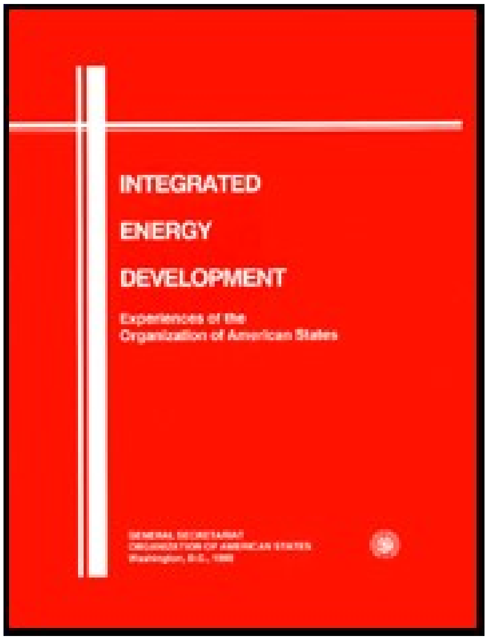
Integrated Energy Development - Experiences of the Organization of American States



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GENERAL SECRETARIAT ORGANIZATION OF AMERICAN STATES

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Preface

While today's low oil prices have reduced the sense of urgency surrounding energy issues, most development practitioners realize that the current calm is neither the end of energy problems in developing countries nor are these low prices likely to continue indefinitely. Instead, it is the ideal time to reflect on recent experiences, evaluating both successes and failures with an eye toward preparing for the future.

This document is intended for development and energy planners in the OAS member states, international agencies and elsewhere. We hope that the lessons which the Department of Regional Development (DRD) has learned through programs in integrated energy development can be beneficial to others.

Recent analyses of the energy situation in developing countries point to a similar need in future energy planning:

> "The energy planning process of a developing country should integrate socio-economic development (determined by economic, industrial, financial, political and demographic conditions) with market pricing of energy supply and use, environmental impacts and its institutional structure."[1]
>
> > [1] John E. Gray, et al., *Energy Supply and Use in Developing Countries: A Fresh Look at Western (OECD) Interests and U.S. Policy Options,* The Atlantic Council, 1986, pp. 12-13.
>
> "International assistance organizations must start thinking in terms of country development strategies-not in terms of enhancing forests, crops or energy alone."[2]
>
> > [2] Mohamed T. El-Ashry, "Resource Management and Development in Africa," *Journal '86,* World Resources Institute, p. 12.

Over the past seven years, the OAS/DRD has followed a path similar to that suggested by the two commentators-integrating energy planning into overall development planning. Contrary to the traditional supply-side view of energy, this approach has a demand orientation, examining energy not as an independent sector but as one component of socio-economic development, necessary and complementary to all others.

The following map shows the countries in which OAS/DRD energy activities have taken place. As the list demonstrates, the scope of these energy-related projects has been as distinct as the countries served - from Human Settlements in the small states of the Caribbean, to Energy and Transportation in Colombia, to Energy Regionalization in Bolivia. In the text that follows, a conceptual framework of the department's approach to integrated energy development will be presented, based less on models and methodologies than on a compendium of real world experiences gained from these programs. Throughout the text, illustrative facets of various programs will be highlighted in separate boxes, called Case Highlights. These Case Highlights do not attempt to capsulize large, multi-faceted regional development programs. Instead, they extract a specific component from a program in order to shed light on the topic discussed in the text.

KIRK P. RODGERS
DIRECTOR
DEPARTMENT OF REGIONAL DEVELOPMENT
ORGANIZATION OF AMERICAN STATES

ENERGY AND ENERGY RELATED PROGRAMS - DEPARTMENT OF REGIONAL DEVELOPMENT, 1982-1987 ORGANIZATION OF AMERICAN STATES

Acknowledgments

The scope of integrated technical assistance as performed by the Department of Regional Development of the Organization of American States is so broad and touches so many individuals that it is truly impossible to acknowledge the entire range of participants in the development of the ideas and programs presented in this report.

Of special importance, however, we wish to acknowledge the international and national project directors of the programs of technical assistance that are shown on the map on the preceding page who, through their day-by-day dedication to the projects in the specific OAS member countries, gave concrete credence to the ideas presented in this report.

The text of the report was prepared jointly by Michele L. McNabb, consultant to the OAS, and by Dr. Wayne R. Park, Senior Energy Specialist to the Department of Regional Development. The authors wish to acknowledge the support of Dr. Arthur Heyman, who helped to generate ideas of integrated energy development, and of the entire staff of the Department of Regional Development, who reviewed the report with care and insight.

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Energía en el Desarrollo Regional
de la Zona Fronteriza, República Dominicana
Energía y
Transporte,
El Salvador
Energía y Alimentos,
Costa Rica
Proyecto de Energía para Asentamientos Humanos
• Barbados
• Dominica
• Grenada
• Antigua y Barbuda
• Santa Lucía
• Suriname
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Producción de Alimentos y Energía
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Bolivia
Componentes Energéticos de los
Programas de Desarrollo Regional en:
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• Provincias Altas de Arequipa, Perú
• Cuenca del Amazonas, Bolivia
• Gran Chaco, Paraguay
• Región Sur, Argentina
Energía en el Transporte en
Uruguay
Energía y Desarrollo Regional,
Uruguay

1. What is integrated energy development?

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[Demand orientation](#)
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Introduction

As a result of the turbulent decade of the 1970s, the critical role that energy plays in virtually all human activities has been widely acknowledged. Without a reliable and affordable source of energy, governments, institutions and individuals realized that everyday activities and future aspirations could be difficult or even impossible to accomplish. Of course, the issue was not new; the importance of energy in improving human welfare has been long-recognized by planners, especially those in poor or poorly-resource-endowed countries.

In the flurry of activities in the energy sector during the 70s, as many new approaches as new problems were identified. Energy issues (and energy specialists) emerged everywhere, some focusing on specific "new" technologies-photovoltaics, wind, synthetic fuels; others taking a sectoral approach-the role of energy in agriculture, utilization of forest resources, and literally dozens more. Energy problems frequently were magnified in developing countries because of a lack of resources, both natural and financial, so that many of these new ideas came to bear on the Third World.

With 15 years of experience in integrated regional development activities in Latin America and the Caribbean, the Department of Regional Development (DRD) of the Economic and Social Secretariat of the Organization of American States (OAS) had been well aware of the importance of energy in development planning. When the 31 member states of the OAS General Secretariat mandated an intensified emphasis on the energy sector in 1979, the DRD was assigned this responsibility.

In addition to regular technical cooperation activities requested by member countries and multi-lateral energy programs coordinated with other development agencies, the OAS established a plurinational program in energy called the Integrated Energy Program for Economic and Social Development. Drawing on the department's philosophy of integrated regional development planning, the method that has evolved for energy development has been distinct from, although often complementary to, the numerous approaches that were initiated in the 1970s.

Instead of defining a specific sector or a single technology as a priority, the DRD has viewed energy as one component in development, albeit a catalytic one. The emphasis centers not on supplying energy or on providing a new technology; instead, it analyzes how energy relates to the development process, searching for ways that these interconnections can be strengthened to promote economic and social development.

This methodology, integrating improved energy inputs with other components of development, results in **synergism.** In other words, separate inputs, acting simultaneously and in coordination, can have a greater total effect than the sum of the individual components. The concept of synergism is central to the integrated energy development approach. This report will attempt to define the synergism which integrated energy development projects strive to create.

Before beginning the discussion of the various facets of integrated energy development, the results of one such project are presented. This project, part of the Bolivian Energy Regionalization program, captures the essence of synergy within integrated energy development (see Case Highlight 1).

As described in the case of Monteagudo, integrated energy development projects go beyond the traditional supply-side approach to energy development. Simply improving the supply of energy to an underdeveloped area like Monteagudo can enhance the quality of life of the residents, providing more hours of electricity per day for lighting and home appliances, for example. But, when improvements in the energy supply are combined with the introduction of economically productive activities, contributions to both improved quality of life and economic development can be made. Identifying opportunities to use energy as a catalytic force to bring about both social and economic development is the underlying goal of the integrated energy development approach.

Case Highlight 1

Synergism, the Integration of Energy and Development: Monteagudo, Bolivia

Monteagudo, the provincial capital of Hernando Siles Province, Chuquisaca Department in southern Bolivia, exemplifies the energy/development problems and opportunities facing many remote areas of Latin America.

The area is rich in natural resources, with a hydroelectric potential, developed natural gas wells, and good arable land. Yet the hydro potential is untapped, pipelines carry all of the natural gas produced out of the region (mainly for export from the country) and very little income is generated from agriculture.

The 6000 residents of Monteagudo have virtually no services. A small diesel generator operates only occasionally, due to high costs of diesel and demand levels limited to domestic lighting. The majority of the people of the province are farmers, raising livestock and crops, and some agricultural products are exported to other towns in the department. Extremely poor roads result in extensive losses on the raw produce and live animals during transportation, rendering little economic return for the farmers.

The technical assistance project team recognized that agroindustrial activities were the key for Monteagudo's continued development. Processing locally grown goods could transform the region's basically subsistence-level farming into a high-value-added economic activity, producing goods with a high value-to-weight ratio and reduced perishability. At the same time, it was recognized that any industrial activity would require a reliable, reasonably priced source of energy. The nature of Monteagudo's underdevelopment problems, common to many regions in the developing world, is evident: potential economic activities would not commence without a reliable and reasonably priced energy supply, yet without increased levels of demand generated by productive activities, new energy supplies could not be justified.

If viewed from a supply-side approach, the existing diesel system basically met the current minimal demand, limited mainly to a few hours of household electricity in the evenings. But if viewed from an integrated energy development perspective, the provision of a larger-scale, reliable energy source *in coordination* with new agroindustrial activities could spur economic and social development in Monteagudo and surrounding areas.

With this approach in mind, an integrated development plan was outlined. Agroindustrial plants for slaughtering and processing meats, producing orange juice concentrate and processing vegetable oil appeared viable with local resources, given an upgraded supply of energy. In turn, the large amount of base-load electricity demanded by such activities would lower energy costs for both commercial and domestic users.

