ENERGY AND SUSTAINABLE DEVELOPMENT IN LATIN AMERICA AND THE CARIBBEAN:
Approaches to energy policy

PROJECT ENERGY AND SUSTAINABLE DEVELOPMENT IN LATIN AMERICA AND THE CARIBBEAN
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FOREWORD

Energy and Sustainable Development in Latin America and the Caribbean is a project jointly conducted by the Latin American Energy Organization (OLADE), the United Nations Economic Commission for Latin America and the Caribbean (ECLAC), and the German Technical Cooperation Society (GTZ).

This project is being sponsored and cofinanced by the German Government and was implemented to build up the region's energy policymaking capacity to harmonize economic growth, social equity, and environmental protection so as to ensure that the energy reforms that are being undertaken by the region's countries will promote sustainable development.

In order to achieve this objective, the project has adopted a systemic approach, one that recognizes that responsibility must be broadly shared by the players in charge of energy development and that policy guidelines must be clearly defined and concrete instruments and actions identified to reach sustainable development orientations and objectives.

As a result of the work that has been conducted to date, it is evident that sustainability in energy development requires the countries to take up a series of challenges for the future. Along with the recovery of economic growth that has become apparent in the nineties, there is still low energy productivity. Added to this there is a low coverage in terms of meeting energy needs and extensive deterioration of forests, as well as low-quality energy consumption and environmental impacts from the emissions that are expected from the incorporation of pollutant sources as a result of the expansion of regional energy systems.

There is no doubt that a rise in energy productivity corresponds to higher efficiency in the use of energy, an aspect that should be a priority goal for energy reforms. This objective will not only exert a considerable impact on international competitiveness and, as a result, economic growth, but will also exert a favorable impact on social equity, by reducing the share of energy spending to meet the needs of residential users.

Alongside the improvement in energy efficiency, the social coverage of energy services must also be enhanced, with the adoption of actions linking high energy consumption levels to job creation and higher income levels. There are various ways, as underscored in the present publication, to ensure the compatibility of energy development programs with economic decentralization actions, especially in rural areas.

In addition, the book expresses current concerns about the sustainability of energy system expansion. At present, the countries of Latin America and the Caribbean do not account for a large share of global environmental problems, since they only generate about 5% of world CO_2 emissions, whereas developed countries are responsible for about 70%. Nevertheless, new energy developments based on a higher consumption of hydrocarbons could increase the region's contribution to environmental degradation. At the same time, expansion based on hydropower generation also has its limitations although it contributes positively to mitigating emissions, which implies new challenges for energy sector reform.

Most of the region's countries have taken major strides in restructuring their respective energy sectors. But these reforms have been motivated more by the perspective of consolidating macroeconomic stability and overcoming financial obstacles to sector expansion. Although this approach may be valid over the short term, it is necessary to incorporate longer-term objectives involving improvement of energy productivity and efficiency and, as a result, international competitiveness, growth, social equity, and the use of energy sources compatible with environmental protection.

The present publication acknowledges the progress that has been achieved to date. Reforms have induced improvements in financial indicators and the operating efficiency of energy sector companies, largely due to price and tariff increases and, in some countries, to major efforts to put state-owned enterprises that were privatized on a sound financial footing. Likewise, the elimination of public monopolies, the search for competitive markets, and the application of regulatory mechanisms to guarantee competitive conditions have stimulated private investment, given impetus to the region's stock markets, and encouraged involvement in international capital markets.

Nevertheless, institutional capacity building has to be ensured and regulatory mechanisms perfected to reach the stability that investors are looking for. In this regard, the best incentives to promote both public and private investment are: overcoming certain trends toward the inappropriate use of dominant market positions; improving the flow of information between companies and regulatory agencies; and above all transparency in determining the costs of energy transactions.

Likewise, it is important to coordinate the energy policies of the countries with current subregional and regional integration processes, in order to optimize system expansion efforts and cope with the influence of new exogenous variables that are emerging as a result of the internationalization of environmental issues. It is evident that environmental concerns have evolved to such a point that they now extend beyond national boundaries and have become one of the major items on the international agenda.

In short, the exploitation of energy resources and the efficient use of energy are crucial aspects of environmental issues. Within this context, stances that favor international standard-setting, which could have highly significant repercussions for the development of these resources, are gaining ever more importance.

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In the present project, the Federal Republic of Germany, through its Federal Economic Cooperation and Development Ministry (BMZ), has been able to cooperate since 1993 with Latin America and the Caribbean in important aspects for sustainable development, such as the interactions of its various dimensions and energy. The project would not have been possible without its funding.

Many persons, especially from the three counterparts, that is, OLADE, ECLAC, and GTZ, have been involved in preparing and implementing the project since its conception. The project's directors would like to extend their appreciation to each one of them for their dedication in conducting a task that, in may ways, has turned out to be quite innovative. The main collaborators in this project are listed below.

The project is being implemented in close coordination with the Executive Secretary of OLADE, the Secretary General of ECLAC, and the Director of Program Planning and Management of ECLAC. As for the German counterpart, the project benefits from the support provided by the agency in charge of its implementation, the German Technical Cooperation Society (GTZ).

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INTRODUCTION

As of the mid-eighties, the countries of Latin America and the Caribbean have been living the most important transformation of their energy sector since the heyday of nationalization. The current transformation extends to all subsectors and entails, depending on the specific circumstances of each country, the gradual abolition of monopolies in some energy markets and the corresponding introduction of competition and the participation of new players, a reorientation of public enterprises toward business approaches, a new distribution of activities between the private sector and the State, the review of sector regulation, liberalization to provide various opportunities for private-sector enterprises (as contractor and/or competitor), the shift of ownership as a result of the sale of State assets, etc. These changes are coinciding with other trends that are transforming the States of the region, especially in terms of decentralization. They also coincide with the growing trend toward globalization, on the one hand, and economic integration, on the other.

The reasons for these huge changes have been presented and discussed in many places although their results have been analyzed only partially, mainly from the viewpoint of financing and efficiency objectives. To date, there does not seem to be any general assessment of these phenomena, much less an assessment of all these trends with respect to the energy sector and the objective of sustainable development, although the latter is increasingly recognized as a major goal by countries from both the region and outside it.

The purpose of the present work, however, is to provide not a detailed assessment but a conceptual appraisal geared to encouraging the revision of energy policies to integrate them into a general policy aimed at ensuring sustainable development.

Reforms in the energy sector and the entire public sector have led to a new scenario. A wide variety of new players have emerged, but it is not yet clear whether the energy sector is actually evolving in the right direction. But before anything, the situation that is being sought has to be defined and expressed in terms of objectives.

There is no doubt that the previous scheme of energy sector management is no longer valid. Now the State must act on the basis of a wide range of other instruments. In other words, the State should not only modify its role, enabling other players to gain access to the sector, but it should also learn the duties of its new role. Government administrators must also learn to observe, analyze, intervene to complement autogenous evolution, pare down cumbersome structures that jeopardize equilibrium, promote the growth of necessary but weak ingredients, and accommodate the insertion of powerful players who can contribute to development without much possibility of controlling them.

After a decade of frustration, there are many expectations regarding the new opportunities that are being provided for business activities and the outlook for sector growth. This situation should not prevent us from recognizing the problems that still do exist, nor should it lead us to blindly trust the new models or give up all involvement in energy policymaking. Nor should the traditional distrust in market mechanisms be the driving force behind any energy policy.

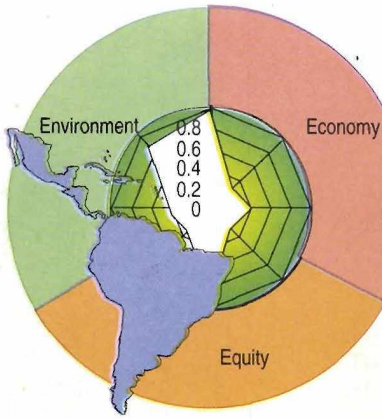
Although a sober analysis of what would happen after applying sustainable development criteria may be lacking, thus leading to the a priori introduction of models that may deflect reform efforts toward hopeless utopias, any action aimed at defining sustainable development policies seems to be highly realistic and well-founded, in view of the political soundness and feasibility of this approach.

The present work, which is the outcome of the ongoing OLADE-ECLAC-GTZ project, is also aimed at ensuring that the current evolution, with its wide range of changes, will turn out to be highly positive for the countries. The book is broken

down into five chapters, the first focusing on general definitions and analysis, the following three analyzing sustainable development dimensions, and the last suggesting policy guidelines, and strives to answer the following queries:

- Definition of sustainable development: What do we mean by sustainable development in the energy sector?
- Description of the status of sustainable development in LAC: What are its economic, social, and environmental development patterns?
- Energy sector's contribution: How does the energy sector exert an impact on sustainable development?
- Evolution of the linkages between energy and sustainable development: What happened to sustainable development and why?
- Recent reforms (electricity, oil, gas, other aspects) and sustainable development: Do the recent reforms point toward sustainable development?
- How external factors are evolving (future energy supply, implications for supply security, global emissions, globalization, integration, internationalization of environmental concerns, the new role of international agencies, financing, transfer of technology) and how to deal with them: What implications do these factors have for sustainable development and how can States defend themselves against the adverse impacts stemming from these factors?
- Is sustainable development possible in LAC? What are the limits to what has already been done and what still needs to be done?
- New political scenario: What is the role of the State?
- Concepts and examples of policies leading to sustainable development: What can be done?

CHAPTER 1: CURRENT STATUS OF THE ECONOMIC, SOCIAL, ENVIRONMENTAL, AND ENERGY DEVELOPMENT IN LATIN AMERICA AND THE CARIBBEAN AND ITS SUSTAINABILITY



1. Status of General Development and its Sustainability

1.1 Definition of the human being as both the subject and target of sustainable development

The concept of development refers to **human development,** which has been summarized by the United Nations Development Programme (UNDP) as *"the process of enlarging the range of options of persons, providing them with greater opportunities for education, medical care, income, and employment, and covering the full spectrum of human options, from good physical environmental conditions to economic and political freedom."*[1] This approach to defining the concept of human development has two major merits. On the one hand, it opens up the range of relevant dimensions and identifies some of their elements:

- by mentioning education, health, income, and employment, **social and economic dimensions** are highlighted;
- by referring to the physical environment, the **environmental dimension** is implied; and
- by indicating that freedom is an option for persons in society, the **political dimension** is underscored.

On the other hand, the human being is placed at the very heart of any consideration, and it is thus clear that development should be viewed as something occurring to persons and, by extension, to society. Each human being is at once an active subject and target of State policy, which as a manifestation of society as a whole and not only the ruling class performs an important role in this process.

This outlook, focusing on the viewpoint of the citizen and on the linkage between persons, society, and the State, prevails in all the reflections of analysis and policymaking developed later in the present article.

The imperative of **sustainability** adds a dimension of time since actions carried out in the present exert powerful impacts on future opportunities. Because of this, human development must be sustainable, that is, *a development that meets the needs of the present without compromising the ability of future generations to meet their own needs.*[2]

Thus, meeting present needs is also a dimension of sustainable development. Concretely, this means that a situation cannot be considered sustainable when a considerable part of the population receives extremely low average wages and is affected by difficult access to basic services, even though over the long term an improvement in this situation is expected. In addition, spontaneous changes cannot be expected. The lower the human development is in the present, the more urgent is the political effort required to change this situation.

Nevertheless, there are certain limitations to the concept of sustainable development due to the indiscriminate use of the global environment by certain countries, thus creating harmful conditions (greenhouse gas effect) over the territorial space of other countries, which can be corrected by introducing *the right to international equality of opportunities, within each generation, to have access to a nature that is as intact as possible.*[3]

1 UNDP, *1992 Human Development Report,* published for UNDP, Bogotá, 1992, page 18.

2 World Commission on Environment and Development (WECD), *Our Common Future,* New York-Oxford, 1987.

3 See the proposal "Zunkunftsfähiges Deutschland: Ein Beitrag zu einer global nachhaltigen Entwicklung" (A Sustainable Germany: Contribution to Global Sustainable Development), Wuppertal Institut für Klima, Umwelt, Energie GmbH im Wissenschaftszentrum Nordrhein, Westphalia, September 1995.

In short, it is evident that the relevant dimensions of sustainable development are political freedom, economic well-being, social equity, and a healthy environment, in addition to a certain conservation of natural resources. These dimensions are extended in space and over time (present and future).

1.2 Assessment of the degree of development and its sustainability

The countries of Latin America and the Caribbean display a wide variety of situations with regard to the degree of development attained. Because of this, building a typification for the countries of the region in terms of degree and type of political, economic, social, and environmental development turns out to be a highly complex task yielding very unsatisfactory results. Nevertheless, the present paper intends, as a first step, to characterize the different typical development patterns, in order to highlight the relative gap between the countries's current situation and the economic, social, and environmental situations that have been established as goals. The political situation is not being considered at this time because it would involve an even more complex dimension.

The degree and sustainability of development are typified by means of the following indicators (see the definitions in Annex II):

- *per capita GDP* for the economic dimension;
- *income distribution,* which represents the social dimension in terms of fairness (equity); and
- *net domestic investment in physical and natural capital* (genuine saving) for the physical-environmental dimension, including natural resources and the environment. This indicator is complemented by *per capita natural assets,* which include both natural nonrenewable (fossil resources) and renewable assets (soil, forests, etc.).

A high per capita gross domestic product (per capita GDP) not only means a high average income but also high productivity of the economy, which in turn is an important element for economic sustainability. Nevertheless, even when taking into account purchasing power to estimate per capita GDP in constant terms, it is evident that this indicator implies constraints in satisfactorily reflecting the populations's quality of living.

In the case of equity, it is understood that a reduction of income distribution asymmetries is socially more sustainable. Average income levels and their distribution do not change from one year to another. Because of this inertia over the medium term, low average income levels or sharp imbalances in income distribution are the subject of much concern, and for policymaking, they should be viewed as severe problems for sustainability.

The third indicator, genuine saving, is complemented by a fourth, the stock of natural capital. The notion of genuine saving is directly linked to sustainability since it reflects the efforts that are being made in the present to enhance the pace of development in the future. To determine this indicator, in addition to the traditional calculation of net investments (gross investment less depreciation of physical capital), reductions in the stock of natural resources (due to depletion), environmental deterioration (due to degradation) as a result of emissions, and investments financed by foreign capital (external savings) subject to transfer abroad are taken into account. Thus, it provides an accurate representation of everything involving the physical environment (see discussion of this indicator in Annex II).

The indicator, genuine saving, shows greater variability over time because it involves a relative variable that has positive and negative values. Nevertheless, it has been observed that countries remain for many years at about the same levels, and when they do eventually shift from one level to another, the change takes place over several years and is not rapidly reverted.

Whereas the three first indicators express current annual levels (flow variables) or changes in structure (income distribution), the fourth indicator reflects the physical-natural base for development (stock). The relevance of this indicator for the sustainability of development is obvi-

ous when you take into account that the greater the abundance of natural resources, all other things being equal, the higher the economic growth that essentially depends on the use of these resources, which is the case for a large number of the countries of Latin America.

On the basis of the above-mentioned criteria and the corresponding indicators, a preliminary characterization of the degree of development in each country was prepared. After examining the resulting values, the extreme values of each indicator (nonsustainability and high sustainability) were determined; the values were then standardized to obtain a range of variation contained in the interval [0, 1].

1.3 Typification of situations of development status and their sustainability

On the basis of indicators for the economic, social, and environmental dimensions and taking into account current trends, it has been determined that there are at least six development patterns that can be differentiated (Table 1.1):

A: High levels of average income, moderate social inequality, low productive integration, dependent on energy exports (for example, Venezuela).

B: High integration and productive diversification with high domestic absorption, marked social and regional differentiation, important base of natural resources, self-sufficient or moderately dependent on energy imports (for example, Brazil).

C: Moderate or high domestic productive integration and diversification, marked social inequality, diversified exports based on natural resources (for example, Colombia).

D. Relatively low development based on natural resources and the export of primary, mining, and/or energy products (for example, Bolivia).

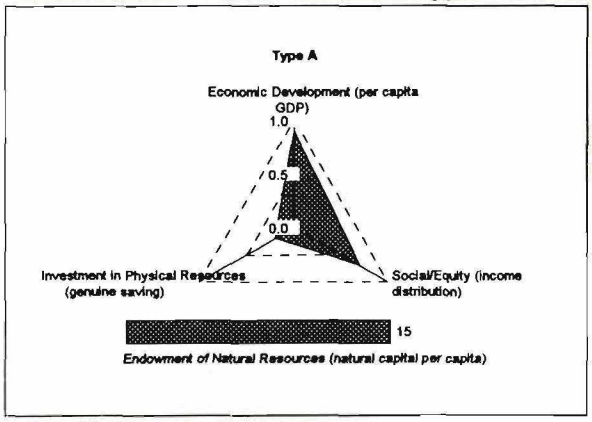
E/F. Low or very low development, with limited natural resource assets (for example, Guatemala and Haiti).

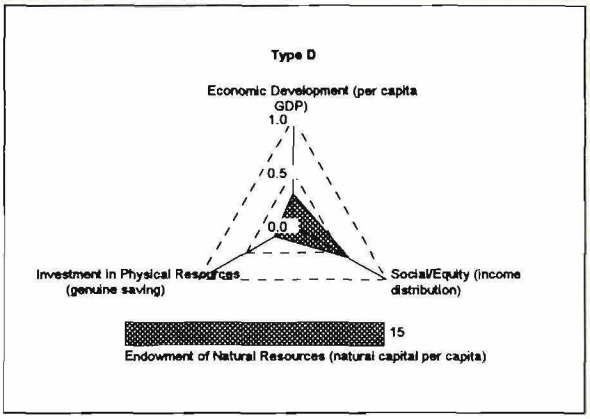
In Chart 1.1, some of the typologies described above are characterized, in order to help the reader visualize the orientation of each group of countries with respect to sustainable development dimensions. The charts underscore biases that may or may not be the outcome of deliberate policies and that, in both cases, may display an orientation or spontaneity inherent to the lack of a conceptual framework for sustainable development aimed at achieving multi-objective solutions. This visualization is only a preliminary estimate, where each indicator (of the triangle) is granted equal importance. Since this preliminary estimate involves a large number of implicit assumptions, there is no general ranking of sustainability of the

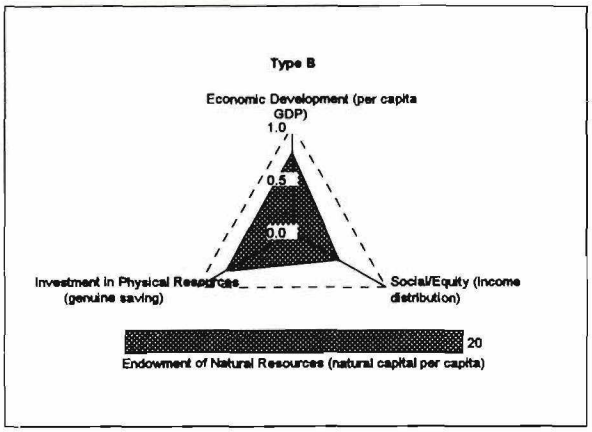
Table 1.1: Typification of the status of human development and its sustainability

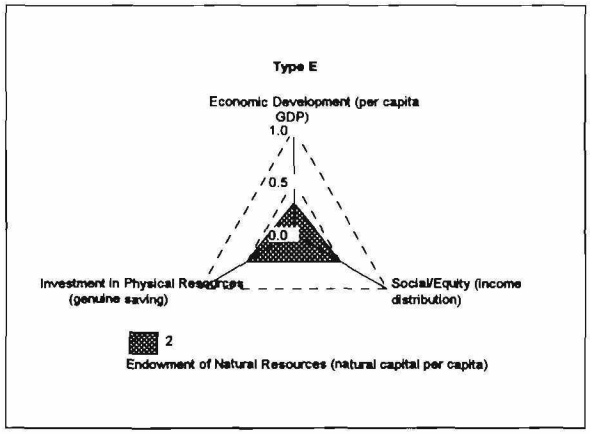
Pattern	Countries	Economic Development (per capita GDP)	Equity (social asymmetries)	Investment in Resources (genuine saving)	Endowment of Natural Resources (capital/per capita)
A	VE, TT, BB	high	medium high	low	high-medium high
B	AR, BR, CL, UY, PY	high-medium high	medium high-medium low	medium high	high
C	CO, CR, MX, PA, JM	high-medium high	medium high-medium low	medium high	high-medium high
D	BO, EC, GY, NI, PE, SR, CU	medium low-low	medium high	medium low-low	high-medium high
E	GT, HN, DO	medium low-low	medium low	medium low	medium low
F	SV, GD, HT	medium low-low	medium low	medium low	low

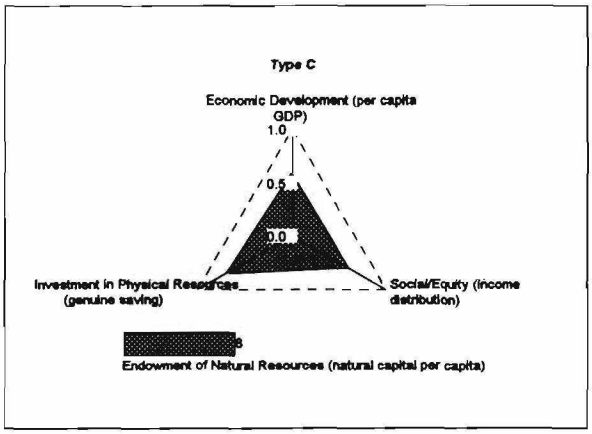
Chart 1.1: Types of development and sustainability

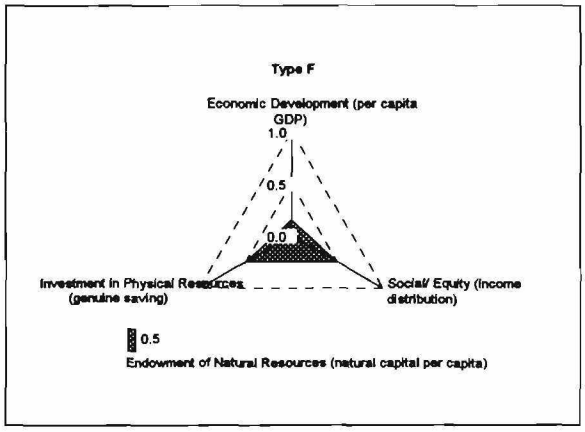












Note: Physical resources include: Fixed assets, natural & environmental resources

countries. At a later stage of the project, the analysis will be more in depth.

2. The Energy Sector's Influence on Sustainability: Inter-relations

The energy system is inter-related with some of the major aspects mentioned above. The level and structure of energy supply and uses interact in a complex way with socioeconomic development, exert intense impacts on natural resources, and bear heavily on the environment. Table 1.2 indicates a set of energy system aspects that affect, in different ways and degrees, the sustainability of development in their political, economic, social, and environmental dimensions.

The aspects indicated are described as objectives and are assigned to different dimensions. Nevertheless, several of these objectives exert effects not only on one dimension but also on two or more of them. A setback in com-

Table 1.2: Energy objectives related to sustainable development

	Dimensions	Objective/how the energy sector contributes to sustainability
Sustainable Development	Political	Sustaining political maneuverability
		Maintaining international weight/influence
		Breaking up political and economic power (State and private)
		Security of installations in face of conflicts
		Security and diversification of external supply
	Economic	Sufficient degree of energy autarky
		Reduced energy quota in imports
		Lesser weight of variable income in the budget
		Lesser weight of balance of payments
		Steady inflow of export earnings
		Taking energy earnings
		Steady inflow of public revenues
		Investment of energy earnings in other forms of capital
		Reduced energy intensity
		Rational use of energy in productive sectors
		Energy efficiency
		Productive efficiency in the energy sector
		Sufficient sector financing
		Higher added value in energy chains
		Higher energy supply quality
		Reliability of supply
	Social	Reduced energy supply costs
		Diversification of energy mix
		Sufficient supply
		Meeting basic needs
		Access to modern energy products
		Greater access to electricity
		Supply of social services
	Environmental	Reduction of local and global impacts from emissions
		Soil conservation
		Sustainable management of firewood
		Nonpollution of water
		Ecocompatible management of the exploitation of fossil resources
		Sustainable management of hydraulic basins
		Sustainable programs for exploiting fossil resources
		Long-term sustainable exploitation of fossil resources
		Use of renewable resources

pliance with the objectives means a lesser degree of sustainability because it entails risks, vulnerabilities, and constraints for socioeconomic development, unfair biases in energy supply, inconsistencies in the use of resources, and environmental impacts. The list does not intend to be exhaustive nor does its selection claim to be final or lead to definitive or undebatable conclusions.

In addition to the interactions between the energy sector and general development process, this listing highlights the inter-relations between the different dimensions. A certain development level with respect to one dimension could jeopardize the long-term development of other dimensions. For example, the intense exploitation of fossil energy is not sustainable when there is a low level of reserves and when it jeopardizes the country's long-term socioeconomic development, especially if there is insufficient re-investment in other forms of capital.

The idea is that, on the basis of this presentation of the set of objectives in various dimensions, a new approach for policymaking will be established, one that takes into account the many dimensions of a complex solution that cannot emerge spontaneously (as if led by an invisible hand) or be directed exclusively by a central authority (the guiding State). Striking a balance between these different aspects constitutes a major challenge for the new era that the region is inaugurating.

Table 1.3: Selected energy sustainability indicators

No.	Indicator	High sustainability is linked to:	Responds to objectives:
1	Energy autarky	Low participation of imports in energy supply	- external supply security - sustainability of political maneuverability (high degree of political independence) - reduction of the risk of balance of payments disequilibria
2.	Soundness in the face of external changes	Low contribution of energy exports to GDP	- steady inflow of export earnings - lesser weight of variable incomes in the budget - reduction of risk of balance of payments disequilibria
3.	Energy productivity	High GDP per unit of energy	- productive efficiency - energy efficiency - sufficient financing (as a result of the reduction of sector investment needs) - reduction of energy supply costs - sufficient supply (due to the reduction in demand) - higher air quality (due to the reduction of emissions with local impact) - reduction of gas emissions with impact on the climate - extension of the durability over time of nonrenewable resources
4.	Electric power coverage	High percentage of electrified households	- diversification of energy mix - sufficient supply - access to modern and productive energy products - supply of social services
5.	Coverage of basic energy needs	Sufficient consumption of useful residential energy	- meeting basic needs - diversification of energy mix - sustainable management of firewood
6.	Relative purity of energy use	Low levels of emissions (CO_2)	- higher air quality (due to the reduction of emissions with local and regional impacts) - reduction of gas emissions with impact on the climate
7.	Use of renewables	High participation of renewables in energy supply	- higher air quality (due to the reduction of emissions with local and regional impacts) - reduction of gas emissions with impact on the climate
8.	Scope of fossil resources and firewood	High reserves-production ratio of fossil energy and firewood	- extension of durability over time of long-term resources - long-term supply security - maintaining minimum natural assets

2.1 Selection of indicators

In order to determine the opportunities and/or conditioning factors for the development of the countries stemming from their energy sector, several important sector objectives, for which it was possible to formulate quantitative indicators, have been selected.

In view of the difficulty of obtaining information, which prevented adequate regional coverage, the quantitative estimate of several aspects that are conceptually relevant for sustainability, for example, energy spending by income group, had to be discarded. On the basis of the availability of data for the majority of the countries, there were eight indicators selected (and their calculation): three for the economic dimension; two for the social dimension; and three for the natural resources dimension.

Table 1.3 displays the indicators that were selected and their respective definition (the annex to the present chapter provides more details on the method-

Table 1.4: Typification of situations and classification of LAC countries in terms of energy sustainability

Countries		Economy			Equity		Natural Resources		
		Energy autarky	Soundness	Energy productivity	Electric power coverage	Coverage of basic needs	Environmental purity of energy use	Use of renewable energy	Scope of fossil resources
I	a: VE, TT	high	very low	medium low	high	medium high	medium	low	high
	b: BB	low	low	high	high	medium low	medium low	low	low
II	a: CO, MX	high	medium high	medium low	medium high	medium	medium high	medium low	high
	b: BO, EC, PE	high	medium low	medium low	medium	low	medium high	medium low	medium low
III	AR, CL, BR, UY, PY	high	high	medium	medium high	medium high	high	medium high	medium high
IV	a: CR, PA, JM	low	high	medium low	medium high	medium low	medium high	medium low	very low
	b: GY, SR, NI, CU	medium low	high	low	medium low	medium low	medium high	medium	medium low
	c: GT, HN, DO, SV, HT, GD	medium high	high	low	low	low	medium high	low	very low

I. Single-export (oil and products) countries and high electricity coverage
II. Energy-exporting countries with:
    a. medium high electricity coverage
    b. medium low electricity coverage
III. Self-sufficient countries or with a relatively low share of energy imports, but with a variable coverage of basic needs.
IV. Energy-importing countries with:
    a. medium high coverage of electricity and basic needs
    b. medium-low coverage of electricity and basic needs
    c. low coverage of electricity and basic needs

ology). In addition, each indicator is related to the various energy policy objectives specified in Table 1.2.

2.2 Typification of situations on the basis of energy indicators

On the basis of the classification of the LAC countries, in keeping with the eight indicators mentioned above, it was possible to identify seven types of situations, differentiated by important differences in at least two of these indicators. As a result, it was observed that these situations could be grouped under four basic types with subgroups (Table 1.4).

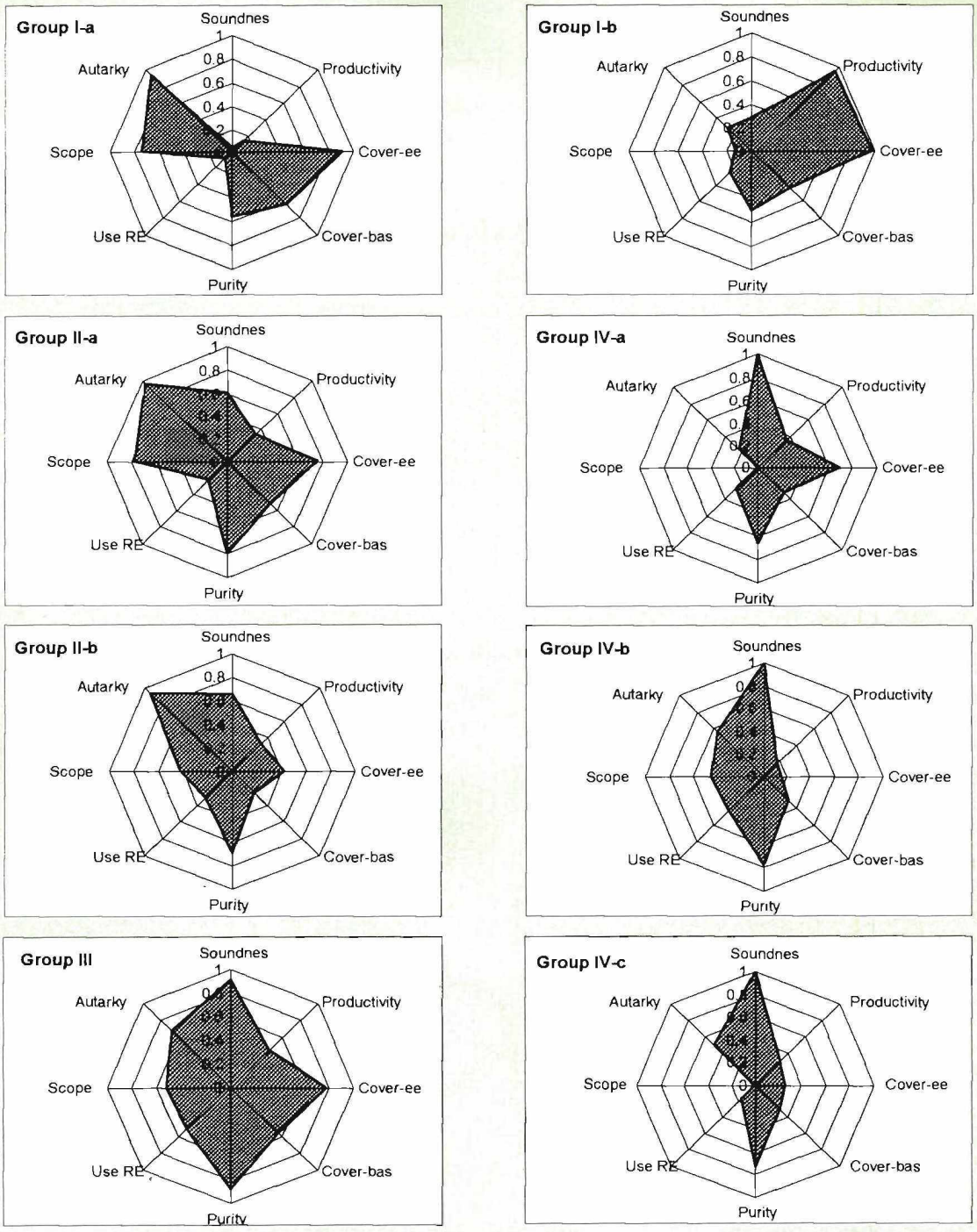
The characterization used is an estimate that permits identifying in the following charts (Chart 1.2) the four typologies, with variants within each one. The elements of interest in these charts involve the following:

- form;
- position; and
- size of the profiles of each set of countries (determined by the average).

The more the ***form*** resembles a octahedron, the greater is the soundness of the energy systems. This configuration is evident in the Groups II-a and III. This soundness is based on the greater equilibrium between the eight dimensions of the radogram and the possibility of making gradual adjustments in each one of them to improve sustainable development conditions.

In Groups I-a, II, and III, expansion of the dimensions of soundness, coverage, purity, and use of renewables is different, owing to the different energy strategy that each country has decided to apply in the past.

