

***Energy for Sustainable Development
Toward a National Energy Strategy for Belize
Energy Sector Diagnostic***

Project funded by United Nations Development Programme, Public Utilities
Commission and the Government of Belize

*Prepared by
Launchpad Consulting
Belize, C.A.
In collaboration with
Dr. Ivan Azurdia
Fundacion Solar
Guatemala City, Guatemala*

*Prepared For
The Public Utilities Commission
National Energy Plan Project*

November 5, 2003

TABLE OF CONTENTS

1.1	The International Energy Outlook	14
	Economic Outlook/Energy Markets	14
	Environment	15
	Social Issues	16
	Energy Security	16
1.2	Regional Context	17
	The Caribbean	17
	Central America.....	18
1.3	National Context.....	19
	General Profile	19
	Political Organization.....	20
	Economy.....	20
	Social Issues	21
	Environment	22
2.0	<i>Physical Characteristics of the Belize Energy Sector.....</i>	23
2.1	Energy Sources and Uses	23
	Traditional Biomass (Wood)	23
	Fossil Fuels.....	23
	Liquified Petroleum Gases	25
	Electricity	25
	Renewable Energy Technologies	26
3.0	<i>Organization and Regulation of Belize’s Energy Industries</i>	26
3.1	Traditional Biomass (Wood)	26
3.2	Petroleum Products.....	26
	Industry Structure	26
	The Wholesale Market	27
	The Retail Market.....	27
	Regulatory Environment	28
3.3	(LPGs).....	29
	Industry Structure	29
	Regulatory Environment	30
3.4	Electricity	31
	Distribution, Transmission and Supply	31
	Generation	33
	Regulatory Environment	37
4.0	<i>Energy and Sustainable Development.....</i>	37
4.1	Belize and Sustainable Development	39
	Energy and Belize’s Sustainable Development.....	40
4.2	Renewable Energy Technologies.....	44
	Defining Renewable Energy.....	44
	Advantages and Limitations of RETs.....	44
4.3	Renewable Energy Technologies in Belize	46
	RET for Electricity Generation	46
	RE in the Transport Sub-sector	48
	Barriers	49

5.0	<i>Domestic Energy Policy</i>	50
5.1	Domestic Energy Policy	50
6.0	<i>International Energy Agreements</i>	53
6.1	Belize and Energy Integration	53
	Agreements and Conventions.....	54
	Institutions and Integration Frameworks.....	55
	Projects	55
	Trade.....	56
7.0	<i>Summary and Conclusions</i>	59
	<i>References</i>	62

TABLE OF FIGURES

Figure 1 – World Primary Energy Demand	14
Figure 2 – Map of Global Energy Poverty	15
Figure 3 – Proven Gas Reserves	16
Figure 4 – Caribbean Oil Production, 1980 – 2002	17
Figure 5 – Central American Consumption of Oil and Hydropower 1980-2001	18
Figure 6 – Primary Energy Sources 2002	23
Figure 7 – BEL Usage 2002	26
Figure 8 – Diagram of SIEPAC Interconnection	55

TABLE OF TABLES

Table 1 – Belize Imports from 1999-2002 Gasoline, Kerosene, Diesel	24
Table 2 – Number of Vehicles in Belize 1995-2001	25
Table 3 – Industry Operators – LPG	30
Table 4 – Energy Sales and Demand Forecast Results	33
Table 5 – Renewable Energy Technologies, 2003 Cost/Kwh	46

ACRONYMS

ACP	African, Caribbean and Pacific States
ACS	Association of Caribbean States
AOSIS	Alliance of Small Island States

AOSIS	Alliance of Small Island Developing States
BEB	Belize Electricity Board
BECOL	Belize Electric Company Limited
BEL	Belize Electricity Limited
BELTRAIDE	Belize Trade & Investment Development Services
BOO	Build Own and Operate
BOP	Balance of Payments
BSI	Belize Sugar Industries
BTB	Belize Tourism Board
C	Celsius
CA	Central America
CARICOM	Caribbean Community
CARILEC	Caribbean Association of Electrical Utilities
CBI	Caribbean Basin Initiative
CCAD	Central American Commission on Environment and Development
CDB	Caribbean Development Bank
CDM	Clean Development Mechanism
CEIS	Caribbean Energy Information System
CFE	Comisión Federal de Electricidad (México)
CFL	Compact Fluorescent Light
CH ₄	methane
CHP	Combined Heat and Power
CO	Carbon monoxide
CO ₂	Carbon dioxide
CPA	Country Poverty Assessment
CPACC	Caribbean: Planning for Adaptation to Global Climate Change
CPRSA	Cost of Power Rate Stabilization Account
CRRH	Regional Committee for Hydrological Resources
CSO	Central Statistical Office
DEI	Dominion Energy International
DOE	Department of Environment (GOB)
EC	European Commission
EIA	Environmental Impact Assessment
EPZ	Export Processing Zone
ESCOS	Energy Services Companies
ESMAP	Energy Sector Management Assistance Programme of the World Bank and UNDP
ESTAP	Environmental and Social Technical Assistance Project
EU	European Union

F	Fahrenheit
FAO	Food and Agriculture Organization of the United Nations
Ft	Feet
FTAA	Free Trade Area of the Americas
FY	Financial Year
GCM	Global Circulation Model
GDP	Gross Domestic Product
GEF	Global Environmental Facility
Gg	Gigagrams
GDP	Gross Domestic Product
GHG	Greenhouse Gases
GOB	Government of Belize
GVEP	Global Village Energy Partnership
GWh	Gigawatt hour
GWP	Global warming potential
ha	Hectares
HDI	Human Development Index
IEEI	International Energy Equities Inc.
HFC	Hydrofluorocarbons
IDB	Inter-American Development Bank
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
IPP	Independent Power Producer
km	Kilometers
ktoe	Kilotonne oil (equivalent)
kW	Kilowatt
kWh	Kilowatt hours
LIC	Land Information Center
LPG	Liquefied Petroleum Gasses
MAFC	Ministry of Agriculture, Fisheries and Cooperatives
mm	Millimetres
MW	Megawatt
MWh	Megawatt hour
NEP	National Energy Plan Project
N ₂ O	Nitrous oxide
NA	Not available
NGO	Non Government Organization
NICU	National Implementation Coordination Unit
NMS	National Meteorological Service
NMVOC	Non methane volatile organic compounds

NO _x	Nitrogen oxides
NRI	Natural Resources Institute
OAS	Organization of American States
OECD	Organization for Economic Cooperation and Development
OPEC	Organization of the Petroleum Exporting Countries
pa	Per annum
PEM	Polymer Electrolyte Membrane
PfB	Programme for Belize
PPA	Power Purchase Agreement
PUC	Public Utilities Commission
RE	Renewable Energy
RET	Renewable Energy Technology
RFP	Request for Proposal
R&D	Research & Development
RP	Rate Period
SHS	Solar Hot Water System
SICA	Central American Integration System (English)
SIEPAC	Sistema de Interconexion Electrica de Paises de America Central
SO ₂	Sulphur dioxide
sq.km.	Square kilometres
SSH	Small Scale Hydro
tC	tons of carbon
tC/ha	Tons of carbon per hectare
TJ	Tera joules
TP	Tariff Period
T&T	Trinidad and Tobago
UN	United Nations
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
USA	United States of America
WEC	World Energy Council
WEO	World Energy Outlook
WTO	World Trade Organization

EXECUTIVE SUMMARY

In July of 2003, The Public Utilities Commission, under the auspices of the United Nations Development Programme (UNDP) and the Government of Belize retained Launchpad Consulting to perform a sector diagnostic of the energy sector in Belize. A

significant portion of the exercise was to include a review of the technical specifics of the sector and an analysis of the context for renewable energies in Belize.

Presented herein are the findings of the study, which was conducted from July 15 – September 15th, 2003.

Summary of Key Findings:

- Given the current energy mix (imports 74%, indigenous 26%), energy security and improving energy autarky should be significant issues for policymakers;
- Belize does not have a formally stated energy sector strategy nor policy although an argument could be made that there is an implicit one;
- The current electricity mix with 51% imported from Mexico is not sustainable given that demand is growing at 9% p.a. The Mexican supply is currently limited, and if additional supply can be negotiated (under a new contract) it is likely to be significantly more expensive;
- The use of renewable energies is technically, environmentally and economically feasible and given the exigencies of the internal and external environment, is highly recommended;
- There are barriers to the use of Renewable Energy Technologies and to the development and implementation of a formal energy policy;
- Policymakers cannot afford to disregard regional and international agreements and the significance of existing and future commitments (particularly in trade) to the development of the energy sector;
- Belize needs to take immediate and decisive action if it is to comfortably meet electricity and energy demand forecasts without increasing its vulnerability and/or compromising its future development;

The Context

According to the World Energy Outlook 2002, there is expected to be rapid growth in the demand for energy to the year 2030, at a rate of 1.7% annually. In fact, by that time it is predicted that the world will be consuming two-thirds more energy than it did in 2002, and the developing countries will replace the industrialized world as the largest group of energy consumers. Fossil fuels, and in particular oil, will remain the dominant sources of energy, though renewable energy will increasingly contribute to power generation.

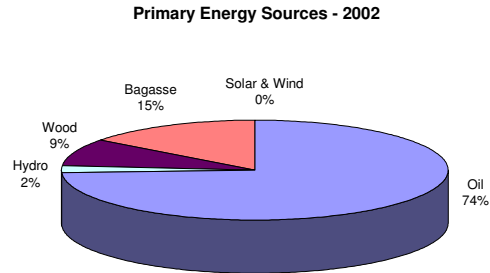
Additionally, “enormous” investments will be necessary to increase production to meet this rising world demand as developing countries alone will need investment of around \$2.1 trillion to meet their own growing demand for electricity. While it is understood that attracting the necessary investment will depend to a large degree on an investment climate capable of yielding a fair return, this will prove a major challenge for developing countries; particularly small developing ones such as Belize. For these countries, it is imperative to address the constraints in the energy sector, and ensure

that future energy policies are developed in accordance with overall development objectives. This dictates a comprehensive approach to national energy planning.

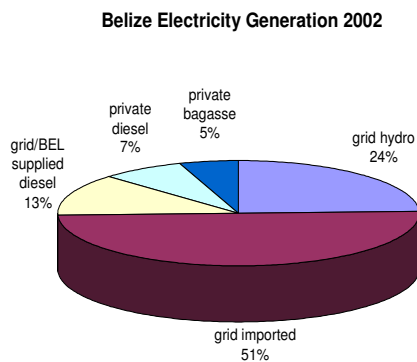
Belize’s Energy Sector

The National Energy Plan Project found that Belize acquires its energy from three main sources, specifically, *imported* Fossil Fuels (74%), Traditional Biomass (9%) and Renewable Energy Technologies (RET) (17%).

Belize currently imports 100% of fossil fuels used. Although there is evidence of petroleum deposits, so far oil has not been discovered in commercial quantities. The main petroleum based sub-products are gasoline, kerosene and diesel, supplied by three main retailers. In the LPG (butane/propane) market, there are four main importers. Retail (pump) prices in both the petroleum and LPG industries are regulated by Government of Belize



NOTE: since this graph is primary energy sources, it does not include the electricity imported from Mexico



Although a part of the energy mix, fuel wood and other traditional biomass products are not part of the formal energy equation. There is no discernable industry structure facilitating the supply and sale of biomass materials, however there is evidence of an emerging market.

In the electricity sub-sector, roughly 51% of electricity produced is imported from Mexico. Grid hydro, grid diesel, private diesel and bagasse account for the balance. Belize

Electricity Limited is the main commercial provider. In 2002, the utility recorded 567 unplanned outages and 226 planned outages. Of the unplanned outages roughly 13% were attributable to imports. Aggregate peak demand in 2002 was 54MW and this is expected to more than double by the year 2010.

Renewable Energy Technologies in Belize

Renewable Energy Technologies (RETs) are not new to Belize and are used both in small, isolated applications and power plants. Field and secondary research undertaken in Belize during August 2003, identified the use of hydroelectricity, stand alone solar PV, small wind electricity generation, solar thermal (water heating), hybrid systems (diesel/PV or diesel/wind), biomass cogeneration and methane production by

small scale biodigesters¹. It also appears that there is a potential for geothermal energy since hot springs have been identified in the country and the established sugar industry may have the potential to produce ethanol.

A distinct conclusion of the field research was that electricity generation from renewable energy sources is technically, environmentally and economically feasible in Belize. According to Dr. Ivan Azurdia of Fundacion Solar², over the next ten years Belize can add 80 MW of renewable energy (35MW of hydro, 25MW of cogeneration and 20MW of wind energy) to its existing 25MW and easily satisfy the ten year projected peak electricity demand of 96.3 MW.

Despite the encouraging technical prognosis for RET development, there are also significant barriers that could limit the widespread use of RE in Belize. Dr. Azurdia discusses these and strategies to overcome them at length in Annex 7 of this report. Three are highlighted below.

The Lack of a National Energy Policy

Energy consumption is rapidly increasing in Belize and to satisfy burgeoning demand, policymakers often choose the most expedient option or adapt traditional practices without an appreciation of the energy supply options or the long term costs and effects. In the case of Belize, the lack of an explicit national policy that encourages the use of RE (where feasible), advances the status quo and encourages the continued use of imported fossil fuels as the most expedient energy supply option for an oil poor nation.

Financial Constraints

Subsidies to electricity consumption, (i.e. cross subsidies between electricity customers and government relief for losses due to the extension of the social tariff), are in effect in Belize and affect potential investment/reinvestment decisions by the electricity utility and reduces the GOB's ability to pursue other social development goals. As demand increases consumption subsidies can become increasingly difficult to control. Additionally and perhaps more relevant here is that consumption subsidies directs the country's limited financial resources away from electricity access subsidies³ and fiscal incentive programs⁴ that can be used to drive the development of RETs.

Also a challenge to RE development in Belize is the inability to finance RE projects from internal revenues and to attract funding from aid agencies or private investors.

Insufficient Capacity

Belize does not have sufficient human and institutional capacity to promote RETs. Additionally, some of the RET projects undertaken are of poor quality due in part to unreliable components, inappropriate design, improper installation and poor maintenance. Unarticulated or poor standards persist and contribute to the poor quality of some RET projects.

¹ A biodigester is a holding tank which composts waste materials (human, animal, plant) anaerobically to produce methane gas for cooking, lighting and in sufficient quantities to fuel pumps and electric generators.

² Dr. Azurdia was retained as the technical specialist for this diagnostic and used field visits and interviews to determine his conclusions.

³ i.e. one-time assistance to encourage grid extension or development of a local supply

⁴ Such as investment grants and investment tax credits

Domestic Energy Policy

Upon review, it seems apparent that an energy policy does *not* exist in Belize. However, while an explicit, articulated national energy policy is not available, *de facto* there is an implicit one. The main features of the Belize energy sector (i.e. privatisation, regulation, competition, international trade, pursuit of alternatives to fossil fuels and subsidies), suggest an implicit policy predicated on the use of fossil fuels. Although the energy balance is shifting to include renewable energies, it is only in the electricity sub-sector. Additionally, the shift is cautious and not the result of a deliberate policy objective but of industry practitioners concerned about unfavourable oil market conditions and costs⁵. Indeed the move toward renewable energies may be prejudiced by existing disaggregated sub-sector policies that welcome competition and private sector involvement, but do not comment on method or scale, encourages price regulation in all sub-sectors (for tax revenue generation or private industry control) and consumption subsidies in the electricity sector.

Furthermore, if these are the core tenets of the country's energy policy, then it is important to point out that the policy is incongruent with other development strategies and that there are important omissions in the policy space. For example in some instances current energy practices are contrary to or fall short of Belize's sustainable development and environmental policies. While Belize has signed on to and made commitments under a number of international conventions, protocols and agreements aimed at reducing greenhouse gases and protecting the ozone layer (see below), its energy balance continues to reflect a heavy reliance on fossil fuels. Furthermore, although a recent energy balance study has shown an increase in the application of renewable energy technologies, the use of traditional biomass as a source of energy continues to be a factor.⁶ Sourcing of wood and other naturally occurring biomass materials is bound to have an added deleterious effect on the environment.

Belize currently sources 51% of its electricity from CFE in Mexico. This suggests a willingness to un-bundle the electricity supply chain in Belize and to do so by engaging in regional cross border trade if necessary. In competitive markets, important services aspects of the electricity supply chain can be isolated, where different suppliers intervene at different levels of the supply chain. While competition and unbundling of the supply chain appears to be a deliberate strategy for the Belize electricity industry, the policy is less clear on the extent to which the market can tolerate and thus regulation and attendant legislation will encourage competition in unbundled electricity supply. In a competitive environment, an explicit regulatory system must be established either to delimit the scope of free play of market forces or to replace them whenever it is deemed that they will not lead to satisfactory or acceptable results from a social or community stand point. It is not clear which position Belize embraces.

Additionally, it is not clear whether the wider policy implications of engaging in cross-border trade in electricity, given Belize's international trade commitments and involvement in regional initiatives, and the guidelines and constraints these place on

⁵ Suggesting only that the issue is not one of commitment to renewable energies or sustainable development but rather to cost reduction and liability mitigation.

⁶ It is worthy of note that this is probably a greater factor than could be ascertained for this report.

national policy space, were (at the time the agreement with CFE was made) or are being considered.⁷

Because energy sector development underpins the national development agenda, Belize cannot afford to continue to subscribe to the unfocused disposition of an implicit strategy. Moreover, when the decision is taken to create a more precise, comprehensive strategy, the country must do it right the first time.

Yet, translating the informal into the formal is not an easy proposition. Several significant challenges persist. Those considered most important are prioritized below. It is important to appreciate however that these are all interrelated and should be addressed comprehensively.

1. Commitment on the part of all the major players, to create the enabling environment that encourages sustainable development policies. Political will to undergo the changes required in the status quo and to undertake and plan for the adjustment costs.
2. A weak energy conservation culture. An uninformed constituency can result in energy and related issues not receiving priority by the policymakers and can lead to resistance to new technologies or to energy saving measures.
3. Institutional capacity and support systems. For example for proper analysis and informed decision-making, reliable, timely, energy sector data and information is a necessity. A clear definition of roles, responsibilities and accountability in supporting institutions is also required.
4. A critical mass of local technical capacity i.e. Policymakers and technocrats versed in the national, regional and global realm of energy policy and law making are required. Specific competencies in energy technologies, trade and international commerce, project management and proposal writing are key.
5. Existing sources of financing for energy related policy initiatives are mainly extra-regional

International Agreements

To add to the challenges in the sector, integration initiatives by Belize into the Central American and Caribbean region have resulted in Belize undertaking a number of obligations that force policymakers to bring environmental and other considerations to bear before there has been time to develop an energy mix that supports an all encompassing national strategy position. The dynamics of energy integration and engagement can be classified into four broad categories, specifically: Agreements and Conventions which address the issue of sustainable development, Institutions and/ or integration frameworks which are concerned with energy and or electricity production and consumption, Projects/Initiatives concerned with sustainable development and energy, and International trade.

⁷ This is discussed in some detail below.

Belize's integration at the regional level occurs in two familiar spheres, specifically: (a) CARICOM, where Belize aligns itself with 13 other Anglophone Caribbean Nations and (b) Central America, which includes the seven (including Mexico) other Spanish speaking countries with physical proximity to it. These two spheres are driven by different, though not necessarily mutually exclusive, socio-economic, development, and political aims and objectives

A recent area of interest is that of International trade. Within this realm, energy is dealt with and considered at various levels and in different forums. At the multilateral level Belize is a member of the World Trade Organization (WTO) which deals with energy under two separate agreements, specifically the General Agreement on Tariffs and Trade (GATT) which deals with trade in goods, and the General Agreements for Trade in Services (GATS) which deals with trade in services. The United Nations Conference for Trade & Development (UNCTAD) also deals with energy issues at the multilateral level but is primarily concerned with providing technical cooperation activities and support including in energy services. At the regional level energy trade is dealt with under the CARICOM framework, whose mandates and dictums also represent Belize under the hemispheric Free Trade Area of the Americas (FTAA).

Even though Belize has not scheduled any commitments under Energy or Energy Related Services under the GATS, the country has undertaken progressive levels of autonomous liberalization in that sector. In this regard, if Belize decides to open core energy services such as transmission and distribution to independent operators or encourage active trade in energy services such as consulting in energy efficiency and renewable energies, construction, maintenance of the network, or distribution services such as metering and billing, which are services subject to the GATS, it may want to schedule commitments in these types of energy services. The principal GATS modes of supply for international trade in energy services appear to be cross-border supply (mode 1), commercial presence (mode 3), and movement of natural persons (mode 4). With the support of mode 3 commitments⁸, competitive suppliers (both local and foreign) could take advantage of the privatization, liberalization and unbundling of Belize's national electricity market. Cross border supply (mode 1) of distribution services, where interconnections exists between different national networks (e.g. CFE and BEL) is also a consideration

As the country continues to seek new investments and new actors in its quest for diversity and balance, understanding the multilateral trading architecture and how it may (or may not) contribute to Belize's immediate and long term energy sector development is critical. Policymakers cannot avoid the externalities.

