

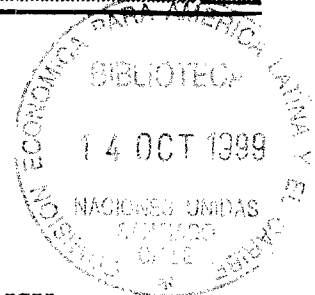


- Antigua and Barbuda
- Aruba
- Bahamas
- Barbados
- Belize
- Br. Virgin Islands
- Cuba
- Dominica
- Dominican Republic
- Grenada
- Guyana
- Haiti
- Jamaica
- Montserrat
- Netherlands Antilles
- Puerto Rico
- Saint Kitts and Nevis
- Saint Lucia
- Saint Vincent and the Grenadines
- Suriname
- Trinidad and Tobago
- U.S. Virgin Islands



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RENEWABLE ENERGY IN THE CARIBBEAN WHERE WE ARE; WHERE WE SHOULD BE



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RENEWABLE ENERGY IN THE CARIBBEAN WHERE WE ARE; WHERE WE SHOULD BE

Introduction

There have been many meetings on the topic of renewable energy in the Caribbean. Indeed, there is a network promoting the use of renewable energy. Yet, not much progress has been made in the use of renewable energy in the Caribbean countries. It has been argued that the issue gets prominence only when the price of oil is high. Since the price of oil has been relatively low during the last 15 years, there has not been much interest in alternative energy sources. While, to some extent the above may be true, it is also true that the providers of energy in the region are monopolies and, in the absence of competition, have not made any effort to reduce their dependence on oil, since they have already made investments in the necessary plant and equipment for oil.

Interest in, and concern for, environmental preservation may help to advance the cause of renewable energy use. However, increases in production and utilization of alternative energy sources, namely, natural gas, may create setbacks to a renewable energy programme, since oil producers and large companies may opt to utilize this product more efficiently in their total energy equation. There are already many signs that this is so, as the large oil companies are beginning to show interest in electricity generation. The use of natural gas is less damaging to the environment, but it is not a renewable source of energy. A change from oil to gas will simply be a reorientation of dependency with respect to energy security, and a foreign exchange drain for those countries without reserves of natural gas.

Energy, development and the environment

The critical role of energy in the development process is recognized by all and need not be stressed here. The level of energy consumption is widely used as an indicator of economic activity. Recently, though, two other factors have come into play within the energy equation. Firstly, the damage to the environment caused by the continued use of oil and secondly, the question of national security, although this is not given importance by developing countries, especially the very small and vulnerable States.

The effects of the by-products of oil-generated electricity on the environment have been well documented. A number of developing countries, however, contend that the degree of environmental degradation through their continued use of oil is insignificant. This may be construed as an excuse for inaction, since it is the cumulative effect that is important.

With respect to the issue of security, this is a two-edged sword. While currently the price of oil is low, oil continues to be a finite commodity and, given that a small number of countries control the vast resources, it is inevitable that the price will increase either through demand and supply mechanisms or as a result of action taken by the suppliers to secure their resources. Additionally, for small States lacking the power to protect themselves, an embargo is all that is needed to bring these States to compliance.

Status of energy sources in the Caribbean

At present, over 90 per cent of energy used in the Caribbean is fueled by oil. There are wind energy turbines, solar panels, hydroelectric plants and geothermal plants that generate electricity, but none anywhere near the region's potential. There are no grid connected solar energy sources, while wind, geothermal and hydro sources are grid connected in isolated cases. The following table shows the amount and sources of energy used in selected Caribbean countries.