Grid extension and upgrading the diesel system were evaluated, but the extension of the natural gas pipeline 30 km to Monteagudo proved most economical, given the projected levels of demand generated by the new processing plants. The project suggested the construction of a gas-driven cogeneration system and a water treatment plant and pumping station, and the addition of a 10-truck fleet to transport the finished products to market. Potential economic and social benefits for the residents of Monteagudo are numerous. The high levels of electricity and water demanded by the new industrial activities would lower the costs and improve the reliability of both crucial services for the town of Monteagudo. In addition to the benefits to farmers, nearly 100 jobs would be created.

Demand orientation

The emphasis on the demand side of the energy equation is essential in integrated energy development. Traditionally, energy companies worldwide, both public and private, receive projections of demand, and attempt to supply these needs. Energy infrastructure - power plants, transmission systems, refineries, etc. - is built; demand is often met.

Under this traditional, supply-side approach, significant inroads have been made throughout Latin America and the Caribbean. Strong, permanent organizations like national electric companies and national oil companies have acquired the technical and institutional capacity to deliver energy to a large percentage of the residents of the region. Energy planning institutions, working parallel to energy supply companies, effectively prepare nationwide energy balances of current and future energy needs.

Yet this traditional, sectoral approach has caused imbalances in energy development. Some areas, especially urban or industrial centers, have access to energy sources at an acceptable quality and price, while many isolated areas are denied this access. Likewise, numerous existing opportunities for improving the overall energy situation, in areas such as transportation, alternative energy development, energy conservation, etc., are neglected because they are not within the traditional spheres of activity of existing institutions. A strictly sectoral approach to energy has difficulty identifying energy development opportunities outside of the conventional areas of action.

By contrast, the integrated energy development approach views energy not as a static good to be estimated and supplied, but as a dynamic input capable of catalyzing economic and social development. Through these means, integrated energy development attempts to incorporate the geographic and subject areas excluded under traditional energy and development planning. The supply-side approach compounds centralization, one of the most pervasive issues in Latin America and in many developing countries. Traditional energy development, by its very nature, encourages centralization.

Centralization allows for organization and management on a national level, which has its advantages and drawbacks. On the positive side, a centralized system for supplying energy lowers unit costs and improves reliability. For example, grid extensions usually provide electricity at far lower costs than small, isolated systems; building many small natural gas pipelines to reach peripheral areas is much more expensive than constructing major pipelines to urban or industrial areas; costs of petroleum products, whether transported by pipeline, truck, rail, boat or animal, depend on distances and surface infrastructure-again encouraging supply to demand centers.

Despite a government's desire to provide an affordable source of energy to all citizens, economic realities often force difficult choices between areas for allocation of scarce resources. Priority is logically placed on satisfying the needs of the largest number of people. Areas with a large population and a developed demand can be supplied with energy at a reasonable price, due to strong economies of scale prevalent in traditional energy sources. In sparsely populated rural areas, on the other hand, the following economic obstacles discourage energy extension:

- the high fixed costs of building the energy infrastructure to reach isolated rural areas;
- the high marginal costs of supplying energy to areas with low load factors;
- the lack of economic resources of the rural poor to pay high energy tariffs.

The current moderation of petroleum prices does not eliminate these economic obstacles; instead they are being compounded by the extremely poor financial conditions of national energy institutions throughout Latin America.

The supply-side approach looks for the least-cost means to overcome these obstacles in isolated rural areas. Grid extension vs. diesel power generation is inevitably weighed; perhaps small-scale hydro or wind potentials are analyzed. Regardless of the system which is identified as having lowest costs, for many remote areas in Latin America and the Caribbean even these costs are exorbitant due to limited demand levels and geographical isolation.

These negative cost aspects have become especially evident in rural electrification projects. Low demand levels, difficult terrain and long distances mean isolated rural areas are the last priority for electrification. Basic electricity economics encourage provision of energy to easily accessible areas with relatively high demands. Patterns of electrification show a progression from centers of population to the periphery. For most countries, budgetary limits are reached before the national territory is electrified.

If a political priority has been placed on nationwide electrification, plans might proceed despite the enormous drain placed on the entire economy. In countries that decide to follow the developed world's model of nationwide electrification regardless of economics, load factors remain low in underdeveloped areas. Demand is often limited to a few hours of household lighting nightly, as in Monteagudo. While this makes some contribution to an improved quality of life for the residents, it brings, at best, only negligible economic development.

This centralized, supply-side approach views energy as simply one of the infrastructural components necessary before productive activities commence - much like roads and bridges. Under the infrastructural approach, national electricity companies provide energy based on existing or forecasted demand figures.

This can bring significant economic gains to the recipients with the previously unmet demand, but in areas with little existing need for electricity, energy does not necessarily catalyze new economic development. These projects have neglected to simultaneously promote economically based activities, which can increase demand, lower unit costs and, ultimately, result in socio-economic development.

A conventional alternative to extending the grid to rural areas has been to install small diesel generators. National electric companies often provide diesel systems, sometimes charging uniform national electricity tariffs for the energy supplied and increasing unit costs for electricity nationwide; in other cases, passing to the local community the responsibility for securing diesel, operating the system, and setting tariffs. Under either situation, fuel and/or electricity costs are too high for many rural residents and the system runs only a few hours a day. On the average, diesel-generated electricity costs between two and seven times more than grid electricity, even with today's lower fuel prices. Breakdowns are frequent; unreliable energy supplies discourage new economic activities.

While small-scale diesel power generation does provide an example of a decentralized approach to supplying energy to rural areas, the deficiencies are numerous. The reliance on petroleum-based fuels, to meet other energy needs as well as power generation, results from a "petroleum mentality." Despite difficult access, high costs and unreliable supplies, many isolated rural communities rely on petroleum products, frequently neglecting alternative energy sources that exist locally.

The institutions supplying energy do not have the authority or responsibility to attempt to influence demand except by encouraging conservation, nor do they have extensive experience in implementing small-scale energy projects in rural areas based on local resources. Historically, energy organizations have operated on a subsectoral basis (petroleum, power/hydroelectricity, etc.) and their responsibility has focused on planning and implementing large scale, centralized projects. The various energy supply organizations have had little basis for cooperation among themselves or with regional and national planning agencies. For these reasons, opportunities for demand generation and small-scale indigenous resource use at the local level are often neglected.

The circular nature of the problems resulting from the supply-side approach becomes obvious: an area lacking economic development - and therefore energy demand - is a very low priority for energy suppliers, yet the very absence of energy is one of the key factors retarding economic development.

On the other hand, the integrated energy development approach looks for interconnections between improving energy supplies and increasing development opportunities. As the Monteagudo example illustrates, the increased agroindustrial activities justified the introduction of a new supply of energy, simultaneously catalyzing development opportunities that might otherwise have remained dormant. Increased demand for energy will lower unit costs, potentially enticing additional productive operations and continuing to improve the quality of life for the residents of the area. Instead of continuing the lack-of-development-lack-of-energy cycle, integrated energy projects can promote a sustainable and progressively higher level of socio-economic development.

Another weakness in a supply-side approach is the "technology focus." The search for areas to apply a solar collector, a biogas digester or a minihydro center, etc. - whether due to a vested interest or merely a strong belief in the merits of a particular technology - often overlooks opportunities to solve development problems by some more appropriate approach. A technology should be supplied on the basis on development needs, not vice versa. The integrated energy development approach begins with the matching of the development needs and opportunities with the available energy resources and then searching for the most appropriate technology.

Similarly, the integrated energy development focus does not carry any generalized notions about which type of energy supply is preferable. Despite the popularity of non-traditional "new" energy technologies, conventional energy supplies can still be the best choice in some circumstances. At the same time, new and renewable energy sources, including biomass, hydro, geothermal, wind and solar, have appeared frequently as components of integrated energy development projects, especially those in isolated rural areas. This results not from a bias against conventional energy, but from four characteristics which favor renewable energy common in these areas: 1) low population density and long distances between demand centers; 2) extremely difficult physiography; 3) the abundance of these non-conventional resources; 4) the increased labor generation from the use of local energy resources.

When international oil prices were increasing rapidly, the replacement of imported petroleum products with alternative fuels became a priority for energy planning. The precipitous drop in oil prices has pushed import substitution out of the spotlight. Because the integrated energy development approach is technology-neutral and does not consider petroleum import substitution a primary aim, the need for integrated energy development programs has not abated with lower oil prices. The constant goal is to provide a reliable and affordable energy source to meet productive needs in isolated regions or to expose the interconnections between energy and an important economic sector promoting integrated planning.

Energy balances, the centerpiece of traditional energy planning, become only one factor in the integrated planning. While they are useful for determining how energy is used, they rarely provide insight into how the energy situation can be improved. In integrated energy planning, cultural, social and institutional factors are weighed, geographical vagrancies, productive capacities and resources are examined. More importantly, interconnections between the various development criteria are highlighted.

By placing current and forecasted energy supply and demand within the context of integrated energy development, energy planning can avoid the limitations of the supply-side approach. Moreover, energy planning can also look for economically productive activities that might be catalyzed through the provision of a reliable energy source.

Vertical and horizontal integration: regional and sectoral integrated energy development

By viewing energy development with a demand-oriented perspective, integrated energy development projects attempt to address regions and sectors that fall outside the traditional mandate of existing institutions.

Many OAS energy projects have adopted a geographically based focus. These projects, such as the Bolivian Energy Regionalization program, of which the Monteagudo project was one component, are aimed at improving the energy and development situation within a specific region. Similar programs have been carried out in over half of the 31 OAS member states. While the size of these projects and their goals have varied widely, a characteristic common throughout is a **spatial orientation,** that is, defining geographical areas on the basis of energy and development problems and potentials. These programs, which will be the central focus of this paper, will be referred to as regional integrated energy development projects.

Other energy activities function on a national scale, emphasizing the interconnections between energy and a critical sector of a country's economy. These programs are known as sectoral integrated energy development projects.

While these sectoral activities comprise an important part of the OAS work, and many promising opportunities have been identified, the vast majority of the projects have focused on geographical regions, especially isolated areas with special development needs. A brief discussion of both sectoral and regional projects follows.

Regional Integrated Energy Development

National energy offices, a relatively new development in non-oil, producing Latin American and Caribbean countries, have grown quite proficient in macro energy planning. Energy balances have been prepared for every country in the region. In the search for reduced dependency on imported oil, conservation projects and alternate energy plans have been examined and sometimes implemented. These offices have often taken a supply-side approach, attracting technicians in the various areas of energy supply - solar, wind, biomass, etc.

