

# **TECHNICAL NEEDS ASSESSMENT OF BELIZE ENERGY SECTOR**

## **BELIZE SECOND NATIONAL COMMUNICATION TO THE UNFCCC**

### **CLIMATE CHANGE PROJECT**

**Submitted to  
The Ministry of Natural Resources and the Environment**

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## ***1.0 EXECUTIVE SUMMARY***

The objective of the Technical Needs Assessment (TNA) in the Energy sector is to identify potential and/or available options or measures suitable for mitigation of greenhouse gas emissions within the energy sector in Belize, and to prioritize these measures according to criteria such as multiple application, cost benefit analysis, best practices, etc.

Whereas energy is probably the single most important factor that determine the strength of an economy, the viability of industry and the well being of a people, Belize has no clear National Energy Plan that defines, determines, regulates, maps out and ensure energy security and supply. This is the most important finding of this report.

The energy sector in Belize was determined to rely heavily on fossil fuels and electrical power, both of which are imported and out of our direct control – both in terms of cost and supply.

Even though fossil fuels will always be a source of energy for the country, this report reflects, and urges, the need to decrease this dependency and to move towards renewable energy technologies. This will result in a more balanced energy sector in term of supply, cost and security. Among the renewable energy options analyzed and recommended are solar energy, hydroelectricity, wind energy, biomass and the use of cheaper and cleaner fuels, as in the

case of ethanol and liquefied petroleum gases (which can have a solid application in industry and transportation sub sectors).

With the discovery of crude in commercial quantities, a strong recommendation is for the operation of a mini refinery to satisfy Belize's energy needs however, this must still be balanced along with renewable sources in order to minimize green house gas emissions. However, from a strictly economic view point, the discovery of oil solves many problems facing Belize today: energy supply, energy security, rising energy costs and the foreign exchange situation, among others. Government must have the political will and determination to take bold steps in this matter so as to achieve the above-mentioned objectives.

## ***2.0 OVERVIEW OF THE ENERGY SECTOR***

For the reporting years of this study, 1997 and 2000, two main energy sources of Belize could be identified: fossil fuels, which are imported, and secondly biomass which includes the burning of bagasse in the sugar industry and fuel wood for domestic use as well as for the production of white lime. In the case of fossil fuels, 100% is imported by two main importers: Esso Standard Oil S.A. Limited (Esso), which is the only authorized commercial importer of fuels, and Belize Electricity Limited (BEL), which also imports diesel fuel from Mexico, for energy production.

### **2.1 Petroleum Industry**

Being the sole commercial importer of fuel, and operator of the only fuel terminal in the country, Esso supplies both Texaco Belize Limited (Texaco), and Shell Belize Limited (Shell), who together are the three petroleum companies operating in the country.

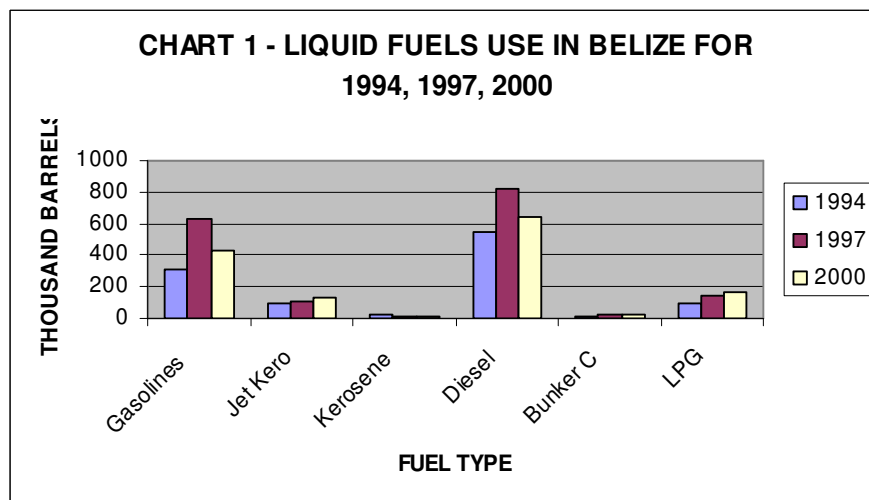
For the year 2000, there were 57 service stations operating countrywide, with all three main players having market presence in all districts countrywide. Fuels offered at service stations include regular and premium gasoline, diesel, and kerosene (mostly sold in rural areas).

The fuel is imported in-country by fuel tankers mostly from the United States of America. The fuel is then transported over land by small and large delivery fuel trucks (3,000 and 10,000-gallon capacity bowzers). In Belize the pump price of fuel is regulated by government and varies in each district due to transportation costs – the lowest pump prices being in Belize City, where the terminal is located.

