Background Data Collection on Bio-Energy in the Caribbean and Central America

Prepared for the United Nations Biofuels Initiative

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ACRONYMS

APUA	Antigua Public Utilities Authority
bbl	barrels of oil
bbl/day	barrels of oil per day
BD	Barbados Dollars
BEC	Bahamas Electricity Corporation
BECOL	Belize Electricity Company Limited
BEL	Belize Electricity Limited
BL&P	Barbados Light and Power Company Limited
BTU	British Thermal Unit
CA	Central America
CAFTA	Central American Free Trade Agreement
CAFTA-DR	Central America-Dominican Republic Free Trade Agreement
CAR	Caribbean
CAR/CA	Caribbean and Central American
CARICOM	Caribbean Community
CARILEC	Caribbean Electric Utility Services Corporation
CDEEE	Dominican Corporation of State Electrical Companies
CFE	Federal Electrical Commission
CIA	Central Intelligence Agency
CNE	National Energy Commission
CNEE	National Commission for Electric Energy
CNFL	Costa Rican National Power and Light Company
COPE	National Commission for Energy Policy
DGE	General Directorate of Energy
DOD	US Department of Defense
ECLAC	Economic Commission for Latin America and the Caribbean
EDH	Electricity of Haiti
EEGSA	Guatemalan Social Electric Company
EIA	Energy Information Administration
ENEE	National Electric Energy Company
ENEL	Nicaraguan Electricity Company
ERSP	Public Services Regulation Board
ETESA	Electricity Transmission Board
EU	European Union
Eximbank	US Export-Import Bank
FAO	Food and Agriculture Organization of the United Nations
FAOSTAT	Food and Agriculture Organization of the United Nations Statistical Database
FDI	Foreign Direct Investment
FOGES	El Salvador Rotary Fund
GDP	Gross Domestic Product

GEF	Global Environment Facility
GHG	Greenhouse Gas
GRENLEC	Grenada Electricity Services Ltd.
GSEII	Global Sustainable Energy Islands Initiative
GW	gigawatt
GWh	gigawatt-hour
HDI	Human Development Index
IADB	Inter-American Development Bank
ICE	Costa Rican Institute of Electricity
IEA	International Energy Agency
IHRE	Panama State-Owned Electricity Company
IMF	International Monetary Fund
INDE	National Institute of Electrification
INE	Nicaraguan Institute for Energy
JPS	Jamaica Public Service Company
km	kilometers
km^2	square kilometers
KTOE	Kilo-tonnes of Oil Equivalent
kW	kilowatt
kWh	kilowatt-hour
LAC	Latin America and the Caribbean
LNG	liquefied natural gas
LUCELEC	St. Lucia Electricity Services Ltd.
MAG	Ministry of Agriculture and Livestock
MARENA	Ministry of Natural Resources
MEEI	Ministry of Energy and Energy Industries in Trinidad and Tobago
MEF	Ministry of Economy and Finance
MEPU	Ministry of Energy and Public Utilities
MICIT	Ministry of Science and Technology
MINAE	Ministry of Environment and Energy
MOPT	Ministry of Public Works & Transportation
MOU	Memorandum of Understanding
MW	megawatt
MWh	megawatt-hour
NCEPA	St. Kitts and Nevis National Conservation and Environmental Protection Act
NEP	National Energy Plan
NEVLEC	Nevis Electric Company Limited
NGC	Natural Gas Company
NPMC	National Petroleum Marketing Company
OAS	Organization of American States
OLADE	Organización Latinoamericana de Energía
PCJ	Petroleum Corporation of Jamaica
PETROTRIN	Petroleum Company of Trinidad and Tobago

SEP	Sustainable Energy Plan
SERNA	Secretariat of the Environment and Natural Resources
SIE	Electricity Supervisors of the Dominican Republic
T&TEC	Trinidad and Tobago Electricity Commission
UK	United Kingdom
UNDP	United Nations Development Programme
UNE	Unión Nacional Eléctrica
US	United States
USEIA	US Energy Information Administration
VINLEC	St. Vincent Electricity Services Ltd.

1. INTRODUCTION

PURPOSE

The purpose of this report is to collect, collate, organize, and document information related to bio-energy development in the Caribbean and Central American (CAR/CA) regions. This report is prepared for the United Nations Foundation (UNF) as part of the UN Biofuels Initiative, which promotes the sustainable production and use of biofuels in developing countries under conditions that can attract foreign and domestic investment. The CAR/CA regions were selected for study because of the strategic interests of these regions to UNF and its UN partners (see textbox); the likely potential for biofuels development in many of these countries; and the significant economic, social, and environmental opportunities that bio-energy can possibly afford.

SCOPE

This report, a desk study, identified opportunities for bio-energy development in Caribbean and Central American nations, including the technical potential for biofuels (ethanol and bio-diesel) and bio-power generation. The study does not attempt to provide a more detailed market assessment for bio-energy in CAR/CA countries. This would require a much more comprehensive analysis, with work to be performed at the country level. As noted in the report, market studies are already underway in several countries with others planned; this report provides background data to help identify opportunities where in-depth studies may follow in an effort to catalyze the sustainable development of these resources.

The countries included in this assessment are: Antigua and Barbuda, Bahamas, Barbados, Belize, Costa Rica, Cuba, Dominican Republic, El Salvador, Grenada, Guatemala, Haiti, Honduras, Jamaica, Nicaragua, Panama, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, and Trinidad and Tobago. For each of these countries, a 2-4 page summary is provided that includes:

- A country overview containing geographic, demographic, and land cultivation data. It also identifies key agricultural products and environmental issues pertaining to bio-energy development.
- An energy overview, to include data on total primary energy consumption by sector, total primary energy consumption by fuel type, and electricity generation by fuel type. Information is also provided on key players in the energy sector and related policy information.
- Bio-energy production technical potential data estimated on a "what-if" basis, assuming varying amounts of current crop production are converted to bio-energy.
- Spreadsheets providing the supporting data used to conduct these assessments, organized by country. The spreadsheets contain statistical information on bio-energy feedstocks, agriculture sector data, energy balances, and environmental, economic, demographic, and human development information.

Partnering on Biofuels: the UN Biofuels Initiative

The UN Biofuels Initiative is supported by the UN Foundation and is being undertaken in partnership with five UN agencies working in coordination. These include: the United Nations Conference on Trade and Development (UNCTAD), the Food and Agriculture Organization (FAO), the United Nations Development Programme (UNDP), the United Nations Environment Program (UNEP), and the United Nations Industrial Development Organization (UNIDO).

OVERVIEW

Caribbean and Central American nations face unique challenges associated with power generation, fuels, and energy use. Most of these countries depend almost exclusively on imported petroleum for electricity production, transport fuels, industrial fuels, and other uses. This high level of dependence leaves these countries vulnerable to the volatility of international oil prices, causes economic and social disruption in countries where significant portions of the population already live below the poverty line, and results in a tremendous drain on capital for imports. In addition, CAR/CA nations—especially small island states—are particularly susceptible to environmental impacts associated with fossil fuel consumption, including local and global climate change impacts such as sea level rise, ocean acidity, and increased strength and frequency of hurricanes.

Most CAR/CA nations have significant renewable natural resources, including biomass, solar, wind, geothermal, and hydropower resources which can be used on a cost-competitive basis for a variety of power, heating, cooling, and transport applications. CAR/CA nations are particularly well suited to increase the use of renewable energy given their small size, the dominance of the agricultural and tourism sectors for their economic development, and their locally available resources.

Although CAR/CA nations appear to be excellent candidates for utilizing biomass and other renewable energy sources to meet an important portion of their energy needs, there has been limited application of these options to date. This is due to a number of barriers including the following, though it should be noted that the extent of these barriers varies widely among the countries in the CAR/CA regions.

- ***Awareness:*** Lack of information and insufficient understanding of the costs, benefits, and applications of these technologies.
- ***Inadequate Resource Data*****:** Many of the countries lack adequate resource data on bio-energy and other resources required for assessing the economic development of the resource.
- ***Technical and Analytic Capacity:*** Need for additional analytic tools and skilled expertise to assess and validate technology options, evaluate cost-benefit tradeoffs, manage and upgrade planning capabilities, and recommend appropriate policy options.
- ***Policy***: Current policy and regulatory climates that favor fossil fuels and hinder development of bio-energy and other clean energy options.
- ***Institutional***: Lack of in-country institutions for all aspects of bio-energy and broader clean energy project design, development, implementation, and operation. This is further heightened by a utility structure that is resistant to transitioning away from conventional fossil fuel generation to cleaner energy options.
- ***Finance:*** Lack of available, affordable financing for clean energy projects.
- ***Project Preparation***: Limited information on project opportunities, as well as limited expertise in areas such as business planning, feasibility studies, and partner development, that is necessary to develop clean energy projects.

WHAT IS BIO-ENERGY?

In this report bio-energy is defined as a solid, liquid, gel, or gaseous fuel derived from biomass. Biomass is defined as organic matter from such sources as agricultural products (including agricultural residues), forestry and related industries, as well as the organic portion of industrial and municipal waste. The three main types of bio-energy discussed in this report are: a) ethanol—also known as ethyl alcohol or grain alcohol; b) bio-diesel—a petroleum diesel-equivalent derived from vegetable oils; and c) biomass-based electricity and/or heat.

WHY BIO-ENERGY? WHY NOW?

Biomass appears to have significant though untapped potential throughout the CAR/CA regions. Increasingly, there is growing interest in many of these nations to explore prospects for development of biomass resources, including for both domestic and export applications. A number of factors are occurring in the CAR/CA regions that are driving increased interest in bio-energy. These include:

- High petroleum prices that have more than doubled in the last two years and are likely to remain high during the current decade and possibly beyond. Many CAR/CA nations pay extremely high prices for electricity; in the CARILEC (Caribbean Electric Utility Services Corporation) countries of the Caribbean, for example, prices range from a low of 0.137 per kilowatt hour (kWh) in St. Kitts to a high of 0.697/kWh in St. Vincent.
- Phasing out over the next four years of the sugar price subsidies by the European Union (EU), which is having a detrimental effect on sugar-producing CAR/CA nations. In many countries the subsidy reductions have caused countries to diversify their value-added products from sugarcane (e.g., for energy applications), while in other countries sugarcane plantations have been downsized or closed down all together.
- Increased interest in bio-energy development in the LAC region by a host of organizations. This includes bilateral organizations such as the US Department of State, the US Department of Defense (DOD), and the US Export-Import Bank (Eximbank); multilateral organizations such as the World Bank and the Inter-American Development Bank (IADB); private companies; international financial institutions, investors and others. The IADB, for example, recently initiated a bio-fuels program/carbon financing initiative in three Caribbean countries (Barbados, Guyana, and Jamaica) and this will eventually become part of a broader bio-energy action plan for the region.
- Opportunities for increasing the productivity and economic viability of the bio-energy industry through carbon credits.
- Interest by CAR/CA countries to reduce energy security vulnerability through the increased development and utilization of locally available energy resources, such as agricultural, waste, and other feedstocks that could support development of a domestic bio-energy industry.

MEETING ENERGY NEEDS AT HOME

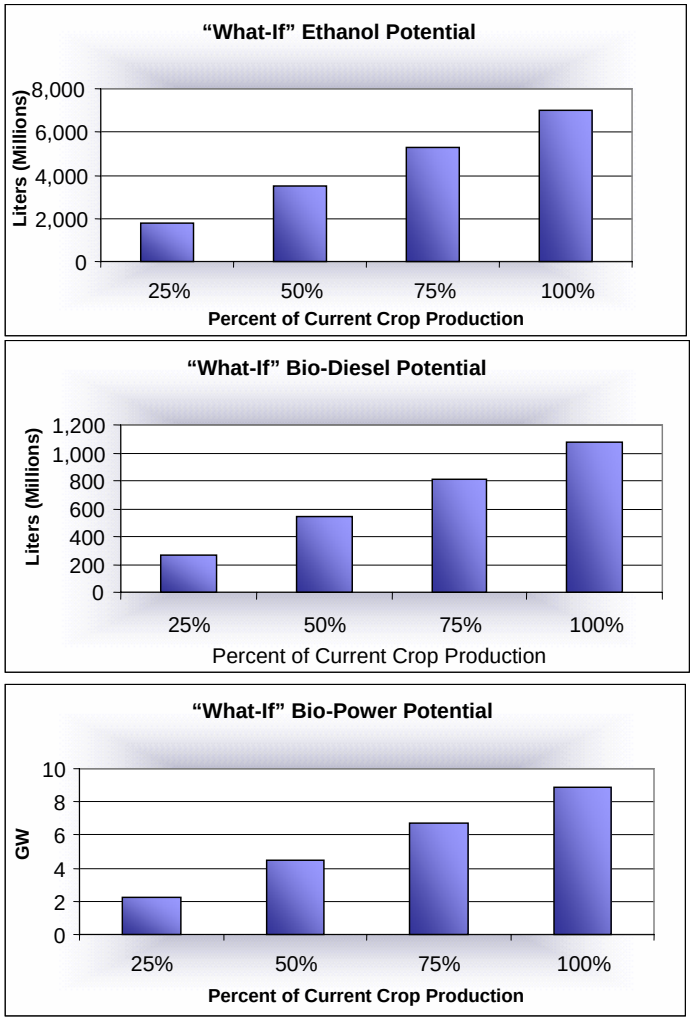
Following up on the last point above, agriculture has been central to the development of many of the CAR/CA economies, with sugar playing a central role in some of the countries. The prevalence of agricultural products in these countries represents a potentially important opportunity for production of modern bio-energy. Near-term possibilities include bio-power generation from agricultural waste and bio-diesel production. Bagasse-based cogeneration is already widely used in the sugar industry, and upgrading of the cogeneration facilities (e.g., introduction of high-pressure boilers and high-efficiency turbines) can provide additional electricity for local power grids. In addition, there is abundant feedstock that could support the production of bio-ethanol, replace some domestic petroleum consumption, and/or be exported to other markets. While the price of bio-ethanol produced from sugar in the Caribbean and Central America is unlikely to be as low as ethanol from Brazil, the special tariff-free provisions for export of ethanol and other agricultural products from CARICOM countries to the US provide a competitive opportunity for exports if their value exceeds the value of displaced petroleum. Key agricultural crops for bio-energy vary by country and include castor bean, coconut, coffee, cottonseed, palm kernels, sugarcane, and wood products. Many of these crops generate waste as a by-product that can be used for combined heat and power, and there is substantial potential for production of crops for energy purposes.

"WHAT-IF" SCENARIOS

What if there was sufficient clean energy investment in the CAR/CA regions to reduce dependence on fossil fuels through conversion of agricultural waste and crops to energy? What if the policy and regulatory environments were reformed in such a way that these developments were made attractive? What if there was an informed population and a capable workforce ready to support business enterprises in bio-energy?

Figure 1 illustrates "what-if" estimates based on the current production of key bio-energy crops in the countries addressed in this report. The "what if" considerations in this report look only at the basic resource potential. While we address the overriding economic and policy trends in each of the subject countries, the linking of the "what-if" resource potential with the realities of the individual or regional country markets was beyond the scope of this study and is recommended for follow on.

Figure 1. "What-If" Bio-Energy Estimates



The "what if" resource potential suggests that the CAR/CA countries studied could produce up to 7,024 million liters of ethanol, 1,080 million liters of bio-diesel, and 8.9 gigawatts (GW) of bio-power. (Currently, there is about 21.9 GW of installed electricity generating capacity in the target CAR/CA countries as shown in totals presented in Table 1). This assumes that 100% of current feedstock is converted to energy and that it makes economic sense to do so. It should be noted that this represents the physical upper limit for the potential for bio-energy production in the CAR/CA countries studied. While the practical development of the biofuels potential for the regions will be well below these limits, the present level of biofuels harnessed is small. By coupling significant scale-up of bio-energy production with increased energy efficiency in the region, bio-energy could provide a strategically important portion of the total energy needs of many of the nations in CAR/CA.

These charts also show the amounts of bio-energy that could be produced based on varying percentages of current crop production. For example, if 50% of ethanol biomass crops are converted to energy, then the "what-if" ethanol potential would fall to 3,512 million liters of ethanol. Table 2 summarizes the distribution of "what-if" bio-energy potential by crop, country, and fuel type. For example, in the case of Barbados, 99.7% of the ethanol potential would be satisfied by sugar while 100% of the bio-diesel potential would be sourced from coconuts.

The majority of ethanol potential is from sugarcane (nearly 83%). Within each region, sugar is the largest feedstock in terms of potential; however, in the CA region corn represents a quarter of the ethanol potential.