Table 1
Breakdown of electricity generation and demand by individual countries in 1992

Country	Total Generation (kWh)	% Source					Installed Capacity (Mw)	Peak Demand (Mw)
		Oil	Hydro	Wind	Solar	Biomass		
Antigua	132.7	100	0	0	0	0	39.0	21.6
British Virgin Islands	69.7	100	0	0	0	0	21.0	10.1
Barbados	570.8	100	0	0	0	0	152.1	91.5
Belize	NA	NA	NA	N.A.	N.A.	N.A.	N.A.	N.A.
*Cuba	9,457	50	4	0	0	46	4082	N.A.
Dominica	46.0	N.A.	N.A.	N.A.	N.A.	N.A.	14.8	8.3
Grenada	67.7	100	0	0	0	0	18.5	11.5
**Guadeloupe								
Guyana	238.6	73	0	0	0	27	107.0	50.5
*Haiti	137	13	5	0	0	82		N.A.
Jamaica	2,232.9	97	3	0	0	0	620.2	354.0
Montserrat	18.0	100	0	0	0	0	4.6	3.0
St. Kitts/Nevis	57.2	100	0	0	0	0	16.3	9.5
St. Lucia	152.1	100	0	0	0	0	34.0	25.2
St. Vincent	56.0	N.A.	N.A.	N.A.	N.A.	N.A.	16.2	9.9
*Suriname	1263	55	34	0	0	11	391	N.A.
+Trinidad/Tobago	3,770.0	N.A.	0	0	0	0	1,251.2	569.0
**USVI	N.A.	100	0	0	0	0	N.A.	N.A.
**Netherlands Antilles								

Source: Petroleum and Energy Statistics in the Caribbean. Prepared by the Regional Focal Point, Scientific Research Council, Jamaica in Association with the CEIS National / Subregional focal point *Source: Energy-Economic Statistics and Indicators of Latin America and the Caribbean. Prepared by the Latin American Energy Organization
+ - Trinidad and Tobago utilizes natural gas for electricity generation

Wind energy use is most developed in Curaçao and Guadeloupe (Marie Galante) where approximately 3 megawatts and 1 megawatt, respectively, are produced. A small experimental 225-kilowatt wind turbine in Monroe College in Jamaica is the only example of a grid-connected wind energy source in the English-speaking Caribbean. Guadeloupe has the only functioning geothermal plant in the region with an output of 5 megawatts of electricity. Jamaica, Dominica

and Saint Vincent and the Grenadines have hydroelectric plants but their importance has been dwindling over the years. Solar energy in the form of photovoltaic cells are used primarily for hot water heating in homes in the region, mainly in Barbados and Saint Lucia. Solar panels also power navigational equipment and other beacons in the region, but there is no case of a grid connected solar energy source.

The potential

It is necessary to caution that the case is not made here for a total break with fossil fuel energy. That would be impractical. However, for the reasons mentioned and in order to reduce the drain on scarce foreign exchange reserves, a case can be made for the region to develop hybrid systems to take advantage of the resources that are available. What is suggested is the development of those energy sources that are most abundant on an island-by-island basis to supplement or complement oil-generated energy and electricity. Given the present state of the technologies, wind, geothermal and mini-hydro energy sources seem to offer the best opportunities for grid connected electricity generation, while photovoltaics and biomass may be included in a total energy package for the region.

Wind

It is estimated that most of the islands have suitable wind patterns for generating electricity. However, actual studies have not been carried for validation, including the production of reliable data for design and positioning of equipment. Advances in material science have corrected many of the earlier problems of corrosion and gearbox failures of earlier turbines, to the extent that most manufacturing companies can now give a 15-year guarantee on their products. In addition, the design of larger units of approximately 500 kilowatts now make it possible to generate a substantial amount of energy from a wind farm utilizing a smaller area, thus increasing the efficiency.

One of the arguments put forward against wind turbines, especially by the solar energy companies, is that they are noisy. However, in the places where wind turbines are operational, persons living nearby disprove that argument by saying that they are no noisier than a hand-held boom box or loud car speakers. Another argument advanced is that wind farms utilize large amounts of space, which could otherwise be used. Again, in practice, the opposite is true. In Wales, for example, farmers graze their livestock in the area of the wind farm, giving farmers another source of income in the same land area. The height of the towers necessary to support the turbines is given as another reason for the lack of support for wind as a source of energy. A factor, it is argued, that must be considered, given our geographic position within the hurricane belt. It can be argued, however, that this is a consideration for any type of structure in the region and there are ways to minimize the deleterious effects of hurricanes on buildings and structures.