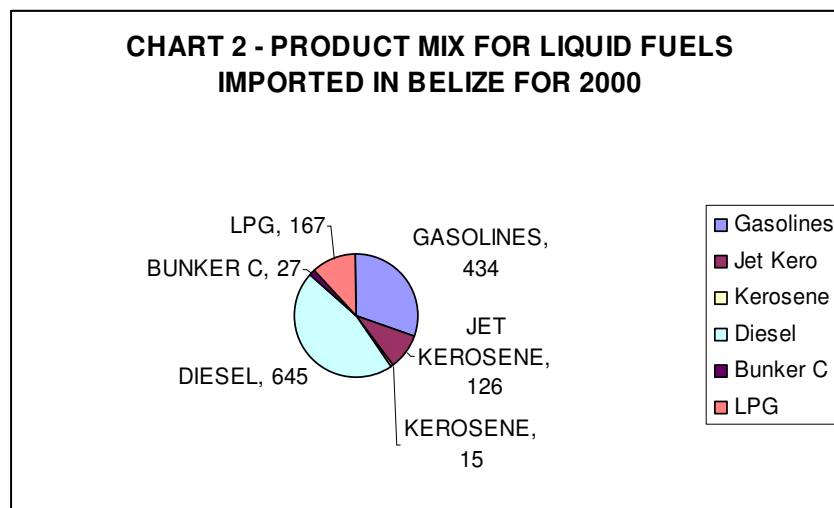
Fuel is sold in Belize through service stations and marinas for road transportation and national navigation (mostly private vehicles and boats) and

directly by the petroleum companies for industrial, agricultural, energy (BEL purchases a small amount of diesel locally) and transportation (mostly public). Both Esso and Texaco also had Aviation Terminals at the Phillip Goldson International Airport in Ladyville. However, the sale of Aviation Gasoline and Jet kerosene were sold mostly to international carriers and are therefore not included in this analysis.

The various categories of imported fossil fuels for the years 1994, 1997 and 2000 are represented in the below diagram:



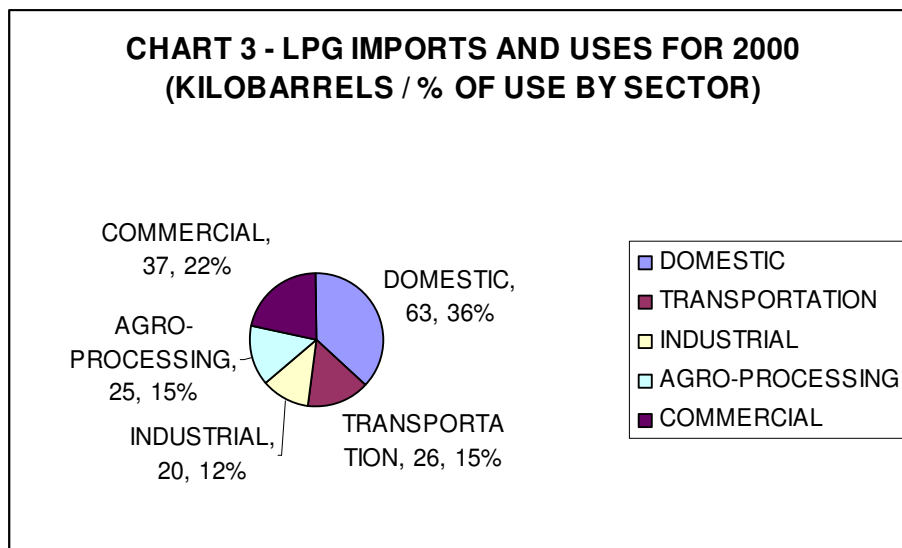
Taking the reference year 2000, being the most recent, the following chart shows the product mix of liquid fossil fuels imported into the country:



From the above information, the most consumed liquid fossil fuels in Belize are Diesel, Gasoline and Liquefied Petroleum Gas (LPG).

LPG is imported into the country by four main importers: Belize Western Energy Limited, Belmont Butane Depot, Belize Gas Limited and Zeta Gas Belize. LPG's imported into the country are from Mexico, Guatemala and El Salvador. They consist mostly of propane and propane/butane mixtures of (70/30% composition).

The three main uses of LPG are: domestic (sold in cylinders), carburetion (for transportation) and commercial / industrial (sold in bulk to restaurants, agro-processing, industrial and manufacturing). The importation of LPG is over land and transported from its point of origin in 10,000 gallon capacity bowsers. The four main importers have distribution point country wide however, up to the year 2000, most rural areas did not have adequate supply.



Unlike the rest of Central America, LPG sold in Belize for domestic use is not sold through distribution centers (as bottled water, for example), but is distributed through a home delivery system that is costly and inefficient. This is due mainly to the fact that in urban areas, bobtail delivery trucks are not permitted to fill domestic LPG cylinders. Instead these have to be picked up

by small delivery vehicles (pickups), taken to the nearest depot to be filled and then returned to the customer. LPG for carburetion is only sold at Distribution points (LPG Depots) and not through “service stations”, since it is a sector which has yet to be fully developed. LPG sold for commercial (restaurants, hotels etc.), agro-processing, institutional and industrial use is delivered to the customer or site using small 3,000-gallon bob tail trucks. Again, unlike Central America, in Belize LPG cylinders for domestic use is owned by the customer, not the distributor. As is the case with fuels, the price of LPG is also regulated by government.