The Road Ahead

Belize is a small, developing, independent state, with an extremely vulnerable, micro economy and abundant natural resources. The Government of the day has, through its various instruments and policy statements indicated a commitment to development, through the pursuit of economic and social strategies that are intended to address poverty alleviation and growth, without adjusting the focus on keeping the country "green".

⁸ indicating on a multilateral level that Belize is committed to competition, does not discriminate against foreign competitors and has the required hospitable climate to attract investment.

The quintessential issues facing policymakers are these:

- How best to reconcile private profitability, market efficiency and cost reduction with security of supply, public service obligations and development goals;
- How best to increase efficiency of production, transmission, distribution and consumption;
- How best to reduce negative environmental impact through the use of technology and alternative energy sources;
- Complementary policy reforms and capacity considerations.

For Belize to meet the electricity demand associated with an average 9% annual growth rate and the increasing demand for fuel in the transportation sector, energy sector planning should be established as a priority, but it must be done carefully. Due diligence must be awarded to analyzing the country's growth options and potential with a trans-temporal and trans-generational commitment.

Given the current interest of central policymakers and strong multi-stakeholder support, Belize is in a strong position to plan for the next ten years. Towards this end, it is necessary to create an enabling mechanism that will create a new "energy road map." The following immediate (less than one year to implement) activities are recommended:

- Develop a "National Energy Policy" that defines the core elements and participants in the National Energy Strategy and encourages the development of sustainable and renewable energy technologies. Ensure clear roles, responsibilities and measurable objectives;
 - Design and implement processes for the collection of credible energy sector data and information;
 - Create the National Energy Implementation Plan 2003-2015. To develop the plan, it is necessary to perform an update of resource assessment taking into consideration isolated as well as on – grid renewable energy technologies, and also develop the feasibility studies of the resources already identified. In the resource assessment exercise particular attention should be awarded to a credible energy balance, incorporating specifically the type and frequency of use of biomass and wood, a wind mapping exercise and the feasibility of ethanol production and application.
-

1.0 ESTABLISHING THE CONTEXT

1.1 The International Energy Outlook⁹

“The world has abundant energy resources for the coming thirty years!” says Robert Priddle, executive director of the International Energy Agency, one year ago on the presentation of his organization’s flagship publication “World Energy Outlook 2002.”

The study, recognized as authoritative throughout the energy world, suggests that the world has no immediate need for concern. However, it does emphasize the need for change in the approaches to the administration of the global energy system¹⁰, at the national, regional and global levels, if the benefits derived from energy are to be equitably distributed among the world’s people now and in the future.

Economic Outlook/Energy Markets

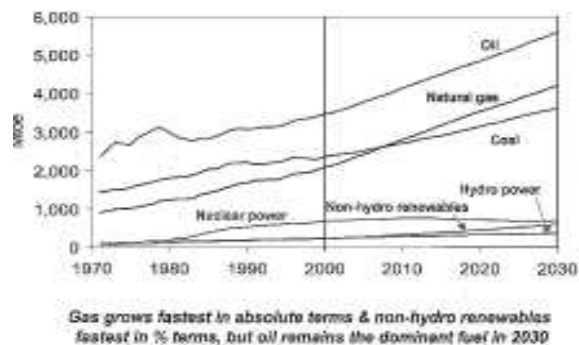
The study predicts rapid growth in the demand for energy to the year 2030, at a rate of 1.7% annually. Thus by 2030, the world will be consuming two-thirds more energy than it did in 2002, and the developing countries will replace the industrialized world as the largest group of energy consumers. In fact, the study suggests that more than 62% of the increase in world primary energy demand between 2003 and 2030 will come from the developing countries¹¹.

Fossil fuels will remain the dominant sources of energy, filling more than 90% of the projected increase in demand. Among fossil fuels, natural gas will grow fastest, doubling in volume over the thirty years, but oil will remain the most important energy source. Coal will grow more slowly and its share in the world energy supply will decline. Under present policies, nuclear power will decline as old plants are retired and few new ones are built. Renewable energy will increasingly contribute to power generation. Use of wind power and biomass will expand very quickly, but from an extremely small base. The two energy sectors expected to grow most over the next thirty years are electricity and transport (64%), especially in developing countries.

Figure 1 – World Primary Energy Demand
Courtesy – World Energy Outlook 2002

To satisfy demand there is expected to be an increase in World Primary Energy Production, with almost all the increases occurring outside the OECD¹² countries.

World Primary Energy Demand



⁹ This sector draws heavily on the study conducted by the International Energy Agency and published in 2002, entitled World Energy Outlook 2002.

¹⁰ The energy system is made up of the energy supply sector and energy end-use technologies. The object of the system is to provide energy services. Energy for Sustainable Development, A policy Agenda, UNDP 2002, pg 28

¹¹ Particularly Asia

¹² OECD list of countries includes the majority of the countries in the developed world including the United States, the countries of the EU, Japan, Sweden, Switzerland, Australia, Canada and Mexico. There are 30 countries party to the Convention.

Reliance on OPEC oil progressively increases and Asia¹³ is expected to realize the biggest increase in import dependence but OECD imports will continue to rise, especially in Europe. The Middle East is expected to strengthen its position as the world's largest oil exporter, as energy trade between regions more than doubles, most of it in the form of oil.

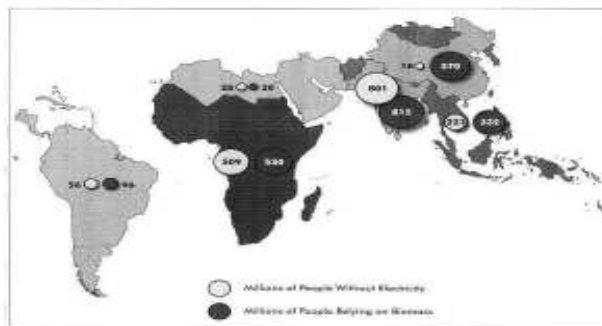
According to the WEO 2002, "enormous" investments will be necessary to increase production to meet rising world demand – and to move that production to market. Attracting the necessary investment will depend on an investment climate that convinces potential investors that they can earn a fair return on their money. The study estimates that cumulative worldwide investment in new power plants will amount to \$4.2 trillion.¹⁴ Developing countries alone will need investment of \$2.1 trillion to meet growing demand for electricity. Finding the funds, it concludes will be a major challenge.

Environment

"The environmental degradation associated with the production and consumption of energy today, particularly fossil fuels, threatens human health and quality of life, and affects ecological balance and biodiversity."¹⁵ Yet, the environmental impacts of energy are not new. For centuries, wood burning has contributed to the deforestation of many areas, According to the World Energy Assessment, what is new is the acknowledgement of energy linkages to regional and global environmental problems and their implications.¹⁶

According to the WEO, 2002 if current energy efficiency and ecological policies are maintained, energy related carbon emissions is expected to grow by 16 billion tonnes, or 70% above 2000 levels. CO₂ emissions will increase faster than demand because the share of fossil fuels in the energy mix grows. The majority of the new emission will come from developing countries. China alone is expected to add 3.6 billion tonnes. If policies are not adjusted, OECD countries with Annex 1 Kyoto commitments will need to rely heavily on the purchase of emissions credits in order to fulfil their obligations. The study

Map of Global Energy Poverty



**1.6 billion people have no access to electricity,
80% of them in South Asia and sub-Saharan Africa**

suggests however, that if policies are adjusted to reflect a more environmentally friendly posture, OECD countries will achieve cuts in carbon emissions, particularly through the use of renewable energy sources in electricity generation. However, meeting the Kyoto targets is still not expected to be easy.

Figure 2 – Map of Global Energy Poverty

Courtesy of World Energy Outlook, 2002

¹³ For example China's net imports are predicted to surge from 1.7 mb/d in 2001 to 9.8 mb/d in 2030.

¹⁴ US dollars

¹⁵ Energy for Sustainable Development, A Policy Agenda, UNDP, 2002.

¹⁶ World Energy Assessment, pg. 9

Social Issues

Energy is closely linked to an assortment of social issues, including poverty, population growth, urbanisation and a lack of opportunities for women. By far however, poverty¹⁷ is the overriding social consideration for developing countries. “The energy consumption patterns of poor people – especially their reliance on traditional fuels in rural areas --- tend to keep them impoverished.”¹⁸

According to the WEO 2002, approximately 1.6 billion people now lack electricity, 80% of them in South Asia and sub-saharan Africa; 4 out of 5 of them live in rural areas. 2.4 billion people in developing countries rely heavily on traditional biomass¹⁹ for cooking and heating and this continues to have significant implications on productivity, health, gender and the environment, see figure 2 above. By 2030, in the absence of radical new policies, 1.4 billion will still have no electricity and 2.6 billion people in developing countries will continue to rely on biomass.

Energy Security

Figure 3 – Proven Gas Reserves
Courtesy of World Energy Outlook 2002

Energy security, that is the availability of energy at all times in various forms, in sufficient quantities, and at affordable prices is a central issue because of the uneven distribution both of the fossil fuel resource on which most countries rely and of the capacity to develop other resources. According to the WEO 2002, oil resources will remain abundant for the next thirty years. At January 1, 2001, the world total in proven gas reserves was 164 tcm. Ultimate remaining resources, including proven reserves are estimated at 453 – 527 tcm, see figure 3. Although there seem to be no immediate physical limits to the world’s energy supply, the potential for conflict, sabotage, terrorism, disruption of trade and reduction in strategic reserves remain on the agenda as security issues and indicate the need to strengthen global as well as regional and national energy security²⁰.



In the final analysis, the study highlights four strategic energy challenges predicted to confront the world over the next thirty years. These are;

- Security of energy supplies

¹⁷ according to the WEO, poverty refers to individual’s lack of access, associated primarily with inadequate income, to basic human needs such as food, shelter, fuel, clothing, safe water, sanitation, healthcare and education.

¹⁸ *ibid*, pg. 7

¹⁹ Biomass is a renewable energy resource derived from the carbonaceous waste of various human and natural activities. It is derived from numerous sources, including the by-products from the timber industry, agricultural crops, raw material from the forest, major parts of household waste and wood.

²⁰ Energy for Sustainable Development, *ibid*, pg. 32

- Investment in energy infrastructure
- Threat of environmental damage caused by energy use
- Uneven access of the world's population to modern energy

These are issues the authors of the WEO 2002, suggests should be paramount in the energy system discussions at the national, regional and global levels.

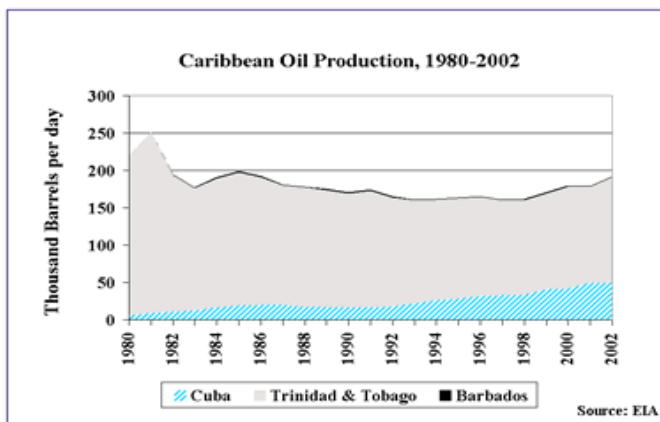
1.2 Regional Context²¹

Any discussion of Belize in a regional context, of necessity must include both the Caribbean and Central American Region. While its geographic location puts it squarely within the Central American Region, the country shares a common history and has established formal alliances with the Anglophone countries of the Caribbean.

The Caribbean

The islands of the Caribbean Basin²² with a total population of approximately 37 million in 2002 are predominantly net energy importers, with the exception of Trinidad and Tobago, which is rich in hydrocarbons. According to the Energy Information Administration, in 2001 the islands of the region consumed a combined total of 2.2 quadrillion Btu of energy. Oil is the dominant fuel, accounting for about 92% of total 2001 energy consumption²³ (see Annex 1 for table of Primary Energy Consumption in the Caribbean in 2001). The islands rely on imported oil for most of their energy needs. Barbados, the Dominican Republic, Haiti and Jamaica are part to the San Jose Accord, under which Mexico and Venezuela supply crude oil and refined products under favourable terms. Natural gas and hydropower are used in countries that have these domestic resources. Natural gas is used most extensively in Trinidad and Tobago.

Figure 4 – Caribbean Oil Production 1980-2002



In terms of production, only three Caribbean countries have oil and natural gas reserves. Barbados, Cuba and Trinidad and Tobago (T&T). Of these T&T is the only significant exporter. The country has become one of the major natural gas development centers in the world and is the world's leading exporter of both ammonia and methanol. In early 2004, the largest methanol plant in the world, Atlas, is expected to be completed there.

Barbados oil production totalled 1,200 bbl/d in 2002. Barbados has no refineries. Its oil is refined in Trinidad and then returned for domestic consumption. Oil production declined slightly since 2001 despite efforts of Barbados National Oil Company to expand

²¹ this second draws heavily on the Energy Information Administration's regional fact sheet.

²² The EIA classification includes the French and Dutch islands, Cuba and Puerto Rico

²³ www.eia.doe.gov, Caribbean Fact Sheet

oil production. In April 2003 Jamaica announced that it plans to restart exploration efforts off the Southern coast, with support from Venezuela and Ecuador.

“Crude oil refining capacity in the Caribbean exceeds 1.7 million bbl/d. Smaller refineries are geared towards meeting local demand, while the larger refineries in Aruba, the Netherlands Antilles, Trinidad and Tobago, and the U.S. Virgin Islands serve both local and export markets. The Hovensa refinery of St. Croix, owned by Hess and the Venezuelan state oil company, PdVSA, is among the largest in the Western Hemisphere. PdVSA also operates the Curacao Isla refinery (the Netherlands Antilles), which the company is in process of expanding. PdVSA is investigating the possibility of building two new refineries in the Dominican Republic, as well as reactivating the Cienfuegos refinery in Cuba”.²⁴

“The Caribbean region has a number of independent petroleum storage facilities, with the capacity to store approximately 100 million barrels of crude oil and petroleum products. In addition to long-term storage arrangements, these facilities offer logistical options for petroleum shipments. Islands with storage facilities include: Bahamas, Trinidad, Puerto Rico, Saint Lucia, Aruba, and St. Eustatius, Curacao, and Bonaire of the Netherlands Antilles”.²⁵

In 2002, the continental United States imported about 390,000 bbl/d of petroleum from the Caribbean. The U.S. Virgin Islands was the largest single regional exporter to the United States (about 236,000 bbl/d of petroleum products), followed by The Netherlands Antilles (about 74,000 bbl/d of petroleum products), and Trinidad and Tobago (80,000 bbl/d of total crude and petroleum products). Trinidad and Tobago is the only exporter of crude oil (68,000 bbl/d) from the region.

According to the EIA, installed electric generating capacity in the Caribbean exceeds 17 gigawatts (GW) however in general the region needs additional capacity. “Electricity is expected to grow substantially in the coming decade.”²⁶ Regarding the use of Renewable Energy, only Jamaica and Cuba had significant amounts of power generated from non-hydro renewable (geothermal, solar, wind, wood and waste), electric sources in 2001. The Dominican Republic was the largest producer of hydroelectricity in the Caribbean in 2001, with 0.7 billion Kwh. This was greater than hydropower produced by Cuba, Haiti, Jamaica and Puerto Rico combined. Refer to Annex 1 for tables on Energy and Electricity prices in the Caribbean.

Central America

Like the countries of the Caribbean, all seven²⁷ Central American (CA) countries categorised by the EIA as the Central American region, rely heavily on imported petroleum and indigenous hydropower to meet domestic energy demand. Although the region has limited energy resources, it is important to world energy markets as a transit centre for oil (via the Panama Canal), and as a potential energy transit centre between North and South America.

²⁴ EIA – www.eia.doe.gov

²⁵ *ibid*

²⁶ *ibid*

²⁷ includes: Guatemala, Belize, Honduras, El Salvador, Costa Rica, Nicaragua and Panama. Excludes Mexico

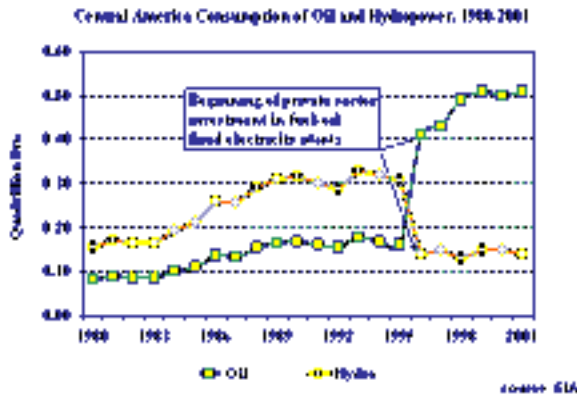


Figure 5 – Central American Consumption of Oil & Hydropower - 1980-2001

Imported petroleum comes primarily from Venezuela and Mexico under the terms of the San Jose Accord and the Caracas Energy Accord. CA consumes no natural gas and very little coal. According to the EIA, historically hydro power has dominated CA's electricity sector. However, since opening up to foreign investors since the 1990s, the use of thermal generation has grown rapidly. As a share of regional electricity

consumption, hydropower has fallen from 61% in 1980 to approximately 50% in 2001.

Within the region, Guatemala is the largest oil producer²⁸, with Panama establishing itself as the only other producer. In terms of production capacity, CA produces relatively small volumes of crude oil, most of which is either sent to the US for refining or consumed domestically. In 2002, oil consumption in the region totaled levels comparable to those of Chile and Hong Kong.

In 2001, hydropower plants generated nearly 90% of Costa Rica's electricity, although the country also generates using geothermal and wind energy. El Salvador is the region's largest producer of geothermal energy which contributed 22% to the total electricity mix in 2002. Oil however remains the chief source of energy for the region. Pollution from cars, industry and power generation is a major problem in several CA countries. Refer to Annex 1 for table on Energy Consumption in C.A, 2001.

1.3 National Context

General Profile

Belize is located on the Central American mainland, forming part of the Yucatan Peninsula. It is bounded on the North by Mexico, South and West by Guatemala and East by the Caribbean Sea. The total land area is 22, 960 sq. km. or 8,867 sq. miles of which 95% is located on the mainland, and 5.0% is distributed among more than 1,060 islands. The mainland is distributed into six districts, which in turn are comprised of cities, towns and villages. Most of the Northern half and much of the Southern third of the country, plus the entire coastal area and all the islands are flat and low-lying²⁹.

The country enjoys a sub-tropical climate which averages temperatures between 70 to 85 °F. At the last population census (2000), the enumerated population stood at 240,204³⁰. The population is a curious mixture of Mayan, Mestizo and other Spanish-speaking ethnic groups, English-speaking Creole, Garifuna and German speaking Mennonite. There is a direct correlation between pockets of ethnic concentration and

²⁸ Produced 24,671 barrels per day in 2002.

²⁹ First National Communications to the Conference of the Parties of the United Nations Framework Convention on Climate Change, Government of Belize, UNDP Project BZE/98/G31/A/1/99, January 2000, pg. 1

³⁰ although July 2002 estimates from the CIA Factbook suggests a population of 262,999

district. For example, the Northern districts reflect a concentration of predominantly Mestizo and other Spanish speaking ethnicities, the Belize district is predominantly English-speaking creole, the Central district enjoys a mixture but the largest concentration of Mennonite communities is situated there, the Stann Creek district boasts the highest concentration of Garifuna, while more than 60% of the inhabitants of the Toledo district are Mayan. The official language is English, but Spanish is dominant. According to the last census three Mayan languages are spoken across the country, kek'chi, Mopan and Yucatec³¹. See Annex 3 for country baseline map

Political Organization

Belize is a sovereign state³² governed under the principles of parliamentary democracy based on the Westminster Model. The Prime Minister and the Cabinet form the executive branch, while the National Assembly forms a bicameral legislature comprising of a twenty-nine (29) member elected House of Representatives and a thirteen (13) member appointed Senate. The current elected House of Representatives³³ consists of twenty-two (22) members of the ruling People's United Party and seven (7) from the United Democratic Party.