This centralized global focus, while valuable for directing national policies, frequently bypasses important regional development opportunities, especially in peripheral regions.

This is not to suggest that the problems of centralization have been ignored in Latin America; regional development organizations have been created in many countries to address the issue. In some countries, these groups are large and well organized, with a defined mandate to promote development activities on the regional level. In other countries, similar organizations have an in-depth understanding of rural development problems, but frequently lack the financial resources or political mandate to translate this awareness into concrete projects.

Energy regionalization incorporates the assumption that spatial disaggregation facilitates development planning. Integrated energy programs carried out in the Dominican Republic, Bolivia and Ecuador, among others, have been extremely successful using this method. (It is important to note that regional development offices are playing very important roles in the Energy Geography Program of Ecuador and the Bolivian Energy Regionalization project.)

As the rural electrification discussion demonstrates, national approaches radiate from the center outward, often bypassing isolated areas. With little economic activity, these areas do not attract energy projects. The Monteagudo case graphically illustrated this point: large volumes of natural gas were *exported* from the region (mostly out of the country) overlooking opportunities for developing demand near the source. In many countries similar situations can be discovered, as very little spatial integration between energy supply and demand occurs.

Energy geography, the characterization of areas by the nature of the energy problems and opportunities, as well as political, institutional and economic factors, serves as the basis for this regional disaggregation. The process of geographic disaggregation spatially defines an area for considering energy and development issues. Carefully selecting and analyzing a geographical area can generate unique insights into combinations of energy and other investment opportunities.

A two-phased process was used in nationwide energy regionalization projects in Bolivia and Ecuador. Other programs, such as the Central American Energy Program and the Energy in the Regional

Development of the Frontier Zone of the Dominican Republic, began on a regional rather than national base, although the stages were similar.

In Bolivia and Ecuador, the first phase was a general analysis of energy and development relationships in various regions of the country. This analysis relied heavily on cartography, flagging similar resources as well as searching for commonalities in development needs and opportunities. In Bolivia, this process was facilitated by the development of a computerized data management system.

On the basis of this analysis, the aggregate project area was divided into subregions. These regions were prioritized according to their likelihood of deriving benefits from a program of integrated energy development. From this prioritization, a pilot region was selected for in-depth analysis and investment project identification.

The second phase focused on the selected sub-region. In-depth analyses were performed in order to define "lines of action," that is, categories of potential energy and development activities. At this stage, all available economic and social indicators were examined, field visits and interviews conducted. From this information, numerous project ideas were generated. These ideas were rapidly evaluated by the project team-some discarded, others set aside temporarily, and several selected for further analysis. This analysis formed the basis for the final stage: the identification of specific integrated energy development projects. The Monteagudo project and other projects described in this report, resulted from this basic sequence.

This very brief summary of the stages in energy regionalization is included here only to provide the framework of action typically followed by the OAS in integrated energy development programs. (The methodology is described in detail in Chapter 3). It should be understood that this process can take anywhere from under a year to several years, depending on the goals of the project, financial constraints, and the specific methodology of the project team.

Sectoral Integrated Energy Development

Energy has a large impact on the development of transportation, agriculture, mining, etc. Sectoral integrated energy projects have attempted to investigate how energy relates to a specific sector and to identify investment projects and policy changes that can result in improved energy utilization.

In the English-speaking nations of the Eastern Caribbean, an OAS project in technical assistance focused on the relationship of energy to the life and development of small human settlements on these islands. This program identified as the most critical of these relationships, that of the communities and their local forests. These forests provide the fuelwood and charcoal used for domestic cooking. Although this program began with a geographical perspective, it eventually centered on the integration of energy and its planning institutions with the forestry and natural resource sector and its institutions. As a result, the descriptions of the lessons learned from this program have been included in the sectoral integrated energy chapter.

In Costa Rica and Panama, as in many other countries of the region, future economic growth is largely dependent on the agricultural and agroindustrial sectors. The economy of each country is also extremely dependent on imported oil. The importance of these two dependencies became increasingly obvious recently as the combination of low international commodity prices and high world oil prices caused a serious deterioration in the terms of trade for the majority of Latin American countries.

While international oil and agricultural prices are largely out of the control of Costa Rica and Panama, very little attention was given to internal policies that could affect this balance, specifically the role of energy within the food sector. Special technical assistance missions studied the interconnections between energy and food sectors, identifying numerous opportunities for improvements.

Similarly, the OAS has assisted its member countries in analysis of the role of energy in the transportation sector, one of the most complex sectors of many Latin American countries. Projects in Colombia, Uruguay and El Salvador have revealed numerous opportunities for energy conservation, substitution and rationalization and are contributing to important cooperation between the many institutions involved in the sector.

While these sectoral projects attempt to integrate energy policy with the target sector - natural resources, food, transportation, etc. - many have expanded to involve additional sectors of the economy. For example, the Energy Rationalization in Transportation Project for Colombia included an analysis of the options in the refining sector, ultimately recommending against construction of a new refinery. In Costa Rica and Panama, analyses of energy in the food sector expanded to incorporate the critical role of transportation, and offered suggestions to rationalize food transport.

The integrated nature of sectoral activities also extends to the institutional structure of the projects. Because of the multi-sectoral nature of energy and transportation, the involvement of many institutions was required, as the example from Uruguay shows.

Case Highlight 2

The Role of Institutional Coordination: Energy and Transportation in Uruguay

Energy in Transportation is an extremely complex issue in most countries of the world, involving literally dozens of institutional actors. Partially because of this complexity, few countries have attempted large-scale projects to improve the use of energy in the transportation sector.

Therefore, when a technical assistance program called "Rational Use of Energy in Transportation" began in Uruguay, coordination between the many organizations involved in transportation on national, regional and local levels was essential. Working closely with the National Energy Office, the program established cross-institutional support from the following organizations:

- Ministry of Transportation
- National Planning Office
- National Census Office
- National Petroleum Refining Company
- Bus and Trolleybus Cooperatives in Montevideo
- Municipal Government of Montevideo
- Taxi Cooperatives in Montevideo
- National Electric Company

The OAS and the National Energy Office agreed that the success of the program, eventually measured in terms of actual improvements to the transportation system of Uruguay, would depend on balanced input and participation from each of these organizations on a technical as well as a political basis. Therefore, a working committee to assist in the operation of the project was constituted of technical representatives from each of these organizations. This type of technical action committee was an extremely effective organization to tackle the complex, integrated nature of transportation problems.

As a result of the program, and the support of this committee, 15 opportunities for energy savings were identified. Of the projects and policies identified, an analysis showed that a renovation and rationalization of the urban transport system in Montevideo would have the greatest impact on the country. The program found that, considering only the values of energy savings attained, a comprehensive new and efficient transportation system for Montevideo could be paid for within four years of its implementation. The project was assigned top priority by the Uruguayan government and efforts to design and implement it are under way.

The effectiveness of this type of working committee resulted in a careful analysis of the specific needs and constraints in the transportation sector of Uruguay. While it is not directly replicable for programs in other countries, it demonstrates the benefits that can be derived from flexibly establishing the institutional structure of an integrated energy program to meet the needs of a specific project.

2. Where does integrated energy development work best?

1. Existence of energy resources
2. Relative isolation
3. Human resources and community organization
4. Institutional structure
5. Potential for economically productive activities
6. Locating regional integrated energy development opportunity

Experience has provided a checklist of characteristics describing an area where the regional integrated energy approach works best. While the list is by no means all-inclusive and the order of priority will vary widely between projects, it offers a broad overview of the conditions that facilitate integrated energy development activities:

- existence of energy resources
- relative isolation
- human resources and community organization
- institutional structure
- potential for economically productive activities

1. Existence of energy resources

The existence of energy resources, currently or potentially utilized, is the first need for any integrated energy project. The focus remains on the demand side of the equation, but some supply of these resources must exist to meet the present and generated demand.

As described previously, energy resources can be conventional or non-conventional. In many isolated rural areas, difficult and costly access for traditional fuels means that renewable resources can be more economical. In some instances, local resources exist but are underutilized. Recognizing the existence of indigenous resources and looking for unique applications of these supplies can spark integrated energy development in areas previously considered resource-scarce.

Overall, many regions of Latin America are blessed with abundance of energy resources. In contrast to many areas of the world, some hydrocarbons reserves are found in the majority of countries in South America; hydropower potential exists in all of Latin America; and, with several critical exceptions, forest resources are plentiful. As a result, in many regions of Latin America, resources that potentially can be integrated with productive activities exist.

In the small states of the Caribbean, the situation is somewhat different. The extreme importance of biomass energy, which is unlikely to change in the near future, means that the issue is not tapping unutilized resources, but rather carefully managing the resources that are locally available and cost-effective to use. As described further in Chapter 5, natural resource management becomes the central concern.

2. Relative isolation

Regional integrated energy development projects work best in relatively isolated areas. This relative isolation cannot be precisely defined, although such regions are usually not connected with the electricity grid. In areas that have been integrated with the national grid, remaining problems probably stem from a lack of overall economic development. A lack of energy is not the factor restraining development in such areas; therefore, the regional integrated energy development method is unlikely to be the most suitable approach. However, in some areas, such as the shrimp farms of Ecuador described below, connection with the national grid can solve existing energy supply problems, as well as catalyze additional development opportunities.

On the other hand, some areas are so inaccessible that generating economically viable activities does not appear feasible. No hard rules can measure relative isolation: Yacuambi, Ecuador, as described on page 10, has no road access, yet it appears to have a high potential for integrated energy development projects.

Geographical isolation, usually accompanied by poor transportation routes, results in difficult and costly access for traditional fuels, such as petroleum products and natural gas. For these same reasons, these areas face problems in integrating with the grid. Infrequent and high-cost fuel deliveries to areas distant from the source of supply (oil or gas fields, refineries or ports), along poor transportation lines, seriously hamper new economic activities. Yet in these areas, where no short or medium term plans exist for connection with the grid, conditions may be favorable for integrated energy development projects.