## 2.2 Biomass

The two main biomass sources for use in energy are bagasse (within the sugar industry) and fuel wood (this has uses in the domestic and industrial sectors).

Bagasse is used by Belize Sugar Industries Limited (BSI) for the production of energy. Most of the bagasse produced by BSI is consumed within the same crop season for energy production. The use of bagasse is a standard practice within the sugar industry as it increases efficiency in terms of production costs. Data collected for the period under study indicates that bagasse production and consumption increased from 293,244 tons in 1994 to 301,525 tons in 2000.

Fuel wood in Belize has two uses: domestic and industrial. In the domestic scenario, for example, 16% of households in the country still used fuel wood for cooking. Data collected showed the use of fuel wood as follows:

**Table 1 - Use of Fuel Wood for Cooking in Belize**

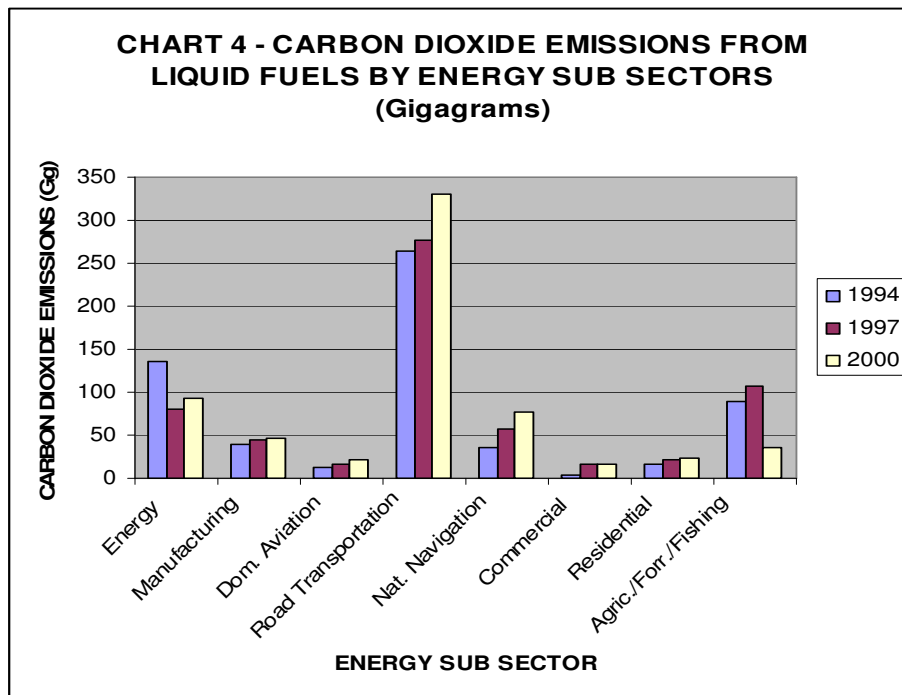
YEAR	1994	1997	2000
FUEL WOOD (TONS)	100,120	109,852	111,614

The use of fuel wood was also found to be significantly different in urban and rural areas. The use of fuel wood for the production of white lime was more in

1994 than it was in 2000. This is mainly because of the unchanging indigenous technology being used, that results in a low quality product, whilst the market has been getting more and more demanding in quality control and product consistency. Uses have traditionally been in the citrus industry.

### 2.3 CO2 Emissions from the Energy Sector by Liquid Fuels

Emissions by the energy sector were calculated using the IPCC guidelines, the source categories methodology. The data used for this estimation was collected from official as well as from direct sources (stake holders). The emission results of this study are summarized in the following charts:



From the above chart, the four sub sectors with the most emissions in 2000 are Energy, Road Transportation and National Navigation, with 93.21, 330.55 and 77.54 Gg carbon dioxide emissions respectively, which total 78% of all Energy Sector CO2 emissions. The liquid fuels include gasoline, diesel, kerosene, jet kerosene and LPG.