The country is a member of the British Commonwealth, CARICOM, Organization of American States, the Non-Aligned movement, the World Trade Organization (WTO), the African, Caribbean and Pacific group (ACP), the Association of Caribbean States (ACS) and the Central American Integration System (SICA), among others.

Economy

According to the Government of Belize³⁴, the economy of Belize is undergoing transformation from one that is primarily agricultural to one that is more service-oriented.³⁵ In 2001,³⁶ the service sector contributed 59.5% to the Gross Domestic Product (GDP), while the primary sector contributed just 16.8%. Among services, tourism represented 18% of GDP and revenues in excess of \$242m in 2001. It has become the largest foreign exchange earner for the country. One in every four jobs is in the tourism industry.

"Belize has a farming population of approximately 16,979 operating on a total land area of 265,000 acres, of which 146,000 are for crops and 119,000 acres are for pastures".³⁷ Agriculture contribution to the GDP in 2001 amounted to 11.3% and 88.9% of total export earnings. The principal source of income in 2001 was citrus exports³⁸ followed by sugar and bananas. Revenue from all three traditional export commodities amounted to \$197.3³⁹m.⁴⁰ Belize has increased production of non-traditional agriculture

³¹ Government of Belize, Medium Term Economic Plan 2003-2005, July 2002, pg. 1

³² Independence achieved from the UK on 21 September 1981.

³³ Determined by the general elections held on March 5, 2003

³⁴ The information in this section extracted from the Medium Term Economic Strategy 2003-2005, declared by GOB, July 2002.

³⁵ Ibid, pg. 2

³⁶ the baseline yr used in the report.

³⁷ Ibid, pg. 2

³⁸ replacing sugar as the largest contributor to foreign-exchange earnings

³⁹ unless otherwise stated all currency is reported in Belize dollars, 2:1 peg to the US dollar.

⁴⁰ includes fresh fruits and by-products

export commodities such as papayas, habanero peppers and aquaculture.⁴¹ The textile industry and the wood industry also serve as important sources of income for Belize.

Belize's major export market is the United States (USA), which accounted for approximately \$170.2m or 52.7% of the total export value in 2001. The European Market accounted for approximately \$101m or 31.2% of total exports and CARICOM for \$21.8m or 6.7% in the same year. Belizean products enjoy preferential access under CARICOM, the Cotonou Agreement⁴², EU/ACP, CARIBCAN (Canada) and the Caribbean Basin Initiative (CBI) (United States). Each of these agreements allows Belize to export products either duty free or at concessionary rates⁴³.

According to GOB's Medium Term Economic Strategy, 2003-2005, in the short term, Belize's economic strategy "aims at strengthening its foreign reserve position and consolidating the fiscal accounts".⁴⁴ GOB is aiming to achieve sustained and balanced growth of 5-6% per annum without sacrificing investment in the social sector and in poverty reduction programs. Investments in health and education are considered critical and the issue of poverty is "high on the agenda"⁴⁵ in the medium term.

Social Issues

Belize's focus on horizontal social issues in the medium term (2003-2005) is defined by action in three key areas; namely health, education and poverty reduction. In the health sector the gains made in the sector will be protected and the focus on HIV/AIDS strengthened in an attempt to arrest the spread of the disease. In education, the focus will be on improving the quality of education and equity of access to it. Proposed initiatives in this sector include building more and expanding existing high schools, investing \$10m in early childhood education, and ensure the provision of free basic primary school textbooks to the needy in Math, Science, English and Social Studies.⁴⁶

Poverty in Belize

According to the GOB's National Poverty Elimination Strategy and Action Plan 1998-2003,⁴⁷ a significant portion of the population do not share in the broader social and economic advances enjoyed by most Belizeans; and poverty persists⁴⁸

Roughly, twenty-five percent (25.3%) of households in Belize, and 33.0% of individuals are poor on the basis of their expenditure on food and non-food items. Approximately ten percent (9.6%) of households and thirteen percent (13.4%) of individuals were considered to be extremely poor or indigent; i.e. their level of

⁴¹ fish and shrimp farming

⁴² formerly the Lome Convention

⁴³ in the case of CARICOM, exports not meeting the rules of origin requirements face the import tariffs prescribed by the Common External Tariff (CET).

⁴⁴ Medium Term Economic Strategy, *ibid*, pg. 9

⁴⁵ *ibid* pg. 10

⁴⁶ Medium Term Economic Strategy, *ibid*, pg. 59

⁴⁷ Although the data is somewhat dated (1995/96), this publication was found to be the authority on poverty in Belize and is used in that capacity in this report. Plans are underway to construct the Poverty plan for 2003-2008.

⁴⁸ Government of Belize National Poverty Elimination Strategy and Action Plan, 1998-2003, National Human Development Advisory Committee, Belmopan Belize..

expenditure was not high enough to enable them to satisfy their basic food requirements. Poverty was most severe in rural areas, with 42.5% of the rural population deemed to be below the poverty line. Of people engaged in the agriculture and fisheries sector 49.4% fell into the lowest income quintile. The poorest quintile had more children and were generally not well-educated and lacked technical and vocational skills. For the most part electricity was used for lighting, except in Toledo, where 63.4% of the population was still dependent on kerosene. The poor were more dependent on wood as fuel for cooking than the non-poor.⁴⁹

The causes of poverty were generally found to be economic, stemming mainly from unemployment, low productivity and low earnings, although level of education and size of household influenced vulnerability to poverty.⁵⁰

According to the GOB, poverty reduction in the medium term will be approached in several ways. Rural poverty will continue to be addressed through the promotion of small-scale agricultural development and the implementation of rural community-based projects to improve social infrastructure in the villages. Skills training will be provided to encourage employment and entrepreneurship in both rural and urban areas and support will be provided for institutions providing credit and advisory services to small and medium enterprises.

Environment

Belize is blessed with a myriad of resources. “The unspoiled nature of the country is one of its most highly prized assets, and protection of the quality of its resources are paramount.”⁵¹ As such the GOB has pledged in its medium term strategy to ensure that attention is placed on strengthening capacity and performance in land-use planning, environmental management and environmental protection.”⁵²

Recognizing that environmental management and environmental protection are horizontal issues important in poverty reduction, health, tourism (particularly eco-tourism and community based tourism), industrial and agricultural development and disaster mitigation and management, the GOB has indicated that the environment and environmental issues will continue to attract significant attention and public sector human and financial resources. Among the proposed medium term initiatives are; the promotion of a sound management plan for the sustainable harvesting of timber; policies for reforestation and provision of incentives for carbon sequestration programs that renew the forests, preserve the environment and generate income through planting rather than cutting; develop and implement policies and laws that protect the environment against deforestation, soil erosion, coastline erosion, destruction of the reef, pollution of water and destruction of natural habitat for wildlife and a biodiversity management project.⁵³

⁴⁹ Poverty Assessment Report – Belize, Caribbean Development Bank, http://www.caribank.org/share/www-site/publications.nsf/pages/POV_Belize, downloaded 8/31/03

⁵⁰ National Poverty Elimination Strategy, *ibid*, pg. 2

⁵¹ A Tourism Strategy for Belize, Ministry of the Tourism and Environment, Belmopan Belize

⁵² *ibid*, pg. 11

⁵³ *ibid*, pg. 71

2.0 PHYSICAL CHARACTERISTICS OF THE BELIZE ENERGY SECTOR

2.1 Energy Sources and Uses

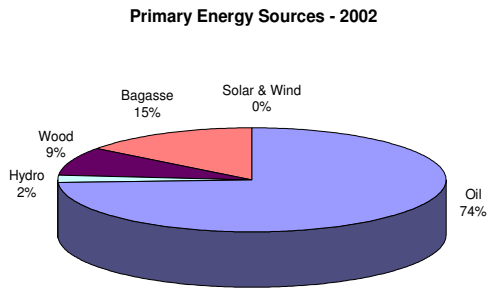


Figure 6

NOTE: since this graph is primary energy sources, it does not include the electricity imported from Mexico

Belize acquires its energy from three main sources, specifically, *imported* fossil fuels, traditional biomass and renewable energy technologies (RET) used to generate electricity. From among these primary sources, the indigenous sources are traditional biomass, hydro, bagasse, solar and wind. Annex 2 provides a detailed breakdown and quantification of the primary sources.

Traditional Biomass (Wood)

In Belize, like in most other developing countries, fuel wood and other traditional biomass products are not part of the formal energy equation. Yet, it represents roughly 9% of the primary energy sources used in Belize⁵⁴. There is evidence of significant household usage and also some use in the food and hospitality industry⁵⁵. Primary research conducted for the National Energy Plan project revealed that firewood is the energy source for lime⁵⁶ producers who use approximately 5,000 pieces of firewood per month. Firewood is also used quite extensively by restaurants for grill cooking and in the production of some mass-produced food items.

Fossil Fuels

Currently, Belize imports 100% of the fossil fuels used in its service. Although there is evidence of petroleum⁵⁷ deposits and there is considerable activity involved in the search for oil in Belize⁵⁸, so far oil has not been discovered in commercial quantities. Belize has several wells with “live oil shows”⁵⁹ and a few barrels of oil have been harvested from some of them. Of the thirty exploratory wells with live shows, only three have yielded a “few barrels of oil”.⁶⁰ See Annex 3 for more information.

The main petroleum based products of importance for Belize are gasoline, diesel and kerosene. Gasoline is used mostly in the transport sub-sector⁶¹. To satisfy transport

⁵⁴ This was extremely difficult to quantify as estimates varied considerably

⁵⁵ particularly in lime manufacturing, food production and hospitality.

⁵⁶ Lime is a key input in the production of tortillas, a popular food item in Belize and as fertilizer in the citrus industry

⁵⁷ petroleum in this context means all natural organic substances composed of carbon and hydrogen; and include crude oil and natural gas, and all other mineral substances, products, by-products and derivatives that are found in conjunction with petroleum, courtesy Production Sharing Agreement

⁵⁸ see Annex 3 for more information on oil exploration in Belize

⁵⁹ Product Sharing Agreement of Belize, Geology and Petroleum Department, Ministry of Natural Resources, the Environment, Commerce and Industry

⁶⁰ *ibid*, exploratory well table

⁶¹ although there is evidence of the substitution of butane for gas and diesel, mostly in the public transportation sub-sector

requirements, Belize imports two grades of gasoline for road transport, regular (octane 85) and premium (octane 90) and small volumes of aviation gasoline for specialist aircraft. Diesel is used both in the transport and electricity sub-sectors and kerosene⁶² is used in the aviation industry and for lighting. According to the 2000 Census, 24% of the households in the rural areas and 2.25% of urban households use kerosene lamps for lighting. 13% of total households use kerosene lamps for lighting as opposed to 1.5% for cooking.

Table 1 - Belize Imports From 2000-2002 Gasoline, Kerosene, Diesel

Imports	Unit	2000		2001		2002	
		Quantity	Value (Bz\$)	Quantity	Value (Bz\$)	Quantity	Value (Bz\$)
Gasoline	Gals	30,093,805	72,223,016	26,915,361	54,509,985	24,422,917	48,881,906
Kerosene	Gals	6,223,804	10,845,904	3,999,039	8,900,667	4,249,834	8,303,857
Diesel	Gals	22,164,678	48,026,490	22,085,284	45,964,104	21,635,079	40,436,530

Source: C.S.O., 8/5/2003

Transportation

Over the last four years gasoline and diesel imports indicated a downward trend. Kerosene is the only import that recorded growth. Yet, the reported data on the number of vehicles in Belize indicates a positive annual growth for most categories of vehicles charted. Private cars and trucks for example reflect a growth of 5 and 8% respectively. It is worthy of note that the higher growth rate of trucks vis a vie cars is not incidental. Rather it is the direct result of government vehicle importation policies that set a higher tariff for cars.⁶³ The import schedule also suggests a policy orientation toward the encouragement of smaller, more fuel efficient vehicles, charging higher tariffs for vehicles, whether cars or trucks, with a six or greater cylinder engine.

Personnel with the Ministry of Transport⁶⁴ and the CSO could not explain the reported reduction in imports vis a vie the escalation in vehicle imports. However, they did suggest that the growing use of butane in the public transportation sector could be a factor. The Ministry of Transport suggested that of the roughly seventy-five (75) bus companies, operating both inter and intra district, "a lot" of the rural bus companies used butane⁶⁵. There is no data on motor vehicle forecasts or expected growth of the transportation sub-sector. The following table indicates the number of vehicles licensed from 1995-2001.

⁶² note that there are two types of uses and users of Kerosene in Belize. The first is an illuminant, by households for lighting and the second is for aviation (known as turbo or Jet A1 fuel), used for small piston engine planes. Because residential consumption is small (less than 1%), A1 kerosene is the only grade imported and used for both households and small piston engine planes. (Courtesy Alamina, Esso).

⁶³ Import duties are levied according to vehicle type and size. The logic is that trucks are used mostly for work, while cars are considered a luxury item. Cars depending of size of engine i.e. 4, 6 and higher are taxed at 57% and 65% respectively. Trucks are taxed at 31% for 4 cyl. and 37% for 6 cyl.

⁶⁴ Mr. Tirso Galvez, Operations Manager, Ministry of Transport

⁶⁵ Tirso Galvez, Operations Officer

Table 2 - Number of Vehicles Licensed in Belize 1995-2001

		1995	1996	1997	1998	1999	2000	2001	Avg annual growth
Public service	Passenger O/bus	404	435	447	211	640	638	642	8%
	Taxi	1,727	1,765	1,918	1901	1,927	2,192	2,191	4%
	Passenger Boat	278	317	476	541	553	727		27%
Private	Cars	7,250	7,517	8,098	8028	8,960	8,896	9939	5%
	Pick-up Truck	6,867	7,387	8,847	8485	9,826	10,198	11,158	9%
	Cycles	679	607	670	513	504	527	518	-3%
	Van	2,242	2,459	2,761	2854	3,044	2,992	3,474	8%
	Other	1,764	1,782	2,157	2680	2,575	2,317	4,758	24%
	Goods	Pick-up Truck	247	284	190	862	283	171	195
	Dump	302	307	257	252	120	151	264	-2%
	Tractor	317	304	384	288	245	251	243	-3%
	Other	1,694	1,738	3,348	1911	2,449	2,286	3,570	16%
Total		23,493	24,585	29,077	28,286	30,619	30,619	36,952	

Source: Abstract of Statistics.

Liquified Petroleum Gases⁶⁶

LPGs used and imported into Belize are butane and propane. According to the Central Statistical Office (CSO), there were 25,335,768 gallons of butane, and 2,479,547 gallons of propane imported last year (2002). There are four primary importers (see details next section), who mix the gases and distribute through their outlets and agents to consumers who use it mostly for cooking.

While the most prevalent use of imported LPGs is for cooking, there is evidence that butane is used as a substitute for diesel and gasoline in the public-transportation sub-sector. Within this sub-sector the main users are those bus companies that serve the rural areas. Informal discussion with representatives from two companies⁶⁷ revealed that the trend is stimulated mostly by the high prices of gasoline and diesel. In fact, the bus companies were generally reluctant to talk about their butane use fearing government regulation and higher taxes. There is no formal data on the use of butane in the transport sub-sector.

Electricity

Roughly, 51% of Belize's electricity production is imported from Mexico. Grid hydro accounts for 24%. Belize Electricity Limited's (BEL) generated diesel accounts for 13%, private diesel 7% and bagasse, produced by the local sugar industry, 5%. In 2002 total demand was over 361 GWh and peak demand was 54MW. Of the electricity supplied by

⁶⁶ Butane and Propane

⁶⁷ Jex & Sons (Crooked Tree Village) who have 2 buses that use butane and Waight's Bus Service (Burrell Boom) who has 1 bus using butane

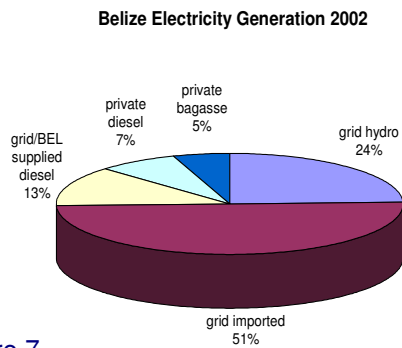


Figure 7

BEL, 56% is for residential application, 31% for commercial application, 8% for street lights (GOB) and 5% for industrial application.⁶⁸ Government of Belize consumes 15% of total electricity consumption annually.

Renewable Energy Technologies

In Belize, the predominant use of renewable energy is in the electricity sub-sector. In that context, the country has a twelve year history with hydro technology and longer with bagasse.

RETs, their history and future in Belize are discussed at length in sections below. Additionally, annexes 4-7 expand the discussion by providing detailed information on renewable energy in general, current and future applications in Belize and the outlook for RETs in Belize.

Annex 1 contains a complete matrix of energy sources and uses. This provides detailed information on the primary energy sources by type, location, application, and ownership. Annex 2 provides detailed energy supply and usage data. Annex 3 contains the available country, electricity and petroleum maps.

3.0 ORGANIZATION AND REGULATION OF BELIZE'S ENERGY INDUSTRIES

3.1 Traditional Biomass (Wood)

Because fuel wood and other traditional biomass products are not part of the formal energy equation there is no discernable industry structure facilitating their supply and sale. However, while there may not be an established chain of supply or distribution, and a measurement of suppliers, consumers and consumption patterns is extremely difficult to ascertain⁶⁹, there is evidence of an established market for firewood. Primary research conducted for the National Energy Plan project, revealed that firewood is used in a number of industries and mostly for heating and cooking.

3.2 Petroleum Products⁷⁰

Industry Structure

In Belize, there are three main players in the petroleum products industry namely, Esso Standard Oil (Esso), Shell Belize and Texaco Belize. The Government of

⁶⁸ Note that the classification system used is based on kwh consumption, such that with the exception of government, this may not truly be reflective of the type or nature of the energy consumer.

⁶⁹ because of the informal and unregistered nature of the transactions

⁷⁰ Excludes Butane and Propane

Belize, through the Ministry of Finance, regulates retail service station prices⁷¹, which are devised to include a high proportion of taxes used to buffer against the international fluctuations in the oil market. Although the wholesale and retail markets are open to multiple importers, currently only Esso has the authority and the facility to import oil for commercial consumption into the country, suggesting a monopolistic structure in the wholesale portion and an oligopolistic structure in the retail portion of the petroleum distribution chain. There are two other authorities licensed to import: BEL⁷² and a private wholesaler Mr. Salvador Fernandez⁷³. These stocks are for specific purposes however and for the most part do not access the general retail market.

The Wholesale Market

The wholesale market is dominated by Esso Standard Oil, a company registered in the Bahamas, who sources oil from the United States. There are no pipelines or refineries in Belize so a tanker averaging 80,000 barrels of refined fuels, arrives in the country every twenty days and delivers its cargo to the only depot in the country. The amount purchased by the retailers is then transported to the retail companies and their service stations via trucks, or barges in the case of the islands.

The Esso depot currently has an installed capacity of 166,000 barrels of which 40,000 is allotted to premium gasoline, 26,000 for regular gasoline, 14,000 for kerosene, 85,000 for diesel and 1,000 for aviation gas. The depot has no formal amenities for reserves but keeps a 5-7 day supply (approx 20-25k barrels) on hand. According to Esso, losses due to spillage are not an issue at the Esso depot.⁷⁴ Evaporation from ship to shore was measured at 0.3% and at the terminal less than 1% for gasoline and 0.5% for diesel.

Supply forecasts are completed on the basis of historical trends and a review of external and internal factors in the company's operating environment. Esso requires its distributors to provide a forecast every three months that forms an integral part of the supply source data. Usually, however a 3% increase is used as a "rule of thumb."⁷⁵

Barriers to entry are significant, as Esso has established an entrenched infrastructure and high capital investments may be necessary for new entrants. A smaller company may find itself unable to compete with the resources and local experience of the incumbent. There is established brand recognition, if not product differentiation, and other entrants would have to compete in a situation bearing significant market (price) distortions.