Table 1. Installed Capacity for Electric Power Generation (GW)

Country	Conventional (Thermal)	Hydroelectric	Other Renewables	Total
Antigua and Barbuda	0.027	-	-	0.027
Bahamas	0.401	-	-	0.401
Barbados	0.210	-	-	0.210
Cuba	3.901	0.057	0.0004	3.959
Dominican Republic	4.184	0.542	0.804	5.530
Grenada	0.032	-	-	0.032
Haiti	0.181	0.063	-	0.244
Jamaica	1.325	0.024	0.120	1.469
St. Kitts and Nevis	0.020	-	-	0.020
St. Lucia	0.057	-	-	0.057
St. Vincent/Grenadines	0.018	0.006	-	0.024
Trinidad and Tobago	1.416	-	-	1.416
CAR - Total	**11.772**	**0.692**	**0.924**	**13.388**
Belize	0.027	0.025	-	0.052
Costa Rica	0.396	1.296	0.248	1.939
El Salvador	0.515	0.442	0.262	1.219
Guatemala	1.353	0.627	0.029	2.009
Honduras	0.578	0.466	-	1.044
Nicaragua	0.511	0.104	0.078	0.693
Panama	0.491	0.833	0.231	1.555
CA - Average	**3.870**	**3.793**	**0.848**	**8.511**
CAR/CA Total	**15.64**	**4.49**	**1.77**	**21.90**

Source: Energy Information Administration, *International Energy Annual 2004*

Table 2. Percent of Bio-Energy Potential by Crop and Fuel

Country	Ethanol			Bio-Diesel					Bio-Power				
	Sugar	Corn	Sorghum	Coconut	Cottonseed	Palm Kernels	Sesame	Soy	Sugarcane	Rice	Coffee	Coconut	Wood
Antigua and Barbuda	-	100.0	-	-	100.0	-	-	-	-	-	-	-	-
Bahamas	97.1	2.9	-	-	-	-	-	-	52.0	-	-	-	48.0
Barbados	99.7	0.3	-	100.0	-	-	-	-	95.0	-	-	1.1	4.0
Cuba	92.8	7.2	0.0	100.0	-	-	-	-	65.5	4.2	0.1	0.7	29.4
Dominican Republic	96.9	3.1	0.0	63.1	-	36.9	-	-	57.6	19.0	1.5	4.2	17.6
Grenada	83.6	16.4	-	99.4	0.6	-	-	-	33.0	-	-	67.0	-
Haiti	55.7	43.5	0.8	70.1	2.7	-	27.1	-	13.1	3.9	1.0	0.7	81.4
Jamaica	99.8	0.2	-	100.0	-	-	-	-	41.5	0.0	0.1	7.6	50.8
St. Kitts and Nevis	100.0	-	-	99.5	0.5	-	-	-	98.8	-	-	1.2	-
St. Lucia	-	-	-	100.0	-	-	-	-	-	-	-	100.0	-
St. Vincent/Grenadines	85.5	14.5	-	100.0	-	-	-	-	74.4	-	2.0	23.7	-
Trinidad and Tobago	97.6	2.4	-	100.0	-	-	-	-	65.1	1.1	0.2	4.5	29.1
CAR - Average	**92.0**	**7.9**	**0.0**	**83.6**	**0.3**	**13.8**	**2.3**	**-**	**55.4**	**6.1**	**0.4**	**2.0**	**36.1**
Belize	88.9	11.1	0.0	91.0	-	-	-	9.0	65.6	1.9	0.0	0.1	32.3
Costa Rica	98.5	1.5	0.0	3.0	0.02	96.9	0.0	-	18.6	3.8	1.7	0.2	75.6
El Salvador	63.4	36.5	0.1	89.3	2.6	-	6.4	1.7	25.8	0.4	1.1	1.2	71.5
Guatemala	78.1	21.8	0.0	16.4	0.2	60.4	20.7	2.2	26.5	0.2	0.9	0.1	72.3
Honduras	66.2	33.8	0.0	1.8	0.1	97.6	0.4	0.1	13.5	0.1	0.7	0.1	85.6
Nicaragua	65.9	34.1	0.1	10.3	1.5	45.7	37.9	4.6	17.5	3.2	0.7	0.1	78.6
Panama	81.5	18.5	0.0	24.2	-	75.1	0.6	0.1	24.7	15.1	0.4	0.5	59.3
CA - Average	**74.6**	**25.3**	**0.0**	**9.1**	**0.2**	**84.2**	**5.8**	**0.7**	**22.1**	**1.6**	**0.9**	**0.3**	**75.1**

There are two key crops for bio-diesel, depending on the region. In the CAR region, coconut represents about 84% of the total "what-if" potential. In the CA region, palm kernels represent the largest biomass input (also at 84% of the regional total). A similar split is seen in terms of bio-power. The CAR region's "what-if" potential for bio-power is comprised of sugarcane (55%) and wood products (36%). Conversely, in the CA region wood products represent 75% of the bio-power potential while sugarcane represents only 22% of the total.

In addition to bio-energy, CAR/CA nations also have strong potential for, and growing experience with, other renewable energy applications including solar hot water, solar photovoltaics, wind, hydropower, and geothermal. The suitability of technologies varies from location to location, but almost all nations could further utilize solar hot water systems and most could employ more effective use of solar photovoltaic systems. Wind energy has been used historically in islands such as Barbados for sugarcane processing, although there is only one modern wind electric power plant in the Caribbean—the Wigton 21 MW facility in Jamaica. Costa Rica, the first Latin American country to pursue grid-connected wind electric power on a commercial utility scale, has some 71 MW of installed wind electric power. Several Caribbean countries covered in this report—Cuba, Dominican Republic, Jamaica, and Haiti—use hydropower for significant portions of their power generation, while others have a largely untapped hydropower potential. Finally, many of the CAR/CA countries have established geothermal power generation or are actively pursuing this opportunity. Those with

installed capacity include Costa Rica, Nicaragua, Guatemala, and El Salvador. Those exploring geothermal are Honduras, St. Lucia, St. Kitts and Nevis, Dominica, and St. Vincent/Grenadines.

While the ultimate mix of clean energy alternatives will be dependent on economic, political, and other factors, the technologies and resources exist today for countries in the CAR/CA regions to increase their energy independence and reduce greenhouse gas emissions (GHG).

KEY FINDINGS AND RECOMMENDATIONS

This study provides a key first step toward analyzing and understanding the potential of bio-energy in the Caribbean and Central America. Currently, there is a relatively large supply of agricultural, waste, and other feedstocks in the CAR/CA regions that could be used to produce bio-energy for transportation and power needs. Likewise, there is considerable experience in the utilization of biomass feedstocks (especially sugarcane and wood waste) for energy production, including electricity and steam heat. This is particularly true among CA countries, but there is also experience in this regard in Jamaica and Barbados. Further, there are pioneer biofuel businesses throughout both CAR and CA that will lay the groundwork for growth of opportunities in this area.

While this study lays the groundwork for this type of evaluation by examining a range of possible "what-if" supply-side potentials, there are other areas that should be explored. The full cost of converting these crops into bio-energy needs to be evaluated to determine the economic impact of using varying amounts of crops as biomass inputs. For example, the tradeoffs between using a crop for energy rather than food production need to be quantified and evaluated. Further, the analysis of potential bio-energy production should include domestic and export markets.

The fact that there is significant interest in developing the potential for bio-energy production in CAR/CA suggests the need for a *flexible analytic decision support framework* to evaluate bio-energy market potential in terms of economic and technical feasibility for top candidate countries. This capability would benefit energy resource planning and prioritization, investment and development strategies, and other policy decisions at both the country and regional levels. It would also enable decision makers to assess and understand the likely impacts of implementing different kinds of incentives, and assess and understand the likely impacts of reducing or eliminating impediments to bio-energy use. An important next step is to analyze what percentage of current energy requirements can be met by bio-energy as well as the potential for export surpluses that may exist by country.

Moreover, this report may serve as a tool for providing a quick overview of the economic, energy, and demographic conditions, together with specific resource data that may be used to make preliminary selections of countries or sub-regions where further investigations are warranted. Using these tools it will be important to follow up with work at the country level, in cooperation with key decision makers, to conduct detailed financial and economic analyses of bio-energy in the country at a programmatic level, compare results with costs incurred in the country, identify project opportunities, determine appropriate policy interventions, identify potential funders, and incorporate this into a *comprehensive national bio-energy program.* As noted above, there are several organizations already engaged and/or interested in supporting bio-energy activities in CAR/CA.

Finally, *UNF should explore partnerships* with these interested organizations to complement and expand the work it is doing in the bio-fuels area. For example, IADB recently launched a $20 million fund to support infrastructure project preparation that includes bio-energy and other renewables; this could be a possible source of funding for follow up pre-feasibility and feasibility studies.

REMAINDER OF REPORT

The remainder of this report is organized as follows. Chapter 2 provides the methodology for data collection and analysis, including data sources used in the study. Chapter 3 provides geographic, demographic, energy, and bio-energy information for the CAR/CA countries studied. Chapter 4 provides statistical data, organized by country for each of the CAR/CA countries.

2. METHODOLOGY

APPROACH FOR CALCULATING BIO-ENERGY POTENTIAL

Approach Overview

In this report, the theoretical or "what-if" bio-energy potential estimates are derived based on two factors: 1) an assumed percentage of currently available crops; and 2) a conversion factor (from agricultural feedstock to energy) which differs depending on the type of energy produced and crops discussed. The potential for bio-power, ethanol, and bio-diesel was calculated based on available crop resources. Crop resources data are provided on both a weight (tonnes) and land under cultivation (hectares) basis. The steps and factors used to convert the available crop resources to the desired output measurement (e.g., kW) are described below.

Ethanol Potential Approach

For ethanol production, the factors used (per crop type) to convert to liters per year, are:

- Corn: 373 liters of ethanol per tonne of corn[1]
- Sorghum: 9 liters of ethanol per tonne of sorghum[2]
- Sugarcane: 79 liters of ethanol per tonne of sugarcane[3]

The 'liters of ethanol per crop' factor is then multiplied by the tonnes of crop (e.g., corn) produced by each country, which results in the "what-if" ethanol potential at 100% of current crop production. "What-if" ethanol potential calculations are also made for 75%, 50%, and 25% of crop production. The equation to calculate ethanol potential in liters is:

Tonnes of biomass input (e.g. corn) x liters of ethanol per tonne

Bio-diesel Potential Approach

For bio-diesel production the factors used[4] to convert to liters per year are:

- Cottonseed: 218 liters of bio-diesel per hectare of cottonseed
- Coconut: 2,151 liters of bio-diesel per hectare of coconut
- Palm Kernels: 4,760 liters of bio-diesel per hectare of palm kernels
- Sesame Seeds: 557 liters of bio-diesel per hectare of sesame seeds
- Soybeans: 300 liters of bio-diesel per hectare of soybeans

The factors are then input into the following formula to estimate the amount of "what-if" bio-diesel at 100%, 75%, 50%, and 25% of crop conversion. The equation to calculate bio-diesel potential in liters is:

Area under production (in hectares) x liters of oil (e.g., cottonseed) per hectare

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[1] Fulton et al, "Biofuels for Transport: An International Perspective." International Energy Agency.
[2] Ibid. Fulton et al.
[3] "Biomass Energy Systems Assessment Saint Kitts and Nevis" (Forthcoming).
[4] Journey to Forever, "Oil Yields and Characteristics," http://www.journeytoforever.org/biodiesel_yield.html#ascend.

Bio-power Potential Approach

For bio-power generation, the input factors used to convert from tonnes of biomass input (e.g., coconut husk) to Btu are:

- 17,629,398 Btu per tonne of coconut husk[5]
- 17,155,489 Btu per tonne of coconut shell[6]
- 15,809,589 Btu per tonne of coffee husk[7]
- 12,890,312 Btu per tonne of rice husk[8]
- 11,152,192 Btu per tonne of rice straw[9]
- 5,639,512 Btu per tonne of sugarcane[10]
- 16,965,926 Btu per tonne of wood[11]

The above biomass input factors are then multiplied by the tonnes of biomass input (e.g., coconut husk) produced by each country and a load factor (Btu per hour), which results in the "what-if" bio-power potential at 100% of current biomass input production. "What-if" bio-power potential calculations are also made for 75%, 50%, and 25% of biomass input production. The equation to calculate bio-power potential in terms of kilowatts is:

$$\frac{\text{Tonnes of biomass input} \times \text{heating value (Btu per tonne of crop)} \times 948{,}800 \text{ (Btu per hour)}}{\text{Heat rate (17,000 Btu/kWh)}} = kW$$

Additional bio-power calculations were required to convert individual crop data to biomass inputs. These are outlined below.

Coconut. The "what-if" estimates of bio-power include both coconut husk and shell as biomass inputs. The raw data provided is in terms of tonnes of coconut with shell (excluding husk). It is assumed that 15% of the coconut with shell equals the amount of the shell available as a biomass input. It is assumed that the weight of the husk available as a biomass input is equal to 33.3% of the coconut with shell (excluding husk).

Coffee. The raw data used is measured in tonnes of green coffee; it is assumed that 1 tonne of green coffee (without husk) yields 1 tonne of coffee husk available as a biomass input.

Rice. The raw data used is measured in tonnes of rice paddy. It is assumed that the amount of rice husk available as biomass input represents 22% of the rice paddy weight. Additionally, it is assumed that the yield of rice straw available as a biomass input is equal to 135% the rice paddy weight.

Sugarcane and Wood. No conversion is necessary for sugarcane or wood as it assumed that the entire yield is available as a biomass input.

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[5] Samson et al, "Strategies for Enhancing Biomass Energy Utilization in the Philippines," National Renewable Energy Laboratory. NREL/SR-510-30813.
[6] Ibid, Samson et al.
[7] Ibid, Samson et al.
[8] Natarajan, Nordin, Rao, "Overview of Combustion and Gasification of Rice Husk in Fluidized Bed Reactors," *Biomass and Bioenergy* Vol 14, Nos 5 and 6.
[9] Putun, Apaydm, Putun, "Rice straw as a bio-oil source via pyrolysis and steam pyrolysis," *Energy*, Volume 29 Issues 12-15, October-December 2004.
[10] "Biomass Energy Systems Assessment Saint Kitts and Nevis" (Forthcoming).
[11] US Energy Information Administration.

DATA SOURCES

All of the biomass input data were obtained from the Food and Agriculture Organization of the United Nations (FAO)—FAOSTAT database. Other key data sources used in this report include:

- Central Intelligence Agency (CIA), *World Factbook*
- International Energy Agency (IEA), *Renewables Information 2006*
- International Energy Agency, *World Energy Outlook*
- International Monetary Fund (IMF), *International Financial Statistics*
- United Nations Development Programme, *Development Report*
- US Energy Information Administration (EIA), *International Energy Annual*
- World Bank Group, *World Development Indicators*
- World Bank Group, Private *Participation in Infrastructure Database*

3. COUNTRY PROFILES

This chapter provides information for the CAR/CA countries studied. For each country the following information is provided: country overview, energy overview, and bio-energy overview, including "what-if" scenarios.

Countries addressed include:

- Antigua and Barbuda
- Bahamas
- Barbados
- Belize
- Costa Rica
- Cuba
- Dominican Republic
- El Salvador
- Grenada
- Guatemala
- Haiti
- Honduras
- Jamaica
- Nicaragua
- Panama
- Saint Kitts and Nevis
- Saint Lucia
- Saint Vincent and the Grenadines
- Trinidad and Tobago.

ANTIGUA AND BARBUDA

COUNTRY OVERVIEW

Antigua and Barbuda at a Glance:

Population: 81,000
Human Development Index (HDI): 0.797
Electricity Access: 98-100%
GDP per capita: $10,160
Major Agricultural Crops: cotton, bananas, coconuts, sugarcane
% of Land under Cultivation: 31.8%

The country of Antigua and Barbuda consists of three islands—Antigua, Barbuda, and Redonda. The closest islands to the country are St. Kitts and Nevis, Montserrat, and Guadeloupe. Antigua is very hilly, and was formed by volcanic rock, coral, and limestone. In contrast to Antigua, Barbuda is very flat and made mostly of coral. Antigua and Barbuda have a small number of streams and rivers, but generally lack fresh groundwater for public consumption.[12]

Antigua's infrastructure and physical facilities are considered good and up to date in comparison to Barbuda, where the infrastructure is significantly less developed.[13] As a whole, the nation has a high Gross Domestic Product (GDP) per capita of $10,160, a middle-high HDI score of 0.797, and electricity access of 98-100%. Tourism is the islands' leading economic activity, making up over half the GDP; however, the islands are in a hurricane-prone location in the Caribbean, which can hinder tourism. In 2004, Antigua and Barbuda exported approximately US$20 million in goods.[14] These items included refined petroleum products (48%), manufacturing (23%), machinery and transport equipment (17%), and food products and livestock (4%). Imports in 2002 were estimated at US$692 million—mainly food products and livestock, manufactured products, chemicals, and oil.[15] One of the nation's main constraints is a shortage of water. Antigua depends on water desalination—this provides 60% of the island's daily water requirements.[16]

Agricultural production, primarily for domestic consumption, makes up 32% of the total land area. Major crops include sugarcane, coconuts, cotton, and bananas. Antigua and Barbuda have great potential and technical skill to cultivate high-quality produce competitively, but due to water shortages and an excess of imported produce, the sector is not expansive. Although the islands have low average rainfall, the main cause of reduced water supply is deforestation of land due to agricultural production of sugarcane—unhindered precipitation runoff limits the ability to maintain an adequate fresh water supply.[17] Only 11.4% of the land is now forested. Other environmental issues

[12] Microsoft Encarta Online Encyclopedia, "Antigua and Barbuda—Resources and Regions," http://encarta.msn.com/encyclopedia, October 2005.
[13] Antigua Barbuda Environment Division, http://www.environmentdivision.info/department/index.htm, 2005.
[14] Bureau of Western Hemisphere Affairs, "Background Note Antigua and Barbuda," http://www.state.gov/r/pa/ei/bgn/2336.htm, 2005.
[15] Central Intelligence Agency, "The World Factbook—Antigua and Barbuda," http://www.cia.gov/cia/publications/factbook, 2005.
[16] Ibid, Antigua Barbuda Environment Division, 2005.
[17] Ibid, Central Intelligence Agency, 2005.

encountered by Antigua and Barbuda are hurricanes and tropical storms which damage the natural environment, including surrounding marine areas.[18]

ENERGY OVERVIEW

All energy and electricity generation in Antigua and Barbuda is fossil fuel based. Petroleum is used extensively—mainly for electricity production and transportation. The dependence on imported fossil fuels makes electrical generation costs susceptible to fluctuating world oil prices. Additionally, the nation is located in a hurricane-vulnerable area of the Caribbean and depends on a structurally enhanced, hurricane-resistant model of power generation and transmission. In the past, Antigua produced sugar by wind power—indicating a good wind resource. However, recent attempts to use wind energy for electricity generation have proved less successful due to high up-front costs, lack of data on wind measurements, and low technical capacity. Antigua and Barbuda are reported to have one of the best potentials for solar energy development in the Caribbean.[19]

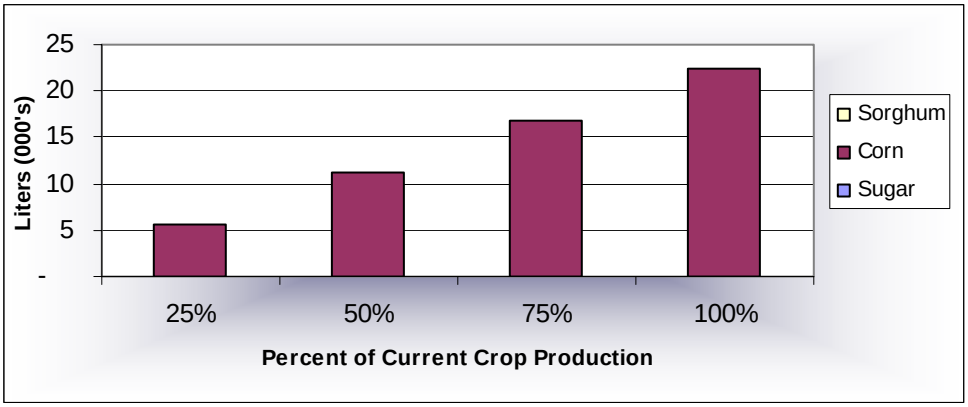
The Antigua Public Utilities Authority (APUA) is a state-owned public utility responsible for the distribution and sale of electricity in the country;[20] it is controlled by the Ministry of Works, Transportation, and the Environment. There is little by way of a national energy strategy; however, the government does have an energy conservation program that includes incentives for the manufacture and use of solar energy units.