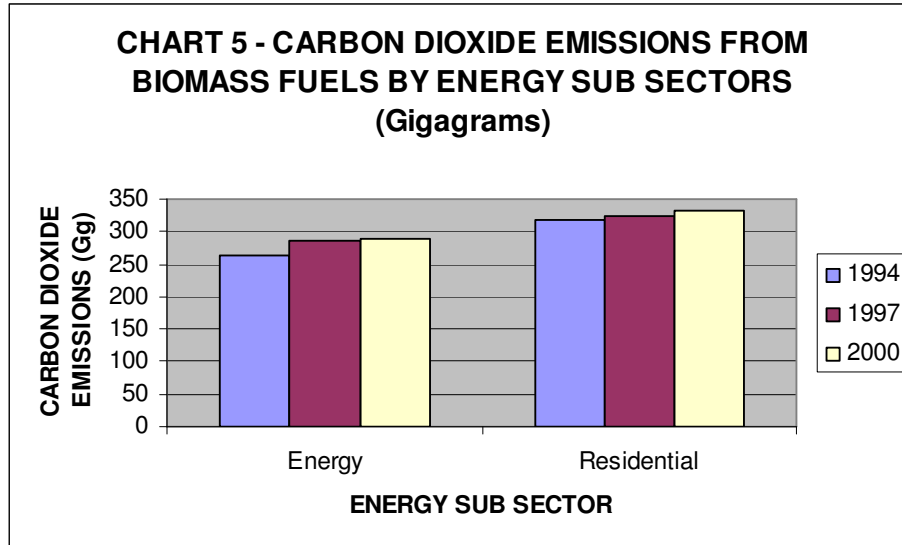
The dip in emissions for the Energy sub sector pertaining to 1997 is as a result of higher acquisition costs from PEMEX and the consequent decrease in purchases of diesel by BEL. This was also accompanied by the completion and commissioning of the Mollejon project by BECOL. This trend is reversed, however, when a comparison is made between emissions in 1997 and 2000. Emissions by the energy sub sector, is therefore one of the principal producers of carbon dioxide.

The principal contributor to CO<sub>2</sub> emissions within the energy sector comes from road transportation. Emissions from this activity were 263.58, 275.94 and 330.55 Gg CO<sub>2</sub> for 1994, 1997 and 2000 respectively. Overall, these emissions accounted for 44.2%, 44.6% and 51.4% of all energy-related activities countrywide.

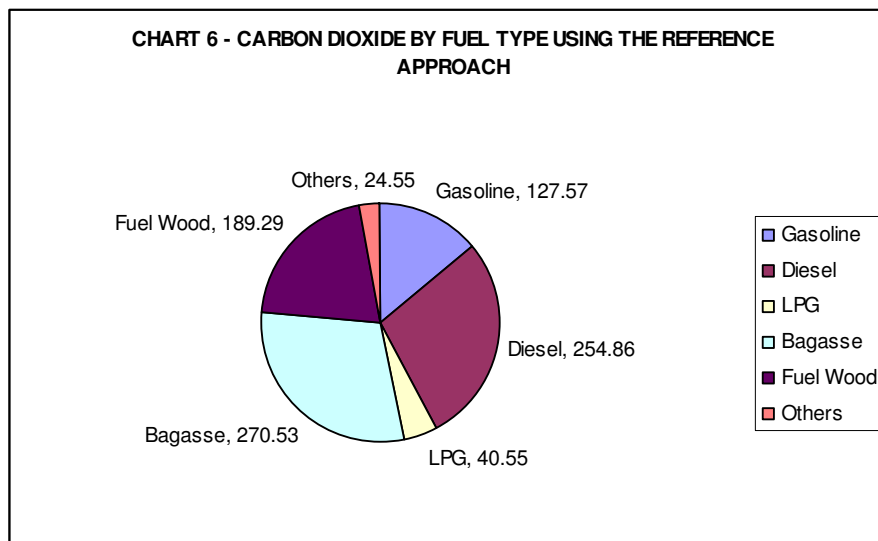
If we consider the reference year 2000, the third largest CO<sub>2</sub>-producing activity would be national navigation. This sub-sector has seen significant activity and growth primarily due to the growth of the tourism industry. As in the case of road transportation, emissions from navigation show a growing trend: 35.51, 57.03 and 74.54 Gg CO<sub>2</sub> for 1994, 1997 and 2000 respectively. These emissions accounted for 5.9%, 9.2% and 12.1% of all energy-related activities countrywide

## 2.4 CO2 Emissions from the Energy Sector from biomass

The two main biomass sources for energy-related activities in the country are bagasse and fuelwood. Emissions are shown below by sub sectors:



In summary, therefore, the major contributors to CO2 emissions in the energy sector can be grouped as follows:



Fuel Type: Gasoline  
Diesel  
LPG  
Biomass  
Activity: Energy  
Road Transportation  
National Navigation

These therefore are the areas of focus which will be considered for this study.

### **3.0 LEGISLATIVE AND POLICY FRAMEWORK**

#### **3.1 Caribbean Renewable Energy Development Project**

Belize, along with twelve other Caribbean states, became a signatory to this project which aims to remove barriers to renewable energy use in the region, thereby reducing the dependence on fossil fuels while contributing to the reduction in green house gas emissions. It undertakes specific action to overcome barriers in terms of policy, finance, capacity and awareness. In 1998, when this project was launched, it was estimated that renewable energy contributed less than 2% of the region's energy balance.