The Retail Market

Exploiting vertical integration synergies, Esso also operates in the retail market and competes with Shell Belize Limited and Texaco Belize Ltd. for customers. These

⁷¹ however direct supply from the oil companies is freely negotiated

⁷² licensed for importation of diesel to run its generators

⁷³ import license for bunker C which he sells to the Citrus Industry and BSI, personal communication, Eldo Lopez, Territorial Manager, Sales Dept. Esso.. Research was unable to discover the quantities allowed under this license

⁷⁴ although he was certain it became an issue for the retailers once the supply left the depot

⁷⁵ Guillermo Alamina, Lead Country Manager – Esso Standard Oil – Belize, personal communication, September 3, 2003

operators do not compete on the basis of price, as pump prices are regulated by GOB.⁷⁶ Since each retailer has its own blending recipe, they do compete on the basis of quality and product differentiation, customer service and the ability to build a loyal customer base by offering credit and other services valued by their customers. Available market share information⁷⁷ suggests that Esso has the largest share in the Industrial segment with 44.1% of the market. Shell and Texaco share the remainder with 27.5% and 28.4% respectively. In the general retail market, Esso has the lowest share at 28.9%, while Texaco has the highest at 40.4%.⁷⁸

Shell Belize, owned jointly by Asiatic Petroleum Company Limited and Shell Petroleum Ltd., both registered in London, owns eight (8) distribution stations. Six (6) other stations bearing its brand are owned by independent franchisers, although the company owns the tanks, the pumps and the canopies used. Esso owns (4) and fifteen (15) franchisers carry its brand. Texaco, owned by the Chevron Texaco Corporation of the United States participates with twenty-nine (29) retailers; however they declined to provide ownership information.⁷⁹ Losses due to evaporation at the pump were not recorded by any of the retailers and spillage rates for those who measured, were not shared. Shell stated that losses above one pint are reported from the retail stations.⁸⁰

According to Shell, last year and through the first quarter of this year, they have not been meeting their revenue forecasts or expected growth rates. Shell's Annual report for 2002 states a gross profit percentage decrease of just under 1%, when compared to the previous year.⁸¹ According to the company, this is due in large part to the Commercial Free Zone and the illegal black market activity associated with it.⁸²

In the retail market barriers to entry are significant as market distortions in price persist and there are few opportunities to exploit economies of scale.

Regulatory Environment

Research could discern no coordinating authority, regulatory organization or Ministry with oversight responsibility for the petroleum products industry, although officially, the Ministry with the portfolio for energy is the Ministry of Works, Transport and Communications. What does exist is a network of government ministries and departments with varying interests in the petroleum sector. Annex 8 provides a listing of the government ministries and departments involved in some aspect in the petroleum products industry.

It is worthy of mention that regulations pertaining to the transportation of fuel via truck (currently unregulated) appear imminent. In early 2003, a bill seeking to regulate fuel transportation was brought before the House of Representatives. The bill proposed to create and give recognition to the Petroleum Haulers Association, and to assign to that body *inter alia*, the responsibility for regulating the haulage of petroleum. The bill

⁷⁶ This is addressed more below

⁷⁷ Available only as of August 2002. Thereafter, individual companies stopped sharing that type of information with the competition and were reluctant to provide it to the researchers on that basis.

⁷⁸ This is logical when compared to the number of retail outlets. Texaco has the highest numbers here

⁷⁹ Neri Briceno, Senior Marketing Consultant, Texaco, personal communication (email) September 4, 2003.

⁸⁰ Joseph Habet, Country Representative, personal communication, telephone September 3, 2003

⁸¹ Shell Belize Limited, Financial Statements, December 31, 2002

⁸² *ibid*, where duty free fuel for export is illegally sold at a fraction of the normal price on the local market

also provided for the issuance of petroleum haulage licenses by the Department of Motor Vehicles, to any person desiring to transport more than 500 gallons at any one time. A condition for license is Petroleum Haulers Association membership and certification of eligibility. To become a full member of the association, haulers must satisfy the association's fee and its membership committee that they have no less than five years experience of driving and operating a petroleum tanker. There is no mention of standards, international or otherwise, and while the bill does impose quite stringent and specific performance requirements to access the association, there are no visible demands on members once they acquire association rights. Additionally the Minister has sweeping discretionary powers including but not limited to approval of all rules made by the association at the general meetings, final arbiter in the license certification appeals process, and final approval on all haulage licenses. At its reading, key stakeholders took exception to specific provisions of the bill and a Senate committee was established to hear arguments and to propose amendments. The proposed amendments are due in November 2003.

Overall the petroleum industry lacks product quality guidelines, technical and safety standards, emissions standards, competition policy and energy security (reserves) legislation.

3.3 Liquid Petroleum Gases

Industry Structure

Currently there are four main importers⁸³ in the LPG distribution market; as follows:

Table 3 – Industry Operators - LPG

Category/Operator	Belize Gas Ltd.	Belize Western Energy Limited	Belmont Butane Gas Co. Ltd	Southern Choice Gas Co.
Ownership Structure	Sole proprietorship (Roque Reyes)	Tropigas International (El Salvador)	Sole proprietorship (Edmund Longworth)	Declined to provide information
Supply Source	Pemex (Mexico)	El Salvador (imported from Venezuela, US and Mexico)	Pemex (Mexico)	"
Distribution Infrastructure	Hauled by road and distributed by trucks and barge	Hauled by road and distributed by trucks and barge	Hauled by road and distributed by trucks and barge	"
Holding Capacities	Declined to provide	350k gals (90% holding capacity)	120k gals	"
Reserves	Declined to provide	50k gals	100k gals	"
No of Agents/distributors	1 Bze, 1 Cayo, 1 OW	6 agents, 1 per district	13 agents ⁸⁴	"
Vertical Integration	Yes, owns all distribution points	No, independent agents (no assistance or financing)	No, independent agent (no assistance or financing)	"
Location of Depots	Orange Walk	Belmopan, Hattville and Ladyville	Corozal	"
Re-supply schedule	Every 3 days	Every 6 days (30k gals)	Every 3 days (according to forecast)	"

⁸³ courtesy Ministry of Commerce and Industry, Personal Communication, Elsy Reyes, Secretary, September 2, 2003

⁸⁴ (3) Corozal, (3) Orange Walk, (2) Belize City, (2) Cayo, (2) Stann Creek and (1) San Pedro

Butane and propane are imported separately⁸⁵ and mixed by the distributors in country for the consumer market. Mixing is necessary to ensure the butane product sold has enough “pressure”⁸⁶ to satisfy the main applications.⁸⁷ The mix formula depends directly on the application. For example the butane product sold to households for cooking is generally a 60/40 propane/butane mix, while the product used for industrial applications is a 70/30 propane/butane mix.⁸⁸ Propane is sold separately if requested, although the demand for pure propane is extremely small.⁸⁹

For the most part, butane⁹⁰ is sold bundled with a tank (deposit paid) and customers pay one price for a single product. Tanks come in varying sizes and consumers can choose to purchase the bundled product from the butane supplier or to purchase the items separately. Like the oil and gas distribution markets, GOB, through the Ministry of Commerce and Industry mandates the selling price for butane, see Annex 8 for formula and district schedule.⁹¹ The retail price changes if there is an increase or decrease of \$4.00 or more in the landed price.⁹² According to the Ministry of Commerce and Industry, the price per district varies because of the costs associated with transportation. Thus costs depend to a large extent on where a company sources its supply, the distance from the supply to the reservoir and finally the distance from the reservoir to the local agent. For example Orange Walk and Corozal signal the lowest butane prices. This is likely because both companies operating in that area source from Mexico and have reservoirs either in Orange Walk or Corozal. However Belize City and Belmopan, where prices are \$1 – 2 dollars above the Northern districts, are supplied to a large extent by BWEL, who has depots in Hattieville, Ladyville and Belmopan, but sources its supply through its parent company in El Salvador. They in turn source from the US and or Venezuela. In the most recent price adjustments released by the GOB in September of 2003, Dangriga and Punta Gorda prices remained unchanged since the purchase price for the main supplier to those districts i.e. Southern Choice, did not change.⁹³

Operators in this sub-sector are able to compete on quality and service. For new entrants, brand identification and loyalty could be a factor and again opportunities to exploit economies of scale are limited.

Regulatory Environment

Like the situation in the petroleum products industry, research could discern no coordinating authority, regulatory organization or Ministry with oversight responsibilities for LPGs, although again, the Ministry of Transport et. al., is responsible for the energy

⁸⁵ although only butane requires an import license, per Ministry of Commerce and Industry, John Banner, Price Control Officer, Oct. 27 2003.

⁸⁶ Angel Matus per John Banner, *ibid*.

⁸⁷ Angel Matus, BWEL as told to John Banner, Price Control Officer, Ministry of Commerce and Industry, Oct. 27, 2003

⁸⁸ Angel Matus, BWEL as told to John Banner, *ibid*,

⁸⁹ Angel Matus, BWEL as told to John Banner, *ibid*

⁹⁰ referent of butane mix

⁹¹ The prices quoted in this report are for the most popular tank size i.e. 100lb or 22 gallon tank. Other standard sizes are 50 and 25 lbs. According to Ministry of Industry and Commerce, prices for these sizes are based on the price for 100lb. Thus a 50lb would cost ½ of the 100lb and the 25 lb, ¼ of the hundred pound.

⁹² Personal Communication, Ministry of Industry and Commerce, Ms. Elsy Reyes (Secretary to the Director), August/Sept 2003

⁹³ Glenda May Martinez, Administrative Officer, Ministry of Industry and Commerce, Personal Communication, October 3, 2003

portfolio. A similar consortium of Ministries, Ministry departments and laws preside over the LPG industry. See Annex 8 for listing. Like the petroleum industry there are legislative and policy omissions. These include, standards for tank and tank use⁹⁴, product quality guidelines, technical and safety standards for providers and end users, competition policy and energy security (reserves) legislation.

3.4 Electricity

Belize's electricity market is liberalized and regulated. Under current regulations vertical integration is permitted but the regulator is mandated to encourage competition in the sector. Although there are meaningful attempts to encourage competition in generation, the distribution/transmission market is currently dominated by a single privately owned bundled supplier (BEL), who is required by law to provide transmission facilities to any generator capable of paying its fees.

Distribution, Transmission and Supply

Belize Electricity Limited (BEL) is Belize's main commercial, transmitter, seller, supplier and distributor of electric current. It is a Limited Corporation owned by Fortis Incorporated of Canada (67%), Social Security Board (25%) and various small shareholders (8%). Current licensing agreement extends to 2015 and under the terms of the license, the Company has the right of first refusal on any subsequent license grant.

BEL's national grid currently serves the Northern districts, including the off shore community of San Pedro⁹⁵, the Central and Western districts and a small portion of the South.⁹⁶ There are small local grids in the most southern communities and the other populated off shore community of Caye Caulker. Under the Power IV project, due to be completed in 2005, the grid is being extended to interconnect the existing local grids in the south⁹⁷ with the national grid. The grid transmission and sub-transmission systems consist of 115 kV, 34.5 kV and 22 kV lines, while the distribution system voltages range from 6.6 kV to 34.5 kV. Please refer to Annex 3 for a graphical representation of the grid and its interconnections.

In 2002, BEL experienced five hundred and sixty seven (567) unplanned outages, due to various reasons, countrywide⁹⁸. Of this, seventy-seven or 13.5% were attributable to the Mexican exporter either at generation or transmission. The average duration of outages throughout the year was roughly two hours. However, the duration spread is significant, starting with a lower limit of six minutes to an upper limit of twenty-one hours. Planned outages for repair and maintenance were calculated at two hundred and twenty six (226).

Beside BEL's local and national grids, there is a small local grid in the closed Mennonite community of Spanish Lookout in the central Cayo district, owned and

⁹⁴ According to Mr. Perfecto Matus of BWEL, retailers are left to self-regulate and use their judgement regarding rust of the tank, regulator and nut wear and tear. Personal Communication, September 12, 2003.

⁹⁵ map indicates a 34.5 KV submarine cable from the Maskal substation to San Pedro Town.

⁹⁶ 34.5 KV transmission line from La Democracia Sub-station to Dangriga town

⁹⁷ Independence and Punta Gorda. Upgrade scheduled for existing transmission line between La Democracia and Dangriga.

⁹⁸ The three most popular reasons were CFE at 13.5%, HV (high voltage) conductor faults at 42.8% and pole issues at 12%. Courtesy BEL.

operated by Farmers Light Plant Cooperative.⁹⁹ Transmission of electricity is provided to 480 customers through a 70 mile 2.4 KV line¹⁰⁰ transmission system. Recorded losses are extremely high at 21%. There is also a small operator, Earth Tech providing service in the Corozal Commercial Free Zone.

Demand Forecasts

BEL's demand and energy forecasts for the grid system are as per the table shown below. Worthy of note is that the forecast figures assume an annual GWh increase of on average 9% per year to the year 2010. Grid peak MW growth is expected to more than double between 2000 and 2010.

Table 4 – Energy Sales and Demand Forecast Results

Courtesy of BEL's Generation Planning Report 2001

Energy Sales and Demand Forecast Results							
Year	Total gwhs	Sales- Growth %	Total System Growth %	Grid gwhs	Sales- Growth %	Grid Generation gwhs	Grid Peak MW
2000	229.4		14.96			214.4	40.9
2001	256.6		11.88			242.5	46.2
2002	273.4		6.56			263.0	47.8
2003	298.0		9.00			295.2	54.3
2004	321.3		7.81			318.1	58.5
2005	349.4		8.73			349.4	64.2
2006	379.6		8.65			379.6	69.8
2007	411.9		8.52			411.9	75.7
2008	446.6		8.43			446.6	82.1
2009	483.8		8.33			483.8	89.0
2010	523.6		8.22			523.6	96.3

Pricing

The new tariff setting methodology under the Electricity Tariffs, Charges and Quality of Service Standards Byelaws, is based on an incentive regulation model under which the cost of services is segmented into three parts: (i) a fixed component to cover overhead expenses and provide the company with a reasonable rate of return for which fees are chargeable to recover the cost and profit associated with each function, (ii) a variable component that reflects the costs of electricity and (iii) a deferred cost of power recovery program. Tariffs are to be adjusted annually (the rate period "RP"). Every four years (the tariff period "TP") a full review of the regulated values takes place, thus setting the values for the first Rate Period of the next Tariff Period. Pursuant to the byelaws, BEL created the Cost of Power Rate stabilization Account ("CPRSA"), designed to stabilize charges in the price of electricity due to fluctuating fuel costs. At December 31, 2002, the balance in this account was \$16.2 million¹⁰¹.

The weighted average electricity rate to consumers at 31, March 1999 was Bze. 0.3578/Kwh and this rate was forecasted to be reduced by five cents Bze by the year

⁹⁹ A company owned and formed by the local farmers to service the industries in the area

¹⁰⁰ although there is a stretch of 7 miles with 7.2KV lines

¹⁰¹ BEL annual report, 2002

2004. Current pricing suggests that this has been achieved. See Annex 8 for current BEL Pricing.

Subsidies and Programs

In their 1998-2003 Manifesto, the government of the day made an election promise to “extend electricity to remote areas.”¹⁰² To that end, in June 1999, GOB embarked on an initiative with BEL to provide electricity to remote villages and towns throughout the country. Touted as the rural electrification project, the effort was underwritten by a \$30m (Belize Dollar) loan from EXIM bank. From 2001 to the present, BEL recorded roughly two hundred and ten (210) government related projects funded by the loan.

Additionally, in an attempt to provide electricity to the most needy, BEL created a “social tariff” as a part of their formal pricing structure. Prior to April 2003, the social tariff was established at \$0.21 between 0-50kwh. Profits from mid and higher end electricity consumers were used to subsidise costs associated with the social tariff.¹⁰³ After April 2003, the GOB negotiated with BEL to extend the social tariff upper limit to 125kwh and agreed that if the company’s revenue streams were compromised by the policy, the GOB would subsidise the shortfall.¹⁰⁴ The effect of this decision and any subsequent subsidy will be determined in the annual tariff review scheduled for the first quarter of 2004. As of June 2003, the number of customers within the social tariff category was 22,000.

Barriers to Entry

BEL’s dominant position and partially subsidized operations would disadvantage unsubsidized new entrants wishing to compete in bundled services or in transmission and distribution markets. Large capital outlays and little opportunity to exploit economies of scale would be a factor. Brand loyalty may also be a factor.¹⁰⁵

Generation

The generation market is open to any viable competitor. Generators usually negotiate and sign long term power purchase agreements with the incumbent provider. Activity in this sector is regulated by the PUC, to whom any entity generating more than 75Kw must apply for a license to operate. As a policy, the PUC is encouraging BEL to outsource generation to other independent providers and to this end is actively assisting and establishing the enabling context to encourage more environmentally friendly generation projects.

In 2002, BEL was able to satisfy its aggregate peak demand of 54 MW from multiple sources. These are the importation of energy from CFE, a Mexican, state-owned power company, the Mollejon Hydroelectric Plant and its own diesel-fired generation. These are described further below:

¹⁰² People’s United Party Manifesto 1998-2003, Strike 3 Set Belize Free, pg. 14

¹⁰³ Personal Communication, Gilbert Canton, PUC, November 3, 2003

¹⁰⁴ *ibid*

¹⁰⁵ Although price differentiation (lower prices) could easily challenge that.

- Purchased power from CFE Mexico at 115 kV. BEL has in place a contract for the supply of up to 25 MW of firm capacity from CFE Mexico. The XULHA substation, which supplies Belize and also supplies the area of Chetumal, is connected to the major CFE generating stations in the Merida area (Central Quintana Roo 350 km away) by a 230 kV line and a 115 kV line. In 2002 CFE accounted for roughly 13% of BEL's unplanned outages.
- The Mollejon Plant, is a 25 MW run of river hydroelectric plant. The plant is located on the Macal river and has installed three 8.4 MW turbines. Generation capability of this plant varies with the hydrologic season as the water storage is very small (the storage can support 25 MW for approximately 11 hours) and only provides daily regulation. BEL classifications of the hydrologic seasons are in two periods, namely the dry season (February to June of each year) and the wet season (July to January). Historical hydrologic records indicate that if the plant is used only for peaking of BEL's system the minimum available water flow can support a peaking capacity of 6.5 MW during the dry season and 10 MW during the wet season. BEL uses the plant in different modes dependent on the season, in the dry season it is used for peaking and emergency backup, while in the wet season it is used as a base load plant.
- The diesel plants owned and operated by BEL are partially a legacy of BEB¹⁰⁶. These consist of 19.8 MW of installed capacity with units varying in size from 0.5 to 3.5 MW. Two plants, namely the Belize and Belmopan Power Plants, have an installed total of 9 base load medium speed units with an available capacity of 13.8 MW, and in addition BEL has five 1.2 MW high speed containerized mobile units which are located at the Belize City Plant, the Belmopan Plant and the old San Pedro Plant site. BEL also maintains four diesel plants in Caye Caulker (0.675MW total available capacity), four in Independence (approx 1.25 MW total capacity) and five in Punta Gorda (3MW total capacity). BEL is allowed to import the diesel it requires to run its generators direct from Mexico. In 2002, BEL used 3,744,039 gallons of diesel for generation of which it imported 2,656,858. The balance was secured from local sources. Even though BEL's diesel generation network would benefit significantly from upgrades and new purchases, in accordance with its policy to encourage competition in generation, the PUC has allowed BEL to invest in one diesel powered gas turbine generator for emergency and peak loads only.

The Mollejon Hydroelectric Plant

In the electricity sub-sector Belize has enjoyed a twelve (12)-year history with renewable energies. In April of 1991, GOB granted a franchise to International Energy Equities, Inc (IEEI) and the Dominion Energy, Inc. (DEI) to build operate and transfer¹⁰⁷ (BOT), a 25MW run of the river hydroelectric plant and a 115 kV transmission line to the Belize City and Ladyville load center. BEB entered into a power purchase agreement with the same companies for a forty (40) year term which provided for the purchase of 120 Gwh per year from the hydro plant at the rate of US \$0.0875/ kWh plus an operations and maintenance fee of 5% of revenues received for hydro-energy sold.¹⁰⁸

¹⁰⁶ Belize Electricity Board; the government owned utility prior to privatization

¹⁰⁷ In 2036

¹⁰⁸ BEL Prospectus

In 1992, the same companies entered into an Assignment Agreement, pursuant to which the GOB and BEB (shortly thereafter BEL) assigned the rights and obligations of IEEI and DEI under their agreements to the Belize Electric Company Limited. In September 1992, BEB and BECOL entered into a Transmission Facility Agreement, wherein BEB agreed to provide BECOL with the access to, and authority over, national and private lands in Belize to enable BECOL to perform under the agreement.¹⁰⁹

In December 1996, the power purchase agreement was renegotiated and in November 2001, after two prior agreements, BEL, BECOL and GOB entered into the Third Master Agreement. This agreement amended the existing agreements but maintained the substantive agreement between BEL and BECOL, in which it was agreed that BEL would agree to purchase the power provided by BECOL at an agreed price, and would refrain from purchasing from any third party source unless all energy from the project was purchased for the operating year.¹¹⁰ GOB would continue to support and guarantee BECOL's investment by legislating an attractive investment climate and providing the resources such as land and tax concessions to allow BECOL to bring in its equipment duty free, operate the facility and repatriate its profits. To this end, a number of legislative instruments were enacted. These are:

- Mollejon Hydroelectric Project (Exemption from taxes and Duties) Act, Chapter 59, 1994 (rev. 2000). As its name implies, this act confers upon BECOL exemptions from taxes and duties payable to the Government of Belize, its agencies, departments, and political sub-divisions and other levels of government granted under section 3 of the act.
- Macal River Hydroelectric Development Act, 2003, which grants BECOL the right to design, finance, construct and operate the Chalillo Project, as defined by the Third Master Agreement.