Wind energy has potential for use as an energy source in the agricultural sector, specifically for irrigation. With furrow irrigation proving to be very inefficient and many water sources in the Caribbean situated in valleys, it is necessary to pump water for sprinkler or drip irrigation systems. Since most farms are outside of the area of the electricity grid, small wind

turbines can be an efficient method of pumping water for irrigation purposes. The small wind turbine can also be used for pumping water for livestock use.

Wind energy can therefore be competitive since it is now possible to produce electricity at approximately 4-6 cents per kilowatt. It also offers the opportunity for cleaner electricity generation, greater versatility in use especially in the agricultural sector for irrigation, and can provide a standby source of electricity to reduce vulnerability.

Solar/photovoltaics

The present stage of development of this source of energy suggests that it will be a long time before it can be considered for grid connection in the Caribbean. However, the potential of this source should not be underestimated. The potential for increased use exists in agriculture, industry, including street lighting, and in the home.

In agriculture, solar crop dryers provide for greater uniformity of drying, with increased output in a shorter period of time. Solar/photovoltaic sources may also be used to pump water for irrigation. Recently a number of countries have installed photovoltaic cells on streetlights in remote and rural areas outside of the electricity grid area. Another widespread use of solar energy is that of providing hot water for household use. While both Barbados and Saint Lucia, because of generous incentives and promotion, have made great strides in this area the other countries of the region are lagging behind. Where solar water heaters have been used, it has been shown to reduce energy costs by about 3 per cent for the household.

Possible deterrents to the use of solar heaters are the initial high cost of installation and the fact that these units have to be mounted on roofs or other raised areas which make them susceptible to hurricane damage. Costs are, however, being reduced due to competition and better designs are being developed to deal with the hurricane problem.

While solar/photovoltaic energy sources are not immediately suitable for grid connection, they can play a meaningful role in rural development. They can make a tremendous contribution to the agricultural sector by reducing post-harvest loss, improving the quality of dried fruits and other products and, as a source of energy for irrigation, increase farm yields. Research work at the University of the West Indies (UWI) has shown the potential for large-scale ice making and refrigeration using photovoltaics. Research in the United States of America and Europe has demonstrated the use of solar energy to provide air-conditioning for office buildings especially those using glass in their design. At present, the estimated cost of generation for solar/photovoltaic is around 6-8 cents per kilowatt and this is decreasing as solar cell technologies improve.

Hydroelectricity

Although the introduction of low volume continuous flow systems have made this technology readily applicable in small streams, poor agricultural practices and inadequate forest management techniques have reduced the potential use of this energy source, as rivers and streams in many islands of the Caribbean are being reduced to trickles. With the exception of the larger Caribbean countries that still have some rivers of note, only Dominica, and to a lesser

extent Saint Vincent and the Grenadines, may be able to explore this energy source economically. It may not, however, be a bad policy to advocate hydro-electricity generation in the region, if only to sensitise our people to understand the damages that have been done to the watershed and adjoining areas, and to instill into the policy makers the need for action to reverse these damages and trends. Thankfully the era of large hydro dam projects are over as this has also done tremendous damage to the ecosystem.

Under conditions of good water supply, the cost of generating energy through hydroelectricity ranges from 5-18 cents per kilowatt and is competitive with oil-based energy generation under favourable conditions. At present, grid connected hydroelectricity is generated in Jamaica, Saint Vincent and the Grenadines and Dominica.

Biomass

Introduced in the region in the late 1970s, this source of energy has not received enough attention, simply because it is a technology that requires large inputs of material. Primarily in the form of bio-digesters, a number of units have been installed and are operational in the region providing small amounts of gas for cooking. In Guyana and Suriname, sawmills operate their own generating plants from millings and provide the electricity and energy necessary for their operations.

The potential use of this technology, though, is limited as it has implications for conservation. The amount of waste produced in the small islands may make it an uneconomical undertaking and, as the other more suitable technologies are employed, the attractiveness of biomass as an energy source will be reduced. Operating costs of biomass plants range from 4-8 cents per kilowatt.