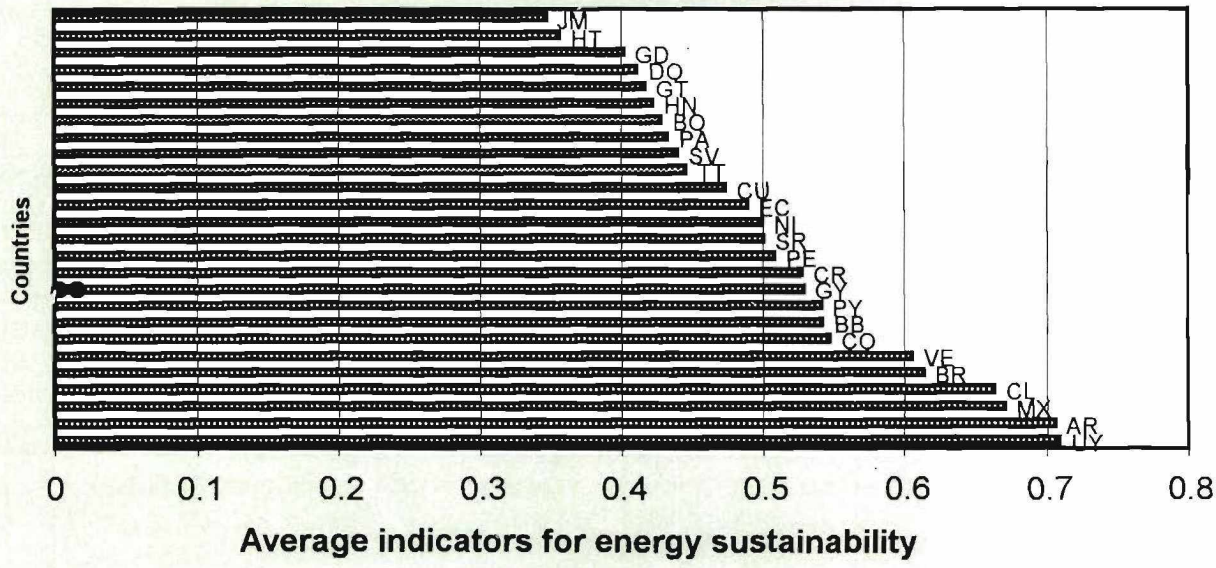
Chart 1.2: Patterns of energy sustainability



The ***size*** suggests the potential of some systems compared to others. It is evident that there are countries that enjoy more advantageous situations as a result of natural endowments, regardless of their willingness to improve their situation.

Nevertheless, there are countries that, despite drawbacks in terms of natural resources, have found solutions that provide them with a better ***ranking.*** Thus the potential does not depend so much on the natural advantages that each country has but rather the overall integration of their energy systems. There are systems, however, that display the same size but a different form or position. This question requires suitable assessment since this circumstance does not necessarily imply an identical level of sustainable development.

Chart 1.3: Energy sustainability ranking of LAC countries



Finally, the situation of countries that are geographically isolated within the region is different from the situation of countries that are part of a subregional geographic unit with energy integration possibilities. Energy integration, by means of power transmission, oil pipeline and gas line networks, helps to consolidate the soundness of exporting countries and subregional autarky as a result of energy diversification and long-term supply security.

The countries of MERCOSUR, the Andean Group, and Central America are those that show the best chances of improving their conditions, by means of subregional integration, with respect to the above-mentioned dimensions of soundness and autarky.

2.3 Classification of countries in terms of energy sustainability

Classifying countries in terms of a multi-dimensional issue such as sustainable development is a complex task, involving a wide range of value judgments at different levels, which are oftentimes implicit in the selection of indicators, their standardization, their relative valuation, etc. If, in a preliminary attempt, an equivalent share (equal weight) is assigned to each indicator, the results show different levels of sustainability; in other words, the countries are ranked (Chart 1.3) according to the attention that, respectively, they have been able to grant to each one of the eight energy dimensions displayed in Table 1.3.

Since this is but a preliminary estimate, the ranking does not have to be explained in detail. But the relative ranking of Jamaica and Haiti must be explained because it shows the influence of the selection of indicators and their definition and standardization on the results.

As indicated by the data in Table C of Annex II, Jamaica has a better ranking than Haiti in four of the eight indicators whereas, in two indicators, its ranking is the same. Only in terms of emissions and autarky does Jamaica show lower indicators. Evidently, Jamaica's energy system emissions are relatively higher owing to its extensive fuel-consuming power system and to high consumption in its transportation sector. Haiti, despite its higher population, does not have these systems. Regarding the autarky indicator, the fact is that Haiti does not import primary energy products because it does not have financial resources to do so whereas Jamaica is a large importer.

It should therefore be emphasized that, when combining energy indicators of equity with economic development, as measured by the per capita GDP index, there is a high correlation, indicating a growing trend toward higher coverage of basic needs and electricity as average incomes increase. This aspect seems to prevail over other indicators linked to economic growth and natural resources, which display an erratic behavior regarding this.

3. General and Energy Sustainability Patterns

Comparison of general development patterns and the types of countries regarding energy sustainability helps to highlight the very close association between them. Table 1.5 therefore ranks the region's countries in terms of the two criteria, development and energy sustainability, to constitute eight groups.

Even though a wide number of indicators have been used and various levels have been defined for each one, it has been possible to establish relations between the typical situations that are observed at the socio-economic-environmental level and those that correspond to the energy sphere so that eight patterns in terms of sustainability can be identified. Nevertheless, linkage of several countries regarding these sustainability patterns does not always turn out to be clear, and a country frequently differs from the typical situation where it has been classified in some of the dimensions considered or two countries linked to the same sustainability pattern differ considerably in some of the indicators considered. Thus, for example, Paraguay (PY) is different from the III-b pattern because of its widespread use of renewables, and Suriname (SR) differs from the IV-d group because of its high genuine saving. Brazil (BR) and Argentina (AR), which have been placed together under the same typical situation, are markedly different in terms of indicators for equity and coverage of basic energy requirements.

If sustainable development conditions are represented both at the general socio-economic-environmental system level and the energy level, the larger the area of its respective radogram, the more sustainable is the situation (see Annex I).

4. Conclusion: Sustainable Development Is Not Only Desirable But Also Possible

The indicators that have been presented show deficiencies and suggest energy policy priorities for sustainable development. One energy strategy compatible with sustainable development would involve expanding the surface of the radograms previously shown, improving the vector positions of each indicator without undermining those of the others.

The examples of the region's most advanced countries in terms of sustainable development confirm the viability of this approach. It is possible to further develop the energy system so that it can

Table 1.5: Association of development patterns and types of sustainability in terms of energy

Patterns	I	II	III	IV
A	VE, TT, BB			
B			BR, AR, CL, UY, PY	
C		MX, CO		CR, PA, JM
D		BO, EC, PE		GY, NI, SR, CU
E/F				GT, HN, DO,SV,GD,HT

become more efficient in terms of productivity, less vulnerable, and more equitable, produce less emissions (regarding this the region is very advanced), use natural resources on the basis of a more balanced approach and with a closer focus on time, and tap renewable energy resources even more extensively. There are actually few conflicts between objectives if it is understood that they can be achieved gradually. In some cases, they can even mutually reinforce each other.

Indeed it is possible to display conflicts at the level of the instruments and their relations with various objectives. The pricing instrument, for example, always has a positive side in terms of efficient resource allocation and in permitting self-financing and a more negative side due to its income effect, especially in lower-income groups. But, in this case as in others, if the instruments are used flexibly, along with well-oriented compensatory measures, the conflict can be resolved.

It is evident that financial constraints impose limits on the rapid achievement of objectives such as greater electricity coverage, greater diversification of energy sources, higher use of renewables, better supply quality, etc. Nevertheless, in view of the multi-functionality of some instruments, if energy integration, which contributes to various sustainable development objectives, is considered on the same footing as rural electrification using an appropriate share of renewables and the adequate application of taxes to enhance energy efficiency, reduce emissions, and secure revenues for the State without exerting a negative social impact and other examples, the financing problem is somewhat relative.

Among the countries of the region, there are some that have managed to improve steadily their situation over the last 25 years, others that have only managed to improve their situation in terms of sustainable development over the last few years, and yet others that are experiencing such a critical situation that they seem to have no chance of emerging from their problems. Nevertheless, the example of more advanced countries and the current backwardness of some of the countries implies, in principle, that there is a wide margin for improvement. All countries could design a more sustainable energy scheme, in political, economic, social, and environmental terms, over the long term, using their own resources.

Impediments usually emerge in the transition phase, which involves adjustments and redistribution impacts and also requires temporary measures to mitigate the crisis and social impacts. The fear of ending up in the group of laggards in this redistribution oftentimes prevents relevant groups from embarking on a strategy of change. If sustainable development implies a major change in many social groups, the transition will be even more difficult. A major effort in terms of convincing and coordination is needed, with careful measures and above all decentralization, to make the democratic system more effective. The latest big changes in the energy sector, carried out within the framework of current reforms, emerged as a result of the breadth of tangible macroeconomic problems. In extreme situations, the most radical changes with the shortest periods of transition have occurred in specific political situations characterized by a certain amount of authoritarianism. The example of other countries shows that the way to consensus is also feasible although it may appear to be slower and more painful. To ensure the shift toward sustainable development, the latter type of transition is the most advisable.

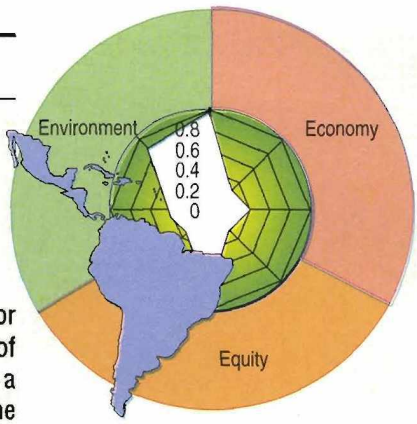
Policymaking using a sustainability approach should be rooted in local or regional realities. When there are already highly sustainable situations in cities or regions within a given country, these situations as well as the policies that fostered them should be examined to serve as the basis for the preparation of practical proposals that can be applicable to other cases.

Finally, it should be recalled that the observations that have been made on the basis of global indicators do not mean that the most important elements for sustainable development should necessarily be placed at, or limited, to the overall national plan. Quite on the contrary, since economic and social development concretely affects individual human beings and most environmental damage exerts a specific local impact, the approach adopted for policymaking should be formulated

to improve the *living space* of persons. This space is determined by concrete local *consumption, production, and distribution styles,* and it is precisely in these areas that the use of energy is evolving in a way that in certain aspects is quite distressing.

The following chapters review the status and evolution of energy to date in terms of the different dimensions of sustainable development. The last chapter returns to policymaking concepts, in an attempt to draw more concrete conclusions. Actions or instruments, players and their possible roles, in addition to objectives, are presented more systematically to facilitate the establishment of a sustainable development strategy from the energy perspective.

CHAPTER 2: ENERGY AND ECONOMY



The inter-relations between energy and the economic dimension of sustainable development take place at various levels.

At the political level, the sector is the subject of much concern with respect to situations of dependency and power imbalances. These situations occur between countries (exporters and importers), between economic groups (suppliers and customers), between regulators and those that are the target of regulation, and between the State and large companies (within the framework of globalization).

In terms of macroeconomics, the sector exerts a heavy impact on the foreign trade balance and fiscal revenues and also on public spending and investments. Before, there was the perception that the sector was also a driving force behind growth, but this view has not worked as expected. At present, the sector's contribution to economic development involves, in addition to making energy available in sufficient amounts and at an adequate quality, generating benefits and investments to incorporate technical progress and coordinating with other sectors to increase domestic value added. Thus, it appears as the pivotal sector for the concept of "productive transformation with equity."

On the sector level, performance of the energy sector is crucial for the economy, especially because of the need for energy supply quality and reliability. To do this, the sector must, first of all, be viable and capable of performing its principal functions; this implies, among other aspects, sound financing. At a higher level, the sector has to achieve optimal operability, which means ensuring energy efficiency in production, distribution, and consumption processes and the efficient allocation of financial and human resources within the sector.

Energy is a production factor or input in almost all activities. Because of this, energy productivity has become a fundamental economic objective. The idea is to use energy more productively: rational use of energy in the different consumption sectors and energy efficiency in processes.

The present chapter attempts to provide an in-depth analysis of these inter-relations, comparing the current status and the evolution of some factors in the countries of the region over the last few years, highlighting persistent deficiencies, risks, and vulnerabilities that have to be dealt with in energy policy.

1. Energy and Economic Growth

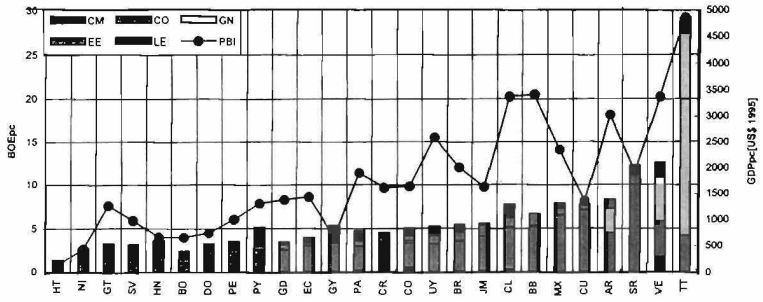
Energy intensity (energy end-use/GDP) or its inverse, energy productivity, is a measure providing information on various aspects of sustainability. High energy intensity of GDP generally indicates (unless it is because of a specific industrial structure) low productivity and low competitiveness of the economy. In addition, it means that the economy is highly exposed to risks stemming from energy price fluctuations and high toxic emissions discharged into the environment.

1.1 Status of the region's energy productivity

LAC countries display unequal economic development. The per capita GDP figures in current U.S. dollars of 1995 range broadly from about US$200 to about US$5,000. Per capita energy end-use (per capita GDP), which provides an estimate of energy used to produce this per capita GDP, correlates relatively well with this diversity.

In Chart 2.1, energy end-use of LAC countries is displayed in an orderly fashion (from lesser to greater) by per capita commercial energy consumption

Chart 2.1: Final energy consumption and gross domestic product (1995)



(without firewood). Afterwards, firewood is added, and this modifies the ranking in terms of total consumption. But the apparent exceptions are even more interesting than the evident regularity of commercial consumption.

The countries that show a close proximity between total energy consumption and per capita GDP are more energy-intensive than others. Vice-versa, in terms of energy productivity, they are less efficient. The cases of Trinidad and Tobago, Suriname, Cuba, Guyana, Honduras, Nicaragua, and Haiti should be underscored. Likewise, Venezuela, Mexico, and Jamaica are relatively less energy-intensive, especially in terms of commercial energy. When including firewood, the Dominican Republic, Paraguay, and Peru and even El Salvador seem to be more energy-intensive than the average.

As rule, it can be said that the elements indicating low productivity, apart from statistical and measurement differences, usually are: an energy-intensive economic structure, especially in industry; a high share of energy products that have a low useful energy content (such as firewood); low economic activity; and/or simply the inefficient use of energy. The main causes are an energy-based industrialization policy, unfocused subsidies for energy consumption, and the lack of local available energy alternatives.

The declining share of firewood in the energy mix, as a result of growing economic development, should be underscored. It is also interesting to observe exceptions to the rule in this structure: high percentage of firewood consumption in countries that are relatively highly developed (Paraguay, Chile, Uruguay, Brazil, and Colombia) and very low percentages in the Caribbean (Cuba, Barbados, Trinidad and Tobago, and Jamaica). There is also a wide variety of reasons for these situations: lack of firewood supply, low commercial fuel prices, diversified supply (liquid fuels, gas, electricity).

A diversified energy supply is a factor that favors economic development. Using the range of different energy products available for total consumption in each country as a benchmark, Colombia, Chile, and Brazil with five energy sources (in addition to various oil products) seem to offer the best conditions, followed by Mexico, Argentina (taking into account the use of coal in electric power generation), and Venezuela. With the development of natural gas use in these and other countries (Peru), conditions will be even better.

1.2 Energy productivity since 1970

1.2.1 Overview

Three highly differentiated phases can be identified in the economic evolution of Latin American countries since 1970, coinciding approximately with the decades themselves:

- rapid growth (37%) between 1970 and 1980;
- crisis and adjustment (-8%) from 1981 to 1990; and
- recovery as of 1991.

By contrast, *energy intensity*,[4] the inverse of productivity, has not changed considerably from the regional average since 1970:

- It declined by about 10% between 1970 and 1980.
- It rose by about 7% between 1980 and 1991.
- It has remained at a standstill since 1991.

4. See OLADE's data base, the Energy-Economic Information System (SIEE).

Nevertheless, there are actually few countries that display an energy intensity performance similar to this average. The apparent regularity of this average is the outcome of a wide variety of evolutions in the countries. Chart 2.2 provides patterns of the evolution of energy intensity indicators and the per capita GDP for the region's countries, with the following classification:

Group 1: Countries that made progress over the last 25 years in the right direction (rising per capita GDP and declining energy intensity).

Group 2: Countries that managed to increase per capita GDP but experienced growing energy intensity.

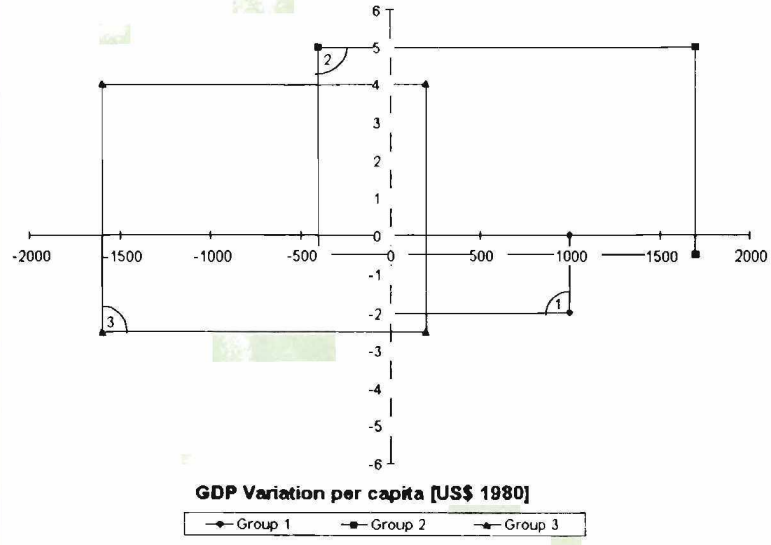
Group 3: Countries that did not manage to increase their per capita GDP and became less energy-productive.

The average of LAC with respect to these indicators shows a behavior that is similar to the countries of the first group (Chart 2.2.1). According to this average, the energy intensity of LAC in 1994 was hardly 3% (0.1 BOE/US10^3 dollars of 1980), below the level of 1970, whereas the per capita GDP in 1994 was more than US$520 (of 1980) higher than the figure for 1970 (a 33% increase), due to the increase achieved between 1970 and 1980 (US$591 of 1980).

The *first* group of countries (Chart 2.2.1), characterized by growth of per capita GDP and declining energy intensity, includes:

- Brazil, Colombia, and Paraguay, which managed to improve considerably both indicators (more than US$500 and more than 1 BOE/US10^3).
- Barbados, Chile, Ecuador, and Uruguay, with higher economic growth but less decline (more than US$500 but less than 1 BOE/US10^3).
- Dominican Republic and Honduras (lesser growth: less than US$500 but more decline, more than 1 BOE/US10^3).
- Costa Rica and Guatemala (lesser growth and lesser decline).

Chart 2.2: Areas of energy intensity: 1970-1994



Whereas Colombia, Chile, and Uruguay improved their indicators relatively steadily, the remaining countries only or substantially improved them throughout the seventies; Barbados and to a lesser extent Uruguay reduced their energy intensity from even the reduced levels they showed in 1970.

The *second* group (Chart 2.2.2) includes Argentina, Mexico, and Panama, which achieved higher per capita economic growth in the seventies and show stag-

Chart 2.2.1: Group 1: Countries with growth and decline of energy intensity

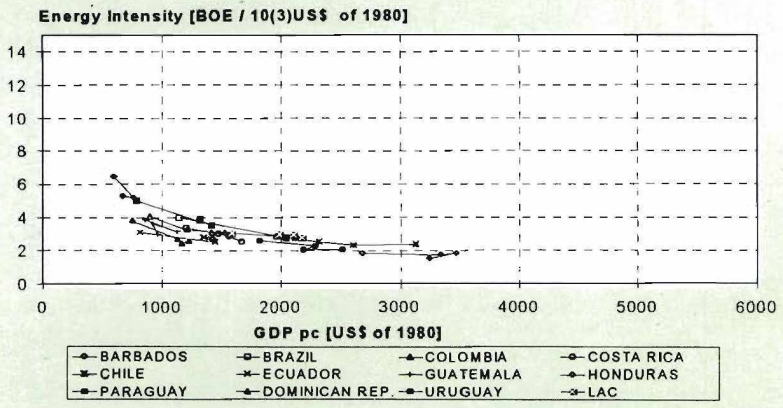
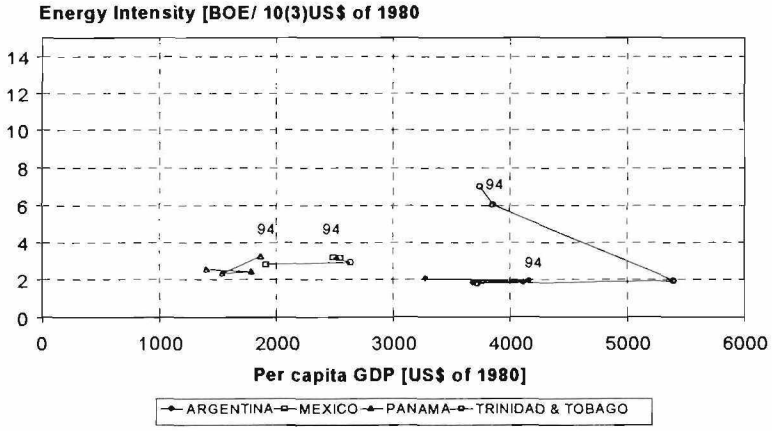


Chart 2.2.2: Group 2: Countries with growth and rising energy intensity



nation or even a slight increase in energy intensity. In contrast, Trinidad and Tobago, which is also included in this group, experienced a substantial increase in its energy intensity, owing to the industrial strategy implemented in the eighties and major fluctuations in the per capita GDP level, the result of sharp variations in oil prices.

The *third* group (Chart 2.2.3) seems far more heterogeneous. What the countries in this group have in common is the experience of a prolonged economic crisis and, in various cases, armed domestic conflicts. On the one hand, there are Jamaica, Guyana, El Salvador, Bolivia, and Peru, which after setbacks in the seventies and eighties, are recovering lost ground. Finally, Nicaragua, despite continuous economic contraction, has maintained the upward trend of its energy intensity.

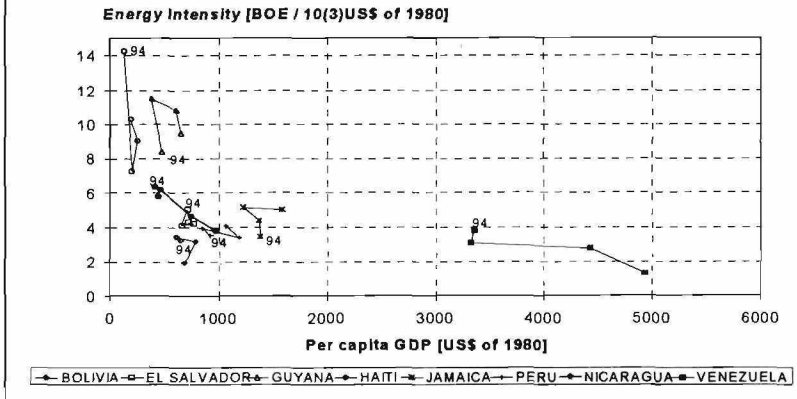
Desirable evolution is characterized, at first, by the combination of growth trends in per capita GDP and reduction of energy intensity; nevertheless, regarding the latter, it should be emphasized that its modifications are not exclusively associated with changes in efficiency in the use of energy. In the case of developing countries, both the industrialization process and the rapid advance in meeting the population's energy needs generally imply an increase in energy intensity. In addition, the most energy-intensive industries were gradually transferred from mature industrialized countries to developing regions during the seventies and eighties, thus contributing to the energy intensity in the latter regions.[5]

1.2.2 Trends in consumption sectors

The above-mentioned relocation of energy-intensive industries toward the region's countries that have an abundance of energy resources has not enabled them to reduce their energy intensity.

In Brazil and Mexico, energy-intensive industries expanded substantially during the eighties. Brazil stopped being an importer of steel and became one of the region's major exporters. Venezuela and Mexico considerably reduced their steel imports and substituted them for national production. In Trinidad and

Chart 2.2.3: Group 3: Countries with economic decline



5 See Byron Granda, "Efectos de la Relocalización Industrial sobre los Sistemas Energéticos Regionales" [Impacts of Industrial Relocation on Regional Energy Systems], OLADE-ECLAC-GTZ, 1995.

Tobago, a large chemistry industry was installed and is exerting a decisive impact on the economy's performance. The relatively lesser diversification of the economies of Trinidad and Tobago and Venezuela has made the rise in energy intensity in these countries considerably higher than the one recorded in Brazil or Mexico. With relocation grinding to a halt, the energy intensity of industry also stabilized. Over the last few years, other downward trends have become apparent. Several specific irnprovements such as the reduction of the energy content of copper production in Chile and in other energy-intensive industrial activities of the region should be underscored. Greater exposure to external competition, along with the reduction of subsidies and new environmental requirements, has encouraged industries to introduce new technologies which have led to the reduction of specific energy consumption.

In addition, comparison of energy intensity between countries during different periods of development can be distorted by the existence of an informal economy and by the estimation of real GDP in terms of dollars. Whereas energy consumption is recorded in energy statistics, its share of GDP is not recorded. In turn, the exchange rate may be subject to a devaluation policy and distort real parities.

In contrast to what occurs in industry, the energy used in transportation has been increasing rapidly due to the growing prevalence of the passenger car. Nevertheless, some examples within the region indicate that it is possible to modify this trend. Energy policy and municipal intervention, for example, can orient consumption toward compressed natural gas (CNG) and foster a more rational evolution of the transportation structure.

Other productive activities with high energy consumption are those of the energy sector itself in both the mining sector and transformation centers (thermoelectric generation stations, refineries, etc.) or in distribution. In LAC, this type of consumption has increased more slowly than in the transportation and industry sectors, not only because of structural changes in power generation (high increase in the share of hydroenergy) but also because of the lack of oil refining during the eighties. During the first half of the nineties, however, this consumption has once again picked up momentum as a result of the expansion of thermal generation capacity.

In residential consumption, energy use is quite inefficient. First of all, firewood consumption implies low energy efficiency (see the following chapter); the equipment or appliances for burning firewood is also inefficient. Although the profits from applying modern technologies for energy use in household consumption (for example, fluorescent lamps, efficient refrigerators) may be significant, the higher costs of initial investment and the lack of information seem to be a major obstacle for their use. Customers do not conduct complicated dynamic cost-benefit analyses to select among available options; they simply purchase a stove, refrigerator, or household appliance whose price is in keeping with the family's budget.

Although structural changes can help to explain part of the energy intensity behavior observed in some countries, it is also certain that this behavior is affected by the lack of progress in energy use efficiency. This preliminary conclusion is drawn when eliminating energy efficiency levels from production processes in several branches of heavy industry, technical characteristics, and the status of motor vehicle fleet maintenance and the type of household appliances, among others, within the region compared to what is observed in industrialized countries.

LAC has not as yet achieved much success in energy productivity. Nor have reforms and price increases implemented since the mid-seventies brought the results that were expected, and the deliberate rational-use-of-energy policies that were applied have not exerted any significant impact.

It has been concluded that there is a major lag in rational use of energy (RUE). Even when it has been fully demonstrated that it is an option that successfully competes with investment in the supply area, the energy policy of the majority of LAC countries continues to focus heavily on the latter (see section 3 of the present chapter).

2. Energy Sector Performance

The aspects of energy subsector performance considered to be of major importance due to their impact on the economy are, among others:

- Sufficient energy service in terms of quantity and quality as a condition for the competitiveness of the economy.

Economic activity is conditioned by energy availability and is more flexible if it can benefit from a diversified energy supply. In turn, the quality of available energy facilitates economic growth. As a result, in view of the high costs of supply systems, the objective is adequate availability in terms of both quantity and quality. High energy supply insecurity leads to the probability of high costs, either stemming from production losses or the need to install reserve systems.

- Viability

In order to provide a service that the economy needs, the sector should be capable of operating efficiently. It should have enough resources (capital goods, natural resources, human resources, and financing). In addition, it should use these resources appropriately.

- Efficiency

As in other sectors of the economy, the more closely the energy sector applies productive efficiency criteria, the more it conributes to economic growth, because less resources per product unit are used and thus part of these resources are available to be used for other activities. Efficiency also leads to cost reduction and, if there are no energy price distortions for other production and consumption sectors, efficiency inside the sector enhances competitiveness.

If viability is a minimum condition for the sector to run adequately, efficiency is an objective to be reached by the sector.

2.1 Situation in the recent past

Over the last 25 years, the region has considerably developed its energy production, transformation, transportation, and distribution infrastructure. Until the mid-eighties, it made huge investments to expand supply for its domestic and export market.

Oil production, which in 1970 was already a mature activity in some countries of the region (Venezuela), grew by about 50% until 1994; the major shares of this production are from Mexico, Colombia, Brazil, Argentina, and Ecuador. Natural gas production doubled, coal grew fourfold, and electricity ninefold.

Installed capacity for refining grew twofold between 1970 and 1980 and since then has stabilized. The installed capacity of power generation grew fourfold. An additional effort has been the development of hydroenergy resources, with its share of installed capacity rising to close to 65%. Investment declined in the eighties, and there were supply shortages.

The debt of the power sector was a heavy burden on public spending and could become a constraint for development. The lack of funds and the deterioration of reliability and service availability[6] were a constraint arising from the intrusion of political factors, which prevailed over efficiency considerations in more than one country.

The priority granted in the seventies to expanding energy service yielded positive results until the eighties, at which time it became evident that the strategy that had been chosen was no longer sustainable, since it depended on external contributions and rejected principles of productive efficiency.

Oil, as the major source of public revenues, had priority over other energy sources in oil exporting countries, thus favoring exports and the domestic consumption of oil products because of their low prices, whereas in the importing countries that had their own potential resources, after the successive crises of the seventies, huge amounts of resources were focused on exploration and development to mitigate the impacts of eventual price hikes on the international market.

Natural gas, with growing production associated to that of oil, barring few exceptions, lacked the necessary transport and distribution infrastructure; this led to the wastage of a large part of its production (flaring into the atmosphere)

6 See World Bank-OLADE assessment in *Evolution, Situation, and Outlook of the Electric Power Sector in the Countries of Latin America and the Caribbean*, December 1991.

or its destination to inappropriate uses that did not justify its combustion.

Coal, depending on geological conditions, product quality, and form of exploitation, was declining in some countries, with considerable prospects in others. This situation has not changed basically since the eighties.

Other energy investments were aimed at projects whose production facilitated the substitution of oil and products, namely, hydropower, national interconnection systems, alcohol programs, geothermal energy and nuclear power, among others, incurring a large share of the sector's external debt in the countries of LAC.

Severe dichotomies between macroeconomic and energy interests in a large number of countries were identified as one of the fundamental causes of the increasingly deficient performance of the energy sector. These contradictions were closely tied to the role played by the energy sector in tackling inflationary pressures, with the consequent impact of pricing and tariff-setting policies on sector financing and the State's management of energy earnings.[7]

To revert this situation, the majority of LAC countries have been undertaking reforms in their energy subsectors since the eighties (see Insets 2.1 to 2.3).

The targets of the reforms, mainly carried out in the electricity and oil sectors, on the one hand, have been focusing, on the sector itself, namely:

- increasing the reliability of systems;
- enhancing productive efficiency;
- securing financing by means of private-sector involvement; and
- protecting the interests of consumers.

On the other hand, these reforms have been focusing on the macroeconomic situation and are aimed at balancing public sector accounts and eliminating the deficit of state enterprises.

7 See F. Sánchez-Albavera and H. Altomonte, "El Desarrollo Energético de América Latina y el Caribe" [Energy Development in Latin America and the Caribbean], report prepared by ECLAC, September 1995.

Inset 2.1: Reforms of electric power systems

Regarding private-sector participation, the legal frameworks and market operation, the region's electric power systems can be grouped as followed:

Group 1: Legally segmented systems with mechanisms for competition and little constraint for private ownership and investment
Group 2: Integrated or regionally segmented systems with limited openness for private investment
Group 3: Integrated state-owned systems

At the beginning of the eighties, the electric power systems of LAC fell mainly in Group 3 and, barring few exceptions, in Group 2.

The reforms, despite the large variety of specific cases, can be classified in two modalities as indicated below:

Modality 1: Broad openness for private-sector investment, competition in power generation, open access to grids (leading to Group 1 systems)
Modality 2: Partial openness in power generation (leading to Group 2)

At the beginning of 1996, in five countries of South America the systems belonged to Group 1 or were evolving in that direction (Chile, Argentina, Perú and, with certain reservations, Bolivia and Colombia). Legislation in Ecuador is also pointing toward openness.

In Group 2 can be found the largest number of electric power systems of the region, the majority of which are small (Central American and Caribbean countries, but also Mexico). It is typical to have the indirect participation of independent power producers (IPP), under power purchase agreements (PPA) with power utilities, keeping the integrated State-controlled power generation, transmission, and distribution system intact. Another typical element of limited liberalization is the application of build-operate-transfer schemes (more commonly known as BOT schemes) to involve private-sector capital.

One group of countries (Venezuela, Uruguay, and Paraguay) has not yet resorted to independent power producers (IPP) using power purchase agreements (PPA), which is a characteristic element for limited opening up; they can therefore be classified under group 3.

In Brazil, the system is being liberalized to permit broader participation of the private sector, at least in the states, before the new federal legal framework enters into force.

The transition process has not concluded. For the year 2000, the trend is toward in-depth changes: almost half of the 30 countries and about 60% of the installed capacity will have adopted some type of modality 1 and some countries that have at present adopted partial openness are not discarding the possibility of taking a further step toward total openness.

Inset 2.2: Reforms in the oil subsector

Over the last few years, modifications have been made in the oil legislation of Argentina, Brazil, Bolivia, Colombia, Ecuador, Peru, and Venezuela.

The origin and motives of oil reforms that have been implemented in these countries are similar although there are several differences inherent to the specific characteristics of each country. As a rule, it can be said that they are in line with the prevailing trend, which grants to market forces the leading role in allocating resources and specifies that the State's intervention is justified only when national interests are at stake, free competition is distorted, or there are adverse impacts in terms of social equity.