BIOFUELS—ETHANOL AND BIO-DIESEL

Ethanol

Based on the current level of production for the biofuel crops identified, Antigua and Barbuda may be able to generate up to 22 thousand liters of ethanol. This assumes that 100% of the currently available feedstock is converted to ethanol. As shown in Chart 1, the ability to produce ethanol declines as the percentage of the feedstock used decreases. All of this ethanol is derived from corn.

Chart 1: "What-If" Ethanol Production for Antigua and Barbuda
As a Percent of Current Crop Production

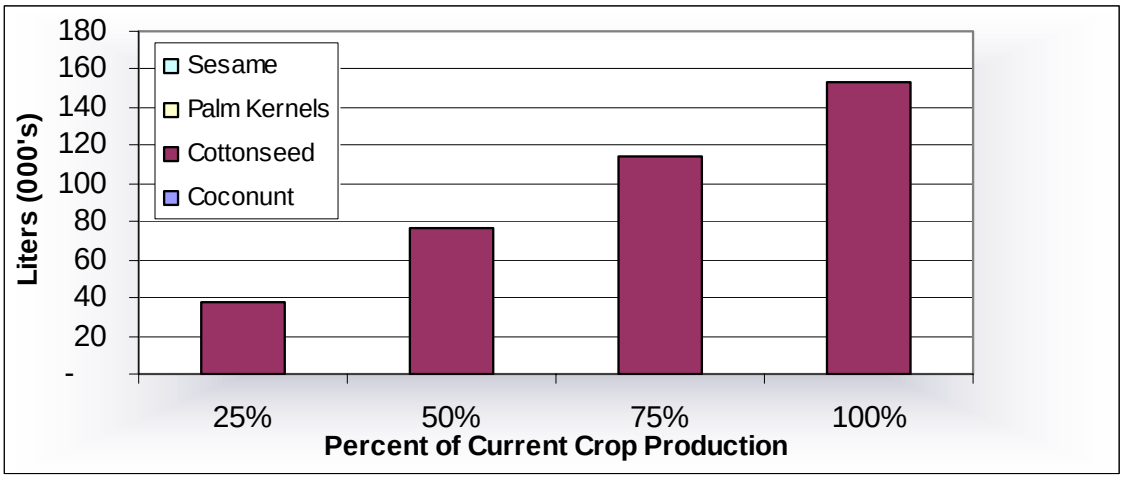


[18] Ibid, Antigua Barbuda Environment Division, 2005.
[19] Office of the Prime Minister, St. John's Antigua and Barbuda, "Antigua and Barbuda's Initial National Communication on Climate Change," http://unfccc.int/resource/docs/natc/antnc1.pdf, May 2001.
[20] Ibid, Office of the Prime Minister, 2001.

Bio-Diesel

Based on the current level of production for the biofuel crops identified, Antigua and Barbuda may be able to generate up to 153 thousand liters of bio-diesel. This assumes that 100% of the currently available feedstock is converted to bio-diesel. As shown in Chart 2, the ability to produce bio-diesel declines as the percentage of the feedstock used decreases. All of this bio-diesel is derived from cottonseed.

Chart 2: "What-If" Bio-Diesel Production for Antigua and Barbuda
As a Percent of Current Crop Production



THE BAHAMAS

COUNTRY OVERVIEW

The Bahamas at a Glance:

Population: 319,000
Human Development Index (HDI): 0.832
Electricity Access: 50-60%
GDP per capita: $14,580
Major Agricultural Crops: sugar, citrus
% of Land under Cultivation: 1.4%

The Commonwealth of the Bahamas consists of a chain of 700 islands and 2,400 cays that are located 97 kilometers (km) off the southeast coast of Florida. The Commonwealth of the Bahamas has a total land area of 10,070 square kilometers (km^2). Only 30 of the 700 islands are inhabited. The majority of the islands have low elevations and are rocky—their foundations consist of fossilized coral and limestone, and there is a multitude of both above-ground and underwater cave systems that run throughout the island chain. All the islands of the Bahamas are in close proximity to one another and do not have significant geographical variations.[21]

The economy of the Bahamas is predominately service-oriented—dependent on tourism and financial services. Although the Bahamas is considered one of the most prosperous countries of the Caribbean, the bulk of the nation's goods and services are expensive. The Bahamas has a GDP per capita of $14,580, a high HDI score of 0.832, electricity access rates of 50-60%, and a population of 319,000. The US is the largest trading partner for the Bahamas, making up more than 50% of the import and export markets.[22] Food imports make up approximately 80% of food product consumption. Besides food, additional imports include: manufactured goods (including vehicles and associated parts); consumable supplies for hotels, restaurants, and hospitals; and consumer/commercial electronics. Exports include salt, aragonite, chemicals, lobster, and some agricultural products.[23] The Bahamas is located in a hurricane zone, and has been hit numerous times in the past, resulting in destruction of infrastructure and a slowing of the tourism economy.

In 2004, agriculture and fisheries accounted for 3% of GDP, with about 1.5% from each. Only 1.4% of the land is under agricultural cultivation, and about 32% of the land remains forested. Major agricultural crops are sugar and citrus, but due to problems with citrus canker, some islands are switching to vegetable crops. Additionally, there is commercial production of sea salt on the island of Inagua,[24] and fishing in the shallow coastal waters off the islands. Some of the current environmental challenges facing the Commonwealth of the Bahamas include coral reef decay—especially coral bleaching—coastline preservation, marine eco-system conservation, salt-water intrusion, and ground water contamination.[25]

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[21] Microsoft Encarta Online Encyclopedia, "Bahamas--Resources and Regions," http://encarta.msn.com/encyclopedia_761576189/Bahamas_The.html, 2005.
[22] Bureau of Western Hemisphere Affairs, "Background Note The Bahamas," http://www.state.gov/r/pa/ei/bgn/1857.htm#econ, 2005.
[23] Ibid, Bureau of Western Hemisphere Affairs, August 2005.
[24] Economist Intelligence Unit, "Country Profile 2004 Bahamas," http://www.eiu.com, 2004.
[25] The Bahamas Environment, Science & Technology Commission, http://www.best.bs/, no date available.

ENERGY OVERVIEW

The Bahamas relies entirely on petroleum for its primary energy and electricity requirements. The country has a total installed generation capacity of 400 MW that is solely generated by the burning of fuel oil in power plants. The potential for using renewable energy to offset fuel oil has not been fully investigated; however, it is thought that there is application potential for small-scale solar and some biomass. Three proposed projects for liquefied natural gas (LNG)—re-gasification and natural gas pipelines—are underway in the Bahamas. The three pipelines would transport natural gas from the Bahamas to different locations in South Florida.[26]

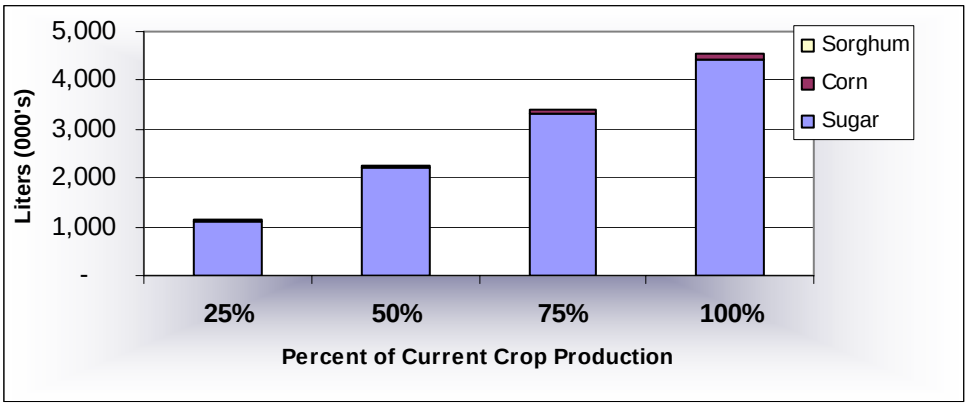
Initial policy support mechanisms for renewables have included the formal removal of import duties for solar energy equipment, yet other incentives and policy measures have yet to be established. The Government of the Bahamas has recently formed a Ministry of Energy and Environment. This body is expected to take the lead in preparing policy and institutional reforms supporting renewable energy alternatives. A first step in this regard is the preparation of a national energy policy. This is currently under development. The Bahamas Electricity Corporation (BEC) is the primary generator and provider of electricity across the Bahamian archipelago. The BEC owns and operates the generation plants and the distribution network of the island nation.

BIOFUELS—ETHANOL

Ethanol

Based on the current level of production for the biofuel crops identified, the Bahamas may be able to generate up to 4.5 million liters of ethanol. This assumes that 100% of the currently available feedstock is converted to ethanol. As shown in Chart 1, the ability to produce ethanol declines as the percentage of the feedstock used decreases. The majority of this ethanol is derived from sugar (97%), while a small amount (less than 3%) is derived from corn.

Chart 1: "What-If" Ethanol Production for the Bahamas
As a Percent of Current Crop Production

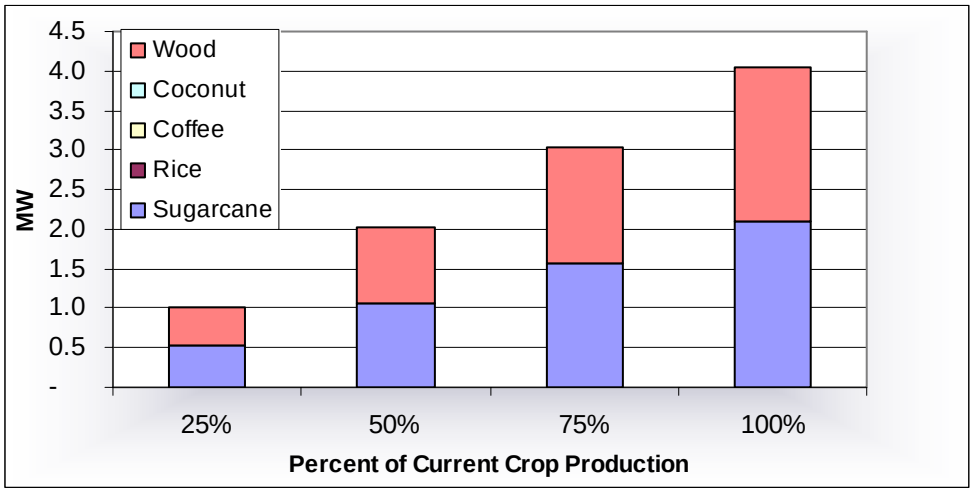


[26] Energy Information Administration, "Caribbean Fact Sheet," http://www.eia.doe.gov/emeu/cabs/carib.html, 2004.

BIO-POWER

Based on the current level of production for the bio-power crops identified, the Bahamas may be able to generate up to 4 MW of power. This assumes that 100% of current available feedstock is converted to power. As shown in Chart 2, the ability to generate power declines as the percentage of the feedstock used decreases. The majority of this power is from sugarcane (52%) and the remainder is contributed by wood products (48%).

Chart 2: "What-If" Bio-Power Production for the Bahamas As a Percent of Current Crop Production



BARBADOS

COUNTRY OVERVIEW

Barbados at a Glance:

Population: 269,000
Human Development Index (HDI): 0.878
Electricity Access: >90%
GDP per capita: $9,430
Major Agricultural Crops: sugarcane, cotton
% of Land under Cultivation: 44.2%

Barbados, an island nation in the West Indies, is the easternmost island of the Caribbean. It has flat coasts with a hilly interior and is surrounded by coral reefs, indicative of the fact that five-sixths of the island has a geologic base of coral. Barbados has a total land area of 431 km^2. The country lies 480 km north of Guyana, 160 km east of St. Vincent, and 965 km southeast of Puerto Rico.[27]

Barbados is an independent nation within the British Commonwealth, and is a stable democracy. Its population has the lowest rate of poverty in the Caribbean region, and in these terms the country ranks favorably compared to other nations of the region.[28] Barbados has a GDP per capita of $9,430, a high HDI score of 0.878, electricity access of over 90%,[29] and a population of 269,000. Barbados has shifted its GDP composition from exports of sugarcane and other agricultural products to services and tourism. Tourism was the leading industry for GDP growth in 2004;[30] in 2000, it was estimated that services accounted for approximately 78% of exchange earnings, mostly comprised of offshore finance activities, light manufacturing, and tourism-based services.[31] The sugar industry, although declining in the export earnings composition, still remains one of the largest sources for employment.[32] The major import partner for Barbados is the United States (42%),[33] and export destinations include the US (18.7%), Trinidad and Tobago (14.7%), the United Kingdom (14.2%), and Jamaica (8%).[34] Infrastructure is fairly well developed within Barbados.

Just over 44% of the country is under agricultural cultivation, and 11.6% remains forested. Sugarcane, used historically to make rum, is the major crop; other crops include cotton and assorted vegetables. Nearly all the population has access to fresh water. However, diminishing resources are becoming apparent and indeed, Barbados has one of the lowest levels of freshwater resources per capita. Water availability is also constricted by droughts, which limit the amount of water that can be used for agricultural activities. Despite its small area, the island does suffer from some serious environmental problems such as polluted coastal waters from the waste of passenger and cargo ships, soil erosion, and illegal solid waste dumping—all of which threaten the island's aquifers.[35]

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[27] Central Intelligence Agency, "The World Fact Book—Barbados," http://www.cia.gov/cia/publications/factbook/geos/bb.html, 2005.
[28] International Monetary Fund, "IMF Executive Board Concludes 2005 Article IV Consultation with Barbados," http://www.imf.org/external/np/sec/pn/2005/pn05115.htm, August 2005.
[29] Pan American Health Organization, http://www.paho.org/English/DD/AIS/cp_052.htm.
[30] Economist Intelligence Unit, "Country Profile Barbados," http://www.eiu.com, 2005.
[31] Ibid, Central Intelligence Agency, 2005.
[32] Ibid, Economist Intelligence Unit, 2005.
[33] Bureau of Western Hemisphere Affairs, "Background Notes Barbados," http://www.state.gov/r/pa/ei/bgn/26507.htm, 2004.
[34] Ibid, Central Intelligence Agency, 2005.
[35] Ibid, Central Intelligence Agency, 2005.

ENERGY OVERVIEW

Fossil fuels (natural gas and oil) are the main source of energy (both overall and for electricity) in Barbados. The energy import bill in 2006 is conservatively estimated at US$200 million, which accounts for some 12.5% of total imports and 6.7% of the GDP. Only three Caribbean countries have oil and natural gas reserves—Barbados, Cuba, and Trinidad and Tobago. Of these, Trinidad and Tobago is the only significant producer.[36] In addition, Trinidad refines oil from Barbados, which is then imported back into the country for domestic consumption.[37] In Barbados, domestic oil production estimates in 2002 were equivalent to approximately 20% of domestic consumption, and the state-owned Barbados National Oil Corporation is currently exploring onshore locations that are expected to increase production and decrease petroleum import demand. Barbados produces limited amounts of natural gas to meet the current domestic demand, but expects to begin importing natural gas or find alternatives to meet future demand from power generation, households, and the tourism industry.[38] The possibility of importing natural gas from Trinidad via an undersea pipeline is now being explored.

The electric utility in Barbados is the Barbados Light and Power Company Limited (BL&P); regulatory oversight of the energy sector is the responsibility of the Ministry of Energy and Public Utilities. With the smallest national oil and gas production sector in the Western Hemisphere, the BL&P is investigating research into non–fossil-fuel sources of energy such as wind, solar, bagasse, and waste-to-energy technologies.[39] Specifically, the BL&P is planning to build a wind farm to reduce the need for imported fuel;[40] currently, installed solar water heaters save the country over US$22 million in energy costs;[41] and a study is underway to develop an industrial base for the production of ethanol from sugarcane as well as the utilization of sugarcane bagasse.[42]

With over 32,000 households using solar hot water heaters in Barbados, the country has one of the highest utilization rates in the world (35% of all homes). This was realized as a result of the focused efforts of the government at seeding the solar manufacturing industry and incentivizing the use of such systems. This commitment was launched in 1974 with the Fiscal Incentive Act of 1974. It offered: (1) support for manufacturing; (2) a consumption tax on electric water heaters (30%); and (3) deductions on personal income tax expenditures for residential customers.

Given the crucial role that policy may play in catalyzing renewable energy opportunities, the government of Barbados is now planning to restructure its sugar industry by early 2009 and to include production of ethanol for fuel (E10). The goal is eventually to replace 10% of all the gasoline with ethanol through blending. This was acknowledged in the Barbados Adaptation Strategy, and prompted in large response the reduction in EU sugar supports by 2009. The Minister of Agriculture has indicated that Barbados will continue to produce sugar, but the focus will be on a sugarcane industry rather than a sugar industry. The country will move away from the export of bulk sugar to the EU market and toward producing special sugars, pharmaceuticals, electricity from bagasse

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[36] Energy Information Administration, "Barbados: Country Brief Analysis," http://www.eia.doe.gov/emeu/cabs/carib.html, July 2004.
[37] Economist Intelligence Unit, "Country Profile Barbados," http://www.eiu.com, 2005.
[38] Ibid, Energy Information Administration, 2004.
[39] Barbados Government Information Center, "Barbados Government Directory," http://www.barbados.gov.bb/contactus.htm, January 2005.
[40] The Daily Nation (USA), "Lamberts St Lucy Reports," http://dialogpro.dialog.com, January 29, 2003.
[41] Caribbean Update (USA), "Wind Farm," http://dialogpro.dialog.com, March 2003.
[42] Business Wire (USA), "Tekron Inc. and Vydexa Industrials corporation Engaged by Barbados Sugar Industries Ltd. to Restructure and Develop the island's Sugarcane Industry," http://dialogpro.dialog.com, August 2004.

cogeneration, and ethanol. The Barbados government has recently warned (August 2006) that unless the island nation restructures its sugar industry quickly, it could lose in excess of BD$100 million (US$50 million) in direct foreign exchange earnings over the next eight years. According to the Barbados Adaptation Strategy,[43] the viability of a restructured sugarcane industry emanates from a reliance on multiple products rather than the traditional bulk raw sugar, and a focus on domestic needs rather than traditional preferential arrangements for primary products. The outputs from a restructured sugarcane industry would include electricity, ethanol, refined sugar, branded specialty sugars, molasses, and a provision for the exploration of additional commercially viable business options from sugarcane. The plan calls for the production of 14 million liters of bio-ethanol from sugar, with the potential for 20 million liters.