Ocean Thermal Energy Conversion (OTEC)

Although employed to a limited extent elsewhere, this source of energy whereby the differential in water temperatures and wave heights are converted to energy for electricity is not employed in the Caribbean. In addition to high operating costs, the technology is still in its infancy.

Alternative energy sources

Often, the terms renewable energy and alternative energy are used interchangeably. However, in this paper and because the focus is renewable energy, a distinction will be made between renewable and alternative energy sources, where the new energy sources are themselves not renewable. For Caribbean States these are primarily geothermal and natural gas sources.

Geothermal

The latest study conducted in 1992 showed that at least six of the Caribbean islands had good potential for geothermal energy. Preliminary studies show that Nevis, Dominica and Saint Lucia have the most potential for the generation of electricity from geothermal sources. Geothermal energy, like wind energy, is capable of grid connection, as relatively large amounts

of energy can be generated from a single plant. A French company is successfully operating a plant in Guadeloupe producing about 3 megawatts of electricity to power a village. An attempt to develop a geothermal plant in Saint Lucia was not successful, due mainly to inadequate feasibility studies. However, after a review of the available data, the French company has expressed an interest in revisiting the project. The cost of geothermal energy is approximately 4-7 cents per kilowatt, making it very competitive with fossil fuel-based energy.

Natural gas

Currently, natural gas as a source of energy is only important in Trinidad and Tobago, where it is primarily used for electricity generation. While the bulk of the natural gas produced is used as fuel, a significant amount is used as processed gas. The gas-based downstream and heavy industry sector has seen increased levels of investment in the ongoing thrust to utilise the country's natural resources. Table 2 provides statistical data on the production and utilisation of natural gas in Trinidad and Tobago. At a cost of around 4-8 cents per kilowatt the potential for increased use in the region, however, is not anticipated. However, with the large oil companies entering into electricity generation, and the technologies for the use of natural gas is readily available, it is possible that gas could replace oil as an alternative energy source in the Caribbean region.

Table 2

NATURAL GAS PRODUCTION 1998 (MMscf/d)		UTILIZATION OF NATURAL GAS 1998 (MMscf/d)	
Amoco Trinidad Oil Co.	617	Power Generation – T&TEC	180.79
Enron Gas and Oil Trinidad	137	Fertilizer manufacturer	337.89
British Gas	176	Methanol manufacture	181.39
Trinidad Northern Areas	45	Iron and Steel manufacture	47.45
Petrotrin	18	Refinery – Petrotrin	47.86
T&T Marine Petroleum Co.	1	Cement manufacture – Trinidad Cement Ltd.	12.03
Coastline International	1	Gas Processing – Phoenix Park Gas Processors	16.97
Moraven	1	Small consumers	11.7
TOTAL	996	Total	836.13

Source: An information guide on the energy industry of Trinidad and Tobago – Ministry of Energy and Energy Industries
www.energy.gov.tt/statistics

MMscf/d – Millions of cubic feet per day

Table 3
Cost of new Electricity Generation in 1987 Dollars
 (cents/kWh)

SYSTEM	LOW	HIGH	AVERAGE
Solar Thermal Hybrid	6.0	7.8	6.9
Petroleum	5.0	8.5	7.2
Natural Gas (Intermediate)	5.3	7.5	6.4
Hydro	5.2	18.9	12.1
Wind	4.7	7.2	6.0
Natural Gas (Combined)	4.4	5.0	4.7
Geothermal	4.3	6.8	5.6
Biomass	4.2	7.9	6.1

Source: Prospects and Achievements of Renewable Energy by Professor A.A.M. Sayigh, Department of Engineering, University of Reading, Reading, United Kingdom, Published in the Proceedings of the Caribbean High Level Workshop on Renewable Energy Technologies, December 5-9, 1994, Saint Lucia

The missing link

There is no clear policy on energy use in the Caribbean. In the 1970s with the increased cost of fossil fuel energy sources, attempts were made to introduce a renewable energy project in the region with emphasis on wind and biogas. Solar thermal sources also received some attention. Unfortunately, because the technologies were in the infant stages the project was not successful. Insufficient data on wind regimes, poor quality of materials and bad designs all helped to mitigate against the success of the proposed Renewable Energy Action Plan. In addition, it appeared that the project was hastily put together to take advantage of available funds.

