)
(Fuelwood consumption/consumption of secondary hydrocarbons)

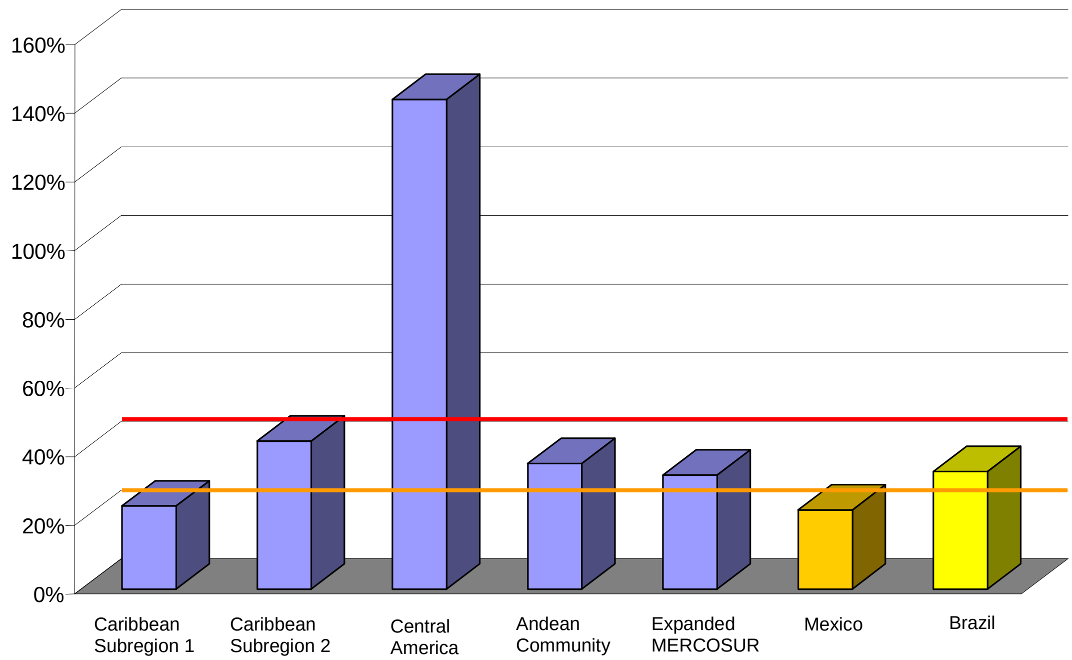


Figure III.11 shows that:

- The subregions most dependent on fossil fuels (Caribbean subregion 1 and Mexico) come under the 20% threshold and are heavy users of secondary hydrocarbons. This means that they should post a higher useful per capita energy consumption rate than the other subregions, and hence are better at satisfying basic energy needs.

- The subregions in the 20% to 40% range can be considered "balanced" and able to meet their energy requirements satisfactorily.

- The Central American subregion has a high RSI, which indicates over-dependence on fuelwood in both poor urban and rural areas. As a result, the basic energy needs of these areas are apparently not being met in terms of either access or quality.

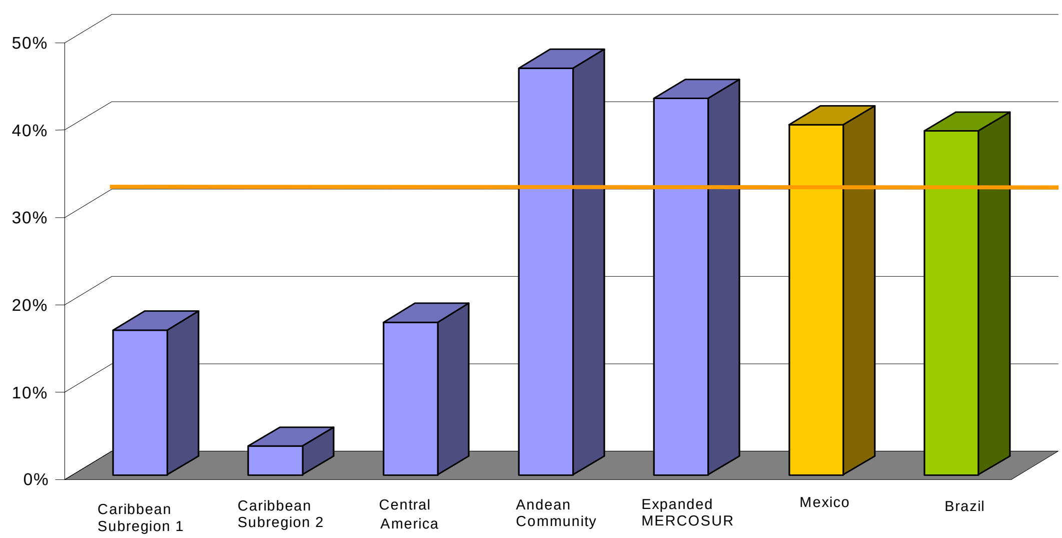
(d) Hydroenergy dependency over total renewable supply index (HDI):

The HDI expresses hydroenergy supply in relation to primary renewable energy supply, showing how important hydroenergy is in a country's "renewable" supply. Thus, a high index means that a country's share of renewable energy is linked more closely with meteorological factors than with technological factors.

Figure III.12

HYDROENERGY DEPENDENCY OVER TOTAL RENEWABLE SUPPLY INDEX (HDI)

(Hydroenergy supply/supply of all renewables)



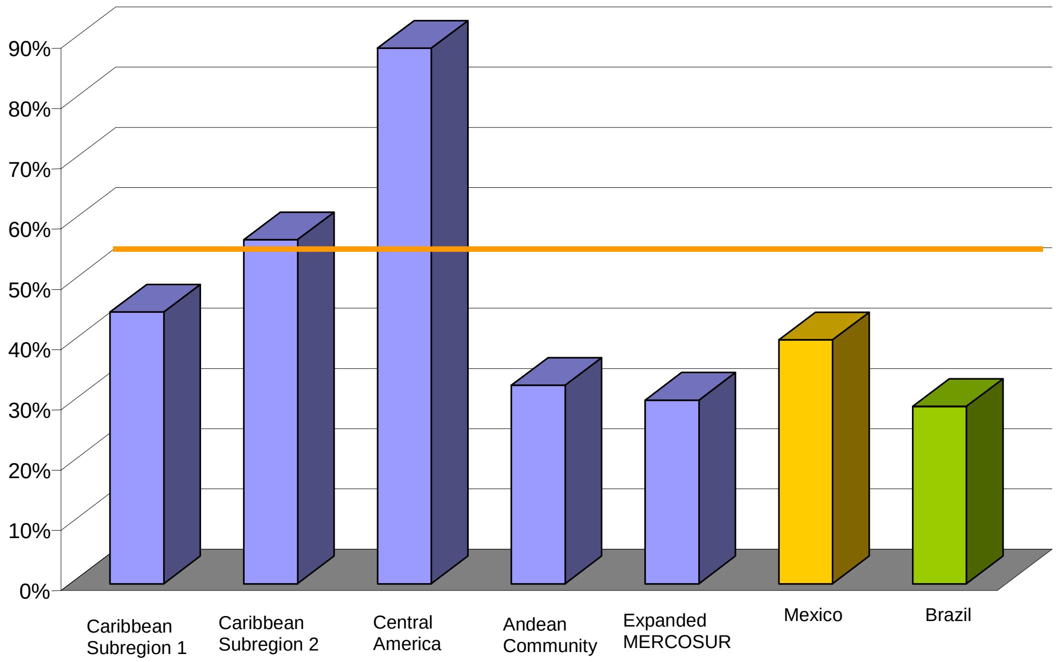
An analysis of figure III.12 shows that the MERCOSUR and Andean Community countries, and Mexico, have high index rates. Taking into account the basic factors discussed in the previous chapter, the Andean Community's high index rate is due to the fact that hydroenergy is its only source of renewable energy. However, in the case of MERCOSUR and Mexico, the development of other technologies, such as geothermal or solar, have not yet been included in the balance sheet. In the case of Brazil, the important role of biofuels —both biomass and biomass alcohol— are eclipsed by the major contribution of hydroenergy to total energy supply.

Central America and Caribbean subregions 1 and 2 have very low HDI index rates, since they have no significant hydroelectric resources.

(e) Forest energy dependency over the total renewable supply (FDI)

The FDI expresses total fuelwood supply in relation to total renewable primary energy supply. It indicates how important wood energy is in a country's renewable supply. A high index rate means that the country's share of renewable energy is linked to an intensive, and hence not always sustainable, use of forestry resources.

Figure III.13
FOREST ENERGY DEPENDENCY OVER THE TOTAL RENEWABLE SUPPLY (FDI)
(Fuelwood supply/supply of all renewables)



For a comprehensive and consistent analysis, the FDI should be compared (subregion by subregion) with the RSI. However, figure III.13 reveals that:

- The supply of renewable energy in the Caribbean subregion 2 countries, particularly those of Central America, is closely linked with the availability of fuelwood.

- Expanded MERCOSUR and the Andean Community have low index rates, since hydroenergy accounts for a high proportion of their total renewable sources.

(f) Oil dominance index (ODI)

The ODI expresses the primary energy supply of oil in relation to a country's total supply of renewable energies, indicating how important a role oil plays in energy supply compared with renewable energy availability and use.

Figure III.14
OIL DOMINANCE INDEX (ODI)
(Oil supply/supply of all renewables)

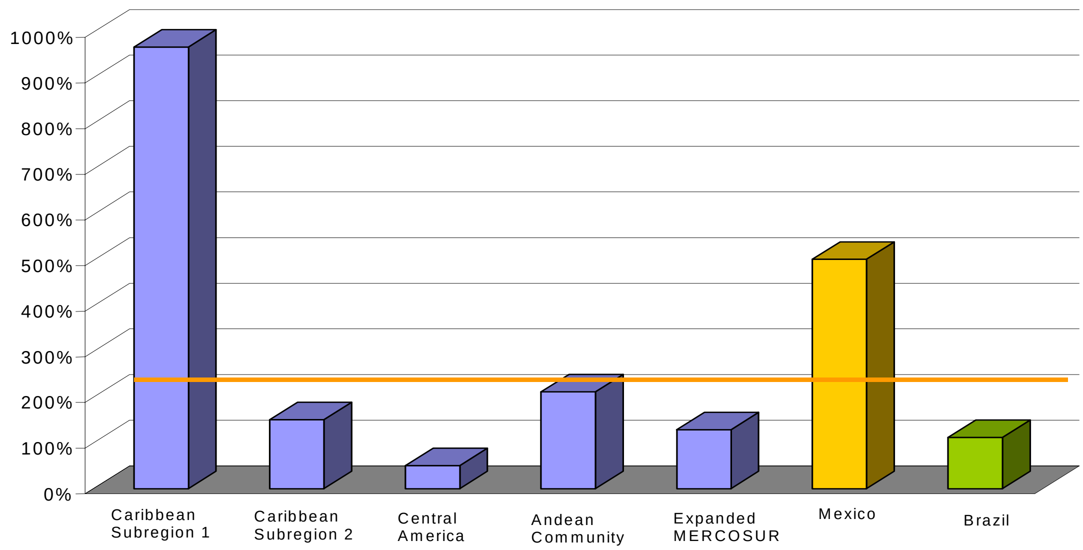


Figure III.14 shows that:

- As one might expect, the subregions with the heaviest dependence on fossil fuels (Caribbean subregion 1 and Mexico) have index rates in excess of 200%. The Andean subregion is close to that threshold, primarily due to Venezuela's important role in supplying oil.

- The Central American countries, which are net hydrocarbon importers, have very low index rates, given that their respective energy supplies are balanced with RES, based mainly on fuelwood.

(g) Polluting consumption index (PCI)

The PCI expresses total emissions of CO_2 (in thousands of metric tons) emitted into the atmosphere in relation to the country's total final consumption in that year (in thousands of barrels of oil equivalent). Thus, a high index means that the country's energy consumption is particularly polluting.

It is important to compare this index over a period of time (for example 1980-2002), in order to identify long-term trends.

If a country already had a high index in 2002 and this rate has been rising continually over the past 20 years, then it is a country with a high global environmental risk, since it is emitting an excessive and disproportionate amount of greenhouse gases per unit of consumption. For the sake of comparison, the index of three developed countries —the United States, Germany and Japan— were also included, since they are known to have high rates of polluting consumption in global terms.

Figure III.15
POLLUTING CONSUMPTION INDEX (PCI)
(Tons CO_2/TBOE)

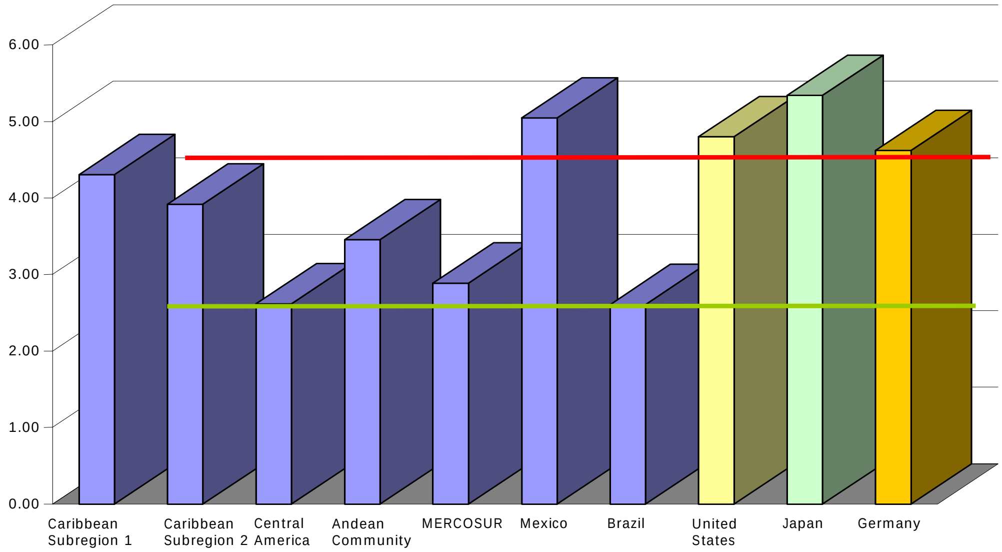


Figure III.15 shows that:

- The Central American countries have a low PCI due to their large share of renewables in total energy supply.

- Once again, the subregions with the heaviest dependency on hydrocarbons (Mexico, Caribbean subregions 1 and 2) are those which, in comparative terms, emit excessive amounts of greenhouse gases, thus contributing to global warming.

- Mexico's index is even comparable with the high values of the most industrialized countries (like the United States, Japan and Germany).

(h) Electric power generating pollution index (EPI)

The EPI is directly linked with a country's entire energy mix, and in particular the total hydrothermal power generation capacity used. In countries with no hydroelectric resources, clearly the EPI will be higher.

It expresses the quantity of CO_2 emitted (in thousands of metric tons) in the electricity generation process (per GWh). While it may seem to oversimplify the situation, it does indicate how polluting the production of each GWh of electricity is.

In qualitative terms, a high index means that, in addition to the simple technical/operating cost of generation, there is a high environmental cost to the country in producing that amount of GWh of electricity, both locally (direct and indirect pollution around power stations) and globally (emissions of substances that contribute to the greenhouse effect).

Figure III.16
ELECTRIC POWER GENERATING POLLUTION INDEX (EPI)
(Tons of CO_2 from electricity generation/GWh total electricity)

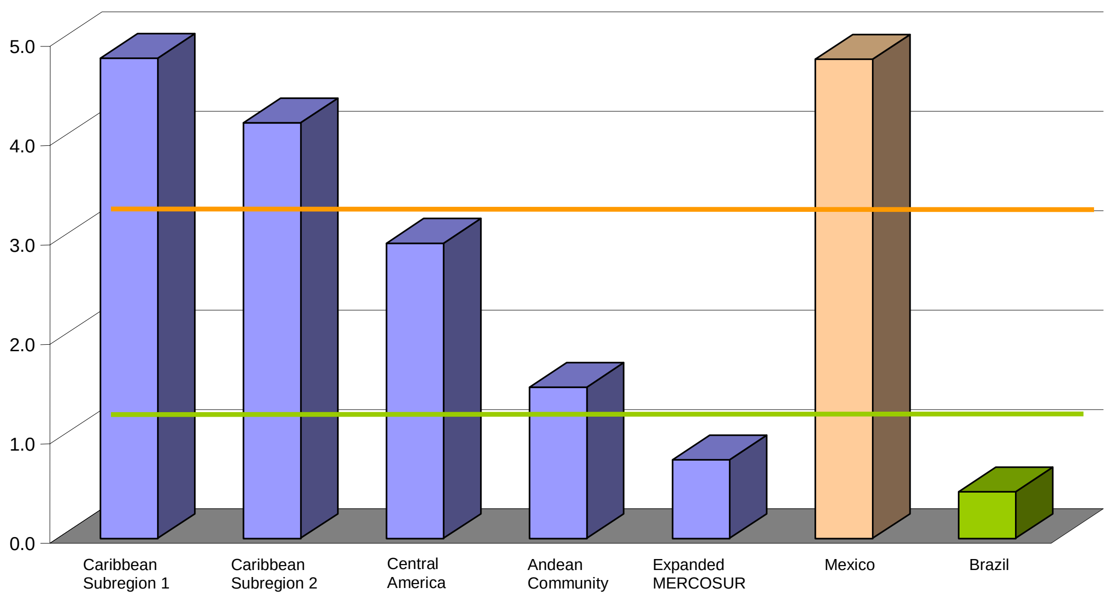


Figure III.16 shows that:

- The Andean and expanded MERCOSUR subregions are relatively "clean" countries in terms of electric power generating processes. The low index rate is due basically to their heavy reliance on hydroenergy (compared with the HDI index).

- Caribbean subregions 1 and 2, as well as Mexico, all show that their generation processes contribute significantly to pollution in terms of CO_2 emissions. In the case of Mexico, this is due to the predominant role of fossil fuels in electricity generation (almost 70% of its capacity is thermal). In the case of the Caribbean countries, it is of course linked with less efficient generation processes, with low yields from thermal generating stations.

Chapter IV

OBSTACLES, OPPORTUNITIES AND KEY ISSUES FOR THE PENETRATION OF RENEWABLE SOURCES

1. General obstacles

On the whole, the obstacles to implementation of energy efficiency and renewable energy measures are well documented and fall into five types: technical, regulatory, economic, financial and institutional.

Along with other measures, identifying specific obstacles should be the basis of public policies to promote renewable energies. This approach is considered to have produced successful policies in the industrialized countries, while in Latin America and other parts of the developing world there has been no such successful experience, at least on the scale of Europe. Being less developed economically, Latin American and Caribbean countries will probably require mechanisms to make good their shortcomings and create greater engagement with policies and programmes of this type, given that they usually have other priorities and that their economic and financial resources are limited. Economic, financial and political obstacles are normally regarded as the most serious impediments to the penetration of sustainable energy uses in the region (Altomonte, Coviello and Lutz, 2003).

In addition to these barriers to the development of renewable energy sources, most of which affect the likelihood of financing being obtained from commercial and development banks, this document also deals with a new type of obstacle created by social behaviour in the region.

(a) Technical obstacles

- **Inadequate information on renewable energy resources**. Lack of reliable data in general and the scarcity of wind, mini-hydroelectric and solar operations with time series going back enough years to make them statistically representative are an obstacle to project implementation. Uncertainty about the availability and quality of the "raw material" increases the financial risk of such projects, and thus the return on them and the interest rate demanded. In the case of some subregions, however, such as the Andean Community, knowledge about energy potential has increased greatly in the last decade, especially for solar and wind energy, as the most promising sites have been mapped and evaluated and studies into hydroelectric potential carried out.

- **There are no capacity payments for wind projects.** Because they are subject to fluctuations in wind speed, projects to generate electricity from wind are not regarded as "firm capacity" and thus only receive cheap energy payments which, at best, reflect the cost of the fuel saved but do not compensate for the depreciation of the capital invested. In the case of some Caribbean countries, the low yield of wind turbines in the past is another factor.

- **Resources "bottled up" owing to lack of transmission capacity.** Renewable energy resources are "tied" to the place where the resource is, which is generally not where consumption centres and thus electricity transmission grids are. The result is that many potential projects cannot be undertaken because they are dependent on local demand. The increasing difficulty of building electricity transmission grids is part of the problem.

- **Underdevelopment of supply chains and inadequate servicing of systems that use renewable energy in off-grid areas.** Instead of being brought on stream through a centralized grid, involving a marginal extension to a well established system operated by a single actor, electricity generated from renewable sources can only be brought to market with the coordinated involvement of a wide and varied range of economic actors, some of whom will not be available in the geographical area where the technology is being applied. To put it another way, it has been shown that for a project involving small installations (such as a photovoltaic cell) or relatively small ones (such as a microgrid centring on a small hydroelectric plant) to be established and survive, it is necessary to have a financing, spares and training network available. In fact, such networks have been created for other purposes, but they have not been taken advantage of in the vast majority of projects and programmes carried out in the region.

- **Limited technical capacity for project design and development.** Because renewable energy projects are new and demand is limited, particularly in the case of wind power, there is little expertise in project design and development in the region. This makes it necessary to engage technicians from other regions with much higher labour costs, which makes projects more cumbersome and costly.

- **Failure to recognize the voltage regulation and waste reduction role of renewables plants.** Because they are situated at the end of the grid or, in the case of hydroelectric plants, can operate as voltage regulators, generating plants that use renewable resources contribute to the soundness and reliability of the electricity system, but this is not taken account of in political decision-making.

- **Specific problems for utilization of biomass.** In some Caribbean countries: a) biomass electricity generating plants have tended to be small because of the dispersed nature of the feedstock. Also, many operating low-pressure boilers have low efficiencies in the range 10% to 18% taking into account losses from bagasse input to electricity output. As a result, biomass plants have relied on low or zero cost of the biomass fuel to be operated economically; b) biomass also has a problem of seasonality. A large quantity of biomass matter may be available in agricultural communities during the harvest season, such as after the processing of sugar cane, but may become scarce during the growing season. Adequate planning is required in order to effect a continuous supply of biomass, to assure a steady output from the power plant.

(b) Regulatory barriers

- **The excessively short terms of energy procurement contracts.** Renewable energy projects have high investment costs and low operating costs. For this reason they require high levels of financing and repayment terms of 8 to 20 years. In most electricity markets, however, there are no contracts with terms of over three years, and this is a serious impediment to obtaining conventional financing for projects that use renewable energies. It is important, then, for regulatory frameworks to address the issue of contract terms.

- **Constraints on installed renewable energy capacity.** Whether for technical reasons relating to system reliability (in the case of wind power), or for regulatory reasons relating to limitations on ownership or vertical disintegration, what are often arbitrary constraints have been placed on the maximum permissible capacity of electricity generating systems that use renewable energies, preventing these from being fully exploited.

(c) Economic and financial obstacles

- **Investment taxes.** In some countries, in Central America for example, the need to widen the tax base has resulted in taxes being levied on company investments. This puts renewable energy projects at a disadvantage as they are highly capital-intensive compared with conventional ones, which require less investment per unit of installed capacity.

- **Excessively high thresholds for direct contracts with energy users.** In most of the region's liberalized electricity markets, small and medium-sized projects capable of providing the electrical system with energy and capacity are faced with high costs of entry to wholesale markets. They also face another major barrier: the power threshold to qualify as a producer or large consumer.

- **The need to compete in the spot market.** If owing to the above it is only possible to sell in the spot market, then the cashflow of renewables projects becomes very uncertain, and this is a serious constraint on financing options.

- **High transaction costs for renewable energy projects.** Projects to use renewable energies have to cope with higher development costs than conventional projects based on fossil fuels. This is due, among other reasons, to (i) their land use characteristics; (ii) a lack of experience in evaluating projects of this type, which means that the evaluation terms are highly discretional; (iii) small-scale renewable energy projects have to go through all the same formalities as larger-scale ones, and (iv) environmental impact assessments are more complex than for projects using fossil fuels.

- **Environmental obstacles inherent in renewable sources that increase their costs**. Directly or indirectly, renewable sources can produce environmental damage. Direct damage is caused by a range of by-products, such as highly polluting black sludge, that are generated when ethanol is produced from sugar cane, and the severe disruption to migratory bird habits caused in some places by wind farms. As for indirect damage, the batteries used to store solar energy have a high lead content, so that once their useful life is over they have to be processed like any other highly toxic product.

- **High generating costs**. Given that cost allocation in the region's countries has not hitherto included externalities, the generating costs of renewables are notably higher than those for fossil fuels. Table IV.1 gives ranges for each technology, and it can be seen that despite the cost reductions achieved in the last 10 years, there are still large differences for some technologies (Coviello, 2003).

Table IV.1
GENERATING COSTS AND INVESTMENT REQUIREMENTS

Technology	Average generating cost (US$cents/kWh)		Average investment (US$/watt)	
Gas combined cycle	3.5	(3.0 - 4.0)	0.6	(0.4 - 0.8)
Coal	4.8	(4.0 - 5.5)	1.2	(1.0 - 1.3)
Nuclear	4.8	(2.4 - 7.2)	1.8	(1.6 - 2.2)
Wind	5.5	(3.0 - 8.0)	1.4	(0.8 - 2.0)
Biomass (25MW combust.)	6.5	(4.0 - 9.0)	2.0	(1.5 - 2.5)
Geothermal	6.5	(4.5 - 8.5)	1.5	(1.2 - 1.8)
Small hydroelectric	7.5	(5.0 - 10.0)	1.0	(0.8 - 1.2)
Photovoltaic	55.0	(30.0 - 80.0)	7.0	(6.0 - 8.0)

Source: M. Coviello, *Entorno internacional y oportunidades para el desarrollo de las fuentes renovables de energía en los países de América Latina y el Caribe*, Recursos Naturales e Infraestructura series, No. 63, ECLAC, September 2003.