Also, the government is examining the potential for initiating production of ethanol from existing factories as opposed to importing it from other sources. As regards the latter, discussions have been ongoing with sources from Trinidad and Tobago, and Brazil. An Implementation Committee comprising industry stakeholders is expected to draft a plan of action for the industry. To enable this project to move forward, a number of activities are to take place, including:[44]

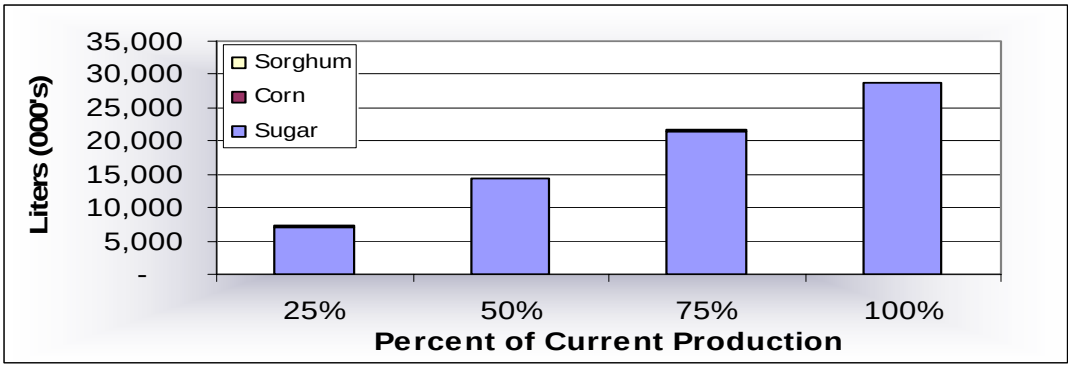
- The identification of a site for the new factory;
- Environmental impact assessments;
- Town and country Planning;
- Research on fuel cane (to included engagement of farmers).

BIOFUELS—ETHANOL AND BIO-DIESEL

Ethanol

Based on the current level of production for the biofuel crops identified, Barbados may be able to generate up to 29 million liters of ethanol. This assumes that 100% of current available feedstock is converted to ethanol. As shown in Chart 1, the ability to produce ethanol declines as the percentage of the feedstock used decreases. The majority of this ethanol is derived from sugar, while a small amount (less than 1%) is from corn.

Chart 1: "What-If" Ethanol Production for Barbados
As Percent of Current Production



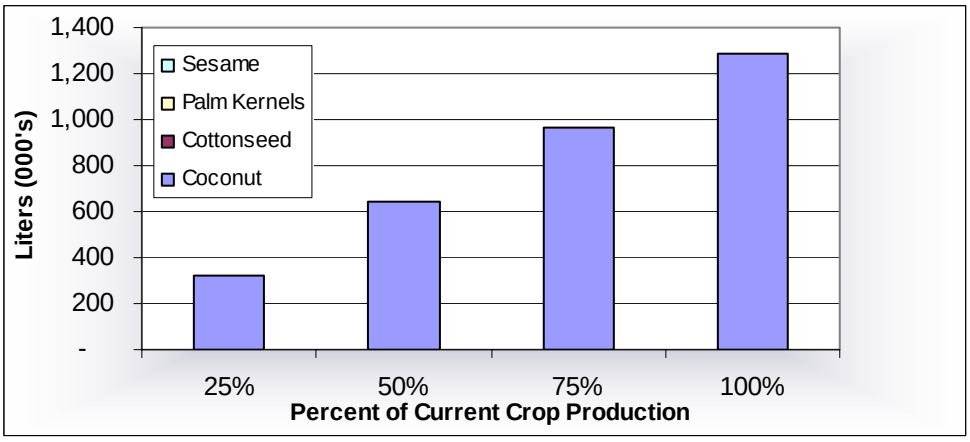
[43] Government of Barbados, "Barbados Adaptation Strategy," April 2006.

[44] Caribbean Energy Information Services (CEIS), "Caribbean Energy News Highlights," http://www.comnet.mt/ceis/news.htm.

Bio-Diesel

Based on the current level of production for the biofuel crops identified, Barbados may be able to produce up to 1.3 million liters of bio-diesel. This assumes that 100% of the currently available feedstock is converted to bio-diesel. As shown in Chart 2, the ability to produce bio-diesel declines as the percentage of the feedstock used decreases. All of this bio-diesel is derived from coconut.

Chart 2: "What-If" Bio-Diesel Production for Barbados As Percent of Current Production

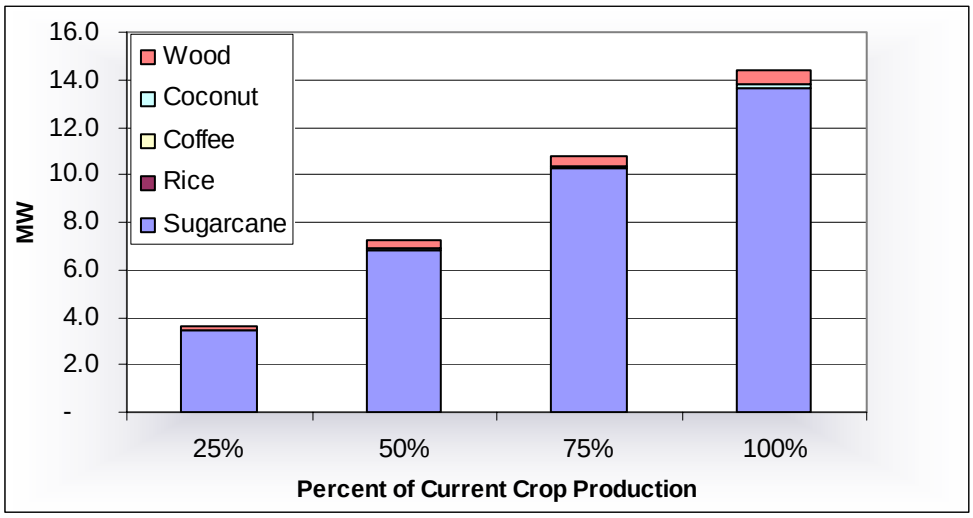


BIO-POWER

Based on the current level of production for the bio-power crops identified, Barbados may be able to generate up to 14 MW of power. This assumes that 100% of the currently available feedstock is converted to power. As shown in Chart 3, the ability to generate power declines as the percentage of the feedstock used decreases. The majority of this power (almost 95%) is from sugarcane, while the remainder comes from wood products (4%) and coconut (1%).

Varieties of sugarcane especially well suited for fuel for cogeneration will be planted and used for power per a new plan under development by the sugar industry. Importantly, fuel cane can be grown during the regular sugarcane's off-season—June to January—ensuring a year-round supply. Furthermore, a field of fuel cane can be harvested and re-grown almost twice as often as ordinary sugarcane before needing to be replanted. Thus it is cheaper for farmers to grow, and brings significant economic benefits.

Chart 3: "What-If" Bio-Power Production for Barbados
As Percent of Current Production



BELIZE

COUNTRY OVERVIEW

Belize at a Glance:

Population: 260,000
Human Development Index (HDI): 0.753
Electricity Access: 90%
GDP per capita: $3,770
Major Agricultural Crops: sugarcane, soybeans, bananas, citrus
% of Land under Cultivation: 6.7%

Belize is located in the northern boundary of Central America with Mexico to the north, Guatemala to the southwest, and the Caribbean Sea to the east. Belize has an area of 22,960 km^2 and boasts the second largest barrier reef in the world. It has protected areas of coral reef and tropical rainforests. Two major rivers, the Hondo and Sarstoon, define most of its northern and southern boundaries, and topographical features divide Belize into two main regions—the Southern Mountain and the Northern Lowland regions.[45]

The economy of Belize is based primarily on tourism and agriculture. With its extensive natural resources, the country has been able to create a strong tourism industry. The overall economy, however, is constrained by an imbalance of trade. In July 2004, the external debt was US$963.5 million.[46]

Compared to the rest of Central America, Belize is fairly developed. It has a small population of 260,000, a GDP per capita of $3,770, a medium-high HDI score of 0.753, and 90% of the country has access to electricity.[47] The economy is focused on the services sector with particular emphasis on tourism, which receives substantial foreign direct investment (FDI) from the US. In addition to the services sector, the economy of Belize benefits from manufacturing and agriculture, and exports goods such as sugar, bananas, clothing, and wood to the US (30.7%) and the UK (25.1%). Imports include manufactured goods, fuel, and food from the US, Mexico, Russia, and Cuba.[48] Although the government is stable, Belize continues to have border disputes with Guatemala. Additionally, Belize has problems with crime and its role as a trans-shipment point for illegal narcotics going to the US and Europe. It also suffers from a lack of infrastructure, which hinders development progress.[49]

Only a small percentage of the country's land is used for agriculture (6.7%), while the remainder is forested (92%). Major crops are sugarcane, soybeans, bananas, and citrus as well as wood products and some seafood. Although much of the country is forested, deforestation in rainforest areas poses a major environmental issue. Deforestation occurs primarily due to logging operations. Belize's conservation record is strong, however, with parks, wildlife sanctuaries, and nature reserves constituting roughly 36% of the country.[50]

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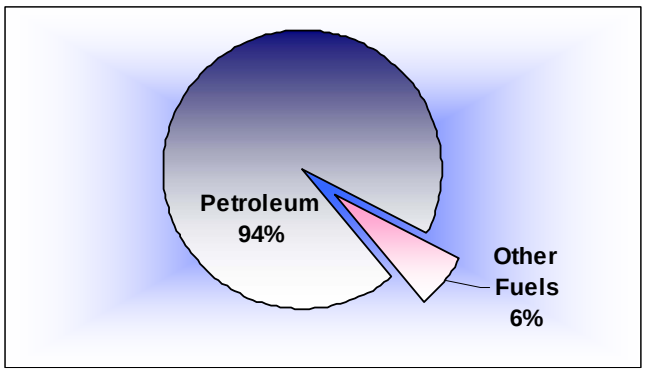
[45] Country Studies—Belize, http://countrystudies.us/belize, 2004.
[46] Economist Intelligence Unit, "Country Report Belize," http://db.eiu.com, November 2004.
[47] Government of Belize, *Formulation of National Energy Plan for Belize*, United Nations Development Programme, September 2002.
[48] Central Intelligence Agency, "The World Factbook—Belize," http://www.cia.gov/cia/publications/factbook/geos/bh.html, 2004.
[49] Colegio Inter Americano de Defensa, "Country Study Belize," http://library.jid.org/en/country%20studies/belize.doc#_Toc58329467, December 2003.
[50] Beltsky, Les, "Environmental Threats and Conservation," http://www.planeta.com/planeta/99/0499belize1.html, 1999.

ENERGY OVERVIEW

Belize was the smallest oil consumer in Central America in 2004,[51] but continues to be a net importer of crude oil and petroleum products from Mexico and Venezuela through the San Jose Pact and Caracas Energy Agreement.[52] Belize's energy and electricity supplies rely mainly on fossil fuel and hydroelectricity (see Chart 1). However, Belize is looking to expand its power generation capacity of hydroelectricity and other renewable energy sources. The country is making efforts to use biomass for the production of electricity—sugarcane being the main source of biomass in the country.[53] It is also working to increase the use of wind and solar energy and has installed some small-scale projects.[54]

Chart 1: Total Primary Energy Consumption (318 KTOE)



Belize Electricity Limited (BEL) is the main generator, distributor, and transmitter of electricity in the country. Belize receives about 54% of its electricity from the Federal Electrical Commission (CFE), Mexico's national power company, and from the Belize Electricity Company Limited (BECOL), which sells all the power generated from Belize's only operating dam, the Mollejon hydroelectric facility.[55] Belize is looking to expand its hydropower generation to reduce dependence on imported petroleum. To accomplish this, the government created a National Energy Plan in 2004 (funded by UNDP in conjunction with the Government of Belize and the Public Utilities Commission) to promote the use of sustainable energy technologies and practices.[56] However, Belize does not have a formally stated electricity sector strategy or policy which has served as an impediment to the expanded use of renewable energy alternatives.[57]

BIOFUELS—ETHANOL AND BIO-DIESEL

Ethanol

Based on the current level of production for the biofuel crops identified, Belize may be able to generate up to 103 million liters of ethanol. This assumes that 100% of the currently available feedstock is converted to ethanol. As shown in Chart 2, the ability to produce ethanol declines as the percentage of the feedstock used decreases. The majority of this ethanol is derived from sugar (nearly 89%), with the remainder coming from corn (nearly 11%) and, to a small extent, from sorghum (less than 1%).

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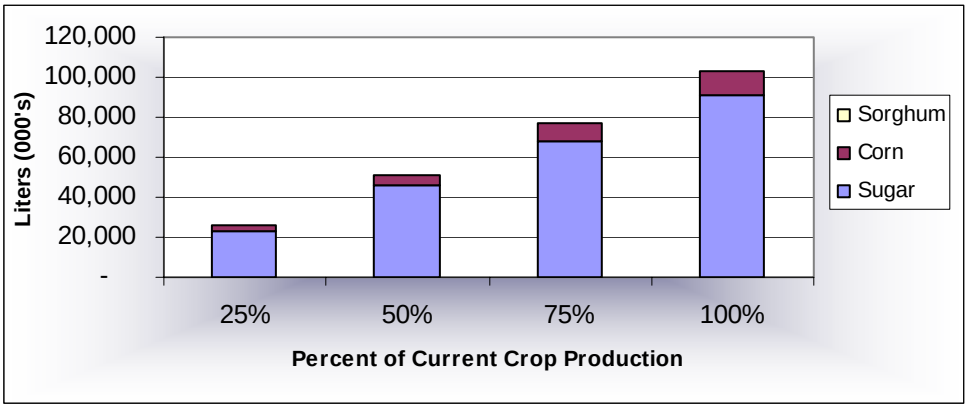
[51] Energy Information Administration, "Country Analysis Brief Central America," http://www.eia.doe.gov/emeu/cabs/centam.html, September 2004.
[52] El Nacional (Mexico), "Government revalidates San Jose energy agreement," August 2003.
[53] Ministry of Natural Resources and the Environment, Commerce and Industry, "National Assessment Report," http://www.mnrei.gov.bz/dbfiles/1Final%20BPOA%20website.pdf, September 2003.
[54] BUN-CA, "Strengthening the capacity in renewable Energy for Central America," http://www.bun-ca.org/publicaciones/18.pdf, July 2001.
[55] Ibid, Energy Information Administration, September 2004.
[56] Public Utilities Commission, "National Energy Plan," http://www.puc.bz/nep.asp, October 12, 2004.
[57] "Energy Sector Diagnostic, Belize," http://www.conservation-strategy.org/projects/mesoamerica/infrastructure/reports/Informacio/Generacin%20Electrica/Belize%20Energy%20Sector%20Diagnostic%20Report.pdf, November 2003.

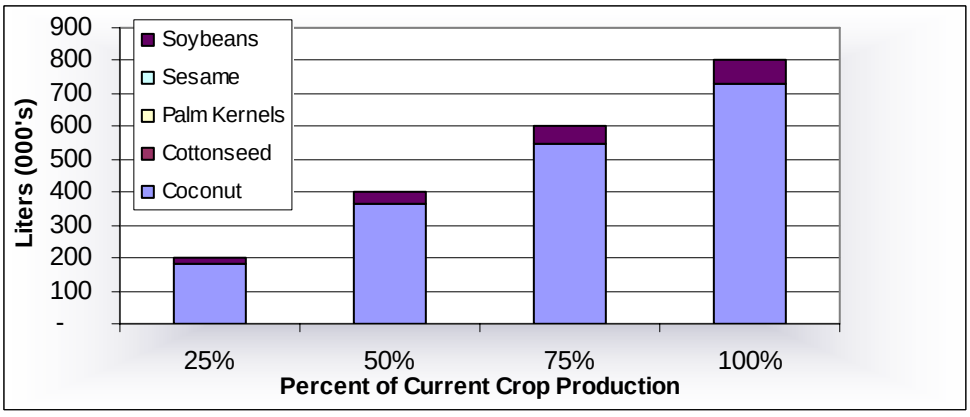
Chart 2: "What-If" Ethanol Production for Belize
As a Percent of Current Production



Bio-Diesel

Based on the current level of production for the biofuel crops identified, Belize may be able to generate up to 803 thousand liters of bio-diesel. This assumes that 100% of the currently available feedstock is converted to bio-diesel. As shown in Chart 3, the ability to produce bio-diesel declines as the percentage of the feedstock used decreases. Of this bio-diesel, 91% is derived from coconut with the remaining 9% from soy beans.