In the present scenario of maturing technologies, it is possible for the region to embark on a systematic programme for the introduction of renewable energy sources that could reduce the deleterious effects on the environment, generate income from industrial development, generate and save foreign exchange and provide some measure of national security.

With very little fanfare, the renewable energy programmes in both the United States and Europe are going apace. The European Community has taken a decision that approximately 30 per cent of its energy needs must be via renewable energy sources by the year 2004. In the United States, although no target year has been set, the Department of Energy funds large projects every year to promote the use of alternatives. There is no reason why the Caribbean cannot develop policies for the promotion and use of renewable energy programmes in the region.

What may be done

At a Caribbean high-level workshop on renewable energy held in Saint Lucia in 1994, a model renewable energy policy was developed. Unfortunately, this document remained largely in the report and has not been studied by any administration. The document is reproduced here

for ease of reference. The main focus of the policy is to encourage governments to develop energy policies designed to encourage energy efficiency and renewable energy sources. With reference to the main energy sources outlined above, the following actions are required:

Wind

- Studies on the wind regimes to determine best sites
- Decision to incorporate wind energy into a national grid
- Funding for a few trial turbines for grid connection
- Funding for a few trial turbines for irrigation purposes
- A policy decision by the utility companies to use wind energy where suitable.

Solar/thermal

- National policies that will promote use of solar water heaters
- Funding for programmes that will promote the use of solar crop dryers and solar pumps for irrigation in the agricultural sector
- A decision by the utility companies to use solar energy where best suited, e.g. streetlights, etc.
- Funding for the continuation of work at the University of the West Indies on solar dryers, distillers, etc.

Hydro energy

The present potential for the application of this energy source is now very low. However, as concerns for the environment and good policies reverse some of the damage done to the watershed, it is possible that the streams and rivers may once again flow with sufficient volume to permit some small continuous flow pumps to be installed, either for grid connection or for stand alone electricity and energy supply in remote areas. An important action, therefore, is for watershed management and reforestation programmes to be instituted and sustained.

Other sources

Geothermal

With the exception of the exploratory work done in Saint Lucia, there is insufficient data on all the other potential sites in the region. Specific requirements include:

- A good programme of data collection and analysis
- Funding for exploratory work on some of the best sites identified

- Funding to build and operate a plant in Saint Lucia as a pilot project.

Ocean Thermal Energy Conversion (OTEC), the other energy source mentioned, has a long way to go before it can be considered viable in the Caribbean. We should avoid making the same mistake of the 1970s with the resulting failures creating a lack of confidence in renewable energy sources when experimental energy technologies were introduced to the region.

Policy and finance

In considering the use of alternate sources of energy, two areas clearly lacking are those of policy and finance.

Policy

While it may be difficult to come to consensus for a regional policy, this continues to be the best option. It has been shown, however, especially by Barbados, that national policies can promote the use of renewable energy and provides examples for regional action. *It is also recognised that for the use of renewable energy to be meaningful in the region, the utilities must buy into the policy and be willing to make incremental changes in their generating strategies.* Given that the utilities would have already made large investments in the traditional source, it is not expected that change will take place over night. However, it is important that the need to diversify the energy sources be recognized and that conscious efforts be made by the utilities to introduce renewable sources of energy, even though they may be more expensive in the short run. Alternatively, if the utilities do not want to incur the risks, they can agree to buy electricity generated from alternative sources from private companies at a cost that is comparable to their own generating capability.

The present state of affairs suggests that utilities on their own will not exhibit concern for the environment and other security measures outlined above. It would therefore be incumbent on governments to enact good environmental legislation as an incentive for the utilities. The model policy provided in this document could be visited by governments for possible implementation.