In Ecuador, the difficulty in supplying conventional fuels to coastal shrimp farms provided an opportunity for integrated energy development activities. The farms, located in mangrove swamps, were not connected to the country's electricity grid. Instead, they relied on diesel fuel, which had to be transported by water. Costs were extremely high and deliveries were infrequent. An analysis of various alternative sources of energy demonstrated that connection to the electricity grid would be the most viable option, due to geography and the national oversupply of hydroelectric generation capacity.

While connection to the grid alone would solve many of the reliability problems caused by diesel, the integrated focus of the project looked for additional opportunities that could be catalyzed by a new energy supply. The new electricity supply could permit shrimp farmers to increase the productivity of their ponds through the introduction of new technologies. In addition, the grid extension would provide electricity to many small settlements along its path that could not justify it by themselves. Although grid extension to isolated areas is never a low-cost option, the expected new electricity demand, the profitability of shrimp farming and the importance of shrimp to the national economy (they are Ecuador's third-largest export) made the project economically and financially viable.

In the Human Settlements Energy Project countries of the Eastern Caribbean, the access of commercial fuels is limited by the unique features of small islands. Not unlike isolated rural regions within Latin American countries, whole islands have a small energy demand, making the provision of petroleum-based fuels extremely costly for the entire nation.

While it is not necessary for a region to have an extensively developed infrastructure in place, most of the economic activities in integrated energy projects include the production of goods for outside markets, requiring access to these potential markets. This access can take the form of roads, railroads, rivers or even airports, but some form of integration with other areas is necessary. In Yacuambi, Ecuador, designing projects to overcome the extremely difficult access was one of the main factors in the program. The project identified cheese as a product with low perishability which could overcome Yacuambi's difficult access.

3. Human resources and community organization

The integrated energy development approach attempts to involve local populations in the planning of programs. Without the input and cooperation of the people that the project is designed to benefit, even technically sound ideas can fail. The presence of people organized together, interested in and capable of assuming part of the responsibility for the development process, greatly facilitates the implementation of the projects.

The existence of this "sense of community", varying from well-organized cooperatives to churches, schools and social clubs, provides the project team with a group of interested people willing to discuss the problems and aspirations of the community. Regardless of the type of organization, a sense of belonging and the precedent for joint, mutually beneficial actions make integrated planning much more likely to result in concrete actions.

Many OAS projects have drawn heavily on existing local groups when establishing the institutional structure of projects, as demonstrated in Case Highlight 3 below from the proposed Pedernales, Dominican Republic fuelwood plantation and electric generation project.

4. Institutional structure

In addition to the need for community participation in projects, an organization capable of implementing and managing projects must be strengthened or created. It is often very difficult to find local people with the necessary skills to manage and operate industrial projects such as the meat and juice processing plants in Monteagudo, Bolivia, or the cheese production plant in Yacuambi, Ecuador.

As it is unlikely that an existing institution will be able to perform such tasks at the start, most programs look to regional or national development organizations for this level of expertise. The private sector can also play an important role, as is currently being investigated for the Monteagudo agroindustrial project.

The example (Case Highlight 3) from the Pedernales wood-fired plant in the Dominican Republic demonstrates the incorporation of regional and national institutions, along with the local population, into the project planning process.

5. Potential for economically productive activities

During the region selection phase, the project team searches for activities, either ongoing or feasible, that have potential to be economically viable. The team looks for current activities that could become more profitable given a reliable source of energy (such as the Ecuador shrimp project), or activities that could be undertaken with the addition of energy and other development inputs (such as the Monteagudo agroindustrial plants).

Case Highlight 3

Community Involvement in Integrated Energy Development: Pedernales, Dominican Republic

The frontier zone of the Dominican Republic, along the border with Haiti, is one of the least developed areas in the country. Although the electric grid reaches the zone, it lies at the westernmost extension of the system and the quality of service is very poor. Frequent voltage fluctuations serve to deter industrial activity.

Pedernales, the only provincial capital in the country not connected to the national grid, receives electricity from a 1.5 MW diesel plant. However, the plant operates infrequently because of maintenance problems; high diesel prices mean that production costs are well above the national average. These conditions are the major reasons why there is no significant industrial activity in the area.

A proposed 3 MW dendrothermal (wood-fired) plant in Pedernales, connected to the national grid, would help resolve several major problems in Pedernales and in the entire zone. First, it would help reduce voltage fluctuations in the system, enhancing the region's ability to attract economic activity. Second, it would meet the electricity demands of the people of Pedernales in a more reliable and less costly manner. Third, excess energy supplied by the plant could induce agricultural and industrial activity in Pedernales and the surrounding areas. Finally, the plant and the fuel-wood plantation would directly generate jobs for residents; additional employment in the future would result from new agricultural and industrial development.

The project design of the Pedernales wood-fired power plant and accompanying fuelwood plantation demonstrates a high degree of involvement of local residents in the planning and implementation of the project. The program successfully incorporated both the traditional agricultural activities of the peasants and their existing community organizations, while at the same time utilizing the technical capabilities of regional and national organizations.

A sociologist assigned to the project met with the local people and town councils to identify the priorities of the residents of Pedernales, and those of the people living in Las Mercedes, located within the forest area proposed for the fuelwood plantation.

An estimated 150 families lived in the area proposed for the fuelwood plantation, practicing traditional slash-and-burn agriculture. While the residents of the area were interested in participating in the project, they did not want to lose their traditional agricultural lifestyle and life support system. To minimize the disruption, the project design provided for the planting of traditional crops in coordination with the trees for the plantation.

The sociologist also discovered that many residents of the area had worked for a mining company (which had since ceased operations), and were dissatisfied with the company's contribution to their development. They had understood that the company would assist in building schools and roads and in providing potable water supplies. In reality, very little assistance was actually provided.

The design of the institutional structure for the plantation and power plant sought to maximize the participation of the residents, while making significant contributions to improving their social and economic well-being.

Base Groups, comprising 10-15 residents each, would make up a Wood Producers Association, producing and supplying wood to the power plant. Each Base Group would establish collective estates, averaging 100 hectares. Wood produced by the Base Groups would be sold to the Wood Production Company to supply the power plant. In turn, the company would provide the farmers in the Wood Producers Association with technical assistance and training.

The Wood Production Company would be a subsidiary of the Dominican Electric Company (CDE) and would be administered by a Board of Advisors, composed of representatives from the CDE, the Patronato Comunal, the Wood Producers Association and individual wood producers.

The Board would determine the amount of a tax to be paid by the Wood Company on wood sold to the plant. This tax would form a fund to promote socioeconomic development in the region.

Unfortunately, such activities cannot be identified in all areas of Latin America. Some regions do not have adequate natural resources to support productive activities and others, while blessed with natural resources, have not yet reached a basic level of economic development at which the provision of energy will have a significant impact. In these areas, small-scale energy projects can make improvements in the quality of life for the local residents, but may not result in integrated investment projects.

Circumstances exist where the social needs for an energy project are so great that concerns about economic viability are put aside. These projects, designed to meet critical social objectives, call for a distinct set of guidelines and should be distinguished from the start from integrated energy programs seeking economically viable projects.

6. Locating regional integrated energy development opportunity

These five characteristics can be thought of as a set of criteria for regional integrated energy development. If a region does not meet the conditions specified, because its level of development is either significantly greater or lower than the parameters described here, other development approaches are likely to be more beneficial.

For example, if a region is not isolated from the rest of the country and access for conventional fuels is not a problem (point 2), integrated energy and development is unlikely to be effective. Such an area is likely to be integrated with the national grid or readily provided with conventional energy supplies, in which case other forms of economic development activities are necessary. If such an area lacks energy, an infrastructural, supply-oriented solution is probably necessary.

Similarly, if a region falls below a minimal level in most or all of these seven categories, an integrated approach to energy and development is not likely to bring about the synergism described here. In a region completely isolated from the rest of the country, with a lack of viable energy resources and little community organization, it is not likely that opportunities for integrating energy with economically viable projects will be found. As these regions are often the most needy areas of the country, other alternatives must be explored.

Case Highlight 4

Locating Regional Integrated Energy Development Opportunity: Yacuambi, Ecuador

Yacuambi, in the northern part of Zamora Province, Ecuador, is one of the few populated mountainous areas not connected to the country's extensive electricity grid. The town is extremely isolated, lying some 60 kilometers from the provincial capital, Zamora. A road from Zamora and Yacuambi ends 12 km from Yacuambi. A footpath allows pedestrian and animal travel during the dry season, although during parts of the rainy season access to the town is difficult.

Electricity is provided to the residents of the town with a mixed hydro and diesel system. The hydro system, built with outside assistance in the 1950s, has a 12 KW mini-hydro generator. Today, the hydro system is supplemented by a 65 KW diesel generator housed in the same plant. Under normal circumstances, the hydro generator operates between 11: 30 p.m. and 8 a.m., while the diesel system generates electricity in the peak demand period between 6 and 11: 30 p.m. During most of the daylight hours, from 8 a.m. to 6 p.m., no electricity is available.

To compensate for Yacuambi's isolation while taking advantage of its abundant natural and human resources, the program looked for productive activities that would meet the following criteria: 1) products made of local resources; 2) products stable enough for transport to markets in the larger towns of the region using the existing mule/horse-path transport system; and 3) products with a high value-added.

Cheese production was seen as an activity that would meet all three criteria. Quality cheese demand was unsatisfied in the closest provincial capitals. Cattle-raising was a familiar activity for the residents of the area. Cheese could be transported to other towns in the province without spoiling and had a high value-added. Cheese production would require a larger, more reliable source of energy. In addition, a new source of electricity could provide uninterrupted and lower-cost electricity for the town. The project team identified the possibility of building a new, minihydro system, taking advantage of unused local hydro potentials.

An economic analysis compared this option with extension of the regional grid to Yacuambi from Loja, and with the construction of a new diesel system. Considering the highly subsidized government price for diesel, the regional grid extension based on current central diesel generation appeared most economical in the first year of operation. However, over the project life cycle, the minihydro system proved least-cost. Furthermore, using international prices for diesel, the hydro option was the most economic from year one.

Further analyses showed the strong potential for replicability of small-scale cheese production throughout the southern mountainous areas of Ecuador.

As seen, Yacuambi does meet the criteria for regional integrated energy development.

Existence of energy resources Yacuambi is situated at the confluence of three rivers. Although the existing hydroelectric system was technically sound, a physical and topographical examination of the surrounding region revealed that it harnessed only a portion of the vertical fall available in the area.