The Chalillo Dam

BECOL, the IPP who owns the Mollejon hydro electric facility is pursuing the development of the Chalillo Project, an upstream storage and generation facility that will increase average Mollejon hydro energy production by BECOL from 80 GWh to more than 160 GWh. BEL has publicly stated that the increased energy production from Chalillo is the least-cost energy alternative in Belize and will provide a number of significant long-term benefits for customers and for the country. The Chalillo Project is expected to increase reliability of service through more consistent production of electricity and will enable more stable electricity costs due to reduced reliance on fossil fuels. It will also improve energy autarky in direct relation to the increasing demands of energy consumers. Construction of the Chalillo Project was scheduled to commence in early 2003 with completion in 2005.

Substantial opposition from environmental groups concerned about the human and environmental effects of constructing a dam on the Macal River has forced BEL/BECOL into court and subsequently to defer the project. In early 2003, The Belize

¹⁰⁹ Although the Third Master Agreement between GOB, BEL and BECOL, November 21, 2001 was the source, it is important to note that the Transmission Facility Agreement is a provision of the First Master Agreement and subsequently retained in the second and third master agreements.

¹¹⁰ *ibid*, section 2.1, pg. 7

Alliance of Conservation NGOs (BACONGO) brought the case to the Privy Council in England, who in unprecedented fashion agreed to review the case. The full case was deferred until December, 2003. However, in August, in a victory for BEL/BECOL, the judges on the Privy Council denied an application by BACONGO to grant an injunction to stop work on the Chalillo project.

In June of 2003, the GOB introduced and subsequently passed the Macal River Hydroelectric Development Act (see above), which legislates BECOL's authority to construct the Chalillo dam. Claiming expediency in the public interest, the GOB legislated the authority for BECOL to proceed with the "design, financing, construction and operation of the Chalillo Project"¹¹¹, as long as the company agreed to full compliance with all environmental laws and policies. This Act also makes the construction of the dam extra-judicial and technically beyond the reach of the Privy Council, although the GOB has agreed to accept the determination of the Privy Council in the case currently before it. In section, 4 (c), the government legislated, that once BECOL is in full compliance with national regulations and policies, "no further or other review, hearing, assessment, approval or other proceeding under any other law shall be required to authorize or permit the design, financing, construction of operation of the Chalillo Project."¹¹² According to BEL¹¹³, work is continuing on the construction of the project.

Farmers' Light Plant

Beside BEL, the other provider to generate and sell is the Farmers' Light Plant in Spanish Lookout. Three diesel generators serve their 480 customers, the sizes of which are: 2MW, 1 MW and 750kW (rating measure).¹¹⁴

Bagasse

The sugar industry in Belize, represented by the dominant operator Belize Sugar Industries Limited, has used its by-product bagasse to provide the energy for powering its factory for over thirty years. The company produces around 1.1 million tonnes of sugar annually and from that is able to retrieve enough bagasse to be able to incinerate approximately 20 tonnes of bagasse per hour. Twenty tonnes of bagasse per hour generates 4-6 MW of energy. However, the company needs only 4-5 MW to fire its current operations.

Within the last three years, the company has considered co-generation and has created a subsidiary company BELCOGEN to oversee the construction of facilities and complete the co-generation agreements. The new company has signed a Fuel Supply Agreement with BSI and in return agrees to build, operate and transfer at the end of the payback period the facilities to BSI. According to BSI, the company is currently in the process of negotiating a PPA with BEL for the purchase of up to 13 MW of energy to feed the grid. Total production is expected to peak at 25MW, however 12MW will be

¹¹¹ Macal River Hydroelectric Development Bill, GOB, June 2003, pg. 4

¹¹² *ibid*, pg. 5

¹¹³ Lynn Young, CEO, personal communication, Sept. 03, 2003

¹¹⁴ Note the particulars of the Corozal operator is not known and thus excluded here. It does have generation capacity and does sell to its customer in the free zone area.

retained for factory and plant use¹¹⁵. The company aspires to produce 25% of the national electricity mix through bagasse cogeneration. To ensure sustainability of the venture, the company is planning to use 100% bagasse from local producers only for the first two years of operation. Thereafter it is planning to augment the local producer yield with the yield from thirty-one (31) acres of sugar cane that it cultivated for this purpose. The company estimates it will require an annual yield of 1.3 million tones of sugar cane to generate energy all year round. The project has an online date of January 2006

Barriers to entry

Fewer barriers exist for entrants desiring to generate vis a vie transmit or distribute, although the issues of technical standards and interconnection may create credible barriers.

Regulatory Environment

It is worthy of note that the electricity sub-sector is the most complete and widely regulated of all energy sub-sectors existing in Belize. This of course does not mean that the sector is without some regulatory omissions. For example there are no RE specific policies either as a part of a comprehensive energy strategy or specific to the electricity sub-sector. Standards that guide the purchase decision of the end-user is also lacking, as well as fiscal encouragement of the use of energy efficient equipment. Finally the sub-sector would benefit from an articulated competition policy that in general addresses the behaviour of enterprises operating in the electricity sub-sector by prohibiting certain business practices such as restrictive horizontal price agreements, acquisitions, abuses of dominant position and restrictive vertical agreements, and that endeavours to control the effect of certain business practices such as mergers, acquisitions and joint ventures, on market structures. Annex 8 details the history and current regulatory framework of the electricity sub-sector.

4.0 ENERGY AND SUSTAINABLE DEVELOPMENT

Development is a complex process with many of its components inextricably interwoven. For example, economic development can either complement or distort the rate and direction of social development. Developing countries seeking to evolve and diversify their economies often find that in many areas they are constrained by a fundamental ingredient of all economies -- energy. Modern forms of energy empower human beings in many ways, by reducing drudgery, increasing productivity, transforming food, providing illumination, transporting water, fuelling transportation, powering industrial and agricultural processes, etc. Given that it can increase human capabilities and opportunities, energy is integral to development. However, for such development to be sustainable it "must not compromise the prospects of future generations"¹¹⁶. Sustainable development consists of progress in social development, complemented by economic development and an awareness of the environmental implications of natural resource use in economic development. Thus, energy produced and used in ways that

¹¹⁵ for both BSI and BELCOGEN facilities

¹¹⁶ Accepted definition put forth by the World Commission on Environment and Development, as quoted in the UNDP publication energy for sustainable development, a policy agenda, UNDP 2002.

support human development in all its social, economic and environmental dimensions is the overarching driver of a sustainable energy strategy.

However, achieving a sustainable energy strategy remains a formidable challenge for the world. Although fossil fuel burning is a leading contributor to carbon dioxide, lead, sulphur and to a lesser degree, cadmium, methane and nitrogen fixation emissions in the atmosphere, at least for the next thirty years it will continue to be the dominant source of energy. The Kyoto Protocol that puts a cap on emissions of six greenhouse gases (GHG)¹¹⁷ by industrialized countries is not supported by the United States, which accounts for 36% of the CO₂ emissions by the industrialized world¹¹⁸.

Just under one-half of the world's population or 2.4 billion people, rely on biomass fuels such as wood, animal dung, crop residues and coal for domestic energy needs. According to the World Health Organization, over the past twenty-five years, transition to cleaner fuels among the poor has slowed dramatically and there is evidence that reliance on biomass is increasing in some parts of the world¹¹⁹. Besides the associated health risks, mainly for women and children¹²⁰ according to the Centres for Plant Diversity: The Americas, published in 1997, by the Wildlife Fund and the World Conservation Union, gathering of fuel wood has caused serious forest degradation in certain countries in the Americas. For example, it estimates that roughly one-half of all the energy consumed in Central America comes from fuel wood and in El Salvador, where it estimates that 75% of the homes use fuel wood, gathering the wood constitutes the principal cause of forest degradation and deforestation. In fact, El Salvador has to import fuel wood from Honduras and Guatemala, because only 5% of its territory is forested¹²¹.

In Rio de Janeiro, twelve years ago, the international community agreed on the overarching goal of sustainable development and it adopted a plan, Agenda 21, on how to get there. The importance of energy systems in underpinning many elements of sustainable development was a common theme throughout Agenda 21. The principles of Agenda 21 have since been echoed by the Millennium Development Goals, developed at the Millennium Summit in 2000 and the World Summit on Sustainable Development in August of 2001. Thus, rhetorically at least, for many countries sustainable development is the objective. The challenge however, remains the implementation of policies and practices that support sustainable energy development.

¹¹⁷ carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF₆).

¹¹⁸ Pronove Gao, *The Kyoto Protocol and the Emerging Carbon Market*, February 2002.

¹¹⁹ WHO study, *The Health Effects of indoor air pollution exposure in developing countries*, Nigel Bruce, Department of Public Health, University of Liverpool, National Institute of Respiratory Diseases and Rachel Albalak, Department of International Health, Rollins School of Public Health of Emory University, 2002. <http://www.who.int/peh/air/indoor/oeH020sum.htm>, downloaded August 31, 03

¹²⁰ It is said to increase the risk of childhood acute respiratory infections like pneumonia, bronchitis and chronic obstructive pulmonary disease. Among women, there is emerging evidence that exposure during pregnancy reduces birth weight, infant and prenatal mortality may also be increased and the smoke from biomass exposure is likely to exacerbate asthma. Source WHO study, *ibid.*.

¹²¹ <http://www.nmnh.si.edu/botany/projects/cpd/ma/macentral.htm>, downloaded August 31, 03

4.1 Belize and Sustainable Development

It is established that the fastest growing economic sectors are the handicraft and furniture industries, agro processing and tourism. Over the past few years tourism has become one of the pillars of Belize's economy. That the country's future is tied to tourism and in particular, eco-tourism and that the development process is underpinned by a commitment to sustainability must be a consideration for energy policymakers. Indeed, given the country's reliance on being "green" one could extrapolate a mandate to energy policymakers to ensure a sustainable energy strategy.

Also a consideration for policymakers is the issue of Climate Change and the obligations under the UNFCCC. As a signatory, Belize recognizes its common but differentiated responsibility to contribute to the international effort to meet the ultimate objective of the Convention: which succinctly put is the . . . "stabilization of greenhouse gas concentrations in the atmosphere at a level that would not upset the delicate balance in the climate system." While this agreement obligates only the industrialized countries (those listed in Annex 1 of the Convention) to institute policies and practices that result in less emissions, Belize cannot afford to be indifferent. The conclusion of the GOB's first communication to the UNFCCC is instructive. "The inventory results confirm that the extensive forest estate renders Belize a net 'sink' or absorber of atmospheric greenhouse gases"¹²². This however is a position that needs to be carefully managed. As an "absorber" Belize is ideally positioned to participate in the Clean Development Mechanism¹²³ and to sell its credits to industrialized countries desperate to meet their emissions obligation. Without proper management, Belize could increase its vulnerability to the adverse effects of climate change and in the process reduce its advantage as a sink.

The globalization of environmental services represents a unique opportunity for Belize to "leapfrog" the fossil fuel stage of energy development, currently a challenge to other developing countries. However, leapfrogging involves looking for solutions appropriate to Belize, which inter alia, are tailored to an environmental services oriented economy based on agro forestry, aquaculture and tourism/culture activities. Given its size and development status, Belize is not in a position to innovate. Thus in its energy development, it is relegated to the role of follower. Nevertheless, given the lack of natural oil and gas reserves and the incongruities associated with maintaining biomass as an indigenous source of energy, in contemplating the energy sources that will power Belize's future, the most efficient high tech, environmentally friendly, and cost-effective technologies must be considered. This should place RETs high on the list.

¹²² First National Communications to the Conference of the Parties of the United Nations Framework Convention on Climate Change, Government of Belize, UNDP Project BZE/98/G31/A/1/99, January 2000

¹²³ The Clean Development Mechanism (CDM) is a part of the flexibility mechanism of the Kyoto Protocol, which allows industrialised countries to fulfill their commitments by investing in projects in developing countries that contribute to sustainable development in the developing country and contributes to the stabilization or reduction of GHG emissions in the atmosphere.

Energy and Belize's Sustainable Development

Energy and Social Development

Modern societies depend on reliable energy supply to sustain their productive capacity and social cohesion. Thus energy is strategically important for developing countries. According to the World Bank, "countries that do not use modern forms of energy efficiently cannot realize their potential for creating wealth nor lift their populations out of poverty."¹²⁴

While there was no information available to this study on the relationship between energy and social development in Belize, there was also no basis to suggest that the Belize experience would differ from that of other countries in like circumstances. Like other developing nations, Belize has high levels of poverty¹²⁵ implying that there are a number of individuals, mostly in the rural areas unable to satisfy what is considered to be basic human needs such as food, shelter, fuel, clothing, safe water, sanitation, healthcare and education. According to the Country Poverty Assessment report in the GOB's National Poverty Elimination Strategy and Action Plan (1998-2003)¹²⁶, even though the majority of people have access to electricity, in Toledo (the poorest district), 63.4% of the population was still dependent on kerosene for lighting. Additionally, in the same district, 55% or 2,455 households use wood for cooking.¹²⁷ While this is a mere 4% of total households in the country,¹²⁸ that the figures are so high in the poorest district in the nation suggests that the poor are much more dependent on wood for cooking than the non-poor.

Energy services, although only one dimension, is a critical input to the primary development challenge of providing basic needs. For example energy supports the provision of cooked food, comfortable living temperatures, lighting, the use of appliances, piped water or sewerage, essential health care (refrigerated vaccines, emergency and intensive care), education aids and communication (the internet, radio, television). In Belize the lack of access to energy services mean that the poor must walk or use animal power, live in badly lighted homes, conduct study activities by candle or kerosene light, cook with polluting fuels like wood and dung and complete productive activities during daylight hours. Additionally, given that kerosene and wood are among the leading fuels used by the poor, a reasonable inference is that the health, education and productive activities of poor Belizean women and children are particularly sensitive to the availability of modern energy sources. Access to modern cooking fuels for example, would free women and children from the burden of collecting and carrying large loads of fuelwood, and from exposure to the debilitating fumes and fires produced by wood burning stoves. According to a WHO report, cited above, fumes from wood burning stoves is said to increase the risk of childhood acute respiratory infections like pneumonia, bronchitis and chronic obstructive pulmonary disease. Among women, there is emerging evidence that exposure during pregnancy reduces birth weight, infant and prenatal mortality may also be increased and it is likely to exacerbate asthma.

¹²⁴ The World Bank Group's Energy Program, Poverty Reduction, Sustainability and Selectivity, Energy and Mining Sector Board, www.worldbank.org, pg. 5

¹²⁵ see section 2. reported at 25% of households mostly in the rural areas.

¹²⁶ Pg 1

¹²⁷ Census 2000. total HH in Toledo = 4,463

¹²⁸ Census 2000 reported total households = 55,798.

Another significant benefit of access to modern energy services worthy of mention is that well improved lighting, versus candlelight, enables adults and children of both sexes to study after their daytime activities improving educational attainment and extending productive pursuits.

Energy and Economic Development

Inextricably linked to the gains in social development are the broader gains in general economic development. An improvement in living standards as a result of access to energy services has a direct correlation with job creation and productivity. According to the World Bank, energy consumption shows a direct correlation with national income i.e. most economic activity would be impossible without energy, even the small and medium enterprises which are the main source of new jobs for the poor.¹²⁹ The challenge for Belize then is to augment its development process by providing access to modern energy services to as many of its people as possible without compromising macroeconomic stability or energy security objectives. RETs can play a key role here.

Thus when viewed in the broader context, for Belize diversifying energy supply sources is a key consideration. A move away from diesel generation to renewable energy technologies in the electricity sub-sector for example could positively impact economic activity by lowering dependence on one or two finite primary forms of energy and by reducing the heavy economic and security burden related to energy imports. In the transportation sub-sector, a policy that mandates the use of biofuels may be an alternative to reduce the dependency on gasoline and diesel imports and improve emissions.

Energy Supply Security

Currently, Belize imports 100% of the fossil fuels and 51% of the electricity used in its service. Belize does benefit from a small, emerging fuel re-export market. Enabled by attractive EPZ legislation¹³⁰, air and bus travel and the proximity of neighbouring countries, fuel importers in 2002 were able to re-export roughly 1.6% of the value imported or just less than 7% of the total quantity of petroleum imports. Aviation and jet fuel, diesel and kerosene were the most popular re-export products.¹³¹

According to National Energy Plan Project, Belize is able to produce roughly 26% of its energy needs¹³². The remainder 74%, all fossil fuels, relies directly on imports from the United States and Mexico. In the electricity sub-sector, roughly 20% of the local response to electricity demand relies on fossil fuels¹³³. Of the 51% imported from

¹²⁹ World Bank, *ibid*, pg 9

¹³⁰ which provides for exemption from all import and export duties and taxes on fuel imported into the EPZ, provided it is not retailed in the domestic market, Export Processing Zone Act of 1990 (rev. 2000)

¹³¹ Please note that this information was included because due diligence required it. However there were discernable incongruities in the figures and any conclusion afforded by these figures is suspect. For example, Aviation Spirit was reported to have less imports than re-exports and if the values are to be trusted in very many cases Belize buys for much more than it sells. A search for information from all known available sources could not inform this issue. This suggests serious problems with the validity of data and regrettably contaminates the conclusions

¹³² The authors recognise the value of energy use figures to the quality of the analysis but previous use figures incorporated in the PUC's energy balance were discarded because of the inability to credibly quantify wood use. Access to a credible source on wood use in Belize would have augmented the analysis greatly.

¹³³ includes BEL at 13% and private diesel (7%).

Mexico through the Xulha substation, the greatest share of the supply mix comes from diesel and natural gas plants located throughout the Merida area¹³⁴. The remaining 29%¹³⁵ is sourced from renewable energy technologies mostly hydro and to a lesser extent bagasse. 100% of the fuel consumed in the transport sub-sector is sourced from imports. The self-sufficiency rating for fossil fuels used in the electricity and transport sub-sectors is nil.

Although there is evidence of petroleum¹³⁶ deposits and there is considerable activity involved in the search for oil in Belize, so far oil has not been discovered in commercial quantities. According to the Geology and Petroleum Department Belize has thirty exploratory wells with “live oil shows”¹³⁷ and of that only three have yielded a “few barrels of oil”.¹³⁸

The promise of oil notwithstanding, an undeniable conclusion from the review of Belize’s energy sector is that energy security is an important issue for Belize. The current energy mix, underpinned by an extreme reliance on imported fossil fuels (74%), renders Belize extremely vulnerable given the importance of the transportation and electricity sub-sectors to the development agenda. Belize is heavily dependent on energy imports in these sub-sectors and according to the statistics reporting the number of vehicles licensed in the transport sector, the dependence is growing. Unfortunately, given that a significant amount of imported fuels is used in the transport sub-sector and that this is expected to continue to increase, Belize can do little, short of improving the efficiency of existing and future vehicle stocks through enforceable policy instruments and reliable transport sub-sector data, to significantly reduce dependence on imported fuels. One option is to consider the use of biofuels and in particular ethanol to reduce import dependence and perhaps as a by product expand the country’s export portfolio. As a sugar producing nation, ethanol production and consumption is a logical consideration for Belize’s energy policymakers.

In contrast to the transport sub-sector, there is scope to reduce the dependence on fossil fuels in the electricity sub-sector. While the experts may disagree about the extent of the contribution from renewable energy to the energy mix, they do agree that renewable energies can and should be further developed in Belize. The management of BEL for example, opine that oil will always be a part of the electricity mix for Belize because there are not enough resources domestically to support the current and forecasted demand for energy. According to BEL’s renewable energy study, commercial domestic sources will be exhausted in the next ten years. However the study is now ten years old and more recent analysis by a renewable energy professional provides a more optimistic outlook. According to Dr. Ivan Azurdia-Brava, Executive Director of Fundacion Solar, over the next ten years, Belize can add 80 MW (35MW of hydro, 25MW of

¹³⁴ Information courtesy of Jose Moreno, BEL Planning Manager. Mexican supply comes from generation plants in and around Merida and from a hydro facility but proportions are not known.

¹³⁵ This figure is likely to be higher because of the hydro contribution of CFE, the proportion of which was unable to be verified.