Finance

Two major sources of financing will be required to advance the cause of renewable energy in the Caribbean. One, to finance research and development work and another to help the utilities offset the additional costs of retrofitting and new equipment. Research and development may be financed by grants from the international financial institutions, such as the World Bank and the Inter-American Development Bank (IDB), from the United Nations Development Programme (UNDP), or the regional Caribbean Development Bank (CDB). Countries may also approach the European Union (EU) collectively for assistance.

The second financing requirement may be of a more commercial nature with loans provided to companies at lower interest rates and spread over longer terms. This will allow the utilities to recover their additional costs within a reasonable period of time. Funds may be sourced from the World Bank, the IDB or the CDB.

Energy conservation

It has been argued that because of the small size of the population and the high cost of equipment the rates of return on investment have not been profitable for the utilities. Thus utilities do not necessarily promote or advocate energy conservation measures and programmes. However, the nature of energy generation and supply require that the utility must always be able to provide over and above demand if a reliable source of energy is to be provided to the population for development. That dilemma can be overcome if the load demand is streamlined. A good, energy conservation programme can help to reduce the demand at non-critical periods. If this is done, the demands can then be met by non-conventional sources at selected points, or the non-conventional sources can be added to the grid at peak periods to meet demand. Expenditure for meeting installed capacity ratios can be then channeled to alternative energy sources.

Renewable energy and integrated planning

It is also important to remember that there is the need to bring electricity to the entire population to, among other things, allow children to do their school work utilizing the latest technologies (computers); give communities the opportunity to embark on projects requiring power tools, thereby increasing productivity; and provide a measure of safety through well-lit areas. In most cases renewable energy units can provide for these amenities when the national grid becomes too costly to expand. These are aspects not always factored into the debate on a programme of electricity expansion with limited population, because of the sectoral approach to planning on this and other similar issues. When the role of energy in the development process is considered the profit margins should not be the overriding factor in decision-making. Matters of employment generation, health, increased agricultural productivity, increased level of education of the population, and security of the population are all factors that impact on the economic well-being of the citizens.

Another aspect of the need for integrated planning around energy is the question of skewed development in the nation. Tardiness in bringing energy to rural communities will invariably encourage migration of persons to urban areas. This then creates strains on both urban and rural communities. The urban community experiences a strain on its amenities and the rural areas experience a shortage of skilled manpower to promote community development work. Invariably a "boom and bust" syndrome is experienced, that can quickly result in shanty towns developing among the less fortunate of the migrants to the urban areas.

Conclusions

It is not the intention of this paper to suggest that skewed development will not occur if a programme of renewable energy promotion is adopted. The topic was selected to demonstrate the effects on the planning process in the context of a service that is a necessity for the development of the State. Other services, including education and tourism, can also be used as examples.

The question of renewable energy use in the Caribbean has implications for a development strategy, environmental preservation, management and security. For example, the

introduction of solar water heaters in Barbados and Saint Lucia has generated employment opportunities, as small and micro enterprises have been able to manufacture these units. In Costa Rica, a programme to provide rural electricity has triggered the manufacturing of small wind turbines by local companies. The potential, therefore, exists in the region for small-scale construction of solar dryers, where a large number could be utilized in the agricultural sector. All of these are activities at the level of small and medium-sized enterprises that may be promoted in the region to generate employment. Larger units will have to be purchased abroad but these costs will be offset by a decrease in the use of fossil fuels.

Environmental protection and management should be the concern of all and whatsoever steps can be taken to contribute to this process should be encouraged and even rewarded. Every effort must be made to ensure that future generations enjoy at least the same or better environmental conditions from the present. Every bit counts.

The absence of a policy to promote renewable energy use in the Caribbean may very well result in another non-renewable energy source replacing oil in the region. As has been mentioned, there is growing interest on the part of major petroleum distributors to begin to utilize natural gas for electricity generation. This would be an unfortunate situation since, except where geothermal energy may be available nationally, such a decision will not result in any saving on foreign exchange, it will not provide security and, though it may reduce the level of environmental damage, it will not remove the total dependence on imported energy sources that Caribbean States now experience.