In terms of general economic policy of the region's countries, it is surprising that even Mexico and Chile, considered to be countries of greater openness and regulation, are among those countries with the least amount of change in the oil sector. In Argentina, Bolivia, and Peru, it was considered that the style of development of the oil industry, based on the hegemony of public enterprises, was no longer valid, and therefore radical changes were made.

In Brazil, Colombia, Ecuador, and Venezuela, the reforms have been aimed at fostering foreign investment in oil exploration and exploitation. The need for a state oil company is not being questioned; rather its adaptation to a free-market system in the different upstream and downstream sectors of the industry is being considered.

In general, the sequence of reforms in domestic markets has taken the following course:

- *price correction,*
- *restructuring the financial scheme of companies and putting them on a sound footing,*
- *organization of a competitive market, and*
- *promotion of private-sector investment and privatization.*

In the eighties a more flexible approach to the remuneration level of contractors in the oil contracting scheme was adopted in order to attract greater investment, as a result of greater available supply on the world market, but the contracting guidelines (service delivery, operation, partnership, participation) were not greatly changed.

Oil openness in the nineties has involved the introduction of new modalities within the contracting scheme. These are in force in Argentina and Peru, with the reestablishment of the concession modality and licensing contracts, respectively, where contractors are entitled to the ownership of the petroleum that is extracted in exchange for a royalty. In other countries, the idea is to share the risk and attract the participation of new contractors with the introduction of the R factor in partnership and participation contracts

Other new events, of possibly even greater impact, are the elimination of the PETROBRAS monopoly in Brazil in 1995, the new contracts for exploiting marginal fields subscribed by PDVSA of Venezuela in 1992-1993, and the recent shared earnings contracts that Venezuela started to subscribe to at the end of January 1996.

The objectives went beyond the sphere of the energy sector and became part of public sector reforms and general economic reforms being carried out in many countries of LAC. These reforms radically contrasted with the conditions prevailing in Latin America, where it was believed that the power sector, especially, was a strategic sector for the economy whose objective was to supply electricity to the largest number of users. This approach enabled some countries to directly eliminate any kind of economic consideration whatsoever in managing power utilities and the sector. The domestic market for oil products, in oil-producing countries, was used to ensure the growing participation of the population and for other macroeconomic purposes (see the following section).

The natural gas subsector has not been reformed overall. Nevertheless, in the nineties, there was a boom in this subsector which led to the formation of natural gas markets in various countries and the integration of networks.

The coal subsector has experienced many different trends in the region. On the one hand, there has been a restructuring and rescoping to a more economically viable size, such as in the case of Chile and, on the other hand, the development of a highly competitive and important export activity, as in the case of Colombia.

2.2 Current performance of the three main subsectors

Many years will elapse before the effects of reform and private-sector participation in the energy sector of Latin America and the Caribbean can be fully assessed. Nevertheless, some preliminary trends can be observed.

2.2.1 Electricity subsector

Since about 1990, the *financial* indicators have been improving in the electric power sector of LAC (debt-capital ratio, internal project financing, debt service coverage, among others), explained to a great extent by tariff increases, debt reduction, and, in some countries, financial restructuring (or ensuring a sound financial footing) of the power utilities prior to the privatization process. The

reform and privatization strategies have been successful in securing financing for the expansion of the power sector. Indeed, whereas the countries that undertook drastic reforms (Chile, Argentina) encountered less difficulty in obtaining financing for their expansion projects, those that introduced limited liberalization (Mexico) are still making efforts to secure this financing.

The problems arising from the use of new forms of financing in a transition period have been aggravated by the instability of regional and world capital markets (Mexican crisis) and the increasingly greater number of investment opportunities as more countries, some of which involve a large market such as Brazil, launch a privatization strategy.

The countries that did not carry out any reforms are implicitly or explicitly moving toward some restructuring. Brazil, for example, with a large number of projects being implemented, is currently looking for private-sector stakeholders interested in setting up partnerships with state enterprises to conclude these projects. Likewise, the severe supply problems in Ecuador have pressured authorities into finding and materializing during 1995 various electric power generation projects with private-sector participation, including temporary leasing.

The adjustments to and changes in the criteria to determine *price* formation, as well as the availability of government guarantees, have played an important role in financing new capacity in systems such as Argentina and Chile. It is difficult to determine to what extent price adjustments, without sector reforms or government guarantees, would have improved the financial situation prevailing in periods before the reforms. Nevertheless, the reorientation of pricing and tariff-setting policies has undoubtedly helped to put energy companies on a sound financial footing.

In addition, efforts have been made to improve *operating efficiency* and downsizing policies have been applied in order to reduce costs. Productive units have been broken up (with the creation of subsidiaries on the basis of holding schemes) in order to ensure the transparency of the performance of productive

Inset 2.3: Gas sector boom and structuring

A preliminary review of the classification of the countries regarding the trends of their policy for the ownership of the assets of natural gas chains underscores certain preferences of the countries with respect to the role that their companies should perform in retaining and controlling gas earnings. While some countries grant special importance to the role of state-owned enterprises in retaining earnings, others prefer minority shareholding schemes, and the establishment of royalties and taxes on earnings and gross income, among other, as a means of obtaining revenues.

Table 1: Classification of countries according to policy trends for restructuring their companies

	Predominantly State Systems	Mixed Systems	Predominantly Private Systems
Exploration Production	Brazil, Mexico, Venezuela	Bolivia, Chile, Colombia	Argentina, Peru
Transport	Mexico, Venezuela	Bolivia, Brazil, Colombia	Argentina, Chile, Peru
Distribution		Brazil, Mexico, Venezuela	Argentina, Bolivia, Colombia, Chile, Peru
Regulatory authority	Ministry of Energy	Ministry of Energy (upstream) Regulatory agencies (downstream)	Ministry of Energy (upstream) Regulatory agencies (downstream)

Source: Own data, April 1996.

In the exploration and production phases (upstream), for the countries with predominantly state systems, the concept of supply security is largely viewed as a responsibility of the State, whereas in those systems that are predominantly private the emphasis is the give-and-take of market forces within certain legal constraints regulating the activity.

In the transport and distribution phases (downstream), policy trends indicate a shift toward mixed or private systems. In these phases, the main concern involves supply security, free access to transport systems, and service coverage to the poorest unattended sectors of society. Nevertheless, part of these aspects tend to be resolved by creating regulatory agencies aimed at watching over the common interest regarding public service delivery and mediating and monitoring compliance with licensing contracts.

In Brazil, with the approval of the constitutional amendment that terminated the monopoly of PETROBRAS in all phases of the gas chain, private-sector participation was facilitated in transport and distribution. In Venezuela and Mexico, there were government declarations and decisions tending to favor private-sector involvement in transport and distribution, especially in the marginal areas of Venezuela. In Colombia, the Plan for the Mass Availability of Natural Gas, launched at the same time as institutional reforms, has been aimed at facilitating the participation of private-sector activities in transport and distribution.

In Argentina, two natural gas transport companies and eight gas distributors controlled by the Gas Regulatory Agency are operating since 1992. Bolivia, as of 1995, has been implementing a capitalization system for the state-owned company Yacimientos Petroliferos Fiscales Bolivianos, which would involve the participation of private-sector players, even in the operation of companies emerging from the reform. In Chile, agreements between Argentina and Bolivia promoting private and mixed projects, which in a few years will change their energy matrix, have been drawn up. Peru is still in the process of materializing the government's policy to favor private-sector initiatives in the field of hydrocarbons.

process phases and avoid transfers (subsidies) from one activity to another that permitted discretionary actions and produced major distortions in the economy.

It is quite evident that, as part of the positive impacts, reforms tend to improve the sector's operating efficiency: service quality and system reliability, cost reduction, increase in productivity (calculated in terms of employee used, customer served, or energy sold) and the reduction of technical and nontechnical losses stemming from changes in commercial management.

It is more difficult to evaluate the effects on the reduction of *power generation costs,* since there are marked biases for medium-sized projects with short lead times (construction periods) and brief useful life, such as gas-fired combined cycle turbines and plants. This bias toward low capital intensity may lead to generation schemes that are not economically optimal. This is all the more evident in the various fuel oil and diesel plants operating on the base of the load structures of some countries. This problem is even more severe in those cases where the new power thermal power stations are built by an independent power producer (IPP) on the basis of a rigid long-term power purchase agreement (PPA) that distorts the economic merit order by which power stations are dispatched.

Compared to the previous situation, the conditions for small-scale electric power production, oftentimes using *renewable energy sources,* and *cogeneration* have improved or at least have become more reliable, since the terms for delivering energy to the grid and remuneration have been defined more clearly within the new legal frameworks. Nevertheless, in practical terms, the positive impacts of the reforms on the expansion of renewables and cogeneration have not been observed in Chile and Argentina, although these options have been more widely accepted in countries that adopted a limited opening-up approach, such as Mexico, Costa Rica, and Guatemala.

Assessing the achievements in efficiency stemming from the reform process, changes in sector objectives should be taken into account. The new objectives are reliable supply at a low economic cost and risk, where as the objective prior to the reforms frequently included social objectives that were not appropriately focused, infrastructure with unforeseen costs and other development goals.

Likewise, this change of objectives, evaluated in terms of *technical progress* and specifically in the case of the power utilities of Chile, suggests that "after privatization, profitability, financial engineering, and modern management methods prevailed over the traditional electrical engineering approach."[8]

Reform of the power sector negatively affected *rural electrification:* on the one hand, the objective of maximizing the earnings of the utilities by using a business approach enhances the sector's interest in supplying only those areas that have a high power demand density; on the other hand, public intervention, measured in terms of concrete policies and actions (subsidiarity) applied, is as yet incipient and in many cases totally absent and therefore incapable of closing the current gap between urban and rural electrification. Nevertheless, some countries with strong support from bilateral and multilateral cooperation are beginning programs to promote rural electrification using renewables (hydropower, wind energy, and solar photovoltaic energy).

Regarding the *rational use of energy* by customers, the reforms have not explicitly included energy efficiency. The vertical breakup introduced by reforms in some energy chains (electricity, natural gas) does not encourage the interest of distributing companies in promoting these conservation actions among customers. Nor have regulatory agencies become involved in this area.

The role of reforms in general and privatization in particular in developing local capital markets is usually included among the positive impacts. In addition, it has been argued that the privatized power utilities in several Latin American countries, especially Chile, have been the first to gain access to international capital markets.

From the viewpoint of market regulation, it can be asserted that the privatization process in Latin American still has

8 See Inostraza G., "Control del Estado y Gestión Empresarial en el Sector Eléctrico Chileno" [State Control and Company Management in the Chilean Electric Power Sector], paper prepared for ECLAC, LC/R.1497, Santiago, February 1995.

many various flaws, some of which affect the *accumulation process*, such as the lack of regulation in noncompetitive markets (preventing the so-called efficiency earnings stemming from privatization from being transferred to the community through lower prices) or the extension of service coverage and quality improvement. It has been concluded that to date the improvement in services as a result of their transfer to the national or foreign private sector is oftentimes, but not always, evident. Experience indicates that the regulatory capacity of the region's governments has been lagging behind reform processes. The success of future privatization programs will depend on their capacity to implement regulatory and monitoring schemes that promote the competitiveness and investment of privatized companies.

2.2.2 Oil subsector

As indicated, in *upstream activities,* the pace of growth picked up in the late eighties, owing to the increase recorded in Venezuela and, to a lesser extent, the increase in other oil-producing countries (Argentina, Colombia, Brazil, and Ecuador). Except for Argentina, these increases cannot be viewed as the outcome of reforms; they involve important findings to be tapped, as in Colombia, and the oil policy within the framework of OPEC, as in Venezuela.

Argentina underwent rapid oil development and its potential is about to reach a ceiling, whereas Mexico, Venezuela, Brazil, Colombia, and Ecuador have developed their capacity gradually to increase production, which remains considerable, over the next five years.

In *downstream activities,* the installed capacity for refining has not increased and the network of oil pipelines has been extended only in some parts (for example, the interconnection between Argentina and Chile). The topic in the refining segment is restructuring (concentration in Central America, adaptation to environmental constraints modifying the structure of process units to obtain cleaner products, etc.) and privatization. The restructuring process has moved slowly but successfully, whereas privatization has done so more gradually. As a result of this process, the refining structure is now more in keeping with domestic demand, although with some important exceptions (Colombia, Ecuador, Peru). The transport network still has bottlenecks in some cases (Ecuador).

Regarding *domestic markets,* the price corrections aimed at reducing budget transfers in the majority of LAC countries involved a gradual approach in keeping with the goals of economic stabilization programs. As a rule, pricing policies that used international schemes as references (opportunity costs) were adopted, although in some countries these are not as yet being fully applied. Between 1988 and 1995, the evolution of prices of the major oil products showed an upward trend in the majority of fuels, with differences in intensity between countries and products. Thus, it can be observed that the highest increases were for gasoline and intermediate products.

Likewise, in the case of those countries that reduced or eliminated their subsidies to liquefied gas for residential consumption and to diesel oil for transportation, the highest price increases in absolute terms were observed.

The capacity of companies to consolidate their *financial* situation has been enhanced, albeit not in all cases and depending on each national reality, by the reorientation of pricing policies, the lower transfer of resources from the companies to the State, the restructuring of liabilities, and the rescheduling of the external debt.

Substantial progress has been made in investment and financing, compared to the situation prevailing in the previous decade. In order to stimulate the inflow of private-sector capital in upstream activities, various contracting modalities with national and foreign capital have been adopted or firms have been acquired to incorporate technology and management, as in the purchase of Maxus by YPF of Argentina. Only Mexico still maintains restrictions in this phase of the industry.

Beyond the export strategy followed by several countries, where the medium or long-term sustainability of proven reserves can be questioned, certain contracting schemes being chosen that raise questions about *domestic supply security* can be mentioned.

Those countries that opted for contracting modalities which include the free availability of crude oil without any commitment to supply the domestic market could find themselves in a situation of greater vulnerability than those countries that opted for domestic supply security, especially if resources are not so abundant.

This may be a situation that, in the future, countries like Argentina and Peru (and probably Bolivia) will have to face, since they are more vulnerable to international market fluctuations and their macroeconomic impacts than countries like Colombia which will have secured their supply. Venezuela, which has opted for opening up the private sector under a profit-sharing scheme, may eventually find itself in the same situation. In the latter case, there are elements that would permit guaranteeing a better distribution of earnings while ensuring domestic supply.

Vertical breakup is also an area of conflict. In some cases, oil industry activities are being radically fragmented, which is in sharp contrast to current vertical integration, not only in LAC but also in the world.

The breakup, in any case, has taken place when operations acquired a certain magnitude but this does not imply that there is a holding company that has taken over central direction and therefore integral strategic planning. In this case, the idea is simply to separate the business units, with transfer prices being set if the company strategies determine this should be done.

There is no doubt that those who have access to crude oil can enjoy new and additional profit margins in refining, which can be extended to direct marketing and distribution activities. This is how the largest companies of the market, both private and public, regional and global, operate.

Maintaining an integrated company provides the opportunity of creating an internationally competitive company, such as the YPF of Argentina. Breakup and privatization into parts, whether by means of capitalization (Bolivia) or by bidding processes, permits other international companies to incorporate these parts.

In short, the relatively better performance of the oil subsector cannot be attributed to a certain type of policy or to the application of a single model. Rather it seems, as a rule, that the improvement in domestic market service stems from the introduction of competition and pricing policies. Privatization does not seem to be necessary if monopolies are eliminated. The region's experience in upstream activities, refining, and transport appears to be quite mixed, and it is not yet possible to associate these better results with one strategy while attributing less auspicious results to another. The review that has yet to be carried out must still address many atypical cases, such as ENAP of Chile, YPF of Argentina, PETROBRAS of Brazil, etc.

As for relatively small markets, such as those of the Central American countries, even though there are not enough elements to facilitate a sound assessment of the results of the liberalization of oil and gas trade, some data are available for a critical appraisal of the actions that were taken.[9] Thus, Costa Rica and Nicaragua, whose state oil companies are in charge of imports, made purchases at an FOB price very close to Platt's for the Gulf Coast of the United States, a price that was very much below the purchase or sale price used by the other countries.

2.2.3 Natural gas subsector

The gas subsector is relatively underdeveloped in the region. The idea is therefore not to reform it in order to achieve better results as in the other subsectors, but rather to develop it.

In all gas-producing countries in the region, major changes in the role being attributed to this energy product have been observed. In some of these countries, this role has been reinforced by high expectations stemming from the potential results of subregional integration processes, which are opening up new horizons for markets and facilitating a reappraisal of gas surpluses by producers, because of the large potential demand among neighbors.

ECLAC, Subregional Headquarters in Mexico, "Istmo Centroamericano: Informe sobre Abastecimiento de Hidrocarburos" [Central American Isthmus: Report on Oil and Gas Supply], ECLAC-Germany Agreement, April 1995.

Until recently, within the flexibility allowed by the gas-oil ratio (GOR), oil discoveries have been granted priority over natural gas exploration in the region. This is partially due to the high oil prices in the seventies and the relatively low natural gas transport and distribution capacity in almost all countries, which in turn explains the high volumes of unused gas. Nevertheless, with the fall of oil prices in the mid-eighties, the GOR ratio began to grow, indicating an apparently greater interest in natural gas.

In 1994, natural gas accounted for 19.6% of the region's primary energy supply. This share was largely covered by countries with a high oil and associated gas production with a high gas and oil ratio, in terms of resources, such as Venezuela, Bolivia, and Argentina, which have had to channel gas for different uses to make available liquid fuels for exports or to reduce their imports. In the case of Chile, which has a high gas and oil ratio, the distance of its reservoirs from consumption centers has led to its captive use in the southernmost part of the country.

In 1994, the gas supply was 808.4 MBOE. Of this supply, 15.7% was consumed in power generation plants, 33,9% was aimed at LPG and gasoline production, 31.9% was for end-use by socioeconomic sectors, and the rest was attributed to own consumption and losses.

The energy end-uses were concentrated in industry (70%), with a considerable share in the residential sector (17.2%), petrochemical installations (6.7%), the commercial, public, and services sector (3.5%), and transportation (1.7%). Penetration in residential consumption has enabled reductions in electricity consumption for cooking and water heating. Penetration of natural compressed gas (NCG) in the transportation sector was intense in Argentina, followed by other countries at the end of the eighties; this was quite advantageous since it reduced consumption of liquid fuels, enhanced the performance of motor vehicles, and mitigated the environmental impact in cities.

In the region, natural gas is the second energy source for power generation in thermoelectric plants after fuel oil, and it is expected that its penetration will continue and that it will substitute considerable volumes of liquid fuels in addition to improving the performance of conventional thermal plants.

The situation that is being described is by no means uniform among all countries. The widest dissemination of gas can be found in Argentina, which in addition has the largest network of gas lines for transport and distribution (about 50,000 kilometers) in the region. The penetration of NCG in public and private transportation has fostered the development of a rather large industry of bus and car equipment. The remaining countries, with different degrees of distribution, generally use natural gas for electric power generation and industry as a priority.

Gas-producing countries which are self-sufficient and have an abundance of gas, such as Venezuela, Mexico, Colombia, and Argentina, have undertaken projects for expanding the use of gas in different sectors by opening up transport and distribution to the private sector.

After sector reform, activity evolution indicators in Argentina show an improvement although it is as yet premature, due to the short lapse of time that the new institutional scheme has been operating, to assert that the system will not produce the changes resulting from the adjustment process. In the remaining countries, the reforms in the sector are very recent or are still in the process of implementation and, in some cases, with lags due to the difficulty of striking a reasonable balance between government and private-sector expectations.

Countries that have little gas available or whose access to gas is hampered by its geographical location, such as Brazil, Mexico, and Chile, have facilitated the development of import projects with financing from public and/or private enterprises. The gas line that is currently being built to connect Argentina with Chile (Gasandes) or the one connecting Bolivia to Brazil are examples of the potential for a subregional gas network that could become fully operational over the coming 15 years.

3. Energy Sector, Macroeconomic and Fiscal Policies, and Development Policy

3.1 Priority of macroeconomic objectives in the past

In Latin America and the Caribbean, the energy sector has been used for various purposes by overall government policies, thus subordinating the sector to macroeconomic objectives:

- To achieve the objective of economic growth, and also for social purposes, the energy infrastructure was expanded, providing further energy supply and extending service.

- To achieve the socioeconomic objective of full employment, a wide range of staff was hired and paid by state companies. The sector ended up by being inefficient because it became a source of redundant jobs, creating a huge bureaucratic apparatus and fomenting social conflicts.

- To achieve the objective of controlling inflation, economic policy regulated energy prices and prevented them from being adjusted to the costs their production incurred, thus ignoring any kind of economic rationality.

- Oil price fluctuations have been a major factor of instability in the foreign trade balance not only for importing countries but also for exporting countries. Importing countries have resorted to an energy resource diversification and import substitution strategy with varying success. The exporting countries, however, have had to sustain severe fiscal impacts in their accounts.

By granting priority to these macroeconomic objectives instead of the self-sustaining development of the subsectors, the State fostered fiscal disequilibria in the majority of the region's countries. In the seventies and eighties, the power sector, as well as many domestic fuel markets, became a heavily subsidized sector. The earnings stemming from oil and gas exploitation led to widely subsidized current expenditure programs, instead of socially focused programs, in the exporting countries, especially during the two high-price periods (1974-78 and 1980-96). With the fall of oil prices, public expenditure programs and habits became unsustainable.

In addition to fiscal imbalance, the policy of high public spending and investment, coupled with other internal and external factors, fostered external indebtedness, which has become a severe burden for the region's countries, halting their economic development well into the coming century by absorbing a large part of their domestic savings. The electric power and oil subsectors have been the final destination or, in some cases, the intermediaries, for absorbing or channelling these external funds.[10]

As a means to counteract the deleterious effects of price fluctuations in the world's energy market, but also to ensure greater supply security and other objective (see next section), broader energy integration in Latin America has always been sought. This process intensified in the nineties (see Inset 2.4).

3.2 Adjustment since the eighties: Predominance of fiscal objectives

Macroeconomic adjustment programs applied in the region, however, since the eighties have been overturning these priorities. Priority was given to ensuring fiscal equilibrium, which implied the reduction of expenditures in the sector, the need to find private financing for the sector, and even financing for the General State Budget by selling energy sector assets. During this phase the idea emerged that, in the energy subsectors as in other public sectors, it would be possible to introduce much more competition, which would in turn improve efficiency (see previous section) and the possible substantial withdrawal of the State.

Using the energy sector for macroeconomic purposes usually involved a purely fiscal dimension. At present, in only a few countries is price controlling practiced for anti-inflationary ends. Downsizing is also an important issue in the sector's adjustment process although it has not been adopted by the sector as one of its objectives. Specific energy import substitution programs have been allowed to expire. Expansion and operation of energy infrastructure is viewed as

10 See OLADE, the *External Debt of the Energy Sector of Latin America and the Caribbean;* and OLADE, *Energy Prospects and Economic Development in the 21st Century: The Outlook for Latin America and the Caribbean in a World Context,* Quito, 1993.

a business, financed and managed by the private sector or at least on the basis of commercial criteria by private and public enterprises, depending on the type of market, whether regulated or self-regulated (see Insets 2.1, 2.2, and 2.3).

The process of privatization has contributed to ensuring fiscal balance in the region's countries.[11] The revenues that accumulated as of the early eighties as a result of the transfer and sale of public enterprises (telecommunications, energy, mining, and other) have increased considerably. The annual amount collected from privatization, which in 1985 amounted to US$40 million, by the end of 1991 had reached a figure of more than US$17 billion. At the end of 1994, the total amount accumulated from the above amounted to US$56 billion. These figures include investments committed or generated from the privatization process, which in some cases involved substantial amounts.

Among the countries involved in a consolidated privatization process, Chile is noteworthy. The amount obtained from this process between 1974 and 1989 amounted to more than 16% of GDP. Chile is followed by Mexico (8.8% of GDP) and Argentina (7% of GDP). Finally, there is Brazil, which displays a lower percentage within this group (only 2%), although the massive privatization plan announced for this country is scheduled for coming years.

Since in many cases the short-term approach for obtaining revenues from privatization still prevails, only in certain exceptional situations has an accumulation process in the privatized sectors been encouraged, explicitly incorporating in bidding processes the promotion of new investments, as in the Bolivian and Peruvian experiences. In the remaining countries, the privatized companies that expanded their capital and investments have been telecommunications, energy (hydropower, gas, and oil), or large mining companies, where there is a large potential for expansion. Nevertheless, since in many countries this process is quite recent, it is not as yet possible to see it reflected in the figures of gross fixed capital formation.

The impact on public finances over the medium and long term seems uncertain since the benefit depends on the destination of the resources coming from the sale of companies. Fiscal constraints are and will continue to be an important factor in accelerating the process of selling public enterprises in Latin America over the last few years.

In addition to the direct impact of privatization on the situation, there are indirect impacts such as not covering the annual deficit of companies, reducing public investments in the power sector, adjusting prices, and restricting subsidies to small consumer groups, which means relieving burdens on public revenues over the medium and long terms.

The oil and gas sector continues to be one of the basic sources for the state budget in many countries of the region. Even when the figures published are calculated on the basis of different criteria, it is possible to confirm that in some countries oil earnings contributed decisively to public revenues[12] and in certain enterprises the State takes the highest share of surpluses.[13]

During the period 1980-1990, the public sector of Mexico was financed by the country's oil earnings, which accounted for between 9% and 13% of GDP, whereas this coefficient fluctuated in Argentina and Bolivia between 2% and 9% and between 1.5% and 3% of GDP, respectively. In Venezuela, these earnings were in the range of between 10% and 19% of GDP during the period 1988-1992. The cases of Bolivia and Venezuela illustrate even more clearly the importance of oil earnings in public revenues. In Bolivia, the share of revenues stemming from oil and gas accounted for between 42% and 50% of total public revenues during the period 1987-1989 whereas in Venezuela this share fluctuated between 55% and 82% for the period 1982-1992.

Using the average income tax rate (30%) in force in the region as a reference, it is possible to differentiate three clearly distinct cases.

1. Companies with high contributions to public revenues, as in the case of ECOPETROL of Colombia (in 1990-1994, equivalent on average to about 52% of operating income) and

11 See Cominetti, R., ECLAC, "El Proceso de Privatización en América Latina" [The Privatization Process in Latin America], paper prepared for the Seminar on Exchange of Experiences on Economic and Social Policies for Development between Latin America, Russia, and Selected European Countries, Moscow, September 1995.

12 ECLAC, "Reformas Tributarias en América Latina: Análisis de Experiencias durante la Década de los Ochenta" [Tax Reforms in Latin America: Analysis of Experiences during the Eighties], paper prepared by R. Carciofi, G. Barris, and O. Cetrángelo, Regional Public Policy Reform Project, Santiago de Chile, 1995.

13 ECLAC, "Tendencias en la Reestructuración de la Industria Petrolera y Estrategias Empresariales en América Latina" [Trends in Restructuring the Oil Industry and Company Strategies in Latin America], study prepared by H. Compodónico for the Natural Resources and Energy Unit of the Environment and Development Division, Santiago de Chile, April 1996 (being published).

PEMEX of Mexico (63% of total income).

2. Companies with medium contributions to public revenues, including PDVSA (from 44% to 23% during the period 1990-1994, yielding an average of 33%), PETROECUADOR (between 1990 and 1992 this contribution declined from 65% to 28% of total income), and PETROBRAS (the average was one third of total income of the company in the period 1992-1994, with a growing trend).

3. Companies with low contributions to public revenues, such as the case of ENAP of Chile (6% of total income) and PETROPERU, which actually ran a deficit with the State until 1990 and contributed on average about 9% of its total income during the period 1991-1994.

3.3 New approaches: The catalytic role of the energy sector

Although the experiences of managing the sector on the basis of macroeconomic objectives have been partially negative, it is obvious that the energy sector can perform a catalytic role in the economic development of a developing country. There is no doubt, however, that the sector should not be used by economic policy if this policy clashes with its own development objectives. Nevertheless, there is a series of areas where the two sets of objectives can coincide, for example, social and environmental dimensions.

It is already evident that *energy sector earnings* are important for the State's budget, which in turn is the principal source of funding for social programs and the basis for future development in the form of education and other human capital investments. It is suggested as a rule that energy earnings be used for investments in physical capital, in conserving natural assets, or in human resources.

Moreover, another possibility is envisaged, that of combining fiscal, economic, environmental, and even social objectives in the *appropriate levying of taxes*. Using a special differentiated scheme for taxing the use of energy products, it is possible to issue signals to ensure the rational use of energy, foster the preference for clean energies, and allocate resources in general. At the same time, attempts are being made to design these taxes so that they can have a redistributive effect. Just as these taxes contribute to fiscal revenues, it is also possible to cut other taxes that could eventually hinder economic growth. These forms of taxes are currently being discussed in Europe and their possible application in the region should eventually be studied.

In addition to its fiscal importance, the sector performs an obvious catalytic role in the *strategy of productive transformation with equity*[14] in all of its elements: opening up, formation of domestic markets of goods and services, formation of financial markets, greater value added, formation of human resources, and the incorporation of technological progress.

- As a sector with many international linkages it is a key element for opening up the economy to the outside.

- Traditionally it is a sector with large investments and, under certain conditions, it is used for attracting private capital.

- Because of its capacity to absorb large amounts of investments, it is one of the most appropriate sectors for the formation of domestic capital markets. If in addition the formation of domestic markets manages to promote domestic savings, one basic condition for the region's economic growth is being fulfilled.

  In the eighties and nineties, the energy sector, especially the power sector, has contributed and taken advantage of local capital markets, which, in some countries, have become a considerable source of financial resources for the power utilities. The development of local capital markets has implied an important taking of domestic savings, especially through pension funds and, to a lesser extent, through the national banking system. In Chile, the privatization of power utilities and the emergence of institutional investors, especially pension funds, performed a decisive role in the formation of capital markets. Other institutional investors are being developed, such as insurance companies and

14 ECLAC, *Productive Transformation with Equity: The Priority Task for the Development of Latin America and the Caribbean in the Nineties*, United Nations, Santiago de Chile, 1994.

shared investment funds, which in other countries (Argentina) also contribute, along with multilateral banks, to meeting the companies' long-term needs for resources. But for the time being, these capital markets can only be characterized as emerging.[15]

Reform, privatization, and private investment have induced an entirely new financial engineering approach to resolve problems involving the scope of operations, profitability, the different types of risk depending on the legal framework, and the organization of the respective market.[16]

- In addition to capital markets and financial engineering, the sector can promote the development of new activities in its environment, creating above all more or less specialized service markets. The idea involves developing services and producing goods for the energy subsectors and for the rational use of energy under competitive conditions. Regarding environmental protection, increasingly more services are needed.

- Greater thoroughness and coordination within the sector itself would lead to a higher value added. This does not means that each one of the countries should have a complete system for each energy chain, but its does involve the idea of trying, on the basis of existing competitive stakeholders, of adding new parts with competitive possibilities.

- The sector can given impetus to the training of highly skilled human resources. The technological level of various energy subsectors is relatively high but technical progress is fast-paced. In order to resolve problems involving resource access or environmental problems or simply to improve efficiency and reduce costs, highly skilled human resources are generally required in research, engineering, management, and finance. If they are trained and upgraded, national human resources will have better opportunities in the sector, sector problems will be the focus of greater attention and solution, and in addition there are dynamic impacts on other sectors such as technological externalities.

- Thoroughness and coordination inward and outward, as well as the creation of domestic markets of products and services, oftentimes innovative, combined with the training of local personnel, can achieve the incorporation of technical progress which in turn exerts important impacts on the country.

A review of the incorporation of technical progress in the region's energy sector[17] indicates that, beyond the State's induction mechanisms, there are possibilities for associating domestic markets and coordinating sector chains.

In various energy subsectors, it can be observed that the quality of energy technologies being applied is inferior to that in industrialized countries. Low energy prices (still subsidized in many countries of Latin America and the Caribbean), the existence of state or private monopolies in the different energy chains, and the policies of closed economies, prevailing in almost all the countries of LAC up until the early nineties, generated few incentives for improving technologies and enhancing efficiency. Therefore, a large part of the technological facilities of LAC is characterized by age, obsoleteness, and lack of maintenance.

This analysis shows that all transfer modalities in the energy sector can be found in the region and in some cases this diversity appears in one single facility. There are technologies whose components are, in part, imported and, in part, built in the country under license or else developed domestically on the basis of know-how transfer within a joint venture and sponsored by international technical cooperation. There are specific situations, however, where "passive" technology transfer schemes prevail (purchase of equipment, direct foreign investment, production under license). This is the case of traditional sectors of great economic importance (oil industry, electricity generation using fossil sources, hydroenergy, nuclear energy, industrial sector, and transportation). In turn, in the case of "young" technolo-

15 See F. Sánchez-Albavera, "Globalización y Reestructuración Energética en América Latina" [Globalization and Energy Restructuring in Latin America], *Revista de CEPAL*, No. 56, August 1995, page 133.

16 See A. Vieira de Carvalho, P.H. Suding, and F. Figueroa de la Vega, "New Forms of Financing for the Electric Power Subsector in Latin America and the Caribbean," OLADE, *Energy Magazine*, Year 19, No. 1, January-April 1995, pages 99-114.

17 See B. Bösl, "Las Transformaciones en el Sector Energético Derivadas de las Transferencias Tecnológicas de los Países Industrializados a América Latina y el Caribe" [Transformations in the Energy Sector Stemming from Technology Transfers from Industrialized Countries to Latin America and the Caribbean], Working Paper No. 44 of the OLADE-ECLAC-GTZ Project, Quito, October 1995.

gies, which as yet are not economically important, the widespread presence of "active" types of transfer can be observed. Some examples of these are the production of ethanol, the gasification of biomass, and the different renewable sources for electric power generation. In all these sectors, the transfer of know-how, sponsorship by technical cooperation, and especially local developments perform an important role.