Relative isolation Yacuambi clearly is isolated from the rest of the country. While its overall level of development is remarkably advanced given this isolation, additional economic development seemed to depend on integration with the markets of larger towns in the region. The road stops 12 km from Yacuambi and fuels for the town's diesel generator had to be carried by mule over the footpaths.

Human resources and community organization The people in Yacuambi expressed interest in new economic activities for the town. An Indigenous Association was willing to participate in new activities, expressing special interest in projects that would include technical assistance for the farmers.

Institutional structure The farmers in the Indigenous Association could form the base of a Producers Association for an agroindustrial activity, and the basic technology required to operate the cheese plant could be adapted to fit the skills of the residents.

Potential for economically productive activities Yacuambi is surrounded by approximately 50 square kilometers (5000 hectares) of gently rolling hills, covered almost entirely with natural grasses. This area provides excellent pastureland, where most of the residents raise livestock.

At these lower levels of development, two options exist:

- a global regional development approach
- a social development perspective

A global regional development approach deals with all of the development problems facing such an area, including basic agriculture, education, transportation, etc. Energy, too, is often a component in this comprehensive approach, although it plays a much smaller role and expectations that it will catalyze economically productive activities are not significant.

In a social development perspective, energy projects are identified to improve the quality of life of residents in these areas of severe deprivation. Such projects, such as photovoltaic refrigeration in rural health clinics, can make an extremely valuable contribution to the welfare of the people. Again, these projects are not expected to catalyze economic development.

Pressures may exist for choosing regions that do not meet the above criteria. Governments, with natural social and political motivations, may push for the selection of the most needy, poorest region of the country to apply the regional integrated energy development methodology. In many of these areas, the minimum level of development inputs described above - natural resources, basic infrastructure, community organization, etc. - is simply not present.

Areas with conditions falling outside this set of criteria certainly merit special attention from governments and assistance organizations. Projects aimed at improving the social welfare of the residents are usually necessary. These projects, by their very nature, are not designed to achieve economic viability and are likely to require continuous financial support.

Funds allocated to natural resources and development in general are limited. Activities must be carefully selected to bring about the greatest development impact with the least amount of money. Applying the regional integrated energy approach to areas that meet the criteria described and thus have a high probability of success is an attempt to maximize the impact of the development efforts.

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3. What are the guidelines for regional integrated energy development

The overall approach
Analyze government policies
Gather information
Prioritize regions
Conduct regional missions
Identify regional lines of action
Collect and analyze regional data
Identify and evaluate projects
Assist governments in defining development opportunities
The role of coordination

The methodology presented below should be interpreted simply as a set of guidelines, not as a step-by-step procedure to be followed rigidly. Each country, region, and circumstance is clearly different and adjustments are necessary to fit the methodology to local conditions. Depending on the situation, some guidelines may be bypassed entirely while others may require significant expansion.

Regional integrated energy development, although ultimately applied on a local level through the projects identified and recommended for implementation, needs to be understood at all levels, from the national to the local. Independent of the stage of analysis and implementation, the goal of integrated energy development is to incorporate energy directly into the development process. This will apply to the community that seeks new possibilities for its own development as well as the entire nation that realizes the potential opportunities derived from integrated energy development and wishes to include these ideas in national policy. The process of integrated energy development can be effectively initiated at any level.

In this chapter, we present a sequence of activities that the OAS has utilized in projects of this nature. The breakdown, which should be viewed as a compendium of these experiences, is as follows:

- Analyze government policies
- Gather information
- Prioritize regions
- Conduct regional missions
- Identify regional lines of action
- Collect and analyze regional data
- Identify and evaluate projects

- Assist Government in defining development opportunities

The overall approach

The appropriate office to carry out integrated energy development projects on the national level depends on the unique institutional structure and strengths in each country, although the national energy office is frequently the most suitable institution. Regardless of the implementing institution, the integrated energy approach is likely to be new and unfamiliar to the staff of these offices.

The approach will be very different from policy analysis, forecasting, generation of energy balances and technology design and assessment, which are the principal and traditional activities of energy offices. Similarly, national and regional planning offices, although deeply involved with integrated development, have not typically dealt with energy planning or energy issues. These traditionally have been considered as limited to supplying energy and hence completely within the purview of the energy companies.

Judging by the experience of the OAS, the approach to integrated energy development requires staff with a great deal of flexibility and good judgment, as well as technical skills. Situations in integrated energy development are rarely standard. Each opportunity identified will have its own idiosyncrasies and will require sequences of analyses and decisions which are difficult to standardize. Although general methodologies are suggested, the approach is not a "cookbook."

At the same time, the integration of energy and development in this context requires strong system and analytical skills and a full knowledge that one generally associates with an "energy expert". For instance, in the context of Isolated electricity generation in a rural agroindustrial project, the staff involved must under- stand the nature of all the aspects of the project-technically, institutionally, culturally, economically, and financially. Moreover, the staff must be able to fit the energy system into this context, recommending the energy source and technology that best match all local conditions. This knowledge and good judgment concerning energy matters are essential.

The delicate issue in any kind of integrated effort is the question of program scope and program responsibility. The key driving factor in regional integrated energy development is that the integration of energy directly with development in various areas provides excellent socio-economic development opportunities, which to date have not been widely cultivated. It is clear that energy is not the sole solution to problems of development and that the integrated energy analysis cannot take over all development questions. The risk of institutional conflict is obvious.

The guidelines that have grown from the experiences of the OAS are that regional integrated energy activities should seek out those areas of development where:

- effective actions are not likely to occur without integration of energy expertise;
- new development opportunities are identified as a result of energy initiatives.

The specific projects cited in this report are reasonable examples of the kind of development scope that regional integrated energy development should be targeting. More is said on this topic below in the section on the role of coordination.

For offices that are considering the institution of integrated energy development programs, it is critical to note that field contact is absolutely essential for the process recommended here. Integrated energy development cannot be performed successfully from within a national office. Governments that decide to pursue integrated energy development must provide the funding and the flexibility for staff to travel throughout the country.

Analyze government policies

Before initiating a program of regional integrated energy development, the energy office must acquire comprehensive knowledge of the national and regional development policies and plans of the government, including priorities and constraints. These need to be understood from an energy perspective, that is, what the national plans are for infrastructure development, rural electrification, new distribution facilities, etc.

The integrated energy development team needs to understand the financing criteria for project funding from international and national public and private sources.

It also needs to acquire an initial orientation to measures of its own future success. At the policy level, the regional integrated energy development team needs to foresee the balance of objectives of its efforts. Rural energy developments have often been plagued with the problem of high overhead costs, that is, high costs of technical services for small economic and energy benefits. The team should establish initial goals of total investment, energy benefit, total people affected or income generated, etc., to direct and measure from the outset the effectiveness of this program. These goals will assist the program in project identification criteria and in maintaining a balance in program implementation.

Gather information

Information gathering must be driven and controlled by the question "In what areas and under what conditions are we likely to find integrated energy/development opportunities?"

The programs of regional integrated energy development of the OAS have approached this question in various ways, from very rapid, time-limited analysis to more structured techniques that have covered more than a year of effort. There is a commonality to all the methodologies, which we briefly present here.

If the regional integrated energy development program begins at the national level, it is necessary to decide on a level of spatial aggregation or regionalization to reduce the scope of the problem to workable sizes. Because development is integrally tied to natural resources, one regionalization approach is to aggregate according to geographical criteria. The benefit of this technique lies in the fact that integrated development opportunities will more likely be similar within geographically uniform regions. It has been found that this approach may be more useful for quick overviews than for more detailed analyses.

In general, information will be available or more easily acquired according to political subdivisions of a country. Moreover, utilizing political borders permits easier implementation of the projects identified at the end of the planning process. For this reason, the OAS has concluded that for extensive analyses, the political subdivisions are often the most effective for regional integrated energy development planning. Development regions, if in use in a country, may also be very useful, especially if these regions are simple aggregates of political regions and if the use of these development regions is institutionalized in national planning.

The first step after the regionalization decision is to begin to characterize the energy and development relationships within a region. On the energy side, this will require information on:

- energy resources
- energy infrastructure
- energy consumption

Data required on development conditions and opportunities include:

- natural resources
- economic activities
- social conditions
- opportunities and needs for development

The energy data, although well defined, in some cases may be difficult to acquire because they have not been collected at this level of aggregation. The typical problem with development data is not unavailability, but dimensionality. Experience has shown that without a careful screening process, much effort can be placed on the data collection without great benefit.

The key to efficient data gathering and analysis is to focus on the desired product of the identification of energy/development opportunities. It is not efficient to collect data that will not be used. A technique which has been effective in some of the OAS programs is to hypothesize energy/development opportunities for the various regions based on initial data and then to pursue in more depth the data required to confirm or reject these hypotheses. In later analyses, more efforts can be directed to filling in the information gaps.

The tools of the regional planner are very useful in data collection and analysis: resource maps, land use maps, demographic information, information on principal productive activities in the various regions of the country, etc.

One product of the data collection exercise which has been useful in a number of the projects has been the construction of an energy/development atlas which provides a cartographic and tabular presentation of the country energy and development data.

Prioritize regions

Before making trips to the various regions, it is important to obtain an initial indication of the areas in the country where integrated energy development is promising. From the information available, the planning team assigned to the integrated energy program should evaluate region by region the criteria given in Chapter 2 and obtain initial ideas of what energy resources might match with productive activities to provide development in that region.

Clearly, if a region shows promise of a number of such activities consistent with the development objectives of the country, that region should become a primary target for further investigation. Of course, the national-level analysis may overlook important integrated energy development opportunities in certain regions which only will surface as a result of direct missions to these areas. These regions will eventually need to be visited as the integrated energy planning process becomes more mature.

Before missions are scheduled, a decision needs to be made as to the sequence of regions that should be visited. Communication with the appropriate institutions in these regions needs to be made with explanation of the purpose of the analysis and requests for regional participation.

Conduct regional missions

Direct contact at the regional level is a critical element of the integrated energy process. Officials in regional institutions generally have excellent knowledge of the development situation throughout their region. They understand the problems and are an excellent resource of ideas about actions that could be undertaken. At the same time, it is common that these people have had little formal experience with energy, and especially with the concept of direct integration of energy in the development process. The interchange between energy experts and these regional development specialists can be extremely productive in the generation of integrated energy development ideas.