(d) Institutional obstacles

- **The de facto predominance of energy policy over environmental policy.** As is the case almost everywhere in the world, energy policy in most of the region's countries is in practice given precedence over environmental policy. The main reason for this is that energy policy seeks to reduce costs so that economic development can take place in the short term, while environmental policy has to cover environmental liabilities and enhance environmental assets over a long-term horizon.

- **The inadequate institutional basis for renewables strategies**, whether in terms of the corporate framework or of the administrative structure and working teams. It has been shown that the countries with the best institutional conditions for the development of renewable energies have trained professionals and technical teams carrying out activities on a continuous basis within a clear strategic framework. This being so, the training of human resources to work in public-sector bodies is absolutely essential and should be given greater priority. Renewable energy training programmes for public-sector personnel should include not only concepts and technologies, but also the aspects of project identification, design and evaluation, management, financing and environmental issues.

- **Benefits not recognized by the energy authorities.** Many of the benefits of renewable energy projects stem from aspects unrelated to the price of the electricity generated, which is the main and immediate concern of the energy authorities. Benefits resulting from the exploitation of renewable energies such as the regulation, protection and reforestation of river basins, stewardship of forests, the development of poor regions, the creation of well paid jobs, the protection of the environment or the development of production chains are not part of the mandate of those who make the decisions or set the rules for participation in renewable energy projects, so that these benefits are not taken into account or are given insufficient weight in these decisions, most of which are taken by energy policy makers.

- **Tendency to give** extension **of the grid priority over exploitation of renewable energies.** It is a well known fact that for many places where there is currently no electricity supply, it is cheaper to provide electricity by creating stand-alone renewable energy systems than by extending the main grid. Those who take decisions about rural electrification continue to give priority to extending the grid, however, often because this is the capacity that actually exists, whereas the cheapest option might require the development of wholly new capacity.

- **There are limits on the concept of additionality which do not favour renewables use in wood and ethanol** projects**.** Projects to produce ethanol and improve the efficiency with which wood is used can be very effective in reducing greenhouse gas emissions. However, the scope of the criteria laid down for establishing the additionality required by the Kyoto Protocol mechanisms for participation in the greenhouse gas emissions reduction market means that the overall impact of these projects cannot be evaluated.

(e) Social obstacles

- **Rejection by society of hydroelectric projects involving dams.** Despite their inherent environmental value, hydroelectric generation installations involving dams are unpopular the length and breadth of Latin America and the Caribbean. This is due to the way projects of this type were implemented in the past, including non-negotiated expulsion of entire communities, chiefly indigenous ones, with little compensation, and the destruction of flora and fauna in zones adjacent to the dams, among other radical measures.

- **Heterogeneous payment capacity.** Given the current state of development of the region’s electricity industry, one of the most serious problems is that of social heterogeneity. In certain countries and areas, the tradition of subsidy, institutional weakness and politicized management of the needs of the population are a major barrier to the economic sustainability of projects using renewable energies for rural electrification. Large social disparities and the poverty in which much of the population lives mean that great care is needed in setting targeted subsidies. It is now well recognized, though, that rural electrification projects require local communities to appropriate the value of installations of this type, and this does not happen when they are free of charge for the community.

2. Successful experiences in the region

(a) Jamaica: the Wigton Wind Farm

In May 2004, the largest Caribbean wind farm will start to operate in Jamaica. The driving force behind the development of this wind farm is the Petroleum Corporation of Jamaica (PCJ). With 20.7 MW nominal generating capacity, the Wigton Wind Farm (WWF) will become the largest wind farm in the Caribbean so far and will boost Jamaica’s role as the leading country for wind power utilization in the Caribbean.

The Wigton Wind Farm (WWF) is located in Wigton in the Parish of Manchester. PCJ will operate the wind farm through a wholly owned subsidiary, Wigton Wind Farm Limited.

The start of operation will conclude a planning and negotiation process that began in 1995 and had to overcome several barriers like financing, land acquisition issues, stakeholder consultations, opposition of environmental groups, and negotiation of the power purchase agreement (PPA) among other issues. Activities since 1995 have included: measurement of wind resources at three alternative sites; site selection and agreement with landowners; optimization of site layout; stakeholder consultations;

power-generating licence from the Office of Utilities Regulation (OUR); environmental and building approval permits; subcontractor and supplier selection; project financing; detailed project planning and construction; project operation and maintenance.

The project is estimated to cost US$ 25 million and is funded by a grant from the Government of the Netherlands, PCJ equity and a bank loan from the National Commercial Bank of Jamaica. The grant from the Netherlands Government will be used in the acquisition of wind turbines from NEG Micon's subsidiary in Holland. The suppliers of the wind turbines will be NEG Micon (Netherlands) and they will provide a five-year warranty on the equipment after installation.

The technical and economic data for the project are summarized in box IV.1

Box IV.1

WIGTON WIND FARM, JAMAICA: KEY DATA

Key technical data

- 23 Turbines with 900 kW each (NEG Micon, Netherlands)
- Annual output is approx. 63 GWh
- Annual savings of oil imports of circa US$ 3.5 million
- 50,000 tons of CO_2 avoidance annually
- Spending on local subcontracts will exceed US$ 3 million during the construction period

Key economic data

- Investment (in millions of United States dollars)	
- Wind turbines including erection	16.5
- Civil engineering: roads and foundations	3.0
- Electrical engineering: site electrical system	2.7
- Electrical connection to Jamaican grid	1.8
Total	**24.0**

Financing scheme (in millions of United States dollars)	
(a) Dutch export grant at 35% of wind turbine costs and associated equipment exported from Holland	5.0
(b) Loan to the Wind Farm Company from NCB, backed by Jamaican Government guarantee	16.0
(c) Equity with availability guaranteed by PCJ, but which could come partially from other Jamaican bodies	3.5
Total	**24.5**

- **Benefits from CERs**

  Economic benefits deriving from the trading of certified emission reductions (CERs) have been estimated at some US$ 5/ton CO_2. CERs resulting from the project will be bought by the Corporación Andina de Fomento (CAF).

- **Benefits for Jamaica**

  It is expected that through the supply of wind power to the Jamaica Public Service Company (JPSCo) Jamaica will continue to diversify its energy mix and realize savings in its annual oil bill, while benefiting from an environmentally friendly source of energy.

- **Objectives**

  Primary objectives: (i) implementation of provisions of the Jamaica Energy Sector Policy regarding renewable energy resources; (ii) diversification of Jamaica's energy mix; (iii) utilization of indigenous (sustainable) energy resources, especially the abundance of wind on the island.

  Secondary objectives: (i) reductions in petroleum-based imports to improve the balance of trade; (ii) technology transfer to Jamaica which will eventually result in local expertise and experience with a large-scale wind energy project; (iii) emission reductions.

  Tertiary objectives: (i) environmentally friendly use of future mining land; (ii) tangible and affirmative action from Jamaica as a signatory of the United Nations Framework Convention on Climate Change (UNFCCC) in relation to greenhouse gas reductions; (iii) educational and research spin-off for the University of the West Indies (UWI), UTech and the SRC; (iv) "champion" project for the region in renewables in Jamaica and the entire Caribbean.

(b) Brazil: the Prodeem, Proinfa and Proalcohol programmes

- **Prodeem - Programa de Desenvolvimento Energético dos Estados e Municípios (Energy Development of States and Municipalities Programme).** This is the main government-sponsored off-grid electrification programme. It was established by Presidential Decree in December 1994. From 1996 to 2000, Prodeem provided 3 MW in photovoltaic (PV) panels to 3,050 villages and benefited 604,000 people for a total investment of 21 million reais, financed from National Treasury funds.

  In 2000, another 1,050 systems[31] were installed, the aim being to benefit an additional 104,000 people. The total budget was 60 million reais for 2001, when 1,086 systems were installed and another 3,000 community systems were put out to international tender, with a winning bid of 37 million reais for equipment and installation, plus operation and maintenance for three years.

  Prodeem is a centralized project which uses a top-down approach to identify sites and install equipment. One of the difficulties faced by the project is the identification of suitable locations for the equipment that has been purchased in bulk. Under this programme, central government-procured photovoltaic panels were allocated free of charge to municipalities upon demand. Rather than electrifying individual households, the programme focuses on schools, health facilities and other community installations.

[31] One PV system is basically composed of a photovoltaic panel plus a standard direct current battery.

- **Proinfa - Programa de Incentivo a Fontes Alternativas de Energia Elétrica (Incentive Programme for Alternative Electric Generation Sources).** Besides the ethanol programme for transport, renewable energy policies were recently introduced in the electricity sector as well. The Federal Government has introduced several measures to stimulate renewables, simplifying authorization processes and proposing marketing prices (“valores nominales”) adapted to the specific costs of each source targeted (wind, mini-hydroelectric and biomass).

  Federal Law 9648/98 extended diesel generating subsidies in the north of Brazil to renewable sources in isolated communities. In addition a bank, the Banco Nacional de Desenvolvimento Econômico e Social (BNDES), is structuring credits to finance electrical interconnection for rural households that already spend money on kerosene and batteries and could afford a 12 reais (around US$ 3.40) per month electricity bill. Law 10438/02 created the Proinfa programme, which provides incentives for wind, small hydroelectric and biomass thermoelectric plants, to be connected to the national grid.

  Following the mandatory cumulative purchase of 3,300 MW from renewables up to 2006, the second phase of Proinfa aims to achieve a share of 10% for alternative renewable electricity production sources in the next 20 years. Prices for the 15-year guaranteed electricity procurement contracts with Eletrobras (the federal electricity utility) will be based upon the weighted average cost of generation from natural gas thermoelectric plants and hydroelectric plants of over 30 MW. The energy prices paid will be equally distributed among final consumers. Producers will be inspected and issued with renewable energy certificates (Goldemberg and others, 2003b).

- **Proálcool - Programa Nacional do Álcool (National Alcohol Programme).** The Brazilian programme to produce ethanol from sugar cane was established during the 1970s as a consequence of the oil crises, and its aim was both to reduce oil imports and to solve the problem of sugar price fluctuations in the international market. The programme has strongly positive environmental, economic and social aspects, and has become the most important biomass energy programme in the world.

  In Brazil, ethanol is used in one of two ways: (a) as an octane enhancer in petrol in the form of 20% to 26% anhydrous ethanol and petrol, in a mixture called gasohol, or (b) in neat ethanol engines in the form of hydrated ethanol. The decision to use sugar cane to produce ethanol in addition to sugar was a political and economic one that involved government investments. It was taken in 1975, when the Federal Government of Brazil decided to encourage the production of alcohol to replace petrol with the idea of reducing petroleum imports, which were putting a great strain on the external trade balance. Besides, the programme had strongly positive environmental, economic and social aspects, and it has since become the most important biomass energy programme in the world.

  Ethanol consumption has been growing overall owing to its use alongside petrol as a fuel. The increase in the production and use of ethanol as a fuel was made possible by three government measures at the time the ethanol programme was launched: (a) the decision that the State-owned oil company, Petrobras, must purchase a guaranteed amount of ethanol; (b) the provision of economic incentives for agro-industrial enterprises willing to produce ethanol, including loans with low interest rates from 1980 to 1985; (c) an effort to make ethanol attractive to consumers by selling it at the pump for 59% of the price of petrol. This was possible because the government set the petrol price at that time.

Nowadays, there are no subsidies for ethanol production and its free-market price at the pump is generally 60% to 70% that of petrol, owing to significant reductions in production costs. These results show the economic competitiveness of ethanol when compared to petrol. Considering the higher consumption of net-ethanol cars, ethanol prices at the pump could be as much as 80% of petrol prices (Goldemberg, 2003). In fact, official policies have brought about a significant and successful change in the economy.

The Alcohol Programme in Brazil was made possible by high petrol prices and the special policies established to favour the programme. In the 1975-1989 period a total of US$ 4.92 billion was invested in the programme (Moreira and Goldemberg, 1999). However, savings on oil imports were much higher, totalling US$ 43.5 billion (in 2001 dollars) from 1975 to 2000 (Goldemberg and others, 2003b). The large amounts of ethanol produced allowed alcohol production costs to decrease substantially. The price paid to ethanol producers fell quickly after 1985, owing to technological progress and economics of scale, and the progress ratio of the technology shifted from 92% in 1980-1985 to 75% in 1985-2002 (the lower the progress ratio, the more prices have dropped, so that low progress ratios mean a technology has penetrated efficiently). In October 2002 dollars, ethanol progress ratios were 93% in 1980-1985 and 71% in 1985-2002.

It is well known that the strongest argument against renewables, in general, is their high cost and therefore their lack of competitiveness with conventional fuels —a common characteristic of new products and infant industries. This was indeed the case when commercial use of such renewable sources began, but as consumption of renewable energy increases, its cost falls, something that the Brazilian ethanol programme has demonstrated.

Today, social considerations are strong determinants of the Programme. Directly and indirectly, ethanol production now accounts for some 700,000 jobs in Brazil, with a relatively low index of seasonal work. There are also environmental considerations. All petrol used in Brazil is blended with anhydrous ethanol. In addition to the alcohol-petrol (gasohol) vehicles, there are 3.5 million running on pure hydrated ethanol in the country, 2.2 million of them in the São Paulo Metropolitan Region.

Lead content was initially reduced as the amount of alcohol in petrol increased, and it had been completely eliminated by 1991. Aromatic hydrocarbons were eliminated and sulphur and carbon monoxide significantly reduced. Alcohol hydrocarbon exhaust emissions are less toxic than those of petrol, with lower atmospheric reactivity. Acetaldehydes from alcohol use are less harmful to human health than aldehydes from petrol and diesel (CETESB, 2002).

With a greenhouse emissions balance of almost nil, in the 1975-2000 period ethanol use prevented emissions of about 110 million tons of carbon from petrol (MCT, 2002). In 2000 alone, the replacement of petrol by ethanol resulted in the avoidance of 9.2 million tons of carbon dioxide emissions (CENBIO, 2000; Goldemberg and others, 2003b).

(c) Peru: the Rural Electrification Plan and Fund

Surveys carried out by the Oficina Técnica de Energía of the Ministry of Energy and Mines when drawing up the 1999 Balance Nacional de Energía Útil (a national stocktaking of usable energy) revealed that flat solar panels were being used by households and businesses to heat water in eight Departments, particularly Lima-Callao. The Estudio Integral de Energía (comprehensive energy study) states that "in Peru, there has been real success with the installation of solar heating systems in the Arequipa area, where 10,092 such systems were counted (totalling some 6.7 MW of installed capacity). There are also more than 19,600 photovoltaic units installed".[32]

Other than solar heating systems and bagasse, non-traditional renewable sources are confined to rural areas and to isolated energy and electricity systems. While energy from wind farms, in areas with suitable wind conditions, is increasingly capable of supplying electricity to grid systems as well, rural electrification is nonetheless the main market for solar energy produced by photovoltaic cells, low-power wind energy and hydroelectricity.

The Rural Electrification Plans (Planes de Electrificación Rural) in Peru have sought to incorporate renewable sources, where economically viable, into extended distribution lines. Under the first Plan, running from 1993 to 2002, national coverage of electricity services increased from 57% to 75%, while the aim of the second Plan is to attain a figure of 91% by 2012.[33] Only 32.5% of rural families had electricity in 2000.

The Rural Electrification Plan has identified 336 projects for the next 10 years, including transmission lines, small electricity systems and small hydroelectric plants. Executing all these projects is expected to benefit over 4 million people for a total investment of US$ 960 million. Table IV.2 summarizes the goals and investments provided for by this Plan, whose renewable energy projects are expected to increase generating capacity by some 20 MW. Figure IV.1 gives unit costs calculated on the basis of these data, assuming that the projects referred to as "alternative sources" are actually photovoltaic units.

Table IV.2

INDICATORS FOR THE RURAL ELECTRIFICATION PLAN IN PERU, 2003-2012

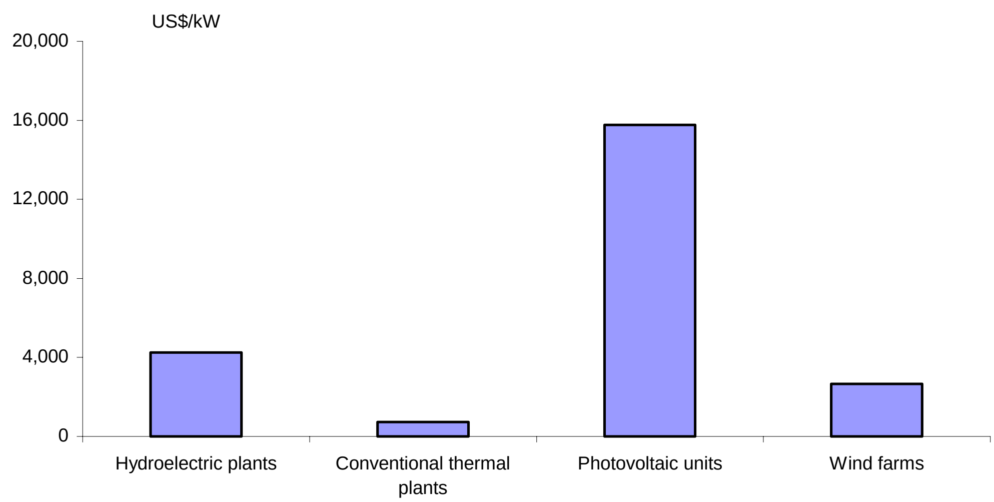
Physical targets	**Units**
1. Transmission lines (km)	2 928
2. Small electricity systems (km)	26 567
3. Hydroelectric plants (kW)	7 277
4. Thermal plants (kW)	4 680
5. Photovoltaic units (kW)	6 100
6. Wind farms (kW)	6 200
7. Population benefited (inhabitants)	4 227 057

Source: Ministry of Energy and Mines, Dirección Ejecutiva de Proyectos, Plan de Electrificación Rural 2003-2012.

32 H.G. Bustamante, *Energía Solar en Perú*, OTERG-MEM, Lima, 2000, cited in Instituto de Economía Energética IDEE/FB, *Estudio Integral de Energía del Perú*, report for the Ministry of Energy and Mines, Lima, November 2001.

33 Ministry of Energy and Mines, Dirección Ejecutiva de Proyectos, *Plan de Electrificación Rural (PER) 2003-2012*, Lima, 2003.

Figure IV.1
ESTIMATED UNIT COSTS OF RURAL ELECTRIFICATION CAPACITY IN PERU



Source: Ministry of Energy and Mines, Dirección Ejecutiva de Proyectos, Plan de Electrificación Rural 2003-2012, Ministerio de Energía y Minas del Perú (2003).

Interesting features of the Peruvian Rural Electrification Plan include its legal framework, financing mechanisms and project management and prioritization proposals. The general framework for the whole of Peru's rural electrification policy is Law No. 27744, the Ley de Electrificación Rural y de Zonas Aisladas y de Frontera (Rural and Isolated and Border Areas Electrification Act), enacted in May 2002.

In an attempt to solve the traditional problem of inadequate and irregular budgetary funding for the implementation of rural electrification projects, the Rural Electrification Act set up the Rural Electrification Fund (Fondo de Electrificación Rural, or FER). Its financing comes from different sources, chiefly: (a) 2% of the profits of electricity generation, transmission and distribution companies; (b) up to 25% of the proceeds from privatizing electricity companies and (c) transfers from the Public Treasury and from local and regional governments. In addition, it is provided that the resources allocated to the FER annually may be no less than 0.85% of the general national budget, or some US$ 85 million on average if the budgets of recent years are taken as the basis. The FER is thus a rotating fund, with the Dirección Ejecutiva de Proyectos (project implementation department) of the Ministry of Energy and Mines being authorized year by year to invest a minimum of 0.85% of the general budget in extending electricity services in Peru.

The methodology used to prioritize rural electrification projects takes three kinds of basic factors into account: technical ones (current state of the project, existing or planned electricity infrastructure, provincial electrification ratio), economic ones (current net social value and per capita investment level) and social ones (poverty index, geographical location). The provincial electrification ratio referred to measures the level of unmet electricity needs in the provinces, and higher priority is given to projects located in the regions whose electricity supply is most deficient.

Renewable sources are being developed well in Peru, especially when it comes to expansion of the electricity supply, while management mechanisms are quite structured and attention is being paid to economic rationality. Much remains to be done, of course, but the institutional and knowledge base in Peru indicates that the road ahead has been mapped out and current activities are going in the right direction.

(d) Argentina: the Renewable Energies in Rural Markets Project and its public-private financing system

Coordinated and directed by the Dirección Nacional de Promoción (national development office) of the Subsecretaría de Energía Eléctrica (Under-Secretariat for Electrical Energy), the Proyecto de Energías Renovables en Mercados Rurales (Permer), or Renewable Energies in Rural Markets Project, is designed to create better living conditions for inhabitants of rural areas not covered by conventional electricity supplies by using renewable energies to generate electricity. The project is being executed and administered by the Energy Secretariat through a coordination and execution unit created for the purpose. Activities are undertaken jointly with the participating province through a provincial implementation unit.

The policies and institutional reforms initiated by the Project include: (i) the establishment of an energy market in which the private sector (cooperatives or companies) can operate so that the service is sustainable, and (ii) development of an institutional framework for off-grid rural electrification.

(i) Beneficiaries and target population

The final beneficiaries of the project in the provinces where it is being implemented are some 54,000 low-income users, a figure which may rise to some 87,000 depending on the size of the provincial markets incorporated and their socio-economic characteristics. These users are supplied with electricity for lighting and basic communication. Apart from the material benefits, it is hoped that these populations will see a considerable improvement in their quality of life as they have the opportunity to enjoy a clean form of energy for final uses such as lighting, communications and small-scale production activities. A positive impact on education, productivity and social development is expected.

The project also benefits the private sector in the province and the country by enabling jobs to be created in the concession areas as people are employed to carry out maintenance and sustainable economic activities based on the concession and expansion of the renewable energy equipment market. Some of this equipment may be produced by local industries. The national government and provincial governments are benefited by successful electrification of scattered rural populations and public services in the countryside (schools, clinics, police stations).

(ii) Project financing

Estimated financing for Permer is some US$ 58.2 million, which makes it one of the largest-scale projects of this type in the world. Of this total, some 52% will be provided by the Energy Secretariat out of a World Bank loan of US$ 30 million, 17% will be covered by a Global Environment Fund (GEF) donation of US$ 10 million, 5% will come from the Ministry of Education for the electrification of rural schools, 9% will come from provincial funds (chiefly the National Energy Fund) and the other 17% will be provided by the private sector, i.e., franchisees and users.

Investment is financed differently from sector to sector. In the case of residential systems, for example, it breaks down as follows:

- The national contribution, about 62% of which comes from the World Bank loan and GEF donation. Specifically, since the second amendment of April 2003, the project provides US$ 4.9 per watt peak installed with IBRD financing plus a variable set sum per unit installed from the GEF donation.

- User payments for connection, representing about 2% of the subtotal.

- The contribution from the province through electricity funds (FEDEI-FCT): 9%.

- The other 27% will be financed by the franchisee over the first management period (15 years). This sum, along with operating and maintenance costs, will be recovered from monthly charges. Tariffs will be covered partly by user payments, the rest being contributed by the province through the Fondo de Compensaciones Regionales de Tarifas (FCT) or Regional Tariff Compensation Fund, or through other funds that the province has available for user subsidies to make up the full tariff stipulated in the tariff table.

(iii) Results during 2003 and 2004

In January 2003 the World Bank suspended payments. When the situation normalized, the Project began a gradual but firm recovery.

- After a tendering process, contracts were awarded for the provision of the solar panels and installation materials required for 750 household solar generating systems of 100 watts peak apiece in the Province of Jujuy, 39 photovoltaic units for 35 schools in the Province of Tucumán, and the provision and installation of solar panels and interior fittings in 157 schools in the Province of Salta.

- The provision of solar equipment for 165 schools in the Province of Santiago del Estero is ready to be put out to tender.

- Electrification of 33 schools in the Province of Río Negro is ready to go to tender, having been postponed owing to a lack of complementary financing from the Ministry of Education. The Province of La Rioja has also stated its intention of electrifying 148 schools.

- The Proyecto Piloto Eólico (Wind Pilot Project) has begun to be implemented in the Province of Chubut. The first stage is now complete with the submission of a report by the Centro Regional de Energía Eólica (Regional Centre for Wind Energy), financed by Permer. As a result of this first stage, tenders have been drawn up for 105 individual wind generators of 300 W and 600 W to be installed in the villages of Pocitos de Quichaura and Costa de Ñorquinco and in protected areas of the province.

- A supplement to the agreement with the Ministry of Education has been signed, extending its duration for another two years, and the third amendment to the agreement with the World Bank has been signed so that financing to schools can be increased to 80% of the total, the idea being that by combining the resources of Permer and the Ministry of Education, which will be providing the other 20%, it should be possible to electrify all the schools in the country by the end of 2004. Progress has been made in discussions with the Province of Córdoba to electrify the last 108 schools still without supply in the province.

(e) Costa Rica: wind generators

Since 1996, when the first wind farm in Costa Rica began operating, the country has led Latin America in its capacity to generate electricity from wind. With 62.3 MW installed in four plants (three in the private sector and one operated by the Instituto Costarricense de Electricidad, or ICE), and with output of over 180 GWh a year, Costa Rica shows how successfully renewable sources can be exploited in the region.

Wind prospecting activities were begun in the early 1980s by the ICE, with European support. Around the mid-1990s, a range of factors, including a drought in particular, induced the Government of Costa Rica to proceed with Law 7200 which creates the opportunity for the private-sector to become involved in generating electricity from renewable energies, and creates incentives (tax deductions for investments) for installations employing them. One very important aspect of these developments, however, is that the plants were built and operate without incentives of any kind, largely because the country has very good wind resources.