Therefore, in view of the economic importance of the sectors, it can be concluded that passive strategies prevail for the transfer of energy technologies to LAC. Although it is evident that there is local technological capacity, since some countries have even built nuclear reactors, turbines for hydropower stations are manufactured, and offshore exploration technologies have been developed, the predominant trend has been the import of equipment. The limited market, the low turnover, and therefore the small amounts of production required oftentimes do not justify investment in local production. Unfortunately, there are various cases where governments or local industry forced national production even though it was not a profitable business; these decisions, although well-intentioned, affected quality and led to even higher costs. Nevertheless, successful experiences are also apparent, especially in the use of the instruments referred to above, and there are current examples that prove that, if there are favorable conditions, local know-how and experience, as well as moderate incentives from the government that do not hamper market forces, they can be highly successful and generate a self-propelling process of technological development (ProAlcool and biomass gasification in Brazil).

Apart from these reasons, based on market conditions, there are other very important reasons, such as the absence of thorough professional training and the lack of later training possibilities.

Likewise, regarding the efficient use of energy, especially in the residential sector, a similar situation can be observed. Due to the lack of financial resources and information, a high proportion of household technologies is obsolete, inefficient, and poorly maintained.

The recent evolution and the impacts of political changes on the development of internal markets of goods and services from and within the energy sector have not as yet been studied satisfactorily. Nor have the impact on training of human resources and the eventual external technological effects on other sectors been studied.

The opening up to competition, including competition from abroad, of energy markets and related markets (financial, services and products for production, transport, and general energy use) provides opportunities for the faster transfer of technology although it also means heavy competition for national players in these areas.

Various concerns have emerged regarding the impact on the development of countries that are becoming involved in globalization involving exclusion, the lack of commitment with long-term development of the country, the lack of profit reinvestment in the country or region, and investments in only a specific part of the energy chain, which will not be generating related services or production. This could even imply a return to primary production schemes instead of creating a high value added.

The reality of these dangers cannot be denied. Nevertheless, without adopting an overly ingenuous stance, it can be asserted that the majority of the abovementioned negative effects can be mitigated or neutralized by means of currently available policy instruments. Some countries of the region continue to display major shortcomings in the formulation of their public policies, thus leading to the emergence or aggravation of these negative effects. Other countries manage to subsist with globalization by maintaining a policy that favors national players, even maintaining certain incoming barriers, practices that exist in other regions of the world. The power utilities of Chile and previously state-owned oil companies

became, under these conditions, more dynamic or were transformed into international companies. An important role of the sector to counteract the dangers of globalization is to coordinate energy policies among the region's countries, which is the topic of the next section.

4. External and Internal Political-Economic Factors

The energy sector lends itself to the accumulation and concentration of political and economic power. Application of this power can weaken the position of individuals or groups that depend on a service controlled by other individuals or groups who wield power. This type of situation has occurred not only among groups of countries, in terms of foreign relations, but also inside countries.

4.1 Political and economic considerations in foreign relations

The concerns of importers regarding supply security with its economic ramifications (high costs) and political consequences (external pressures) have always been of the utmost importance and sometimes have even led to armed conflicts. Recently, energy exporters have also been faced with external conditions.

- The issue of supply shortage (due to a cut in supply in order to ration a product so as to raise its price or apply pressure to achieve a specific objective) is an ongoing concern of industrialized countries, confirmed by the oil crisis of 1974 and once again emerging with the Persian Gulf crisis. These countries, in addition to including military measures in their strategy, have erected and agreed upon international contingency mechanisms involving strategic storage schemes, efforts to increase domestic supply, measures aimed at diversifying energy sources and supply origins, and ensuring general energy savings.

- For the region's oil-importing countries, the concern over eventual shortfalls on the international market with its concomitant price hikes is no less important. The strategies of these countries have focused on their own resources. In many countries, electrification programs have been implemented with the construction of hydropower facilities with a huge capacity, whereas alternative energy programs have been feasible only for countries with a high economic potential such as Brazil (alcohol) and Venezuela and Argentina (natural gas). The multilateral or unilateral support programs between countries and groups of countries have not been very effective, except for the cooperation between Mexico and Venezuela, on the one hand, and the Central American countries, on the other hand, or the shared binational hydropower developments between the MERCOSUR countries.

- Oil-producing countries have to deal increasingly with new conditions imposed upon them by importing countries or, multilaterally, by world trade organizations which go beyond the quality of the products and extend to the very means of production and even go so far as the call for embargos. There are actually very few forums where the region's exporters or importers can defend their interests, and even those have yielded highly unsatisfactory results.

This underscores the need for greater regional coordination and organization.

The growing physical integration of energy systems will lead to greater supply security, not only favoring greater economic growth but also more policymaking freedom in critical situations.[18] Energy integration (see Inset 2.4) is a basic instrument for national supply security over the short, medium, and long term; it is also a way of preventing the intrusion of factors that are external to energy supply that could be wielded by the foreign policy of third countries.

4.2 Internal political and economic ramifications

Inside the countries, the traditional concentration of sector control and management has in the past led to the concentration of political and economic power in the hands of those groups closest to each successive government administration. This concentration has

18 See OLADE, *Energy Integration in Latin America and the Caribbean,* (Central Topic of the XXVI Meeting of Ministers); F. Figueroa de la Vega, "The Impact of Bloc Formation on Regional Energy Integration," OLADE-ECLAC-GTZ Working Paper, 1995; IDEE, "Energy Integration in Latin America and the Caribbean in a Context of Sustainable Development," paper for GTZ, 1995; and P.H. Suding, "The Contribution of Energy Integration to Sustainable Development: Elements for an Assessment," *Energy Magazine,* OLADE, Year 20, No. 1, January-April 1996, pages 75-82.

Inset 2.4: Energy integration in LAC

Since the eighties, renewal of integration processes in LAC has taken place along with the growing intensification of the impacts stemming from globalization and the unilateral liberalization policies that the region's countries were adopting. In many cases it was observed that the combination of trade liberalization and deregulation and privatization processes led the private sector to develop a special interest in new business opportunities, surpassing even the expectations of the governments.

In Latin America and the Caribbean, the following subregional blocs are identified: the Common Market of the South (MERCOSUR), the Andean Group, the Central American Common Market, the Group of Three, and the Caribbean Common Market. The first step to link LAC with the United States and Canada has been the signature of the North American Free Trade Agreement (NAFTA), which includes Mexico. The second has been the process that started in December 1994 with the Summit of the Americas. Physical integration involves various activities: electric power interconnections, gas pipelines, oil pipelines, and the development of shared hydropower resources.

There are, among the countries of the region, various energy aspects that involve cooperation elements and forms that oftentimes are linked to physical integration. Regarding this, there is a great deal of potential, among which the following are noteworthy, according to the degree of integration and institutionalization:

- ⇒ *Coordination between various countries on specific issues: joint negotiation of specific projects; implementation of environmental management programs; adoption of coordinated stances in international forums.*
- ⇒ *Bilateral economic agreements and collaboration between national entities.*
- ⇒ *Joint training programs.*
- ⇒ *Exchange of results and coordination in research and development; transfer of technologies; and energy innovations.*
- ⇒ *Sharing of information (creation and maintenance of information systems).*
- ⇒ *Cooperation mechanisms in case of contingencies or crises.*
- ⇒ *Regional policy subsidiary to country policies.*
- ⇒ *Permanent coordination of energy policies.*
- ⇒ *Reduction of customs and non-customs barriers in energy.*
- ⇒ *Harmonization of domestic laws and regulations, including public revenue policies (taxes, subsidies).*
- ⇒ *Creation of unified markets for one or various energy products.*

The incipient process of regional integration has generated energy trade flows that have led to a substantial increase in transactions of oil and products, as well as coal. The highest increase was observed in 1990, year in which trade flows were redirected toward the region's market. MERCOSUR and the Andean Group have been the most dynamic regions regarding this new scheme and have given priority to exports aimed at the countries of their own subregion. A similar tendency has been observed in the Central American Common Market, which although still a net importing subregion has increased its share of oil product exports aimed at its own subregion.

enabled these groups, on the one hand, to use the sector for macroeconomic purposes and, on the other hand, to abuse the sector for personal ends.

Reform, starting with the separation of state duties from company functions and the commercial reorientation of state-owned enterprises, but especially privatization itself have led to the possibility of breaking up this stranglehold over supply. Reform intends to create opportunities for decentralizing political and economic power in the sector. To what extent this decentralization has been achieved would have to be studied.

In some cases, power is concentrated in the hands of the managers of power utilities that are vertically integration or affiliated. In other cases, conglomerates have been set up with important interests in various phases of the energy chains. The State, as part of its regulatory functions and as the representative of consumer interests, is in a relatively weak position, above all because of the asymmetry of information in the regulatory processes (see Inset 2.5).

The sector reforms discussed in the previous section, supported by trends that are consolidating a subsidiary State that intervenes only in correcting market flaws and external conditions, raise certain questions about the eventual constraints that the State may have to face with respect to its capacity for formulate public policies that will enable sustainable development objectives to be achieved.

The free availability of natural resources, the critique of public enterprises, the distribution of public and private control over oil earnings and contracting schemes, the relationship between regulators and the target of their regulation can be underscored as important variables for the formulation of an energy policy geared to ensuring the goals of sustainable development. In certain countries, it would more difficult to achieve these goals simultaneously.

5. Conclusion: Priority Guidelines

The pivot of energy policy regarding its economic dimension seems to be energy productivity, observing the priority of lower cost and risk. This emphasizes

the importance of efficiency in energy processes in particular and rational use of energy in general. Nevertheless, the imperative should not only be saving energy and producing energy efficiently but also, of far more importance, providing a restructured supply that will ensure sustainable development.

Energy costs are an important factor in only very few branches of the economy. The quality of energy, that is, energy forms available and supply reliability, however, is important in almost all branches. For the development of industry, between higher-quality supply at a higher cost, on the one hand, and lower-quality supply at a lower cost, on the other hand, the first alternative seems preferable.

The creation of energy-intensive industries based on cheap and possibly subsidized energy has oftentimes led to failures due to their low productivity and high vulnerability to price changes stemming from market shifts and other reasons, such as the nonsustainability of subsidies, the inconsistency of prices with environmental costs. Even in some cases subsidized prices have been an obstacle to economic integration.

A reduced incidence of energy on the costs of producing goods and services coupled with a potential rationalization in energy consumption, means the possibility of effectively using pricing mechanisms to induce a more productive use of energy. Another condition is a stable demand for products. These conditions do not exist in all the countries of the region, nor are they apparent in all branches of the economy.

Especially in countries in transition, which have not yet implemented and overcome the effects of structural reforms of the public and energy sectors, a cautious strategy would have to be applied. We do not believe that a shock strategy is advisable for inefficient high-cost industries, leaving them the option to adapt or to die. In these cases a systematic approach should be applied (with technical assistance for technological and marketing matters, loans, tiered price increases) so that the companies will have better chances of adapting, rescuing these activities in the country, maintaining employment, etc.

Inset 2.5: Evolution of energy regulation

There is still a great deal of role confusion regarding regulatory issues. For example, there are different concepts under the same name: politics in general, jurisdictional authority, the function of state companies in competitive markets. In many cases, political, regulatory, and entrepreneurial duties are discharged by the same entity. Nevertheless, beyond the modalities assumed by energy industry reforms in the different countries, a widespread tendency toward greater clarification of these roles has become apparent.

Likewise, important changes have been introduced with respect to policymaking roles and, in particular, the design of regulatory norms (legal frameworks, regulatory resolutions) with reference to those functions that are most closely tied to supervision and monitoring of compliance with standards, the arbitration of conflicts, and the policing of services. Nevertheless, the general trend is that the separation and clarification of these roles is in a much more incipient stage, since this requires a far more complex learning process.

The design of regulatory standards is a specific responsibility of public policymaking agencies, since, by means of these norms, certain objectives linked to productive structure, institutional organization, and the functioning of markets in the different energy chains can be achieved. Regarding the functions most closely related to the application and enforcement of these norms and with the arbitration of conflicts that may emerge among the different players, the trend is toward the establishment of institutions that have greater autonomy with respect to political power. Nevertheless, in these two areas, there are still major problems:

- *In some cases, there is no clear separation between these two sets of functions, and there are various regulatory agencies with overlapping jurisdictions.*
- *In other cases, the functions of supervision, monitoring, and arbitration, although they were clearly differentiated from the more political roles, were attributed to specialized subsector agencies (electricity, natural gas, etc.). Keeping in mind the strong interaction of energy chains, in both production and consumption, the establishment of externally specialized standard-setting institutions and frameworks creates regulatory voids (no man's lands).*
- *At the other extreme, there are situations where the agency in charge of supervision covers a very broad jurisdiction (the full range of public services), but not always with the necessary internal specialization.*

Because of the conviction that, in one single production chain, only in some of the links or segments is competition permitted, the following were suggested as means to achieve this objective: vertical and horizontal breakup, open access to the grids (electricity, natural gas), and the liberalization of markets for oil activities. Nevertheless, in some cases, the concrete restructuring of electric power and natural gas chains did not fully respond to this segmentation approach, thus leaving, at the same time, the regulatory agency without any instruments to control monopolistic practices. Beyond these practices, the economic concentration that was fostered by privatization in some countries in the face of regulatory agencies that are still weak is reducing the capacity of the latter to defend the interests of consumers, which is one of the main purposes, explicitly stated, of their fucntions.

The collaboration of associations and chambers, on the one hand, and national and local authorities, on the other hand, to promote and support industry, seems essential. This collaboration would have to adopt a long-term outlook, for which purpose adapted production styles would have to be defined. Energy supply should contribute to offering appropriate energy services (heat, cold, lighting, motor power) instead of amounts of determined energy products.

Energy productivity in the transportation sector is evolving in a way that is the cause of much concern. Rising individual passenger transportation, despite improvements in the efficiency of individual motor vehicles, seems inevitable. Nevertheless, there are examples, albeit not many, in cities of Europe, Asia, United States, and also Latin America where the use of individual cars has been reduced in favor of modern and effective public transportation systems. Avoiding the copy of individualized transportation systems means setting cities on a different course in terms of lifestyles. This is also a highly systemic task, which involves almost all the functions of city government and support from the government and other central institutions, which should not only finance projects but also establish a favorable framework of traffic, urbanization, pricing, and energy supply regulation laws.

Inter-city public transportation in the large countries of Latin America is being transformed into systems with increasingly smaller units using oil products (car, bus, plane), whereas railways seem to be disappearing. At the same time, various European and Asian countries are making major efforts for to revive their railways, with a certain degree of success. Transportation policy will have to be reviewed (including privatization) favoring this highly energy-efficient mode of transportation.

Finally, the way of producing, living, and transporting in the countryside, in other words, the lifestyle of the rural sector, depends on available energy and, in turn, determines energy use. Rural producers need to gain access to markets since, to stimulate rural production, markets are needed. In both aspects, energy is involved, first as a motor fuel and then as a locally supplied good, around which economic activities can be developed. Thus, providing energy to the rural sector, involving more than just traditional electrification and a more differentiated supply in the rural sector, is the correct strategy. Another time, this requires a systemic approach by local and national private and public players involved in the energy sector, rural development, agriculture and forestry, rural financing, and engineering.

A relatively low energy intensity is like insurance against energy market risks. This is true at both the company and national level. Low intensity reduces the vulnerability stemming from market changes or other energy supply risks.

High energy prices are not advocated simply to promote the rational use of energy. They should also be based on cost internalization, such as environmental costs. This should in no way mean giving carte blanche to a costly energy sector because of inefficiency. One of the priority objectives of the energy sector should be productive efficiency, including energy efficiency.

Regarding the reform of energy subsectors, in addition to efficiency objectives, the specific characteristics of each subsector should be underscored. The vertical breakup of power systems that are sufficiently ample in the course of privatization seem to be an effective element to reach efficiency and increase service quality. This does not necessarily mean that oil industry should also be vertically broken up.

As in the case of industry, the government should become concerned over the viability and survival of a national energy industry, which is not the same as a nationalized industry. The cases of both Argentina (in the oil sector) and Chile (in the power sector) show that private enterprises, on the basis of a totally commercial management, can contribute to a structure of domestically and internationally competitive national enterprises.

Privatization and a commercial focus are not necessarily at loggerheads with a national development strategy or with objectives such as more extensive markets, better incorporation of advanced

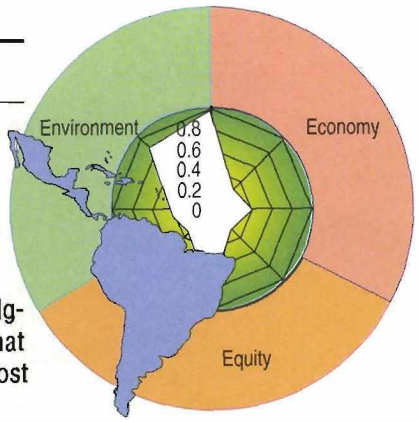
technology, and a higher added value of the energy chain. It seems that the countries that have taken the road of broad liberalization in their energy sectors have achieved better results in this aspect than the countries with a limited opening up (see Inset 2.1). Build-own-transfer (BOT) schemes and take-or-pay contracts ensure, on the one hand, supply capacity and, on the other hand, keep technology transfer within a limited framework.

Surely the evolution in these countries has led to a redistribution of political and economic powers generally in favor of the private sector, especially specific groups. Nevertheless, we do not believe that these impacts are more important than the achievements made by efficiency. The extension of these powers has to be counteracted and eventually attempts have to be made to diminish them. The only player that can do this is the State, for the preservation of the common good.

The idea, therefore, is not to blindly apply theoretical recipes but to move forward cautiously. The treatment of and dealings with transnational companies are surely a field where the most caution, intelligence, and experience are required. The coordination between the region's countries should prevail over any competition between them that might exist.

Finally, we believe that energy integration is another key element for the sustainable economic development of the region. It is difficult to identify any drawbacks from greater integration. Once again, great caution should be applied to resolve any transition problems that might arise and so that the advantages of integration are distributed as satisfactorily as possible for all the parties involved.

CHAPTER 3: ENERGY AND EQUITY



The inter-relations between energy and equity being discussed in the present chapter take place at different levels:

- Inequality between countries: The energy consumption structures and consumption of households are different throughout all the countries of LAC and depend not only on economic progress, that is, income and distribution, which affects demand, but also on energy supply (expansion of power services, energy availability).

- A part of the households do not manage to cover their basic energy needs: The percentage of coverage varies, and in many countries this coverage does not even reach half of the population. In addition, a part of social services lacks energy.

- Inequality within the countries: In addition the lower-income groups are obliged to channel a substantial share of their income and/or time available on low-quality energy supply. This involves different efforts within the families themselves (men, women, and children).

- Energy sector reforms, along with reforms in other public sectors, have exerted a major impact on available income and the well-being of broad sectors of the population and have affected employment in the sector.

Before providing more details on these inter-relations, the status and evolution of general equity in LAC will be described.

1. Status and Evolution of Equity in LAC

Equity is undoubtedly a complex notion that embraces a broad set of aspects or dimensions; any assertion that is made regarding this concept inevitably requires the formulation of value judgments. Nevertheless, it is clear that income distribution is one of the most important dimensions of equity.

The first chapter showed that equity in terms of income distribution in the region is clearly lagging. Indicators for some countries are highly unsatisfactory.

In the countries of LAC, the gaps in income distribution widened considerably during the eighties. The trend in the early nineties, however, is less clear since in some cases a reversal of the previous trend is apparent, and in other countries, after some improvement, once again there are signs that income distribution imbalances are increasingly sharper.

The evolution of distribution inequality did not totally correlate with the magnitude of widespread economic deterioration that was evident in many countries during the eighties.[19] Thus, for example, Mexico and Venezuela displayed a similar rise in distribution inequality, emerging from comparatively low levels, yet in Mexico the pace of economic growth did not decline as sharply as in Venezuela. Brazil's high distribution inequality increased, although its per capita GDP remained almost constant during this decade. In Chile, the per capita GDP rose at the same time as income distribution inequalities increased. In turn, Colombia managed both to improve its income distribution and to ensure steady economic growth.

In the nineties, equity levels improved slightly in various countries although they were unable to return to the levels of 1980. During this period, improvements in distribution did not fully match per capita GDP movements. For example, Colombia, which, along with Uruguay, had been one of the few cases where distribution asymmetries had declined during the eighties, showed a change of trend between 1990 and 1992,

19 See ECLAC, Social Panorama 1994, United Nations, Santiago de Chile, 1994.

even though its per capita GDP continued growing. Both those countries that made economic adjustments, such as Chile, Mexico, and Argentina, and others such as Venezuela and Brazil recorded declines in their distribution equity.

On the basis of the above, it can be concluded that the adjustments that have been promoted in LAC as of 1980 have indeed led to a considerable deterioration in social equity conditions. These conditions, however, are not clearly reflected in the variations recorded in the average indicators such per capita GDP, and it seems that the recovery of economic growth of the nineties does not necessarily imply improvements, at least of the same scope, in distribution inequality.

2. Residential Energy Consumption Structures in the Countries of LAC

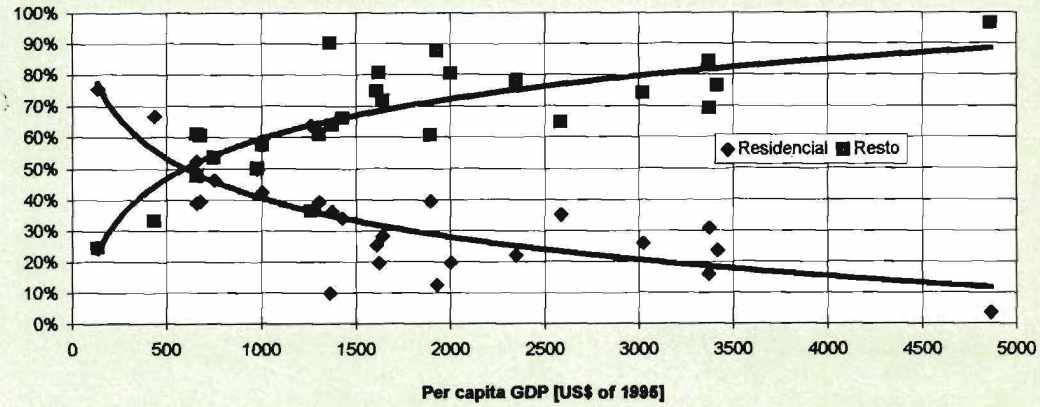
2.1 Importance of residential consumption in the region

The previous chapter describes the correlation between energy consumption levels and gross domestic product. Since per capita GDP is the measure of a country's average income, its relationship with per capita energy consumption in the countries of the region also provides a preliminary indication (Chart 2.1) of the relative social conditions of the countries and their resulting energy consumption. The poor countries of the region consume much less energy per capita than the relatively rich countries. Further along this line, Chart 3.1 shows how the share of the residential sector in energy end-use declines as per capita income increases, with a sharp downward trend up to the income level of US$1,500 and vice-versa in the remaining economic sectors. Further along, it will be seen, even when residential consumption is relatively important in low-income countries, a large part of the population does not manage to meet its basic needs.

Economic growth therefore exerts a strong impact on society's direct and indirect energy consumption. In low-income countries, the high percentages of direct energy consumed reflect the poor development of industry and transportation and the shortage of goods and services.

When comparing total end-use (see previous chapter) with residential consumption, it is apparent that as per capita GDP grows not only is there a greater availability of commercial energy in the residential sector but also the energy aimed at other sectors increases. Comparing the relative rankings in terms of per capita end-use (Chart 2.1) and residential consumption (Chart 3.2), Trinidad and Tobago, Suriname, Cuba, Guyana, Brazil, and Colombia favor the consumption of commercial energy products in productive sectors, whereas the Dominican Republic and Grenada, as well as Uruguay, Chile, and Argentina, favor commercial energy use in the residential sector. If firewood consumption is taken into account, Chile and Uruguay, as well as Paraguay, the Central American coun-

Chart 3.1: Final energy consumption distribution



tries, and Mexico, move even further up on this ranking scale and display the same level of residential consumption as Argentina and Venezuela.

2.2 Level and structure of residential consumption as a function of average income

There is no clear correlation between residential energy consumption and average income (per capita GDP). But if only commercial energy is considered, the correlation is more evident (Chart 3.2).

It can therefore be inferred that, as a rule, the direct consumption of commercial energy is positively tied to the economic development status of a country whereas firewood consumption is negatively linked.

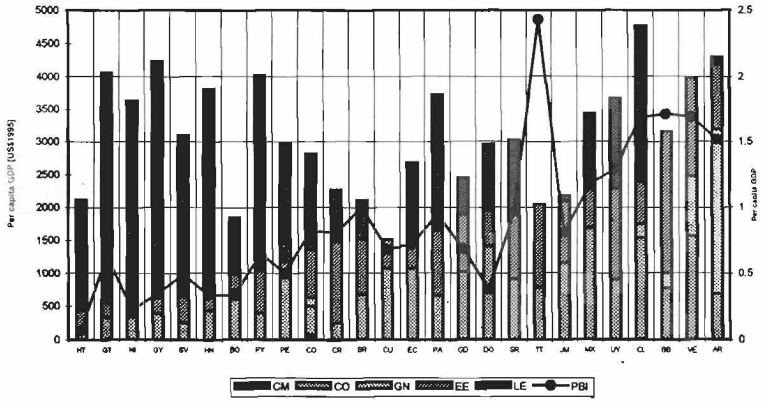
There are exceptions to this rule, such as Chile, Uruguay, Mexico, and other countries, where other factors are involved, such as access to firewood supply, the pricing policies for other energy products, whether district heating is needed or not, or a certain marginalization of part of the population, which can lead to high levels of firewood consumption in households because they have no access to other energy sources.

Some countries have managed to achieve a high diversification of residential sector supply sources. For example, in Colombia, in addition to firewood, the energy mix includes different types of fossil fuels, electricity, coal, and increasingly natural gas. Other countries with a broader diversification are Argentina, Chile, and Mexico.

At the other extreme, there are countries with only a slight diversification in their energy mix, such as Haiti, where the share of electric power consumption is virtually zero, and other countries where firewood and liquid fuels account for more than 80% of residential sector supply (Guatemala, Nicaragua, Honduras, and Guyana).

It is also evident that the highest consumption of electricity in households can be found in those countries that have the highest average income, whereas the use of other fuels, preferably liquid

Chart 3.2: Residential energy consumption

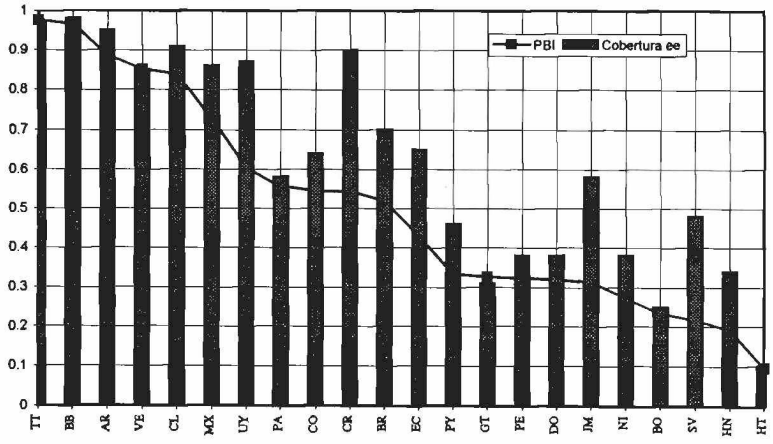


(including LPG), tend to be replaced by natural gas in the highest-income countries.

2.3 Supply: Electricity coverage and energy diversification

A higher share of electricity in residential consumption depends on the existence of corresponding supply, among other causes. Electric power coverage, in fact, shows varying degrees in LAC (Chart 3.3). Only a handful of countries reach satisfactory levels of coverage. Evidently, the most dramatic situations of

Chart 3.3: Electricity coverage and GDP level



insufficiency can be found in the previously mentioned countries whose energy mix is only slightly diversified.

The most important determinant of electricity coverage is the degree of economic development. Among other factors that ensure wide electrification, there are the extent and types of urbanization of each country (Brazil), administrative and social policy (Costa Rica, Chile, Uruguay, Jamaica, Trinidad and Tobago, Barbados), the policy of mass dissemination of oil products in oil-producing countries (Ecuador, Colombia, Mexico), and the abundant availability of electricity (Paraguay). The factor of equity is also involved, since some countries with a fairer income distribution structure achieve higher degrees of electrification. Nevertheless, the latter aspect cannot be attributed exclusively to equity since there have also been government policies promoting household connections and subsidized power supply to population groups that a rigorous market system would have been otherwise unable to attend.

Electrification has traditionally received more attention and has been identified with energy in general. Recently, it has been recognized that energy supply can be improved appropriately by promoting other energy products and improving the supply infrastructure with energy products such as LPG, kerosene, and coal, creating the groundwork for the application of renewable energy technologies in the rural sector and even natural gas in urban areas. The creation of balanced firewood markets based on sustainable supply, eventually ensured by multi-functional plantations, also contributes to expanding and diversifying energy supply. In addition, this can generate new jobs and income.

The crux of the problem of unmet supply seems to be the small size of the markets in general, especially energy markets, in marginal urban and rural areas of the region; this in turn is both the result and the cause of the previously indicated social imbalances, preventing large strata of the population from gaining access to these markets. The small economies stemming from this situation, due to the lack of an appropriate scale of production, generate a regressive process that is difficult to resolve and which oftentimes is only vaguely perceived by decision makers. In other situations where the perception is clearer and widespread, there may be a paralysis due to management structures that prevent actions from being taken. These situations have favored non-competitive activities that systematically require state protection. It is impossible to break away from this scheme by only focusing on energy; an integral approach is needed. Models of more balanced societies display broader markets that offer greater opportunities for choosing and lower costs of goods and services, which in turn broaden the population's purchasing capacity and, therefore, ensure that its needs are met more satisfactorily.

3. Coverage of Basic Energy Needs

3.1 Current status of basic needs coverage

The low average consumption of commercial energy products suggests that many households in LAC are unable to completely meet their basic energy needs. Using a theoretical calculation, it is estimated that for temperate regions about 0.18 barrel of oil equivalent (BOE) of useful energy per inhabitant (700 kcal per day for cooking, lighting, and heating),[20] that is, about 25 kilograms of oil equivalent (KOE), is needed to meet basic energy needs.

Table 3.1 shows the consumption of final energy and useful energy (the latter is calculated on the basis of coefficients) for the region's countries. It can be observed that the average of certain countries like Bolivia, Nicaragua, Guyana, Guatemala, Jamaica, and others barely reach the theoretically necessary level of 0.18 per capita BOE and that Bolivia has still not managed to achieve this level. A below-average household consumes only half or less of the average per capita useful energy of the residential sector as a whole.[21] On the basis of this estimate, it is evident that many households of the region do not have enough useful energy available to meet their basic needs. Taking the case of Colombia, a country with an average per capita useful energy slightly lower than the average in LAC, population groups 1 and 2 (that is, 40% of households) do not have an acceptable energy coverage to meet their basic needs. The percentages in the countries

20 See R.K. Bhatia, "Demand Analysis Methods," in V.K. Ramani et al. (ed.), *Rural Energy Planning: Asia and Pacific Experiences*, APDC and GTZ, Kuala Lumpur, 1988.

21 This is the result of an analysis conducted by H. Pistonesi; see OLADE-ECLAC-GTZ, "Energy and Development in Latin America: Case Study of Colombia," OLADE-Ministry of Mines and Energy, Quito-Santafe de Bogotá, chapter 11.

farther from the average are most certainly higher.

The region must therefore confront the reality of this underconsumption as one of its major challenges. The energy needs of large social groups of the region are vital, but their present energy consumption can scarcely ensure conditions of survival. This manifestation of poverty has even greater implications for the environment (see next chapter).

3.2 Evolution of residential consumption and coverage in the past

During the period 1970-1994, final per capita energy consumption of LAC in the residential sector declined from 1.5 to 1.3 barrels of oil equivalent per inhabitant (per capita BOE). This decline of final per capita energy consumption in the residential sector is clearly associated to firewood substitution processes. Thus, despite this drop, there was a steady increase in per capita useful energy consumption during this period (in BOE per inhabitant): 0.31 in 1970; 0.38 in 1980; 0.41 in 1990; and 0.46 in 1994. In addition to firewood substitution, there are other substitution processes, especially the increased share of electricity which has led to this different pattern of per capita final energy and useful energy. These trends, in terms of regional average, indicate that a certain amount of progress is being achieved in meeting the energy needs of households. Nevertheless, the evolution in the different countries has been quite varied.

Chart 3.4 (Groups A-D) provides a comparative evolution of per capita final energy and useful energy in the different countries over the last 25 years. Three different types of behavior have emerged:

- increased per capita final energy and useful energy consumption (Groups A and B);
- stagnation of useful energy consumption and sharp reduction of final consumption (Group C); and
- rise in useful energy consumption and reduction of final consumption (Group D).