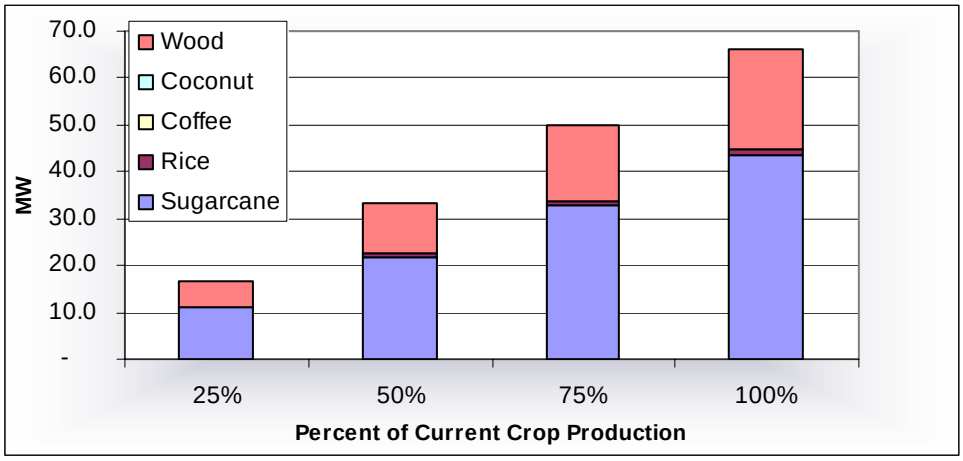
Chart 3: "What-If" Bio-Diesel Production for Belize
As a Percent of Current Production



BIO-POWER

Based on the current level of production for the bio-power crops identified, Belize may be able to generate up to 66 MW of power. This assumes that 100% of the currently available feedstock is converted to power. As shown in Chart 4, the ability to generate power declines as the percentage of the feedstock used decreases. The majority of this power is from sugarcane (66%) and wood products (32%), with rice (less than 2%), and a small percentage from some coconut and coffee making up the remainder.

Chart 4: "What-If" Bio-Power Production for Belize
As a Percent of Current Crop Production



COSTA RICA

COUNTRY OVERVIEW

Costa Rica at a Glance:

Population: 4.25 million
Human Development Index (HDI): 0.838
GDP per capita: $4,230
Electricity Access: 96%
Major Agricultural Crops: bananas, sugarcane, palm kernels
% of Land under Cultivation: 56.1%

Costa Rica, located in Central America, is bordered by Panama on the south, Nicaragua on the north, the Pacific Ocean on the west, and the Caribbean Sea on the east. It is a country with diverse geographic features spanning from active volcanoes to rainforests and coastal regions; its land area covers 51,100 km^2. Costa Rica's only large river is the San Juan, forming part of the border with Nicaragua. The three major geographic regions of Costa Rica are the Pacific Coast, the Central Highlands, and the Caribbean Lowlands.[58]

Costa Rica has one of the highest standards of living in Central America, based on a GDP per capita of $4,230, a high HDI score of 0.838, and an electricity access rate of 96%.[59] Until the 1980s, Costa Rica received significant international development assistance funding, which has now been greatly reduced due to its relatively high HDI and GDP per capita. The government is stable, and Costa Rica has good relations with its Central American neighbors as well as the US. Although Costa Rica has not yet ratified CAFTA, it has begun liberalizing trade; in 2003, bilateral trade with the US exceeded US$6 billion.[60] Costa Rica's population is just over 4.2 million, with a relatively low population growth rate. The country tends to escape the impact of natural disasters such as hurricanes, thus its infrastructure is in better condition than neighboring countries.[61]

About 56% of Costa Rica is under agricultural cultivation, and about 30% of the country remains forested. Major agricultural crops include bananas, sugarcane, palm kernels, and wood products. However, tourism—especially eco-tourism—has replaced agriculture as the largest market in a country well known for its biodiversity and its comprehensive environmental conservation efforts. In fact, 22% of the total land area is protected under the National Protected Areas Scheme.[62] Even with this protection in place, however, deforestation remains an issue, with the majority of forest cutting and burning occurring due to timber extraction, clearing for cattle pasture, crop farming, and sometimes as a way for rural residents to claim "unused" land as their own by developing it.[63]

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[58] Mega Essays, "*Costa Rica,*" http://www.megaessays.com/viewpaper/77405.html, January 4, 2005.
[59] World Bank: Private Participation in Infrastructure Database, http://ppi.worldbank.org/explore/ppi_exploreCountry.aspx?countryId=107, September 2006.
[60] Bureau of Western Hemisphere Affairs, "*Background Note Costa Rica*," http://www.state.gov/r/pa/ei/bgn/2019.htm#econ, August 2004.
[61] The Economist Intelligence Unit, "2004 Country Profile Costa Rica," http://www.economist.com, January 1, 2004.
[62] Ibid, The Economist Intelligence Unit, 2004.
[63] Beletsky Les, "*Conservation in Costa Rica*," http://www.planeta.com/planeta/98/1198cr.html, 1998.

ENERGY OVERVIEW

With large hydropower and geothermal resources, Costa Rica is the most self-sufficient country in terms of electricity in the region; however, it imports all of its crude oil (mainly from Mexico and Venezuela).[64] The Costa Rican government has been approached by companies looking to develop offshore oil, but due to environmental concerns, this has not moved forward. Costa Rica neither produces nor consumes natural gas. As shown in Chart 1, the transportation sector constitutes the highest energy demand, followed by the industry sector; as shown in Chart 2, this translates into a high demand for fossil fuels. Costa Rica also has superb wind resources at Tejona, and 71 MW of wind electric power has been developed to date.

Chart 1: Total Primary Energy Consumption by Sector (4,286 KTOE)

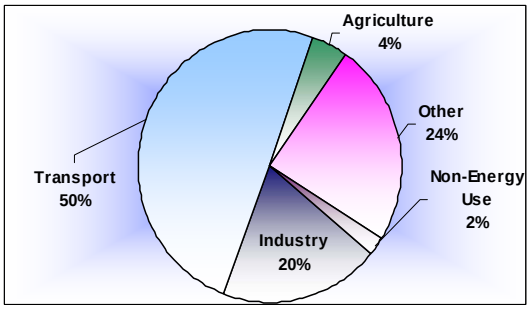
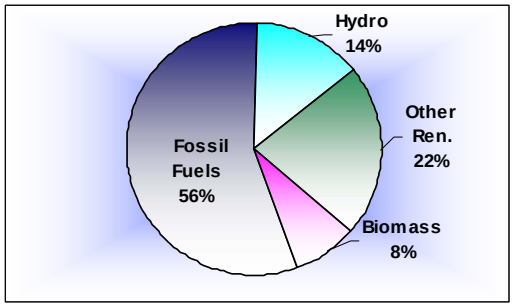
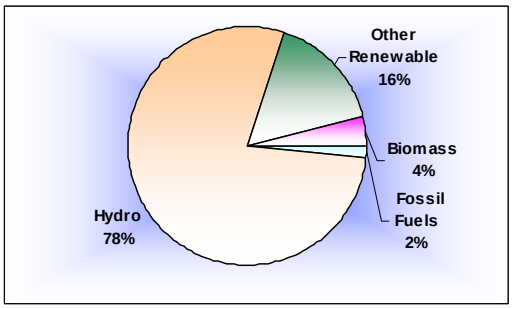


Chart 2: Total Primary Energy Consumption by Fuel (4,286 KTOE)



Costa Rica takes notable advantage of its hydropower resources for electricity production, which makes up 78% of the total electricity generation in the country (see Chart 3). The country has good biomass, solar, and wind resources as well—some of which are being utilized. (As of September 2002, Costa Rica had developed 27.7 of biomass cogeneration resources.) Costa Rica promotes the participation of the private sector (Law No. 7508) for the generation of electricity from renewable energies such as biomass, geothermal, solar, and wind resources, and is encouraging further investment in the energy sector. However, investment in energy projects has decreased in the past five years (see Chart 4).

Chart 3: Electricity Generation by Fuel Type (7,566 GWh)



[64] Gelardi, M., "Environment, Economy and Energy in Costa Rica: The Case Study of Petroleum Exploration in the Province of Limon," Macalester College, *ACM Tropical Field Research*, Minnesota, USA, 2001.

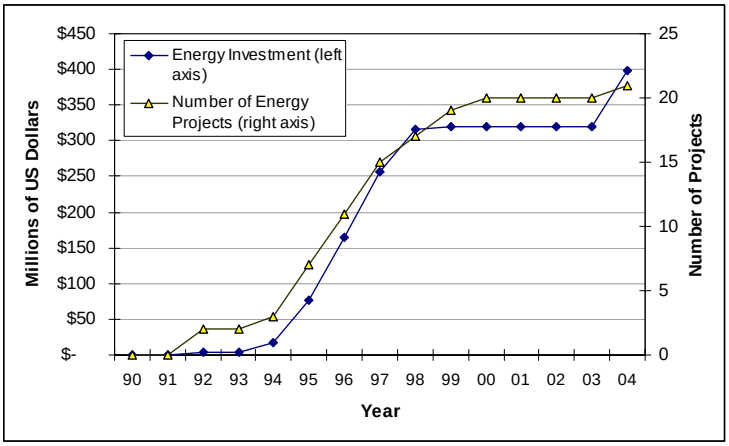


Chart 4: Cumulative Energy Investments in Costa Rica

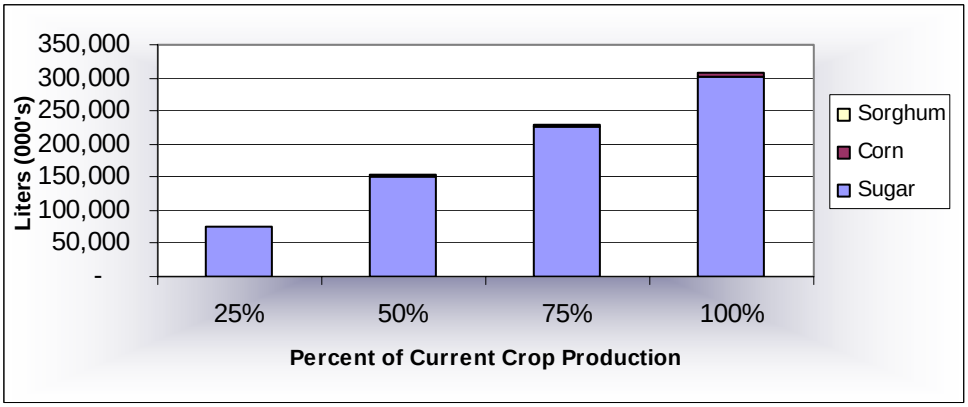
The energy sector in Costa Rica is state-owned. The Costa Rican Institute of Electricity (ICE) and its subsidiary, National Power and Light Company (CNFL), supply and distribute nearly all the electric power of the country.[65] The Ministries that are key in setting energy, agricultural, and environmental policy at the federal level include the Ministry of Environment and Energy (MINAE), the Ministry of Agriculture and Livestock (MAG), the Ministry of Science and Technology (MICIT), and the Ministry of Public Works & Transportation (MOPT).

BIOFUELS—ETHANOL AND BIO-DIESEL

Ethanol

Based on the current level of production for the biofuel crops identified, Costa Rica may be able to generate up to 307 million liters of ethanol. This assumes that 100% of the currently available feedstock is converted to ethanol. As shown in Chart 5, the ability to produce ethanol declines as the percentage of the feedstock used decreases. The majority of this ethanol (98%) is derived from sugarcane, while the remainder comes from corn and sorghum.

Chart 5: "What-If" Ethanol Production for Costa Rica As a Percent of Current Crop Production

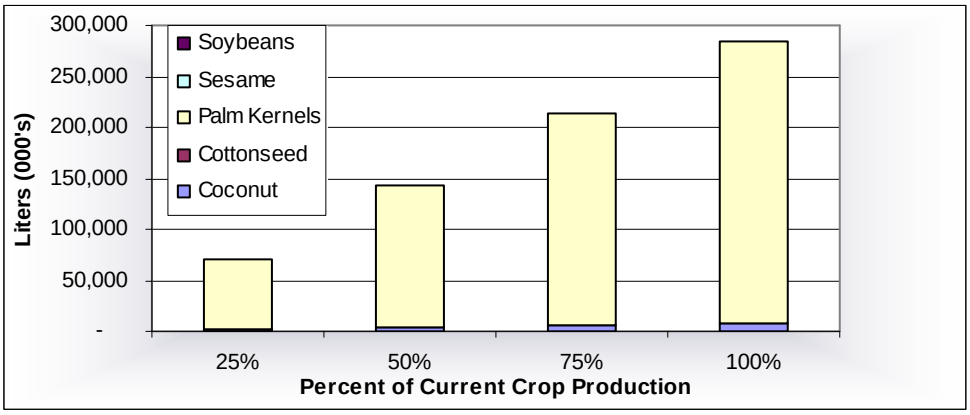


[65] Energy Information Administration, *Costa Rica Country Analysis Brief*, September 2003.

Bio-Diesel

Based on the current level of production for the biofuel crops identified, Costa Rica may be able to generate up to 285 million liters of bio-diesel. This assumes that 100% of the currently available feedstock is converted to bio-diesel. As shown in Chart 6, the ability to produce bio-diesel declines as the percentage of the feedstock used decreases. The majority of this bio-diesel comes from palm kernels (almost 97%), with 3% coming from coconut and the remainder from soybeans and cottonseed.

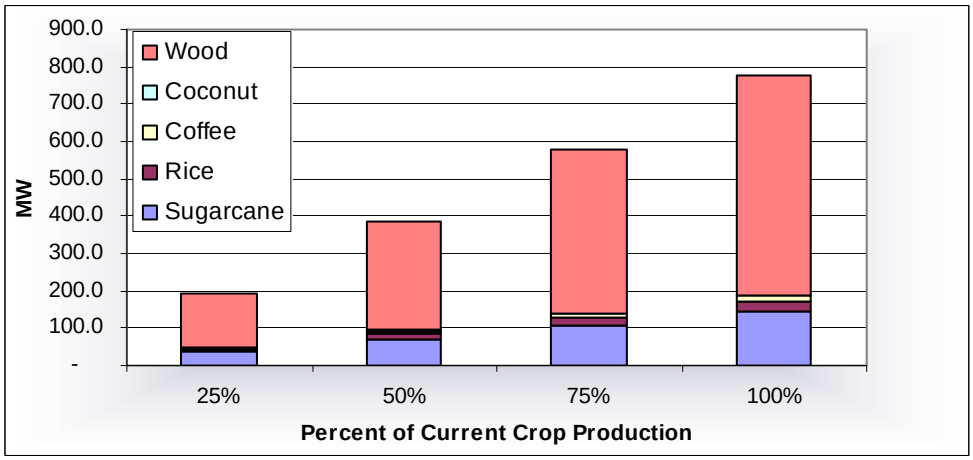
Chart 6: "What-If" Bio-Diesel Production for Costa Rica
As a Percent of Current Crop Production



BIO-POWER

Based on the current level of production for the bio-power crops identified, Costa Rica may be able to generate up to 775 MW of power. This assumes that 100% of the currently available feedstock is converted to power. As shown in Chart 7, the ability to generate power declines as the percentage of the feedstock used decreases. The majority of this power (75.6%) is derived from wood products, while the remainder comes from sugarcane (18.6%), rice (3.8%), coffee (1.7 %), and coconut.

Chart 7: "What-If" Bio-Power Production for Costa Rica
As a Percent of Current Crop Production



CUBA

COUNTRY OVERVIEW

Cuba is the largest and westernmost island of the West Indies. The island of Cuba, together with the Isla de la Juventud and the archipelagos of Sabana, Colorados, Jardines de la Reina, and Canarreos, form the Republic of Cuba. Cuba is located in a central position between North and South America. Three-quarters of the land is fertile, consisting of rolling plains. Cuba is unique among the Caribbean islands because so much of the country is arable and accessible to harbors. The country has a total land area of 110,860 km^2.[66]

Cuba at a Glance:

Population: 11.33 million
Human Development Index (HDI): 0.817
Electricity Access: 97%
GDP per capita: $630
Major Agricultural Crops: sugarcane, rice, tobacco, citrus, coffee
% of Land under Cultivation: 61%

Cuba is a communist state with one single party, the Cuban Communist Party. It is ruled by Fidel Castro, the world's most enduring leader with more than 45 years in power. Cuba is the only country within the Caribbean region to have a command economy where most sectors are government-owned and the state provides employment—approximately 93% of the labor force is state employed.[67] Cuba has a growing tourism sector, but most employment is in manufacturing or agriculture. While the nation has a low GDP per capita of $630, most social services are paid for by the government; its HDI score is high at 0.817, and 97% of the 11.3 million Cubans has access to electricity.[68] Cuba's major trading partners in the Western Hemisphere include Canada, Mexico, and Venezuela—the US does not allow trade with Cuba. Difficulties facing Cuba today are the collapse of communist regimes in Eastern Europe that has left Cuba with very few allies, and a shortage of medicine, supplies, food, and electricity. Although the country is relatively stable, the Castro regime has a history of oppression and violence.[69]

Cuba's major agricultural products include sugar, citrus and tropical fruits, tobacco, coffee, rice, beans, meat, and vegetables. About 60.6% of the land is under agricultural cultivation and 23.7% remains forested. Cuba shares many of the environmental problems experienced by the rest of the Caribbean region including air and water pollution, biodiversity loss, and deforestation. Reforestation efforts are planned that will increase overall forestation to 28% by 2015.[70]

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[66] Microsoft Encarta Online Encyclopedia, "Cuba-Resources and Regions," http://encarta.msn.com/encyclopedia_761569844/Cuba.html, 2005.
[67] Central Intelligence Agency, "The World Fact Book – Cuba," http://www.cia.gov/cia/publications/factbook/geos/cu.html, 2005.
[68] World Bank: Private Participation in Infrastructure Database, http://ppi.worldbank.org/explore/ppi_exploreCountry.aspx?countryId=177, September 2006.
[69] Ibid, Central Intelligence Agency, 2005.
[70] Ibid, Central Intelligence Agency, 2005.