Electrification has also gone well in Costa Rica. The country has now attained an electrification index of 95% and the country's electricity demand is covered almost entirely from renewable energy sources. There is a programme to reach 100% electricity cover in the medium term, with plans for renewables to be used in isolated communities where connection to the main grid is not viable.

(f) Cuba: electrification of rural schools using solar systems

In 2000, the Cuban Government directly financed a photovoltaic panel programme to supply electricity to rural schools that lacked it. In less than a year, solar systems were installed in 1,994 schools, benefiting 34,000 children in rural areas.

Each system comprises a 165 watt solar unit, a 20 amp controller, a 250 watt inverter and a 220 amp-hour battery bank. Three of the systems include small wind generators. This system can be used to operate two 15 watt direct current bulbs, an alternating current television and a video player for educational programmes, for five hours a day. If the video player is not used, the usage time for the rest of the equipment rises to eight hours. The average cost of each solar unit was US$ 1,480.

This project was executed by an NGO, Cubasolar, and by the installation company Ecosol Solar. It involved the training of teams in each of the provinces, composed of university professors, students, schoolteachers and other volunteers. In all 25 teams participated, installing the units and training local staff in system maintenance. Follow-up support is being provided by Ecosol, which sends a maintenance technician to each school every 90 days. Ecosol also held a maintenance workshop in each province.

In June 2001, Cubasolar was elected to the United Nations Environment Programme (UNEP) Global 500 Roll of Honour for this rural school electrification programme. The Cuban Government subsequently launched a programme to install a computer in every school, for which purpose an additional panel is being added.

(g) Mexico: the Programme of Renewable Energy for Agriculture

In Mexico, there are three programmes of considerable size that have made use of solar energy from photovoltaic cells. The first, in the 1970s, involved the creation of a system of so-called *telesecundarias* or "tele-secondary schools", consisting of classrooms in rural areas where teaching was conducted with the help of a programme broadcast to television sets powered by electricity from photoelectric cells. This programme used cells manufactured in Mexico by the Centro de Investigación y Estudios Avanzados (Centre for Advanced Studies and Research, or Cinvestav), so that the programme did not result in the development of a market for this type of technology. The purpose of the second programme, implemented in the late 1980s, was to electrify rural dwellings and over 40,000 systems were installed. Most of the equipment broke down, however, as the programme strategy did not include any repair and maintenance component, so the programme cannot be regarded as a success.

The third programme, called the Programa de Energía Renovable para la Agricultura (Programme of Renewable Energy for Agriculture) has been successful. Its background is in the work carried out by Laboratorios Sandía with sponsorship from the United States Department of Energy (USDOE) in the early 1990s. At that stage, a certain amount of equipment was installed for agricultural applications (water pumping and refrigeration to conserve foodstuffs) in rural areas not connected to the electricity grid, most of them in Chihuahua, a state in the north of Mexico. In 1994, the success of the first pilot stage led to the United States Agency for International Development (USAID) and the Fideicomiso de Riesgo Compartido (Firco) becoming involved, as a result of which it was expanded and some 200 units were installed specifically for water pumping purposes.

The success of the programme can be gauged from a number of considerations: (i) the evaluations carried out show that it has created an ever-growing market for products and services, with users of the equipment expressing great satisfaction with it (it scores over 82% for reliability and performance); (ii) the number of providers has been growing; (iii) equipment has been installed without financial support from the programme, and (iv) the price of the systems has been falling.

Furthermore, while the programme has included a partial subsidy for equipment purchases, financing mechanisms have been developed to pay for the unsubsidized part. The success of the programme is also reflected in its current expansion, as it is being implemented on a larger scale with support from the World Bank Global Environment Facility (GEF). The aim is to invest US$ 35 million in installing 1,152 units for use in pumping water and chilling agricultural produce. Its main focus is on removing market barriers through supplier development and it includes mechanisms for financing through suppliers, training for users and suppliers, technical standards for equipment and systems, and product and supplier certification.

Seen as a process that began with the first trial installations in the early 1990s, the programme owes its success to a number of key elements in its strategy:

- Focus on productive activities. Unlike previous programmes, which focused on bringing highly subsidized electricity to communities but did not identify any productive use for it, this programme has concentrated since the outset on supporting measures that increase production activities (and thus incomes) in the community. In turn, these incomes enable users to recover investment costs and pay back any financing taken out.

- Construction of local alliances and capabilities. This being a programme that originally relied on foreign technology and technicians, the fact that technicians from the country and the region where the systems were installed were involved from the outset through alliances with a variety of local individuals and institutions meant that the cost of installing and operating the systems was progressively reduced, while companies specializing in these activities were enabled to develop.

- Spreading of costs and risks. First at the intergovernmental level, where programme costs were shared, and then at the user-government level, where individual project costs were shared, the fact that the programme was not free but involved sharing of risks and rewards meant greater commitment all round, particularly from final users.

- A strong technical assistance component. To create confidence in the technology and provide certainty for those involved, the programme has had a strong technical assistance component to ensure that the problems which naturally arise in the course of any technology adaptation process are dealt with.

- Monitoring. Alongside the above, the programme includes ongoing monitoring of different technical and other parameters, particularly those related to technology uptake.

3. The international market for carbon credits

Latin America has become the main world supplier of emission credit projects involving clean development mechanism (CDM) type instruments, owing among other factors to the institutional support given by the region's governments to implementation of the Kyoto Protocol, the fact that CDM project approval systems are operating favourably, and the presence of local experts in CDM promotion institutions.

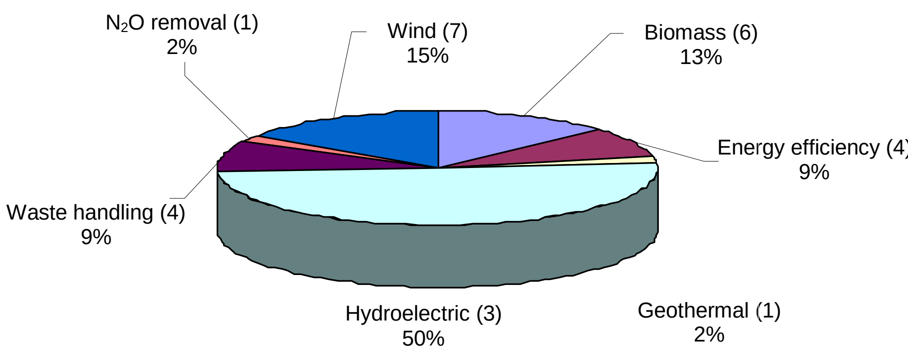
According to information from Prototype Carbon Fund (PCF) portfolios and the specialized agency of the Dutch Government (Senter), Latin American projects account for 29% and 48%, respectively, of the total amounts negotiated in their global portfolios, making it far and away the most important region for both funds. Of a total of 46 Latin American projects, 50% are hydroelectric, 15% wind power, 13% biomass, 9% solid waste handling, 9% energy efficiency, 1% geothermal and 1% nitrous oxide (N_20) removal (figure IV.2).

The lack of carbon sequestration projects, except for two cases in Brazil, is due to the fact that the rules for such projects have not yet been fully defined and investment funds are therefore unwilling to risk investing in them.

The relatively high share of hydroelectric projects in the CDM project portfolio of the region is due, among other reasons, to the fact that these projects generally save large amounts of emissions, so that selling them brings in significant revenue and the transaction costs of the CDM operation are covered. Also, it is fairly simple to calculate the quantity of emissions they would avoid, and to establish the necessary monitoring and verification plan. There are criteria, laid down mainly by the World Bank, for establishing the additionality of these projects and in general of electricity generation projects connected to national grids, like most wind projects.

Figure IV.2

THE LATIN AMERICAN AND CARIBBEAN CARBON MARKET: NUMBER OF PROJECTS BY TECHNOLOGY TYPE



Source: L. Eguren, *El mercado de carbono en América Latina y el Caribe: Balance y perspectivas*, ECLAC, August 2003.

Projects to generate energy from biomass have a large share because of the opportunities for replacing fossil fuels, for example in projects to use charcoal from sustainable plantations or agricultural by-products as an energy source. These projects use the energy for industrial processes, cogeneration and/or the production of electricity which is then fed into the grid.

While only four solid waste handling projects were being negotiated as of September 2003, they belong to the sector that has perhaps the greatest CDM project potential. They prevent the emission of large quantities of greenhouse gases at relatively low cost and are clearly additional, and the carbon revenue significantly improves project returns.

Preliminary studies of the carbon market established that Mexico and Brazil had the greatest potential in the region for the development of CDM projects, owing basically to the size of their economies and their degree of industrial development. This could at least partially explain the fact that Brazil is currently the leading country in the region where the sums negotiated in the carbon market are concerned. However, large countries such as Argentina and Mexico have not achieved a major share, while small and medium-sized ones such as Chile, Colombia, Panama and Costa Rica, among others, have done so (table IV.3)

Table IV.3
LATIN AMERICA AND CARIBBEAN COUNTRIES IN THE CDM MARKET

Country	Number of projects	Amount (millions of dollars)	Emissions (tCO_2e)
Nicaragua	1.0	0.5	141 600.0
El Salvador	2.0	1.4	347 400.0
Bolivia	1.0	1.8	713 990.0
Jamaica	1.0	2.5	457 200.0
Guatemala	2.0	8.1	2 168 231.0
Ecuador	7.0	11.2	3 239 320.0
Mexico	3.0	17.7	5 083 400.0
Peru	3.0	20.2	6 026 191.0
Costa Rica	7.0	21.0	4 765 201.0
Panama	3.0	21.4	3 952 735.0
Colombia	3.0	22.7	9 653 000.0
Chile	5.0	27.3	7 423 973.0
Brazil	8.0	54.9	11 319 026.0
Total	**46.0**	**210.6**	**55 291 267.0**

Source: L. Eguren, *El mercado de carbono en América Latina y el Caribe: Balance y perspectivas,* ECLAC, August 2003.

There are basically two reasons for this: (a) opportunities for the development of renewable energies arising from favourable State policies and the country's stock of renewable energy resources, and (b) institutional dynamism for CDM promotion in the country, as seen mainly in Costa Rica and Colombia.

In current market conditions it is not possible to characterize countries by the size of the projects they have proposed, mainly because the number of projects offered per country is still very small. Panama is a small country, for example, but it has submitted a fairly large hydroelectric project with an emissions reduction sales contract for more than US$ 18 million. This is more than the combined total negotiated for all the seven projects submitted by Ecuador and almost matches the total for all the projects of Costa Rica. Countries like Brazil have offered both small projects and fairly large ones.

On the whole, very large projects are not well regarded in this environmental market because they have large environmental effects on adjoining areas. The PCF/World Bank, for example, has been looking for hydroelectric projects whose capacity does not exceed 100 MW and whose reservoir size is in accordance with international environmental constraints. In fact, none of the CDM renewable energy projects identified in this document exceeds 100 MW.

4. The impact of international agreements

(a) The Kyoto Protocol[34]

A central question is whether, given its focus on specific, defined projects, international emissions trading is an appropriate way of inducing countries, particularly those of Latin America, to take a comprehensive view of sustainability in their energy policies.

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[34] Taken from M. Coviello, *Entorno internacional y oportunidades para el desarrollo de fuentes renovables de energía en países de América Latina y el Caribe*. Recursos Naturales e Infraestructura series, No. 63, Santiago, Chile, October 2003.

Furthermore, all such schemes are based on the approaches and mechanisms defined in the Kyoto Protocol, signed in 1997 and currently undergoing ratification by accession countries. To date, 111 countries have ratified it (including all those of the European Union and Latin America, except Venezuela). Russia is debating ratification, while the United States and Australia have decided not to join the initiative.

For the Protocol to come into force, it is necessary for it to have been ratified by at least 55 countries representing at least 55% of world CO_2 emissions in 1990. So far, the cumulative total of emissions represented by signatories is only 44.2%, which makes it necessary for Russia, representing 17.4% of world emissions, to ratify the Protocol.

The problem is that ratification now depends on the Russian Parliament (the Duma) and the priority it gives the Protocol on its political agenda. Considering the complexity of the world political situation and the position with different negotiations on other planetary matters that are more serious and pressing for Russia, there is no guarantee that the Duma actually has the desire and intention to ratify the Protocol in the near future. Some analysts had speculated that Russia might ratify Kyoto during the ninth Conference of the Parties held in Milan in December 2003, with others expecting Russia to take a good deal longer in analysing the pros and cons of the agreement, completing the process no earlier than mid-2004.

In any event, should Kyoto fail, it needs to be asked what alternative scenarios there might be for global measures to mitigate climate change and implement global carbon credit markets.

If the Kyoto Protocol is not ratified, the most likely scenario, in the view of many analysts, is that different bilateral or multilateral carbon markets, largely replicating the different “mono-markets” for carbon now operating in terms of size, characteristics and rules, might be generated almost simultaneously, but independently of one another.

In this case, it is most likely that at least three large geographical markets might be created: one led by the European Union, another operated by the United States and countries such as Australia, the Philippines, Indonesia and Israel that have not ratified Kyoto, and one linked to the Japanese market. In this scenario, the countries of Latin America would have the opportunity to play a strategic role, as they would be in a position, for example, to participate selectively in all three markets, to which they would bring tremendous credit generation potential as regards both energy (renewable sources and energy efficiency) and land use (forestation, reforestation and so on).

An effort would thus seem to be required to coordinate and harmonize the different approaches and interests of the Latin American countries in relation to climate change, so that the countries can engage in joint, synergetic discussion of the region’s possible role whether Kyoto is ratified or not.

As was noted in earlier paragraphs, the value of a ton of CO_2 currently ranges from US$ 3.50 to US$ 5. It is extremely hazardous to predict future values for this environmental commodity, not so much for economic reasons as for political and strategic ones.

The uncertainty as to whether Russia will ratify Kyoto and the refusal of the United States to do so are two of the main factors complicating price forecasting.

This has been demonstrated by the large shift in the trading prices and volumes proposed before and after the refusal of the United States. Before President Bush decided not to participate in Kyoto, projections for the world market in CDM-linked emissions credits ranged from US$ 2.8 billion to US$ 21 billion, and the price of CO_2 ranged from US$ 10 to US$ 37 a ton.

Now that the largest international player in the market has definitively withdrawn, the projections are far more conservative, with prices in no cases exceeding US$ 7 a ton and trading volumes of well under US$ 1 billion. This assumes, furthermore, that the Protocol actually is ratified by Russia, which recent studies indicate would be the largest beneficiary from the creation of a global emissions market, as it could earn some US$ 10 billion from selling its “hot air”.

If the Protocol does come into effect, the Latin American countries will benefit from this new global market, albeit not at particularly high prices, owing to the fact that:

- the potential volume of emissions that Latin America could sell to the industrialized countries is enormous, in the fields of both energy (renewable energy projects, energy efficiency) and forestry (forestation and reforestation projects);

- at present, as we have already seen, Latin America is unquestionably the continent with the greatest “historical experience” and “project volumes” when it comes to the implementation of initiatives on the ground linked with the sale of carbon credits, which will lead to strong competition for resources.

(b) The World Trade Organization (WTO)

Multilateral liberalization of trade in the energy sector has come up against three problems. The first is the need for a broad definition of the different activities in the sector, both for energy goods and for energy services. The second problem, a no less important one, concerns the dismantling of State monopolies and the consequent break-up of vertically integrated public services. The third problem are changes in the legal frameworks and public policies governing energy.

A broad definition should include clear criteria for the differences between energy products and energy services, and determine which products are to be considered as commodities like oil and solid fuels. Some countries do not regard gas and electricity as services but as products, and even bind them for tariff purposes.[35]

As regards the second problem, the dismantling of monopolies and what this means in terms of trade restrictions and distortions, governments in most countries (and Latin America is no exception) have always used financial and administrative instruments (regulations, taxes, budgetary transfers) to intervene directly or indirectly in the energy sector. Sectors like energy generally have some natural monopoly characteristics, so that many countries exclude them from negotiations or include them only with reserves.[36]

Meanwhile, government services are explicitly carved out of the General Agreement on Trade in Services (GATS): it does not outlaw government or even private monopolies, a State cannot be obliged to

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[35] In the Harmonized Commodity Description and Coding System of the World Customs Organization (WCO), electricity is classified in the same way as oil, coal and gas.

[36] In its free trade agreements, for example, Chile has an annex II reserve that allows it to adopt new measures for environmental services, essentially water and treatment, which contravene treaty provisions. Annex 1 allows the country to retain presidential discretion in the granting of concessions to exploit national energy resources.

privatize service industries, and government services are not subject to market access and national treatment commitments. It may happen, though, that a government wishes to make an undertaking concerning the level of foreign competition in a particular sector because it regards this as a governmental function, or for some other reason. In this case, the multilateral obligations of that government are minimal, perhaps including commitments such as transparency in sectoral regulation and non-discrimination among foreign suppliers. Unilateral decisions by countries in relation to sectoral access that affect third parties and are not bound in a specific offer are generally dealt with locally on a bilateral basis.

A third problem connected with the above is the issue of transparency in the regulatory framework of the energy sector; whether or not the sector is controlled by the State, this is a necessary condition in the multilateral system of trade in services. Governments have to publish full information about the laws and regulations governing any service sector.[37] The same thing happens with incentive and subsidy regimes even if these are not subject to multilateral trade system regulations. “Commitments to liberalize do not affect governments’ right to set levels of quality, safety, or price, or to introduce regulations to pursue any other policy objective they see fit”.[38] In energy services sector trade negotiations, States have clear objectives for the amount of liberalization[39] they are prepared to accept and these are generally determined by national energy policies, since this sector is a particularly sensitive one for many governments.

(i) Commercial treatment of the energy services sector

Although the mode of supply related to commercial presence is linked to the issue of investment, this linkage is limited. In fact, multilateral trade rules only apply to investment in energy services provision and to cross-border trade in energy services, and this does not extend to the production of energy goods. The authority within WTO that deals with issues relating to investment in physical goods production[40] is the Agreement on Trade-Related Investment Measures (TRIMs). These provisions generally affect cross-border goods trade more than the establishment of companies as such (commercial presence). TRIMs basically counters the international trade performance requirements imposed by host countries on foreign investment, and trade in services is not included. By contrast, GATS regulates the commercial presence of energy providers and there are no provisions on investments in energy products.

The multilateral framework does lay down binding rules against the creation of monopolies and the existence of exclusive service providers, but the rules apply only to monopolistic actions that may affect other related industries which are not monopolies (“arms-length”), the idea being to prevent

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37 Changes to regulations applying to services covered by specific commitments are notified to WTO. When a government takes an administrative decision that affects a service, it also has to nominate an impartial body such as a court to review this decision.

38 http://www.wto.org/english/thewto_e/whatis_e/tif_e/agrm6_e.htm.

39 Countries accept specific commitments by presenting “schedules” that list such commitments, or use positive lists to liberalize aspects of different sectors for which commitments are made.

40 Investment was not considered in the Uruguay Round, the focus being on issues that had a direct effect on trade and foreign investment flows. Hence, the TRIMs agreements were created to deal with trade-distorting investment policies. There is a provision that agreements of this type will not be applied to national treatment in matters of domestic taxation and regulation (Article III) and the general removal of quantitative restrictions (Article XI).

restrictive trade practices.[41] The nub of the competition rules, in the case of energy, is access to electricity transmission and distribution grids.[42]

Although more progress has been made with energy services than with energy goods, a proposal has been made by countries like Japan to include such goods in environmental goods schedules. With Doha, again, services negotiations have only looked at two subsectors related to the transportation of energy goods included in the WTO listing of services sectors (W120), and to date no progress has been made with this.

(ii) Renewable energies

Although renewable energies were not included in the sectoral list, the growth of this industry has led some countries to make proposals to WTO. The use of renewable energies by OECD countries contributes to the security of their internal supply, but they still import 15% of the gas and 50% of the oil they consume from non-OECD countries. An indicator that shows the growing importance of renewable energies is the percentage of the research and development budget they account for in the OECD countries, as compared to the amounts set aside for coal.

The key to sustainable development is to ensure that the price and structure of incentives reflect the true costs and benefits of production and consumption. The environmental effects of doing away with trade restrictions and distortions depend on how this affects energy prices, how consumption responds to the change in prices and how research and development is focused in this new situation.

A 2002 study by the Energy Information Administration (EIA) shows that removing subsidies that are mainly for consumption results in lower demand for energy imports in countries that were previously net importers of energy, making more energy available for export.[43]

(c) The North American Free Trade Agreement - NAFTA

One way of approaching the issue of energy sector liberalization in Latin American trade negotiations is to analyse the different regional trade integration schemes and the business opportunities opening up to the countries.

The North American Free Trade Agreement (NAFTA) has clear provisions for different areas of the energy sector. Chapter VI, dealing with energy and basic petrochemicals, includes measures relating to energy and basic petrochemical goods and some relating to cross-border trade and investment in services linked to energy goods. Article 606 relates to energy regulatory measures defined as “any measure by federal or sub-federal entities that directly affects the transportation, transmission or distribution, purchase or sale, of an energy or basic petrochemical good”. This is basically the framework within which energy sector negotiation and liberalization takes place under NAFTA, with many of the provisions deriving from multilateral negotiations (energy goods, some of which might come to be included in the schedule of environmental goods proposed for market access). It is necessary to consider the OECD Classification of Environmental Goods and Services Industry, which includes “Cleaner/resource efficient products” in the Cleaner Technologies and Products category and “Heat/energy saving and equipment” and “Renewable energy plant” in the Resources Management category.

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41 Article IX of GATS seeks to combat restrictive trade practices.

42 In the European Union, States have two options: third party access, or a sole buyer to organize transmission and distribution grids.

43 See IEA, *World Energy Outlook. Looking at Energy Subsidies: Getting the Prices Right*, Paris, 1999, pp. 62-69.

Perhaps one of the greatest successes of NAFTA in the energy sector is to have induced Petróleos Mexicanos (Pemex) and the Comisión Federal de Electricidad (CFE) to open up procurement to foreign suppliers. In Mexico, again, some imported equipment containing clean technology is automatically tariff-exempt owing to the “zero tariff” policy adopted by the Mexican Government in 1996 to stimulate investment in pollution control. This measure is outside the framework of NAFTA (CCA, 1999).

At present, the greatest interest seems to be in the issue of energy sector liberalization. According to the International Energy Agency, the total investment required over the next decade to expand electricity generating capacity in North America is very high, particularly in Mexico (about 3% of GDP), mainly because of the intention to alter the fuel type mix of generating equipment.

The three signatories (the United States, Mexico and Canada) have stated their interest in creating an electricity market that will ensure a reliable energy supply while protecting health and the environment. In 2001, electricity companies, investors and energy planners announced their intention of building some 2,000 new electricity generating units in North America by 2007, representing more than 50% of current installed capacity.[44] The removal of barriers to trade and investment in the electricity sector could include major government initiatives to stimulate access to clean technology, such as government acquisitions and trade in equipment, for the benefit of the environment. These measures in turn affect public policy-making as it relates to infrastructure, energy sources and market access and environmental norms and regulations, and involve NAFTA institutions (regulatory cooperation and convergence).[45]

Some renewable energy initiatives are in progress in North America, both in the United States (reverse auctions for renewables in California and wind energy installations) and in Canada and Mexico (projects to generate electricity from renewable sources already in the market). Implementing projects of this type requires government participation to help create the right market conditions for energies of this kind. Renewable energy financing has been one of the issues of greatest concern in all three countries. To promote renewable energy generation and consumption, two types have funds have been created: joint public-private investment in green energy, and green price initiatives.[46]

The North American Commission for Environmental Cooperation has also attached importance to the development of efficient energy use criteria, which vary by technology and region. The greatest potential for improving energy efficiency in Canada and the United States lies in changes to building codes to improve the energy characteristics of residential and commercial buildings.

The countries have also adopted some national initiatives to stimulate the creation of renewable energy markets. According to EIA data, energy measures recently adopted by some countries are the result of changes in their sectoral incentive policies which have had repercussions for their trade and investment policies. Brazil, for example, has done away with major subsidies for fossil energy consumption, although there are still large production subsidies. That country has also implemented a number of renewable sources programmes. In particular, the Proinfa act should result in the installation of 3,300 MW of generating capacity from renewable sources by 2006.

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[44] According to information provided by Resources Data International/Platts for Canada and the United States and the Comisión Reguladora de Electricidad and Comisión Federal de Electricidad for Mexico.

[45] The list of institutions is given in the NAFTA text. The most important include the North American Electric Reliability Council, the Western System Coordinating Council, etc.

[46] With this method, the surcharge for environmentally friendly electricity is charged to final users.

Chapter V

PUBLIC POLICY-MAKING, KEY ISSUES, PROPOSALS AND A STRATEGY FOR RENEWABLE SOURCES OF ENERGY

1. Theoretical framework for the formulation of an energy policy[47]

(a) Environment, objectives and sequencing

Given the range of issues and methodologies involved in this subject, this section will summarize the most important issues to be addressed in the formulation of an energy policy focused on sustainable development as well as its logical sequence, and the coordination and consistency of the different phases and stakeholders involved in the process.

(i) Energy policy must be seen in the context of national development policy

Development policy is focused on the structural aspects of the socio-economic system. Development policy is also, by definition, a long-term policy. Its constituent elements fall into two broad categories that are inextricably linked: general or cross-sectional policies (prices and incomes, employment and the development of human, financial, trade, institutional and technological resources) and sectoral policies (mining, agricultural, forestry, industrial, energy, and transport). These policies are aimed at designing and carrying through a national development plan and, as such, are subject to international constraints and must be pursued in a power-sharing environment. Thus, sustainability is a key element of the implementation strategy.