Table 3.1: Net and final energy in the residential sector

	FINAL ENERGY [BOEpc]				USEFUL ENERGY [BOEpc]			
	1970	1980	1990	1994	1970	1980	1990	1994
ARGENTINA	1.364	1.675	1.475	1.678	0.596	0.816	0.732	0.855
BARBADOS	0.529	0.912	1.314	0.702	0.321	0.534	0.890	0.437
BOLIVIA	0.444	1.097	0.868	0.766	0.110	0.206	0.209	0.192
BRAZIL	1.685	1.252	0.886	0.830	0.249	0.266	0.311	0.322
COLOMBIA	1.516	1.211	1.223	1.220	0.295	0.285	0.350	0.358
COSTA RICA	2.107	1.791	1.571	0.830	0.388	0.443	0.394	0.356
CUBA	0.556	0.760	0.743	0.608	0.230	0.335	0.344	0.277
CHILE	1.739	1.645	1.824	2.205	0.447	0.493	0.506	0.638
ECUADOR	1.395	1.190	1.045	1.045	0.214	0.302	0.296	0.301
EL SALVADOR	2.251	2.174	1.406	1.969	0.276	0.294	0.241	0.331
GRENADA	0.543	0.541	0.832	0.495	0.132	0.150	0.271	0.257
GUATEMALA	2.000	2.290	2.180	1.871	0.248	0.284	0.274	0.233
GUYANA	0.808	1.519	1.613	1.540	0.185	0.246	0.234	0.220
HAITI	1.592	1.846	0.996	1.485	0.166	0.197	0.118	0.157
HONDURAS	2.602	2.377	2.005	1.812	0.309	0.319	0.289	0.284
JAMAICA	0.446	0.359	0.507	0.562	0.173	0.155	0.207	0.238
MEXICO	1.523	1.632	1.602	1.760	0.347	0.479	0.553	0.660
NICARAGUA	1.960	1.811	1.672	1.618	0.260	0.259	0.216	0.213
PANAMA	1.769	1.684	1.608	1.435	0.387	0.496	0.529	0.349
PARAGUAY	2.428	2.252	2.358	1.967	0.274	0.295	0.363	0.402
PERU	1.749	1.662	1.444	1.382	0.305	0.343	0.306	0.279
DOMINICAN REP.	0.884	0.954	1.159	1.449	0.183	0.241	0.348	0.458
SURINAME	0.970	1.237	1.151	1.164	0.273	0.433	0.383	0.421
T & T	0.364	0.510	0.523	0.644	0.170	0.308	0.383	0.428
URUGUAY	1.567	1.501	1.390	1.486	0.448	0.449	0.464	0.550
VENEZUELA	0.861	1.113	1.067	1.611	0.399	0.582	0.569	0.837
Mexico	1.523	1.632	1.602	1.760	0.347	0.479	0.553	0.660
Central America	2.129	2.111	1.827	1.702	0.291	0.324	0.297	0.279
Caribbean	0.833	1.019	0.911	1.051	0.199	0.268	0.287	0.299
Andean Zone	1.351	1.290	1.194	1.286	0.294	0.352	0.369	0.422
Brazil	1.685	1.252	0.886	0.830	0.249	0.266	0.311	0.322
Southern Cone	1.536	1.696	1.628	1.824	0.529	0.678	0.631	0.745
LAC	1.527	1.426	1.245	1.305	0.313	0.381	0.407	0.456

Group A shows a continuous rise in per capita final and useful energy consumption over three decades: this group is comprised of Caribbean countries (Jamaica, Dominican Republic, Trinidad and Tobago, and Suriname) in the lower tier and Southern Cone countries (Argentina and Chile), Venezuela, and Mexico in the upper tier. This movement seems desirable if the rise in final energy is not faster than that of useful energy and if the ratio between final energy and useful energy does not surpass certain limits. Regarding this, the evolution of consumption in Chile gives some cause for concern.

The second group, that is, Group B, which also increased consumption in both indicators, is different from the previous group inasmuch as its increase was not steady. This group is comprised mainly of the other countries of the Caribbean and Bolivia. The element that should be underscored here is the reduction of per capita useful energy consumption which can only be explained by a deterioration in the level and/or distribution of income along with energy price hikes.

Chart 3.4: Group A: Steady evolution of residential consumption of final and useful energy

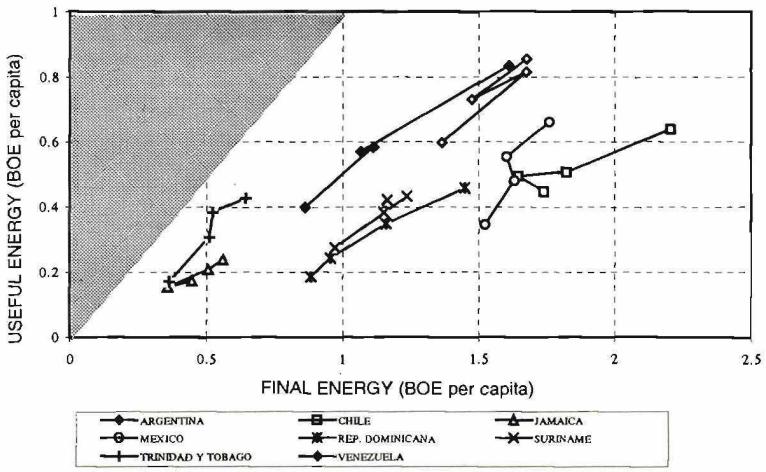
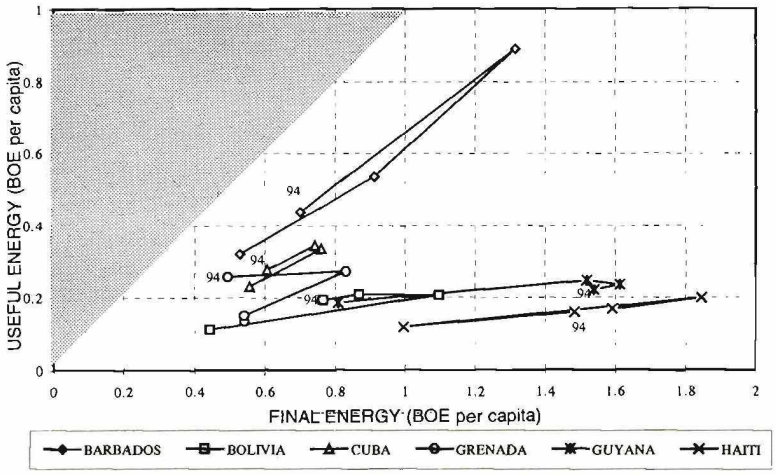


Chart 3.4: Group B: Erratic evolution of residential consumption of final and useful energy



The third group, Group C, has been recording this pattern, which is the source of much concern, for several decades, coupled with a sharp decline in final energy consumption. This group is comprised of the Central America countries and Peru. It may be indicating that the poorest sector of the population is experiencing firewood supply constraints and has no possibility of gaining access to commercial energy sources and is also affected by the factors indicated for Group B.

The last group, Group D, comprised of Colombia, Ecuador, Brazil, Paraguay, and Uruguay, show a reduction of per capita final and useful energy, indicating situations where firewood substitution has been effective and significant.

4. Energy Use and Spending by Income Level

Unfortunately, there is as yet no systematic analysis of energy consumption by socioeconomic strata for the countries of LAC. There are only isolated studies of national cases. For example, there are results stemming from case studies on El Salvador[22] and Colombia,[23] but we believe that additional studies will confirm the general validity of the results.

In El Salvador, the highest- and middle-income strata, which account for 37% of the population, consume the highest-quality, most versatile, and least pollutant energy sources, such as LPG (70%) and electricity (65%). At the other end of the scale, the lowest-income sectors, which account for about 62% of the population, consume mostly firewood and kerosene; this phenomenon is even more marked in the rural area. These figures confirm the unequal distribution of sources. It is assumed that this is a region-wide phenomenon.

Low-income families and those that do not have alternative sources require the same final energy but end up by obtaining far less useful energy. This is due to the low energy yields of firewood for cooking and of kerosene for lighting.

In the eighties, the energy spending of households from different urban socioeconomic strata did not show any major difference: the poor paid as much as the rich but for much lower quality energy. In the rural sector, the poorest sector of the population managed to reduce its money spending because it had access to firewood gathering.

With the growing shortage of firewood in the nineties, the poorest groups in the rural sector of El Salvador now have to curtail their energy consumption due to the lack of energy alternatives and monetary resources; for the poorest urban groups, however, the supply situation is improving and relative spending is declining thanks to a policy of subsidies for electricity and LPG.

22 See H. Altomonte, "Analysis of the Effects of Energy Policy on Equity in El Salvador," working document from the OLADE-ECLAC-GTZ Project, ECLAC, June 1995, page 23.

23 See OLADE-ECLAC-GTZ, "Energy and Sustainable Development in Latin America: Case Study of Colombia," op. cit., chapter 11.

In Colombia, the highest-income group (stratum 6) consumes almost seven times more useful energy than the lowest-income group (stratum 1), and it consumes 3.2 times more final energy. In the two lower strata, the prevailing sources are firewood, cocinol, and kerosene, whereas in the two upper strata, the main sources are electricity, natural gas, and LPG. In the two lower strata, cooking accounts for more than 80% of total household energy consumption.

If the Lorenz curves corresponding to energy consumption distribution by urban socioeconomic group are considered, the above is corroborated (Chart 3.5).

First of all, it is evident that distribution imbalances in electricity consumption are significantly higher than the imbalances in useful energy consumption. This fact, which also turns out to be quite common when analyzing residential consumption, is of special importance in Colombia owing to the presence of electricity for the use of cooking, which is increasingly intense beginning with stratum 3.

Second, the asymmetries in income distribution are less noteworthy than the asymmetries in energy consumption distribution; although they declined during the eighties, in Colombia they continue to be comparatively high level.

The asymmetries mentioned with respect to average energy consumption in the different socioeconomic strata are correlated with the coverage of uses and the quality of sources used.

Even when the details in the countries are different, the structures of use and spending by income level are similar. In the countries of the case studies, the lower-income groups pay the same price as upper-income groups even though their purchasing power is inferior.

One should keep in mind that the poorest rural sectors spend the time they have available, instead of money, to gather fuel. On the one hand, it is a kind of earning because they save money by spending time on these chores instead. On the other hand, this an activity with low remuneration which oftentimes involves an additional burden on women and children.

Chart 3.4: Group C: Stagnation of residential consumption of final and useful energy

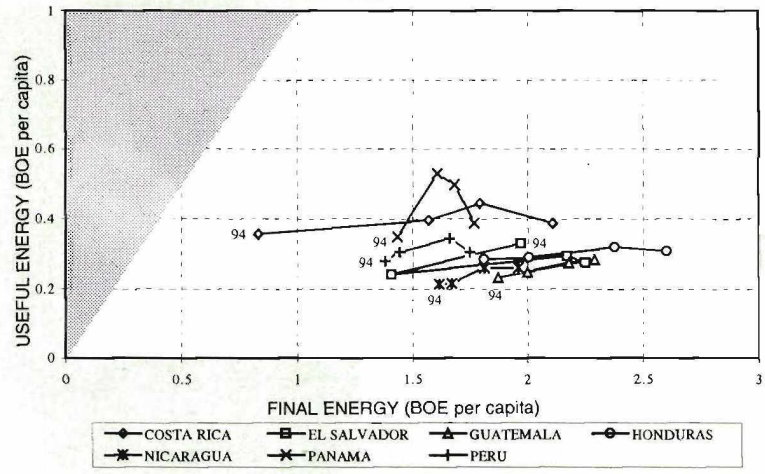
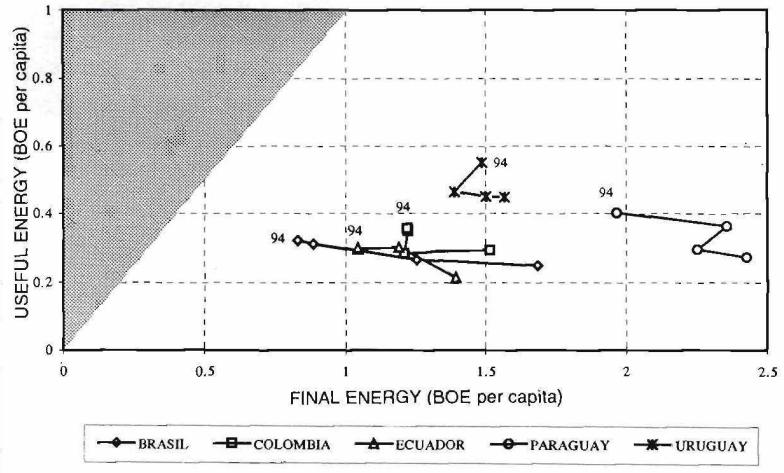


Chart 3.4: Group D: Evolution of the substitution of residential consumption of final and useful energy



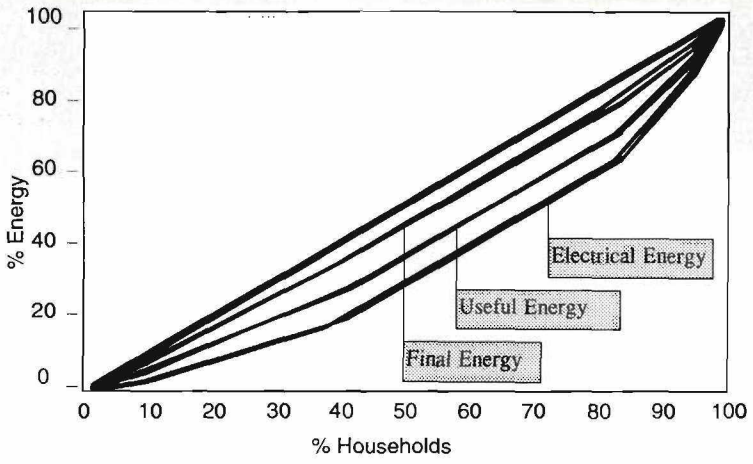
A recent study for Brazil has reached similar results and asserts that the quality of living of a family is closely related to the quality of energy it consumes.[24]

5. Social Impacts of Adjustments and Energy Reforms

Over the last few years, energy spending in households has been deeply affected by price adjustments in the region's countries that undertook reform processes. In addition, there are the

24 See A. de Oliveira and E.L.F. Almeida, "Estilo de Vida e Consumo de Energía no Brasil" [Lifestyle and Energy Consumption in Brazil], IEI-UFRJ, Rio de Janeiro, 1996.

Chart 3.5: Colombia: Distribution of energy consumption by stratum



social impacts stemming from broad economic adjustments:

- Price adjustments have affected, in varying ways, the lower-income social groups. In certain cases (Argentina, Peru), when the tariff structures were changed, the tariffs exerted adverse impacts on lower-income sectors. In other countries (Colombia), a cross subsidy system from high-income groups to low-income groups was chosen.

- When power utilities are put on a sound financial footing by means of pricing regulations, there are redistributive effects between the owners of the power utilities and their customers, especially small customers in captive markets (Chile, Peru).

- The decline in the pace of rural electrification directly affects meeting the needs of the rural population and indirectly affects their productivity.

- Privatization reduced the negotiating power of public sector unions, leading in some countries to a redistribution of political and economic power.

- In certain countries where public enterprises acted as a disguised mechanism for absorbing unemployment, the process of privatizing and rationalizing the public sector has exerted a dual impact: on the one hand, a sharp decline in the number of employees without any parallel social policy to reabsorb this manpower, as a rule, contributed to increasing unemployment rates; on the other hand, this phenomenon led to increased productivity.

The repercussions have been much more important in the countries where the adjustments in the energy sector were associated with adjustments in other public service sectors (telecommunications, water, sewage system, etc.), which were coupled with indirect effects, especially because of increases in transportation costs. Salaried groups, who before the adjustment benefitted from low costs for theses services and, oftentimes, lost their employment during the general adjustment, were the ones who suffered most from these changes.

6. Conclusions: Priority Guidelines

Sustainable development means that all households should be able to meet at least their basic needs, including energy needs. The objective is therefore to visualize a great majority of families performing the tasks of cooking, lighting, communicating, preserving food, and heating both effectively and practically in keeping with their needs, without incurring an extreme burden on women and children, and within their economic constraints. There are increasingly more alternatives, in terms of technology and energy products used, to ensure the fulfillment of these activities. This means that the goal of sufficient energy supply does not involve any pre-determined form of energy.

The basic constraints are economic in nature: the limited capacity to pay for energy services and make investments in installations for lower-income groups. In the rural sector, one has to add high costs for supplying scattered energy products, which limit accessibility.

The approach of the strategies applied to reach these objectives, instead of the traditional state or private-sector paternalism, should be based on efforts of the people supported by local or national, state or nonstate institutions or agencies. Therefore, a social policy specifically focusing on energy should not be the priority; rather what is needed is a broad

social policy that tackles energy needs, coupled with a general development policy which, to the extent possible, uses energy sector instruments.

In the marginal urban area, the extension of energy supply is an objective, but implementing it turns out to be less of a problem if there are municipal standards to define a given settlement of the population.

- A competitive fuel market is able to develop its urban coverage without extensive regulation, since there are no regulations that hamper supply, other than security concerns.

- Power distribution utilities in turn are interested in expanding their service in cities under certain conditions. An extremely effective approach involves the mandatory connection and supply of all customers who request service at current tariffs, but with support for the utilities in their efforts to reduce technical and nontechnical losses, in other words, to avoid illegal connections. A widespread practice involves granting subsidies to those groups that consume the least electricity. The deficit can be absorbed by the State or by other private customers. This would imply a cross subsidy, that could be viewed as an indirect means of redistribution. Nevertheless, it is important to eliminate this type of political action when it does not suitably focus on the sectors that require its benefits.

- For the least-favored sectors, a reachable supply has to be provided. An element to achieve basic electricity service is the application of a restricted subsidy policy. In contrast to the power sector, subsidies for tradable fuels (LPG and kerosene) have one major drawback: they are difficult to focalize. Because of this, it is preferable not to use them as a social policy instrument. Nevertheless, from the point of view of environmental policy, they can be effective in prevent the logging of forests.

- The expansion of natural gas service also contributes to diversifying supply; the cost characteristic of this service would nevertheless be limited to high- and medium-income groups. Since it involves network service, like electricity it is suitable for price discrimination, striving for tariff structures that enable coverage to be extended more rapidly.

In any case, energy supply should be an element to be considered in housing policy and urban development policy in general.

In the rural sector, reaching energy supply objectives is far more difficult due to the high cost of energy supply expansion and the high degree of poverty. The strategy is based on the participation of consumers in supply, complementing central supply with decentralized systems, and applying a systemic approach involving the intervention of various players.

- The power utility extends the central system by means of networks until the profitability of the additional extension reaches its lowest point. The State or its decentralized branches, by means of power distribution utilities, can intervene in the financing or investment of the power infrastructure to enhance coverage.

- Beyond the frontier of power expansion by means of networks, decentralized technologies can be applied. In small remote settlements there is often the possibility of tapping local hydraulic potential using mini or micro power stations. Likewise, the traditional diesel solution can be replaced by other forms of small power generation, using wind energy or biomass, where supply provides them with the opportunity to ensure the sustainable exploitation of plantations. The problems of these standalone systems are not so much technical as managerial and involve difficulties in terms of economic sustainability. In these situations, the grassroots sectors need the support of local, national, and international institutions, as well as the intervention of local power distribution utilities.

- Another option for providing an energy source to a rural household for the purpose of lighting, communicating, or other low-wattage service is pho-

tovoltaic systems. The usefulness and feasibility of this technology in the marginalized rural sectors have been tested in various countries of the region. Once again, the problems these systems must cope with are not technical; rather they are organizational. State support is still important. No state organization is needed to ensure the penetration of these technologies; but a financial contribution to the extent that it can be justified due to external, economic, social, and environmental impacts may indeed be needed.

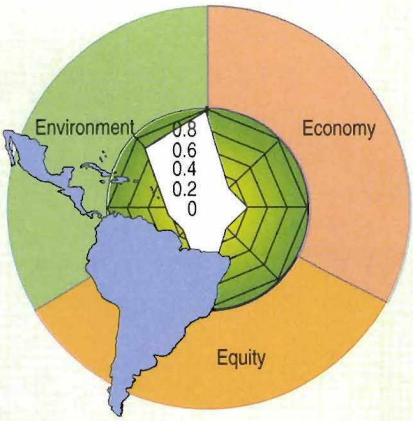
- Supply of energy needs (cooking, and heating) in the rural sector can continue to be based, in the majority of the countries, on biomass if it is used in a balanced fashion. Sometimes this implies the regulatory intervention of, or sometimes incentives from, local institutions, whether municipal or the agencies in charge of rural development or wood conservation and protection organizations, combining conservation with the rational and sustainable exploitation of natural areas.

- In the countries and areas where deforestation has reached extreme situations, all the players in the ecosystem have to coordinate their respective exploitation. It may be essential, from the environmental point of view, to use alternative fuels to mitigate the situation and find time to come up with a sustainable solution (see next chapter).

Ensuring a supply of tradable fuels (LPG, kerosene, etc.) fundamentally contributes to diversifying rural energy supply. In addition to fostering opportunities (support for the installation of storage facilities, etc.), one must control prices because when the size of the market is reduced, monopolistic situations are enhanced, unless there are price controls.

This is by no means the place to describe alternative techniques. It is important to highlight their potential and clarify the roles of the different players. A systemic approach means that the different players (national, provincial, municipal governments and the energy, social, financial, and technological sectors, or international cooperation, and the population as a whole) must collaborate and coordinate their activities to support the efforts of persons striving to achieve a higher standard of living.

CHAPTER 4: ENERGY AND NATURAL RESOURCES



Strictly speaking, the environment is part of natural resources. The difference between the two stems from the fact that, before, the environment, especially air, was viewed as a free commodity whereas traditional natural resources, such as fossil and mining resources and even the land and forests, were considered scarce resources, which therefore meant that they had economic value. Whereas subsoil and surface land resources are the subject of exploitation, environmental resources suffer the external effects of these activities. In national accounting systems, the depletion of natural resources, including environmental degradation, will have to be considered on par with physical capital depreciation so that national savings can be adequately quantified (see Annex II).

The present chapter therefore proposes the term "natural resources" in addition to or in lieu of the environment, since these topics will be dealt with as one single issue owing to the cause-effect linkages and interactions they imply.

Indeed, there is a circular interrelation between the exploitation of land resources and environmental resources. Production, consumption, and distribution processes involving fossil energy resources (coal, hydrocarbons, etc.) emerge as determinants of environmental impacts on the air and the atmosphere. In turn, the quality of the environment exerts an impact on surface resources, the soil, and water. The pollution and deterioration of water and soil entails an immediate loss of productive resources, whereas atmospheric pollution implies a direct threat to health as a result of surface warming and to the bases of life of future generations.

Natural resources and energy processes intervene in various aspects and in different places in this cycle. The sustainability of this cycle very much depends on the intensity and form by which energy products are explored, produced, transported, transformed, and used. Intensity and form have repercussions on the quality of the atmosphere, the duration of forests, and the scope (durability over time) of fossil resources.

The discovery of adverse effects, which first became evident with the death of the forests in Europe in the eighties, placed the issue of emissions stemming from energy processes at the center of environmental concerns. At first, it focused on the SO_2 and NO_x emissions from large combustion facilities (power generation) with their regional impacts, solid particulates, metal and chemical substances emitted by industry, and transportation with their local impacts. The multiple inter-relations between energy and the environment are even more apparent in global climate effects, which were confirmed again in the report from the Scientific Commission of the Intergovernmental Panel on Climate Change (IPCC), which concludes that "the balance of evidence suggest that there is a distinguishable human influence on global climate."[25] Likewise, the energy sector and the energy source mix have been placed at the very heart of the discussion on CO_2 emission reduction.

Latin America and the Caribbean is part of the discussion and has been the target of many actions, not because of its own CO_2 emissions, which are very low, but because it is the region where the largest reserves of CO_2 are located in the form of forests; this means it has a huge absorption capacity (see Inset 4.1).

Sector activities have also exerted direct and indirect adverse impacts on other mediums such as water, soil, and land cover. That is why environmental objectives such as atmospheric purity (lower emissions), soil conservation (low

25 See IPCC, "Science of Climate Change, 1995," Report of Working Group I, Chapter 8.

deterioration), the sustainable management of firewood (reforestation), the nonpollution of water, the eco-compatible management of fossil resource exploitation, and the sustainable management of hydro basins have become so important.

The energy sector performs an important role on two fronts, which interact with each other: on the one hand, handling of natural resources, and on the other hand, its impact on the environment. Since, at present, energy use is mainly based on fossil resources, the issue of depletion of energy resources as well as other nonrenewable resources has been the subject of much concern for the sector and its long-term development policy, that is, sustainable development. Therefore, objectives such as greater sustainability of programs for tapping fossil resources, aimed at mitigating environmental impacts and conserving natural resources, require that the wider use of renewable resources become a major priority.

1. Natural Resources and the Environment in LAC

As indicated in Chapter 1, LAC has an abundance of natural resources both on the surface of its land (soil, flora, and fauna) and underground (minerals, hydrocarbons, and geothermal energy). In addition, it has vast inland and sea water resources, a relatively unpolluted atmosphere, an abundance of solar radiation, and exploitatable wind resources in various countries. This wealth of per capita natural resources in LAC seems highly satisfactory. An estimate of the value of per capita natural capital (including, land, fossil resources, and water) amounts to US$18,400 per capita, which places LAC above any other developing region, including the Middle East.[26]

It would be a terrible mistake to conclude that this relatively high average of natural capital should not be the focus of concern for sustainability:

- The wealth of natural resources is very different in each country. The estimate for Haiti turns out to be only US$200 per capita and for Salvador US$570 per capita, whereas the values calculated for Mexico amount to about US$12,000 per capita, for Brazil and Venezuela, around US$21,000, for Chile US$30,000 per capita, and for Argentina US$61,490 per capita, not to mention Guyana at US$82,730 per capita and Suriname at US$298,360 per capita. The average value depends heavily on population density, the relative value of the land and, to a lesser extent, the abundance of mining and energy fossil resources (Chile, Trinidad and Tobago, Venezuela, and Mexico).

- The distribution of valuable land ownership is highly uneven within the countries themselves. In Ecuador, for example, only 3% of the farm units own about 50% of all farmland.[27]

- The exploitation of fossil resources increased more rapidly in the seventies than gross domestic product, especially as of 1977. In real terms, the market value of natural resources use (production) in 1982 amounted to 400% of the value for 1970, rising from 3% of GDP in the latter year to 7% in 1982. This value remained high until 1985 and only as of 1986 did a downward trend become apparent.[28] It is clear that this behavior of the product of natural resource exploitation has been decisively influenced by crude oil price patterns. Nevertheless, it is important to emphasize that, in terms of physical amounts, the extraction of fossil resources has grown steadily in LAC since 1975. In addition to this depletion of fossil resources, there has been land deterioration, whose value is hard to quantify.

- If the natural capital were to decline gradually (without the depletion of fossil resources or environmental degradation), demographic growth in itself would be enough to reduce the per capita natural capital. Over the last 25 years, the impact of this factor amounts to 36%.

2. Environmental Impacts of the Energy Sector

The environmental impacts of energy activities are multiple: air, water, and land pollution in the cities due to the emission of SO_2 and NO_x, gases, lead and

26 Preliminary estimates of World Bank working groups. See "Global Approach to Environmental Analysis," internal technical support paper for the project Monitoring Environmental Progress (see the report "A Report on Work in Progress," Environmentally Sustainable Development Vice-Presidency, Washington, D.C., 1995).

27 See World Bank, "Ecuador: Poverty Report," World Bank paper, 1995.

28 This analysis is based on internal World Bank documents, especially "Global Approach to Environmental Analysis," internal technical support paper for the project Monitoring Environmental Progress.

other heavy metals, as well as different toxic materials and untreated discharges from energy use and transformation activities; river pollution due to the production of bio-fuels; and in the rural sector the loss of soil due to unplanned human settlements, inappropriate land use, mining, and the building of hydropower dams. The impacts on the atmosphere and their inter-relation with the evolution of the forests seem to be the most impressive, despite the other impacts.

To these direct impacts of energy activity on the atmosphere and, to a lesser extent, on forest resources, must be added indirect impacts stemming from, for example, the exploration of hydrocarbons in fragile ecosystems such as the Amazon region, where erosion and destruction of biodiversity occurs not so much because of the exploratory activities themselves (building access facilities for exploration, production, and transport, such as oil, gas, and power lines) but because of later human settlements (facilitated by the opening up of energy activity) and the intensification of land use in the hydrographic basins, partially fostered by the construction of the dams and reservoirs, which has contributed to erosion and sedimentation. Nevertheless, environmental policy has made important progress (see Insets 4.1 and 4.2).

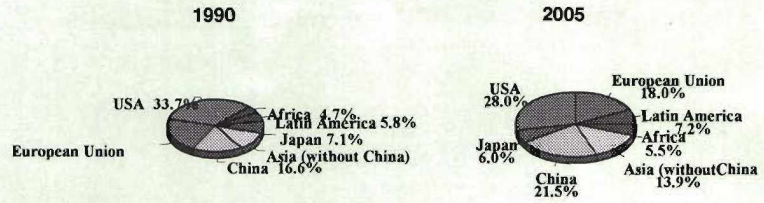
2.1 Emissions into the atmosphere

As a result of the activities that produce toxic *emissions* into the atmosphere, emissions with strictly local impacts (particulates, chemical substances, etc.) are differentiated from those that exert regional impacts, such as SO_2 and NO_x, and global impacts, such as CO_2. The use of CO_2 volumes as an indicator to represent the behavior of atmospheric emissions from the energy sector is justified in LAC, because there is a high correlation with the emission of these gases since SO_2 and NO_x mitigation technologies have never been implemented.

In LAC, total CO_2 emissions stemming from the energy sector rose from 664 million to 1,008 million tons (that is, by 52%) between 1970 and 1990.[29] Bearing in mind that the growth of other emissions has been on the same order, it should be observed that LAC emissions have risen at a slower pace than in other parts of the world and have remained at a relatively low level. In 1990, total CO_2 emission of Latin America and the Caribbean accounted for only 5.8% of the world total (Chart 4.1).

The behavior of the above-mentioned emissions indicator, in addition to being linked with economic growth rates, has been influenced by factors inherent to the energy sector, such as structure changes in the supply system (rise of hydropower generation and the declining use of firewood) and, to a lesser extent, technological modifications in production and consumption.

Chart 4.1: World structure of CO_2 emissions



Source: IDEE-FB, on the basis of *Energy in Europe: A View to the Future*, EC, DG XVII, September 1992

The countries of LAC have managed to achieve relatively significant progress in reducing regional and global atmospheric pollution from the energy sector, which is mostly clearly evident in the specific emissions. The specific emissions of CO_2 from the total energy system declined by more than 20% between 1970 and 1990; the most important reduction (23%) took place between 1972 and 1985.[30] Since 1985, specific emissions have remained constant.

The most important achievements in reduction took place in Brazil, where between 1970 and 1980 specific emissions from the energy sector declined by one third, and the level achieved at that time has remained unchanged up to 1995 (Chart 4.2). Mexico, however, managed to reduce by 15% the specific emissions

29 See C. Suárez, "Diagnóstico de Impactos Ambientales de la Evolución Histórica del Sistema Energético de América Latina y el Caribe" [Environmental Impact Assessment of the Historical Evolution of the Energy System of Latin America and the Caribbean], *Energía*, No. 2, December 1995.

30 See N. Di Sbroiavacca and C. Suárez, "Impacto de la Energía en el Desarrollo y el Ambiente de América Latina y el Caribe," OLADE-IDEE, 1992.

of the energy sector between 1975 and 1983, but this decline was partially offset by later increases. In the Central American and Andean subregions, the drop of this indicator was slow but steady. In the Caribbean, as well as in the Southern Cone, no clear trends were recorded.

Chart 4.2: Evolution of specific CO_2 emissions

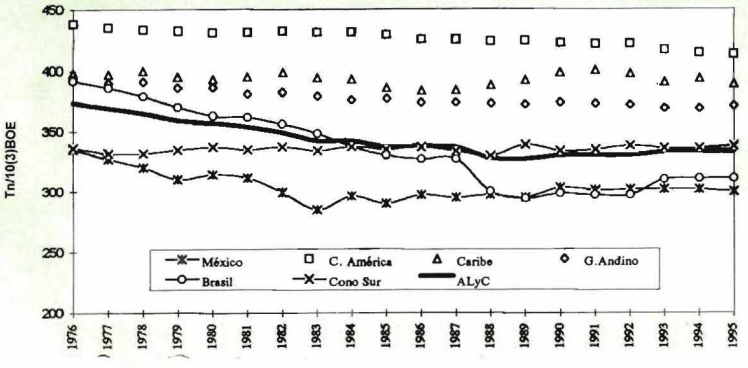
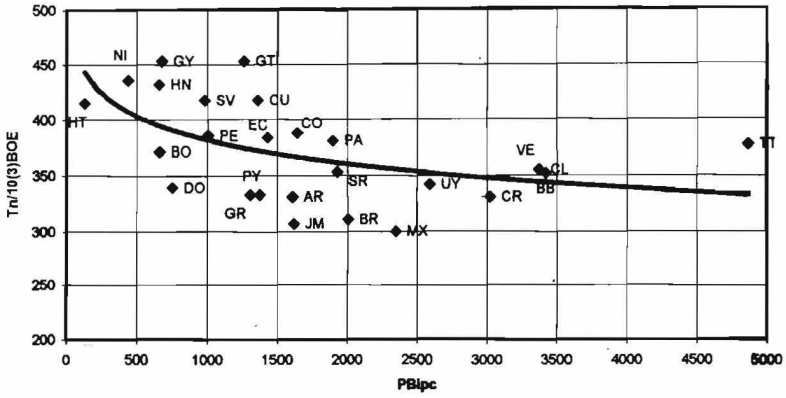


Chart 4.3: LAC: CO_2 emissions and development



The ratio between specific emissions generated by the energy sector and the income level in the region shows a downward trend (Chart 4.3), which would be more marked if, at the extreme end of the range, there was not an atypical case such as Trinidad and Tobago.

The last inventories of greenhouse gas emissions indicate that the emissions stemming from the burning of forests exert, in many countries, a multiplier effect on energy sector emissions. Nevertheless, it should be kept in mind that the energy sector contributes indirectly to these emissions as a result of the human settlements fostered by the implementation of energy projects in the tropical rain forest.

Although the energy sector of LAC contributes little to global or regional environmental problems, it does however contribute heavily to local pollution. Among these direct effects, the following should be underscored: air pollution due to chemical substances (CO_2, SO_2, NO_x, etc.) and particulates (lead, soot, etc.) in large cities, produced by motor vehicle traffic and industrial activities; local air pollution from particulates stemming from coal production; land and water pollution from oil exploitation or intensive alternative energy programs; and finally the loss of land due to the construction of hydropower dams and reservoirs.

The average emission or pollution values, given as national estimates, do not reflect the local incidence of these impacts. Even more eloquent than these averages are the specific examples: air pollution stemming from motor vehicle transportation and industrial activities in large cities (Mexico City, Santiago de Chile), spills, and oil slicks in the jungle, etc.

2.2 Energy concerns and involvement in reducing forest resources

In addition to the value stemming from its development as a resource (wood, firewood, the products of its biodiversity), the forests contribute other especially important functions for environmental sustainability such as their CO_2 absorption capacity. Because of this, humankind attributes special importance to LAC for its vast forest areas and, therefore, its huge capacity as a CO_2 sink, its biodiversity, and other functions as well. Regardless of the fact that the reason for this importance goes far back in history, involving other regions of the planet, the exploitation of their own natural resources, their depletion, and the intensity of greenhouse gas production, the world

hopes that forests in general, especially the region's natural tropical forests, will continue to perform the above-mentioned role and therefore watches with much concern their deforestation.