The mechanism that the OAS has used successfully in the generation of these ideas is what we have called "the structured interview." Using the knowledge gained from review and analysis of the regional data at the national office, the interviewers can extract from conversations with regional experts the development picture across the various subregions of the area and assure that certain topics of potential integrated energy and development application are discussed.

Clearly, the visiting team will want to review the body of information existing in the regional offices, attempting to fill in important data missing at the national level.

The visiting team will want to visit and interview a wide range of individuals from various regional institutions. Regional offices of the electric company, the petroleum company, regional development organizations, the offices of elected regional officials, church officials, etc., are all potential targets for these structured interviews. Each will provide a different perspective and insight on the development picture in the region.

In conjunction with the local counterpart organization, the team should also organize a short mission through the region to identify firsthand some of the resources, projects, communities, problems, etc. The process of structured interviewing needs to continue throughout these missions, capturing a fuller picture of the regional development situation.

The team and the local counterparts need to use this time in the region to brainstorm and discuss ways in which energy could be instrumental in catalyzing development. Ideas will be generated through interviews and the initial cartographic and data analysis. Quite possibly, additional development ideas will be proposed because energy opportunities in a certain sub-region looks so promising.

Documentation during this mission needs to be almost continuous so as not to lose ideas. Project ideas, even those discussed only briefly at this stage, can later generate additional integrated energy development possibilities given new or better information. A mission report, including a summary of all the ideas discussed, should be prepared before the mission returns to the national office, if at all possible.

Identify regional lines of action

A line of action is a statement of an action required to solve a given energy-related problem (improve the LPG distribution network, increase the overall efficiency of fuelwood stoves, provide electricity to new mining companies, etc.). For each region that is analyzed in some detail in the field, it is useful to provide a summary of the lines of actions in energy and integrated energy development that are identified. These lines of action are useful for national energy planning and also for regional authorities in the assignment of priorities for development activities.

Collect and analyze regional data

The evaluation of the combination of the existing regional energy and development data, the structured interviews, and the direct contact of the project team in this region may show that the information available is inadequate to support specific hypotheses concerning problem areas or project opportunities. In these cases, depending on the time and resources available, it may be recommendable to organize a data gathering effort. The additional effort can be extremely beneficial in providing hard evidence for supposed problem areas.

In larger efforts, the OAS, in conjunction with the counterpart organizations, has found that the preparation of a regional energy balance has been most useful for planning purposes. In most of these cases, some additional energy data collection has been required.

Identify and evaluate projects

Integrated energy development projects can appear at any time in the process. Because of this fact, it is wise for the integrated energy planning team to develop a system for presenting and cataloging project ideas. A standard mechanism, through which projects identified automatically enter an evaluation process, will eventually result in investment, construction, and implementation of the best ideas. The standardized levels of project presentation and evaluation used commonly by financing institutions are useful to provide for easy transfer of projects to these institutions at the appropriate stage.

These levels are as follows:

- Profile
- Advanced Profile
- Prefeasibility Study
- Feasibility Study

With the prioritization of the projects identified agreed upon by the participating institutions, the high-priority projects should be evaluated technically to determine their viability.

The national energy office should maintain the technical capability to evaluate the energy aspects of the integrated energy development projects identified. Because of the integrated nature of these projects, it is essential that the energy office coordinate with other national and regional offices possessing the technical capability to evaluate the non-energy portions of these same projects. To facilitate the efforts, it is very useful for the national energy office to have specific budget for evaluation of projects of particularly promising opportunities. Additional funds for project evaluation will need to be extracted from other preinvestment sources.

A key element in the evaluation process is the institutional need for an implementing agency. Special emphasis needs to be placed on this aspect since integrated energy projects may easily fall outside the purview of existing institutions.

Assist governments in defining development opportunities

The work of integrated energy development planning will provide new insights into the possibilities of energy in the development arena. It is likely that this will need to be incorporated into national energy planning. Two types of target opportunities have appeared in the integrated energy programs of the OAS: first are projects that have been identified and developed on a regional basis as noted above; second are those that may have specific regional application, but also are seen as highly replicable throughout the country (regional natural gas use in Bolivia, charcoal production systems in the Dominican Republic, industrial wood energy use in Uruguay, etc.).

It is recommended that the national energy office provide a mechanism by which these replicable opportunities become incorporated into national energy and development planning, and eventually implemented.

The role of coordination

The successful implementation of an integrated energy development program will be in large part dependent on the capability of the institution involved to become a focus of coordination and cooperation among the various institutions that will be involved in an integrated energy project.

At the national level, this coordination will need to be applied to all the agencies that have responsibilities in the subject material of the identified area of integration between energy and development. A good project idea may easily flounder late in the project development process if an important institutional tie has been omitted. Although possibly burdensome at the initial stages of such efforts, the establishment of good coordination ties pays off at the point of evaluation and implementation. This coordination is also most essential between energy agencies.

At the regional level, experience has shown that regional institutions are most interested in becoming involved with energy and development issues. A written blanket agreement between the national energy office in charge of the integrated energy development effort and the regional institution can be very useful for eliminating conflicts and delays during actual field work. Probably most important is that these regional institutions are the key agencies for providing the links to the actual projects themselves and also may be the key institutions for controlling the financing and even the implementation of these projects.

Case Highlight 5

The Role of Institutions: Bolivia and Ecuador

In the Ecuador Energy Geography Project, the National Energy Institute (INE) acted as coordinating agency between the regional development agency, PREDESUR, the national electricity company, INECEL, and the local organizations of shrimp producers in the identification and initial evaluation of a coastal electrification program in El Oro province to provide electricity for water pumping and more efficient and cost-effective shrimp production.

In the Bolivian Energy Regionalization Program, the activity of the Monteagudo agroindustrial project was initiated at the national level from the Ministry of Energy and Hydrocarbons (MEH), which has the responsibility for national energy policy. At the departmental level, the principal coordinating institution was the Chuquisaca Development Corporation (CORDECH). The coordination of these two institutions spread to the National Petroleum Company (YPFB) for the agreement on the extension of the natural gas pipeline network to Monteagudo, and to the National Electricity Company (ENDE) in the planning of options for provision of electricity to the Monteagudo community.

4. Who should "do" integrated energy development?

National energy companies
National and regional development agencies
National energy planning institutions
Financing institutions

Regional integrated energy development, with its focus on demand development, regional disaggregation and interconnections between factors of development, requires cooperation and expanded scopes of responsibility from every actor involved in energy and development activities.

Because of the integrated nature of the programs and the distinct institutional framework existing in each country, no single agency can be assigned to "do" integrated energy development. In some countries, energy planning agencies have the institutional capacity to identify and promote projects. In other countries, strong regional development organizations exist that can appropriately assume the lead role in planning and implementing integrated projects. In still others, national energy companies can lead an integrated effort. The goals of the program and the level of interest expressed by the various agencies are also important factors to consider. Regardless of the organization best suited to plan or implement projects, a concerted, cooperative effort between agencies is essential.

In Uruguay, cooperation between government development agencies, private cooperatives and national energy companies resulted in an extremely successful integrated project for energy and transportation. The OAS role in such groups is to facilitate coordinated activities between all of the national counterpart agencies.

National energy companies

The traditional energy institutions of Latin America and the Caribbean, the electricity, petroleum and gas companies, take a supply approach to energy development. The perceived and in many cases assigned responsibility is to provide energy as the needs arise. The demand for energy is generally treated as an externality, an important factor for accurate estimation and forecast which then drives the development of the energy supply infrastructure: generation plants, electric transmission systems, petroleum refineries and petroleum storage facilities, for example.

This supply approach, common throughout the world, does not provide adequate flexibility to take advantage of specific energy demand opportunities which offer not only development benefits but also significant improvements in the provision of energy at low costs. In the developed as well as the developing world, cogeneration is an outstanding example of the way that some industries can provide for their own process heat and electricity needs in a way that is much more efficient than combined direct purchase of grid electricity and self-generation of process heat. Moreover, cogeneration buy-back schemes can benefit electricity companies by balancing system load factors and improving system reliability.

In Latin America and the Caribbean, electricity companies need to expand their activities to include development and integration options in their planning and analysis. Although subdivisions of responsibilities begin to overlap, these energy companies need to coordinate with other development institutions, so overall development and energy development proceed hand in hand.

National and regional development agencies

In a similar fashion, those agencies with responsibilities for economic and social development, at both regional and national levels, traditionally have not considered energy as an integral factor in their planning for development projects. These institutions need to consider the mechanisms for provision of energy for productive activities and not just leave the responsibilities in the hands of the energy companies to provide energy where needed.

The integrated energy and development opportunities provide mutual benefits to both energy and development institutions. Because of the overlap of responsibilities to achieve these benefits, the only mechanism available is for energy and development institutions to cooperate in areas of overlap. This means that energy institutions need to become involved in demand generation (development) and development institutions need to become involved in evaluations of energy supply. The amount of overlap clearly needs to be based on the extent of the benefits that will be obtained. It is hoped that the results described in this report will show the type and level of benefits that can be obtained and the conditions under which they are likely to occur, and convince decision makers in these institutions of the value in pursuing this type of cooperation.

National energy planning institutions

National energy planning institutions, typically separate from the energy companies noted above, provide global information about the way energy is delivered and consumed in a country and global policy definitions in future national energy matters. Generally, alternative energy supply considerations are assigned to the staff in these offices. As in the case above, there is a supply orientation to these efforts with ample technical expertise in the technologies for conversion to new and renewable or alternative energy supplies. There is a general knowledge about the location and quality of the various energy sources, but other than technology demonstration projects, there has been little success in the integration of these concepts into actual development and development projects.

These national energy planning institutions also would do well to expand their scope to permit entry into integrated energy development projects. Again, these institutions would need to provide the cooperation or extension services necessary to assist development institutions, both regional and national, with the expertise to show how alternative energy sources in certain cases can enhance the development process through specific projects throughout the country. This service in turn can feed back to national policy planning to provide new directions for global as well as regional energy matters.

These energy planning institutions, by the nature of their centrality, have a unique opportunity for providing the cooperation setting to bring together other institutions to participate in integrated energy development.