In this way, energy policy is a sectoral strategy that is part and parcel of a longer-term socio-economic policy. Additionally, given the existence of various production mechanisms within the energy system, energy policy can be categorized in the same way as development policy: general or cross-sectional policies (supplies, prices, finance, institutions, technology, environment, the rational use of energy, the training of human resources, etc.) and sub-sectoral policies (oil, gas, electricity, nuclear power, coal, new and renewable sources of energy). It is clear that the general or cross-sectional policies typical of the energy sector are a particular manifestation of the various categories of general development policy.

(ii) The State should set energy policy

The State has sole responsibility for designing and implementing an active energy policy that consists of targeted intervention in cases of imperfect market performance. Moreover, the State cannot entirely entrust the private sector with the allocation and use of resources through decentralized decisions. If it were to do so, private and social interests would be in alignment only if there were no market externalities, no common property resources, and the rationales of both sides were precisely the same. However, that hypothetical situation is very far removed from actual realities and, as a consequence, there are a number of factors that justify the need for State intervention in energy systems through proactive policies.

[47] ECLAC/OLADE/GTZ Sustainable Energy and Development in Latin America and the Caribbean. Guide for the formulation of energy policies. First edition. ECLAC Notebooks No. 89, Santiago, 2003.

(iii) Energy policy should be pursued within a systemic framework

Taking into account the importance of the interactions between the energy system and the economy, society,[48] the natural environment and politics, it is clear that the design of an energy policy geared toward sustainable development needs to have a systemic focus.

(iv) Changing environment for energy policy

The changes introduced in the productive and institutional structure and in the operating mechanisms of our region's energy systems generally entail far-reaching shifts in the environment for the design and implementation of energy policy. As a rule of thumb, the reform efforts applied to energy industries entailed a departure from the previous system of centralized command and control, dominated by public utilities, and this reform has resulted in a multitude of scenarios, characterized by bold policies involving varying degrees of State intervention and a greater participation by market mechanisms and the growing presence of private stakeholders. In this context, it is not possible to conceive of the State as a discrete and homogeneous entity, but as a body of participants who often uphold viewpoints or interests that are to some extent divergent or contradictory.[49]

(v) Logical sequence

The objectives identified within the policy design process reflect the issue of determining desirable future scenarios; the strategic guidelines will have to establish approaches to achieving this kind of scenario. At the same time, efforts will have to be made to identify appropriate tools for implementing these strategies, and finally the activities and actions through which the various tools are developed represent a response to the question of how the policy is to be implemented effectively.

(b) Policy instruments to strengthen and refine our reform efforts

Within the general context of State reform, the energy sector of Latin America and the Caribbean is passing through structural changes that have not yet come to fruition. Since the beginning of our present decade, we have observed a number of different situations which range from countries where the State and public companies continue to play a leading role, both in electrical energy and oil and gas, to other cases in which this role has been entrusted to market mechanisms and the private sector. It goes without saying that in between these opposite ends of the spectrum we encounter a broad mix of composite options.

In a number of countries then, the State is no longer responsible for the business operations and direct control of energy sector activities. In these countries, following the development of the new framework of productive and institutional organization and the basic regulatory frameworks for the system, the policy instruments still remaining in the State's hands play a fundamentally indirect role. This does not mean that the State is no longer able to lay down the law or take direct action where necessary; the point is that, in cases in which the authorities have opted for forms of sustained co-ordination based

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[48] Civil society can form intermediate organizations of a non-corporative private nature (NGOs) that can carry out roles linked to the defense of the rights of citizens vis-à-vis private or public authorities, while handling training and dissemination of FRE technologies.

[49] See Juan Carlos Lerda, Jean Acquatella and José Javier Gómez. Integration, Consistency and Co-ordination of Sectoral Public Policies (reflections on the case of fiscal and environmental policies). ECLAC Environmental and development series, No. 76, November 2003, pp. 12-13.

on market mechanisms, most of the policy instruments used will be able to encourage or discourage certain kinds of behaviour through indirect incentives entailing benefits or costs of an economic nature.

This new structure for the systems of energy supply goes hand-in-hand with the pre-existing presence —in the context of the final consumption of energy— of an extensive number of decision-makers who might well have priorities that differ sharply from the needs of energy policy makers. Moreover, the cross-border conditions (in the international context) impose additional constraints on policy implementation. In other words, in the context of the design and implementation of sustainable energy policies, considerable importance must be attached to the behaviour exhibited by the different groups of consumers, through the use of instruments for the management of demand and of responses to the consumption of renewable sources of energy. These are factors which were not taken into consideration during the first round of reform programmes.

Within these constantly changing environments, energy policy design should not focus exclusively on developing a matrix of objectives and instruments —a strategy exemplified by the controversial regulatory approach to policies in which the authorities' efforts at this preliminary reform stage were squandered in precisely this fashion. At the design stage, which includes the identification of instruments the authorities will use to implement public policy in the system, in accordance with chosen strategic guidelines, particularly close attention must be paid to issues pertaining to sustainability. In this respect, the above-mentioned strategic guidelines focusing on sustainability are of the utmost importance.

Thus, in addition to preparing a matrix that links objectives to strategic guidelines and instruments, and which should help to examine the degree of internal consistency between policy instruments as well as undesirable effects on other objectives, it also follows that successful policy design requires researching the level of opposition among societal stakeholders (including other areas of the public sector itself) to the use of certain instruments and the objectives themselves. From the conceptual point of view this entails identifying impact functions for key stakeholders with reference to the chosen policy instruments, so as to assess the pre-requisites for ensuring the sustainability of the policy proposal.

Drawing a parallel with environmental policy, the work of Lerda, Acquatella and Gómez[50] argues that "the complex process through which the authorities manage, formulate, design, articulate and co-ordinate public policy actions (which constitute the visible side of governmental activities that are geared to achieving community-oriented objectives that set out to attain goals of collective interest) proves to be a breeding ground for manifold government policy breakdowns ultimately attributable to the quality and interaction of an important cluster of organizations, institutions and public policies (OIPP). These entities constitute a troika which is frequently viewed in isolation, as if it had a life of its own and were essentially autonomous. Closer scrutiny reveals the following major risks:

- Conflicts of interests between the public and private interests may be created and there may be agency problems in the management of political organizations and/or bureaucracies of the State;

- The institutional infrastructure that sets rules and standards, establishes incentives, and regulates conduct, may lead to punishable irregularities and behaviors by public and

[50] Juan Carlos Lerda, Jean Acquatella and José Javier Gómez. Integration, Consistency and Co-ordination of Public Sectoral Policies (reflections on the case of fiscal and environmental policies). ECLAC Environmental and development series, No. 76, November 2003.

private personnel, possibly involving performance of a quality lower than the standards required for the kinds of results that are desired; and/or

- There are insufficient information and incentives to assure the necessary integration, consistency and coordination of sectoral policies (between themselves and in relation to general governmental objectives)”.

The interaction of the components of this “troika” and environmental policy challenges are also present in the design of an energy policy geared toward sustainable development and market penetration through renewable sources of energy. In this way, it will be important to design the strategic guidelines or escape route providing an exit from the adverse circumstances characteristic of the identified problems (for example, the barriers identified in the previous chapter) in such a way as to usher in the desired future circumstances that truly reflect the agreed-upon goals.

In the case of renewable energy, there will be an indisputable need for the political authorities and structures to commit to establishing the necessary mechanisms just as they did with the reform of the energy system which helped to bring into being the system that exists today. The goal is that the strategic policies of the various energy platforms in the various countries should explicitly mainstream a stronger focus on renewable sources of energy with the aim of ensuring a higher degree of energy security and thereby reducing poverty, curbing environmental problems, husbanding foreign exchange resources and improving energy trade performance. This means that the authorities must forge local alliances within the framework of international foreign aid efforts.

In other words, the purpose of this plan is to replicate the kind of enabling environment that helped to promote the changes triggered by the first round of reforms. If these processes were accompanied by actions directed at modifying institutional organization, the regulatory principles and coordination mechanisms, then State action will also be necessary in the area of renewable sources of energy, with the following aims in view:

- Developing an institutional framework that is stronger and more compatible with the policy proposal;
- Introducing fundamental changes to existing regulatory frameworks;[51]
- Focusing on the organization of markets, degree of jurisdictional decentralization, access requirements; secondary policy areas for the State.

This indicates, moreover, that in these three spheres the State will have an essential part to play. Moreover, the State will have to play a coordinating role, reflecting the newly developed opportunities for ensuring policy sustainability.

Additionally, it is also necessary to define the scope of the policy instruments that are involved in this process.

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[51] As will be seen later on, in the case of some European countries, in particular Germany, laws have been created or amendments have been made to existing laws and these are governed by EU directives regarding the penetration of renewable sources.

- Direct action instruments. These can be very diverse and depend on the opportunities created by the environment established by energy policy itself. Here the reader may observe efforts in support of the actions performed by businesspeople who engage in activities characterized as public utilities, such as occur in many links in the energy production chains (for example rural electrification), where the State may execute the investments either directly or use development policy instruments to encourage other participants to get involved.

- Instruments of persuasion or development policy. These instruments by their very nature are far more indirect and are generally designed to influence the rationales adopted by those participants who operate directly in the system. A clear example of this is to be found in the use of taxes and subsidies which affect energy prices. The use of these kinds of instruments can be applied to various goals of an energy policy for sustainable development. One such example might include a tax on substitution between sources and/or on the penetration of cleaner sources of energy so as to promote the rational use of energy and environmental objectives.

- Subsidies also include those facilities which are aimed at reducing the financing costs associated with certain kinds of investments, such as those linked to the promotion of energy efficiency or renewable sources of energy for certain kinds of end-users. Another instrument of this kind is to be found in education or outreach campaigns focusing on goals of rational use or environmental preservation, and the penetration of renewable sources of energy.

2. Comprehensive strategic overview: new issues in public energy and environmental policies and the implicit value of using renewable energy

At present, renewable energy is a topic that has been thrust into the public arena by those concerned with the issue, from within the government or within civil society. Such support is helpful for setting initiatives in motion; however, renewable energy lacks sufficient political backing in view of the fact that environmental issues have been overshadowed by the economy in most national agendas. For this reason, when entering the energy policy environment (which is fundamentally economic in nature) renewable energy issues tend to get shunted aside.

This situation, however, is changing given that other issues related to the public agenda, connected in various ways with the utilization of renewable energy, currently constitute a key focus of the national governments of most countries in the region. This explains the need to take another crack at achieving a comprehensive strategic vision of the energy sector with a view to ensuring sustainable development. There are many reasons for undertaking such efforts.

Economic impacts related to the trade balance. Both in the production of electrical energy and of fuels derived from renewable sources, the economic impacts can be sizable although these vary according to each sub-region and/or country of a region. Depending on the energy source that is to be substituted, renewable energy can reduce fuel imports and help improve the current account balance. Thus, in the Andean Community, where the share of electric power generation accounted for by hydroelectricity is almost 60% and the production of oil is four times greater than consumption, it might initially appear that renewable sources of energy would have little effect on imports. However, as one moves from country to country, one’s attention is drawn to the oil and gas dependency of Peru and

Bolivia that produce respectively 38% and 78% of their demand. Especially in the case of these two countries, the use of local energy resources could facilitate efforts to husband foreign exchange resources in direct relation to the displaced quantity of petroleum products used for the generation of electricity. Moreover, it is interesting to observe that the implementation of these energy technologies may lead to other imports and generate maintenance costs incurred abroad, which could dampen the prospective benefits.

Saving of foreign exchange. It is necessary to recognize that some of the costs involved in the implementation and operation of renewable energy technologies entail expenditures in local currency, in order to pay wages, domestic materials and other services rendered, and possibly taxes. Thus, depending on the cost structures (whether in local currency or foreign exchange) associated with the implementation of a plan or programme for renewable energy, there may be good reason to pursue an active tax policy that will vigorously promote the introduction of technology, even if this sometimes occurs under marginal conditions of economic sustainability. Particularly in Bolivia, and judging by interviews with private local organizations, some components of photovoltaic systems (regulators and batteries) could be locally produced, but given the fact that these systems are generally given as donations, when they arrive they have already been fully assembled abroad and this means that very little associated industrial activity gets generated in the process. Moreover they qualify for tariff advantages and incur fewer taxes. Conversely, about half of the costs of a mini-hydroelectric power station are accounted for by civil engineering and other local costs[52] and, as a consequence, renewable energy technology can lead to more significant economic benefits.

Employment. As usually happens with energy projects, in the case of renewable energy, the demand for manpower is quite intense during the implementation phase and less so for the operation and maintenance phases. This is partially true for bio-energies which are the most labor-intensive energy option in view of their associated agricultural activities (cultivation, harvest and transport). Compared with the other power generation technologies (whether renewable or not) bio-energies can entail the creation of unskilled jobs on a scale 10 or 20 times more substantial.

Rural development. There is an urgent need in many countries in the region to reduce migration from the rural area to the cities. There is a correspondingly urgent need to improve rural development strategies in which renewable energy can and should make a significant contribution. A proposal along these lines is made in (b).

Universal electrification. The electrical reform process in many countries in the region presents a clear social obligation: namely, ensuring access for large social groups to sources of energy in general and to rural electrification in particular. It has been proved and accepted that the extension of the existing electricity network is much more costly than local generation of electricity from renewable sources and, moreover, a more effective use of the latter resources is a clear alternative way of fulfilling this social obligation.

Development of a tourism industry. Tourism is a very important source of income for many of the region's countries. At the same time, the environmental agenda continues to loom large in the agenda of the tourism industry. The success of Costa Rica as an ecotourism destination, the wealth of biodiversity and greenery still present in the region, and the demand on the part of an increasing number of travelers

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[52] José Luis Monroy C., The Bolivian Experience in the Design and Construction of Hydro-Electrical Micro Power Stations. Greater University of San Andrés, La Paz, available at htpp:// www.unesco.org.uy/phi/libros/microcentrales/monroy.html.

for "green" or "clean" spaces means that the domestic tourism industry requires inputs that meet ecological criteria, and that includes electricity.

Water governance. A key issue that is not only environmental but economic (as well as a public health issue) is water. At the same time, it is well-known that to avoid droughts and to prevent flood-related disasters, it is essential for forests to be protected. This has resulted in the establishment (as in Costa Rica) of environmental forest services which, in their turn, offer incentives to those who live in these areas.

At the same time, the development of technology and of the market for equipment and systems utilizing renewable sources of energy has provided increasing assurances for those who consider these issues to be key components of policy or working strategies in the above-mentioned areas.

3. Key concerns for the region: proposals and actions

(a) Need for an environmental and social reappraisal for renewable and sustainable hydro-energy

Traditionally ranked among the renewable sources of energy, hydro-energy associated with medium and large power stations have lately received strong criticism which has led to its virtual exclusion from the renewable energy context, not because hydro-energy is an inherently nonrenewable source of energy but because of its environmental and social impact. There are four arguments against hydroelectric power stations entailing high capacity and large dams:

- Emissions of greenhouse-effect gas (including methane gas) on account of decomposition of flooded vegetation;
- The displacement of populations on account of the formation of dams and the flooding of vast stretches of land;
- The reduction of the speed of currents with changes in the biota that can promote the spread of pathogenic vectors;
- Changes in the transport of sediments which adversely affect coastal regions situated downstream of the dam.

Mainly on account of the first two considerations, today's environment is characterized by sharply polarized viewpoints concerning the impact of hydro-energy on a large scale;[53] this controversy has complicated efforts to ensure a proper contribution by this potentially renewable source of energy, reflecting the essentially unstoppable cycle of rain and evaporation which absorbs 23% of solar radiation on the planet.[54]

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[53] See for example International Rivers Network, Twelve Reasons to Exclude Large Hydro from Renewables Initiatives, available at htpp://www.irn.org/programs/greenhouse/12reasons.pdf and A. Palmieri, (Environment Department, The World Bank), Dams and Development-The Evolving Role of the World Bank, "Benefits and Concerns about Dams" Symposium, Annual Meeting of the International Commission on Large Dams, Dresden, September 2001.

[54] V. Smil, MIT Press, Cambridge 1999.

At present, with an annual total output of 2.1 million GWh, hydroelectric power stations contribute approximately 20% of the supply of the world's electrical energy and their use has displaced emissions in thermo-electric power stations to the tune of at least 1000 million tons of coal and more than 25 million tons of sulfur, which correspond respectively to 15% and 25% of the total man-made emissions of the pertinent gases.[55]

The hydroelectric potential that is economically usable in Latin America and the Caribbean amounts to 504 GWh, of which at present only 22% is used (OLADE 2002). Here the reader's attention is drawn to the low rate of use on the part of the Andean Community, where hydroelectricity accounts for almost 60% of the installed capacity for electricity generation. However, these facilities represent less than 10% of the identified potential of 267 GW; and consider the case of Central America whose utilized potential is less than 13% of a total of 28 GW. A contrasting situation is provided by Brazil, where installed hydro capacity is 155 GW (which represents 60% of the country's 260 GW potential).

Compare this situation with countries in Europe and North America where the systems have already been developed and are using over 45% of hydroelectric potential, as well as Asia and Africa, whose utilized potentials are respectively 11% and 3.5%, considering units of over 1 MW.[56]

These figures highlight the fact that, notwithstanding the current importance of hydro-energy in the Andean Community, Central America and other sub-regions, there is still untapped potential which is surprisingly large due to the particular conditions of topography and existing rainfall patterns. Failure to mainstream these issues within renewable energy sources can be a major damper on national development. It is regrettable that many small and medium sized hydroelectric power stations should have fallen into disuse over the last decades, for example in Andean countries, due to the installation of long-distance transmission lines and the expansion of electrical distribution using large centralized power-generation systems. However, the most recent changes introduced in the regulation of electricity markets that allow independent producers to gain access to the network and market their power surpluses could help to bring these plants back to life.

Given the "renewable" character of hydroelectric power stations, perhaps it is less essential to establish a cutoff point for their inclusion as "modern"[57] renewable facilities (statistical compilers usually only include the small power centers, with capacities that vary between 10 and 30 MW), and instead to set a maximum standard for categorizing them as sustainable, based on social and environmental indicators.[58]

It is clear that the utilization of hydroelectricity through the hydroelectric pass-through plants (non-reservoir plants) does not in general have associated environmental impacts. In the case of reservoir plants, these will naturally always cause impacts of one kind or another but it is simplistic and often mistaken to draw an immediate correlation between environmental and hydroelectric problems. There may have been observed negative impacts in hydroelectric power stations, some of which are irreversible, but these are intrinsic to the technology. In a considerable number of cases, the damage is not that

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[55] V. Smil, Energy at the crossroads: global perspectives and uncertainties, MIT Press, London, 2003.

[56] ICOLD, International Commission on Large Dams, World Register of Dams, Paris, 2003 (see also www.icold-ICOLD.org).

[57] T.B. Johansson and J. Goldemberg, (editors), Energy for Sustainable Development, UNDP, New York, 2002.

[58] A proposal concerning the requirements to be met in achieving sustainability in hydro-energy is presented to the ICOLD, International Commission on Large Dams, Position Paper on Dams and Environment, 2000, available at http://www.icold-ICOLD.org.

extensive or can be compensated for, as evidenced by the thousands of units that have been operating for decades. The reader's attention is drawn to those hydroelectric facilities which lend themselves to multiple uses and can provide interesting advantages: apart from the generation of electricity, they help promote fish production, water supply, irrigation, stream flow management (reduction of flooding and the alleviation of droughts), inland waterways, the promotion of tourism, and the use of local resources, etc.

Perhaps in no other electrical generation technology do we find such meaningful and tried-and-tested opportunities for integration and synergy with non-energy related issues. In fact, many hydroelectric power stations throughout the world, and particularly in Latin America, have been the source of important and beneficial impacts in terms of the promotion of local development, improving agricultural productivity and helping the population to become firmly established in rural areas. The key point is to ensure that such projects adhere to the principles of sustainability and make rational use of an available resource, which is undoubtedly in plentiful supply within the Andean Community.

Allow us now to set forth some guiding principles and issues for a proposed agreement.

(i) Principles

From the perspective of national policymakers, electrical companies and project developers, hydroelectricity is the kind of project that could make the most substantial contribution to the region's electric power supply. Moreover, the initiative for water, forestry, and the community is being predicated on the following principles:

Hydraulic projects have a clear and beneficial environmental synergy with forestry. One of the most important lessons that has been learned by the developers and operators of hydroelectric plants —particularly reservoir plants— is that forestry is indispensable for the existence if these kinds of plants. Accordingly, any modern development of hydroelectric plants is associated with forest management, which can represent a source of environmental synergy that facilitates efforts to reduce greenhouse gas emissions while capturing the carbon associated with these emissions.

Hydraulic projects bolster electrical systems and offer clear operational synergy with wind power projects. Because of the ease and rapidity with which their capacities change, the hydroelectric plants have a key role to play as voltage regulators and thus in ensuring the quality of electrical energy supplied by the underlying grid system. Moreover, the value of the energy produced by wind-power projects increases when the latter operate in conjunction with hydraulic projects given that this approach can convert these facilities into projects with sustainable capacity, boost their profitability, with the result that fewer government subsidies are required. At least in Central America where the wind is stronger when it does not rain and vice versa, the market value of a hydraulic-wind factor combination is greater than the value of the sum of the two projects in isolation.

Marginal increases in the number of existing dams are a very economical way of reducing greenhouse gas emissions. Building hydroelectric power stations with small dams can mean reduced local environmental impact but also limits the profitability of the projects and at the same time limits the scope for reducing greenhouse gas emissions. Additionally, without increasing installed generating capacity it is possible to achieve a greater production when building or expanding dams.

The electricity that comes from hydraulic plants has low unit costs. Although they are more expensive per unit of installed capacity, the unit cost of the energy produced by hydraulic power stations is low, due to the long service life of the projects.

The hydraulic potential is well evaluated and many of the possible projects have already been identified and characterized. For many years, hydroelectric power stations were the alternative preferred by national electrical companies and development banks as a way to boost electric power supply. For this reason, hydraulic resources have been carefully considered and many potentially useful sites (at least those of a medium or large size) have been thoroughly evaluated and have even undergone preliminary characterization for construction purposes.

Projects have to be developed hand in hand with the communities, not in isolation from them. Some of the many benefits of hydroelectric projects should undoubtedly be bestowed upon the communities in question and compensate for the negative effects which such activities unavoidably possess in some degree. The assessment of these costs and benefits needs to be viewed as the centerpiece of efforts to implement these projects and not as an afterthought.

There is technical capacity in the region to execute these projects. Precisely because of the importance associated with hydroelectric projects in the region, there is a plentiful supply of the expertise and technical capacity required to design and build them, and this represents an opportunity for business development in the region.

However, these kinds of projects have serious problems in terms of the public's perception of their environmental and social impact, particularly in view of the methods used to execute those projects that have relied upon huge dams, given that this has involved the resettlement of communities, the destructions of forests and the flooding of extensive areas of farmland. At the same time, the amortization periods for these kinds of installations are excessively long in relation to the maturities for purchasing contracts established in some of the local laws, which makes it difficult to gain bank approval and financing for them.

Moreover, the authorities need to undertake a full-scale social reappraisal and an intense effort in public relations in order to do justice to these projects. As signs of progress toward a viewpoint that is more favorable to sustainable hydro-energy, the conclusions of the World Summit on Sustainable Development which took place in Johannesburg in 2003 proposed: "To call upon Governments, as well as relevant regional and international organizations and other relevant stakeholders to implement the recommendations and conclusions.... concerning energy for sustainable development that would....diversify energy supply by developing renewable energy sources, including hydroelectric energy",[59] without restrictions. At the same time, as has already been indicated in chapter 2 of this paper, the International Energy Agency presents definitions for renewable energy,[60] including hydro-energy, and commenting that arguably a fraction of the biomass could not be considered renewable.

This brief overview of hydroelectricity in the region highlights the need for suitable consideration of renewable energy and a proper definition of sustainability and renewability in the context of Latin American and Caribbean countries. Undoubtedly, seeking the reduction of the widest possible range of polluting emissions while increasing the participation of renewable sources of energy entails expanding the use of the resources and attributes of the region where, in addition to solar energy (such as radiation or biomass) and wind power, emphasis should be given to hydroelectricity and geo-thermal resources.

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[59] United Nations, Division of Sustainable Development, Implementation Plan for Decisions of the World Summit on Development, available at http//www.un.org/esa/sustdev/documents/WSSD-POI-PD/Spanish.

[60] IEA. Renewables in Global Energy Supply, Paris, 2003.

(ii) Elements of the Proposal

Comprehensive environmental assessment of hydroelectric projects. Above and beyond their potential impact in terms of reducing greenhouse gas emissions, hydroelectric projects have to be evaluated also in terms of their indirect contribution to forest management, not only on account of how they are developed but also through the manner in which they help to provide a firm anchor for the neighbouring communities.

Establish a code of conduct for communities. It is both urgent and necessary to spell out a number of rules that are accepted universally and supervised both nationally and internationally so as to commit the project developers to adopting a fresh approach to those communities affected by the development of hydraulic power plants.

Establish fees for environmental services. One way of supporting the communities —as has happened in Costa Rica— is to have payments established for project developers for forest-related environmental services so that they can be channelled as incentives to those who live in these areas.

Modify the terms and conditions set forth in energy purchasing contracts. One way of recognizing the value of the hydraulic projects is to modify the regulations so as to lengthen the permitted terms in the electricity buying-selling contracts starting with hydraulic power stations in such a way as to obtain better financing terms.

Establish mechanisms that highlight the synergy between wind power and hydroelectric projects. At present, the rules prescribed for electricity markets are established for individual power stations and not for comprehensive capacity supply packages. Given the synergy between wind and hydraulic projects, it is advisable to revise these rules and if necessary to modify them so as to recognize this synergy and thereby enhance the profitability —with more competitive prices— of these projects.