ENERGY OVERVIEW

The main energy sources in Cuba are petroleum, natural gas, and non-hydro renewable power. Fossil fuels comprise 78% of total energy consumption (see Chart 1) and a significant portion of electricity production (see Chart 2). The industrial sector requires the largest amount of energy (see Chart 3). Cuba does have some oil reserves and produced 77,900 barrels of oil per day in 2004; however, the country is still dependant on petroleum imports. In October 2000, Cuba signed the "Integral Cooperation Accord" with Venezuela, which stipulates that in exchange for Venezuelan oil, Cuba will provide goods and services.[71]

Chart 1: Total Primary Energy Consumption by Fuel (11,876 KTOE)

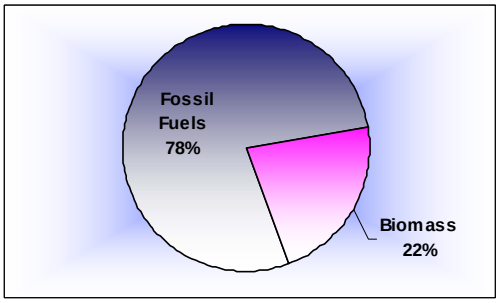
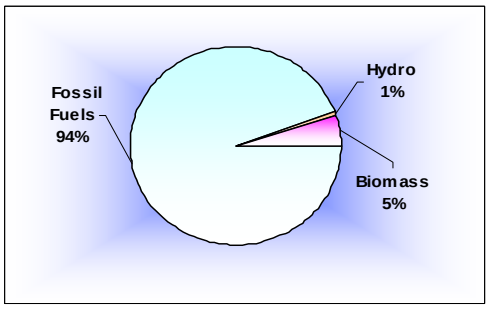
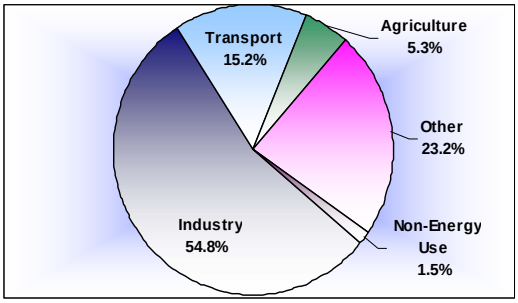


Chart 2: Electricity Generation by Fuel Type (15,909 GWh)



In Cuba's renewable energy mix, biomass and hydropower play the major roles. As regards the former, resources include solid and liquid biomass, and biogas. Regarding the latter, Cuba takes advantage of hydropower resources which account for up to 2% of the country's total electricity production—further, most of these hydroelectric plants are small-scale or micro-hydro.[72] Cuba has the potential for electricity generation from geothermal, solar, and wind energy, and wood, waste, and other biomass. In 2002, Cuba generated the most electricity in the Caribbean region with respect to non-hydro renewable resources.[73]

Chart 3: Total Primary Energy Consumption by Sector (11,876 KTOE)



The electric utility company in Cuba is the Unión Nacional Eléctrica (UNE). Currently, Cuba is facing electricity production problems due to old and outdated electricity production plants that frequently break down. Most of the electric generating plants are 25-35 years old and have not been well maintained, resulting in major power shortages.[74]

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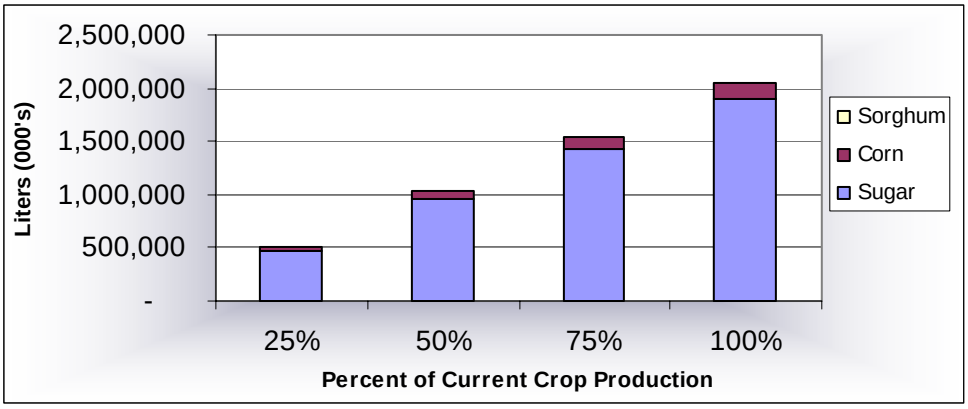
[71] EarthTrends Country Profiles, "Energy and Resources—Cuba," http://earthtrends.wri.org/pdf_library/country_profiles/Ene_cou_192.pdf, 2003.
[72] Instituto Nacional de Recursos Hidráulicos, "Hidroenergía," http://www.hidro.cu/hidroenergia.htm, 2003.
[73] Energy Information Administration, "Caribbean Fact Sheet," http://www.eia.doe.gov/emeu/cabs/carib.html, 2004.
[74] Central Intelligence Agency, "The World Fact Book—Cuba," http://www.cia.gov/cia/publications/factbook/geos/cu.html, 2005.

BIOFUELS—ETHANOL AND BIO-DIESEL

Ethanol

Based on the current level of production for the biofuel crops identified, Cuba may be able to generate up to 2,054 million liters of ethanol. This assumes that 100% of the currently available feedstock is converted to ethanol. As shown in Chart 4, the ability to produce ethanol declines as the percentage of the feedstock used decreases. The majority of this ethanol is from sugar (nearly 93%), while the remainder comes from corn (7%) and sorghum (less than 1%).

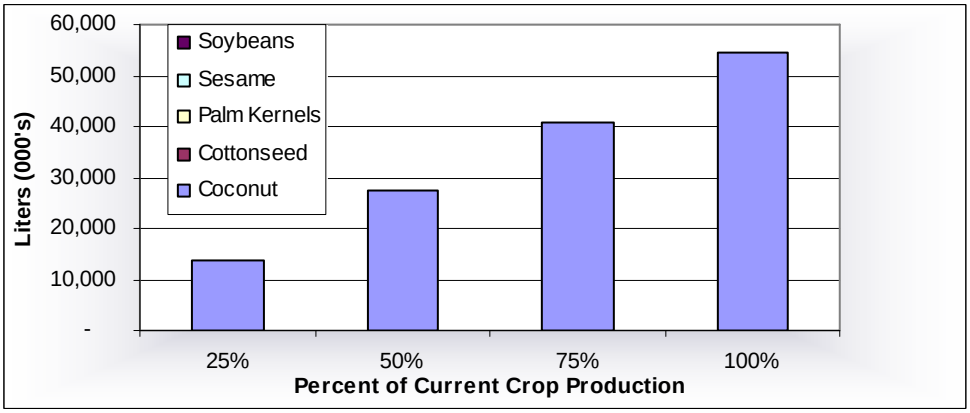
Chart 4: "What-If" Ethanol Production for Cuba
As a Percent of Current Crop Production



Bio-Diesel

Based on the current level of production for the biofuel crops identified, Cuba may be able to generate up to 55 million liters of bio-diesel. This assumes that 100% of the currently available feedstock is converted to bio-diesel. As shown in Chart 5, the ability to produce bio-diesel declines as the percentage of the feedstock used decreases. All of this bio-diesel is derived from coconut.

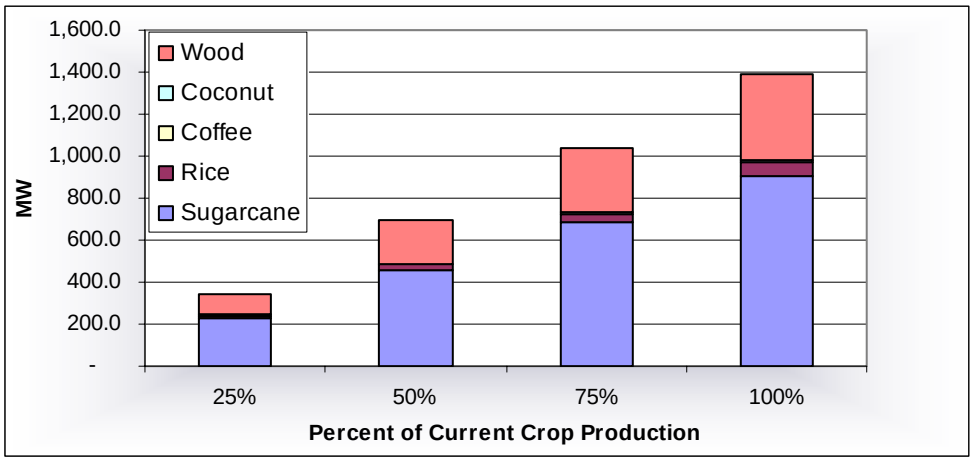
Chart 5: "What-If" Bio-Diesel Production for Cuba
As a Percent of Current Crop Production



BIO-POWER

Based on the current level of production for the bio-power crops identified, Cuba may be able to generate up to 1,388 MW of power. This assumes that 100% of the currently available feedstock is converted to power. As shown in Chart 6, the ability to generate power declines as the percentage of the feedstock used decreases. The majority of this power is from sugarcane (nearly 66%) and wood products (29%), while the remainder comes from rice (4%), and coffee and coconut (less than 1% each).

Chart 6: "What-If" Bio-Power Production for Cuba
As a Percent of Current Crop Production



DOMINICAN REPUBLIC

COUNTRY OVERVIEW

Dominican Republic at a Glance:

Population: 8.4 million
Human Development Index (HDI): 0.749
Electricity Access: 67%
GDP per capita: $2,430
Major Agricultural Crops: sugar, coffee, tobacco, rice
% of Land under Cultivation: 76%

The Dominican Republic is located on the island of Hispaniola in the West Indies. It occupies the eastern two-thirds of the island; Haiti occupies the western portion. It covers a total land area of 48,400 km^2. Mountain ranges, which run parallel from the northeast to the southwest, dominate 80% of the country's area and divide it into three regions—north, central, and southwest. The Dominican Republic is topographically diverse for its size, with vegetation ranging from evergreen forest to a desert-like environment. The island has a tropical maritime climate with 70% average humidity levels year-round.[75]

The Dominican Republic has a medium-high HDI of 0.749, a GDP of $2,430, and 67% of the country has access to electricity.[76] During the 1990s, the Dominican Republic had one of the fastest growing economies in the world, due to macroeconomic policies of export-led growth and increased tourism. However, prolonged electricity failures (which contributed to multilateral organization support of projects to improve electricity infrastructure[77]) and a downturn in the US economy has had adverse impacts on development. Current growth is occurring in tourism, telecommunications, and free-trade–zone manufacturing. The Dominican Republic has signed CAFTA and the US is its largest trading partner, followed by Canada, Western Europe, and Japan.[78] The government is planning infrastructure improvements to attract more FDI.[79] Currently, the Dominican Republic has good international relationships—especially with the US. The country has a population of 8.4 million and a stable population growth rate.

Agriculture and natural resource extraction activities constitute the basis of the island's economy, with 76% of the land area under cultivation. Main agricultural exports are sugar, coffee, and tobacco. Only 12% of the country remains forested, but the annual rate of deforestation has decreased significantly. Other pressing environmental issues include the destruction of lagoons and mangroves from urban expansion, and the extraction of materials from rivers, which eventually causes erosion.[80]

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[75] Microsoft Encarta Online Encyclopedia, "Dominican Republic," http://encarta.msn.com/encyclopedia_761563569/Dominican_Republic.html, 2005.
[76] World Bank: Private Participation in Infrastructure Database, http://ppi.worldbank.org/explore/ppi_exploreCountry.aspx?countryId=109, September 2006.
[77] The World Bank, "Dominican Republic Country Brief," http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/LACEXT/DOMINICANEXTN/0,,menuPK:337779~pagePK:141132~piPK:141107~theSitePK:337769,00.html, 2004.
[78] Bureau of Western Hemisphere Affairs, "Background Note Dominican Republic," http://www.state.gov/r/pa/ei/bgn/35639.htm#econ, 2005.
[79] Organization of Economic Cooperation and Development, "Caribbean Rim Investment Initiative Business Environment Report Dominican Republic," http://www.oecd.org/dataoecd/62/21/2635572.pdf, 2003.
[80] ListinDiario, "Una Feria en Favor del Medio Ambiente," http://www.listindiario.com.do/antes/enero04/080104/cuerpos/vida/vid2.htm, 2005.

ENERGY OVERVIEW

The Dominican Republic, like most of the islands of the Caribbean basin, is a net energy importer, especially as concerns petroleum.[81] It imports 100% of fossil fuels for energy generation; over 30% of the national budget is used for servicing this debt. Venezuela provides 75% of the oil imported to the Dominican Republic, which is approximately 20,000 barrels per day,[82] and most of the LNG is imported from Trinidad and Tobago. The largest energy demand is from the industrial and transport sectors (see Chart 1). The overall electricity market in the Dominican Republic is unreliable, due to poor infrastructure and government debt to private corporations that furnish electricity and supply fuels.[83]

Chart 1: Total Primary Energy Consumption by Sector (7,331 KTOE)

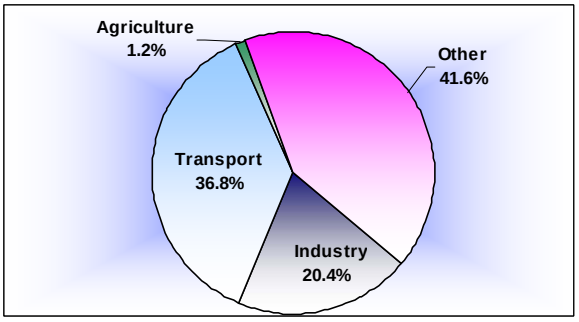
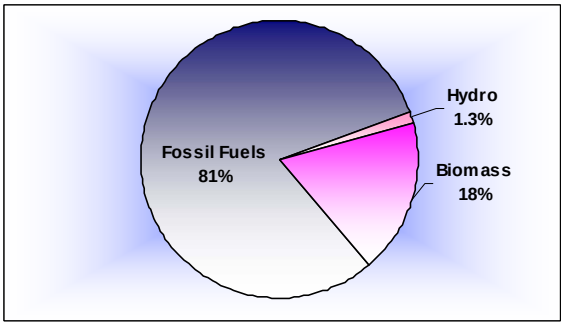
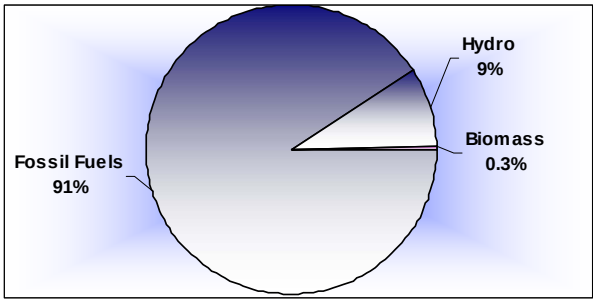


Chart 2: Total Primary Energy Consumption by Fuel (7,331 KTOE)



Although the Dominican Republic relies on fossil fuels for most of its energy and electricity production (see Charts 2 and 3), it is the largest producer of hydroelectricity in the Caribbean.[84] The country also generates power from renewable non-hydroelectric power sources, mostly geothermal but also solar and wind.

Chart 3: Electricity Generation by Fuel Type (13,507 GWh)

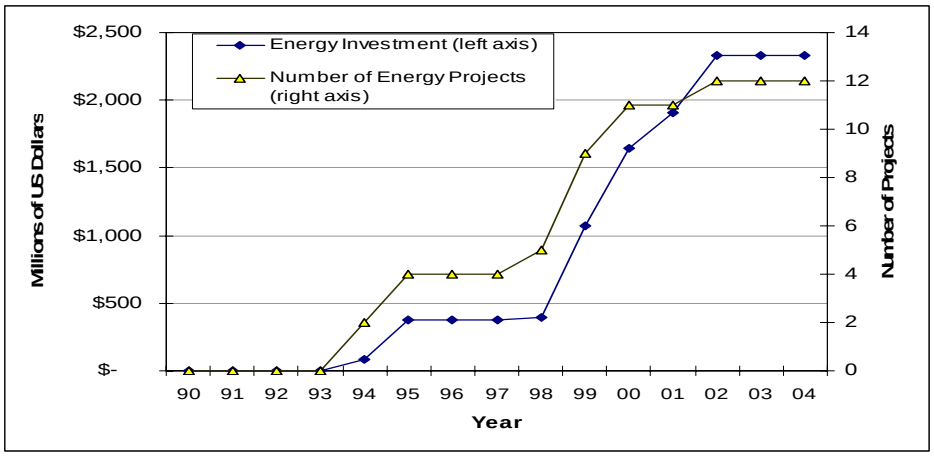


The Dominican Corporation of State Electrical Companies (CDEEE) and the Electricity Supervisors of the Dominican Republic (SIE) are respectively the energy generating and regulating companies of the country. Privatization of the generation and distribution operations began in 1999, when the government sold 50% of ownership while retaining control over the island's transmission assets and hydropower plants.[85] Overall investment in the energy sector has been strong since privatization occurred (see Chart 4). Further policy reform to encourage the development and use of renewable energy systems is currently being considered by the legislature. The bill, Incentives for the Development of Renewable Energies, has been approved by one house of congress and is awaiting confirmation in the

[81] Energy Information Administration, "Caribbean Fact Sheet," http://www.eia.doe.gov/emeu/cabs/carib.html, June 2004.
[82] United Press International, "UPI Energy Watch," http://washingtontimes.com/upi-breaking/20040929-022731-6813r.htm, September 29, 2004.
[83] Ibid, Energy Information Administration, 2004.
[84] Ibid, Energy Information Administration, 2004.
[85] Ibid, Energy Information Administration, 2004.

second. It is likely that this bill will be approved in the near term and will provide incentives including exemptions from income taxes for ten years, and preferential dispatch and special tariffs for grid-connected renewables. The Dominican Republic has also begun to work with and support private sector entities and civil society organizations to convert Jatropha Curcas, an endemic tree-plant that exists on the border with Haiti and in some of the poorest provinces in the central and eastern side of the country, to convert this tree plant into bio-diesel. Dominican Republic is also pursuing ethanol production. The Dominican Republic views renewable energy, bio-diesel, and ethanol production as a means for eradicating poverty, combating deforestation, reversing desertification, protecting the ecosystem and reducing its 100% dependence on fossil fuels for energy generation.

Chart 4: Cumulative Energy Investments in the Dominican Republic

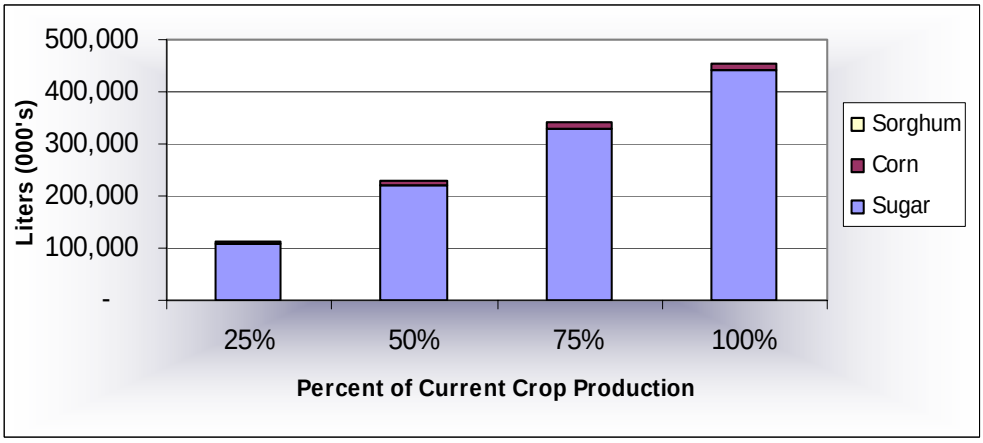


BIOFUELS—ETHANOL AND BIO-DIESEL

Ethanol

Based on the current level of production for the biofuel crops identified, the Dominican Republic may be able to generate up to 455 million liters of ethanol. This assumes that 100% of the currently available feedstock is converted to ethanol. As shown in Chart 5, the ability to produce ethanol declines as the percentage of the feedstock used decreases. The majority of this ethanol is from sugar (97%), while the remainder comes from corn.