Typically, energy planning offices, unlike the energy companies, are financed out of tax receipts. Because of their defined global planning and analysis role, little budget is assigned for travel. To be effective in integrated energy development, the staff involved must travel to the field, to project sites, to work with development institutions, to participate directly in cooperation. This travel requires funding and must be a prime consideration in the decision of any institution to pursue integrated energy development. The OAS experience has shown this country budgetary limitation on travel to be a factor in nearly every energy/development project in technical cooperation that it has undertaken.

Financing institutions

Financing institutions, with traditions of providing sectoral loans, need to understand the process and benefits of integrated energy development and to become comfortable with the mechanisms available for financing integrated energy and development projects. This includes national as well as international financing agencies.

Because integrated projects do not directly fit into the standard structure used by international agencies, financing may require extra effort and ingenuity. Again, a familiarity with the process and benefits of integrated energy development can reduce these problems. The procedures for the financing of the more general regional development programs are well established and can be very useful as models for approaches to funding of integrated energy development projects.

Financing institutions, as service organizations, need to respond and adjust as good ideas and opportunities are identified. It is well known that those requesting financing will be reluctant to submit projects that will cause confusion within the financing institutions. The resolution to this predicament is that financing institutions need to be prepared. They need to preplan approaches to the development and financing of integrated energy development projects. In their own programming missions, financing institutions need to include professional staff with broad and interdisciplinary capabilities that will seek and encourage the presentation of integrated energy projects when they are evident and justified.

5. Sectoral integrated energy development

Energy and transportation
Energy and food production
Energy and natural resource management
General suggestions for sectoral integrated energy development programs

Sectoral Integrated Energy Development is an approach to resolving specific development problems through the analysis of the relation between energy and one or more other economic sectors. The sectors that the OAS has evaluated in this manner are energy and transportation in Colombia, Uruguay and most recently El Salvador; energy and food in Panama and Costa Rica; and energy and natural resource management in the English-speaking Caribbean. Each of these programs has examined the role of energy within an extremely important component of the countries' respective economies. While these projects are sectoral by nature, they focus on interconnections between components of development in a similar fashion as the energy regionalization projects.

Energy and transportation

The importance of energy in the transportation sector is evident from a few statistics:

- Transportation accounts for one-third of all energy consumed in Latin America.
- Petroleum derivatives account for nearly all energy used in transportation.
- Nearly 80% of the Latin American's energy is consumed in urban areas.
- Despite congestion problems throughout the region, private automobile ownership is growing between 10 and 20% annually.

However, comprehensive programs of energy rationalization in the sector have been uncommon in Latin America. Many reasons explain this absence. On the whole, improving transportation is not a supply issue. With some exceptions, major technological breakthroughs are unlikely. Furthermore, transportation is so intrinsically linked with the economies of the region that large-scale alterations are difficult.

With the exception of Brazil's innovative substitution efforts, the technologies and resources duplicate those utilized in the developed world with little or no modification. In addition, benefits from fuel use rationalization in the transportation sector accrue disproportionally to the less than 10% of the population that owns private vehicles.

The OAS first was asked to address this problematic sector by the government of Colombia in 1982. Colombia faced a critical situation. The transportation sector consumed 65% of the total petroleum liquids in the country. Despite rapidly increasing petroleum production, the country's refineries could not keep up with the growing demand for gasoline. Gasoline imports were expected to reach 17, 000 barrels per day by 1987.

The available options did not seem attractive. Continued imports of high-cost gasoline would require hard currency and constrain the government's development options. Alternatively, adding refinery capacity to meet gasoline demand would be very costly and result in excess production of heavy products. Potential export markets for excess fuel oil were distant, so transportation costs would lower already small profit margins on heavy products.

A third option certainly existed: conservation and fuel substitution. Yet the potential contributions from such programs were unknown, as very little disaggregated data or analysis existed on the sector.

In Uruguay, the situation was distinct from Colombia. Almost all transportation energy was based on imported petroleum fuels and the design of the national refinery strongly affected the product slate for liquid fuels. A tariff system on high-priced fuels was designed to generate national income, to encourage rational use of other fuels, and to place the heaviest burden on private vehicle owners. Because of the high prices of liquid fuels in Uruguay, potential benefits for conservation initiatives appeared to be significant. In January of 1984, the Uruguayan government requested an OAS technical assistance program in energy and transportation to investigate conservation options.

In Colombia, as in Uruguay, the first step was to collect thorough information on the sector in order to develop a data base for evaluating new policies and fuel substitution options. Due to the complex nature of the sectors and the lack of reliable information, both studies considered the creation of information systems as a prerequisite for other activities.

Data base organization was a difficult undertaking in both countries. The existing data on the transportation sector were spread among many different sectors, agencies and ministries. Other information had to be generated. Instead of designing open-ended surveys to meet data needs, surveys were structured to test specific issues, such as "What relative prices of gasoline and diesel best meet the needs of the country?," and "What effect does the age of the transport fleet have on energy consumption? Do high import duties on vehicles actually provide a net loss to the country?" Because of the immense quantities of data and the interrelationships between information, statisticians were essential.

As discussed in Case Highlight 2, coordination between agencies plays a critical role in energy and transportation studies. The structure and needs of the transportation sectors differ greatly in the two countries.

Colombia, a large country with a growing production of natural resources, had opportunities for gasoline substitution not available to Uruguay, which is completely dependent on imported fuels. As Case Highlights 6 and 7 show, the study of potential gasoline substitutes in Colombia yielded some surprising results, while in Uruguay possibilities were great for conservation programs, especially in greater Montevideo.

Energy and food production

Like the critical relationship between energy and transportation, the interconnections between energy and the food system in agricultural, oil-importing countries have been a focus of OAS studies. In Costa Rica and Panama, agroindustry accounts for a significant portion of Gross Domestic Product and is seen as the key to future economic growth and development. A significant portion of each country's high imported petroleum bill can be traced to the sector, including petroleum products for production, transportation and processing, but also for fertilizers, chemicals and animal feeds.

Case Highlight 6

CNG as a Gasoline Substitute: Energy and Transportation in Colombia

Options for gasoline displacement in Colombia included dieselization of additional vehicles, increased use of electric transport, and the utilization of compressed natural gas (CNG) as a fuel. These substitutes were compared with gasoline and weighed against each other on the basis of:

- cost and availability
- pollution and safety
- short-term implementation and savings potential
- relations to the country's overall energy strategy

Increased use of diesel and electricity, especially for public transportation in urban areas, showed promise nationwide, although with a relatively high cost and little gasoline displacement. The real surprise was that the use of CNG on a regional basis demonstrated economic viability.

Most of the country's natural gas reserves are located in the Ballena-Chuchupa offshore fields at the northeastern tip of the country. These fields, containing 84% of Colombia's 4000 billion cubic feet of proven reserves, are linked by pipeline to the main ports and cities of the northeast. Additional utilization of the region's abundant gas has stagnated because of the high costs of additional inland infrastructure, a depressed international market for liquid natural gas and other exportable natural gas products, and the recent concentration on oil and coal development.

The project focused on a disaggregated analysis of CNG potential for the northern region of the country. Freight transportation is extremely important in the region, which has major ports and industrial centers and produces meat, milk, oilseeds, cotton and fruits.

CNG use requires a conversion system added to each vehicle. In addition, CNG service stations must be constructed at well-placed intervals to compress and dispense the gas. The project proposes a phased implementation, beginning with the construction of 18 CNG stations for light vehicles and buses in urban areas and for inter-urban passenger and freight transport. This network will service up to 4800 vehicles per day, and will allow CNG-fitted vehicles to operate in all major cities and along major highways, including the major north-south highway to the inland city of Bucaramanga, connected to the nearby El Centro gas fields.

Project costs for this phase are estimated at US$13 million plus about $4.7 million for vehicle conversions. Subsequent phases to meet the total demand in the region would require three times as many service stations, at a cost of $39 million over six years. The completed project would fuel 80% of the urban public transport and 50% of the interurban freight and passenger service. This would displace 3200 barrels of gasoline per day, or about 25% of the national gasoline deficit.

Increasing oil prices throughout the late 1970s and early 1980s, combined with decreasing prices for the primary agricultural commodities on which both countries rely, resulted in an imbalance in trade efficiencies between the two sets of commodities. This imbalance has been compounded by export food sectors characterized by simple post harvest systems-crude commodity exports with little value added through packaging or processing.

The volume of coffee, banana and sugar exports (the primary agricultural exports of both Costa Rica and Panama) required to meet imports of crude oil has increased significantly with rising oil prices. Even with the current decline in oil prices, imported fuels and chemicals still represent up to half of total food production costs.

Case Highlight 7

Energy Conservation in Transportation Montevideo, Uruguay

A comprehensive study of the transportation system in Uruguay revealed important opportunities for energy savings throughout the country. Fifteen opportunities of energy rationalization were identified.

Because data on energy use in the transportation sector were incomplete and disorganized, one of the fundamental steps in the project was the collection of data and the design of a data base on the Use of Energy in Transport (UET). A new system, including the data base and the expansion of an existing energy planning model to include the transportation sector, was constructed as a means for ongoing planning and analysis for the program's counterpart agency, the National Energy Bureau (DNE).

Among the recommendations resulting from the analysis of options for rational energy use in transportation were:

- Renovating the urban bus and trolleybus system in Montevideo. The program recommended that the Municipal Government of Montevideo (IMM), in collaboration with the DNE, restructure the entire public transport system of Montevideo, including redesigning the bus routes, investigating the use of smaller buses and extending the trolleybus system.

- Establishing a "piggyback" system for transporting empty trucks returning to the countryside from Montevideo. The program recommended that the Ministry of Transportation and Public Works concentrate on implementing this "piggyback" system to bring energy savings in the short term. Medium- and long-term savings to promote rational energy use in highway cargo transport include reforming the railroad system and central freight terminals.

- Implementing a wide range of policies to improve the efficiency of the transportation system, including import taxes, pricing, and administration.

On the basis of the results of this initial energy and transportation program, the OAS and the municipal government of Montevideo are now developing a new urban transportation system and plans through the year 2000.

Studies carried out in Costa Rica and Panama examined the interconnections between the two sectors, aiming to help both national governments make integrated policy decisions to maximize economic benefits derived from these two sectors. Structurally, the projects had to integrate the efforts of many agencies and sectors, including energy, planning, agriculture, transportation, agribusiness, etc. A vertical analysis of the food sector, from production to final distribution, revealed opportunities for savings.