Comprehensive watershed management policy. The multiple uses and effects of water are typically encapsulated within the watersheds in which water is captured and flows out to sea. Accordingly, it is necessary to view hydraulic systems as watersheds in which it is essential to optimize profits and minimize the negative effects of temporary and territorial shifts in water flows. This calls for establishing a system for measurement and monitoring and decision-making and requires concerted efforts to achieve interinstitutional coordination between central governmental agencies and regional governments.

Meet social obligations and resolve existing conflicts. It is necessary, on the one hand, to finish fulfilling the obligations to the communities resulting from the construction of the dams and, on the other hand, to disentangle major conflicts related to the construction of hydroelectric plants, at least those that have meet acceptable criteria by the standards of this new policy.

Public outreach and transparency of information. To bring about a societal reappraisal of these kinds of projects, it is necessary for the initiative to showcase an intensive PR effort in order to give these kinds of projects the credit they truly deserve in this day and age.

(b) The challenges and outlook for renewable sources of energy from the standpoint of achieving the broad-based development of rural communities

One of the most important niches for renewable energy in the region —as well as from the poverty reduction standpoint— is rural electrification. This is because the electrification of rural zones is a long-term, solemn social and political obligation. This is also because, given that centralized grid networks are so far away, rural electrification is the most expensive to supply, while simultaneously lending itself to the kinds of options afforded by renewable sources of electricity. It is also the case that the quality of the electricity that comes from a centralized grid network peters out at its farthermost corners which is where the rural communities are located. Finally, rural electrification matters precisely because the rural environment is where we generally find resources, whether solar radiation, waterfalls or watercourses, wind or biomass.

But these opportunities are going begging. A primary reason is the cost of the technology which is relatively high when compared with the investment that is required for a conventional system that functions with fossil fuels or when its unit amortization costs are compared against the rates charged users in urban areas. A second reason is that electrification has traditionally been performed by the electricity companies and their normal job is the extension of the grid network rather than operating hundreds of small autonomous systems that require a technology and supervision different from those customarily operated by electrical companies. A third factor is that the rural sector has traditionally been viewed as a community of end-users who lack the ability to pay and that, moreover, need large subsidies to be successfully supplied with electricity. Finally —and this has happened recently with the reforms in the electric sector in some subregions such as Central America— private distributors are only obliged to provide energy on the basis of their existing grid networks which limits the geographical reach of their obligation to serving communities in the vicinity of the network.

However, the new paradigms for rural electrification are having an impact on the planning efforts of those policymakers who are responsible for carrying out a commitment to supplying these communities with electricity. But this effort needs to find a greater role for local governments who should be entrusted with the follow-up of those actions that have been undertaken —in other words, they should be a part of the proposed strategies from the outset.

Of the new paradigms, the most important is to showcase the productive potential of a community —in other words, this effort must go beyond the mere fact of bringing light to rural homes. In addition, rural electrification is more than just an electric power network; rather it is the extension of a network for the delivery of goods and services. In this way, reflecting the need to call a halt to the flows of migration to the cities, the strategies for bringing electricity to the non-electrified zones are evolving rapidly.

For this reason we are making the following proposals:

(*i) Principles*

Renewable energy is an abundant resource that can be harnessed from the technical standpoint. Despite the fact that renewable energy resources are not adequately evaluated, they are clearly present, evidently abundant and, they are found in some or many of their forms in the greatest part of the region’s territory.

Technology for harnessing the renewable energy that exists in the market. The technological development of the last thirty years introduced to the market equipment and systems that harness renewable energy, that are available and accessible in many parts of the region.

Renewable energy is, in many localities, the cheapest and of best quality. Firewood is the energy resource that is the most economical for many communities and, in many cases, for these same communities, it is cheaper to generate electricity in-situ with renewable energy than to transport it through centralized grid networks. At the same time, the quality of electricity coming from a centralized grid network is liable to peter out in the outlying areas where the rural communities are situated.

The programmes should be designed to reflect needs and local opportunities. In order to be a success, the programmes need to focus on identifying unmet needs and the productive opportunities of communities and based on that definition to identify the resources and the technology that are most suitable for meeting these priorities. In this way, from the start the focus should be on identifying the resources and ways in which the end-users can contribute to recouping the investment costs and committing the community to taking care of the systems.

The market of the rural energy services is a niche for new companies. When we treat these initiatives as an attempt to extend the networks for delivering products and services rather than as centralized energy systems, we open up important opportunities for new business ventures that include the manufacturing of equipment (such as is the case with improved stoves), system design and installation, marketing of equipment and spare parts, the operation and maintenance of small systems, training and micro credit, activities which may build upon other operations that are already in existence (albeit not focusing explicitly on energy) or partially or totally integrated into energy service companies that specialize in these niches. This, moreover, opens up new opportunities of employment for specialized technicians which is a cornerstone of development.

Energy production for the centralized networks can represent income for communities. As well as the possibilities of the systems that provide energy for local communities, the production of electricity for centralized systems on village land (based on wind power, using energy installations, or in small hydroelectric reservoir plants) would be an important and permanent source of income for these communities.

(ii) Elements of the Proposal

In carrying forward this initiative, the reader’s attention is drawn to the various component parts which should form an integral part therof, in particular:

Utilization, strengthening and/or development of local capacities. The utilization of local capacities should be a prerequisite for supporting the development of the projects in isolated areas. For this purpose it is not only important to assist them in the procurement of equipment and systems but also to strengthen the local capacity to design, produce and implement, supervise and operate equipment and projects that meet the priority needs of the communities. When action is taken —through alliances with a variety of local institutions and persons— to involve technicians from the country and region where the systems are to be installed, the authorities will achieve success in lowering the costs of installing and operating the system, while successfully managing and developing firms engaging in such activities.

The strengthening and development of networks for the supply of goods and services. In many communities there are already ways of gaining access to products on the market given that the worlds of commerce and services stretch much farther than the conventional energy networks. These business and service networks may be successfully converted into a framework for mechanisms for the delivery of equipment and spare parts, financing, training, maintenance and service for the teams and systems that use renewable sources of energy.

Integration of small networks. In many situations, stakeholders are given the opportunity to resolve the needs of many communities using a single central power plant that distributes energy through a small network that serves a limited spatial context. This ushers in the possibility of economies of scale that lower energy costs. Moreover, it gives stand-alone systems the option to utilize renewable sources of energy. This supports local needs but also contributes to a centralized system which in turn lends support to the local network itself.

Rules and mechanisms for sharing costs and risks. The blueprints for the projects, even for the poorest communities, must incorporate mechanisms to ensure that the target community is at least partly responsible for shouldering the costs and risks associated with the facilities.

Technical quality standards. Arguably the most important role played by central governments is to ensure that the equipment and systems in the market meet with sustainability and performance standards.

Monitoring. The programs, from their design, must integrate a considerable component of diverse technical parameters, in particular those related to the acceptance of technology.

Technical assistance to resolve technological problems. Another necessary element is the establishment of a technical assistance system that focuses on the problems that inevitably arise in any process of technological reform.

(c) Rational use of firewood

Firewood plays an important role in the energy policy of a considerable number of the region's countries and the economic livelihood of most of the inhabitants of rural zones. From an environmental and public health point of view, the use of firewood is recognized as a serious issue that requires comprehensive and systematic solutions. However, it is only a few years ago that energy policy was focusing intently on firewood, albeit in the interests of substitution rather than in terms of the utilization of a renewable resource.

As well as a possible disdain for a form of energy that might be seen as obsolete by policymakers in a sector notable for its high-tech characteristics, the informal sector focus on firewood supply and management is one of the reasons why it has failed to acquire priority status within the energy sector. By the same token, given the non-formal nature of the market, energy policy strategies have focused on the substitution of wood for fuels marketed in the formal sector. For this reason, in spite of its widespread use (or perhaps because of its arguably peripheral status), information is exceedingly scarce about firewood (and biomass in general) as a resource and its patterns of use and this complicates efforts to pursue well-founded and knowledgeable policies.

In this area, given that policy efforts are focused on lowering rather than broadening its consumption, the level of use and the opportunities associated with firewood are inversely proportional to the results achieved thus far given that policy efforts have been confined to initiatives undertaken by NGO's with limited resources. However, those who work in these areas report that clear progress is being made in the technological development of improved stoves. Furthermore, the various participants are poised to undertake programs that include business-oriented components.

A key element in the outlook for firewood in the present analysis has to do with its nature as a renewable source of energy. On the one hand, its utilization represents a use of renewable energy. On the other hand, its current patterns of use indicate that it is not a sustainable resource —in direct violation of our insistence that renewable sources of energy contribute to sustainability. Thus it is important to spell out the role to be played by firewood in energy in the region in future and the policy efforts required to ensure that it can be clearly identified as a source of renewable energy which, in the final analysis, contributes to sustainable development.

The following proposals are made:

(i) Principles

Firewood is renewable energy. Firewood should be showcased as a form of renewable energy that, as opposed to other kinds of renewable energy, is especially in need of sustainable utilization strategies.

Changing the patterns of use of firewood has many advantages. A more efficient use of firewood does not only make more sustainable its utilization but also reduces the health impacts due to exposure to flue gases and reducing the time and effort necessary for their collection (or the associated economic costs).

The current consumption of firewood can be reduced considerably without reducing the level of performance that it provides. It is demonstrated that better designs of stoves can reduce by up to 70% current consumption without modifying the amount of heat that is thereby generated for the cooking of foodstuffs.

The technological solutions are very homegrown. Experience in the development of technology for a more efficient use of firewood indicates that benefitting from local materials (with sizable local value added), with designs that more closely reflect household customs (they should at least look like traditional stoves) and an active participation by local craftsmen will facilitate efforts to introduce lasting and optimal technological solutions.

(ii) Elements of the Proposal

To improve the awareness of the sustainable use of firewood and the potential of its use as an energy resource. A broad-based strategy will require ensuring that patterns of use are disseminated and replicated as widely as possible. In order to achieve this it will be necessary to increase the efforts of many researchers so as to reach a better understanding of the characteristics of natural resources that are available in specific locations and the patterns of use of each community. There is a concomitant need to establish parameters for the sustainable use of firewood, associated with the fact that wood is a resource that is currently facing certain constraints as an integral part of forests and thus a key component of biodiversity.

Evaluation of the market and monitoring. Before moving ahead with the programmes, it is necessary to carry out studies to measure the market potential of the improved stoves and our work must incorporate assessment principles and monitoring considerations from the outset.

Supporting the use of the firewood in productive applications. As in the case of rural electrification, the use of firewood can go beyond home-and-hearth issues and ultimately serve as a full-fledged input for productive activities in the community.

Promotion of technology so as to ensure a more efficient use. The market already offers a sizable array of equipment which can significantly improve efficiency in the use of firewood while eliminating environmental pollution problems in rural homes. This equipment should be promoted through high-profile demonstration projects that are primarily designed to persuade women of their advantages.

The development of networks for the supply of goods and services. It is necessary to support the establishment and/or strengthening of networks for the supply of equipment and spare parts and for the provision of financing and service and maintenance. In this area, local craftsmen must make the transition from individual production to large-scale production and play a full role in developing these networks for promotion and marketing.

(d) A new perspective for biomass and biofuels

The world's energy agenda has been dominated, since the first half of the last century, by oil and its byproducts. The energy infrastructure has in turn been developed mainly to exploit, transport, store, distribute and take advantage of oil's energy capacity. However, chiefly due to the lack of domestic resources of some countries in a market of high prices and subsequently concerns relating to the global environment (global warming), people have been taking a fresh look at what is ultimately a de facto system for the storage of solar energy: we are referring, of course, to biomass.

Nowadays, in addition to the traditional uses of firewood in the poorest regions, biomass has once again been recognized as an important resource in the generation of electricity (in particular sugar cane bagasse and other agro-industrial wastes) and as an input for the production of the so-called "biofuels".

Other factors, such as the fact that it can be converted into fuel so as to be used in transport, the obvious limits on current oil reserves, biotechnological developments, the growing instability in the Middle East, the existence of territorial reserves in countries in the region that can be used for the cultivation of energy and the need for a fresh approach regarding rural development have compelled a strategic reappraisal that is increasingly focusing on this variety of renewable energy.

Few regions in the world are so ripe for incorporating biofuels into the energy matrix as Central America.[61] In this region, where the reliance on fuel imports (such as oil and oil byproducts) is virtually absolute, there are soils and climates suitable for agricultural production, "energy-oriented" cultivation has been known for centuries and it's distinctly puzzling that there should be no domestic consumption of anhydrous ethanol fuel which is instead being exported in growing volumes (Guatemala, El Salvador, Costa Rica).

An initiative of this nature is based on the following principles and proposals:

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[61] See Luis Horta, Perspectives on a Biofuels Program in Central America. ECLAC/Federal Republic of Germany Project. Sustainable use of hydrocarbons, December 2003.

(i) Principles

Biofuels represent renewable energy options that are becoming used on a growing scale. The ethanol from sugar cane or corn and the biodiesel from vegetable oils are consumed by motor engines in a great many developed and developing countries in view of their environmental and job-creation-related advantages, their scope for boosting agro-industry and reducing their energy dependency. Among the biofuels the reader's attention is drawn to the ethanol produced by sugar cane.

The development of the technology for the production of ethyl alcohol has boosted productivity levels, far in excess of those recorded for other alternative sources. The use of ethanol in engines, whether pure or mixed with gasoline, constitutes a proven and commercial technology. For use in mixtures containing up to 10% of ethanol, it is not necessary to make changes or adjustments to engines and vehicles. However the production of ethanol from sugar cane is liable to generate adverse environmental impacts[62] that can and must be reduced to the bare minimum. Experience in Brazil has borne out the potential of biofuels. Using for nearly 30 years these fuels in almost all the light vehicles in its fleet (15 million cars use gasohol with 25% ethanol, 3 million use pure ethanol hydrate), Brazil has demonstrated two key points: technical problems have been overcome and the economic cost of ethanol have improved to levels that allow it to compete, given appropriate tax policies and without subsidies, with gasoline derived from oil.

In the 1980s there were attempts to introduce ethanol to Central American countries but these attempts were not successful. In Guatemala, El Salvador and Costa Rica, experiments were carried out to develop the commercial use of gasohol but these were nipped in the bud by problems relating to quality, management and prices. However, these countries retained their expertise and nowadays export this biofuel to the USA.

In Central America there are countries that are eminently well suited for rapidly promoting the use of gasohol. The technological scenario for the sugar industry in Guatemala, Costa Rica and El Salvador demonstrates encouraging levels of productivity with indicators that are comparable to plants in Brazil. Moreover, this sector is noteworthy for its capacity for management and political coordination and this goes hand-in-hand with the establishment of regional organizations for the promotion of biofuels (Association of Renewable Fuels of Central America).

There have been increasing initiatives to formalize gasohol programmes in countries in the region. Most clearly in the case of Costa Rica and Guatemala, several countries —at the government level and in coordination with the sugar sector— are implementing proposals for the mandatory adoption of gasoline/ethanol blends. The basic goal for the business community is to improve the flexibility and scale of production of its agro-industry whereas the government is focusing on advantages in regard to the environment, reducing imports, creating jobs and energizing the economy.

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62 The processes involving the acid and enzymatic hydrolysis of cellulose substrates (as in the case of ethanol production) produce chemical results of a high toxicity, including the "black liquor" which has to be managed and eliminated suitably.

(ii) Elements of the Proposal

Ethanol requires support mechanisms to ensure its viability. Given that the prices of gasoline in Central America are even lower than the prices quoted by sugar mills, the authorities need to spell out the intended apportionment of the additional costs that result from the addition of ethanol to gasoline —i.e., how these costs are to be divided up among consumers, the government and sugar mills.

Stakeholders need to rethink the heavy government involvement in the sugar industry that could harm the desirable development of biofuels. At present we still encounter mechanisms for the fixing of quotas and prices, monopolies, high tariffs and distortions in sugar prices which reflect the underlying economic costs only to a limited extent. The proposal for producing and using ethanol seek to identify more suitable mechanisms, conducive to technological progress and capable of promoting efficiency gains and passing them through to prices. Any support or development system based on the existing procedures ought to have a strictly finite lifespan.

It is important to stress institutional training so as to grasp the potential benefits, impacts and limits of biofuels. Government entities must play a consistent role in defining a suitable programme for the introduction of biofuels, focusing on societal outreach that builds consensus and ensures appropriate burden sharing.

Biodiesel is still being developed and presents costs that limit its competitiveness. This biofuel will be able to play an important role, its production technology has made strides but currently its production costs are very high compared to those derived from petrol. Moreover, producing and selling vegetable oil is more lucrative than burning it, given the current price environment. However, to the extent possible, stakeholders must pursue their efforts to develop this biofuel.

Central America can increase rationally its energy sustainability through biofuels.While recognizing their advantages and opportunities, stakeholders must develop a clear overview of the impacts, cultural obstacles and problems of an economic nature. Biofuels and especially ethanol produced from sugar cane and used in mixtures with gasoline cannot be regarded as a panacea; but their implementation may be a major catalyst for sustainable economic, environmental and social development.

Costa Rica, El Salvador and Guatemala have been shown to possess the maturity needed to carry through a biofuels programme. However, work still has to be carried out in the tax, legislative and management spheres, yet there can be no question that these countries already have the necessary wherewithal to ensure that, in the short term, they can proceed with the production and utilization of biofuels.

Honduras, Nicaragua and Panama, even though they have the basic ingredients (the existence of a sugar industry, availability of suitable climates and land, reliance on fuel imports), were not judged to be countries in a position to implement short-term programmes.

Important considerations to be taken into account when designing sound programmes for introducing the rational use of biofuels in Central American countries definitely include societal outreach and appropriate burden-sharing.

The typical sugar harvest in Central America is 120 days or less while in Brazil it is 200 days. Increasing the harvest fundamentally presupposes the suitable management of sugar-cane cultivations as well as an appropriate industrial utilization period for the sugar cane. Don't forget the importance of ensuring the availability of early, normal and late varieties of sugar canes.

4. Opportunities for Emissions Provided by the New European Directorate (EuroKyoto)

The purpose of the proposed linking directive 2003/0173 (COD) is to govern the relationships between the European Trading Scheme and the Kyoto Protocol (i.e. to allow credits from the Joint Implementation (JI) and Clean Development Mechanism (CDM) project-based activities under the Kyoto protocol to be converted into emission allowances within the European Union). Many refer to this new initiative as the "EuroKyoto".

This requires the recently-adopted Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading to be amended.

The rationale behind this is that, since climate change is a global phenomenon, it does not matter in which part of the world emission reductions take place. Moreover, as a rule it costs less to reduce emissions outside the EU than within the EU.

As is well known, Joint Implementation projects involve industrialised countries or countries with economies in transition, whilst CDM projects concern developing countries, as is the case with Latin American nations. The precondition for undertaking such projects is that the countries concerned have ratified the Kyoto protocol. Ultimately such projects result in an exchange: countries with economies in transition and developing countries receive capital and know-how, whilst Europeans obtain credits for reduction of greenhouse gas emissions.

Information provided by the Member States of the European Union indicates that by the start of 2005 they intend to invest approximately € 350 million in CDM projects. This figure will undoubtedly increase once this directive has been adopted.

Nevertheless, the EU will most probably fall well short of its Kyoto target. Instead of reducing greenhouse gases by 8% by 2010, it will only achieve a 5% reduction.

And this figure does not even take into account higher economic growth. It is particularly striking that greenhouse gas emissions are beginning to rise again in Germany, and the country is unlikely to reach its goal of a 21% reduction in emissions even though it is currently already very close to that figure, with a 19% reduction.

To date, flexible mechanisms as well as land use have played a secondary role in the approach taken by Member States. However, should it become more strongly evident that the EU will not reach its Kyoto target, interest in flexible measures are likely to increase significantly.

Currently under discussion is a proposal to raise the upper limit of emission allowances within the Community for JI or CDM projects[63] from 6% to 8%.

As a matter of fact, 6% of allowances correspond to approximately 2% of total base year emissions (4,017 million tons CO_2 equivalent), that would equate to a figure of approximately 80 million tons for project-based mechanisms, which is precisely a quarter of the 320 million tons CO_2

[63] Respectively: Emission Reduction Units (ERU) for JI projects and Certified Emission Reductions (CER) for CDM ones.

equivalent reduction that the EU has to achieve under its Kyoto obligations. Based on a figure of € 10/ton CO_2 equivalent, the cost of the measure would be € 800 million a year.[64]

Taking 8% as the upper limit, over € 1 000 million per year would flow into developing countries and countries with economies in transition via JI and CDM projects. During a post-Kyoto period, if the European Union were to be required to further reduce emissions, a figure of € 10,000 million a year could easily be reached given higher CO_2 equivalent prices.

This directive therefore comes at the right time for developing countries. It may possibly play a greater role in climate policy than many at present suppose and —with regard to Latin America— will offer the region's countries a unique opportunity to enter into an "institutionalized" global trading system, taking advantage of the expertise and projects already successfully developed under the Kyoto "pilot phase" (see chapter IV for details).

5. The success of guaranteed purchase systems or "Feed-In" in Europe: an example for Latin America?

Under a "feed-in" regulation (also known as "pricing" system) electric utilities are obligated to enable renewable energy plants to connect to the electric grid, and they must purchase any electricity generated with renewable resources at fixed, minimum prices.

These prices are generally set higher than the regular market price, and payments are usually guaranteed over a specified period of time. Tariffs may have a direct relationship with cost or price, or may be chosen instead to spur investment in renewables.

The precursor to the pricing law was enacted in California during the 1980s. The U.S. Public Utilities Regulatory Act (PURPA) required utilities to interconnect with and buy energy from "qualifying facilities," including renewable energy plants, at incremental or avoided costs of production. In California, the implementation of PURPA involved the use of standardized long-term contracts with fixed (and, in some cases, increasing) payments for all or part of the contract term. The costs of the contracts were covered through higher electric rates for consumers. While these contracts proved costly, it is widely believed that the alternative (nuclear power) would have been even more expensive.

The time length of the contracts (15 to 30 years for wind projects), combined with fixed energy prices for much of that time, assured producers of a market for their product and finally gave them something they could take to the bank to obtain financing. While most other U.S. states saw little development during the 1980s, California —for a time— became the world's leader in renewable energy use.[65]

The early feed-in laws in Europe, in Denmark and Germany, also required that utilities give small wind and other private generators access to the electric grid, and they guaranteed producers a minimum share of the retail rate —at least 85% in Denmark, and 90% in Germany.

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[64] Extracted from the "Draft Opinion" of the Rapporteur of Committee on Industry, External Trade Research and Energy of the European Parliament, on the proposal for amending the Directive 2003/87/EC, December 2003.

[65] Extracted from "National Policy Instruments: Policy Lessons for the Advancement & Diffusion of Renewable Energy Technologies Around the World", Thematic Background Paper for "World Renewable Conference 2004", December 2003.

The German system was revised in 2000, and today most pricing laws provide a fixed payment for renewable electricity that varies according to technology type, plant size, and occasionally by location (e.g., wind energy), and is generally based on the costs of generation. Payments guaranteed to new projects decline annually, and are adjusted every two years. The tariffs last for 20 years from date of project installation.

The costs of higher payments to renewables are covered by an additional per kilowatt-hour (kWh) charge on all consumers according to their level of use (e.g., Spain, Germany as of 2000), a charge on those customers of utilities required to purchase green electricity (e.g., Germany until 2000), or by taxpayers, or a combination of both (Denmark through feed-in rates and reimbursement of the carbon tax).

Laws similar to Germany's pricing law have been enacted in Spain, and several other European countries, including France, Austria, Portugal, and Greece, in addition to South Korea. It is important to note that feed-in laws have not succeeded in every country that has enacted them.

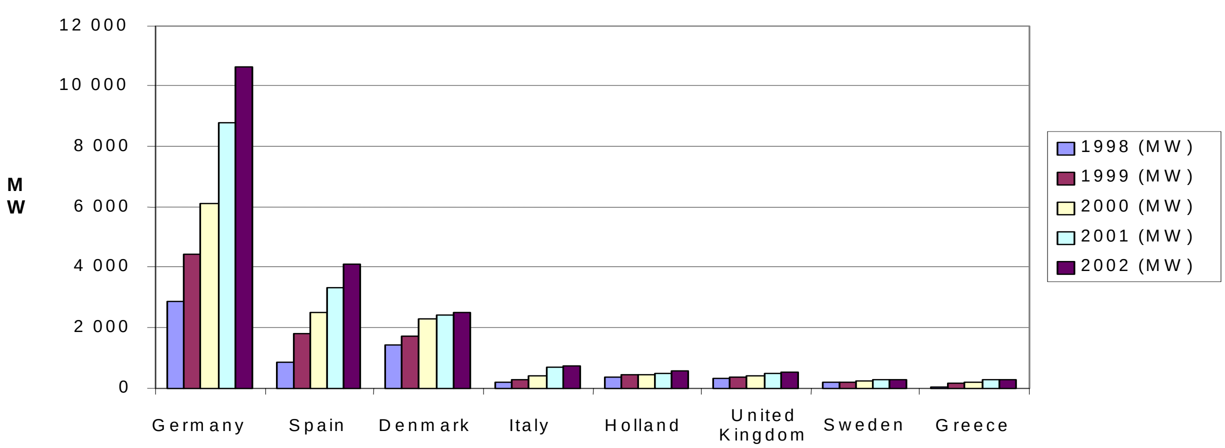
In order to succeed, tariffs must be high enough to cover costs and encourage development of particular technologies; they also must be guaranteed for a time period long enough to assure investors of a high enough rate of return.

The success of pricing laws is also determined by factors such as charges for access to the electric grid, limits set on qualifying capacity, and the ease of permitting and siting (influenced by the existence and specifics of national or regional standards).