The elimination and indiscriminate use of forest resources increase the load of CO_2 in the atmosphere and reduce, at the same time, their capacity to absorb greenhouse gases, thus generating instability in the earth's life system; if this persists it can lead to critical situations of no return.

In the ten years between the mid-seventies and the mid-eighties, the forests of LAC declined by 5% as a result of steady inroads made by agricultural and livestock activities, encroaching upon the forest.[31] In monetary terms, the total value of the land has probably not changed much, since the transformation of forests into farmable lands increases their value while their conversion into grazing land diminishes their value. But the value of LAC resources probably has diminished considerably since the losses have been greater in terms of biodiversity and other intangible aspects.[32] Deforestation reached a ceiling in the mid-eighties.[33]

In some regions, deforestation is the principal cause of soil degradation and erosion; in other areas, however, this is only a secondary cause, and rather it is agricultural and livestock activities that adversely affect the land. There are various reasons for deforestation in Latin America. The use of wood for energy purposes is only one of them, especially in Central America and the Caribbean; this use, however, is secondary in other regions.[34] The trends observed in the past in Central American and Caribbean countries indicate a reduction in firewood supply and/or an increase in supply costs. As indicated in the preceding chapter, the

31 See, WRI, *World Resources 1990-91*, Oxford, New York, 1990.

32 According to the estimates of the Global Environment Facility (GEF) and the World Resources Institute (WRI), LAC has 28.6% of natural capital estimated in non-monetary terms, whereas its share amounts to only 8.7% in monetary terms. See E. Rodenburg et al., "Environmental Indicators for Global Cooperation," GEF, Working Paper No. 1, Washington, D.C., 1995.

33 See WRI, op. cit., page 42.

34 See WRI, op. cit., page 127.

Inset 4.1: Systematization and institutionalization of environmental policy

At the start of the nineties, there was an important breakthrough in environmental policy in LAC. In almost all the countries, the legal framework and institutional structure of environmental policy have changed considerably. Various countries have managed to systematize efforts that previously had been isolated, scattered, and probably highly inconsistent in various areas and subsectors. At the same time, there was been widespread decentralization and citizens are increasingly involved in the decisions that affect them. This task has become even more complicated with the reforms and broader private-sector participation in the energy subsectors.

Concern for the environment emerged gradually in some countries of LAC in the sixties. The first activities to not only clean up the environment but also reduce emissions in the air and water stemming from oil industry factilities, such as refineries and wells, took place in the energy sector. The state oil industries of Venezuela, Colombia, Mexico, Brazil and other countries established environmental control units within their respective companies. The oil industry's example of incorporating environmental issues into its activities was adopted by companies from other subsectors (electric power and coal).

The implementation of ecological considerations depended heavily on the willingness of the companies in the different subsectors. The large-scale hydropower projects of the eighties in the region included, on a regular basis, studies on their environmental and social impacts, at the request of multilateral and bilateral financing institutions. The latter institutions performed an important role in fostering the incorporation of environmental aspects into general development policy and, specifically, the establishment of environmental impact assessment studies, which eventually became mandatory for large projects.

Air pollution problems in large cities led some of them, such as Mexico City and Santiago de Chile, to develop specific regulations for transportation and industry, including the establishment of specific agencies aimed at improving air quality. In terms of national energy policy, environmental considerations appeared in regulations focusing on fuel quality and, in some countries, on the promotion of less toxic energy products.

Over the last few years, new environmental laws were enacted in many countries of the region. Interministerial environmental commissions were organized, and, in some cases, Environmental Ministries or Executive Secretariats were established. Municipalities and even individuals were empowered to participate in energy project decision-making processes. Nevertheless, in many cases, the real power of these new institutions is still quite limited.

The current environmental debate focuses on the polluter pays principle, the internalization of environmental costs, and the resulting allocations. Nevertheless, in the implementation of policies to date, the majority of the measures with environmental objectives in LAC have been "command and control." There have been virtually no incentive-type measures (such as tax discrimination against energy products that emit a greater amount of toxic substances) and very few measures based on market mechanisms (tradable permits for the emission of particulates and sanctions imposed on urban highway use rights for buses in Santiago).

Inset 4.2: Internationalization of environmental issues

In LAC, local ecological problems are felt much more keenly than global problems. In fact, the contribution of the Latin American energy sector to global and regional ecological impacts (greenhouse effect) is slight, especially because of low energy consumption and the relatively high share of hydroenergy reservoirs and dams for the generation of electric power. Therefore, the countries of Latin American may be considered the beneficiaries of an "outstanding environmental credit" whereas the industrialized countries, due to their high CO_2 intensity and the disappearance of their forests, have over the years accumulated an "environmental debt."

Although the latter countries do not view themselves as responsible for global ecological problems, they do understand that part of the solution lies in this region, more concretely speaking, in the conservation of tropical forests. A certain group of countries (to which the Caribbean countries belong), which are most severely affected by global warming, are advocating the application of strong and immediate measures for the reduction of CO_2 everywhere.

One group of coal- and oil-exporting countries (Venezuela, Mexico, Colombia, and Ecuador) feels especially affected by the efforts of industrialized countires to reduce CO_2 emissions by levying taxes in these countries (for example a tax on CO_2) and by imposing environmental standards in the region on the exploration, production, and transport of oil for export. Both of these measures will curtail the export earnings of the region's oil-producing countries. Further taxes on the consumption of oil products and coal would lead to a decline in consumption, which is what is being sought, but it would also lead to a decline in sales in the oil countries. In addition, this would lower the prices of crude oil and coal. If, at the same time, more environmental costs are internalized in the region's production chain, energy margins and revenues will drop even more.

Although, to date, the Europeans have failed to enact the introduction of a general tax on CO_2 in the European Union, there are nevertheless some countries that are making progress in this direction. The most critical point in a system of this kind is the equitable distribution of the tax and the use of the environmental funds stemming from it. Indeed, when externalities attain planetary levels and affect the entire world population, it seems reasonable that the distribution of these funds be made in accordance to some principle related to population. The use and application of these funds should, at the same time, focus on development and environmental protection objectives, as well as social equity.

The present description of the problems indicates that, regarding climate change, a multilateral agreement covering all environmental aspects within the framework of a New International Environmental Order is missing, although it is apparent that there is a noteworthy trend in this direction. Nevertheless, much time will be needed before it can materialize, as it was apparent in the conferences of Berlin in 1995 and Geneva in 1996, where no substantial agreement was drawn up.

Instead of agreements of this nature, bilateral instruments at the project level, such as debt-for-nature swaps, joint implementation, the program of measures to prevent climate change, etc., have been established, within the context of the Framework Convention on Climate Change of the United Nations Conference on Environment and Development held in Rio de Janeiro in 1992. While the debt-swap scheme (bilateral and commercial) has been applied in the majority of the region's countries, joint implementation has been limited to only a few specific countries in the region (Central America). Another specific instrument is the Global Environment Facility (GEF) of the World Bank and the United Nations Development Programme (UNDP), which focuses on differential investment financing caused by greater environmental protection in project development.[37]

backdrop to this problem is a depletion of firewood resources in certain countries or areas. If the population has no access to any other alternative, this depletion is quite severe, because it prevents the population from meeting its basic needs and does not remove the pressure on forest resources.

2.3 Environment and poverty

The common denominator of the majority of environmental problems in Latin America and the Caribbean is poverty.[35] The migration of the poor to marginal regions, oftentimes located beyond the agricultural frontier in the jungle or the mountains, accelerates deforestation and erosion; migration to the marginal zones of cities also undermines the situation of the inhabitants, since here the families often have no basis for sustaining themselves.

It has been acknowledged that poverty and the environment are interrelated problems. This inter-relation is starting to be reflected in recent economic and ecological policy proposals.[36] This approach must also be extended to energy policies. Therefore, in the most affected countries of Latin America and the Caribbean, it is increasingly urgent to implement a decisive policy for enlarging energy supply (see conclusion to the preceding chapter).

3. Scope (Durability) of Fossil Energy Resources

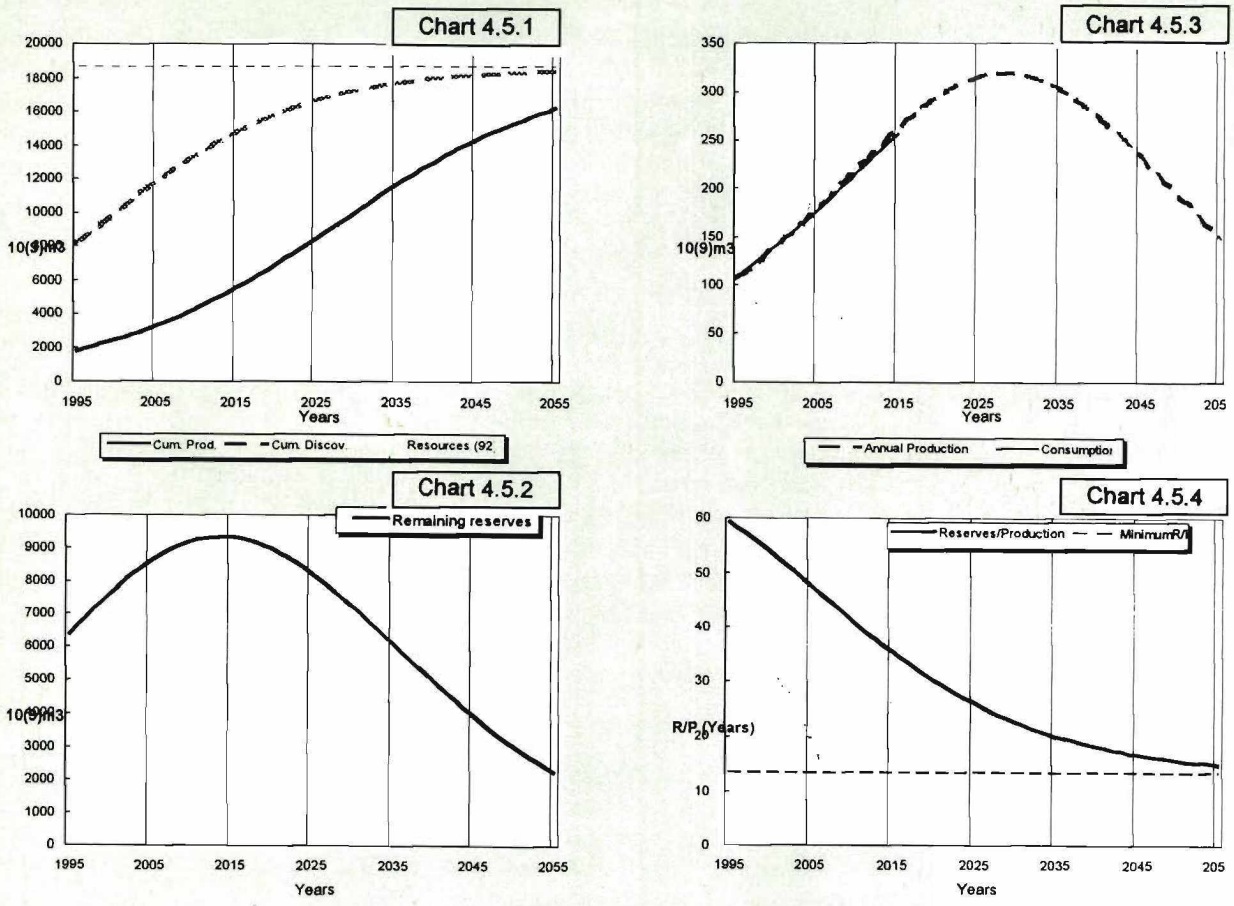
Regarding the use of fossil energy resources and its sustainability, the discussion usually focuses on the ratio between proven reserves and current production (R/P), that is, the number of years that present production can remain at the same level. Nevertheless, this is a static indicator that requires cautious interpretation. The R/P ratio in LAC grew over the last 25 years for all fossil energy products, owing to the intensification of exploration, the application of new technologies

35 See ECLAC, *Sustainable Development: Productive Transformation, Equity and the Environment*, Santiago de Chile, 1991.

36 See Development and Environmental Commission for Latin America and the Caribbean, *Our Own Agenda*, IDB/UNDP, Washington/New York, 1990.

37 See C.I. Pérez and A. Umaña, "El Financiamiento del Desarrollo Sustentable" [Financing Sustainable Development], INCAE, Alajuela, 1996.

Chart 4.4: Natural gas activity trends



in exploration and production, and a reappraisal based on higher market prices.

Many analysts believe that reserves will continue to grow in the future by means of the same mechanisms. Nevertheless, this belief stumbles against the certainty that it is impossible to have an infinite amount of resources. The question is therefore when will the finite character of these resources become apparent?

On the basis of a dynamic analysis, which takes into account the level of ultimate resources (Chart 4.4), a better perspective of sustainability of the policy regarding nonrenewable energy resources can be obtained.[38] On the basis of this approach, the R/P ratio cannot increase but rather it will tend to fall to a minimum, where exploration and development costs are equal to the economic value of the resources (Chart 4.4.4).

Assuming that the geological estimates of the current ultimate resources adequately reflect their definitive availability[39] and that the speed of discovery of reserves is maintained at the same pace as the one observed over the last few years, it can be concluded that a certain lapse of time will be needed for these resources to become proven reserves: in the case of natural gas, for example, this would amount to about 15 years (Chart 4.4, from 1 to 4).

Assuming that the trends observed in the exploration, exploitation, and internal use of the above-mentioned resources are maintained and by applying a model based on this approach, the course of production can be traced (Chart 4.4.3). The curve would show a peak and then a decline until reaching a point in time when growth of domestic demand cannot be met in increasingly more countries until finally even the most richly endowed countries are unable to export.

38 See F. Figueroa de la Vega and B. Bösl, "Production, Reserves, and Renewable Energy Sources in Mexico and the Andean Group," working paper, OLADE-ECLAC-GTZ, Quito, January 1996.

39 Historically, geological estimates of ultimate resources have varied to such an extent that present cumulative production is greater than initial geological estimates.

It is clear that reality will not necessarily adjust to this evolution, which in addition to assuming that the estimate of ultimate resources will remain at their current levels does not take into account the technological changes that may affect all the trends being considered. Nevertheless, bearing in mind all of these constraints, the progressive depletion of fossil energy resources in the world and LAC implies price hikes and changes in exploration, production, and consumption patterns, with considerable costs to adjust to the new conditions.

A single message arises from this analysis, one that does not involve the literal consideration of the ceilings over time that have been estimated but rather the more qualitative aspects, that is, the costs of adjustments after a rapid exploitation of available resources. It is clear that this message will have a different content depending on the situation of available reserves and their exploitation in the different countries.

In the case of oil, the approach yields the following results: Mexico, if it keeps the same policy it has applied over the last few years, will reach its oil production peak in 20 years and will lose its status of oil exporter in 30 years. For Ecuador, these critical moments will be 10 years earlier, whereas for Colombia the figures are similar to those for Mexico. The oil future of Peru has yet to be defined, because for many years it was engaged in very little exploratory activities; nevertheless, it is clear that it cannot expect to enjoy a situation similar to the ones estimated for Mexico or Venezuela. Only Venezuela can remain a major exporter over the long term. Because of its broader ultimate resources and its less advanced exploitation, Brazil may be able to maintain its level of autarky shown in Chapter 1 for more time than Argentina.

In the case of natural gas, a high sustainability of the current policy is only possible in Venezuela and Peru. Bolivia's export programs will not be sustainable over a term greater than 20 years and they will need back-up from Peruvian reserves. Mexico and Colombia will be able to maintain the development of their gas on their domestic markets if they intensify exploration and development of their gas resources. Ecuador would have resources to develop a limited domestic market, and Argentina would reach its peak in a few years.

Regarding coal, Colombia could follow its policy without encountering any limitations for a long time, in view of the resources it has available. Mexico forecasts an increase in its coal imports which turns out to be sustainable in view of the regional and world availability of this resource.

4. Renewable Energy Resources

Regarding renewables, the concern does not focus on their depletion and scope or durability over time, but rather on their optimal use. From the environmental viewpoint, it is desirable that their share in the energy mix grow increasingly. From the economic viewpoint, capital availability needed to take this form of energy has to be taken into account.

4.1 Firewood and waste, biomass, and biogas

The use of firewood as an energy resource is characterized by imbalances. While in some areas, such as the Amazon region, available firewood is not used as an energy product and firewood waste is left to rot in standing forests or areas that have been logged or is burned in farmland extension processes, in other areas, the lack of any other alternative fosters logging, thus contributing to deforestation, as in the Caribbean islands and certain areas of Central America. The objective is therefore not to reduce the use of firewood, wood waste, or products such as charcoal but rather to achieve a balance. This could include the production of firewood for energy purposes in appropriate areas.

In the case of shortages, in addition to the lack of alternatives, the absence of title rights over resources has permitted indiscriminate access and logging. The enforcement of entitlement rights leads to controlled use and can even foster the establishment of a firewood market with incentives to renew the resource.

As for the opposite situation, the lack of a market, possibly due to the exis-

tence of subsidized energy alternatives, leads to wastage.

In the region, there are examples of a balanced development of firewood in situations of self-consumption but also through the market mechanism. At the residential consumption level, the use of coffee shrub branches has reduced the logging for firewood in Costa Rica and other countries. The energy use of woody biomass of the forests for industrial purposes has a long history, with high expectations for its extensive application in Brazil and Paraguay (carbonization and gasification of firewood); the renewed use of firewood waste in the paper and cellulose industry in Chile is noteworthy in the nineties.

Waste from the wood, paper, and cellulose, and sugar industries are highly appropriate for the cogeneration of electricity and heat for own use and sale to the electric power grid. In Guatemala, Jamaica, Brazil, and other countries of the region, important steps have been taken in the sugar industry.[40] The economic conditions for cogeneration have not improved in the course of the reforms, owing to the relative depreciation of electricity supplied to the public grid. Thus, the significant potential for cogeneration in sugar mills has taken time to materialize.

The energy recovery from municipal solid waste is still being studied and only involves preliminary installations (Brazil and Argentina).

The most important biomass use program is the PROALCOL Program of Brazil, implemented after the oil crisis of 1973. Brazil managed to substitute a considerable portion of its gasoline use in the transportation sector. A positive element of this program is its contribution to the country's autarky, the conservation of fossil resources, added value and employment for the entire alcohol industry, the reduction of CO_2 emissions, and oil conservation. Its drawbacks, however, include problems linked to single-crop farming, water pollution, and a slight economic loss for the oil industry to the extent that there was a slight decline in the prices of oil and its products.

Despite their apparent economic advantages and many private exploitation projects, the production of biogas by means of anaerobic digestion has not yet achieved any major significance.

4.2 Hydropower

In the eighties, the expansion of hydropower generation was considered to be the pivot of energy policy aimed at ensuring greater self-sufficiency and autarky, that is, reducing the dependence on imported oil. The magnitude, long lead times, and cost overruns of various projects and the absence of full-capacity operation have been added to the unexpected economic burden stemming from the capital intensity and long return period which contributed to the high indebtedness of many of the region's countries.

In addition to its positive impact on self-sufficiency, hydropower has had a highly positive effect on emissions. The mitigation of emissions as a result of the substitution of thermal stations has not been fully appraised despite the acknowledgment of the breadth of global climate problems. This effect has become an asset for the region in world negotiations on strategies to prevent climate change.

There is still a broad untapped hydro potential. OLADE statistics suggest the possibility of increasing sixfold the current hydropower capacity of 100 GW.[41]

Nevertheless, the expansion of hydraulic expansion must address its own environmental limits in those places where increasingly larger extensions of land[42] and the displacement of larger amounts of persons are required or where it must compete with water use for other purposes, mainly irrigation. Intensification of land use in hydrographic basins, partially fostered by the construction of the dams, has contributed to erosion and sedimentation, even in the reservoir itself. Settlement and deforestation in the hydrographic basin have produced in some cases local climate changes so that, in certain extreme situations (El Salvador, Colombia, Ecuador), the available capacity and/or energy available have turned out to be considerably below those that were planned.

40 See the *Proceedings of the Regional Seminar Legal Framework and Economic Characteristics of Cogeneration in Latin America and the Caribbean*, Monterrey, Mexico, OLADE-CONAE-GTZ.

41 See OLADE, *Energy-Economic Statistics and Indicators of Latin America and the Caribbean*, June 1996.

42 There is no clear trend in the use of land for new reservoirs. In several different regions of LAC, there are still projects whose implementation would entail the flooding of only small areas (1 to 20 hectares per MW), whereas plainland projects involve up to 1,000 MW per hectare (see Suárez, C., op. cit., page 135).

4.3 Small hydropower stations and other renewables: geothermal, wind, and solar energies

Renewable energies managed to reach a certain level of development in LAC. Nevertheless, the current level is unsatisfactory, except for the use of large-scale and medium-scale hydroelectric projects and geothermal energy.

Nevertheless, it seems that a new phase in market penetration is beginning. The possibility of building facilities using solar, geothermal, wind, and other energy below 10 MW has increased considerably. There is no lack of promoters, financiers, know-how, or marketable technology. The political will demonstrated in national programs and the new international hemispheric agreements recently subscribed to seem very important. The reforms of legal frameworks and the sector's structure in the region should provide new possibilities for the integration and remuneration of self-producers, cogenerated energy producers, and private developers of smaller power stations.

Compared to the previous situation, the theoretical conditions for small-scale power production and cogeneration have improved or at least have become safer, since the terms for grid connection and remuneration have been more clearly defined within the new legal frameworks.

In practical terms, the impacts of the reforms on the expansion of renewables in general, as well as cogeneration and energy efficiency, are still taking time to be felt. The implementation of an in-depth reform in Chile and Argentina has not contributed much to promoting the use of renewables or cogeneration in electric power generation, whereas these options have been more widely accepted in some countries that adopted the limited liberalization of Mexico, Costa Rica, and Guatemala.

One of the reasons for these highly disappointing results may be that the small-scale and industrial power producers of Chile and Argentina do not belong to any club or pool, that is, as members of the bulk market, central dispatch committees, etc. They are viewed as lower-category supplies who oftentimes are not linked to any association, union, or defense group with any kind of political leverage. Local transmission rights are not clearly defined and distribution utilities are not obliged to purchase or transmit electricity produced by small projects. In addition, governments have not been able or are not willing to implement an effective incentive program for renewables or cogeneration.

The relatively greater success of renewables and cogeneration in countries with limited reforms is due to special programs or legal provisions. Guatemala promoted the production of electricity using biomass in the sugar industry by means of a specific program. The Federal Electricity Commission (CFE) of Mexico started cooperation with industry to develop cogeneration and with various promoters to develop generation fueled by renewables. Costa Rica facilitated the establishment of small private stations of up to 20 MW which channeled private investment in this direction.

Nevertheless, the high expectations for this market, duly supported, do not involve renewable energy technologies in smaller units such as small photovoltaic plants designed for decentralized energy supply. The massive dissemination of these facilities depends on support from technical cooperation and the State. It has already been proven that participatory approaches are unsuccessful, and in order to ensure their expansion individual projects have to be grouped under one single package and need a propitious framework and decisive systemic support.

The small power sources based on renewables are appropriate to meet the power demand of remote communities.

As indicated previously, some of the LAC countries, with strong support from bilateral and multilateral cooperation, are beginning programs to promote rural electrification on the basis of renewables (hydropower, wind and photovoltaic solar energy).

5. Conclusion: Priority Guidelines

The preservation of natural resources and the environment are obvious objectives for sustainable development: rational use of energy; substitution

of energy products with high contents of toxic substance for clean energy, especially the use of renewables; and the application of clean energy production, transport, and use technologies and processes.

The issue is when will these objectives be achieved over time. The problem lies in the course of action that must be taken to ensure that these objectives will be reached. To date, the approaches have been mostly isolated, limited in space and time. Thus, the energy efficiency of certain industries in some countries and the efficiency of electric power use in a sector of a city have been enhanced, photovoltaic systems have been disseminated to a certain extent in a given area of a country, small hydropower stations have been retrofitted and built in other countries, and a prototype facility for the clean use of coal has been commissioned. In some cases even, a project has been expanded into a national program, with financial support from a specific institution.

Nevertheless, in very few cases is it possible to discern a systemic and widespread policy approach. A policy of this nature would mean creating, at the least, equitable market conditions for rational use of energy and the small-scale use of renewables. Energy sector reforms in the majority of countries have given little importance to these topics. Generally, the conditions for rational use of energy and renewables have not improved much, even for cogeneration. Vertical breakup, restricted participation on the market, and tariff-setting schemes have done nothing to promote them.

The impact that certain changes in rules can exert is evident in the boom of natural gas use for electric power generation, because the technology is perfectly adjusted to business conditions, and above all, to the risk. This boom may exert positive environmental impacts if it manages to reduce the use of coal and oil products in electric power generation. It remains to be seen whether it will really contribute to mitigating emissions as it replaces the use of emission-free technologies such as hydrogeneration.

At least it is apparent that efforts are being made to maintain the pace of growth of renewable energy technologies and rational use of energy but, as mentioned before, within the framework of funding projects or programs. These efforts will definitely not change the course of events. There is no consideration of impacts and incentives in the relevant parts of the legal framework and the policy that is being implemented. Quite on the contrary, in the majority of countries, the prices of renewables do not even reflect opportunity costs; in various countries, prices still encourage wastage or the use of the most polluting energy products. And in those countries that have undergone a certain international price adjustment, there is no serious initiative to foster the use of renewables and penalize the use of rival energies that are toxic due to their external environmental impacts.

For both economic (see Chapter 2) and social reasons (see Chapter 3), and especially for environmental and resource-conservation reasons, the countries should not allow these policies to be applied. The countries that still do promote the nonrational use of energy should change their approach as soon as possible. In the countries that have already implemented reforms and price adjustments, the rules of the game of the markets and energy use standards should be reviewed and developed not only so that the building of combined cycle stations (using natural gas as feedstock) can become a profitable business but also so that wind, geothermal, small, and mini hydro stations, as well as solar water heaters, can be installed.

The countries producing hydrocarbons and coal should be particularly interested in the development and application of clean technologies that reduce the emissions stemming from energy processes, consumption, and above all transformation. This is where the respective energy chains have opportunities for coordinating their activities and increasing their added value. The industries of the countries of LAC must become involved in the production of clean energy technology equipment.

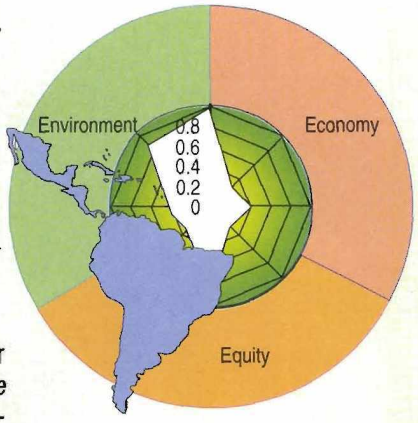
Regarding their international stance, the countries of LAC should intensify their efforts to reach multilateral agreements that compensate the countries for their energy sector's relatively benign impact on the environment. The

concept of international equality of opportunity in using the environment suggests that industrialized countries that tackle their global environmental problems by internalizing costs and levying taxes and duties in their countries should share these revenues with developing countries to the extent that the latter have contributed to reducing global emissions.

Multilateralism would be very appropriate for the region's countries, since the prevalence of national approaches could lead to trade reprisals, thus generating an even more pernicious form of unequal trade, imposing conditions on the development of natural assets without considering compensatory measures. Thus LAC should capitalize on the efforts it has made in the past to mitigate environmental damage.

Although multilateralism is moving ahead slowly, the countries could take advantage of those new instruments that already exist such as joint implementation, debt swaps, and the Global Environment Facility (GEF). Nevertheless, it would have to ensure that a selective application and different conditions will not divide the region's countries.

CHAPTER 5: ENERGY POLICY GUIDELINES FOR SUSTAINABLE DEVELOPMENT



1. Introduction and Recapitulation

The present chapter should start with a remark that will help to put into perspective the need to begin sustainable development actions: with the depletion of nonrenewable resources and some renewable resources and the deterioration of environmental resources, there will be increasingly less economic and social options for the future. If this situation is not overturned, human development will come to a standstill and the opportunity for politics to promote this development will be increasingly curtailed, since over the long term political options depend on economic growth, which in turn depends on natural, physical, and human capital.

Only if actions are taken in the present, keeping in mind the need to maintain these assets in all of their shapes and forms to ensure long-term opportunities, will there be hope for embarking upon a sustainable development process.

If no action is taken to increase this capital in general and preserve natural capital in particular, the idea that politics can determine socioeconomic development which, in turn, can develop resources over the long term may well end up by being a simple mirage or illusion fostered by an overestimation of political power.

In the previous chapters, the evolution and situation of energy in terms of the three dimensions of sustainable development were analyzed. A series of problems, insufficiencies, lags, and risks to reach sustainable development objectives were identified. Priority lines of action to improve the situation with respect to each dimension have been indicated, underscoring the fact that many of the problems are so closely intertwined that a solution to one problem in one dimension must forcibly consider its impact on the other dimensions.

Among the priority guidelines for energy policy, the objective of *rational use of energy* is noteworthy for its contribution to improving the situation in all dimensions: increasing economic productivity, reducing exposure to the risk of rationing or rising cost of energy inputs, enhancing the productive efficiency of the energy sector, mitigating pollution, facilitating the conservation of natural resources, and even reducing household spending.

Another important guideline is *energy diversification* and improving access to a wide range of products and technologies. This helps to ensure supply quality and security, opens up new production opportunities, as well as social service and welfare options, and contributes to conserving resources and mitigating toxic emissions.

The increasing *use of renewable energy resources* evidently also has positive multi-dimensional impacts.

Another line of action with positive impacts in many aspects is *energy integration,* whether in the form of physical integration or market integration.

The latter approach implies joint, matching political actions by various countries, whereas the other three are rather the outcome of a strategy to be defined within each country. The definition of guidelines and the description of options for a sustainable energy development strategy is the focus of the present chapter.

The previous chapters mention several principles for a suitable strategy: it has to be integrated, systemic, and widespread and should not function merely at the project level. On the basis of external conditions and the new institutional scheme, this chapter tries to conceptually systematize energy policies in

order to configure a strategy for sustainable development: objectives, approaches, instruments, players, and processes.

2. The Sector's New Environment and Trends

2.1 The energy sector's emerging organization

The reforms that have been applied, or are in the process of being implemented, in the State's administrative system, public enterprises, and energy system management have led (or will lead, after a more or less prolonged transition phase) to profound modifications in their organizational structure. The structural details of the energy sector will be different, depending on the country, but it is still possible to underscore their most common features.

In a few years, the State will have withdrawn from its entrepreneurial role in many countries, even in those areas considered strategic and of public service. Companies under corporate law and using private-sector approaches will be performing these functions, although, in terms of ownership, they may be state-owned, private, or mixed. Regarding government administration, the Central State will have transferred many of its duties to provincial and municipal entities.

In the energy sector, there is shift in ownership structure, with greater participation of the private sector, restructuring of subsectors, oftentimes vertical breakup, the introduction of elements of competition with the subsequent need for regulation, and external opening up.

A new distribution of work between the State and the private sector has been established in the energy sector. The insets of the previous chapter attempt to provide a general but systematic overview of the electricity, oil, and gas subsectors (Insets 2.1 to 2.3), the current situation of energy market regulation (Inset 2.5), the new institutional framework of environmental concerns (Insets 4.1 and 4.2), and regional integration trends (Inset 2.4).

The new way of managing the sector is closely tied to the role and nature of planning, an energy policy instrument that has been highly privileged in the past. The State still displays a great deal of insecurity with respect to energy development planning and development processes in the new macroeconomic and sectoral institutional scheme. The following sections attempt to outline possible future approaches to an energy policy that will ensure sustainable development within a new institutional environment.

2.2 Trends of external conditions

The conception of national energy policy must take into account the predictable situation of external markets, as well as the behavior and expectations of important external players who can influence the data of the business they are interested in and even affect the maneuverability and options of a country.

World economic and energy market trends are highly relevant for energy policy:

- low economic growth in industrialized countries and greater buoyancy in some developing regions;
- growth of demand in the world oil market with implications for the concentration of supply;
- rapid growth of thermoelectric generation in emerging economies, increasing the emission of CO_2 and other toxic substances;
- a larger volume of international energy trade;
- the establishment of new capital markets and new financing schemes;
- the applicability of market forces to capital account management; greater international mobility in the allocation of resources and the elimination of constraints for internal and external credit use, while regulations for attracting capital are made more flexible (issuance of share, bonds, and other titles);
- a general rise of globalization, placing developing countries in a more difficult situation but also providing them with opportunities, and competition between countries for foreign invest-

ments, which could be coordinated if ambitions are curtailed or partnerships are established to ensure greater benefits; and

- the concentration and difficult accessibility of technological development.

The following political trends are noteworthy for the repercussions they can have on energy policy:

- the reassertion of an institutional framework in world markets, keeping in mind that group or unilateral actions to influence the market (OPEC) are contrary to free trade;
- the formation of regional blocs;
- internationalization of environmental concerns;
- promotion of international standards within the framework of the OMC and others;
- redefinition of the role of multilateral and international cooperation agencies, lesser priority for financing state energy projects, and privatization schemes of greater importance within terms of conditionality;
- the inclusion of issues involving sustainable development, with an environmental bias, as part of the objectives of international organizations and national states, where one of the central issues continues to be energy; and
- incipient consideration of equity and energy issues.

In addition to the previous, already visible trends, model trends shared by mainstream thinking and supported by the think tanks of international organizations must be taken into account:

- consideration of assets and natural resources, as well as free availability, governed by market rules;
- questioning the control of assets of natural resources by the State;
- elimination of restrictive policies for direct foreign investment to exploit new resources, enlarge and modernize existing developments, and in general absorb the benefits of technical advances;
- elimination of energy trade barriers; and
- the consolidation of a subsidiary State whose legitimacy to intervene stems from its capacity to correct market imperfections.

3. Energy Policy Guidelines

3.1 Energy policy principles

On the basis of the new national organizational scheme and new international coexistence and bearing in mind experiences to date, a series of energy policy principles is being proposed to face internal challenges (reverting economic, social, and environmental deficiencies) and external challenges (contributing to the competitiveness of national players faced with globalization), which can be used as general principles to formulate an energy policy for sustainable development.