Lastly, because this is not a technical paper on renewable energy sources, the details of the technologies were kept at a minimum. Instead, the focus was on the need for a renewable energy programme to meet energy needs in the region while also meeting our obligations to resource management, environmental preservation and sustainable development.

RESOLUTION AND MODEL ENERGY POLICY

UNESCO /CCST/UWICED

Caribbean High-Level Workshop on Renewable Energy Technologies

Saint Lucia

We, the regional delegates to the Caribbean High-Level Workshop on Renewable Energy Technology, held in the context of the World Solar Summit Process in Saint Lucia, from 5-9 December 1994:

Recognising the impact of the cost of energy on the economies of the region and, consequently, the need to develop indigenous sources;

Noting the endowment of the region in sustainable sources, such as solar, wind, hydropower, geothermal, biomass and the conversion of wastes, and the contribution to be made by the development of such sources to local industry and employment opportunities;

Recognizing the harmful impact on the environment of the current and projected future use of fossil fuels;

Aware that sustainable development requires the efficient use of resources in harmony with the environment;

Recognising that the development of renewable sources is likely to be the least cost option for the region in the long run, but requires initial development support;

Aware of the importance of a diversity of energy sources to the stability and security of the region;

Conscious of the need for energy policies which reflect these principles;

Noting that member States of the European Union, the United States, India and some Caribbean States have introduced a combination of legislation and fiscal incentives to stimulate the implementation of Renewable Energy Technology;

Now:

1. Urge governments of the region to follow these examples by authorizing premium rates or other suitable incentives for the use of renewable energy sources;
2. Urge all governments in the region to develop energy policies designed to encourage energy efficiency and the use of renewable energy sources; and to establish a regulatory framework which will allow electric utilities to undertake the actions called for in such a policy;

3. Request the sponsors of the workshop, as a first step, to facilitate the development of a model energy policy using one country to illustrate the necessary elements; and
4. Recommend Saint Lucia as the first **territory to which the policy should be** applied, in view of its endowment with sustainable sources, the apparent potential for increased efficiency, and the expressed interest of the Government in preliminary studies already done.

Model energy policy

The delegates to the Caribbean High-Level Workshop on Renewable Energy Technology held in Saint Lucia from December 5-9, 1994, recommend to governments of the region that policies to promote efficiency and encourage the use of renewable energy should include the following elements:

Goals

Energy policy aims to support national development by maximizing net foreign exchange earnings, promoting job creation, local entrepreneurship and equity among social groups in the development process, as well as reducing environmental impacts such as deforestation and air and water pollution. To be effective, it must also contain the means of communicating these goals to the public in terms easily understood.

General provisions

- Extend existing databases on energy supply, end use and consumption, and develop analytic capability in order to provide a sound basis for energy planning.
- Establish the net impact on employment, energy use and foreign exchange requirements of all major energy development initiatives, to be considered as part of the approval process.
- Require rational use of energy by matching appropriate energy sources to end uses; e.g. the use of solar energy, LPG, or natural gas for cooking; or solar energy for heating water.
- Ensure that energy prices to consumers fully reflect the economic cost; and that instruments, such as taxes and duties, have the effect of encouraging efficiency.
- Establish mechanisms for regional cooperation in energy planning and development.

Petroleum supply

- Require a least cost regime for the procurement of petroleum supplies.

Environmental

- Quantify and evaluate the ecological impact of energy projects, both renewable and conventional, and ensure that the costs of these impacts and mitigation measures are included in project costs.
- Provide zoning protection for potential renewable energy locations, such as hydropower basins, solar collector and wind power sites and forested areas; and guarantee individual rights to solar and wind resources.

Renewable sources

- Encourage the use of sustainable energy sources, by authorizing utilities to offer incentives, and by facilitating the procurement of venture capital where necessary.