Today, it is possible to state that those countries that have experienced the most significant market growth and have created the strongest domestic industries have had pricing laws (see figure V.1).

Figure V.1

IMPACTS OF THE "FEED-IN" SYSTEM IN THE EXPANSION OF WIND-POWER USE IN EEC COUNTRIES



Source: Based on data provided by EUROSTAT 2003 and the "Renewable Energy Information 2003" (IEA).

6. Risk management as a prerequisite for ensuring viable financing[66]

The management of risk (risk/profitability tradeoffs) in renewable energy projects is one of the major bottlenecks standing between a particular sector and increased participation by public and private investors, not only in Latin America where the problem is of the utmost importance but also in developed countries.

Participation in the equity structure of ventures —be they in the private sector or public sector— represents a key component in the evaluation of the risk factor in projects.

For this reason, the possibility of complementing the structure of the initiative with locally available equities, while enhancing local management capacity through equity-based public and private financing instruments, should be regarded as a vital tool for boosting renewable energy initiatives in a competitive environment.

The most important risks associated with private investment in renewable projects are (i) of a political nature and (ii) of a commercial nature related to the activities involved in exploration for the renewable resources and in the industrial development of the plants that convert these resources into energy.

Political risk is related with the expectations of private investors regarding the degree of permanence of specific regulatory standards, key policies and the extent to which governments and state agencies keep their promises.

Commercial risks are basically associated with the availability and trustworthy nature of the information that is provided —i.e., the quantity and quality of the wind, sun, wood, sugar cane products, organic wastes, endogenous steam, etc. This information determines the degree of confidence with which one can establish the characteristics of the "potential renewable business" in such a way as to allow for an acceptable assessment of the financial viability of the investments.

The ultimate objective is therefore to generate sufficient and suitable information that can pinpoint the prospective design characteristics of an electricity generating plant, including service life, capacity for power generation, level of confidence in the availability of a resource and sustainability of operational yields.

At present, foreign investors are equipped with diverse mechanisms to hedge against political risks which are normally administered by agencies that specialize in developed countries (export agencies such as the United States Overseas Private Investment Corporation (OPIC)), by multilateral organizations through the guarantee programmes of the Inter-American Investment Bank and the World Bank (such as the Multilateral Investment Guarantee Agency-MIGA) and by private insurance companies.

However, the market currently lacks mechanisms to cover the commercial risks associated with the research and development of renewable projects.

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[66] Extracted from M. Coviello, "International Environment and Opportunities for the Development of Renewable Sources of Energy in Countries in Latin America and the Caribbean". Natural resources and infrastructure series, No. 63, Santiago, September 2003.

- **Proposal: Creation of a Regional Guarantee Fund**

Based on this conceptual focus, it would be advisable to establish a guarantee mechanism that serves to diminish the risk entailed by preliminary investment in renewable projects, in particular those associated with very expensive exploration processes which entail higher commercial (technical and financial) risk.

The scheme would be based on insurance against commercial risks, associated with exploration for renewable resources, which would be provided by private insurance companies to investors contemplating the implementation of such projects.

For this to occur, regional and multilateral institutions must provide financial assistance, as must state technical assistance agencies that are ready to participate in the design of a package of coverage for private projects which are, in turn, insured by private insurance companies.

In this way the equity-based instruments will effectively leverage the available financial resources, both public and private.

The contingent commitments of these guarantors could allow for the creation —for example, in the case of Latin America— of a Regional Guarantee Fund for renewable projects whose ultimate goal would be to promote the incorporation of companies (public and private) in the development of renewable energy projects in Latin America and the Caribbean, through action to mitigate the risks associated therewith.

Initially a regional entity[67] could be responsible for the design and implementation of the Guarantee Fund, endeavoring to harmonize the interests of the main stakeholders involved in the initiative: (i) the governments; (ii) international guarantors; (iii) insurance companies; (iv) project developers.

Subsequently —after setting the stage for this new structure and its operations— the Regional Fund should be equipped with a specialized operating entity to conduct its day-to-day affairs and to expand the Projects Portfolio, already implemented and well-stocked by the regional entity. Figure V.2 shows a conceptual blueprint for the Fund.

In tandem with, or as an alternative to the Guarantee Fund, the specialized operating entity could also manage a trust fund —i.e., an equity-based investment instrument designed to leverage financial resources (public and private) and to give greater stability to and inspire greater confidence in the flow of the funds.

This trust fund could participate in the development of projects as a sponsor and could dispose of its equity holdings once the projects become fully operational. A similar operating mechanism has already been implemented by some multilateral entities in projects involving renewable energy and carbon credits, as is the case with the World Bank[68] and the Inter-American Development Bank.[69]

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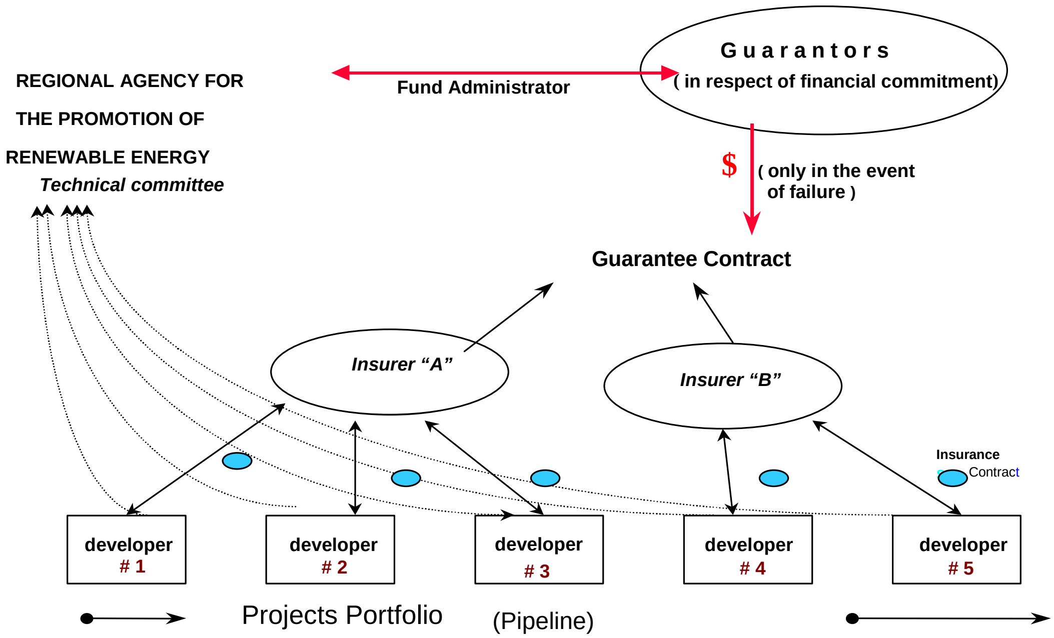
[67] For example, a "Regional Promotion Agency for Renewable Energy".

[68] Participation in the syndication of international funds for the "Zunil II" geo-thermal project in Guatemala, through the International Finance Corporation (IFC).

[69] Participation in the creation and financing of the "Clean Tech Fund", through the Multilateral Investment Fund.

Figure V.2
REGIONAL GUARANTEE FUND



A mechanism of this kind would allow for the creation of a team of professionals that would manage the operational structure of the Fund and would be paid by means of the management fees from the initiative. In this way, this process will help to build a proactive team which will help to create and manage opportunities for properly evaluated and supervised investment.

If they decide to go ahead with the creation of this type of Fund for sponsoring renewable energy projects, the countries of the region should take steps to enlist the aid of international financial organizations so as to design and implement the mechanisms in question. The fact that countries in the region can point to prestigious and solvent financial development institutions that are both regional (Inter-American Development Bank) as well as sub-regional (Andean Development Corporation, Central American Bank for Economic Integration, Financing Fund for Development of the River Plate Basin) is an advantage in the sense that these institutions will be able to help push the process along.

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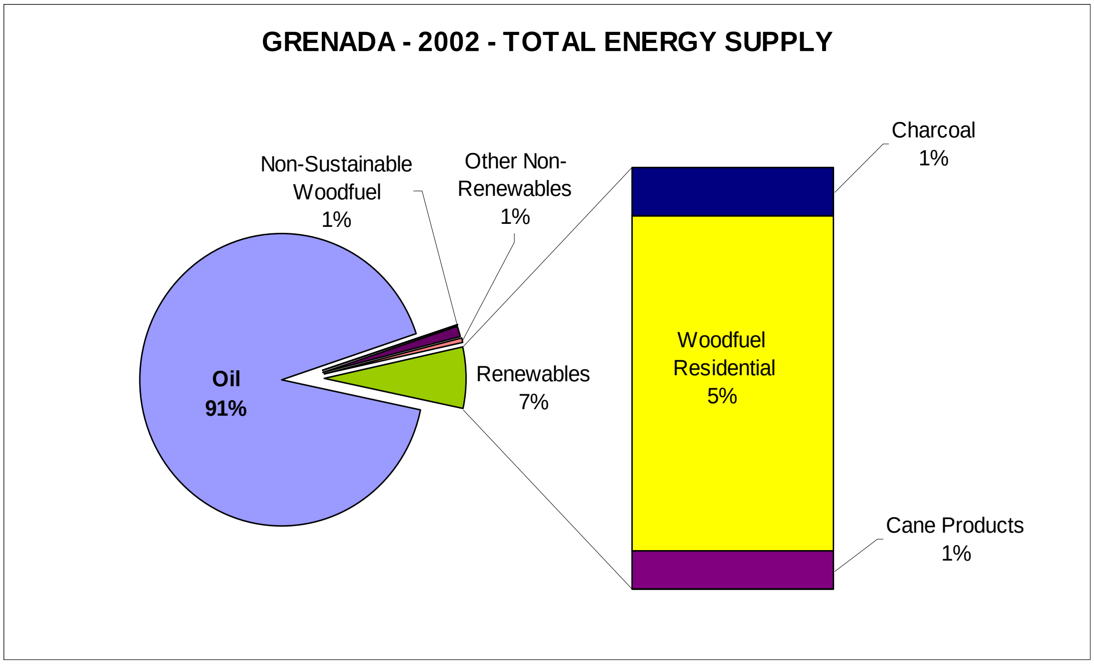
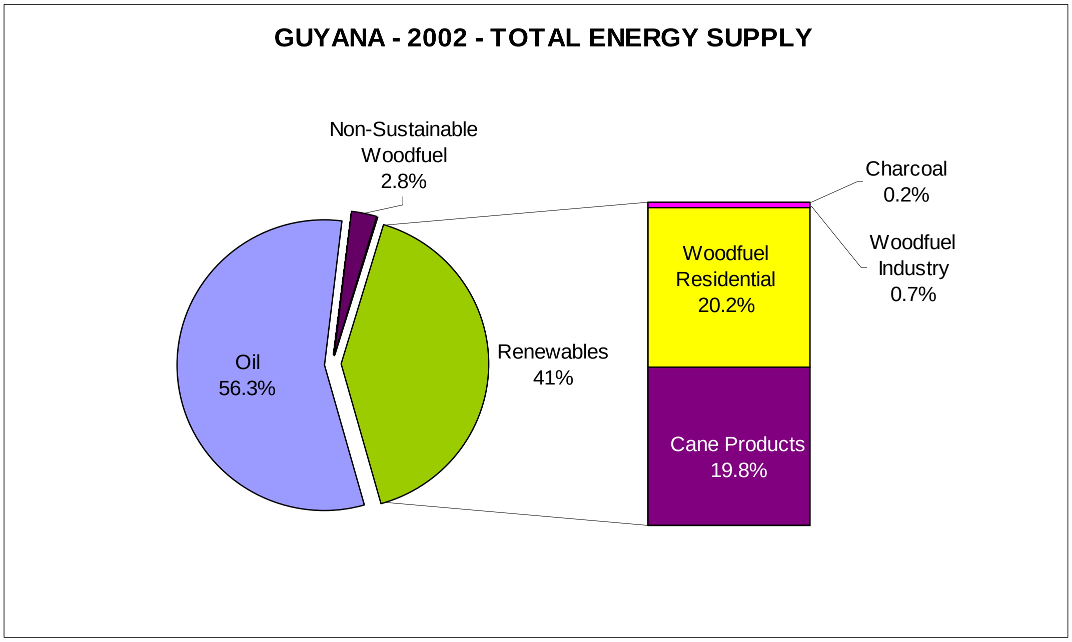
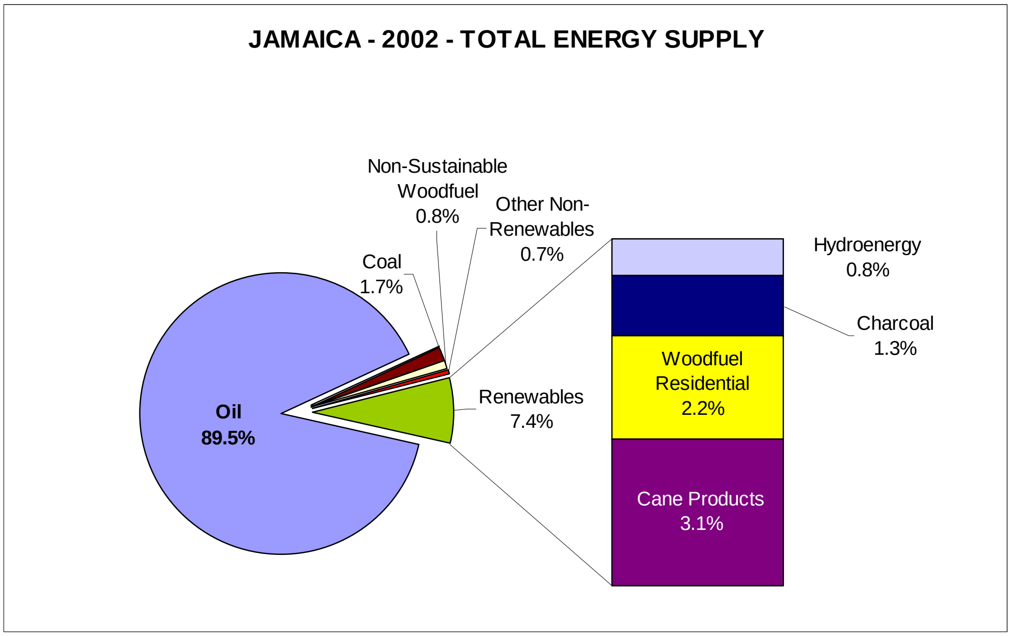
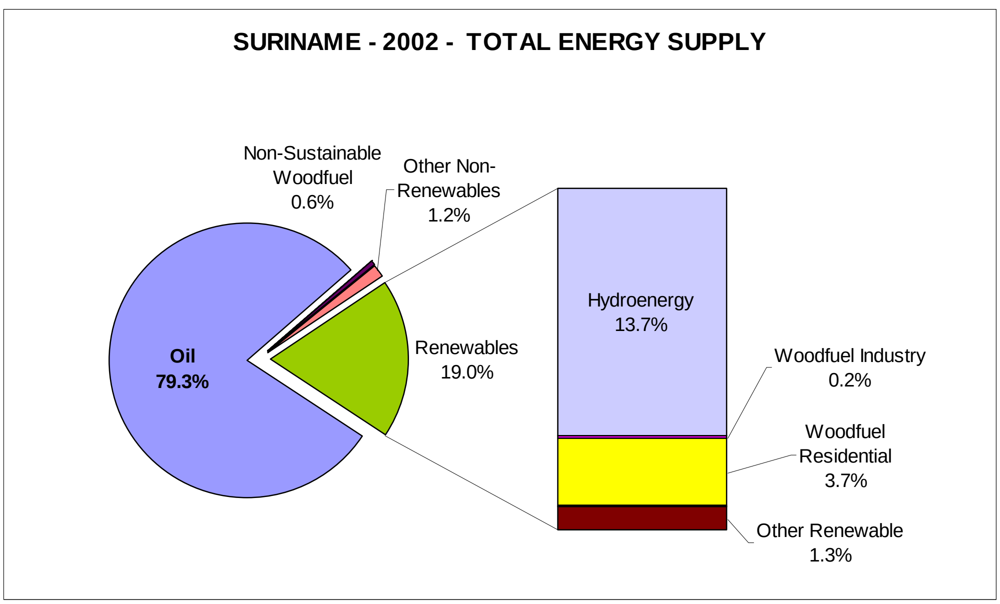
ANNEX

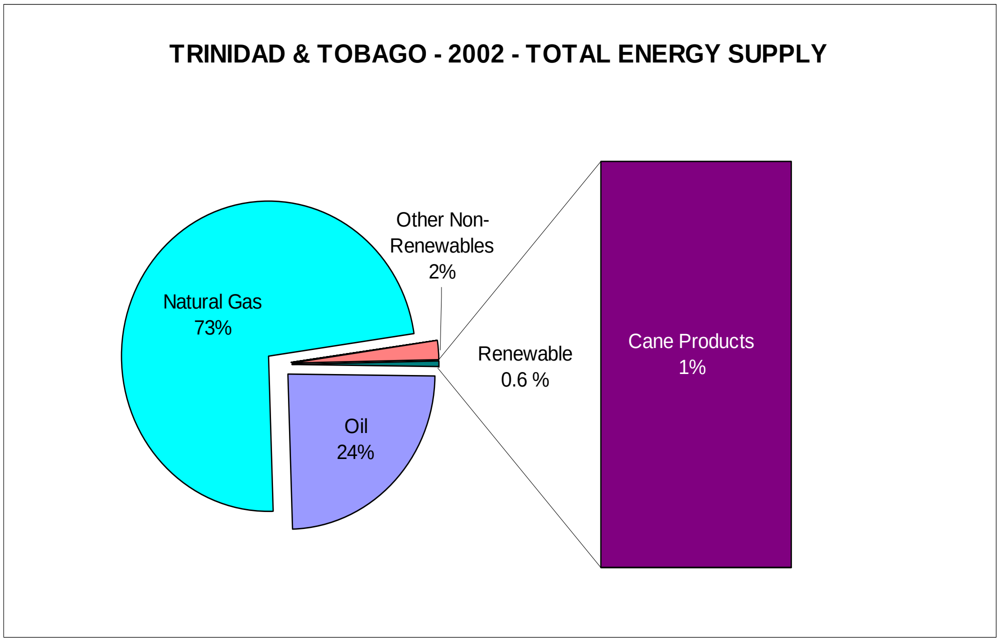
CARIBBEAN “1”

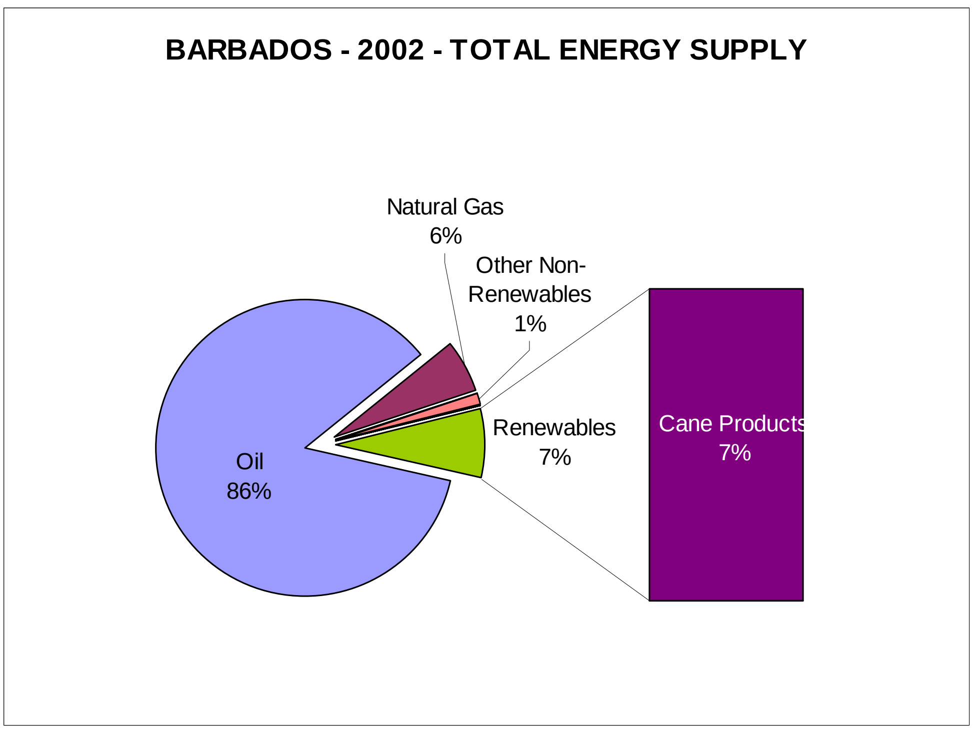

GRENADA - 2002 - TOTAL ENERGY SUPPLY
Non-Sustainable Woodfuel 1%
Other Non-Renewables 1%
Charcoal 1%
Woodfuel Residential 5%
Renewables 7%
Oil 91%
Cane Products 1%


GUYANA - 2002 - TOTAL ENERGY SUPPLY
Non-Sustainable Woodfuel 2.8%
Charcoal 0.2%
Woodfuel Residential 20.2%
Woodfuel Industry 0.7%
Oil 56.3%
Renewables 41%
Cane Products 19.8%

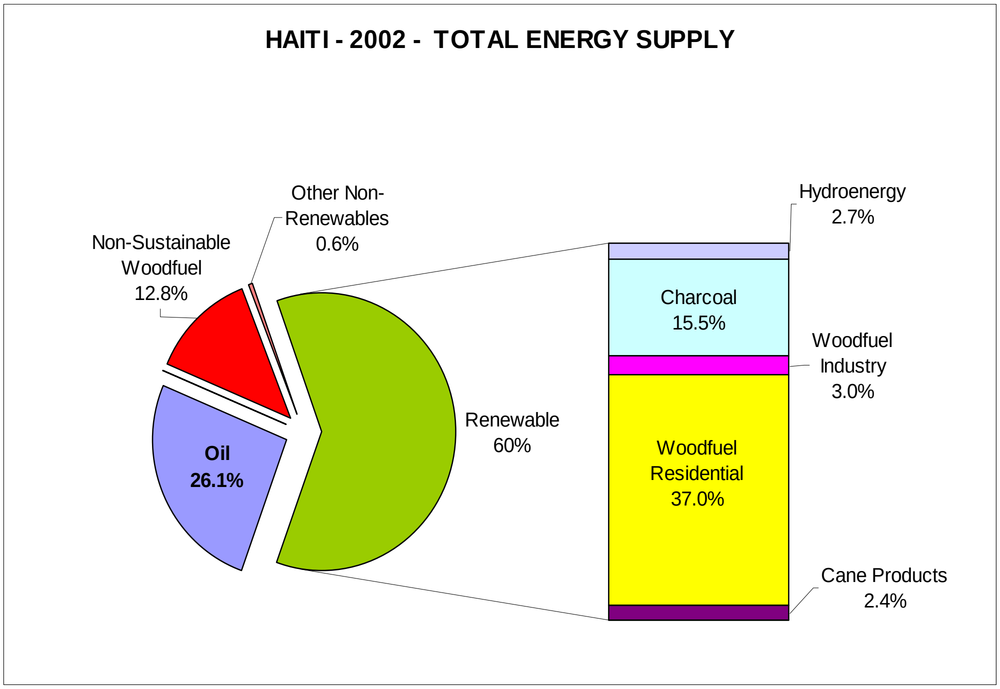

JAMAICA - 2002 - TOTAL ENERGY SUPPLY
Non-Sustainable Woodfuel 0.8%
Other Non-Renewables 0.7%
Coal 1.7%
Hydroenergy 0.8%
Charcoal 1.3%
Oil 89.5%
Woodfuel Residential 2.2%
Renewables 7.4%
Cane Products 3.1%

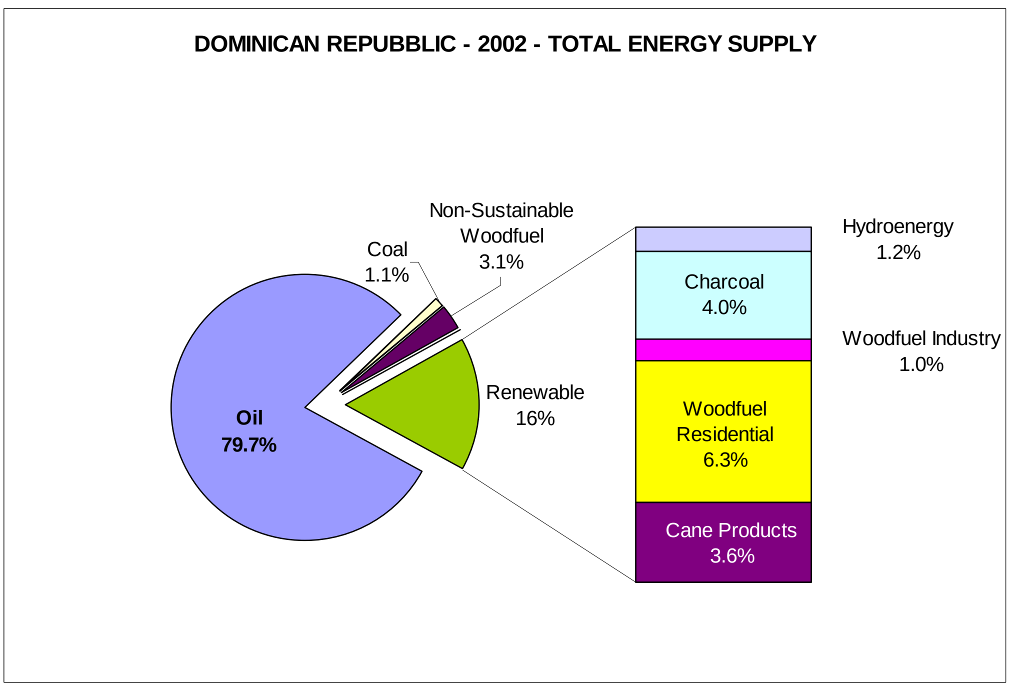

SURINAME - 2002 - TOTAL ENERGY SUPPLY
Non-Sustainable Woodfuel 0.6%
Other Non-Renewables 1.2%
Hydroenergy 13.7%
Oil 79.3%
Renewables 19.0%
Woodfuel Industry 0.2%
Woodfuel Residential 3.7%
Other Renewable 1.3%