¹³⁶ petroleum in this context means all natural organic substances composed of carbon and hydrogen; and include crude oil and natural gas, and all other mineral substances, products, by-products and derivatives that are found in conjunction with petroleum, courtesy Production Sharing Agreement

¹³⁷ Product Sharing Agreement of Belize, Geology and Petroleum Department, Ministry of Natural Resources, the Environment, Commerce and Industry

¹³⁸ *ibid*, exploratory well table

cogeneration¹³⁹ and 20MW of wind energy) of renewable energy¹⁴⁰ and easily satisfy the ten year projected peak electricity demand of 96.3 MW. However, even if one subscribes to the more optimistic perspective, identified RE opportunities will just cover ten year demand and thus satisfy requirements only in the medium term.

Whatever the perspective on RE's contribution to the energy mix, the experts concur that without the discovery of significant oil reserves, the application of renewable energy for electricity supply underpins Belize's energy security measures.

Informing the discussion significantly is the question of sustainability and reliability of the existing electricity mix. Consider this, in 2002 BEL experienced five hundred and sixty seven (567) unplanned outages, due to various reasons, countrywide¹⁴¹. Of this, seventy-seven or 13.5% were attributable to CFE either at generation or transmission. The average duration of outages throughout the year was roughly two hours. However, the duration spread is significant, starting with a lower limit of six minutes to an upper limit of twenty-one hours. Add to this the number of planned outages for repair and maintenance, calculated at two hundred and twenty six (226) and one could infer at least two outages per day, everyday in 2002¹⁴². The outage frequency was of course not so neatly spread and it is fair to say that there were days in 2002 where electricity supply was constant. However an inference of the data is that at least in 2002, electricity supply in Belize was generally unreliable. Additionally, the Commercial and Industrial Energy Survey, carried out by the PUC in 2003, suggests that historically supply has been unreliable, causing businesses to invest in back-up capacity. Twenty-nine percent (29%) of the companies surveyed in Belize had standby generators for emergency generation in 2002, comprising over 14.5 MW of generation capacity.¹⁴³

Given the general unreliability of the domestic grid and to a lesser extent imports, Belize's current electricity supply mix cannot sustain expected growth patterns, a situation clearly recognized by the dominant provider. In early 2003, BEL's CEO declared that their priority was to increase supply to keep up with demand growth, and to improve reliability. He also opined that the company needed to reduce the dependence on imported electricity, "since it is unreliable and the price has doubled in the last three years."¹⁴⁴

In the final analysis, it is clear that unless current exploratory initiatives yield oil in commercial quantities, the best Belize can aspire to, in order to improve energy security is to reduce the dependency on imports in the electricity sub-sector, practice energy conservation and review the possibility of biofuels to ameliorate the extreme dependence in the transport sub-sector. Strategies to reduce both the reliance on imported fuels and imported electricity, will likely involve the development of REs. If the application of REs in the electricity sub-sector is limited and/or there is no feasible utility for ethanol in the Belize context, then energy security defined as the ability to ensure the

¹³⁹ Although BELCOGEN expects to provide only 13MWs in the first instance, output capacity is 25MWs. They are planning to establish the capacity to provide 25% of the electricity mix Peak demand in ten years is forecasted to be 96.3MW. 25% of this is roughly 24MW.

¹⁴⁰ to its existing 25 MW hydro facility

¹⁴¹ The three most popular reasons were CFE at 13.5%, HV conductor faults at 42.8% and pole issues at 12%. Courtesy BEL.

¹⁴² Total outages were spread across the entire country and in some cases represent simultaneous outages across two, three, four, five or six districts. Unplanned 567 planned + 226 planned = 793/365.

¹⁴³ Commercial and Industrial Energy Survey, PUC, September 2003

¹⁴⁴ Lynn Young CEO BEL, in a presentation made to the PSC, courtesy of the PUC.

availability of energy at all times, in various forms, in sufficient quantities, at an affordable price will remain a significant challenge for Belize and more, will likely impact the country's sustainable development objectives

4.2 Renewable Energy Technologies

Defining Renewable Energy

Sources of renewable energy exist in the form of direct and indirect solar radiation, the heat of the earth (geothermal energy), and the gravitational effects of the moon that creates the tides. Direct solar radiation striking the earth also drives the global weather system and photosynthesis. This, in turn, creates the wind, waves, and biomass. The energy produced by falling water may also be considered a renewable energy source but only if the local environmental impacts are sustainable. Generally, new large-scale (more than 10 MW) hydropower schemes are not considered a source of renewable energy due to their substantial environmental impacts. Renewable energy can be converted to many other energy forms. Electricity can be generated from solar, wind, biomass, geothermal, hydropower, and ocean resources. Heat can be generated from solar thermal and geothermal sources, while biofuels such as ethanol and methane can be obtained from combinations of renewable sources.¹⁴⁵ To inform the discussion, Annex 4 provides a more detailed description of Renewable Energy Technologies.

Advantages and Limitations of RETs

Renewable energy technologies are first and foremost the cleanest options for producing energy and eliminating greenhouse gas emissions. But there are many other advantages. These include energy, economic, and environmental security.

Energy Security

RETs can diversify the energy supply, thereby promoting energy security and price stability. For some nations, RETs can reduce dependence on imported fuels, an issue that is particularly important for developing countries. RETs can also promote energy security by decentralising energy supplies with smaller, modular, and rapidly deployable energy projects that are particularly suited to the electrification of rural communities in developing countries.

Economic Security

RETs are often the most economical choice because of their scale. Their modular nature means they can be built (and paid for) as the demand for energy grows, and embedded within an existing network, if there is one. By contrast, large, centralised energy systems take much longer to build and are normally designed to supply a future demand. The vulnerability of central power plants and transmission lines to power interruptions is also important. In the United States, without taking into account the

¹⁴⁵ UNEP. 2000. Natural Selection, Evolving Choices for Renewable Energy Technology and Policy. United Nations Publication. Paris, France

August 2003 greatest black out in history, power interruptions cost as much as \$80 billion annually.¹⁴⁶

For developing countries, the energy security provided by RETs makes them attractive in rural areas, while simultaneously offering a clean “leap” over fossil fuels. The modular and distributed nature of RETs can also reduce the need for upgrading electricity distribution systems, or for expanding distribution or transmission capacity. RETs can also provide regional and local job opportunities, particularly in rural areas. This can contribute to the stability of local communities, which then slows urbanization—a particular problem for many already overcrowded cities in developing countries. In addition, if energy is locally produced, money is invested in the local community and not exported, although RET products and services can be exported. All of these impacts can create an increase in local tax revenues, which can then create a more diversified tax base. In terms of electricity generation, RETs are more employment intensive than fossil fuel or nuclear options.¹⁴⁷ For example, RETs are up to three times more employment-intensive than fossil fuel power options: 188 worker-years are created locally for every megawatt of small solar electric systems.

Limitations of RETs

The major limitation of RETs lies in the intermittent and site-specific nature of the energy source. Solar cells, for example, generate electricity only when light is available, and wind generators operate only when there is sufficient wind. However, even though such resources are intermittent, they are often highly predictable. In terms of electricity, most modern grid systems can absorb up to about twenty percent of their capacity from intermittent generating sources such as wind. Even this limitation can often be overcome with the right mix of technology. For example, wind energy and photovoltaic systems, when combined with some form of energy storage such as a hydropower reservoir, can provide a much higher percentage of electricity in a grid system. Crops harvested on a continuous basis can often fuel biomass energy systems, and solar water heaters can store heated water in a tank for later use. Another key issue that can limit RETs is the need to establish trained support where RETs are installed. Experience has shown that many failures have resulted from lack of maintenance or inappropriate operation. RETs are also at different stages in their development and therefore may have technical limitations. Many of these limitations, however, are being continuously overcome with further research and development (R&D).

Renewable Energy Costs/kwh

RETs can be very competitive across several technologies and applications, even where there is no internalization of externalities. RETs offer cost-effective solutions. RETs are site specific, therefore there are a range of cost / kWh, depending on the availability of the resource. The following chart summarizes current levelized costs:

¹⁴⁶ Dunn, S. 2000. Micropower: The Next Electrical Era, Worldwatch Paper 151, Worldwatch Institute. ISBN 1-87807-53-x.

¹⁴⁷ *ibid*, UNEP 2000

Table 5 - Renewable Energy Technologies, 2000¹⁴⁸

Windpower	\$0.04 – 0.08/kWh
Solar Photovoltaic (PV) Electricity	\$0.25 – 1.25/kWh
Modern Bioenergy	
Electricity	\$0.05 – 0.15/kWh
Heat (a)	\$0.01 – 0.05/kWh
Crop residue (b)	\$2.5 – 3.0/GJ
Plantation crops	\$1.6/GJ (Brazil) \$3.0/GJ (US)
Transportation Fuel	
Ethanol from sugar	\$15 – 25/GJ
Ethanol from cellulose	\$10 – 15/GJ
Methanol	\$11 – 13/GJ
Hydrogen	\$8 – 10/GJ
Solar Thermal Electricity	\$0.8 – 0.18/kWh
Small Scale Hydro (c)	\$0.04 – 0.15/kWh
Large Hydro	\$0.02 – 0.08/kWh
Geothermal	
Electricity	\$0.02 – 0.10/kWh
Heat	\$0.005 – 0.05/kWh

a. Heat embodied in steam, often produced in combined heat and power systems.

b. kWh = kilowatt-hour, GJ = gigajoule

c. Small hydro is usually defined as 10 MW or less, although the definition varies by country, sometimes extending to 30 MW.

4.3 Renewable Energy Technologies in Belize

Grid connected Renewable Energy Technologies (RETs) are not new to Belize and are used in both in small, isolated applications and power plants. Field and secondary research undertaken in Belize during August 2003, identified the use of hydroelectricity, stand alone solar PV, small wind electricity generation, solar thermal (water heating), hybrid systems (diesel/PV or diesel/wind), biomass cogeneration and methane production by small scale biodigesters¹⁴⁹. It also appears that there is a potential for geothermal energy since hot springs have been identified in the country and the established sugar industry may have the potential to produce ethanol. Annex 1 provides a characterization of RETs currently being used in Belize. Research also provided an opportunity to determine RET projects that were planned or in the pipeline, these are listed in Annex 5.

RET for Electricity Generation

A distinct conclusion of the field research was that electricity generation from renewable energy sources was not only technically, environmentally and economically feasible in Belize, but that it was recommended. In fact, according to Dr. Azurdia, with the proper enabling environment and investment climate, renewable energy

¹⁴⁸ United Nations Development Programme, United Nations Department of Economic and Social Affairs, World Energy Council, 2000. World Energy Assessment: Energy and Challenge of Sustainability. J. Goldenberg (Chairman, Editorial Board). New York: UNDP.

¹⁴⁹ A biodigester is a holding tank which composites waste materials (human, animal, plant) anaerobically to produce methane gas for cooking, lighting and in sufficient quantities to fuel pumps and electric generators.

technologies have the potential to provide the energy to satisfy total projected peak electricity demand by 2010.

Hydroelectricity for example has the potential to produce an additional 35 MW of electricity per year over the next ten years and should be developed to add value to endangered watersheds. One of the principal purposes for developing hydroelectric plants should be to improve watershed protection that in turn allows for ecosystem protection, water production and renewable energy generation. If the environmental services of watersheds –water, biodiversity, energy, carbon sinks- cannot be valued by appropriate best practices, then it will be very unlikely that those ecosystems will be protected. Hydroelectricity in plant sizes less than 10 MW should be pursued as the solution to add value to any given watershed. In the broad context of sustainable national development, energy from hydro plants is a by-product.

Cogeneration is the second most important resource; with the potential to generate an additional 25 MW per year over the next ten years. Belize Sugar Industries is currently capable of producing an excellent renewable energy product. However, it is plagued with its own challenges. Nurtured by the security of preferential markets in Europe and the United States for years, the sugar industry in Belize in 2003, is severely challenged by the restrictions of the global trading regime and has an extremely short window in which to make itself competitive in its market. Competitive positioning forces the issues of supply quantities and quality to the fore and these along with the remunerative issues associated with the BSI supply chain (small farmers) continues to plague the industry. The prognosis by all accounts is not good. Research and development to determine the feasibility of a high fiber sugar source can be one option for ensuring the viability of the industry¹⁵⁰ and the use of an indigenous source for sustainable energy for the future. However cane production purely for the creation of electricity would likely increase the price of the electricity produced. Depending on the costs of production this could significantly influence the economics and dynamics of the sub-sector, as well as all other sectors underpinned by electricity as a cost of production.

Wind resources are of world-class caliber in the Baldy Beacon eco-region. It is estimated at least 20 MW can be developed at the site over a ten year period, which has a minimum average per year wind speed of 7 m/s. Additionally the location is not forested nor does it possess human settlements. The development of a viable wind farm at Baldy Beacon will depend on data collection that is currently underway and on the hydro development along the Macal River. Once the Chalillo dam is completed, a high voltage transmission line will run close to Baldy Beacon making the project a highly competitive option. It is worthy of mention however, that Baldy Beacon is likely not the only suitable location for wind generation in the country. The location was chosen because there are already small turbines in operation there which provided access to reliable wind data. A wind mapping exercise should be considered as part of the National Energy Plan.

Solar PV has the potential to provide 50,000 Wp in isolated off-grid applications, especially those related to early warning and disaster relief. Solar thermal is also highly recommended. Solar water heaters have the potential to develop a viable market in tourism related services.

¹⁵⁰ loss of preferential access in all major markets expected by 2005.

RE in the Transport Sub-sector

The research was not as conclusive on the issue of biofuels and in particular ethanol blends. Ethanol, a form of alcohol, is a biofuel that can be used by itself or blended with gasoline to create gasohol. Ethanol is produced when yeast ferments the glucose, contained in food crops such as cane sugar, corn and other starch-rich grains. When burned, ethanol produces far less air pollution¹⁵¹ and greenhouse gases than gasoline. It is non-toxic and quickly biodegradable in surface water, ground water and soil. According to the Renewable Fuels Association, in 2001, ethanol use in the U.S. reduced carbon emissions by approximately 3.6 million tons, the equivalent of removing more than 520,000 cars from the road.¹⁵² Refer to Annex 4 for a more complete discussion on the subject.

Given Belize's long history with sugar, ethanol production is a logical consideration for energy policymakers. Under the right circumstances, ethanol production and consumption as a gasoline blending agent, could reduce gasoline imports, favourably impact emissions and export balances and help to mitigate against the adjustment costs associated with the move to markets for the sugar industry. The local sugar industry while readily admitting that Belize has "no ethanol experience"¹⁵³ indicates a willingness to consider its production as a by product of sugar production, if it can be assured of a market. However, the representatives of the local petroleum industry suggest that within the local and export market contexts there may be considerable obstacles to overcome before Belize can realize real gains from ethanol production and consumption.

If for example, GOB like the United States Government were to embrace a policy that mandates or encourages renewable fuel as part of its national energy policy, the petroleum importers opine that such an action will likely result in higher end-user costs while providing less miles per gallon. Higher costs associated with importation of a special type of boutique fuel, with transportation and with blending¹⁵⁴ would unfavourably impact base costs. If current taxation schedules are added to this increased base cost, pump prices could become prohibitive. Additionally, whether such a policy would reduce reliance on imports and improve self-sufficiency is uncertain and depends on a number of factors including the type of crop used to make the biofuels, the process for producing the biofuel, the sustainability of the supply and the use of by-products.

In the final analysis, informed decision making on this issue is precluded by the lack of information on the subject. The scope and mandate of this effort while broad did not accommodate a feasibility study on the production and application of ethanol in Belize. However given Belize's commitment to sustainability, its extreme reliance on imports, particularly in the transportation sub-sector and its indigenous productive capacity, the recommended course of action is to inform the decision making process with a feasibility study on the subject.

¹⁵¹ Results in greater fuel combustion, reducing tailpipe emissions

¹⁵² Renewable Fuels Association, Ethanol Industry Outlook, Growing Energy Security
www.ethanolrfa.org/outlook.2002.html

¹⁵³ Notes on Ethanol Discussion, PUC April 15, 2003, pg.1

¹⁵⁴ importers would require in some cases new blending equipment and storage facilities

To complete the discussion on the subject Annex 6 provides a matrix of the RET priorities recommended for Belize.

Barriers

Despite the encouraging technical prognosis for RETs however, there are also significant barriers that could limit the widespread use of RE in Belize. Dr. Azurdia discusses these and strategies to overcome them at length in Annex 7 of this report. Three are highlighted below.

The Lack of a National Energy Policy

Energy consumption is rapidly increasing in Belize and to satisfy burgeoning demand, policymakers often choose the most expedient option or adapt traditional practices without an appreciation of the energy supply options or the long term costs and effects. In the case of Belize, the lack of an explicit national policy that encourages the use of RE (where feasible), advances the status quo and encourages the continued use of imported fossil fuels as the most expedient energy supply option for an oil poor nation.

Financial Constraints

Subsidies to electricity consumption, (i.e. cross subsidies between electricity customers and government relief for losses due to the extension of the social tariff), are in effect in Belize and affect potential investment/re-investment decisions by the electricity utility, and reduces the GOB's ability to pursue other social development goals. As demand increases consumption subsidies can become increasingly difficult to control. Additionally and perhaps more relevant here is that consumption subsidies directs the country's limited financial resources away from electricity access subsidies¹⁵⁵ and fiscal incentive programs¹⁵⁶ that can be used to drive the development of RETs.

Also a challenge to RE development in Belize is the inability to finance RE projects from internal revenues and to attract funding from aid agencies or private investors.

Insufficient Capacity

Belize does not have sufficient human and institutional capacity to promote RETs. Additionally, some of the RET projects undertaken are of poor quality due in part to unreliable components, inappropriate design, improper installation and poor maintenance. Unarticulated or poor standards persist and contribute to the poor quality of some RET projects.

¹⁵⁵ i.e. one-time assistance to encourage grid extension or development of a local supply

¹⁵⁶ Such as investment grants and investment tax credits

5.0 DOMESTIC ENERGY POLICY

5.1 Domestic Energy Policy

Upon review, it seems apparent that an energy policy does *not* exist in Belize. However, while an explicit, articulated national energy policy is not available, *de facto* there is an implicit one. The following constitute the key policy features of the energy sector landscape in Belize. Notably however, these are concentrated in the electricity sub-sector and include:

- Privatization, Regulation, Competition and International Trade: The market landscape of the electricity industry in Belize is one of privatized dominant distributor (BEL), and a few independent power producers (BECOL and CFE). Since electricity is purchased from CFE, a Mexican company, international trade is part of the equation. Such a structure also represents the unbundling however incipient, of the electricity sub-sector and introduces competition. Oversight and regulation of all market and economic activity in the electricity industry is the responsibility of the Public Utilities Commission. Electricity pricing in particular is well regulated and codified in a number of laws including the “Amended 1992 Electricity Act, the Public Utilities Commission Act of 1999, and the Electricity Tariffs, Charges and Quality of Service Standards By-Laws of 2001.”¹⁵⁷

These principles are also a part of the market landscape of the petroleum products industries. Private distributors exist in both the petroleum products and LPG industries and while the petroleum products market is dominated by a single distributor, competition is encouraged. Competition is healthier in the LPG industry with four key distributors. As a non oil producing country, participation in international trade (imports) is a requirement of both industries. Regulation, while not as balanced or robust as in the electricity sub-sector is present. Price regulation, carried out by separate government ministries, is a key feature of the market structure for both petroleum products and LPGs. Regulation, beyond pricing, is extremely limited and without the benefit of a focused regulatory organization.

- Pursuit of alternatives to fossil fuels: Motivated by the lack of control over the cost of fossil fuels and of energy security, over the last decade activities in the sector have focused on the search for alternatives to fossil fuels. In this regard, BEL has “continued to pursue the development of more hydropower ... as well as more power generated from biomass.”¹⁵⁸ Prior to privatization of BEB, a Renewable Energy Study was undertaken as part of the Power I Project with the subsequent recommendation that a hydro development be pursued along the Macal River in the Cayo District.¹⁵⁹ After privatization, BEL undertook the Power II Project “designed to synchronize the Belize Power System to the Mexican Grid and to expand new power supply into Belize.”¹⁶⁰ Currently the country’s peak demand of approximately 54 MW, is sourced with “hydro energy from BECOL,

¹⁵⁷ *Ibid*, page 7.

¹⁵⁸ Belize Electricity Limited Annual Report 2002, page 4.

¹⁵⁹ Chalillo HydroPower: Project Summary (October 2001), page 6.