Electric utilities

Require electric utilities to:

- (a) Evaluate the economic merit of energy efficiency and renewable sources as part of their regular planning process, and to demonstrate that these factors are fully considered in their least cost planning.
- (b) Determine and publish long-term marginal or avoided costs using methodology recognized by the utility industry and regulatory agencies.
- (c) Provide fair and reasonable rates, based on avoided cost, for the purchase of energy from co-generation and renewable energy producers, and for the provision of stand-by service where necessary.
- (d) Allow connection to the respective utility grid systems of independent producers of energy, based on renewable and co-generation sources, provided agreed standards of firm capacity and reliability are met.

Encourage utilities to:

- (e) Assist their customers in minimizing energy use by offering rebates or other forms of cost sharing in efficiency investments. Where independent regulatory agencies exist, governments should ensure that the policies of these agencies allow the utilities to offer these incentives.

Allow utilities to:

- (f) Earn at least the same return on efficiency investments as on other capital investment.

Transportation

- Reduce energy usage and exhaust emissions in transportation by the articulation of system management policies and investments in traffic system management schemes: the fuel efficiency of engines: and vehicle maintenance, to be reflected in more rigorous inspection in relation to licensing.
- Investigate new fuels and propulsion systems, such as fuel alcohol or electric cars.

Training and education

Specific provision must be made for keeping the staff of governments, utilities and regulatory agencies, up-to-date with new developments in the field of energy technology and integrated resource planning.

Other elements

- Require the establishment of energy efficiency building codes to be incorporated into the draft Caribbean Building Code.
- Establish efficiency standards for industrial and domestic appliances.
- Encourage effective waste management and the use of agricultural and other wastes as energy sources.

Suggested reading materials

1. Caribbean Energy Conference and Trade Exposition, October 22-29, 1993. Conference Proceedings Edited by Solomon Kabuka, DBA. Produced by the Virgin Islands Energy Office/ University of the Virgin Islands.
2. Renewable Energy – An International Journal. Special Issue: World Renewable Energy Congress IV – Renewable Energy, Energy Efficiency and the Environment, 15-21 June 1996, Colorado, and U.S.A. Late papers. Editor-in Chief: A.A.M. Sayigh.
3. Renewable Energy Climate Change and the Environment. World Renewable Energy Congress, 11-16 September 1994, Reading, U.K. Part III. Edited by A. A. M. Sayigh.
4. Caribbean Least Cost Petroleum Supply study (1991). Submitted by consultants: T. G. Steigerwald and J. R. Peet.
5. Proceedings: SATIS'94 Sustainable Alternatives for Tropical Island States, 14-16 March 1994, Barbados. Edited by L. L. Moseley and O. St C. Headley. Produced by the University of the West Indies Centre for Environment and Development supported by the Rockefeller Foundation in association with the Commonwealth Science Council, The World Renewable Energy Congress, UNESCO and the Caribbean Solar Energy Society.
6. Energy-Economic Statistics and Indicators of Latin America and the Caribbean, Quito, May 1993. Produced by the Latin American Energy Organization.
7. Proceedings of the Caribbean High Level Workshop on Renewable Energy Technologies, December 5-9, 1994, Saint Lucia. The World Solar Summit Process. Editor: Rhonda G. Wilson. Supported by the United Nations Education Scientific and Cultural Organization (UNESCO), Caribbean Council for Science and Technology (CCST) and The University of the West Indies Centre for Environment and Development (UWICED).
8. Workshop on Renewable Energy in the Caribbean, Curaçao, October 11, 1996. Papers presented at the NOVEM/KODELA/FAPE, Workshop on Renewable Energy in the Caribbean.
9. CCST/UWICED/UNESCO Workshop on Investment Funding for Renewable Energy and Energy Efficiency Projects in the Caribbean, Kingston, Jamaica, 17-19 January 1996. LC/CAR/G.479 CCST/96/2. Produced by the United Nations for Latin America and the Caribbean Sub-regional Headquarters for the Caribbean, Caribbean Development Committee.
10. Overview of Renewable Energy Sources. Prepared by: Ministry of Public Utilities and Transport, Jamaica.
11. Séminaire sur la maîtrise de l'Énergie des pays ayant en commun l'usage de français. Avec le concours du: Groupe Conseil Eduplus Inc. Ste-Lucie, 16-19 novembre, 1992.

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