- All the countries of the region have their own problems and options, requiring a variety of solutions. Keeping in mind the political and economic culture, as well as the basic operating conditions, of each country, the conclusion has been reached that there is no single, blanket recipe.
- It is not advisable to apply extreme models, but rather flexibility and prudence should be applied, nor should policies be judged or selected on the basis of ideologies but rather by analyzing the situation, objectives, options for action, probable effects regarding all the dimensions, etc. Paradigms can serve as a reference but not as mandates.
- A formal reform of the public sector is not enough to foster the private initiatives that are expected, the self-organization of communities, and the appropriate intervention of decentralized entities such as municipalities. The policy should induce measures to foment all of these desirable initiatives. Even when it is apparent that in

many countries statism has been officially abandoned, the notion of a philanthropic state in both political spheres and civic attitudes, especially in those areas that were previously governed by the State, such as energy sector management, remains strong.

- The concept of a self-regulated market (with its elements of supply, demand, and price formation) involves a series of advantages, and therefore its implementation is recommended in many parts of the sector to replace the concept of public monopoly and the concept of self-supply in the rural sector. Therefore, wherever feasible, markets should be multiplied, promoting this system but jealously controlling its operation and the balance of powers.

- It has become evident that, in effect, it is possible to apply the principle of competition as a reference for the sector's organization and private-sector participation in more sections of the energy sector than what was thought possible in past decades. Indeed there are less natural monopolies in the sector that need regulated market schemes, when the corresponding regulatory entities are created. This observation holds true especially for more mature and larger markets, where the objectives of productive efficiency prevail over the objectives of infrastructure development.

- A reform is a not an end in itself, but an instrument to provide the sector with better conditions to carry out its duties and achieve its objectives. Reforms, even when they are profound (including restructuring, regulation, and/or privatization) are unique developments in a country's evolution, although they may take place over a long transitional period. After reform, the processes become part of everyday routine, eventually changing the course of the country's economy. Therefore, efforts must already focus on the post-reform era in those countries that are approaching it.

- During the course of energy sector reform, which all the region's countries have undertaken sooner or later and in one way or another, a new division of labor between the private sector and the State has been established. Nevertheless, the State must perform an important role in various sector aspects:

  * Sector management, after the reform, assigns to the State various precise duties, whether modified or new, especially in the regulation of monopolistic markets. If these duties are not performed, the results that are being expected from the reforms will not appear, especially in terms of efficiency of resource allocation.

  * The reformed system, even when it functions better in terms of economic efficiency, does not automatically ensure that all the human development objectives that society expects will be achieved. Therefore, the State must adopt a balanced and cautious approach to its subsidiary role and consolidate its responsibilities regarding the sustainability of development.

  * In view of the energy sector's inherent characteristics (intensity of capital and natural resources, investments with slow return, production of essential services and commodities for quality of life and the functioning of social and productive activities, marked oligopolistic or indisputable monopolistic markets, heavy environmental impact), it is indispensable that, in this sector, market mechanisms are complemented by coordinating actions by the State, in many cases indicative in character and in other cases using indirect instruments or actions.

  * The principle that the State has eminent domain over nonrenewable natural resources should be reasserted so that their use can be monitored and directed.

- Globalization processes such as domestic liberalization and the dynamic forces stemming from these processes should not be viewed as forces that are superior to those of the State itself, thus permitting a sort of laissez-faire approach. The State should not surrender its prerogatives and sink into inertia, but rather create options and take advantage of those that are available. Thus, for example, external financing sources may be considered as complementary sources; likewise, the role to be played by foreign investment must be defined and national capital markets consolidated.

- Due to the lack of a supranational political power in charge of regulating the actions of globalized companies and correcting the undesirable effects they might produce, national governments should take over these duties. It is imperative that the governments of the region identify the national factors they can control.

- In international terms, the region's countries should coordinate and cooperate to improve their participation in the institutional framework of world energy markets. They should also coordinate and consolidate regional stances in international negotiations on environmental issues. Without going into further detail regarding the strategy to be used to ensure these guidelines, it should be emphasized that regional energy integration exerts such decisive impacts on development that it can be viewed as an energy policy principle.

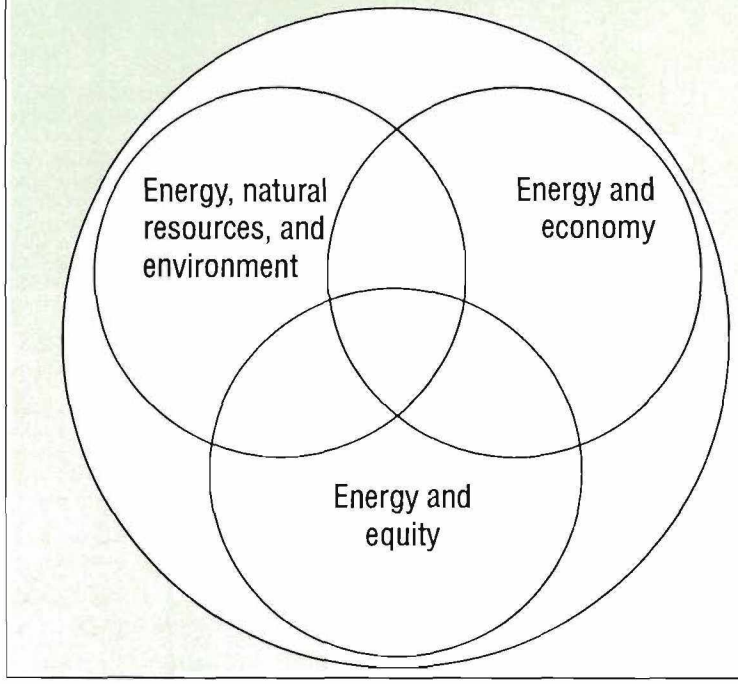
3.2 Enlarged and multi-dimensional objectives: sequential approach to conflict-solving

Placing sustainable development as the highest goal of energy policies implies enlarging the range of sector objectives. Chart 5.1 provides a view of sustainable development as an area in the shape of a large circle in which three smaller circles representing the areas of energy and economy, equity, and resources. The blank area is meant to be the area of political sustainability, which serves as the base for the three others. Interfaces between two and three dimensions can also be observed in this scheme.

The range of objectives that have been presented by classification of impact dimension is used once again in Table 5.1, but indicating a list of actions that will help to achieve these objectives. This wide range of objectives implies an opening up and reorientation of current energy policy.

At present, the efforts being deployed to reorient energy policy toward sustainability over the long term have been displaced and conditioned by energy sector restructuring to ensure competitiveness, an aspect that can be seen as a limitation for sustainability. The transition and implementation phase of the reforms is still in full process of development. Therefore, the energy policy of the countries of Latin America and the Caribbean faces a dual challenge: suitably implement the reforms and promote long-term objectives, especially those involving sustainable development. But, as this phase comes to an end, it will become apparent that the region's energy problems go far beyond mere reform.

Chart 5.1: Dimensions of sustainable development and their inter-relations



Of course, not all the objectives are equally relevant for each country; for

example, for countries that do not have an abundance of fossil resources, the objectives involving the rational exploitation of these resources are not as relevant as for those countries that indeed do have a wealth of these resources.

The expansion of objectives, taking into account various dimensions, heightens the problem of formulating policies with multi-dimensional objectives.

If in a multidimensional policy there are already conflicts between objectives and inconsistencies between measures and objectives (undesirable secondary effects on the objectives of third parties), these conflicts are simply multiplied when considering the other dimensions.

Chapter I warns that, despite these problems, the sustainable development of the energy sector is not only desirable but also possible. The solution for these

Table 5.1: Objectives and instruments of energy policy to ensure sustainable development

Dimension	Objectives	Actions/Instruments
Political	Sustaining political maneuverability	Coordinating liberalization policies in the region
		Participating in organizations and forums
	Maintaining international weight	Setting up international coalitions
		Separating sovereign from entrepreneurial functions
	Breakup of political-economic power	Consolidating authority and autonomy of regulators
		Ensuring democratic control of regulatory functions
	Security of installations during conflicts	Consulting defense and domestic security authorities
		Diversifying energy sources and countries of origin
	External supply security	Drawing up long-term contracts
		Storing energy products for short-term shortages or outages
Economic	Sufficient degree of autarky	Promoting the development of national sources
	Small energy share in imports	Furthering the region's energy integration
	Lesser weight of variable incomes in balance of payments and state budget	Diversifying exports
		Creating and administering income stabilization funds
		Limiting risks in futures markets operations
	Steady inflow of export earnings	Applying instruments for taking earnings in order to provide incentives, instead of fiscal measures
	Steady inflow of public revenues	Restructuring the State's budget toward investment in human resources
		Promoting the rational use of energy (range of instruments)
	Taking energy earnings	Ensuring orientation from prices to costs
	Investment of revenues in other forms of capital	Structuring and regulating tariff-setting with incentives for energy savings
		Limiting the establishment of energy-intensive industries
	Low energy intensity	Incorporating the subject of rational use of energy in urban policy
	Rational use of energy in production sectors and transportation	*Considering the rational use of energy in land use and the planning of transportation*
		Considering the rational use of energy in traffic regulations
	Energy efficiency in processes	Creating and supervising competition in self-regulated markets
	Productive efficiency in the sector	Ensuring the sound functioning of regulation in regulated markets
		Regulating cautiously the profitability of regulated enterprises
	Sufficient sector financing	Considering the competitiveness of the users of regulated services
	High energy supply quality	Permitting sufficient self-financing in the regulation of prices
	Reliability of energy supply	Giving impetus to interaction with domestic financial market players
	Low energy supply costs	Ensuring the access to international capital markets
	Higher added value in energy chains and related sectors	Taking advantage of private-sector management benefits
		Supporting the control of technical and nontechnical losses
		Regulating the quality of services and energy products
		Ensuring reserve capacity in regulation
		Promoting internal development and transfer of technology
		Ensuring technology transfer in regulations for foreign investments
		Promoting an entrepreneurial environment for the sector (services for the sector)
Social	Diversification of energy mix	Promoting the transformation of energy products in the country
	Sufficient supply	Promoting the production and purchase of efficient facilities
	Access to efficient and appropriate energy products	Promoting the use and application of energy and appropriate technologies
		Promoting diversification of supply in urban areas
	Coverage of basic needs	*Promoting basic infrastructure to extend access in the rural sector*
	High electricity coverage	Creating energy markets in the rural sector
	Supply of social services	Reforesting and promoting energy plantations
		Ensuring ownership rights and regulating access to firewood
		Permitting price discrimination to foster market development
		Structuring tariffs that permit well-focused and transparent subsidies
Environmental/ Resources	Purity of atmosphere	Internalizing external effects in energy prices
	Soil conservation	*Promoting the penetration of clean energies*
	Sustainable managment of firewood	Assessing environmental impacts of projects and their consequences
		Creating terms of reference for sector activities and ensuring their compliance
	Preservation of water	Defining fossil energy exploitation profiles and enforcing their compliance
	Ecocompatible management of hydraulic basins	Defining norms, standards, emission ceilings, etc., in consumption sectors
		Creating and operating effective and practical compliance enforcement mechanisms
	Sustainable profiles of fossil resource exploitation	Creating contingency systems for all the installations
		Fostering the development of appropriate emission mitigation technologies
	Greater scope of fossil resources	Creating a legal framework and equitable rules for renewables
	Greater use of resources	

problems can be found in procedures. The idea is not to attempt to resolve problems aside from the dynamic force of the systems, but to underscore the fact that the solution of these problems is part of a process.

Policies will have to identify the actions that exert a positive impact on the maximum amount of objectives without adverse effects on any of them (the win-win solution). These respective actions or instruments already exist in energy policy, as we saw previously (promotion of rational use of energy, renewables, and regional integration). This is more feasible in a situation in which the degree of achievement of the objectives is less in the majority of dimensions, a situation that prevails in most countries of the region.

Other actions may have contradictory effects on various aspects. Considering these actions to improve the position of the country regarding an objective, collateral actions must be carried out to stimulate the effort in other objectives or avoid adverse effects on some of them (compensatory solutions, avoid a trade-off).

The dynamics of development processes and politics enable this principle to be promoted and to make progress relatively more in one direction and relatively less in another. Therefore, policies and the intensity of actions stemming from them have to be harmonized.

It is not enough to conceive a strategy that resolves problems once and for all, progress should be achieved step by step, gaining experience and correcting mistakes along the way. The best point of departure to set up, in practical terms, this type of strategy would probably be an analysis of current policy, first identifying perverse incentives, that is, measures and instruments currently in force that are curtailing the achievement of one or several objectives. For example, one perverse incentive of the past, which was widespread in the region, was maintaining the price of energy products far below their economic costs. Another was, for example, maintaining the price of a product that causes environmental damage below the price of a clean substitute.

A second practical step would be to identify impediments to reaching the objectives. There are many obstacles of this type in all countries of the world. One obstacle is the exclusion of small electric power generation capacity, oftentimes based on renewables or cogeneration, from the grid or discrimination in access conditions for these plants. Another example is the customs discrimination against renewable energy technology and equipment compared to convention technology and equipment.

Finally, the possibility of introducing sound incentives will have to be studied in order to achieve sustainable development objectives, such as for renewable energy technologies, rational use of energy, etc.

3.3 Political instruments

Table 5.1 summarizes the most relevant actions of sustainable development along with objectives. The actions are defined generally and without indicating inter-relations between them. Nevertheless, some of the actions involve various possible instruments. Specifically, where the action "promote" is indicated, the entire range previously presented should be considered, from information to regulation and mandate. Afterwards, they should be structured hierarchically, an aspect that we do not intend to deal with in the present chapter.

The changes in the role of the State will imply a profound change in the modalities of energy policy implementation. The State will no longer perform a leading role, directly managing energy supply by means of sector institutions and enterprises and controlling variables such as investments and prices.

Nevertheless, even when the State has abandoned these modalities of direct control, it still has at its disposal a broad spectrum of instruments, as indicated in Table 5.1, with a wide variety of characteristics, which to date have been used only slightly, to achieve its objectives:

- soft instruments, such as information, training, promotion of research and technological development;

- more intrusive instruments, such as fiscal incentives, subsidies, and taxes (including the taking of revenues and their redistribution) and even public investments;

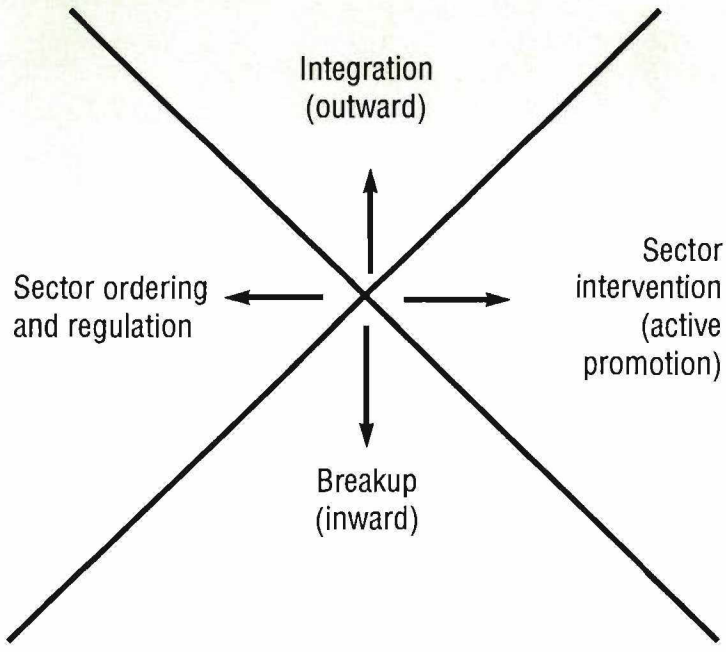
- instruments that provide new opportunities for new players, such as the establishment of markets that until then did not exist (creation of tradable ownership rights, licenses); and

- instruments that limit, in different ways, the sphere of action of the players, establishing frameworks, rules of the game, and regulatory standards, sanctioning certain actions in their most restrictive form, arranging actions, etc.

Energy policy instruments can be divided into two major groups. One of these groups is comprised of instruments linked to the organization of structures and procedures, which have to be set and maintained without any substantial changes for long periods of times, thus permitting greater security for the expectation of players, which means lesser risk, lesser cost, greater investment, etc.

These policies associated with *sector ordering* focus on the creation, supervision, and regulation of:

Chart 5.2: Major axes of energy policy



- energy production chain structures;
- institutional organization (ownership, rights, market structure, and obligations);
- transaction rules; and
- standards and limitations.

The other group contains instruments that are appropriate to actively intervene in sector management over the short and medium term, in other words, *interventions* that are variable, such as:

- information;
- measures of persuasion;
- research;
- education and training;
- fiscal incentives (transfers, subsidies, and taxes); and
- public investments

These interventions do not have to be abrupt but rather must be the outcome of a previously announced and transparent policy, in order to avoid any unnecessary instability for the players involved.

Thus, once the changes related to the first group of policy instruments have been introduced, the State's intrusion by means of its energy policy will be much more indirect and almost exclusively linked to the second group of instruments.

Thus, prices, investments, and energy supply in general, just like demand, will be the outcome of various factors, and the State will control only some that are relevant, such as subsidies and taxes.

These structuring policies, on the one hand, and transparent intervention, on the other hand, should be combined, if possible, with other general axes: outward integration and inward decentralization.

- The need to harmonize policies with neighboring countries to facilitate energy integration should be taken into account.

- The role of the State should be classified at decentralized levels, especially the jurisdiction of municipalities and provinces with respect to energy.

- Non-energy rules (environmental regulations, etc.) that have major implications for the energy sector should match energy rules.

Chart 5.2 provides a picture of the different axes of this energy policy and its instruments.

3.4 Approaches and processes

3.4.1 Integrated and systemic approach, shared responsibility, situation in the appropriate sphere

The political approach from the energy perspective should be inserted in a more general context, because the energy sector, as a subsystem that meets human needs, interacts with the other production, transport, distribution, and consumption subsystems.

It has been observed that many sustainability problems stemming from energy sector impacts are closely interrelated with other sectors of activity. Suffice it to mention, as an example, the problems appearing in certain hydrographic basins where there has been an unbalanced use of land and water, especially as a result of the building of hydropower stations and extensive farming, diminishing overall productivity and even leading to drastic land depreciation. Another example involves sustainability problems stemming from urban transportation, including very low productivity and unbearable air and noise pollution, as well as other living quality problems for the population.

In order to tackle this type of problem, an *integral approach* is needed, one that goes far beyond the energy sector's policy, covering the entire range of macroeconomic, industrial, social, and environmental policies.

Basing development on the participation of players at different levels (local, national, and even international or supranational) and of different types (private and public) implies a *systemic approach* for policy conception and implementation. This means taking into account the actions of many players, each one handling of wide range of instruments as a result of political-economic opening up.

In order to achieve the objectives that were listed, the State can rely on certain aspects, on market forces, and especially on efficiency measures, since in the energy sector, the State should be more watchful so that the market and competition will reach the results that are being sought. Nevertheless, there are many other areas where it should act on its own initiative, in some cases organizing markets where there are none and in others controlling any imperfections that might arise.

Therefore, the policies and actions that are to be applied in the energy sector require a systemic approach, as well as analogous efforts in the other sectors. In addition, this approach requires the involvement of players that are the both the protagonists and target of sustainable development, such as the powers of the State (executive, legislative, and judicial branches) at different levels (central, provincial, and municipal), as well as company representatives, workers, and the rest of society because sustainable development is a *shared responsibility* that is unavoidable and is compatible with democratic system. While the latter establishes a political mechanism for social coexistence, sustainable development promotes equilibrium in meeting social needs, which ensures this coexistence.

Since considerations tied to the sustainability of development imply an enlargement of policy objectives and in view of the changes in the role of the State, private-sector players, and the nature of new instruments available, the countries will have to rebuild the energy sector's assets structure and its relations in the State's organization and the energy policymaking modalities. For this, a learning process is necessary to assimilate the new modalities of operation, responsibilities must be defined, and strategies that combine appropriate instruments must be developed

The details of redefining the division of labor and the roles between the public and private sectors, as well as the appropriate mix of instruments, depend on the conditions of each country.

3.4.2 *Development from the bottom up: "living space" and responsibilities at different levels*

The basic idea behind the systemic approach and shared responsibility is that all the players should be involved in resolving problems, especially highlighting those that are affected by or involved in these problems, since the ultimate overall goal is sustainable development, whose target and subjects are persons.

The reference system for designing policies is space, where people live and act, that is, their *living space*. This living space is not only the tangible area (the environment in the strictest sense of the term) where a person lives, it is also the intangible aspect of this area, that is, the set of conditions, aptitudes, skills, rights, obligations, and opportunities. Local communities and social groups, in one way or another, share all of these aspects.

Designing policies to improve this living space (which has been downgraded and oftentimes considerably reduced in size) and to recover it (where it has been lost), means adjusting the policy's perspective to an approach from the bottom up. Nevertheless, the responsibility over this living space does not always lie with the grass roots. This responsibility therefore has to be determined according to the scope and effectiveness of the policy action. Thus, in the post-reform era, *areas where problems occur* have to be identified and activities and responsibilities have to be inter-related so that actions can be taken.

In addition, some objectives and issues do not directly affect the concrete living space of citizens, they only do so indirectly, such as the taking and use of energy revenues. Although it may be necessary for citizens to supervise the use of these revenues depending on the objectives of society, negotiations on the taking of revenues should not necessarily involve the grass-roots of society. There are topics which, because of their characteristics and handling, pertain exclusively to top-level government institutions.

Starting from the bottom and moving up, the political spaces of the municipalities or regional (such as provinces), country, or supranational entities have to be identified since certain responsibilities are transferred by the countries. The municipalities are the political entities that should exert the most influence on the following tangible living spaces:

- Cities, for the organization of housing and industrial, commercial, transportation, and public service activities and the construction of their respective facilities.

- Rural areas, for local structures, housing, farming and livestock development, forest and energy and mining activities, as well as the installation of infrastructure.

The intermediate levels of responsibility should be minimum (one or two) until central government authority is reached.

Tangible living spaces do not exactly match political delimitations; sometimes they are smaller than the extension of a municipality, in other cases they are much larger. As a result, living spaces of different sizes can be delimited according to the topic and type of interrelation. For example, many hydrographic basins are much more extensive than municipal territories, and they sometimes even stretch beyond a given country's boundaries. On occasion, the municipality provides the space for acting, permitting the self-organization of the population.

The decentralized agencies, whether state or private, deserve a far more important role in the formation of a more efficient, equitable, and dynamic energy structure. Therefore, the trends toward decentralization of the State should be taken advantage of and promoted to create new options for rural development and integrate energy actors into urban development concepts, delegating to the municipalities responsibilities to favor a lifestyle that is compatible with the better use of energy.

Another group of players that should be much more involved is the large consumers and the organizations representing consumer groups (chambers of commerce, industry and transportation associations, housewives, etc.), at the so-

called middle level. Insets 5.1 and 5.2 provide the structure for a policy with a systemic approach to better achieve certain sustainable development objectives.

In many countries, the objective rational use of energy is already one of the principal goals of energy policy (Inset 5.1). In other words, attempts are being made to ensure high efficiency in all energy uses, especially, by order of importance, in industry, transportation, and households.

Finally, it has been demonstrated that the topic *sustainable development of biomass,* in various countries and areas within the countries, is a fundamental issue for social and environmental sustainability. Inset 5.2 provides elements for a policy aimed in this direction.

3.4.3 Processes and functions of the central State: policymaking and decision-making, coordination, planning, information, and monitoring

As indicated previously, as a result of institutional changes, the opening up to private-sector participation, decentralization, and restructuring of the State and democratization, new energy policymaking and decision-making processes are being implemented. In addition, focusing attention on sustainable human development as a policy guideline requires new decision-making approaches, based on social consensus.

In various countries of the region, policymaking processes have already changed and the participation of those affected by project decisions has increased. Nevertheless, within a sustainable development perspective, *participatory* processes have to be reviewed and systematized.

One basic condition is a *consensus* on the orientation of energy policy in society. Considering the many diverging positions stemming from different political currents and opposing interests of pressure groups, it would be illusory to strive for a total consensus of society. Nevertheless, what can be achieved is a consensus on major guidelines, for example, that energy sector evolution should correspond to sustainable development.

Inset 5.1: Rational use of energy

PRIMARY OBJECTIVE: Reduce in general economic costs, enhance productivity, improve accessibility, and mitigate environmental impacts.
PROBLEMS: Great potential for conserving untapped energy resources.
APPROACH: Using public policies to influence energy use decisions (behavior) and investment decisions determining the energy use of individuals or organizations.
WHERE TO FOCUS: Energy sector (generation, transformation, transport) and end-use of sectors (industry, transportation, residential, public sector).
CONDITIONS: Prices that reflect economic costs, tangible and reversible energy spending.
INSTRUMENTS: Information, awareness-raising, persuasion, education; technological dissemination, research and development of technology; revision and reorientation of relevant regulations and standards, even spatial structuring (eliminating obstacles); incentives (subsidies and taxes, financing programs, creation of markets, licenses, etc.); creation of specific or related environmental norms, standards, and regulations; creation of, or support from, specialized institutions.
PLAYERS/STAKEHOLDERS:
CENTRAL: Users (tenant, driver, worker, keeper, etc.); investor (industrial, transporter, owner, institution, etc.); energy company, service company, agency in charge of energy policy.
INTERMEDIATE: Manufacturers and importers of equipment; consultants; consumer associations, investors, and residents; chambers and federations; educational system; research and training centers; financial institutions and funds; foundations and other NGOs; international cooperation agencies; municipalities; political parties.
POLITICAL: Executive; legislative.

Inset 5.2: Sustainable management of biomass

PRIMARY OBJECTIVE: Sustainable exploitation of biomass, enhanced availability of, and access to, energy products for users.
PROBLEMS: In areas where there are shortages: loss of the natural capital stock. In areas where there are surpluses: suboptimal development.
APPROACH: Attract constructive forces acting from the bottom up; promote local interest in supporting the living space; involve private players; ensure the commitment of large-scale players.
WHERE TO FOCUS: Rural areas in disequilibrium.
CONDITIONS:
INSTRUMENTS: Awareness raising; information, education, training; creating local energy markets; supporting specific production and trading of biomass, ensuring ownership deeds, regulating rights-of-way, granting licenses for forests that are not privately owned; incentives (financing, payments to upkeep forests, payment for services such as CO2 absorption, recreation, etc.), international sources (JI, GEF, etc.); creating income from the existence of the forest; restructuring of space (use of land, reserves, parks, exploration zones).
PLAYERS:
CENTRAL: Communities, municipalities, campesinos, resource owners, exploiters, traders, loggers, tourist promoters, biomass energy development companies.
INTERMEDIATE: Local NGOs, associations, international cooperation agencies, join implementation institutions (JI), GEF, FAO.
POLITICAL: Executive (forest authorities); legislative; local government.

In any case, the groups involved in, and affected by, decisions should be consulted before any important decisions are taken.

The new legal frameworks established in many countries of the region provide opportunities for redefining the level and scope of participation. In those countries where the reform has already been implemented, participation has been mainly extended to sector players that are independent of the government. Decisions are now being shared by various players. Nevertheless, some countries are quite concerned because they believe that the weight has shifted too much to the private sector and because private-sector players now have more freedom in making investment decisions that determine the energy system's future (for example, on the size and laying of a gas pipeline) and these decisions oftentimes do not match society's objectives over the long term.

The new regulatory frameworks, in addition to private-sector participation, provide for the broader participation of affected groups (sector customers, industrialists, workers, and companies) in regulatory and supervisory institutions. From the point of view of certain social groups, this participation is not wide enough because it excludes representatives of the large mass of consumers.

Generally, one has to abandon the custom of discretionary government decision making.

The establishment of transparent rules and the enforcement of compliance diminish the risk for all players and creates a culture of compliance. In those cases where conflicts arise between the objectives eventually being sought by different groups of society, decision-making rules have to be laid down and complied with.

The regulatory and supervisory function has to be conceived as an autonomous function to be carried out by a specialized institution outside the direct domain of the current government. Nevertheless, it is possible to introduce into the law and regulations governing the institution's operation criteria and rules that consolidate sustainable development, that is, objectives aimed at favoring, for example, the rational use of energy or promoting the use of renewables.

The integrated approach suggested below requires *coordination* between the entities in charge of the areas covered (fiscal policy, economic policy, social policy, environmental policy, energy policy) and the associated regulatory agencies.

A systemic approach requires, in addition to a vertical coordination between central, regional, and local agencies, *systemic management.* In contrast to traditional management, where the State and its institutions were in charge of handling everything except energy consumption, systemic management emphasizes a system that is relevant for a given objective. Progress in attaining certain objectives (rural energy supply, rational use of energy, etc.) is oftentimes hampered by the lack of know-how, the lack of information on institutions, the lack of players with know-how, and the lack of suitable programs in existing institutions. Systemic management facilitates connections between players so that they can carry out the necessary transactions, eventually supporting them in the creation of the link of the missing system (for example, the appropriate type of credit), providing incentives for the transactions desired, etc. The idea is to activate a latent potential and dynamic. In this management, the intermediate organizations, such as financial, research, and engineering institutions, industry and trade associations, cooperatives, local committees, manufacturers of equipment, consulting firms, etc., as well as local government administration, play an important role.

The previous energy policymaking scheme, in which the State performed a leading role and was broadly responsible for the sector's overall development, required in-depth and comprehensive *energy planning,* which served as a guideline for building and expanding the sector. With the withdrawal of the State from its entrepreneurial functions, a substantial change took place with respect to the need to resort to the traditional normative style of energy planning. At present, there is considerable insecurity regarding the future role of sector planning and its institutional structure.

In order retrieve what is most important from energy planning, the radical stances for and against "planning," as a result of the association of this term with certain paradigms, have to be dropped and the subject dealt with rationally. There is nothing bad about planning. It is evident that all players continue planning to ensure rationality in their organization's actions, whether in the public or private sector. All kinds of organizations resort to planning in their operations, objectives, activities, procedures, resource allocations, etc. This procedural planning is also conducted by energy policy institutions (planning advisory services, consultations, preparation and debate of bills and regulations, etc.).

Insecurity arises when the following questions are posed: to what extent, in which part of the energy chain, and for what purpose (normative, indicative, orientational, referential) should the State carry out substantial planning of the energy system when it has no entrepreneurial functions?

A positivist approach (on the basis of existing criteria) to answering these questions involves the legal framework of different countries, where the division and allocation of responsibility have been determined. For example, if a country opts for limited liberalization in electric power generation, where the State or its respective agency defines the electric power generation expansion program and enters into build-own-operate-transfer (BOOT) contracts with private-sector players, it is evident that considerable planning in the form of a master plan is necessary. If, on the contrary, a country opts for broader competitiveness in electric power generation, it would not be advisable to establish normative planning in this subsector. Nevertheless, it may be useful for the State to provide power generation system forecasting to serve as a guideline for private-sector players regarding its expectations. The State could upgrade the information for all the players and reduce the risk of mistaken investments by promoting forecasting studies conducted by third parties (science institutes, consultants) and encouraging sector companies to participate in the debate, contributing the results of their own strategic planning.

In order to monitor the impacts of its own policy and verify to what extent the system deviates from the optimum, the State should promote studies comparing the system with a referential system to study costs, emissions, and other system aspects. In addition to the State, there are, as a rule, other organizations (foundations, political parties, company associations, academic institutions) that conduct or sponsor energy sector studies.

In the latter topics, the function of planning is combined with that of monitoring and information.

Another example of where planning is needed in the energy sector is the regulatory agencies, which require specific planning in accordance with the form and scope of the regulatory rules.

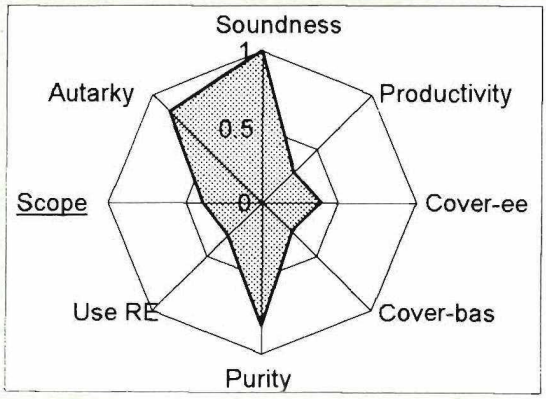
Moreover, this planning function is necessary so that the State can perform its subsidiary role in private-sector decision making, especially in the area of rural and marginal urban electrification.

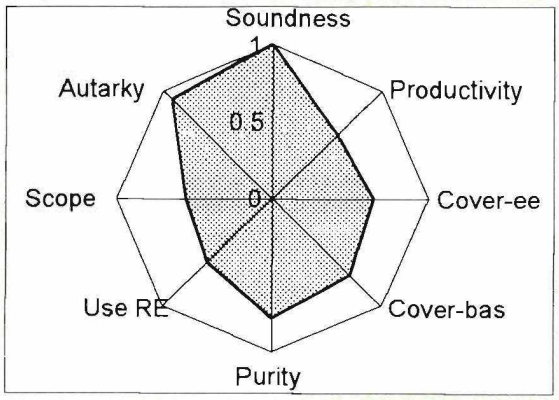
Other examples for appropriate planning can be planning of energy supply installations and procedures, urban transportation and environmental impacts.

The need for the State's *guiding hand* is increasingly being felt as a result of the intensification of links between energy chains in the area of energy production, especially between electricity and natural gas in those countries or economic regions that have, or can gain, access to the latter energy source. Regarding this, coordination and orientation of investment decisions by private and/or players are especially relevant in order to bring microeconomic rationality closer to a sustainable development approach in all of its dimensions.

Energy planning should therefore have a strategic and indicative character and abandon the rigidity inherent to the traditional normative approach. Thus conceived, it is an essential instrument for the formulation of an integrated, flexible, and feasible energy policy, aimed at explicit objectives regarding sustainable development, verifiable by means of quantitative indicators and based on a forecasting of the sector's probable

Chart 5.3: Sustainable development indicators in a country of the region





behavior. For a new formulation of policies, the energy policy that is currently in force must be reviewed, maintaining totally or partially the previously mentioned objectives, incorporating those aspects involving sustainability, and taking into account the entire spectrum of newly available instruments.