¹⁶⁰ *Ibid*, page 6.

imported energy from Mexico, and energy generated from within the company.”¹⁶¹ There are other initiatives underway including the study of wind generated electricity. Additionally encouraged by the PUC, a recent BEL Request for Proposal (RFP) for the supply of base load generation included a “socio-economic component”¹⁶² which awarded points to applicants who proposed using renewable and/or fuels local to Belize. At the end of the process, the successful suppliers were those who proposed using renewable energy technologies to supply the required base load. These were Hydro-Maya Limited, a company operating in the Toledo District (hydro) and the BELCOGEN (co-generation (bagasse)).

- Consumption and Access Subsidies. The GOB’s rural electrification program, underwritten by a \$30M bzd GOB loan, is used by the electricity utility to provide electricity to remote villages and towns throughout the country. Additionally cross and consumption subsidies, are in place in the price structure of the electricity utility.

Thus, the main features of the Belize energy sector suggest an implicit policy predicated on the use of fossil fuels. Although the energy balance is shifting to include renewable energies, it is only in the electricity sub-sector. Additionally, the shift is cautious and not the result of a deliberate policy objective but of industry practitioners concerned about unfavourable oil market conditions and costs¹⁶³. Indeed the move toward renewable energies may be prejudiced by existing disaggregated sub-sector policies that welcome competition and private sector involvement, but do not comment on method or scale, encourages price regulation in all sub-sectors (for tax revenue generation or private industry control) and consumption subsidies in the electricity sector.

Furthermore, if these are the core tenets of the country’s energy policy, then it is important to point out that the policy is incongruent with other development strategies and that there are important omissions in the policy space. For example in some instances current energy practices are contrary to or fall short of Belize’s sustainable development and environmental policies. While Belize has signed on to and made commitments under a number of international conventions, protocols and agreements aimed at reducing greenhouse gases and protecting the ozone layer (see below), its energy balance continues to reflect a heavy reliance on fossil fuels. Furthermore, although a recent energy balance study has shown an increase in the application of renewable energy technologies, the use of traditional biomass as a source of energy continues to be a factor.¹⁶⁴ Sourcing of wood and other naturally occurring biomass materials is bound to have an added deleterious effect on the environment.

Also, on one hand, the continued cost of importation of fossil fuels and of energy continues to have a knock on effect on the national balance of payments and Belize’s economy. In 2002 for example, the cost of importation of fossil fuels (including lubricants, diesel, gasoline, and kerosene) was approximately BZ\$107 million; and the

¹⁶¹ BEL Annual Report 2002, page 11.

¹⁶² Request For Proposal For the Supply of Base Load Generation for the Belize Electricity Limited’s Power System, January 2002.

¹⁶³ Suggesting only that the issue is not one of commitment to renewable energies or sustainable development but rather to cost reduction and liability mitigation.

¹⁶⁴ It is worthy of note that this is probably a greater factor than could be ascertained for this report.

cost of importation of electricity from Mexico BZ\$24.2 million. This represents a total of BZ\$131.2 million in 2002 or roughly 8% of GDP¹⁶⁵. Additionally, the fluctuations in world prices make diesel generation a relatively expensive option. On the other hand, the costs of implementing renewable energy technologies such as solar PV remains prohibitive and the construction of a hydro facility at Chalillo while it will shift the energy balance some will not necessarily translate into cheaper electricity rates. In addition, the bagasse co-generation facility at the Belize Sugar Industries which was initially to have provided an alternative product market for sugar may be faced with its own paradigm issues given the envisioned reduction in world sugar prices resulting from the challenge within the WTO to the EU sugar regime and the fact that BSI's current approach is to produce sugar with energy as a by-product and not the other way around.

Belize currently sources 51% of its electricity from CFE in Mexico. This suggests a willingness to un-bundle the electricity supply chain in Belize and to do so by engaging in regional cross border trade if necessary. The supply of electricity involves several activities, including constructing power stations and generating electricity, expanding, operating and maintaining transmission and distribution networks, trading bulk electricity (both nationally and internationally), supplying and metering customer billing and accounting systems. In competitive markets, important services aspects can be isolated, where different suppliers intervene at different levels of the supply chain. While competition and unbundling of the supply chain appears to be a deliberate strategy for the Belize electricity industry, the policy is less clear on the extent to which the market can tolerate and thus regulation and attendant legislation will encourage competition in unbundled electricity supply. In a competitive environment, an explicit regulatory system must be established either to delimit the scope of free play of market forces or to replace them whenever it is deemed that they will not lead to satisfactory or acceptable results from a social or community stand point. It is not clear which position Belize embraces. Thus, while there continues to be meaningful attempts at competition in generation, BEL continues to dominate local generation, transmission and distribution. Additionally, while there have been some improvements, electricity prices have not decreased significantly and blackouts remain a factor. What are the long term goals of reform measures encouraging competition and service supply unbundlingprivate investment, improved energy efficiency and lower costs, lower prices, quality of service, universal service, environmental improvement...? How policymakers respond to this question will dictate the policy direction. Once decided other issues that will have to be addressed include¹⁶⁶, will competition be enhanced in all market segments (supply chain) or will it be relegated to generation? How will policymakers set rates in non-competitive segments? How will private investment be encouraged systematically? How to manage consumer protection, environmental protection, energy efficiency issues?

Additionally, it is not clear whether the wider policy implications of engaging in cross-border trade in electricity, given Belize's international trade commitments and involvement in regional initiatives, and the guidelines and constraints these place on national policy space, were (at the time the agreement with CFE was made) or are being considered.¹⁶⁷

¹⁶⁵ 2001 GDP quoted by the CSO at 1.6 billion. 2002 figures not available at the time of this report.

¹⁶⁶ The list is by no means exhaustive and meant only to inspire discussion and thought

¹⁶⁷ This is discussed in some detail below.

The existing process does not address omissions and incongruities fundamental to successful energy sector development. This is the result of an involuntary failure in policy behaviour due to the application of an implicit policy. Because energy sector development underpins the national development agenda, Belize cannot afford to continue to subscribe to the unfocused disposition of an implicit strategy. Moreover, when the decision is taken to create a more precise, comprehensive strategy, the country must do it right the first time.

Yet, translating the informal into the formal is not an easy proposition. Several significant challenges persist. Those considered most important are prioritized below. It is important to appreciate however that these are all interrelated and should be addressed comprehensively;

1. Commitment on the part of all the major players, to create the enabling environment that encourages sustainable development policies. Political will to undergo the changes required in the status quo and to undertake and plan for the adjustment costs.
2. A weak energy conservation culture. An uninformed constituency can result in energy and related issues not receiving priority by the policymakers and can lead to resistance to new technologies or to energy saving measures.
3. Institutional capacity and support systems. For example for proper analysis and informed decision-making, reliable, timely, energy sector data and information is a necessity. A clear definition of roles, responsibilities and accountability in supporting institutions is also required.
4. A critical mass of local technical capacity i.e. Policymakers and technocrats versed in the national, regional and global realm of energy policy and law making is required. Specific competencies in energy technologies, trade and international commerce, project management and proposal writing are key.
5. Existing sources of financing for energy related policy initiatives are mainly extra-regional

6.0 INTERNATIONAL ENERGY AGREEMENTS

6.1 Belize and Energy Integration

Belize's integration at the regional level occurs in two familiar spheres, specifically: (a) CARICOM, where Belize aligns itself with 13 other Anglophone Caribbean Nations and (b) Central America, which includes the seven (including Mexico) other Spanish speaking countries with physical proximity to it. These two spheres are driven by different, though not necessarily mutually exclusive, socio-economic, development, and political aims and objectives

For Belize the dynamics of energy integration and engagement can be classified into four broad categories, specifically: (i) Agreements and Conventions which address the issue of sustainable development, (ii) Institutions and/ or integration frameworks

which are concerned with energy and or electricity production and consumption, (iii) Projects/Initiatives concerned with sustainable development and energy, and (iv) International trade.

Agreements and Conventions

Belize has undertaken obligations in a number of international agreements and protocols that deal with the issue of sustainable development and which have implications for energy usage.

First there are agreements such as Agenda 21, the Barbados Program of Action, and the World Summit on Sustainable Development (WSSD) which place obligations on Belize for addressing the issue of sustainable development, and within that the issue of energy but only as a function of sustainable development. Under the WSSD Plan of Implementation, energy is dealt with in paragraphs 8 & 9, and calls for “improved efforts at all levels to improve access to reliable and affordable energy services for sustainable development sufficient to facilitate the achievement of the millennium development goals.” In its National Report to the World Summit on Sustainable Development, Belize committed itself to lead the CARICOM Sustainable Development Task Force.

The WSSD Plan sets out a number of actions including:

- a) Improving access to reliable, affordable, economically viable, socially acceptable, and environmentally sound energy services and resources;
- b) Improving access to modern biomass technologies and fuelwood sources and supplies;
- c) Supporting the transition to the cleaner use of liquid and gaseous fossil fuels;
- d) Developing national energy policies and regulatory frameworks; and
- e) Enhancing international and regional cooperation to improve access ... to sound energy services;

Second there are conventions and protocols which place obligations on Belize to undertake specific measures such as those directly aimed at (a) ‘capping or reducing the emission of greenhouse gases’ (Kyoto Protocol)¹⁶⁸, (b) “...implementing measures to control, reduce and prevent activities that cause adverse effects ... through modifications to the ozone layer ...” (Vienna Convention)¹⁶⁹, (c) “...controlling the annual consumption and production of substances ...” that deplete the ozone layer (Montreal Protocol)¹⁷⁰, and (d) “...regulating levels of green house gases concentration in the atmosphere, so as to avoid the occurrence of climate change on a level that would impede sustainable economic development...” (UN Framework Convention on Climate Change).

¹⁶⁸ Although it must be reiterated that emission reduction under the Kyoto Protocol is a mandate for industrialised countries only, as defined by Annex 1 of the agreement.

¹⁶⁹ Belize adopted the Vienna Convention for the Protection of the Ozone Layer in 1985 and it entered into force in 1988. Source: Environmental Treaties Ratified by Belize, IDEAS/RODA (July 2000).

¹⁷⁰ Belize adopted the Montreal Protocol on Substances that Deplete the Ozone Layer in 1987 and it entered into force in 1989. Source: Environmental Treaties Ratified by Belize, IDEAS/RODA (July 2000).

Institutions and Integration Frameworks

Institutions and/ or integration frameworks which are concerned with energy and or electricity production and consumption and which Belize is associated or affiliated with include: the Caribbean Renewable Energy Development Project, and the Caribbean Energy Information System (CEIS). Sustainable development alliances include: Central American Alliance for Sustainable Development (ALIDES), the CARICOM Sustainable Development Task Force, the Caribbean Planning for Adaptation to Global Climate Change (CPACC), the Caribbean Association of Electrical Utilities (CARILEC), the Alliance of Small Island States (AOSIS), the Central American Commission on Environment and Development, the National Council for Sustainable Development (COADES) in Central America,

Given Belize's long-standing participation and membership in the Caribbean Community it has pursued deeper and wider integration initiatives within CARICOM than it has done within Central America. For example, Belize is part of both the Caribbean Renewable Energy Development Project, and the Caribbean Energy Information System (CEIS) but does not participate actively in the Sistema de Interconexion Electrica de Paises de America Central (SIEPAC), or ALURE, a cooperation program between the European Union and Latin America in the energy sector; one of the aims of which is to "improve the growth sub-sectors of electricity and natural gas" This presents some divergences in opportunities for Belize given its geographical location as a part of the Central American mainland.

Projects

Belize is invited to participate in many initiatives but lack the capacity to develop adequate proposals and representation.¹⁷¹ There are currently several projects and initiatives on the table including, the Energy and Environmental Partnership with Central America, Electrical Interconnection System of the Countries of Central America (SIEPAC), a part of Plan Puebla-Panama, the PLANER Project Regional Program, the Central American-United States of America Joint Accord (CONCAUSA), the Central American Integration System (SICA), Caribbean Renewable Energy Development Programme (CREDP) and Development of Energy Efficiency in the Caribbean (DEECP). It is worth discussing a few of them here.

The objective of the Finnish Government's Energy & Environmental Partnership with C.A. is to promote the use of renewable energy sources and clean technologies in a sustainable way, as well as to make energy services more accessible to the rural population throughout Central America. Under this project Belize has the opportunity to submit proposals for pilot projects to demonstrate renewable energy technologies but with the proviso that such technologies have to be sourced from Finland.

¹⁷¹Ascertained through conversations with the PUC

Figure 8 – Diagram SIEPAC Connection

Plan Puebla-Panama Initiative for Energy Integration was devised to unify Central American countries' electricity grids to reduce costs and the frequency of power disruptions, as well as attract private sector investment for the development of new power plants. The first stage of the project is the Sistema de Interconexión Eléctrica para América Central (SIEPAC). The project entails the construction of transmission lines



connecting 37 million customer in Panama, Costa Rica, Honduras, Nicaragua, El Salvador and Guatemala. SIEPAC will cost an estimated \$320 million and is scheduled for completion in 2006. A second goal of the project is to integrate Mexico with the Central American electricity market by constructing a 62.5 mile, 400KV transmission line between the sub-stations of Tapachula, Mexico and Los Brillantes, Guatemala. On May 30th, 2003, Mexico and Guatemala signed an energy integration accord to develop this interconnection and the line is expected to be operational by 2005. The third goal of the project is to link Belize's electricity network with the CA system. The project entails constructing a 122 mile, 230kv power transmission line between substations in Santa Elena, Guatemala and Belize City and the initial stages of the project were tentatively scheduled to start in 2003. Belize however has adopted a "wait and see" approach. While it is going through the process of joining SIEPAC, it is not anticipating active participation in the regional market. SIEPAC will allow the member countries to trade electricity regionally. It will also allow countries with severe electricity deficits to purchase power from their neighbors, while enabling countries dependent on thermal power to gain access to CA's abundant hydropower.

The DEECP is a CARICOM based project aimed at developing regional scope to contribute to overcoming the barriers to the application, implementation and dissemination of least-cost energy efficiency technologies and to promote the efficient distribution and use of electrical energy. This is still in the proposal stage.

The CREDP is a proposed five year program involving sixteen countries across the Caribbean. It aims at supporting the implementation of policies, legislation and regulations to enable RE development; improving regional RE information network; and building capacity of selected RE players in the field. As of September 2003, the new project document should have been submitted to the GEF for approval.

International Trade

A fourth and relatively recent sphere¹⁷² is that of international trade. Within this sphere, energy is dealt with and considered at various levels and in different forums. At the multilateral level Belize is a member of the World Trade Organization (WTO) which deals with energy under two separate agreements, specifically the General Agreement on Tariffs and Trade (GATT) which deals with international trade in goods, and the General Agreements for Trade in Services (GATS) which deals with international trade

¹⁷² for Belize

in services. The United Nations Conference for Trade & Development (UNCTAD) also deals with energy issues at the multilateral level but is primarily concerned with providing technical cooperation activities and support including in energy services. At the regional level energy trade is dealt with under the CARICOM framework, whose mandates and dictums also represent Belize under the hemispheric Free Trade Area of the Americas (FTAA).

A major difficulty in energy trade is the required differentiation between energy goods and energy services. Traditionally, the industry did not distinguish between energy goods (i.e. oil, solid fuels, natural gas, electricity – though the latter is a complex one given its non-storability¹⁷³), and energy services (i.e. value added to energy goods produced, transported and distributed and including but not limited to metering and billing, energy management, energy audits, liquid or gas storage, trading and brokering, etc.). This previous lack of distinction was the direct result of what were previously vertically integrated energy markets. “When the WTO Services Sectoral Classification List was designed the energy sector was by and large run by state-owned companies that performed all the functions needed for the supply of energy within their home markets.”¹⁷⁴ While the issue of classification, particularly as it relates to non-storable items such as electricity and natural gas, is still uncertain, according to the WTO, “it seems generally accepted that the production of primary and secondary energy does not constitute services subject to the GATS, but results in goods, whose trade is subject to the GATT. Transmission and distribution of energy constitute services according to the GATS, if they are produced independently.”¹⁷⁵ Classification will become a concern for Belize only if the electricity industry¹⁷⁶ is developed to the extent where it is able to export. If Belize subscribes to the status quo and continues to classify electricity as a good subject to the GATT, Belizean exporters may encounter obstacles such as tariffs, non-tariff barriers and restrictive business practices as they seek to trade with regional neighbours.¹⁷⁷ If as a service and subject to the GATS, market access, national treatment and restrictive practices may be the barriers.

One important aspect of classification however, lies in the fact that that under the current WTO agreements the distinction between production (goods, GATT) and transmission/distribution services (services, GATS) might create an imbalance in the application of multilateral trade rules to different liberalized segments of previously vertically integrated markets. For example the GATS provides legally binding rules (including Most Favoured Nation (MFN), National Treatment (NT), market access and domestic regulation) applying to the establishment¹⁷⁸ of energy service suppliers, while there continues to be no comprehensive rules on investment for goods (petroleum products, natural gas and electricity). Under the GATS, MFN is an unconditional

¹⁷³ The World Custom Organization’s Harmonized Commodity Description and Coding System (HS) classifies electric energy as a commodity, like coal, gas and oil, but it is an optional heading in the HS classifications indicating that not all members are required to classify it as a commodity for tariff purposes. Belize does not at this time, apply tariffs to the importation of electric energy.

¹⁷⁴ UNCTAD Secretariat, “Making “Request-Offer” Negotiations under the GATS: The Case of Energy Services,” Paper Presented to the UNCTAD Ad Hoc Expert Meeting on Energy Services (UNCTAD/ DITC/TNCD/2003/5), 23 May 2003, page 6.

¹⁷⁵ Guide to the GATS, An overview of issue for further liberalization of Trade in Service, World Trade Organization, 2000, pg. 261

¹⁷⁶ Or if natural gas is discovered in commercial quantities and exported.

¹⁷⁷ Since Belize is forced to consider and encourage importation of electricity, it does not now and is unlikely to levy tariff restrictions of electricity imports.

¹⁷⁸ Commercial presence of energy suppliers

obligation, while market access and national treatment barriers are dealt with in Articles XVI and XVII and by progressive negotiations for specific commitments. In the case of electricity, often regarded as natural monopolies, “Article VII would require members to ensure that (a) the incumbent (monopoly) in a given market does not act in a manner inconsistent with MFN and with the member’s specific commitments in that market and (b) that the incumbent (monopoly) does not abuse its position in services markets, which are the object of specific commitments under the GATS.”¹⁷⁹ Thus as it relates to international trade in energy goods (including electricity), no changes in the current regime and framework is expected and Belize will continue to apply tariff measures (i.e. duties and taxes, except in the case of electricity) at the point of importation. In this regard, any effects to the energy sector would likely be structural market ones and derive from fluctuations in the world prices for oil and petroleum products. As it relates to international trade in energy services however a different picture emerges¹⁸⁰.

Even though Belize has not scheduled any commitments under Energy or Energy Related Services under the GATS, the country has undertaken progressive levels of autonomous liberalization in that sector. In this regard, if Belize decides to open core energy services such as transmission and distribution to independent operators or encourage active trade in energy services such as consulting in energy efficiency and renewable energies, construction, maintenance of the network, or distribution services such as metering and billing, which are services subject to the GATS, it may want to schedule commitments in these types of energy services. The principal GATS modes of supply for international trade in energy services appear to be cross-border supply (mode 1), commercial presence (mode 3), and movement of natural persons (mode 4). With the support of mode 3 commitments¹⁸¹, competitive suppliers (both local and foreign) could take advantage of the privatization, liberalization and unbundling of Belize’s national electricity market. Cross border supply (mode 1) of distribution services, where interconnections exists between different national networks (e.g. CFE and BEL) is also a consideration

Belize currently engages in one out of the three principle modes of supply for trade in energy services under the GATS, specifically mode 4 or movement of natural persons (foreign consultants working in the industry in Belize). As the country continues to seek new investments and new actors in its quest for diversity and balance, understanding the multilateral trading architecture and how it may (or may not) contribute to Belize’s immediate and long term energy sector development is critical. The rules governing trade in energy services and in particular those relating to market access, national treatment, and restrictive business practices by incumbent operators will be a key consideration. In sum, policymakers cannot avoid the externalities. The gains and losses from regional trade in energy services (beyond electricity) should preoccupy policymakers.

¹⁷⁹ Guide to the GATS, *ibid*, pg. 270

¹⁸⁰ The discussion of trade in energy services is decidedly focused on electricity because trade and its requisite adjustments will impact this sector most. The other sub-sectors will be impacted only if Belize discovers oil in commercial quantities and decides to export. The market for exploration and extraction activities of crude oil, drilling, completing and equipping wells is open in Belize.

¹⁸¹ indicating on a multilateral level that Belize is committed to competition, does not discriminate against foreign competitors and has the required hospitable climate to attract investment.