At the production level, the possibility of substituting unused agricultural wastes - coffee and rice hulls, banana starches and fish byproducts-for fertilizers and animal feeds were examined. Also, opportunities to reduce losses during processing and transportation were identified.

Food transportation accounts for a significant portion of fuel use in agriculture. Opportunities for fuel conservation in transportation were outlined. For example, in Costa Rica, unhulled rice was transported to mills in San Jose, resulting in the transportation of hulls and water. Processing goods at the production site could eliminate the transportation of wastes.

In addition, it was recommended that priority on the identification of value-added products for export, be placed bringing greater economic return to the country.

Energy and natural resource management

Natural resource management played an important part in the OAS Human Settlements Energy Program, carried out in the English-speaking Caribbean. The countries involved in the program face energy problems unique to small island states, with no known hydrocarbon resources and small and isolated energy demands. While certain activities in these countries (such as transportation) depend on imported oil, biomass resources form the basis of energy supply for the majority of rural and low-income urban residents. Neither situation is likely to change in the foreseeable future. Energy development activities in the region must focus on management of forest resources in order to secure future energy supplies.

Yet the issue includes more than the energy sector alone. Inadequate management of forest resources can result in deforestation, soil erosion, sedimentation problems, and overall environmental degradation, severely affecting other economic sectors. Therefore, while protecting future energy supplies, biomass management efforts can reduce other economy-wide threats.

General suggestions for sectoral integrated energy development programs

Sectoral integrated energy development is much less amenable to methodological development than regional integrated energy development because of the wide differences between sectors and countries. Specific methodologies will have to be developed on a case-by-case basis. However, some general suggestions can be made for projects of this category based on the experiences gained in the technical assistance programs just described.

1. Make a preliminary analysis of the importance of energy in the sector in question.

Before undertaking a major program in the integration of energy within a given sector, it is recommended that the office initiating the activity make a preliminary analysis of the extent of the linkages between energy and the activities in that sector, with specific focus on the likelihood of significant benefits if integrated energy actions were to be undertaken. In other words, it is essential to determine if there is a problem and if reasonable actions are available to effect significant change.

2. Guarantee Intel-institutional support and participation at the highest levels before initiating a sectoral integrated energy program.

To ensure the support needed during and, more important, after a sectoral integrated energy development program, the decision to initiate such a program must be made at the highest levels of authority within the participating institutions. As part of this decision, an inter-institutional technical team should be appointed to work together on the program, providing the direct day-by-day technical liaison between the program and the represented institutions.

3. Identify and prepare integrated energy information for the sector.

The technical team should make an initial identification of the major energy issues in the sector in question. Using these guidelines, the team should identify the data required to assess these issues, and then seek this data from the databanks of the participating institutions. It has been confirmed repeatedly by experience that the desired data often will not be available and a variety of surveys and statistical analyses will be required to attain an adequate level of information. Creativity and innovation are required at this step to generate this information within the time and resources available. The generated database and its methodologies must be carefully organized, documented, and set in a framework that is easily replicable in the future. This will provide a meaningful measurement of changes occurring automatically with time or resulting from policy initiatives.

4. Identify and select lines of action for integrated energy development within the given sector.

From analyses of the database that has been developed, structured interviews with experts within the sector, and the judgment of the technical team, this same team should identify potential lines of action to resolve energy problems in that sector (improve its productivity, reduce its energy consumption, etc.). These lines of action should be evaluated in sufficient detail to allow decision makers within the represented institutions to assign meaningful priorities and to select the lines of action to be analyzed in detail.

Case Highlight 8

Energy and Natural Resource Management: Saint Lucia

The critical role of biomass in the energy supply of the Eastern Caribbean states, especially for lower-income groups, was confirmed early in the Human Settlements Energy Project. While firewood and charcoal account for less than one-third of total energy consumption, it is estimated that 70-80% of all households in the region are at least partially dependent on biomass. The commercial energy supply, virtually all based on imported products, serves mainly the small upper and middle classes.

In Saint Lucia, over 70% of all households rely on biomass for energy; in low income, rural areas an estimated 85% of all households use charcoal or firewood. These traditional fuel supplies are likely to remain predominant in the future due to a combination of cultural preferences, high prices and limited availability of electricity and petroleum-based fuels, and the financial inaccessibility of modem LPG, kerosene or electric appliances.

Due to the extreme dependence of most human settlements in Saint Lucia on biomass, the Human

Settlements Energy Project first focused on an assessment of the resource base. While present forest reserves appeared adequate, a computerized analysis discovered alarming trends.

Under the present utilization rate, some 3000 hectares, or 12%, of the total suitable forest reserves were being consumed annually. At that rate, serious biomass shortages could be expected within 8-14 years. The decline in biomass availability was seen to be more than solely an energy supply problem:

• As easily accessible, primary forest is depleted, other forest species with a higher economic or ecological value would be exploited.

• As firewood and charcoal became more scarce, imports of petroleum products would increase, requiring additional foreign exchange and constraining other development programs.

• Environmental degradation resulting from diminished forest stands would cause numerous ecological and economic problems. Soil erosion could jeopardize agricultural projects; hydropower potentials would decline.

The serious and far-reaching nature of the potential problem led to the recognition that policy initiatives were essential. A joint study group, composed of government officials from the Energy Desk of the Central Planning Unit and the OAS, formed to recommend potential policies to reverse the problems.

A computer model adapted for the case study allowed planners to test various supply and demand cases and government policies. Three options were developed to improve the situation:

• A ten-year, 20 hectare per year Leucaena plantation program with an expected sustainable harvest beginning in 1992.

• The introduction of metal kilns capable of achieving an average charcoal conversion efficiency increase of 15% by 1988 and 20% by 1992.

• The reduction of import duties on kerosene stoves in 1988, generating a one-time, 30% shift from charcoal to kerosene.

The model demonstrated that, if implemented simultaneously, the three policies would conserve over 14, 000 hectares of forest by the year 2000, bringing a gradual and sustainable increase in biomass supply.

5. Analyze high-priority lines of action and prepare, analyze, and recommend sectoral integrated energy development policy and projects.

It has been seen in virtually all technical assistance programs that there is a natural tendency for data generation and problem analysis to be self-justifying. As in the case of regional integrated energy development, the activities of sectoral integrated energy development programs are justified only if they result in actions. Policy and decision makers must not be left with just information. They need specific recommendations for policy and/or investment actions that are shown to have desired effects and returns.

6. Looking ahead

This document has not attempted to suggest that integrated energy development can solve the energy or development problems in Latin America and the Caribbean. On the contrary, we have defined a relatively constrained set of circumstances in which this approach can be most effective. In areas which meet these criteria, and there are many throughout Latin America especially, integrating energy with the development process can make a discernible contribution to socioeconomic growth. In other areas, and in overall planning and policy, certain facets of integrated energy development may be applicable, even when the entire process is not appropriate. One of the foremost lessons from integrated energy development that can be applied in many instances is the inter-sectoral coordination promoted by these projects.

The future of integrated energy development, on both a regional and a sectoral level, rests largely on the willingness of various institutions and agencies to step outside of their traditional roles and acknowledge the interconnections linking the development process. As this paper has stressed, no one agency can "do" integrated energy development. Instead it must involve a cooperative effort among all participating agencies.

We have shown that energy does not necessarily have to be viewed with the traditional, supply orientation. When seen as a catalytic force capable of bringing about development, energy becomes an integral part of all activities, more than a sector in itself. Again, this approach is not meant to replace the traditional supply-side emphasis, but to complement it. Energy balances must still be compiled, new energy infrastructure must be built. Yet with an expanded scope, supply organizations can see opportunities for demand development projects; development organizations can incorporate energy into their planning process. A number of possibilities exist for the future. On a sectoral level, the methodology could be attempted in additional sectors in which energy plays a critical role, such as mining and other industries. For regional integrated energy development, potentially promising activities are undoubtedly located throughout Latin America and the Caribbean. We hope that the experiences of the OAS and counterpart agencies, as described in this document, will assist others in identifying opportunities in their planning for energy development.

The Organization of American States

The purposes of the Organization of American States (OAS) are to strengthen the peace and security of the Hemisphere; to prevent possible causes of difficulties and to ensure the pacific settlement of disputes that may arise among the member states; to provide for common action on the part of those states in the event of aggression; to seek the solution of political, juridical, and economic problems that may arise among them; and to promote, by cooperative action, their economic, social, and cultural development.

To achieve these objectives, the OAS acts through the General Assembly; the Meeting of Consultation of Ministers of Foreign Affairs; the three Councils (the Permanent Council, the Inter-American Economic and Social Council, and the Inter-American Council for Education, Science, and Culture); the Inter-American Juridical Committee; the Inter-American Commission on Human Rights; the General Secretariat; the Specialized Conferences; and the Specialized Organizations.

The General Assembly holds regular sessions once a year and special sessions when circumstances warrant. The Meeting of Consultation is convened to consider urgent matters of common interest and to serve as Organ of Consultation in the application of the Inter-American Treaty of Reciprocal Assistance (known as the Rio Treaty), which is the main instrument for joint action in the event of aggression. The Permanent Council takes cognizance of matters referred to it by the General Assembly or the Meeting of Consultation and carries out the decisions of both when their implementation has not been assigned to any other body; monitors the maintenance of friendly relations among the member states and the observance of the standards governing General Secretariat operations; and, in certain instances specified in the Charter of the Organization, acts provisionally as Organ of Consultation under the Rio Treaty. The other two Councils, each of which has a Permanent Executive Committee, organize inter-American action in their areas and hold regular meetings once a year. The General Secretariat is the central, permanent organ of the OAS. The headquarters of both the Permanent Council and the General Secretariat is in Washington, D.C.

The Organization of American States is the oldest regional society of nations in the world, dating back to the First International Conference of American States, held in Washington, D.C., which on April 14, 1890, established the International Union of American Republics. When the United Nations was established, the OAS joined it as a regional organization. The Charter governing the OAS was signed in Bogota in 1948 and amended by the Protocol of Buenos Aires, which entered into force in February 1970. Today the OAS is made up of thirty-two member states.

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