#### **3.2 Caribbean Energy Information System (CEIS)**

Belize, along with 17 other Caribbean countries, belong to this co-operative networking system committed to the pooling and exchange of energy information in order to provide a sound guide for energy policy makers.

For the period under study, the following renewable energy technologies (RET's) were identified as existent in Belize:

- Hydroelectricity
- Solar Photovoltaic Electricity
- Wind Electricity Generation
- Solar Thermal (Water Heating)
- Biomass Cogeneration

It is estimated that these five technologies contribute just over 29% of the national energy needs, with biomass cogeneration contributing 26% (includes fuel wood), hydroelectricity contributing 3% and solar and wind less than 0.1%.

## **5.0 PRIORITY AREAS FOR NEEDS ASSESSMENT**

The three areas previously identified for needs assessment were:

- Energy
- Road Transportation
- National Navigation

This study will also comment on the three fuel types that contribute the most to CO2 emissions:

- Gasoline
- Diesel
- LPG
- Biomass

### **5.1 Energy**

In 2006, the aggregate demand from BEL was 56 MW, which the company sourced from different sources:

a) Comision Federal de Electricidad (CFE)

CFE is a Mexican state-owned power company with which BEL has in place a 25 MW supply agreement. BEL is supplied from the Xulha substation in Quintana Roo. The supply from CFE has been generally reliable, even though some outages are experienced annually.

b) Mollejon Hydro Plant

The hydroelectric plant is located on the Macal River and consists of three 8.4 MW turbines, thereby having an aggregate 25 MW installed capacity. Due to its relatively small water storage capacity, this plant has only been able to provide 6.5 MW during the dry season and 10 MW during the wet season. For this reason, during the dry season BEL uses the plant as peak and emergencies backup, and during the wet season as a base load.

c) BEL Generation

BEL's generation capacity is due to diesel generators which the company operates from different locations, with a total installed capacity of 19.8 MW. The principal generating plants are located in Belize City and Belmopan. Other smaller diesel generators are located in Caye Caulker, Independence and Punta Gorda. In addition, the company also has five 1.2 MW containerized mobile units, which are deployed in Belize City, Belmopan and Ambergris Caye. As mentioned before, BEL also imports its own diesel fuel used for generation directly from PEMEX in Mexico, and procures a minimum amount from ESSO locally.

d) Chalillo Hydroelectric Dam

The Chalillo Hydroelectric plant is designed as a complement to the Mollejon Plant. It is located upstream of the Macal river from the Mollejon Plant and has an installed capacity of 7.5 MW.

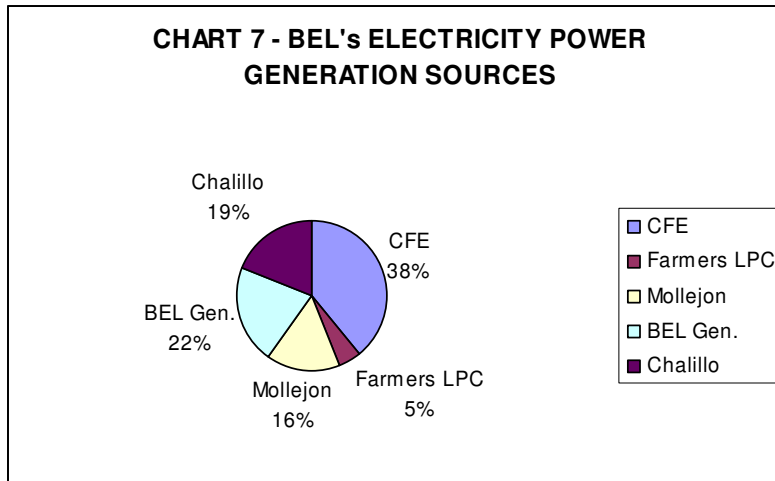
e) Farmer's Light Plant Cooperative (Farmers LPC)

This provider operates and supplies generated power to the Spanish Lookout (Mennonite Community) only. They have three diesel generators of 2 MW, 1MW and 750 KW ratings.

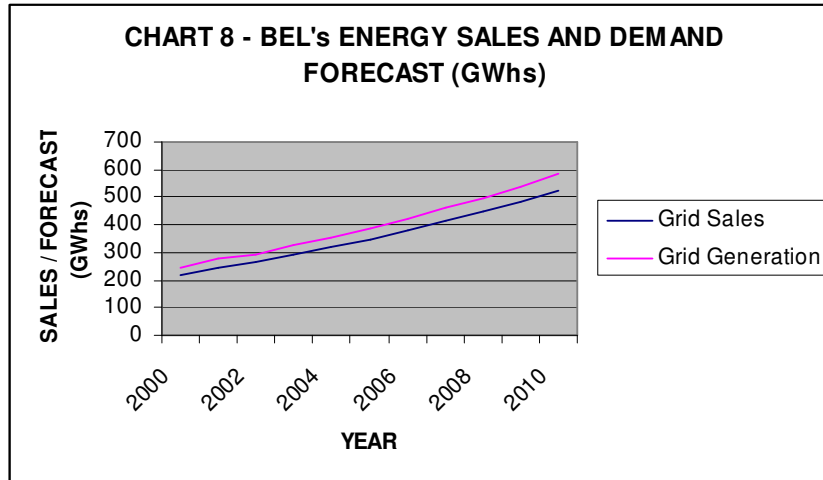
f) Earth Tech

This operator provides service to the Corozal Commercial Free Zone, but did not provide any information.