7.0 SUMMARY AND CONCLUSIONS

Belize is a small, developing, independent state, with an extremely vulnerable, micro economy and abundant natural resources. The Government of the day has, through its various instruments and policy statements indicated a commitment to development, through the pursuit of economic and social strategies that are intended to address poverty alleviation and growth, without adjusting the focus on keeping the country “green”.

Energy, because of its established links to the development process through issues such as poverty alleviation, the environment, and economic growth, is a central part of the development equation. Thus, it must be a consideration for Belize and its policymakers as they contemplate the country’s medium and long-term development strategies. Development does not need energy per se but rather the services that it provides. The country’s ability to develop in accordance with its defined strategies, in the medium term and beyond is inextricably linked to its approach to energy, the diffusion of energy services and energy security.

In the final analysis, the energy sector diagnostic revealed the following:

- Given the current energy mix (imports 74%, indigenous 26%), energy security and improving energy autarky should be significant issues for policymakers;
- Belize does not have a formally stated energy sector strategy nor policy although an argument could be made that there is an implicit one;
- The current electricity mix with 51% imported from Mexico is not sustainable given that demand is growing at 9% p.a. The Mexican supply is currently limited, and if additional supply can be negotiated (under a new contract) it is likely to be significantly more expensive;
- The use of renewable energies is technically, environmentally and economically feasible and given the exigencies of the internal and external environment, is highly recommended;
- There are barriers to the use of Renewable Energy Technologies and to the development and implementation of a formal energy policy;
- Policymakers cannot afford to disregard regional and international agreements and the significance of existing and future commitments (particularly in trade) to the development of the energy sector;
- Belize needs to take immediate and decisive action if it is to comfortably meet electricity and energy demand forecasts without increasing its vulnerability and/or compromising its future development;

The quintessential issues facing policymakers are these:

- How best to reconcile private profitability, market efficiency and cost reduction with security of supply, public service obligations and development goals.
- How best to increase efficiency of production, transmission, distribution and consumption
- How best to reduce negative environmental impact through the use of technology and alternative energy sources
- Complementary policy reforms and capacity considerations;

For Belize to meet the electricity demand associated with an average 9% annual growth rate and the increasing demand for fuel in the transportation sector, energy sector planning should be established as a priority, but it must be done carefully. Due diligence must be awarded to analyzing the country's growth options and potential with a trans-temporal and trans-generational commitment. Energy intensity is used to "measure" a country's performance and growth. Traditionally the greater the energy consumption, the greater the economic growth and thus the greater per capita GDP. Today, it is possible to decouple the economic growth/energy consumption parallel because economic growth can be achieved without a corresponding growth in energy consumption. Countries such as Belize, with a transitioning economy and a clear and necessary commitment to sustainable development have an opportunity to leapfrog and avoid the pitfalls associated with inefficient energy consumption.

Given the current interest of central policymakers and strong multi-stakeholder support, Belize is in a strong position to plan for the next ten years. Towards this end, it is necessary to create an enabling mechanism that will create a new "energy road map." The following immediate (less than one year to implement) activities are recommended:

- Develop a "National Energy Policy that defines the core elements of and participants in the National Energy Strategy and encourages the development of sustainable and renewable energy technologies. Ensure clear roles, responsibilities and measurable objectives;
- Design and implement processes for the collection of credible energy sector data and information;
- Create the National Energy Implementation Plan 2003-2015. To develop the plan, it is necessary to perform an update of resource assessment taking into consideration isolated as well as on – grid renewable energy technologies, and also develop the feasibility studies of the resources already identified. In the resource assessment exercise particular attention should be awarded to a credible energy balance, incorporating specifically the type and frequency of use of biomass and wood, a wind mapping exercise and the feasibility of ethanol production and application.

While significant challenges persist, there is a commitment of the country's energy policymakers to charting the way forward. Belize's energy policymakers understand that the growth of the energy sector needs to be planned and orchestrated in tandem with national priorities and development objectives. The National Energy Plan

Project is an important first step. The next step is to develop the blueprint in the form of a sustainable energy strategy that harnesses the synergies in the sector toward a common objective guided by national priorities and underpinned by national participation and transparency. An explicit policy is now required.



REFERENCES

- A Tourism Strategy for Belize, Ministry of the Tourism and Environment, Belmopan Belize
- Ahmed, Kulsum. 1964. Renewable Energy Technologies. A review of the Status and Costs of Selected Technologies. World Bank, Technical Paper, ISSN 0253-749, No. 24. Washington, DC.
- BECOL. 2001. Macal River Upstream Storage Facility, Environmental Impact Assessment – Part 2“. Support documents. Volume I-IV. AMEC E&C, Services
- Belize Electricity Limited, 2000, Annual Report. Belize City, Belize.
- Belize Electricity Limited, 2001, Annual Report. Belize City, Belize.
- Belize Electricity Limited, 2002, Annual Report. Belize City, Belize.
- Belize Electricity Limited, 1992, “Offer for Sale Relating to Shares and Debentures”, Prospectus, Belize City, October 1992
- Belize Dangerous Goods Act., Chapter 134, rev. 2000, Laws of Belize
- Belize Electricity Act, Chapter 221, (rev. 2000), Laws of Belize
- Belize Environmental Protection Act, Chapter 328, rev. 2000, Laws of Belize
- Belize Export Processing Zone Act of 1990, Chapter 280 (rev. 2000), Laws of Belize
- Belize Fiscal Incentives Act, Chapter 53, (rev. May 2003), Laws of Belize
- Belize Macal River Hydroelectric Development Bill, June 2003 (proclaimed and promulgated)
- Belize, Petroleum Haulers Association Bill, 2002, Gazetted 18th January 2003, proclaimed but not promulgated
- Belize Petroleum Act, Chapter 225, (rev. 2000), Laws of Belize
- Belize Public Utilities Commission Act, Chapter 223, (rev. 2000), Laws of Belize
- Bösl, Bernhard. 1994. Assistance to Belize Electricity Limited to Identify and Assess Strategies to Control Electricity Demand and Plan the Supply. UNIDO. Vienna, Austria.
- Bösl Bernhard, Reuter Albrecht, Schmid Günter, 1993. “Cost Effectiveness Analysis in the Energy-Environmental Sector – Tools and Experiences”, Presentation on the Energy Conference of Latin America and the Caribbean ENERLAC93, Santa Fe de Bogotá, June 15-18 1993.

Bösl Bernhard, 1993. "Technical Report: First Mission of Consultant", UNIDO Project No. SI/BZE/92/803, Institute for Energy Economics and the Rational Use of Energy (IER), University of Stuttgart, November 1993.

Bösl Bernhard, Mencias John, Moreno José Armando, 1994. "Technical Report Vol. 2: Training Program", UNIDO Project No. SI/BZE/92/803, Institute for energy Economics and the Rational Use of energy (IER), University of Stuttgart, April 1994.

BUN-CA. 2001. Guide for Renewable Energy Projects in Belize. Belize City, Belize.

Canadian International Power Services Inc. 1990. "Renewable Energy Study", Ontario, March 1990.

Central Bank of Belize, Annual Report 2001.

Central Bank of Belize, 1991. "Tenth Annual Report and Accounts 1991", Belize City, April 1992.

Central Statistical Office. 2001. License Granted under Section 15 of the

Central Statistical Office, Major Findings: Population Census 2000, September 2001.

Central Statistical Office, Ministry of Finance. 2001. Abstract of Statistics 2000-2001. Belmopan, Belize.

Central Statistical Office, "Abstract Of Statistics 1992", Ministry of Finance, Belmopan, March 1993.

Electricity Tariffs, Charges and Quality of Service Byelaws, 2001, Sl. No. 60, Laws of Belize

General Electric, "Calendar 1994", New York, 1993.

Challillo Hydropower Project Summary, BECOL/FORTIS/BEL October 2002

Dunn, S. 2000. Micropower: The Next Electrical Era, Worldwatch Paper 151. Worldwatch Institute. ISBN 1-87807-53-x.

Energy Information Administration, Caribbean and Central American Fact Sheet www.eia.doe.gov

FORTIS/BECOL. 2001. Chalillo Hydropower Project Summary. Belize City, Belize

First National Communications to the Conference of the Parties of the United Nations Framework Convention on Climate Change, Government of Belize, UNDP Project BZE/98/G31/A/1/99, January 2000

Generation Planning Report, BEL, October 2001

Geology of the Chiquibal Area, Belize, Central America, Thesis of Richard William Flanders, University of Idaho Graduate School, May 1978.

Government of Belize, Medium Term Economic Plan 2003-2005, July 2002,

Government of Belize National Poverty Elimination Strategy and Action Plan, 1998-2003, National Human Development Advisory Committee, Belmopan Belize

Grant from USAID's Alternative Energy Systems Project for a Mini-Hydro Pilot Project – Belize, Paper presented at Seventy-Fifth Meeting of the Board of

Directors of Caribbean Development Bank, October 28, 1982.

Hall, D.O., Frank Rosillo-Calle, Robert H. Williams, and Jeremy Woods. 1993. Biomass for Energy Supply Prospects. In Thomas B. Johansson and others, Eds, Renewable Energy Sources for Fuels and Electricity. Washington, DC. Island Press.

Hanselmann Martin, "PROFAKO – A computer Aided Planning and Optimizing Tool for Cogeneration Systems", short description, IER, University of Stuttgart.

Hydro Electric Power Development and Markets in British Honduras, R.L. Walker, Chief Water Resources Engineer, Hunting Survey Corporation Ltd., May 1960.

Hydromaya Limited. 2002. "RFP for the Supply of Base Load Generation". Idaho Falls, ID, USA.

Hyman Eric L. "How to Conduct a Rural Energy Survey in a developing Country", in: Renewable Sources of Energy, Vol. 1, No. 2, 1983.

International Energy Association,. 2001. Key World Energy Statistics from the IEA. International Energy, Agency. Paris, France

International Energy Conference on Demand-Side Management: A Current and future Resource. Copenhagen, 23rd-24th October 1991, Conference proceedings published by IEA/OECD, 1992.

IREDA. 2003. The Bulletin on Energy Efficiency. April 2003, vol 3, issue 5. New Delhi, India.

Keegan, Joseph. 2002. The Potential of Using Biomass/Energy Systems in Belize Utilizing New Energy Crops and Existing Agriculture and Aquaculture Wastes. Clean Energy Systems. Belmopan, Belize.

Laing Richard. CAREAIR- Computer Aided analysis of Reduction Strategies for Emissions and Ambient Air Pollution, Presentation on the International Workshop on Environmental Monitoring and Impact Assessment and Energy Masterplan for Rural Development, Ile-Ife, Nigeria, April 6-10 1992.

Ministry of Communications, Transport & Public Utilities Power Lane. 2003. Belize – GE Wind Energy. Belmopan, Belize.

Ministry of Natural Resources, Environment and Industry. 2002. Belize

National Report to the World Summit on Sustainable Development. Belmopan, Belize.

Ministry of Public Utilities, Energy and Communications. 2000. Belize First National Communication. Belmopan, Belize

Mollejon Hydroelectric Project. 2000. Exception from Taxes and Duties, Act Chapter 59, (rev. 2000), Laws of Belize

National Human Development Advisory Committee, Belize National Human Development Report 1997

Pronove Gao, The Kyoto Protocol and the Emerging Carbon Market, February 2002

Peoples United Party Manifesto, 2003 – 2008

Perlack, R. D., J. W. Raney, and M. Russell. 1991. Biomass Energy Development in Yunnan Province, China (Preliminary Evaluation). ORNL (Oak Ridge National Laboratory). Report ORNL/TM-11791. Oak Ridge, Tennessee.

Poverty Assessment Report – Belize, Caribbean Development Bank, http://www.caribank.org/share/www-site/publications.nsf/pages/POV_Belize, downloaded 8/31/03

Product Sharing Agreement of Belize, Geology and Petroleum Department, Ministry of Natural Resources, the Environment, Commerce and Industry

Programme for Belize in Collaboration with the Inter-American Development Bank, Towards a National Protected Areas Systems Plan for Belize, 1995.

Renewable Fuels Association, Ethanol Industry Outlook, Growing Energy Security www.ethanolrfa.org/outlook.2002.html

Request For Proposal For the Supply of Base Load Generation for the Belize Electricity Limited Power System, January 2002

Report on Water Power and Flood Control of the river Macaw with a Note on Wind Power, Sir William Halcrow & Partners, December 1952.

Second International Energy Efficiency & DSM Conference: Customer Focus. 1993. Stockholm, September 21-23 1993, Conference Proceedings published by Conference Connection Inc., Pennsylvania, 1993.

Shell Belize Limited, Financial Statements, December 31, 2002

SIEE. 2002. Energy Statistics, OLADE, European Commission. Version 14. Quito, Ecuador.

Situation Analysis for Integrated Resource Planning in the Danish Electric Utilities. 1993. Published by IRP project, ELKRAFT, Ballerup/Denmark, April 1993

Smith, D.T. and Panton, W. F. On the Climate of Belize and Some Implications for National Economic Development, Belcast Journal of Belizean Affairs-Vol. 3, Nos. 1&2, June 1986.

Sustainable Development International. 2001. Strategies and Technologies for Agenda 21 Implementation. London, UK.

Terrado, E. 1985. Technical and Cost Characteristics of Dendrothermal Power Systems. Industry and Energy Department, Series Paper 3. World Bank. Washington, DC Processed.

The Geology and Mineralogy of the San Luis Barite Prospect, Belize, James E. Robinson, Prepared for the Anschutz Corporation Minerals Division, November 14, 1976.

The Geology of the Maya Mountains, Belize, Overseas Memoir 3, J.H. Bateson, I.H.S. Hall, Institute of Geological Sciences, 1977.

The World Bank Group's Energy Program, Poverty Reduction, Sustainability and Selectivity, Energy and Mining Sector Board, www.worldbank.org,

Third Master Agreement between GOB, BEL and BECOL, November 21, 2001

Toledo Research and Development Project, Belize, Daily Records of Rainfall and Water Levels, S.H. Walker, F. Ramirez, S.C. Watson, Land Resources Development Centre, Overseas Development Administration, 1983.

UNCTAD Secretariat, "Making "Request-Offer" Negotiations under the GATS: The Case of Energy Services," Paper Presented to the UNCTAD Ad Hoc Expert Meeting on Energy Services (UNCTAD/ DITC/TNCD/2003/5), 23 May 2003,

UNDP/European Commission. 1999. Energy as a Tool for Sustainable Development for African, Caribbean and Pacific Countries, European Commission. Brussels, Belgium.

UNDP/IIIIEE/IEI. 2002. Energy for Sustainable Development, a Policy Agenda. Edited by T.B. Johansson and J. Goldemberg. United Nations Development Programme. New York, NY.

UNDP. 2003. National Energy Plan Project. Draft Analysis on Survey April-May, 2003. Belize City, Belize.

UNEP. 2000. Natural Selection, Evolving Choices for Renewable Energy Technology and Policy. United Nations Publication. Paris, France.

United Nations Development Programme, United Nations Department of Economic and Social Affairs, World Energy Council, 2000.

United Nations Development Programme, United Nations Department of Economic and Social Affairs, World Energy Council, 2000. World Energy Assessment: Energy and Challenge of Sustainability. J. Goldenberg (Chairman, Editorial Board). New York: UNDP.

World Energy Outlook 2002, International Energy Agency, www.iea.org.

World Energy Assessment, : Energy and Challenge of Sustainability. J. Goldenberg (Chairman, Editorial Board). New York: UNDP.

WHO study, The Health Effects of indoor air pollution exposure in developing countries, Nigel Bruce, Department of Public Health, University of Liverpool, National Institute of Respiratory Diseases and Rachel Albalak, Department of International Health, Rollins School of Public Health of Emory University, 2002.

<http://www.who.int/peh/air/indoor/oeh020sum.htm>, downloaded August 31, 03

Personal Communication

Telephone Interviews

Department of Geology and Petroleum

Personal Communication. Department of Geology and Petroleum. Evadne Wade 31 July 2003.

Department of the Environment

Personal Communication. Department of the Environment. Celie Cho 1 August 2003

Personal Communication. Department of the Environment. Ismael Fabro 22 August 2003

Personal Communication. Department of the Environment. Jeavon Hulse 25 August 2003

Ministry of Natural Resources, the Environment and Industry

Personal Communication. Ministry of Natural Resources, the Environment and Industry. Sharon Lindo. 27 August 2003

Ministry of Commerce and Industry

Personal Communication, Ministry of Commerce and Industry, John Banner, October 27, 2003

Personal Communication. Ministry of Commerce and Industry. Nigeli Sosa, 3 September 2003

Personal Communication. Ministry of Commerce and Industry. Elsy Reyes. 2 September 2003.

Personal Communication. Ministry of Commerce and Industry. Glenda Martinez. 29 August 2003.

Ministry of Finance

Personal Communication. Ministry of Finance. Zita Magaña. 3 September 2003
Personal Communication. Ministry of Finance. Artemio Osorio. 29 August 2003

Central Statistical Office

Personal Communication. Central Statistical Office. Raphael Lima. 20 August 2003
Personal Communication. Central Statistical Office. Rene Ogaldez 3 Sept 2003
Personal Communication. Central Statistical Office. Izor Zuniga 2 Sept 2003

Lands Information Center

Personal Communication. Lands Information Office. Noreen Featherweather 28 August 2003

Meteorology Department

Personal Communication. Meteorology Department. Justin Hulse. 1 August 2003
Personal Communication. Meteorology Department. Carlos Fuller 20 August 2003
Personal Communication. Meteorology Department. Michelle Smith 31 July 2003

Ministry of Transportation

Personal Communication. Ministry of Transportation. Tirso Galves 4 September 2003

National Assembly

Personal Communication. National Assembly. Georgia Cardenez 28 August 2003-09-07

BELTRAIDE

Personal Communication. BELTRAIDE. Jorge Espat 29 August 2003

BEL

Personal Communication. Belize Electricity Ltd. Geovana Fernandez 31 July 2003
Personal Communication. Belize Electricity Ltd. Derek Davis 27 August 2003
Personal Communication. Belize Electricity Ltd. Jose Moreno 19 August 2003.

PUC

Personal Communication, Public Utilities Commission, Gilbert Canton, August 27, 2003, and November 4, 2003
Personal Communication. Public Utilities Commission. Herman Charlesworth 29 August 2003.

Cooperatives Department

Personal Communication. Cooperatives Department. Hugo Miranda 28 August 2003

NEMO

Personal Communication. NEMO. Earl Arthurs. 25 August 2003

Ministry of Economic Development

Personal Communication. Ministry of Economic Development. Nancy Namis 28 August 2003

Other

Personal Communication. Belmopan Convention Hotel. George Sosa. 16 July 2003

Personal Communication. Belize Audubon Society. John Pinelo. 18 July 2003

Personal Communication. Programme for Belize. Herbert Haylock 15 July 2003

Personal Communication. Programme for Belize – La Milpa. Ramon Pacheco. 16 July 2003

Personal Communication. Programme for Belize – Hill Bank. Leopoldo Pol. 16 July 2003

Personal Communication. Tenchtronics. Evan Tench. 16 July 2003

Personal Communication. Belize Western Energy Ltd. Perfecto Matus. 3 September 2003

Personal Communication. Jex & Sons Bus Line. Jerry Jex. 21 September 2003

Personal Communication. Esso Standard Oil SA Ltd. Guillermo Alamina. 3 September 2003

Personal Communication. Esso Standard Oil SA Ltd. Eldo Lopez. 8 September 2003.

Personal Communication. Shell Belize Ltd. Joe Habet. 3 September 2003

Personal Communication. Texaco Belize Ltd. Neri Briceno. 3 September 2003

Personal Communication. Belmont Butane Gas Company Ltd. Edmund Longworth. 3 September 2003

Personal Communication. Hydro Maya Ltd. Darius Avila. 2 September 2003

Personal Communication. Toledo Cacao Growers Association. Christopher Nesbitt. 18 August 2003

Personal Communication. Toledo Cacao Growers Association. Gregor Hargrove. 14 August 2003.

Personal Communication. Jaguar Creek. Mark MacReynolds 19 July 2003

Personal Communication. Blacaneaux Lodge. Bernie Matute. 15 July 2003

Personal Communication. Sarteneja Health Clinic. Sandra Reyes. 15 July 2003

Personal Communication. Sylvia Baumgart . Janus Foundation. 25 August 2003

Personal Communication. David Dyck and Marian Krahn. Blue Creek Construction. 15 August 2003

Personal Interview

Interview. Belize Chamber of Commerce and Industry Conference Room. Senator Hulse 3 September 2003