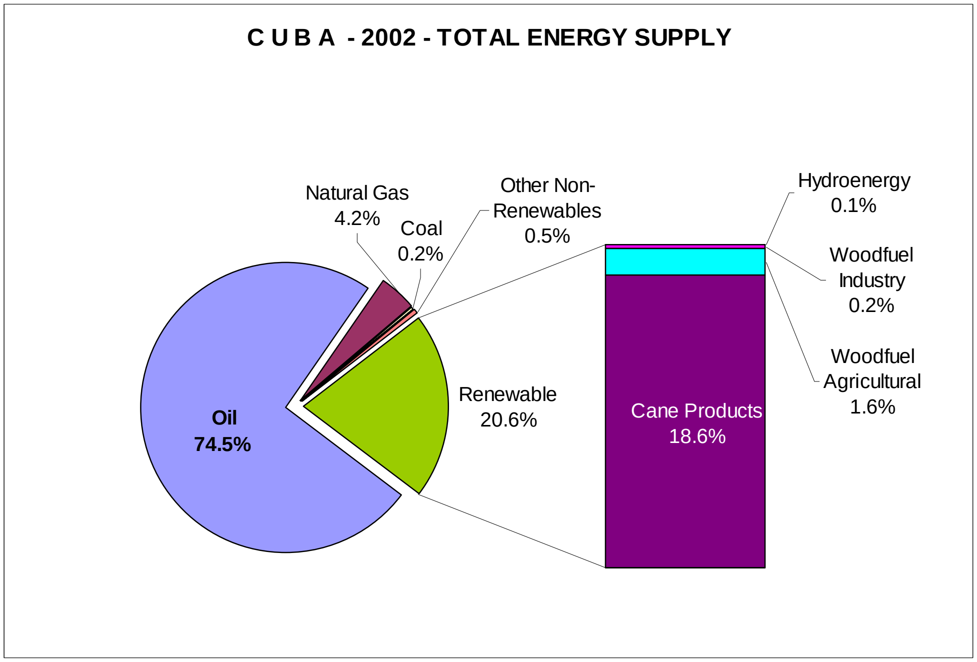

TRINIDAD & TOBAGO - 2002 - TOTAL ENERGY SUPPLY
Natural Gas
73%
Other Non-
Renewables
2%
Renewable
0.6 %
Cane Products
1%
Oil
24%


BARBADOS - 2002 - TOTAL ENERGY SUPPLY
Natural Gas
6%
Other Non-
Renewables
1%
Renewables
7%
Cane Products
7%
Oil
86%

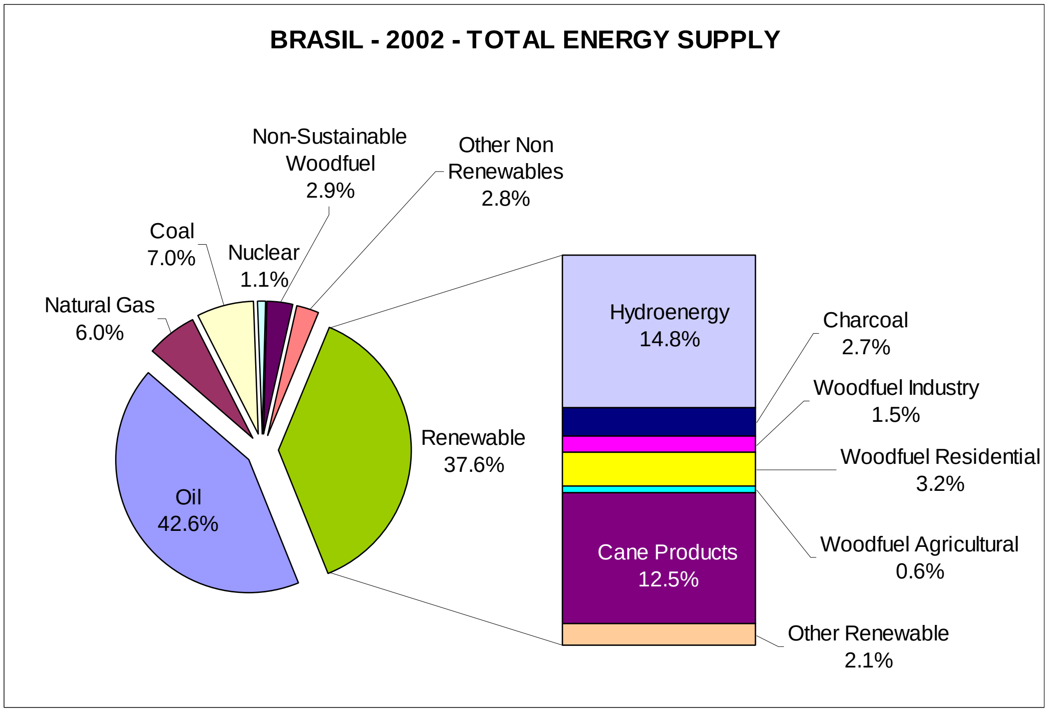
CARIBBEAN “2”

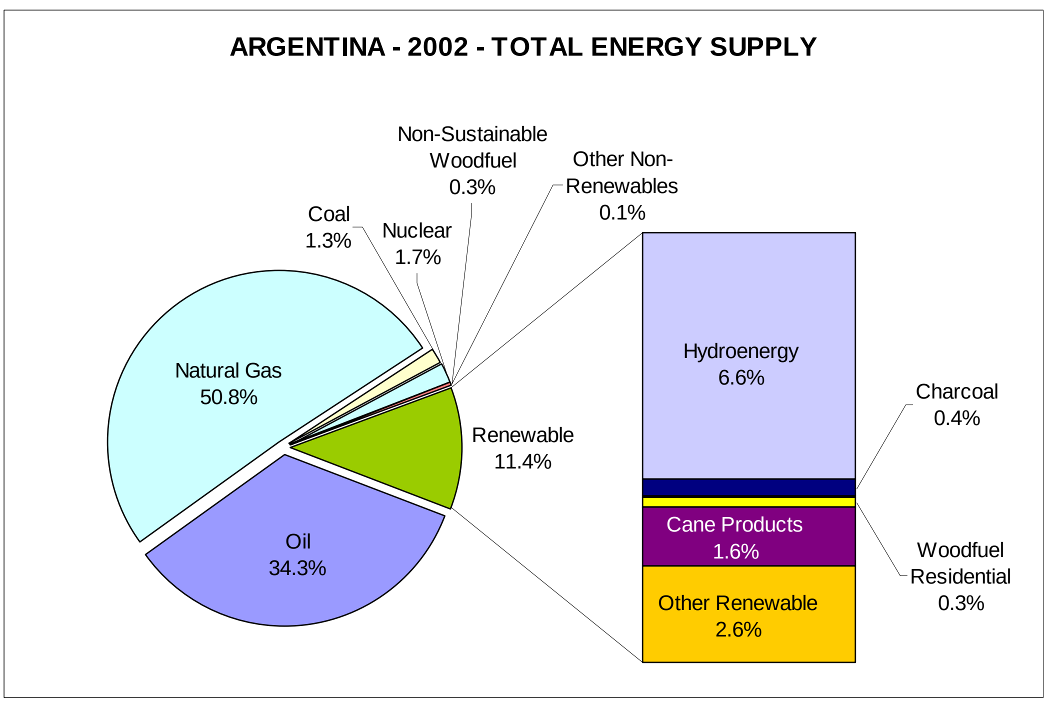

HAITI - 2002 - TOTAL ENERGY SUPPLY
Other Non-Renewables 0.6%
Non-Sustainable Woodfuel 12.8%
Oil 26.1%
Renewable 60%
Hydroenergy 2.7%
Charcoal 15.5%
Woodfuel Industry 3.0%
Woodfuel Residential 37.0%
Cane Products 2.4%

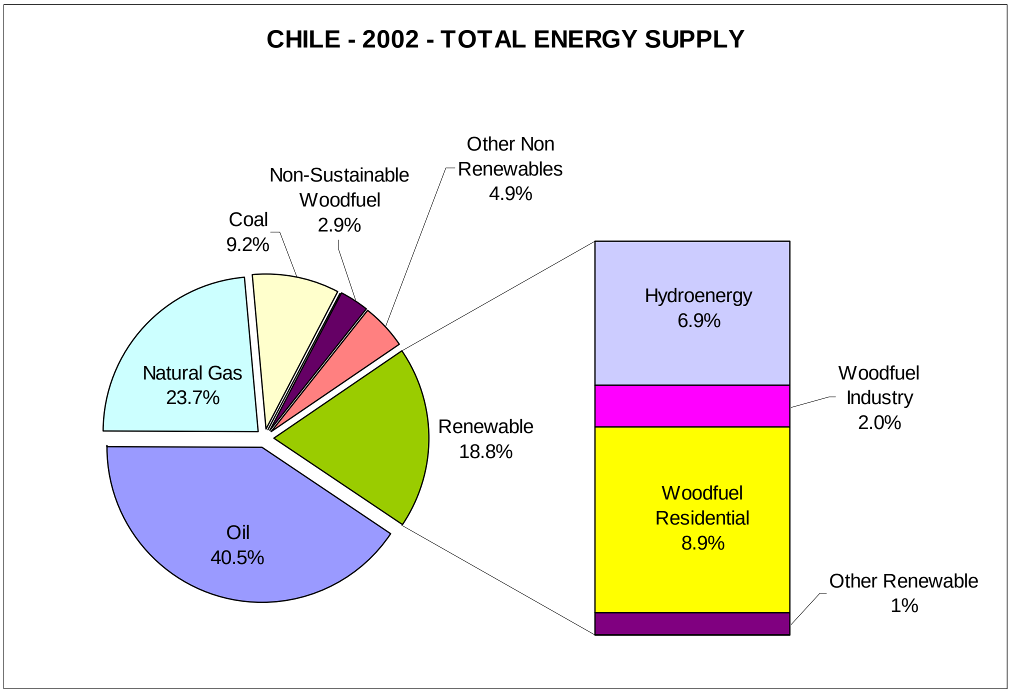

DOMINICAN REPUBBLIC - 2002 - TOTAL ENERGY SUPPLY
Non-Sustainable Woodfuel 3.1%
Coal 1.1%
Oil 79.7%
Renewable 16%
Hydroenergy 1.2%
Charcoal 4.0%
Woodfuel Industry 1.0%
Woodfuel Residential 6.3%
Cane Products 3.6%

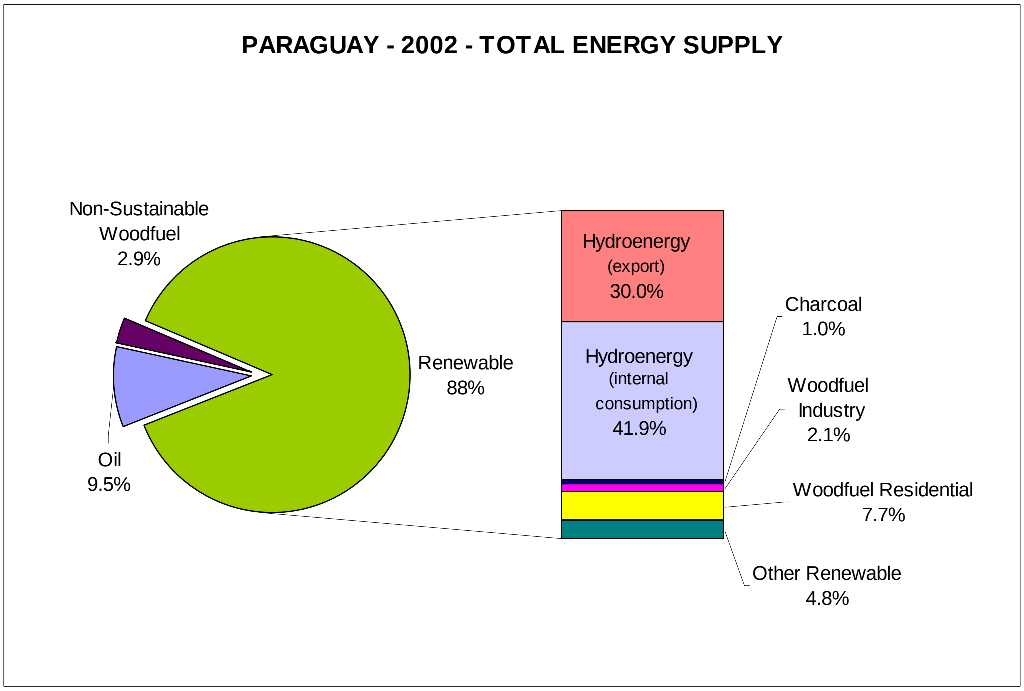

C U B A - 2002 - TOTAL ENERGY SUPPLY
Natural Gas
4.2%
Coal
0.2%
Other Non-Renewables
0.5%
Hydroenergy
0.1%
Woodfuel Industry
0.2%
Woodfuel Agricultural
1.6%
Renewable
20.6%
Cane Products
18.6%
Oil
74.5%

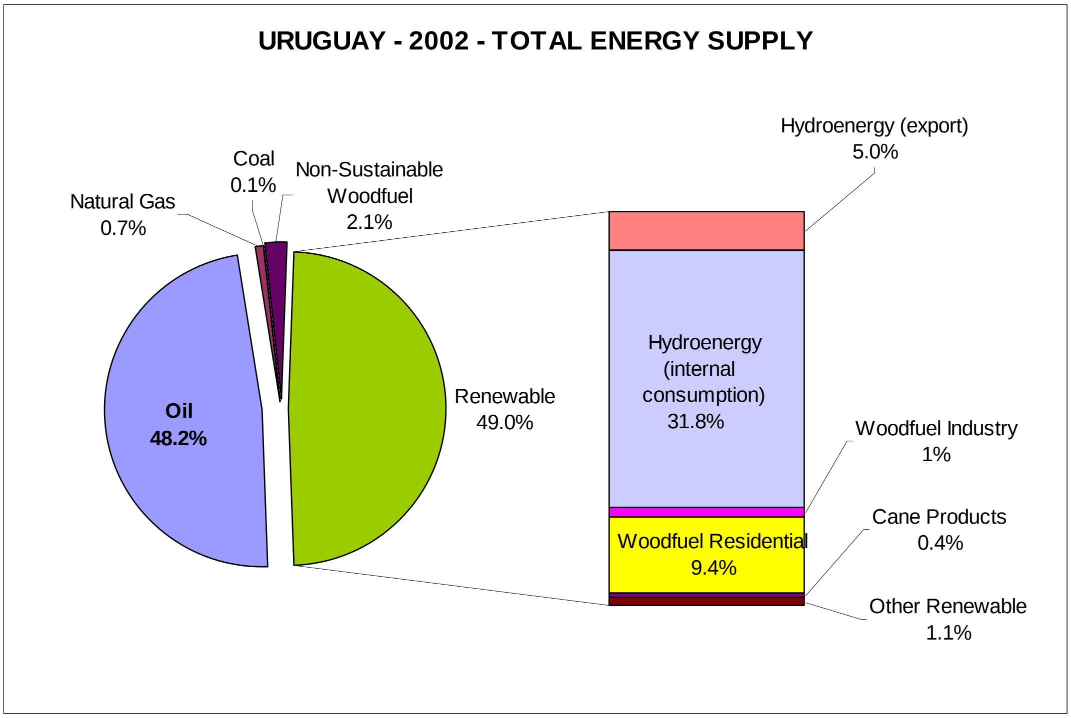
EXTENDED MERCOSUR


BRASIL - 2002 - TOTAL ENERGY SUPPLY
Non-Sustainable Woodfuel 2.9%
Other Non Renewables 2.8%
Coal 7.0%
Nuclear 1.1%
Natural Gas 6.0%
Oil 42.6%
Renewable 37.6%
Hydroenergy 14.8%
Charcoal 2.7%
Woodfuel Industry 1.5%
Woodfuel Residential 3.2%
Woodfuel Agricultural 0.6%
Cane Products 12.5%
Other Renewable 2.1%

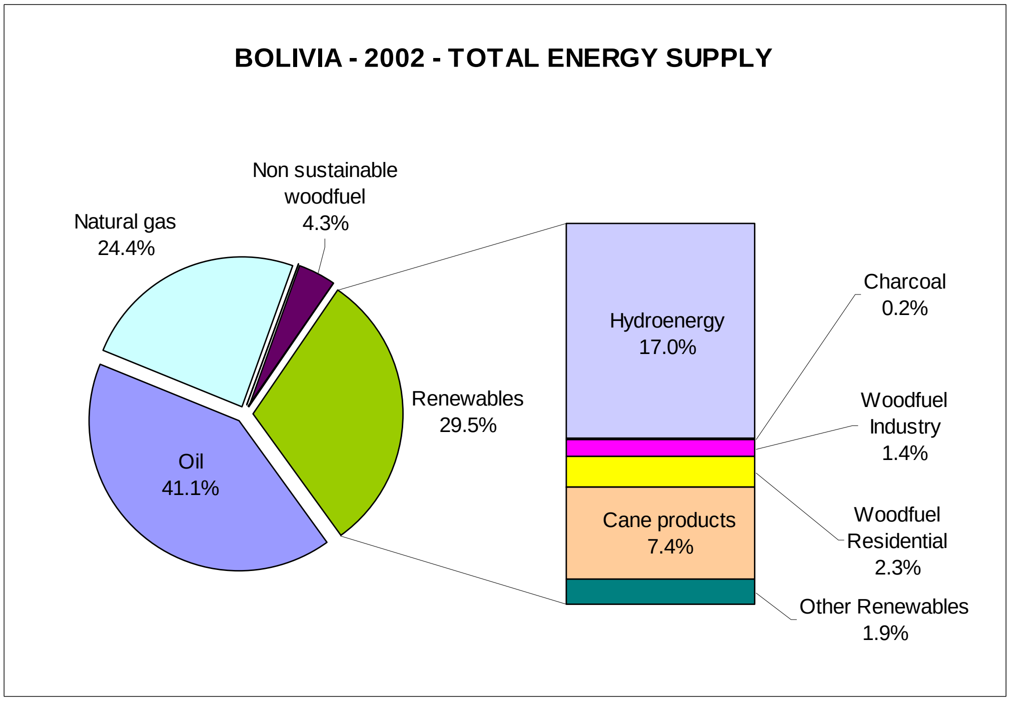

ARGENTINA - 2002 - TOTAL ENERGY SUPPLY
Non-Sustainable Woodfuel 0.3%
Other Non-Renewables 0.1%
Coal 1.3%
Nuclear 1.7%
Natural Gas 50.8%
Oil 34.3%
Renewable 11.4%
Hydroenergy 6.6%
Charcoal 0.4%
Cane Products 1.6%
Woodfuel Residential 0.3%
Other Renewable 2.6%

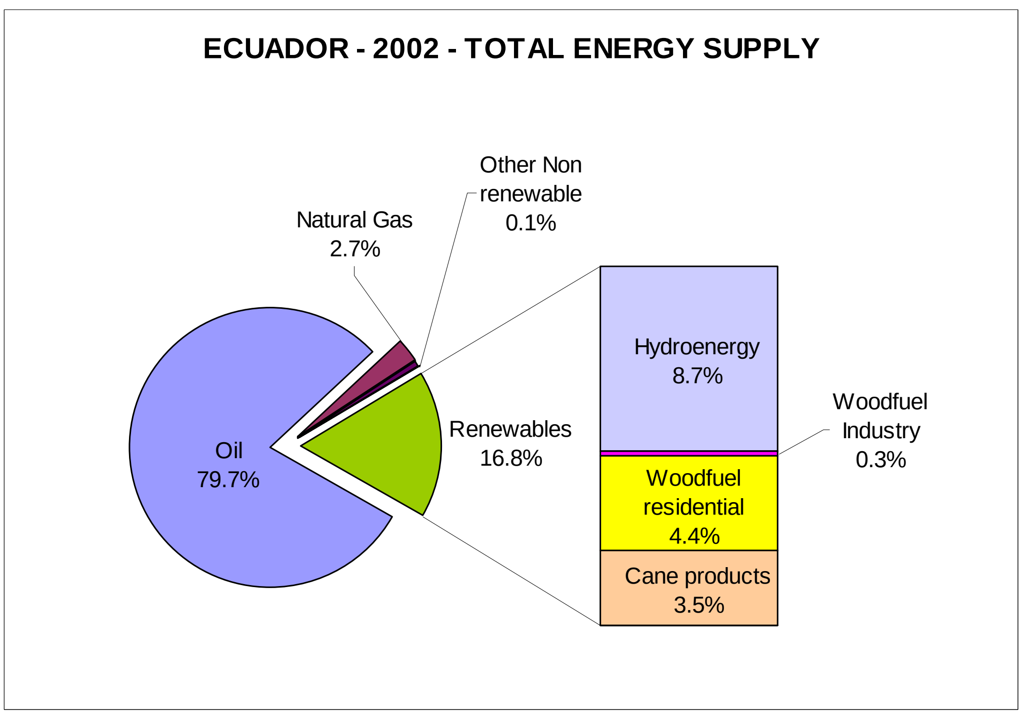

CHILE - 2002 - TOTAL ENERGY SUPPLY
Other Non Renewables 4.9%
Non-Sustainable Woodfuel 2.9%
Coal 9.2%
Natural Gas 23.7%
Oil 40.5%
Renewable 18.8%
Hydroenergy 6.9%
Woodfuel Industry 2.0%
Woodfuel Residential 8.9%
Other Renewable 1%

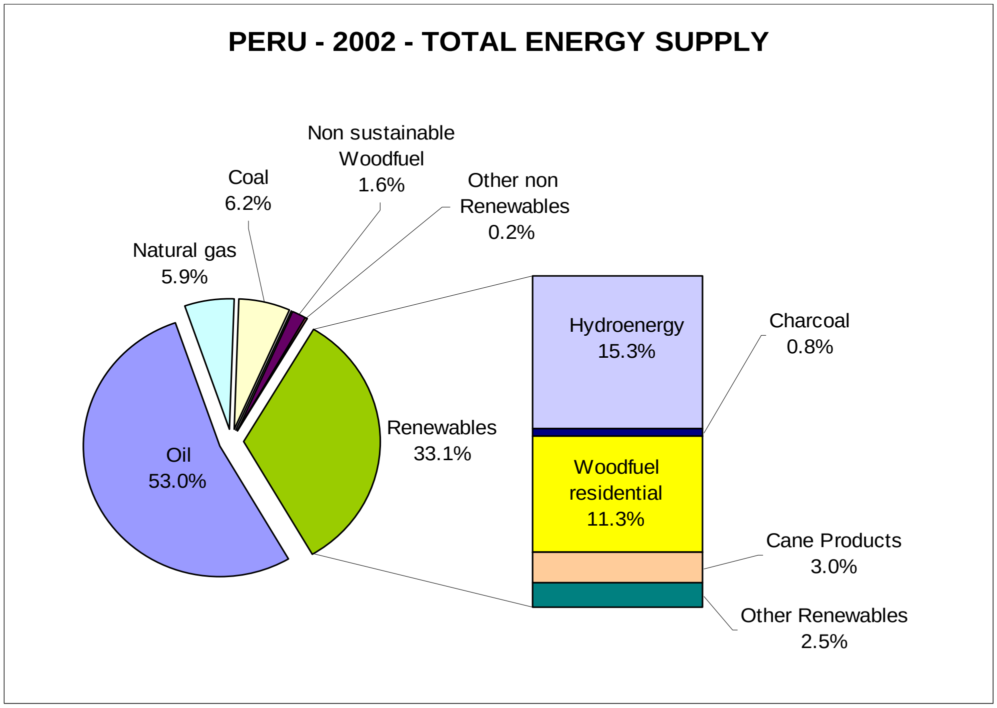

PARAGUAY - 2002 - TOTAL ENERGY SUPPLY
Non-Sustainable Woodfuel 2.9%
Oil 9.5%
Renewable 88%
Hydroenergy (export) 30.0%
Hydroenergy (internal consumption) 41.9%
Charcoal 1.0%
Woodfuel Industry 2.1%
Woodfuel Residential 7.7%
Other Renewable 4.8%