In summary, BEL's generated sources are as shown in the below diagram. It highlights the critical dependency on a foreign supplier (CFE) and also the high dependency of generated power from fossil fuels.



BEL's demand forecast is for an annual increase of 9%. The trend for the period 2000 to 2010 is as follows:



Directionally, any additional growth in supply should, by policy, be through renewable energy and not fossil fuel-generated. This policy should be in place for two specific reasons:

- **Energy Security**  
 Being dependent on CFE for 38% of our energy needs in electricity is quite high and should be offset through RET's. One aspect of the CFE supply agreement that could not be clarified is the priority BEL would be given in the case of a national disaster in the Quintana Roo area, which is the area supplied by the XULHA substation.
  
- **Cost Stability**  
 Energy generation from fossil fuels is dependent on rising world crude prices. 27% of Belize's electricity needs are directly supplied through diesel generators (22% BEL and 5% (Farmers LPC). However, the 38% procured from CFE is also mostly from fossil fuels. This therefore, maintains the cost of generation directly dependent on the cost of fuel, which is outside of our control. This is evident as BEL has been regularly applying to the Public Utilities Commission (PUC) for tariff reviews as a result of increasing generation costs.

This study considers hydroelectricity and cogeneration as the two main RET's that should be adopted as policy in the energy sub sector. Following are viable RET's that have been identified for Belize

### **5.1.1 Hydroelectricity**

Hydroelectricity is not new to Belize since this technology has been used in the Belize for a long time of which the principal ones are the Mollejon and the Chalillo.

This option should continue to be developed and more options explored. The existing hydroelectric sources in-country have been identified and discussed above.

Since the potential of this RET is already being maximized in the country, no adoption analysis is necessary.

### **5.1.2 Cogeneration**

Cogeneration is considered the second most important RET that should be adopted in the energy sub sector.

In 2004, Belize Cogeneration Energy Limited (BELCOGEN) announced it had signed a 15-year Power Purchase Agreement with BEL to supply 13.4 MW to the national grid. This project proposes to use all available bagasse produced by BSI, thereby maximizing the adoption of this RET.

GOB has also announced plans to rehabilitate the Libertad Sugar Factory for the production of ethanol. If this plan becomes reality, cogeneration should also be incorporated into the scope of the project to increase the feasibility of the project as well as to maximize the use of this resource. No data with regards to the Libertad Sugar Factory was available to this consultancy therefore the full scope of it is unknown.

Given that the BELCOGEN cogeneration plan includes the full use of all the bagasse produced by BSI, no further RET adoption analysis is found necessary.

### **5.1.3 Solar Photovoltaic (PV Systems)**

#### **5.1.3.1 PV Heaters**

Two factors that make this technology viable is the abundance of sunlight and the high cost of generating electricity from fossil fuels. However, as technology advances occur, cost is driven down, thereby reducing this gap and making this option even more viable. Specific application of this technology can be that of solar water heaters. Even though available technologies presently limit the capacity of solar water heaters, the relatively low installation cost can be recovered in as little as 2 to 3 years.

This technology has special applications in the tourism sector as well as for disaster relief. In fact, PV Systems should be conditional to Environmental clearance for the tourism sector. One downside to this technology is its vulnerability to natural disasters such as hurricanes. Another negative aspect is that of reliability in cloudy conditions. For this reason, the tourism sector should have dual systems installed in order to have electric heating as backup only.

#### Barriers

1. High initial cost
2. Lack of commercial market
3. Lack of technology awareness

#### **5.1.3.2 PV Lighting**

Another application of PV Systems can be for lighting of both on and off-grid uses.

#### Barriers

1. Limited application and use
2. High initial cost
3. Lack of standards and recommended practices

### **5.1.4 Wind Energy**

Due to its geography, Belize is in an enviable position to utilize wind energy technology. This is especially true for the Baldy Beacon area. Even though there is already a small number of wind turbines in this area, estimates indicate that up to 20 MW can be developed at the site over a ten year period. Even though this site has a minimum wind speed of up to 7 m/s, there is no country wide data available. It is therefore recommended that this study be undertaken

#### Barriers

1. Lack of country-wide wind data
2. High initial capital investment
3. Lack of expertise in wind energy technology

### **5.1.5 Other Biomass**

The use of rice husks and saw dust are options that should be studied and encouraged. Hillbank Agriculture in Blue Creek is the only entity that has experimented using rice husks as an energy source (heat). No data, including experimental, was available regarding the use of saw dust.