The State can considerably facilitate the performance of decentralized and private-sector entities, providing them with a relevant, practical, and up-to-date information system. Within the framework of this *information system,* forecasting of the sector's evolution can be made available to the players.

Today, one has to distinguish between forecasting and political objectives. Forecasting is an estimate whereas the presentation of objectives is a disclosure, so to speak, of priorities and preferences of the government, acting as majority representative of society. Frequently, there is a confusion regarding this aspect not only within the group of external government players but also its internal players. Any forecasting carried out by the government or any other interested party entails a certain amount of wishful thinking or political will. Because of this, the distinction between forecasting and objectives can only be achieved partially. One way of differentiating them is to use different forms and means of presentation.

On the basis of a strictly statistical information system, the State can create, in addition, a system of indicators. Indicator systems are used for various purposes and should therefore be conceived depending on these purposes.

The first chapter presented a system of indicators to characterize the region's countries in terms of overall development and energy development. A system of indicators similar to the one used for the energy portion in Chapter 1 (see Chart 5.3) could serve as the basis for *monitoring the situation and progress* of a country toward sustainable development. Evidently, the system should be adapted to the situation of each country and its principal concerns. This system, with relatively few indicators, can be used for top-level policy monitoring, because it permits assessing the situation in an aggregate and summary fashion.

This same system of indicators could also be applied to forecasting (Chart 5.3.b). Thus, an instrument with the most important implications would become available, with a scenario on the economy, the social situation, the environment, and natural resources in a concise but informative and attractive format.

For other levels and political purposes, the system of indicators should be modified. For example, *the analysis of impacts stemming from a specific policy* would require the corresponding indica-

tors. A rational-use-of-energy policy cannot be monitored on the basis of merely one aggregate indicator; efficiency indicators in different subsectors of industrial production, transportation, public and commercial sector, energy transformation, etc., would also have to be included.

Finally, the State should foster the establishment of indicator systems to assess the social and environmental situation of development, not only to monitor policies but also to enable researchers, scientists, and the public as a whole to examine the situation, its impacts, and inter-relations. Although existing statistics contain a large amount of economic information, provided by the accounting systems of companies and stemming from the statistics of established institutions, the development of statistics is still in its infancy in the area of the environment. The energy sector can contribute to making information available and closing the gap between development indicators at a very decentralized and specialized level to measure the local environmental situation and highly aggregate indicators.

4. Conclusion

The restructuring of the energy sector within each country, the requirement to decentralize, outward energy integration, the challenge of globalization, the multitude of new players participating from within and outside in the countries, the claims for wider participation, enlarged and multidimensional objectives aimed at ensuring sustainable development, and the extension of the range of policy instruments, all of which is evolving in a situation of scarce information and know-how, may seem to be a huge chaos compared to the traditional closed energy system, theoretically governed by central planning.

Nevertheless, it is neither possible nor desirable to return to the conditions prevailing a decade ago. It may be that, in the former situation, it was easier to conduct energy planning. But the real results have not emerged at random. This and the challenge to effectively conduct a policy in current conditions, with a vision toward the future, prevent us from fruitlessly yearning for the past. The new reality has to be confronted.

The present work has dealt with all the aspects mentioned in an orderly fashion, developing a conceptual framework in which each aspect finds its place. The readers, however, should not be misled or government officials seduced into finding new concepts for conducting policy in a directed fashion. This work strives to offer an overview or a broad map, not a master plan.

Most efforts must seek to place the players in their respective space. Because of this, they need freedom to act and also a sufficient dose of supervision. Above all, they need enough human and financial resources, to share responsibility, and locate the treatment in its appropriate context. The State, on the one hand, should mainly organize processes so that the system, which appears chaotic, will adopt a course toward sustainable development. In addition, when guiding, supervising, regulating, and correcting, the State should intervene to favor sustainable development objectives. To do this, it must be informed and provide information to others; it must also be involved in forecasting and planning depending on its needs, systemically and systematically monitoring, promoting, and coordinating.

The ideas described in the present work are open-ended, receptive to further information on the current situation, and are aimed at generating a vision of the future. Visions and forecasting in the shape of desirable scenarios have to be fostered, and research must be carried out on the conditions and actions that are required to achieve a sustainable future for Latin America and the Caribbean, in all of its dimensions.

Situation of Energy Sustainability in LAC

The examples provided below describe the energy situations presented in Table 1.4 and Chart 1.2 (I to IV), showing the sustainability of various countries belonging to the patterns indicated.

Pattern I-A is characterized by its heavy reliance on natural resources (oil), which is also the major source of exports, on which the countries depend. In terms of value, the exploitation of these depletable resources considerably surpasses the level of net investments, so that these countries (Venezuela and Trinidad & Tobago) do not completely compensate for the disinvestment stemming from the use of their natural assets with capital investments of another kind. Their resources, however, enable them to maintain this hardly sustainable accumulation pattern for a relatively long lapse of time. Nevertheless, this development scheme is subject, especially in the case of Venezuela, to price fluctuations on the world market and the conditions of its own hydrocarbons production. Broad coverage has been achieved in domestic energy supply. Renewable resources still account for an insufficient share of the energy mix. Low energy productivity (high intensity) is partially the result of structural problems (due to the industries of intermediate chemical goods and iron and steel). Nevertheless, to the extent that it reflects inefficient energy use, it can end up by being a barrier to the competitiveness of production activities. The level of emissions is high compared to Latin American standards, but medium compared to industrialized countries.

The case of Barbados, which is atypical in Group I-A, is even more atypical in terms of energy sustainability, since it has high productivity and electric power coverage, thus differentiating it from the other countries considered in this and other patterns.

Pattern III-B is represented by Argentina, Brazil, and, albeit with certain biases, Chile and eventually could include Uruguay and Paraguay. This pattern seems relatively well balanced in terms of the economy because of the diversified production structures and/or the large size of the domestic market. But some features of imbalance can be observed, including marked asymmetries in income distribution in Brazil and clear trends of concentration of economic power in Argentina, for which it has not yet been possible to define an indicator. The abundance of natural resources is tapped both for supplying the domestic market and for exports, with a relatively more diversified pattern compared to the subregion (increasingly so) or the rest of the world.

Investments and genuine saving show highly satisfactory levels. In terms of energy, major breakthroughs have been made in ensuring self-supply and even in contributing to exportable surpluses (Argentina and Paraguay). This situation mitigates the vulnerability of the economies to the ups and downs of the hydrocarbons markets. In addition, energy intensity is relatively low.

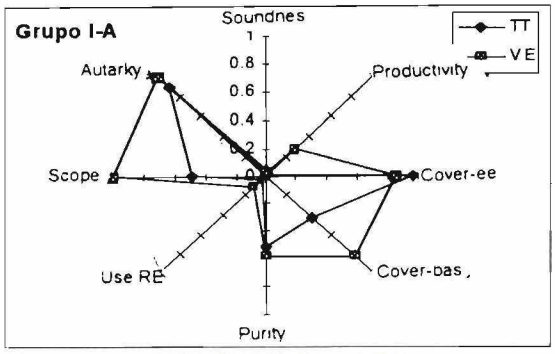
Pattern C is different from A because it has less natural resources and a greater diversification of the economy and export base. In addition, this group is characterized by the level of economic development reached and domestic savings which surpass the depreciations of physical assets and disinvestment (exploitation) of depletable resources.

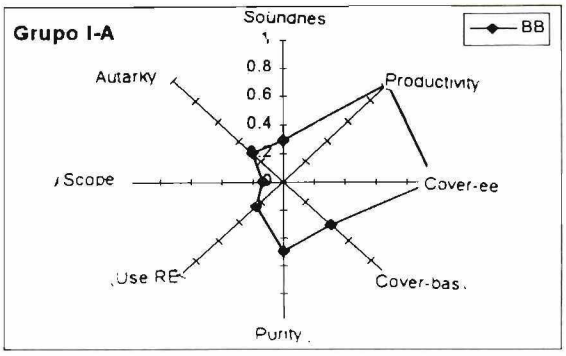
Group II-C is comprised of oil exporting countries that display this development pattern. Because of their greater diversification, these countries are not as affected by changes in world oil markets. In addition, they have higher energy productivity, which grants them greater stability than the countries of Group A.

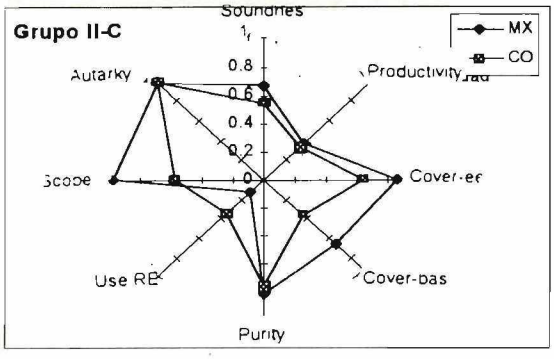
In addition, they have made substantial progress in the coverage of basic energy needs, although at a lower level and, in the case of Colombia, with major shortages. This group also uses renewable energy sources more extensively.

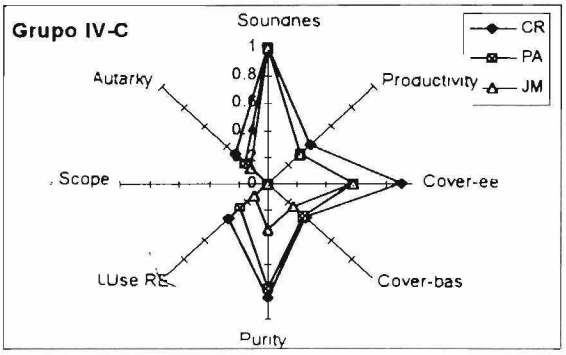
The characteristics of Pattern C are also evident in Costa Rica, Jamaica, and Panama, which constitute *Group IV-C*. Their medium per capita income, relative equality of distribution, and genuine saving are noteworthy. As energy importers, they are different from the Group II-C countries. In contrast to the latter, they are therefore highly affected by changes taking place in the oil markets and they have no fossil energy resource base.

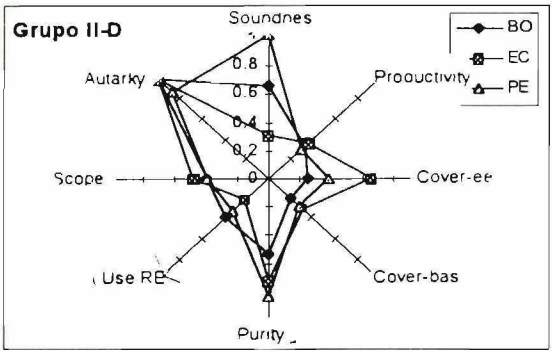
Chart: Development and energy sustainability patterns

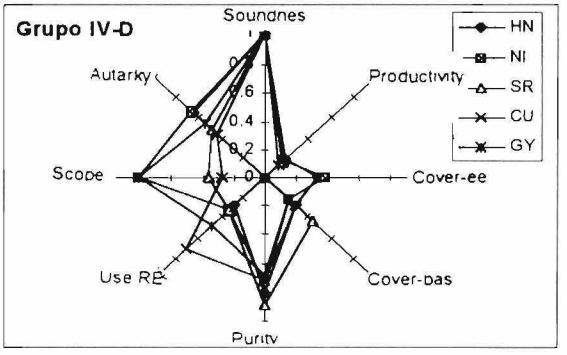


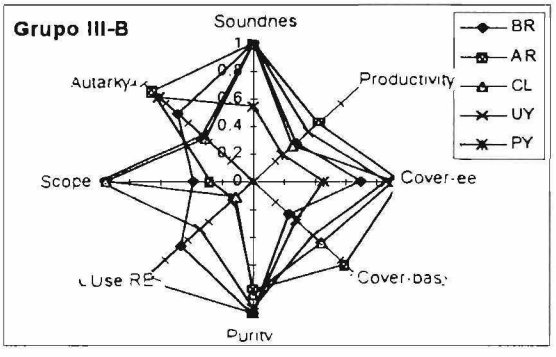


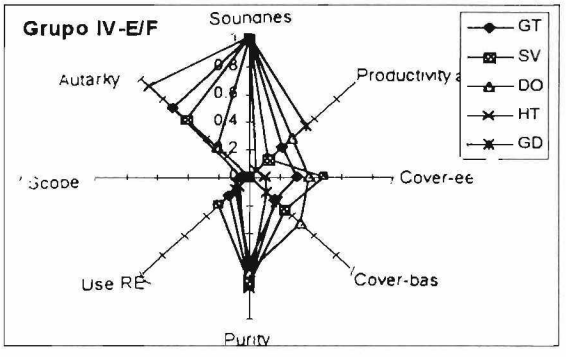












In addition, in the past, these countries applied a very unsustainable approach to the tapping of forest resources. At least in Costa Rica, this approach has improved. The remaining countries show similar values for their energy indicators: major progress in electric power coverage, meeting basic energy needs, and tapping renewables, medium energy productivity in regional terms.

Group II-D shows a relatively high endowment of natural resources, which is the basis for exports or self-supply, slight coordination and/or tapping for overall development, and low genuine saving (Ecuador, Bolivia, and Peru). The importing countries with the pattern of *Group IV-D,* that is, Guyana, Suriname, Nicaragua, and Cuba, display a high dependence on hydrocarbons imports for their domestics supplies, and their development is heavily affected by the price variations of these energy products.

The countries of *Group IV-E,* that is, Guatemala, Honduras, the Dominican Republic, and Grenada, have few natural resources. Their economic development is limited. There are some positive signals, however, coming from genuine saving, which are at relatively higher levels than the savings achieved by the groups of countries included under types A and D. High energy intensity and dependence on imported sources, however, undermine supply security. Electric power coverage is low, and there are major deficiencies (in terms of both quantity and quality) in meeting basic needs. In view of the limited amount of natural resources, the heavy pressure being exerted by the population on these resources (especially forests) is one of the most distressing signals for the sustainability of this development pattern.

The countries of *Group IV-F,* El Salvador and Haiti, have such few natural resources that these resources indeed run the risk of disappearing altogether. Economic development is quite limited (Haiti). El Salvador, however, over the least few years has taken rapid strides toward development and at present may well have overtaken the countries of Group F. As in Group E, there are positive signals coming from genuine saving. In terms of energy, there are no major differences between Groups E and F: high energy intensity, dependence on imported energy sources, and major deficiencies in meeting basic needs. High demographic pressure and extension of the agricultural frontier have led to the virtual disappearance of natural resources.

This characterization of the situation of development sustainability of the different countries of LAC has been carried out, taking into account national average values. Therefore, regional diversity within the countries has not been reflected. This does not mean that it ignores that this diversity, in some cases, is so pronounced that the national average ends up by representing very poorly major social/territorial groups inside the country. This occurs especially in those countries where economic and social asymmetries correspond to territorial asymmetries. Thus, for example, a large part of the population of northeastern Brazil displays a situation which, both for the present and the future, is not too far from that of Group E. The prevalence of the central, southeastern, and southern regions of Brazil in national averages, however, has determined the country's classification under pattern B.

In calculating averages, lifestyles and forms of organizing production that are highly different within one single country are mixed. It is clear that these lifestyles depend on both the natural conditions of the region where the population is located and the opportunities that arise from, or are generated through, local economic and social institutions. At the same time, these lifestyles and living qualities are highly diverse, depending on their association to different ethnic groups and social classes.

Technical and Methodological Notes

A. General Sustainability Indicators

a. Definitions, calculations, and standardization by sector

1. Per capita GDP

The 1993 real per capita GDP, in U.S. dollars transformed according to purchasing power parities (PPP), United Nations sources (UNDP, *Human Development Report,* 1994 and 1995), and the World Bank (*World Development Report, 1995),* was used here.

Standardization was linear, taking the absolute minimum of US$100 as unsustainable (= 0) and US$10,000 as sustainable (= 1).

2. Income distribution

The Gini index is not directly applicable here because it is an inequality coefficient and therefore it correlates negatively with sustainability. With data available from ECLAC (*Social Panorama,* 1994) and additional information from the Project's case studies, an equality index was built for the year 1992, correlating the area below the Lorenz distribution curve with the area below the equitable distribution line.

Standardization was linear, with the coefficient of 0.2 considered unsustainable (= 0) and the coefficient of 0.8 sustainable (= 1).

3. Genuine saving

3.1 Definition and calculation

The concept of genuine saving is relatively recent, and a more in-depth explanation of the indicator used and a discussion of its application to LAC countries seem appropriate.

As defined in recent literature, especially from the World Bank's Environmentally Sustainable Development (ESD) Vice Presidency (see the presentation by Ismail Serageldin, "Monitoring Environmental Progress (MEP)" in the *Third Annual World Bank Conference on Environmentally Sustainable Development*; the paper "Global Approach to Environmental Analyses (GAEA);" and K. Hamilton, "Genuine Saving in Developing Countries," all published in 1995), the notion of genuine saving is aimed at reflecting the magnitude of the net investment fund that is based on domestic efforts and represents a variation of total social capital.

The latter is comprised of the sum of the values of produced assets (man-made capital), natural capital, and human capital. Therefore, the quantification of genuine saving should reflect the annual variations (positive or negative) of these three components of total capital, as a result of the corresponding net annual flows in a given socioeconomic space (country or region).

This concept reflects the weak sustainability approach demanded by the additivity and substitutability of all forms of capital, highly criticized by many environmentalists. The approach seems valid as a first estimate and, above all, because of its result in the shape of an indicator that highlights an important fact: what the countries of the region are saving on average is not enough for their future development.

This approach will have to be complemented by identifying where sustainability has already been lost with respect to a given dimension, where minimum limits are already being reached, and up to what point disinvestment and substitution should not be permitted (strong sustainability).

Traditional national accounts contain a quantification of net domestic investment, which represents the variation of produced assets, deducting the annual depreciation of gross domestic investment. To valuate total capital variations, the variation of natural capital and human capital has to be calculated, a task that turns out to be far more complex.

The World Bank's ESD Vice Presidency uses shortcut methods to obtain the two most important elements of the variation of natural capital: depletion due to the exploitation of natural resources and degradation of the environment due to emissions. Extraction of natural assets (or assets sales) valued at a current price (50% of the price on the

world market of the respective product) was used for the depletion part whereas a value of US$20 per ton of CO2 emission was used as a proxy value for the negative impact on water, land, and air.

By discounting net domestic investment due to depletion and degradation, one obtains genuine saving without investment in human capital.

The investment in human capital varies according to preliminary estimates from the World Bank itself between 2% and 9% of GDP (Hamilton, page 16). By adding this investment, one obtains genuine saving.

The present work uses, as the basis for the respective indicator, the estimates of the World Bank and its collaborators (Hamilton) for the region's countries. This is genuine saving without investment in human capital, because there are no general estimates for this investment as yet.

Average genuine saving was calculated from 1986 and 1991, and the countries were classified by sustainability level according to their genuine saving rates:

Sustainability of the genuine saving rate/GDP:

high (0.9)	=	about 10% and higher
medium high (0.7)	=	about 5%
medium low (0.5)	=	about 0%
low (0.3)	=	about -5%
very low (0.1)	=	less than -10%

3.2 Discussion

The concept of genuine saving and its calculation are somewhat new, since they show distressing variations of total capital in Latin America. The estimate is still preliminary. Nevertheless, even if the calculation were to be refined, the result for the region would be similar. The average genuine saving for the region has turned out to be very unsatisfactory over the last 15 years and far below, for example, the genuine saving of newly industrialized and developing countries in the Far East.

When estimating genuine saving, the investment in human capital has to be taken into account. Nevertheless, this investment continues to be weak in many countries of the region; thus, genuine saving, including investment in human capital, will not show a relatively better picture.

There are many reasons for this situation. Depreciation and depletion due to the exploitation of natural resources seem to be important factors, although in reality only exploitation is relatively more significant than in other developing regions. The crucial reasons, however, can usually be found in other areas, indicated above in the calculation of national accounts: relatively low savings and the obligations stemming from external debt repayments, that is, the net negative payment to external factors.

In order to develop and refine the concept of genuine saving in the future, several modifications, in addition to the ones mentioned below (identification of minimum thresholds, even investment in human resources), are being proposed. First, reappraisal of fossil reserves, highly frequent as a result of exploration activities, as capital additions will have to be considered. Second, the genuine saving approach should incorporate more thoroughly world environmental degradation. These modifications would enable the calculation to provide a relatively better picture of the region.

Regarding the environment, it can be said that the overall natural assets of humankind are comprised of two parts: one is made up of those elements that are appropriate for the nation and the other is made up of natural capital that is commonly owned by the planet.

Since the notion of genuine saving is defined in the above-mentioned literature at the country or regional level, that variation (net flow) corresponding to natural capital, if it is to be compatible with the others, should refer to that part of the capital that belongs exclusively to each nation. The previous calculations used to take into account the impacts (variations) on commonly owned natural capital (for example, the atmosphere or international waters) and external impacts (elements of natural capital or actions or a country that indirectly lead to benefits or damages to other countries) within the calculation of

genuine saving may lead to severe distortions, especially between countries or regions.

These distortions are conceptually independent of the problems linked to the valuation of impacts on the natural environment.

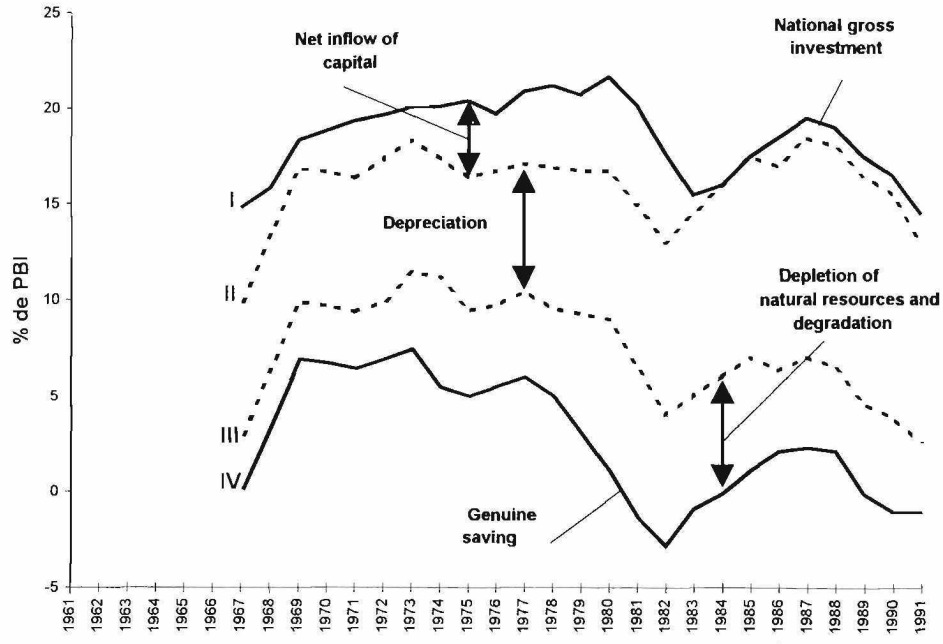
The problem is relevant for net variations linked to natural capital by the degradation of the remaining elements of the environment, since some impacts on the natural capital that is viewed as commonly owned by the planet (for example, greenhouse gases) are incorporated into it. To validate the above-mentioned comparisons of the genuine saving indicator, there are difficulties not only if a partial consideration of these impacts is included but also if they are totally ignored, considering only the impacts on the local (national) environment.

One way of dealing with the impacts on assets commonly owned by the world and the above-mentioned external effects within the concept of genuine saving to enable valid comparisons between countries or regions to be made is to resort to a system of compensations.

These compensations should be viewed as debts by those countries that cause an above-average degradation of the commonly owned environment payable to those countries that are responsible for a below-average degradation and by those countries that produce impacts that indirectly damage the natural capital belonging to other countries. This approach would still be valid even if quantitative thresholds were imposed on these impacts. It is clear that, in the first case, the compensations for these debts should be calculated on the basis of the average magnitude of the impact and not in incremental terms. Even then, compensations for cumulative historical impacts up to the present would not be incorporated into this calculation.

Beyond the discussion on how to best calculate these compensations, their consideration within the concept of genuine saving would imply financial flows from the industrialized countries to those belonging to the developing world. Thus, the relative ranking of the evolution of genuine saving of some countries (for, example LAC) and others (industrialized countries or regions) would be different. With the incorporation of these consider-

Chart A: Genuine saving



On the basis of data from the World Bank's Environmentally Sustainable Development Vice Presidency

Table A: Macroeconomic sustainability

Code	Country	Economy (real per capita GDP)	Equity (income distribution)	Genuine Saving	Resources (per capita natural capital)
AR	Argentina	0.885		0.600	0.829
BB	Barbados	0.966			0.558
BO	Bolivia	0.233	0.683	0.050	0.723
BR	Brazil	0.519	0.385	0.900	0.748
CO	Colombia	0.543	0.552	0.600	0.662
CR	Costa Rica	0.543	0.626	0.900	0.640
CU	Cuba	0.335			0.670
CL	Chile	0.839	0.498	0.600	0.775
EC	Ecuador	0.429		0.100	0.639
SV	El Salvador	0.217	0.568		0.477
GR	Grenada	0.376			0.506
GT	Guatemala	0.326	0.436	0.300	0.559
GY	Guyana	0.172		0.050	0.852
HT	Haiti	0.096		0.600	0.398
HN	Honduras	0.192	0.445	0.500	0.579
JM	Jamaica	0.313	0.694	0.100	0.766
MX	Mexico	0.727	0.562	0.500	0.707
NI	Nicaragua	0.272			0.602
PA	Panama	0.556	0.469	0.700	0.688
PY	Paraguay	0.332		0.500	0.719
PE	Peru	0.323	0.638	0.100	0.682
DO	Dominican Rep.	0.321	0.568	0.900	0.531
SR	Suriname	0.367		0.500	0.948
TT	Trinidad & Tobago	0.976		0.100	0.671
UY	Uruguay	0.603			0.738
VE	Venezuela	0.851	0.656	0.100	0.748
United States		1.000	0.744		0.869
Canada		1.000	0.788		0.985
Germany		1.000	0.810		0.743
United Kingdom		1.000	0.709		0.693
France		1.000	0.771		0.768
Italy		1.000	0.801		0.713
Spain		1.000	0.893		0.763
Australia		1.000	0.738		1.000
Japan		1.000	0.883		0.697
South Korea		0.924	0.806		0.576
China		0.187	0.772		0.472
India		0.114	0.843		0.464
Standardization		Original			
0.00		$100	0.2	<- 50%	0
0.50		$5,050	0.5	+/- 0%	771
1.00		$10,000	0.8	>+15%	594650

ations, the genuine saving curve displayed in the chart would shift upward and would therefore probably not show the negative values observed between 1979 and 1983 or between 1989 and 1991.

4. Per capita natural capital

For this indicator, data from the World Bank's Environmentally Sustainable Development (ESD) Vice Presidency, discussed in the paper *Monitoring Environmental Progress (MEP)* and published in the document *Global Approach to Environmental Analysis* in 1995.

It is an estimate of the commercial value of natural resources, including land. Land was valued using multiples of per capita income of the respective land (classified by land type according to FAO), whereas forest and subsoil assets were calculated on the basis of 50% of the world market price.

As in the case of genuine saving, the calculation of per capita natural capital involves only a preliminary estimate. The deepest critique focuses on the commercial valuation of natural capital, which ignores everything that is not at present appraised in terms of market prices or in terms of its exploitation for the purpose of creating income. Likewise, scarce consideration is given to the biodiversity of the natural forests and their value as sinks for CO_2, etc.

Table B: Sustainability indicators in energy terms

	Indicator	Definition	Source of data	Standardization
1.	Energy autarky	Share of imports in total imports and primary production, 1994	OLADE-SIEE, project cal-culations	0 = 100% 1 = 0% without standardization
2.	Soundness in the face of external changes	Share of energy exports in GDP, 1994 (BOE/ US$(1980))	OLADE-SIEE, project calculations	0 = 14 BOE/US$1,000 1 = 1 BOE/US$1,000 linear standardization
3.	Energy productivity	Inverse of GDP energy intensity, 1994 (GDP/BOE)	OLADE-SIEE, project calculations	0 = 0 US$/BOE 1 = 1,000 US$/BOE without standardization
4.	Electric power coverage	Percentage of households with electric power supply, 1989	World Bank/OLADE 1991	0 = 0% 1 = 100% without standardization
5.	Coverage of basic energy needs	Residential useful energy consumption, 1994 (BOE/inhab)	OLADE-SIEE, project calculations	0 = 0 BOE/capita 1 = 1 BOE/capita without standardization
6.	Relative purity of energy use	CO2/energy consumption, 1994	OLADE-SIEE, project calculations	0 = >= 1 t/BOE 1 = <= 0.3 t/BOE linear standardization
7.	Use of renewables	Share of renewables in energy supply, 1994	OLADE-SIEE, project calculations	0 = 0% 1 = >= 50% linear standardization
8.	Scope (durability over time) of fossil resources and firewood	Ratio between production and fossil resources (R/P); and rate of deforestation, 1994	OLADE-SIEE, project calculations	0 = 0 years; >=1% 1 = 25 years; <=0% linear standardization

In the present work, standardization was non-linear. A minimum value of US$100 was considered unsustainable (= 0), a value of about US$800 moderately sustainable (= 0.5), and a value of US$21,000 highly sustainable (= 0.75).

b. Results

Table A presents the degrees of sustainability calculated for the region's countries and other selected countries.

B. Sustainability Indicators from the Energy Viewpoint

a. Definitions

1, 2, and 8. Autarky, soundness, and scope

The indicators of autarky and soundness constitute, so to speak, a set. They represent the dependencies and vulnerabilities of national economies due to external factors. The first indicator points to the fragile economic sustainability of energy-importing countries; the second highlights the vulnerability of economies that are highly dependent on their energy exports. The indicators of autarky and scope (durability over time of fossil resources and firewood) constitute another group, since they mutually enhance each other. With a broad scope of resources, autarky is worth even more, in terms of sustainability. That is why the two indicators are placed together.

3. Productivity

This indicator is the inverse of the usual energy intensity indicator. The concept has a more normative connotation than that of energy intensity and seems more suitable for the sustainable development framework. It is positively correlated

Table C: Energy sustainability indicators

	Economy			Equity		Resources and Environment		
	Autarky	Soundness	Productivity	Electric power coverage	Coverage of basic needs	Purity	Use of renewables	Scope (durability)
TT	0.886	0.041	0.018	0.97	0.428	0.515	0.03	0.482
BB	0.289	0.289	0.958	0.98	0.437	0.503	0.253	0.128
AR	0.924	1	0.6	0.95	0.855	0.779	0.171	0.273
VE	1	0.026	0.27	0.85	0.837	0.587	0.117	1
CL	0.449	1	0.37	0.91	0.638	0.811	0.161	0.955
MX	0.956	0.654	0.35	0.86	0.66	0.818	0.116	0.963
UY	0.464	1	0.5	0.87	0.55	0.907	0.488	1
PA	0.215	1	0.31	0.58	0.349	0.787	0.258	0
CO	0.965	0.541	0.33	0.64	0.358	0.763	0.339	0.576
CR	0.307	1	0.4	0.9	0.356	0.848	0.383	0
BR	0.689	1	0.4	0.7	0.322	0.952	0.654	0.388
EC	0.98	0.304	0.36	0.65	0.301	0.721	0.214	0.473
GD	0	1	0.51	s/d	0.257	0.61	0.12	0
SR	0.475	1	0.15	s/d	0.421	0.896	0.321	0.364
CU	0.438	1	0.15	s/d	0.277	0.719	0.703	0.272
PY	0.87	0.545	0.27	0.46	0.402	0.947	1	0
GT	0.693	1	0.3	0.31	0.233	0.764	0.191	0.052
PE	0.856	1	0.29	0.38	0.279	0.823	0.316	0.386
DO	0.294	1	0.4	0.38	0.458	0.684	0.131	0
JM	0.165	1	0.31	0.58	0.238	0.343	0.128	0
NI	0.66	1	0.17	0.38	0.213	0.738	0.32	0.8
BO	0.984	0.654	0.31	0.25	0.192	0.531	0.393	0.393
SV	0.584	1	0.18	0.48	0.331	0.759	0.282	0
HN	0.651	1	0.19	0.34	0.284	0.808	0.287	0
GY	0.531	1	0.12	s/d	0.22	0.682	0.477	0.8
HT	0.921	1	0.07	0.1	0.157	0.795	0.098	0

with a higher degree of sustainability. High energy productivity means that more GDP is produced per energy unit consumed.

In addition to its unusual version, this indicator has to be interpreted with great caution; it does not necessarily indicate energy efficiency. The structural impacts, among others, have to be taken into account (the weight of energy-intensive industries), as well as informal sector accounting of the respective economy, conversion effects in a common currency, and the calculation of real GDP.

4. Electric power coverage

Unfortunately, there are no updated data for all the countries from one single source. A major effort would be needed to build an up-to-date data base.

5. Coverage of basic needs

Consumption of useful energy was based on data from OLADE's Energy-Economic Information System (SIEE), applying transformation efficiencies of final energy delivered in useful energy for each energy product: electricity (0.8), LPG (0.4), gasoline, kerosene, diesel, fuel oil (0.35), natural gas, other gases (0.5), coal (0.2), firewood, charcoal (0.1), and other primary products (0.07).

6. Environmental purity

Standardization enables the scale to be inverted: a level of 1 ton of CO2 emissions per BOE of energy consumption is considered unsustainable, whereas a value of 0.3 ton per BOE, almost attained by some countries, seems to be sustainable.

7. Use of renewables

The renewable energy sources considered were: hydroenergy, geothermal energy, sugar cane products, and other primary sources (as defined by OLADE's SIEE). As long as deforestation

remains at unsustainable levels, firewood is considered, along with fossil resources, as a nonrenewable energy source (indicator No. 18).

8. Scope of fossil resources and firewood

The indicator is built weighting these variables by the relative share of each energy product in the production of primary energy. Firewood was included with fossil resources to highlight the degradation of forest resources in those countries with a high share of firewood in domestic supply.

Those countries that have no fossil energy reserves and that reported, in the past, a deforestation rate of over 1% are assigned a value of 0 in terms of sustainability. Because of this, the countries type F, E, and C.b (Central America and the Caribbean islands) tend to display low scope levels.

b. Results

Table C presents the values by country.

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