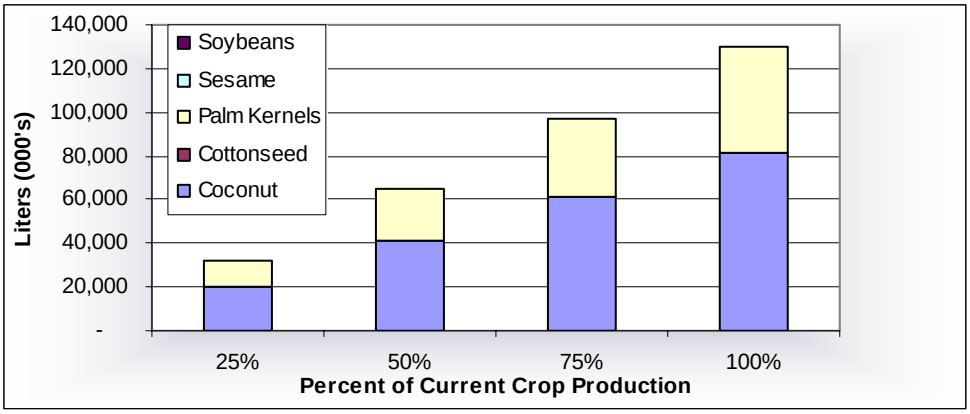
Chart 5: "What-If" Ethanol Production for the Dominican Republic As a Percent of Current Crop Production



Bio-Diesel

Based on the current level of production for the biofuel crops identified, the Dominican Republic may be able to generate up to 130 million liters of bio-diesel. This assumes that 100% of the currently available feedstock is converted to bio-diesel. As shown in Chart 6, the ability to produce bio-diesel declines as the percentage of the feedstock used decreases. The majority of this bio-diesel is derived from coconut (63%), while the remainder comes from palm kernels (37%).

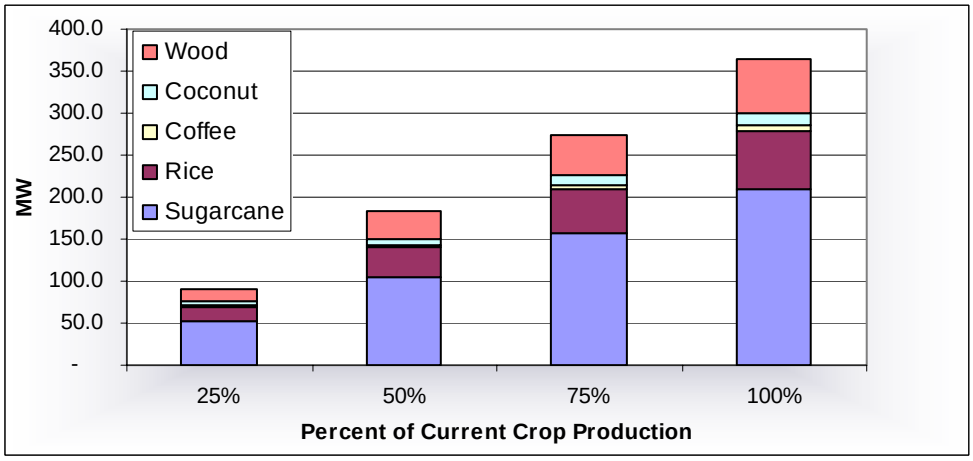
Chart 6: "What-If" Bio-Diesel Production for the Dominican Republic As a Percent of Current Crop Production



BIO-POWER

Based on the current level of production for the bio-power crops identified, the Dominican Republic may be able to generate up to 365 MW of power. This assumes that 100% of the currently available feedstock is converted to power. As shown in Chart 7, the ability to generate power declines as the percentage of the feedstock used decreases. The majority of this power (58%) is derived from sugarcane, while the remainder is from rice (19%), wood products (18%), coconut (4%), and coffee (1%).

Chart 7: "What-If" Bio-Power Production for the Dominican Republic As a Percent of Current Crop Production



EL SALVADOR

COUNTRY OVERVIEW

El Salvador at a Glance:

Population: 6.76 million
Human Development Index (HDI): 0.722
Electricity Access: 71%
GDP per capita: $2,130
Major Agricultural Crops: coffee, sugar, corn, rice, beans, cotton, oilseed, and sorghum
% of Land under Cultivation: 82.2%

El Salvador is located on the Pacific coast of Central America, bordered by Honduras on the northeast, Guatemala on the west, and the Pacific Ocean on the south. It is the only Central American country that does not have access to the Atlantic Ocean. El Salvador has an area of 21,040 km^2. The country is mountainous in the north with fertile valleys in the southern coastal region.[86]

El Salvador has the third largest economy in Central America with a GDP per capita of $2,130, an HDI score of 0.722, and 71% of the population with access to electricity.[87] With a population of 6.76 million, El Salvador has one of the highest population densities in the Western Hemisphere. Although economic growth has been minimal in recent years, the government is hoping to stimulate the economy by opening new export markets, encouraging foreign investment, and modernizing the tax and healthcare systems. El Salvador was the first country to ratify the Central America–Dominican Republic Free Trade Agreement (CAFTA-DR). The country's trade deficit has been offset by annual remittances from Salvadorans living abroad—about 16.6% of GDP. The US is El Salvador's largest import and export partner. In 1992, the country ended a 12-year civil war and has been stable since that time.[88]

About 82% of the land in El Salvador is under cultivation with major crops including coffee, sugar, corn, rice, beans, cotton, oilseed, and sorghum. Only 5.1% of the land remains forested—El Salvador has one of the highest deforestation rates in the hemisphere and has been trying to promote reforestation programs for more than 50 years, without success. The country has a high level of consumption in regard to forest products, and approximately 93.5% of this is wood used for energy.[89] Additionally, the country's high population density contributes to urban environmental problems, including air and water pollution.

ENERGY OVERVIEW

Most of El Salvador's primary energy supply is from fossil fuels, with a smaller percentage coming from hydropower and geothermal energy (see Chart 1). El Salvador imports petroleum products from

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[86] Central Intelligence Agency, "The World Fact Book," http://www.cia.gov/cia/publications/factbook/geos/es.html, 2004.
[87] World Bank: Private Participation in Infrastructure Database, http://ppi.worldbank.org/explore/ppi_exploreCountry.aspx?countryId=111, September 2006.
[88] Washington Post, "International Spotlight; El Salvador," http://www.washingtonpost.com/wp-adv/specialsales/international/spotlight/elsalvador/article9.html, 2004.
[89] FAO Country Reports, "El Salvador," http://www.fao.org/docrep/006/AD097S/AD097S05.htm, no date available.

Ecuador, Chile, the US, and the Caribbean.[90] Electricity production relies heavily on hydropower as the main resource, with fossil fuels and geothermal power also contributing (see Chart 2). In September of 2002 it was reported that El Salvador had generated 61 MW of biomass cogeneration. Chart 3 illustrates energy demand by sector.

El Salvador has demonstrated interest in Mexican natural gas via a Central American pipeline, to promote regional economic integration and substitute for traditional fuels such as diesel and wood.[91] There was significant investment in the energy sector during the period 1998–2001 (see Chart 3). In February 2006, a law to incentivize renewable energy was presented. This law exempts projects with a limit of up to 20 MW from importation rights and property tax (excluding LaGeo and CEL, electric generation companies focusing on geothermal and hydropower, respectively). In May 2006, LaGeo opened the first phase of a new geothermal unit in Berlín, which will increase installed capacity by 40 MW and was projected to start operating in September 2006. Currently the Ministry of Natural Resources (MARENA) is developing a Renewable Energy Promotion System to facilitate contracts with stable pricing and periods exceeding 10 years. This may include the creation of a rotary fund (FOGES) that allows for financial compensation (soft credit).[92]

Chart 1: Total Primary Energy Consumption by Fuel (3,006 KTOE)

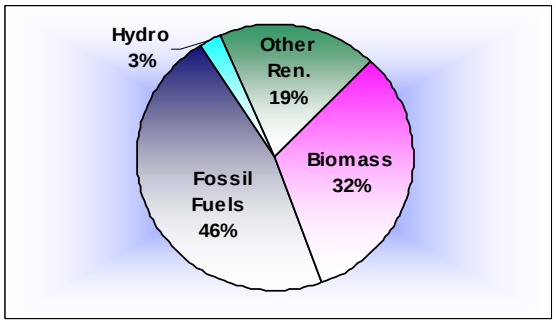
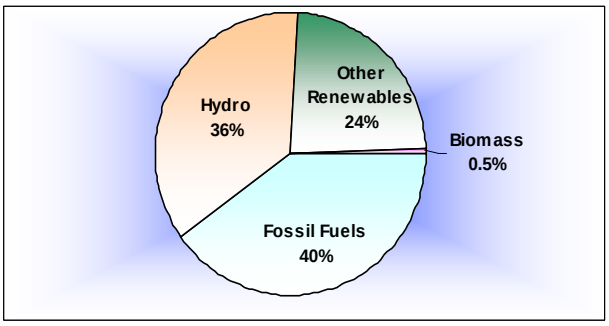
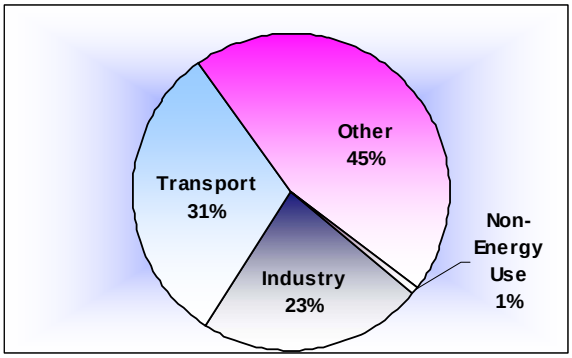


Chart 2: Electricity Generation by Fuel Type (4,044 GWh)



El Salvador has a fairly strong renewable energy sector, excluding large hydropower, which can be divided into two main groups: geothermal energy and other renewable initiatives. Geothermal energy is an important energy resource and plays a significant role in the supply of energy in the country—making up roughly 22% of El Salvador's electricity demand.[93] El Salvador's total installed generating capacity of geothermal power in year 2002 was 161.2 MW, making it the largest producer of geothermal energy in Central America.[94] Although electricity generation based on biomass gasification

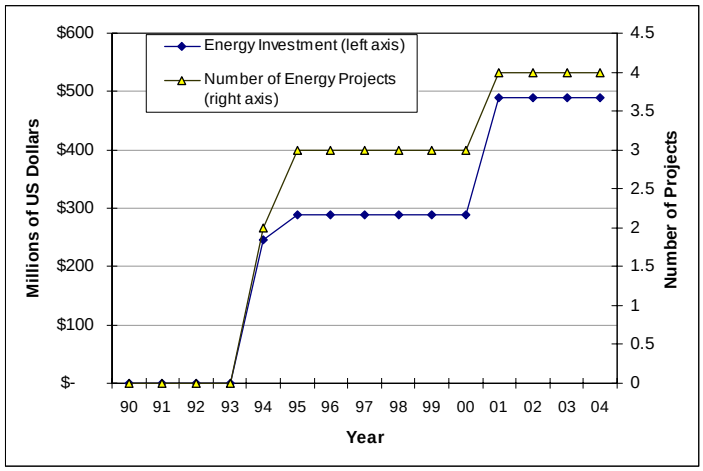
Chart 3: Total Primary Energy Consumption by Sector (3,006 KTOE)



[90] El Diario De Hoy, "El Salvador: Thermal Power Generation to Increase," July 6, 2001.
[91] Caribbean/Latin American Action, "El Salvador—Caribbean/Latin American Profile," 2004.
[92] Coveillo, M.F., ECLAC, United Nations, "Energias Renovables en America Latina y el Caribe: Barreras y Avances," no date available.
[93] Ibid, Caribbean/Latin American Action, 2004.
[94] Energy Information Administration, "Country Analysis Briefs; Regional Indicators: Central America; El Salvador," http://www.eia.doe.gov/emeu/cabs/centam.html, 2003.

and solar energy has been reported in the country, the power generated by these resources does not have a significant impact on total installed capacity.[95] Both the government and the private sector have also expressed interest in exploring opportunities for increased biomass development for biofuels and power applications.

Chart 4: Cumulative Energy Investments in El Salvador

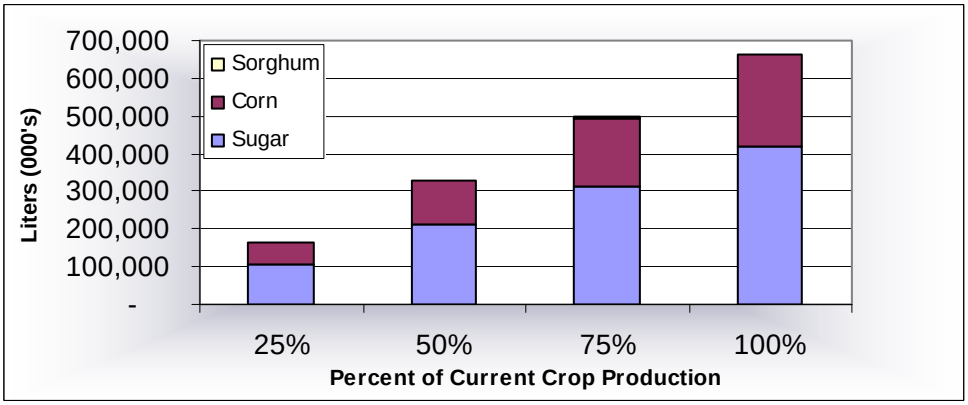


BIOFUELS—ETHANOL AND BIO-DIESEL

Ethanol

Based on the current level of production for the biofuel crops identified, El Salvador may be able to generate up to 662 million liters of ethanol. This assumes that 100% of the currently available feedstock is converted to ethanol. As shown in Chart 5, the ability to produce ethanol declines as the percentage of the feedstock used decreases. The majority of this ethanol is from sugar (63%), while the remainder is comprised of corn (36%) and sorghum (less than 1%).

Chart 5: "What-If" Ethanol Production for El Salvador
As a Percent of Current Crop Production

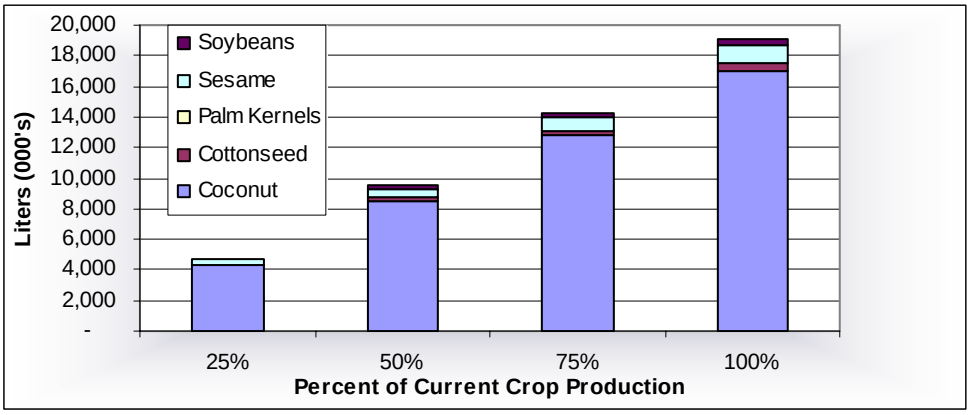


[95] Ibid, Caribbean/Latin American Action, 2004.

Bio-Diesel

Based on the current level of production for the biofuel crops identified, El Salvador may be able to generate up to 19 million liters of bio-diesel. This assumes that 100% of the currently available feedstock is converted to bio-diesel. As shown in Chart 6, the ability to produce bio-diesel declines as the percentage of the feedstock used decreases. Almost all of this bio-diesel is from coconut (89%), with the remainder from sesame seeds (6%), cottonseed (3%), and soybeans (2%).

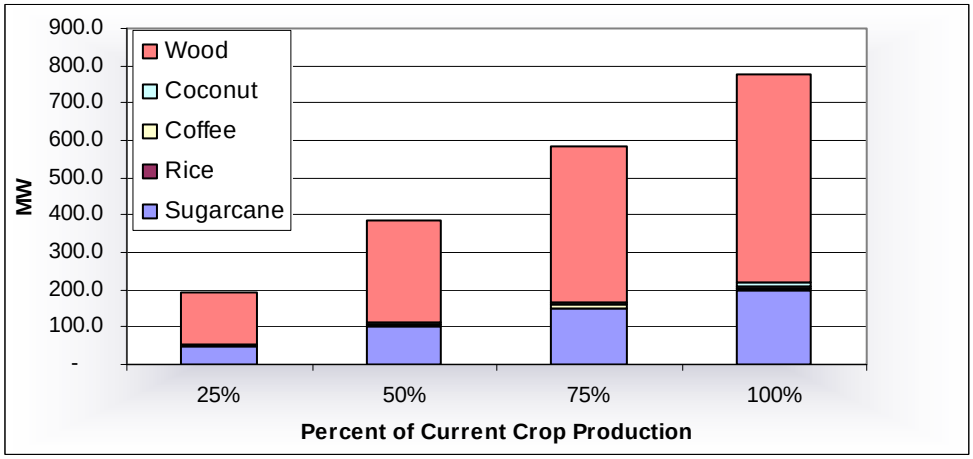
Chart 6: "What-If" Bio-Diesel Production for El Salvador
As a Percent of Current Crop Production



BIO-POWER

Based on the current level of production for the bio-power crops identified, El Salvador may be able to generate up to 775 MW of power. This assumes that 100% of the currently available feedstock is converted to power. As shown in Chart 7, the ability to generate power declines as the percentage of the feedstock used decreases. The majority of this power (almost 72%) is from wood products, while sugarcane (26%), coconut and coffee (less than 2% each) and rice (less than 1%) comprise the remainder.