### **5.1.6 Crude Oil**

In 2006, it was made public that crude oil in commercial quantities had been found in Belize. The obvious policy, given this discovery, is to, through a mini refinery, become self sufficient in fossil fuels. Presently

Belize is exporting crude oil and importing refined products (gasoline, diesel, LPG, etc). Among the benefits that would be derived from this policy are:

1. Savings in foreign exchange
2. Energy security
3. Energy cost stability

Barriers

1. Initial Cost
2. No obvious political will

## **5.2 Road Transportation**

Road Transportation is the principal energy sub sector in consumption of fuel (diesel and gasoline) and is also the principal emitter of carbon dioxide (see Chart 4). The approach to reverse this trend has to be multi-pronged:

### **5.2.1 Reducing the use of Gasoline and Diesel**

In order to reduce the use of these two fuels, they would need to be replaced so as not to affect this key energy sub sector. In doing so, the objectives to pursue would include:

#### **5.2.1.1 Ethanol**

Given the fact that Belize is a sugar producing country, the production of ethanol is definitely a viable option. Ethanol can be used to mix with gasoline (gasohol), and allow a cheaper a transportation fuel. This technology is available (e.g. in Brazil), and therefore a feasibility study should be conducted in order to establish its adaptation in Belize. BSI is at this time focused on sugar production and cogeneration (BELCOGEN), therefore the

Libertad Sugar Factory (LSF) would be the likely source for ethanol. As mentioned before, no information on LSF was available to this study.

#### Barriers

4. Technology not readily available
5. No obvious political will to replace traditional fuels
6. No data on costs of engine conversion

#### **5.2.1.2 Liquefied Petroleum Gas (LPG)**

According to 2000 data, 15% of LPG consumed was by the transport sector. It is estimated that less than 3% of vehicles in Belize can run on LPG. Within the LPG Industry, carburetion sales (sales to motor vehicles), has been on an increase over the last three years. This is as a direct result of rising fuel costs. As an example, the cost of a gallon of LPG is less than 50% the cost of a gallon of gasoline, and the mileage attained from it is close to 93% from that of gasoline. Another benefit is that it is a cleaner fuel, with lower emissions than gasoline. The estimated cost of conversion is around \$1,800.00 BZ, including hardware and labor. Actually, it is not really a conversion, since the LPG consumption ability is added to the vehicles, and the "gasoline" option is left operational. Presently, conversions are mainly done in Spanish Lookout since there is not much expertise in this technology countrywide. On the upside, an investment on conversion can be recovered within a year from savings of not having to consume gasoline. On the downside, diesel engines cannot be converted to LPG use, since there is no technology available for this. By policy, incentives should be made available to consumers to switch to this cleaner fuel.

#### Barriers

1. Relatively high installation cost
2. No established or “formal” filling stations
3. Not much awareness on the part of the consumer

Two other factors that also need to be addressed are fuel efficiency and emissions. In Belize, most vehicles are “secondhand” vehicles imported from the US. These vehicles therefore, cannot be considered fuel efficient due to their age and use before imported into the country. As a result, policy must dictate both fuel efficiency as well emissions, since locally there are no standards.

### **5.3 National Navigation**

National navigation is the third largest contributor to carbon dioxide emissions within the energy sector. Carbon emission from this energy sub sector has increased from 35.5 to 57.0 to 77.5 Gg of carbon dioxide for the years 1994, 1997 and 2000 respectively. Over this six year period, emissions more than doubled due to the dramatic increase in tourism-related activities. Since there is no data regarding the use of small sea craft and cruise ships, it is recommended that a study be done on the effect on the environment due to national navigation.

## ***6.0 CONCLUSIONS AND RECOMMENDATIONS***

The following conclusions were arrived at as a result of this consultancy:

### **6.1 National Energy Plan**

Belize is in need of a comprehensive National Energy Plan. Given the fact that Belize is highly dependent on imported fossil fuels to fulfill its energy needs, and given the fact that the cost and supply of imported fuels is outside of the control of the country, there is the need to define and formulate an energy plan that incorporates the findings and recommendations presented in this consultancy.

### **6.2 The Energy Sub Sector**

The Energy Plan must closely, through formulated policy, guide and monitor the energy sub sector to ensure the adequate, secure and well-managed energy sources, to ensure the timely, cost effective and affordable energy supply for the country. This should be achieved through renewable energy sources in order to minimize the dependency on fossil fuels or imported electricity from Mexico.

### **6.3 Cogeneration**

Belize should ensure that cogeneration, which is already being spearheaded by the private sector, continues to be maximized. This is especially true in the case of the Libertad Sugar Factory coming back on line.