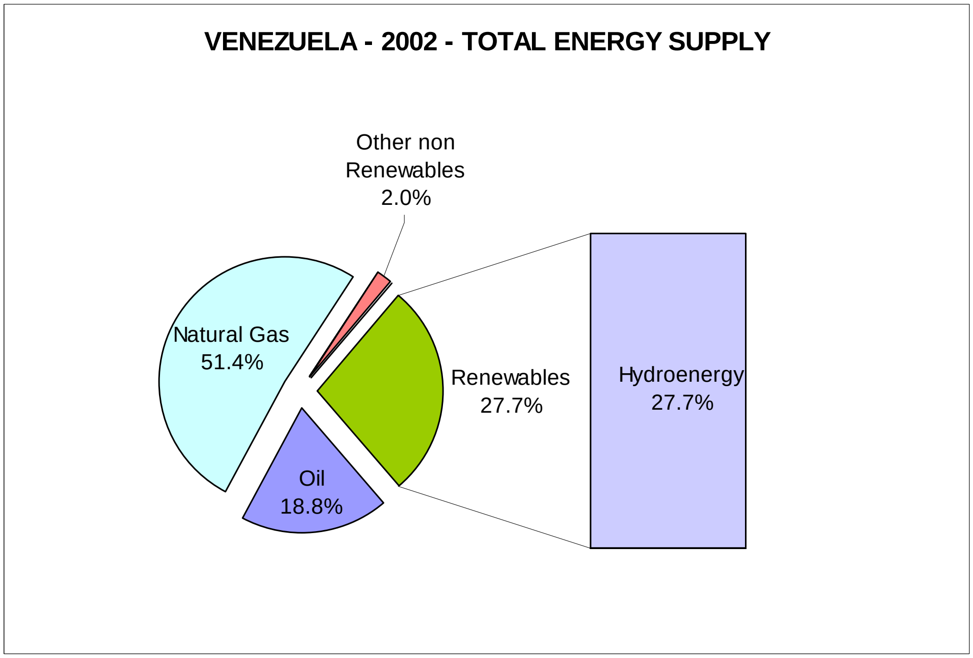

URUGUAY - 2002 - TOTAL ENERGY SUPPLY
Natural Gas 0.7%
Coal 0.1%
Non-Sustainable Woodfuel 2.1%
Oil 48.2%
Renewable 49.0%
Hydroenergy (export) 5.0%
Hydroenergy (internal consumption) 31.8%
Woodfuel Industry 1%
Cane Products 0.4%
Woodfuel Residential 9.4%
Other Renewable 1.1%

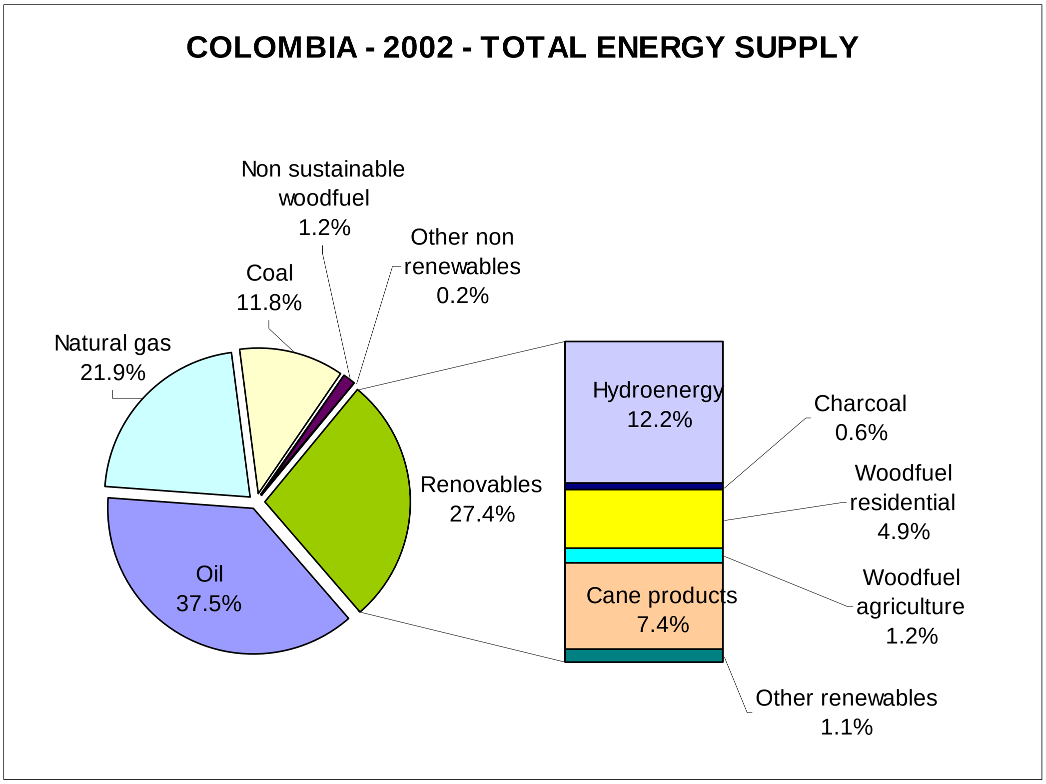
ANDEAN COMMUNITY


BOLIVIA - 2002 - TOTAL ENERGY SUPPLY
Non sustainable woodfuel 4.3%
Natural gas 24.4%
Renewables 29.5%
Oil 41.1%
Hydroenergy 17.0%
Cane products 7.4%
Charcoal 0.2%
Woodfuel Industry 1.4%
Woodfuel Residential 2.3%
Other Renewables 1.9%

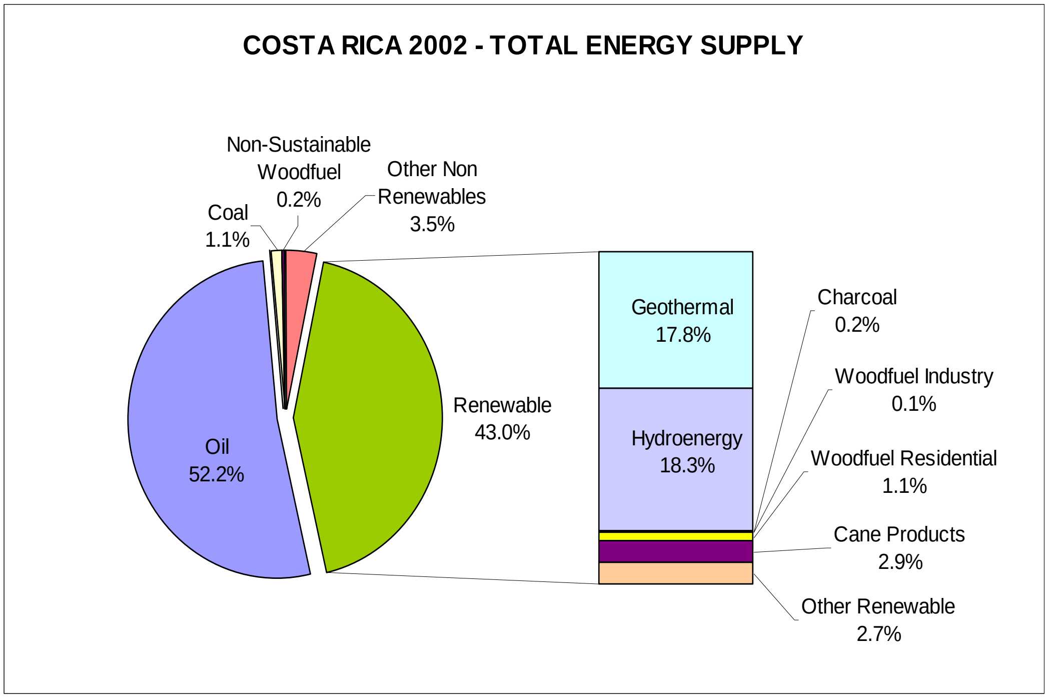

ECUADOR - 2002 - TOTAL ENERGY SUPPLY
Other Non renewable 0.1%
Natural Gas 2.7%
Renewables 16.8%
Oil 79.7%
Hydroenergy 8.7%
Woodfuel residential 4.4%
Cane products 3.5%
Woodfuel Industry 0.3%

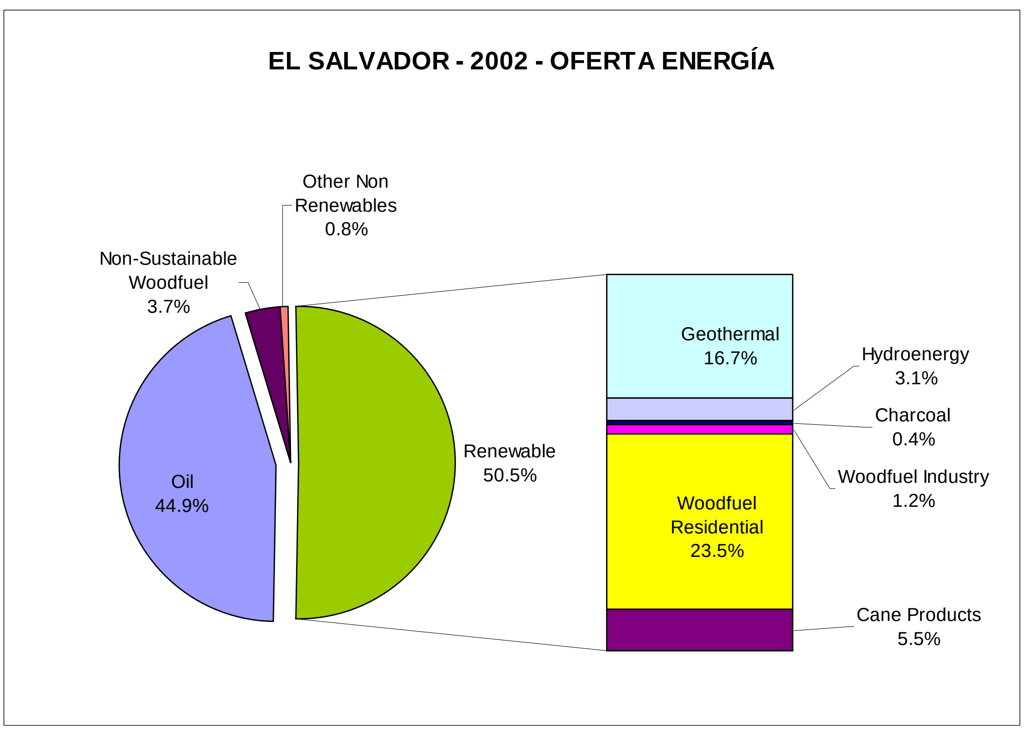

PERU - 2002 - TOTAL ENERGY SUPPLY
Non sustainable Woodfuel 1.6%
Coal 6.2%
Other non Renewables 0.2%
Natural gas 5.9%
Oil 53.0%
Renewables 33.1%
Hydroenergy 15.3%
Charcoal 0.8%
Woodfuel residential 11.3%
Cane Products 3.0%
Other Renewables 2.5%

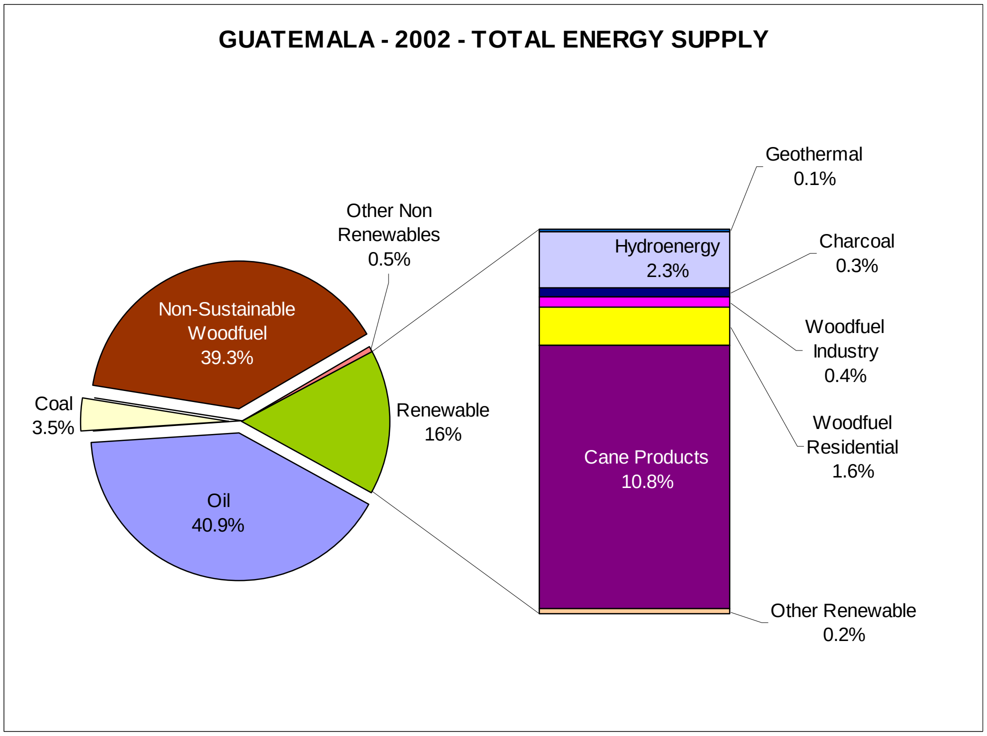

VENEZUELA - 2002 - TOTAL ENERGY SUPPLY
Other non Renewables 2.0%
Natural Gas 51.4%
Renewables 27.7%
Hydroenergy 27.7%
Oil 18.8%

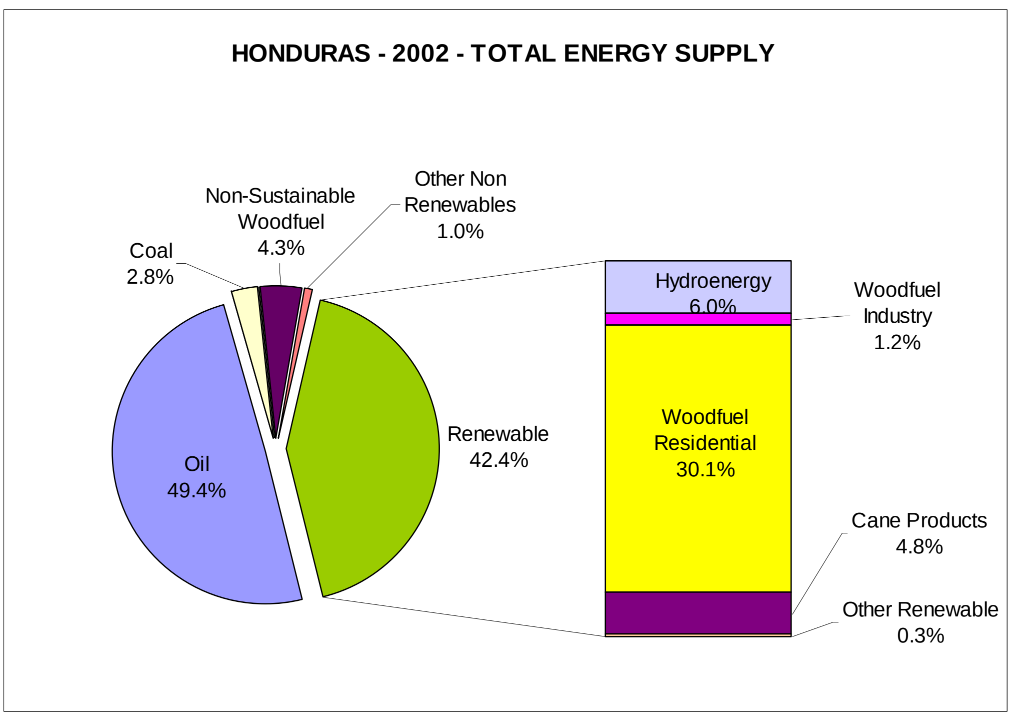

COLOMBIA - 2002 - TOTAL ENERGY SUPPLY
Non sustainable woodfuel 1.2%
Other non renewables 0.2%
Coal 11.8%
Natural gas 21.9%
Oil 37.5%
Renovables 27.4%
Hydroenergy 12.2%
Charcoal 0.6%
Woodfuel residential 4.9%
Woodfuel agriculture 1.2%
Cane products 7.4%
Other renewables 1.1%

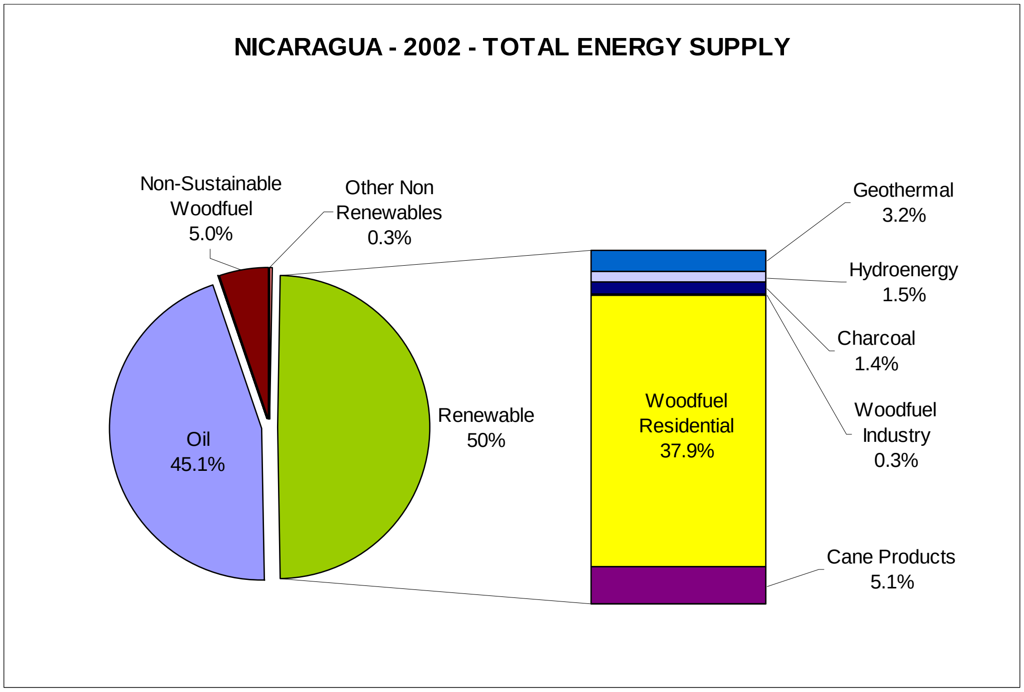
MEXICO AND CENTRAL AMERICA

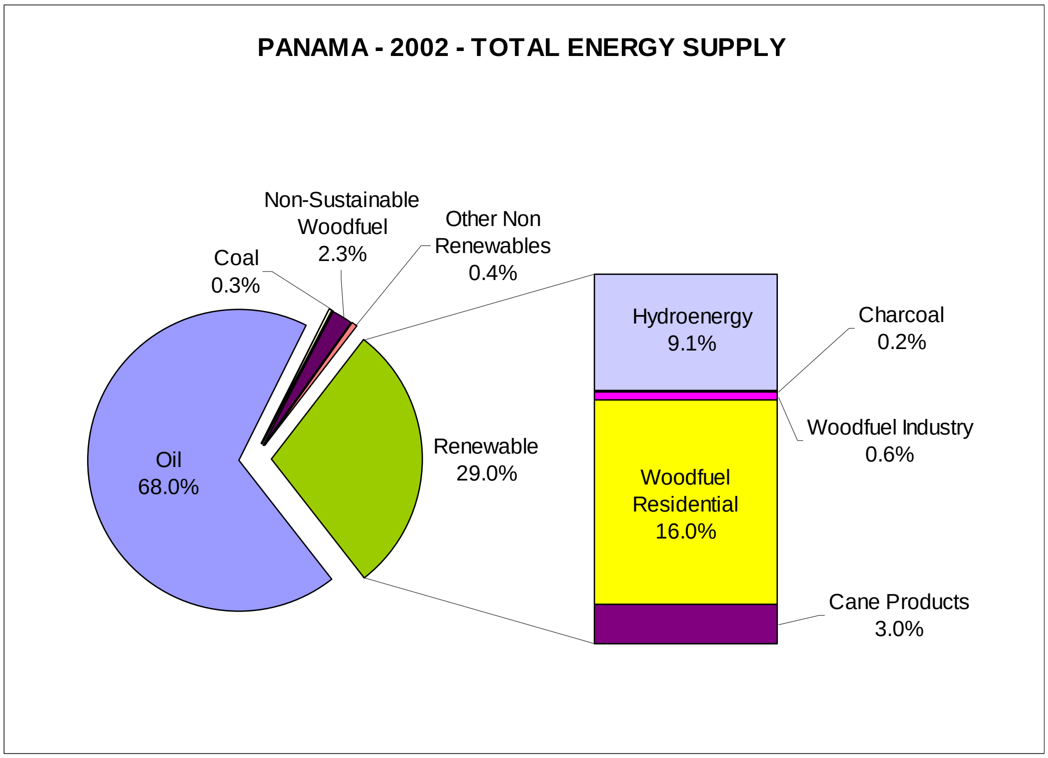

COSTA RICA 2002 - TOTAL ENERGY SUPPLY
Non-Sustainable Woodfuel 0.2%
Other Non Renewables 3.5%
Coal 1.1%
Geothermal 17.8%
Charcoal 0.2%
Woodfuel Industry 0.1%
Renewable 43.0%
Hydroenergy 18.3%
Oil 52.2%
Woodfuel Residential 1.1%
Cane Products 2.9%
Other Renewable 2.7%

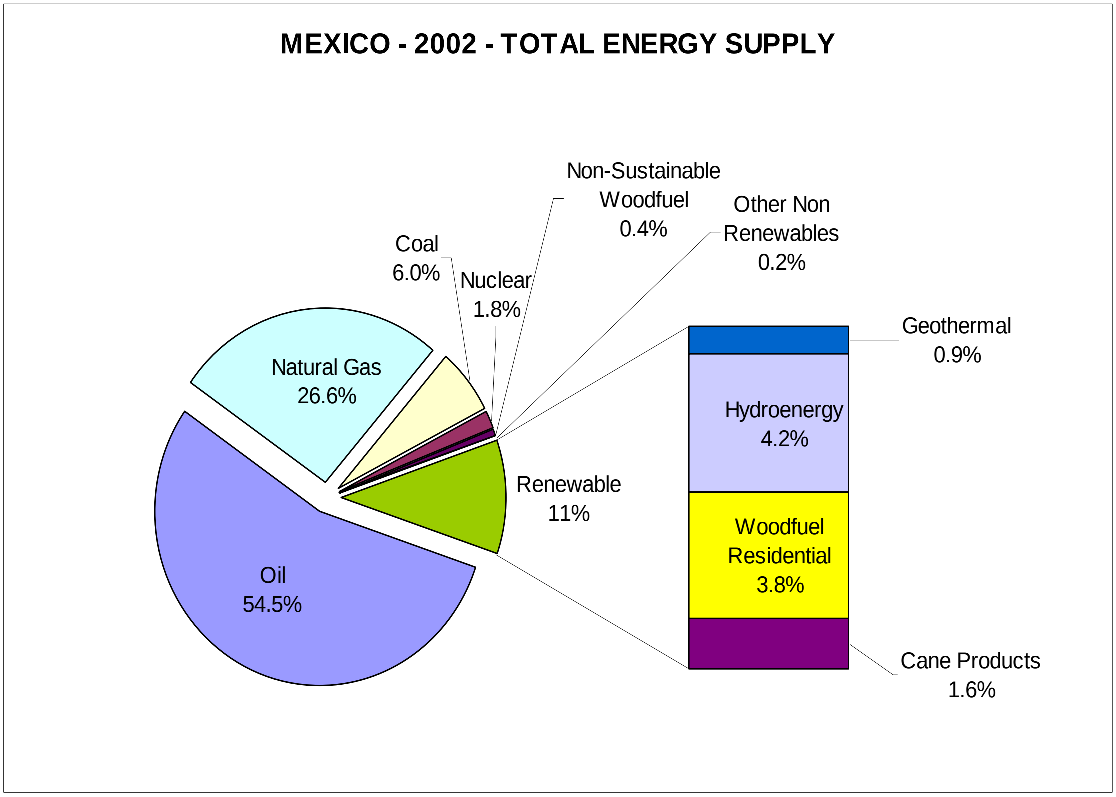

EL SALVADOR - 2002 - OFERTA ENERGÍA
Other Non Renewables 0.8%
Non-Sustainable Woodfuel 3.7%
Geothermal 16.7%
Hydroenergy 3.1%
Charcoal 0.4%
Renewable 50.5%
Oil 44.9%
Woodfuel Industry 1.2%
Woodfuel Residential 23.5%
Cane Products 5.5%


GUATEMALA - 2002 - TOTAL ENERGY SUPPLY
Non-Sustainable Woodfuel 39.3%
Other Non Renewables 0.5%
Coal 3.5%
Oil 40.9%
Renewable 16%
Geothermal 0.1%
Hydroenergy 2.3%
Charcoal 0.3%
Woodfuel Industry 0.4%
Woodfuel Residential 1.6%
Cane Products 10.8%
Other Renewable 0.2%


HONDURAS - 2002 - TOTAL ENERGY SUPPLY
Non-Sustainable Woodfuel 4.3%
Other Non Renewables 1.0%
Coal 2.8%
Oil 49.4%
Renewable 42.4%
Hydroenergy 6.0%
Woodfuel Industry 1.2%
Woodfuel Residential 30.1%
Cane Products 4.8%
Other Renewable 0.3%


NICARAGUA - 2002 - TOTAL ENERGY SUPPLY
Non-Sustainable Woodfuel 5.0%
Other Non Renewables 0.3%
Oil 45.1%
Renewable 50%
Woodfuel Residential 37.9%
Geothermal 3.2%
Hydroenergy 1.5%
Charcoal 1.4%
Woodfuel Industry 0.3%
Cane Products 5.1%


PANAMA - 2002 - TOTAL ENERGY SUPPLY
Non-Sustainable Woodfuel 2.3%
Coal 0.3%
Other Non Renewables 0.4%
Oil 68.0%
Renewable 29.0%
Hydroenergy 9.1%
Woodfuel Residential 16.0%
Charcoal 0.2%
Woodfuel Industry 0.6%
Cane Products 3.0%


MEXICO - 2002 - TOTAL ENERGY SUPPLY
Non-Sustainable Woodfuel 0.4%
Other Non Renewables 0.2%
Coal 6.0%
Nuclear 1.8%
Geothermal 0.9%
Natural Gas 26.6%
Hydroenergy 4.2%
Renewable 11%
Woodfuel Residential 3.8%
Oil 54.5%
Cane Products 1.6%