#### **6.4 Hydroelectricity**

Belize should ensure that other hydroelectricity sources be explored, and if feasible, be pursued in order to add to the national grid. This will contribute to decreasing our dependency on fossil fuels.

#### **6.5 Solar energy**

Given Belize's abundant sunlight places the country in an enviable position to use this resource as an energy source. It is recommended that a comprehensive study be conducted to qualify and quantify this as a renewable energy source. The applications for this must be two-pronged – lighting and water heating. This will further contribute to decreasing our dependency on fossil fuels.

#### **6.6 Wind Energy**

A comprehensive study must be carried out to study the feasibility of using wind energy as an energy source. Even though no country data is presently available to give an educated opinion, the data from Baldy beacon is very encouraging so as to pursue this possibility. This will contribute to further decrease our dependency on fossil fuels.

#### **6.7 The Petroleum Industry**

The discovery of commercial quantities of oil in Belize should be capitalized on in order to secure our energy needs. In order to achieve this, the country cannot afford to consider this industry as a revenue source but have a more global outlook in terms of energy security and self-sufficiency. The recommendation is to create a National Energy Industry and refine enough crude to

satisfy our national needs via the operation of a mini refinery. This will also resolve the ever-present foreign exchange situation as well as stabilize fuel prices.

## **6.8 Fuel Wood**

As a matter of policy, Belize should discourage the use of fuel wood, in order to slow down the deforestation that is taking place due to the use of fuel wood as an energy source. Even though this fuel source has traditionally been used, and to some extent it could be argued as being a matter of culture, in the long run it is not sustainable. Given this fact, fuel wood should be replaced with LPG, which is a “cleaner” fuel and does not cause deforestation. This can be achieved through education and by offering some incentive to the lower income bracket to make it affordable.

## **6.9 Lime Industry**

The use of fuel wood as the energy source for this industry should be discouraged. This recommendation is in line with the recommendation made by the Industry Sector Consultancy. The Lime industry should become formalized in terms of the process, quality control, efficiency and organization. Even though this industry has provided employment for many, it has been in the decline for several years now due to the indigenous process being used and the lack of quality control. By organizing this industry, the use of LPG can help in making it more efficient and controlled.

## **6.10 LPG**

Given the fact that PG is a much cheaper fuel, and that there is available technology to convert vehicles from the use of gasoline

to LPG, this should be encouraged through policy. It must also be noted that this will also result in foreign exchange savings as well as less emissions due to the fact that LPG burns cleaner.

#### **6.11 Energy Efficiency / savings**

Stakeholders in the energy sector (Utility, Fuel, LPG, etc), should be mandated by policy to produce consumer awareness programs in order to educate consumers as to energy savings tips so as to conserve energy, lower their energy costs, and decrease emissions.

## ***7.0 LIST OF PERSONS INTERVIEWED***

Mr. Guillermo Alamina, Country Representative, Esso Standard Oil S.A. Ltd., Belize City

Mr. Freddy Flores, Sales Representative, Esso Standard Oil S.A. Ltd., Belize City

Mr. Jose Espat, Operations Manager, Esso Standard Oil S.A. Ltd., Belize City

Mr. Eladio Alamina, Service Station Dealer, Orange Walk Town

Miss Lupita Longsworth, Service Station Dealer, Commercial Free Zone, Santa Elena Border

Mr. Reynaldo Burgos, Procurement Manager, Belize Electricity Limited, Belize City

Mr. Ariel Lizama, Purchasing Officer, Belize Electricity Limited, Belize City

Mr. Antonio Herrera, Purchase Manager, NOVA Belize Limited, Ladyville

Mr. John Gillet, Factory Manager, Belize Sugar Industries Ltd., Orange Walk District

Mr. Jose Contreras, Director Civil Aviation, Civil Aviation Department, Ladyville

Mr. Michael Godoy, Chief Transport Officer, Traffic Department, Belize City

Mr. Peter Dyck, Proprietor, Hill Bank Agriculture Limited, Blue Creek, Orange Walk District

Mr. Jake Lekeman, Farmers' Light Plant Corp. Spanish Lookout, Cayo District

## ***8.0 REFERENCES***

Formulation of a National Energy Plan for Belize (Sector Diagnostic & Policy Recommendations) Project, Public Utilities Commission, December 2003

Energy for Sustainable Development Towards a National Energy Strategy for Belize (Energy Sector Diagnostic), Launch Pad Consulting, November 2003

Ghana's Climate Change Technology Needs and Needs Assessment Report, January 2003

Robert Perry, Chemical Engineer's Manual, 5<sup>th</sup> Edition, Volume 1, 1986, McGraw-Hill

Robert Weast, Handbook of Chemistry and Physics, 55th Edition, 1975, CRC Press

Greenhouse Gas Inventory Work Book, Volume 2; Intergovernmental Panel on Climate Change, UNEP

Greenhouse Gas Inventory Reference Manual, Volume 3; Intergovernmental Panel on Climate Change, UNEP