Chart 7: "What-If" Bio-Power Production for El Salvador
As a Percent of Current Crop Production



GRENADA

COUNTRY OVERVIEW

Grenada at a Glance:

Population: 102,000
Human Development Index (HDI): 0.787
Electricity Access: >90%
GDP per capita: $5,060
Major Agricultural Crops: bananas, cocoa, spices, citrus, sugarcane, corn
% of Land under Cultivation: 38%

Grenada is a Caribbean nation comprised of a mainland and the islands of Carriacou and Petite Martinique along with several minor islets. All of the islands are part of the Lesser Antilles volcanic chain. Grenada is the second smallest nation in the Western Hemisphere, followed only by St. Kitts and Nevis—Grenada and all of its island parishes have a total area of just 344 km^2.[96] Grenada lacks the size and geographical diversity for separate geographical regions.

Grenada has a GDP per capita of $5,060, an HDI score of 0.787, and more than 90% of the population of 102,000 has access to electricity. The Grenadian economy is heavily reliant upon agriculture—mainly spices for export—and tourism. However, the economy is threatened yearly by tropical weather patterns, due to the country's geographical position within hurricane routes.[97] Offshore financial services also provide foreign exchange.[98] Estimated exports in 2002 were approximately US$22 million, consisting of agricultural products of spices and tropical fruits destined for St. Lucia, the US, Antigua and Barbuda, the Netherlands, and St. Kitts and Nevis.[99] Imports consist of food, manufactured goods, machinery, chemicals, and fuel—mainly from Trinidad and Tobago, and the US. Although the economy is growing, Grenada still suffers from widespread poverty which is increased by the effects of hurricanes on the country. For example, when Hurricane Ivan struck Grenada in 2004, it caused damage to over 85% of the structures on the island and at least 39 deaths.[100] Infrastructure development is constrained by such hurricanes.

Roughly 38% of Grenada is composed of agricultural land. Main crops include bananas, cocoa, nutmeg, mace, citrus, avocados, root crops, sugarcane, and corn. Only 8.8% of the islands remain forested and rapid development of the tourism industry further threatens existing rainforests. Additionally, there is no policy directing the use of the forests.[101] Other environmental issues include soil erosion, beach and coastline erosion from hurricanes and tropical storms, waste management, and water pollution.[102]

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[96] Microsoft Encarta Online Encyclopedia, "Grenada--Resources and Regions," http://encarta.msn.com/encyclopedia_761572963/Grenada.html, 2005.
[97] Central Intelligence Agency, "The World Fact Book," http://www.cia.gov/cia/publications/factbook/geos/gj.html, November 2005.
[98] Bureau of Western Hemisphere Affairs, "Background Note Grenada," http://www.state.gov/r/pa/ei/bgn/2335.htm, 2005.
[99] Ibid, Bureau of Western Hemisphere Affairs, 2005.
[100] Ibid, Central Intelligence Agency, 2005.
[101] World Resources Institute, "Earth Trends: The Environmental Information Portal," http://earthtrends.wri.org/text/forests-grasslands-drylands/country-profile-74.html, 2005.
[102] A Rapid Environmental Impact Assessment, "Hurricanes Ivan and Jeanne in Haiti, Grenada, and the Dominican Republic," November 4, 2005.

ENERGY OVERVIEW

Petroleum is the sole source of energy consumption in Grenada, at 100%. Grenada does not produce any oil and is dependent entirely on imports to meet its energy requirements. In 2002, Grenada signed the Caracas Agreement on Energy Cooperation and will receive 500 barrels of crude oil per day from Venezuela according to the signed agreement.[103] Grenada is also looking at the potential for oil and gas exploration in its territory.[104] The Grenada Electricity Services Ltd. (GRENLEC) is the sole provider of electricity for the country.

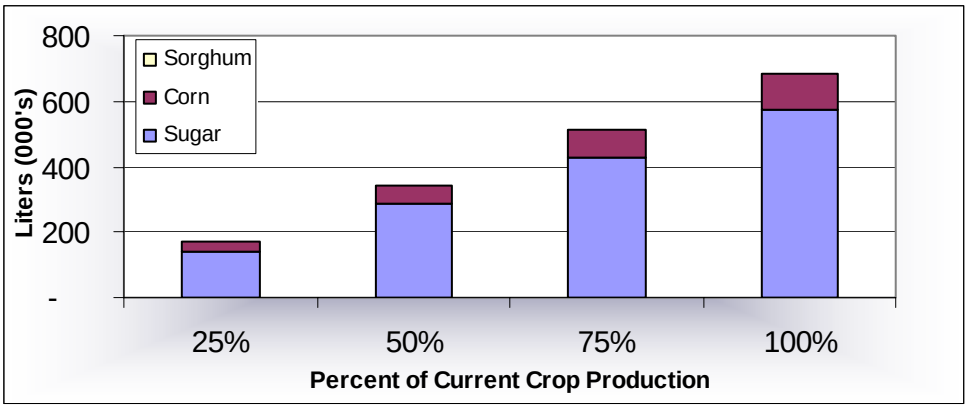
At the World Summit on Sustainable Development in 2002, Grenada's Minister for Environment and Health discussed the country's plans to set up targets that will transform Grenada's diesel energy system to a renewable energy base. Some of the plan's initiatives include a solar water heater program and a renewable energy assessment to measure the resource potential of wind, biomass, and geothermal energy, and hydropower.[105] Grenada is also part of the Global Sustainable Energy Island Initiative; activities have included preparation of a Sustainable Energy Plan for renewable energy and energy efficiency development and identification of associated project opportunities.

BIOFUELS—ETHANOL AND BIO-DIESEL

Ethanol

Based on the current level of production for the biofuel crops identified, Grenada may be able to generate up to 684 thousand liters of ethanol. This assumes that 100% of the currently available feedstock is converted to ethanol. As shown in Chart 1, the ability to produce ethanol declines as the percentage of the feedstock used decreases. The majority of this ethanol is from sugar (84%), while the remainder (16%) is from corn.

Chart 1: "What-If" Ethanol Production for Grenada
As a Percent of Current Crop Production

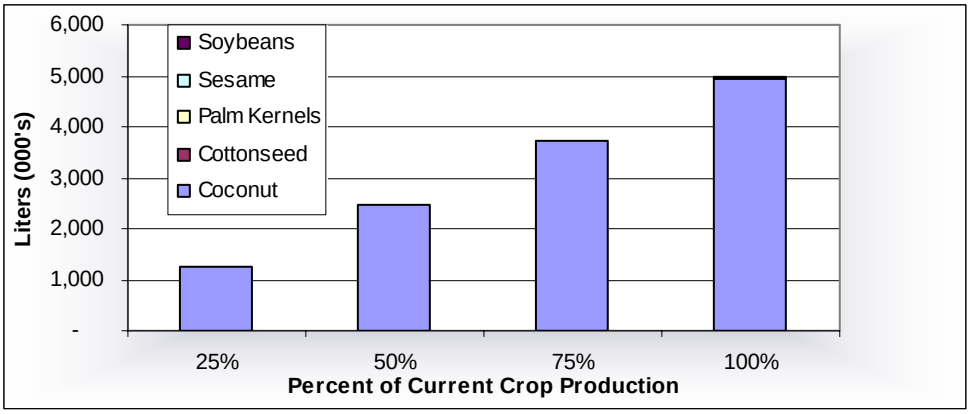


[103] The University of the West Indies, "The Impact of High Oil Prices on the OECS," http://www.uwi.tt/uwitoday/2005/april/oiloecs.asp, April 2005.
[104] BBC International Reports, "Grenada Looking at Oil and Gas Exploration," http://dialogpro.dialog.com, March 2004.
[105] World Summit on Sustainable Development, "Press Conference on Renewable Energy in Dominica, St. Lucia, Grenada," http://www.un.org/events/wssd/pressconf/020902conf4.htm, September 2002.

Bio-Diesel

Based on the current level of production for the biofuel crops identified, Grenada may be able to generate up to 5 million liters of bio-diesel. This assumes that 100% of the currently available feedstock is converted to bio-diesel. As shown in Chart 2, the ability to produce bio-diesel declines as the percentage of the feedstock used decreases. Almost all of this bio-diesel is derived from coconut with less than 1% coming from cottonseed.

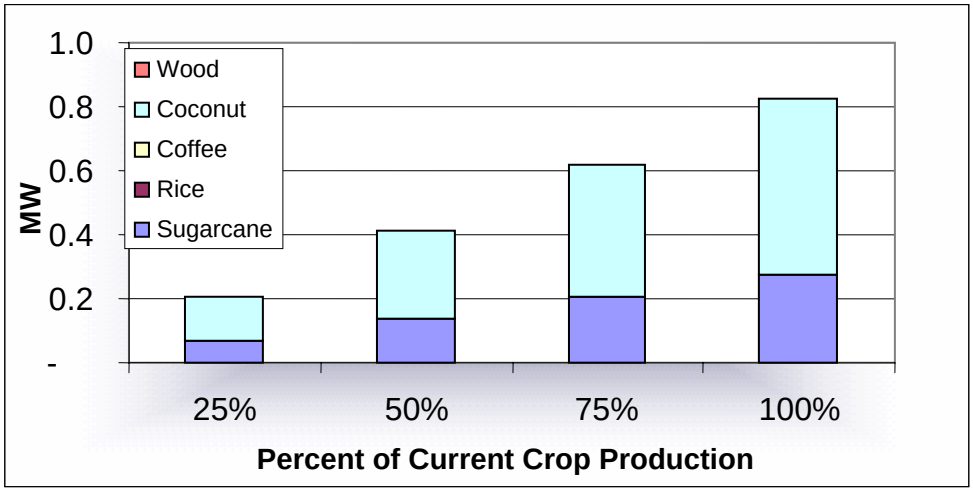
Chart 2: "What-If" Bio-Diesel Production for Grenada
As a Percent of Current Crop Production



BIO-POWER

Based on the current level of production for the bio-power crops identified, Grenada may be able to generate up to 0.8 MW of power. This assumes that 100% of the currently available feedstock is converted to power. As shown in Chart 3, the ability to generate power declines as the percentage of the feedstock used decreases. The majority of this power (67%) comes from coconut, while the remainder comes from sugarcane (33%).

Chart 3: "What-If" Bio-Power Production for Grenada
As a Percent of Current Crop Production



GUATEMALA

COUNTRY OVERVIEW

Guatemala at a Glance:

Population: 12.3 million
Human Development Index (HDI): 0.66
GDP per capita: $1,670
Electricity Access: 67%
Major Agricultural Crops: sugarcane, soybeans, sesame seeds
% of Land under Cultivation: 42.9%

Guatemala is located at the northwestern edge of Central America. It is bordered to the west and north by Mexico, to the east by Belize and the Caribbean Sea, to the southeast by Honduras and El Salvador, and to the south by the Pacific Ocean. Guatemala is the only country in Central America where over half of the population is made up of an indigenous group, the Maya. Two-thirds of Guatemala's total land mass is composed of mountains and it suffers from frequent volcanic eruptions, earthquakes, and heavy rains, making the maintenance of the country's infrastructure of roads and railways very difficult. The total area of Guatemala is 108,890 km^2.[106]

More than one-third of the total inhabitants of Central America reside in Guatemala, making it the most populated country in the region (12.3 million). Guatemala has a GDP per capita of $1,670, an HDI of 0.66, and an electricity access rate of 67%.[107] Due to its economic, political, social, and geographic circumstances, Guatemala is one of the most powerful countries in Central America. Private sector business makes up 85% of GDP in the country; agriculture accounts for 22% of GDP, 70% of exports (mainly coffee, sugar, and bananas), and 50% of employment.[108] The US is Guatemala's largest trading partner, accounting for 30% of Guatemalan exports and providing 26% of Guatemalan imports.[109] Although Guatemala's 36-year civil war impaired its regional and international relations, in the last decade the country has made progress in this regard. With poor infrastructure, Guatemala remains a high-cost country for conducting business.[110]

About 43% of the land in the country is under agricultural cultivation, with 48% forested. Major agricultural products include sugarcane, coffee, sesame seeds, bananas, soybeans, and wood. Guatemala is one of the most biologically diverse countries in the world; however, its biodiversity is at risk due to deforestation. Other environmental problems include soil erosion, agrochemical contamination, air, water, and soil pollution, water resource development problems, and unsound land

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[106] Microsoft Encarta Online Encyclopedia, "Guatemala-Natural Resources," 2005.
[107] World Bank: Private Participation in Infrastructure Database, http://ppi.worldbank.org/explore/ppi_exploreCountry.aspx?countryId=113, September 2006.
[108] Central Intelligence Agency, "The World Fact Book-Guatemala," http://www.cia.gov/cia/publications/factbook/geos/gt.html, 2005.
[109] Bureau of Western Hemisphere Affairs, "Background Note Guatemala," http://www.state.gov/r/pa/ei/bgn/2045.htm#econ, 2004.
[110] ASIES, Carta Informativa Semanal, Asuntos Economicos, "Presentan Propuesta Fiscal", http://www.asies.org.gt/carta-informativa/2003/carta41-2003.pdf, October 2003.

use.[111]

ENERGY OVERVIEW

Guatemala is the only oil producing Central American country, with an estimated 526 million barrels of proven oil reserves located primarily in the country's northern jungles in the Petén basin. In 2003, oil production increased by 22%.[112] The transportation sector creates the highest energy demand (see Chart 1). Although Guatemala mainly uses oil for transport and electricity, it also has the first coal-fired power plant in Central America, which uses imported low-sulfur coal.[113] In addition, hydropower contributes to the total energy and electricity mix (see Charts 2 and 3). Guatemala has a small installed capacity for geothermal, although the potential for further development is high. Biomass, solar, and wind energy are mainly used in isolated systems or rural areas; however, the trend is growing.[114] For example, Guatemala has an installed capacity of 200 MW of energy from biomass, which also accounts for over two-thirds of the installed capacity of biomass in Central America.[115] Biomass power generation plants operate with sugarcane bagasse and fuel oil, or fuel oil only.[116]

Chart 1: Total Primary Energy Consumption by Sector (4,381 KTOE)

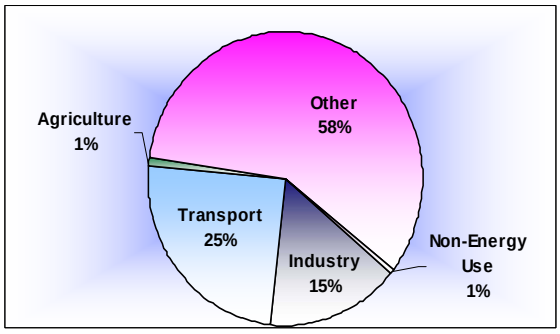
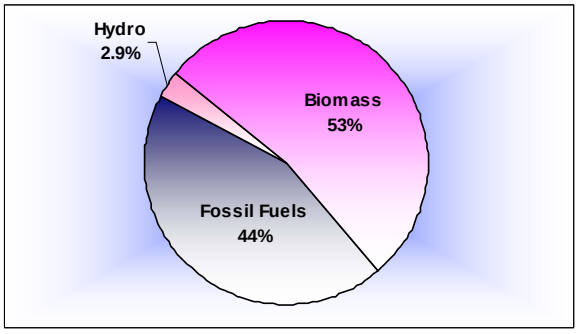
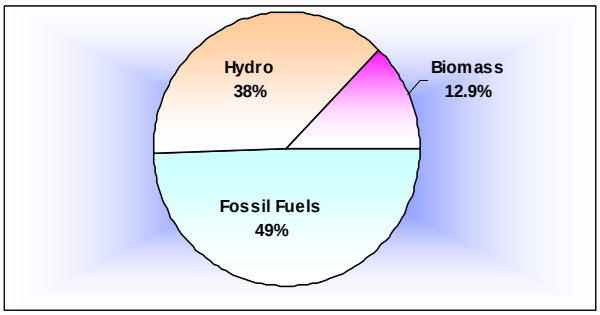


Chart 2: Total Primary Energy Consumption by Fuel (4,381 KTOE)



Privatization of the energy sector began in October 1996 with the approval of the General Electricity Law (Decree 93) that required the Guatemalan Social Electric Company (EEGSA) and the National Institute of Electrification (INDE) break up into separate commercialization, distribution, transmission, and generation functions. At the current time, 60.4% of electricity is generated by the private sector, 38.8% by the INDE and the remaining

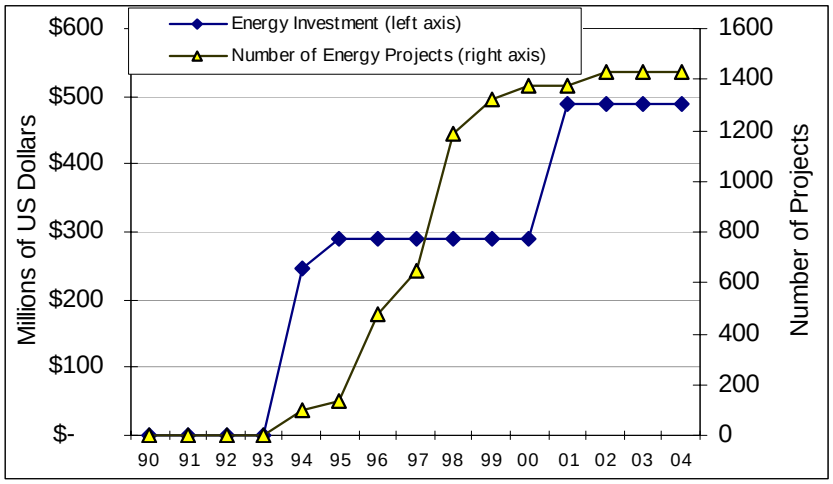
Chart 3: Electricity Generation by Fuel Type (6,561 GWh)



[111] Center for International Policy, "Guatemala Country Profile," http://ciponline.org/central_america/guatemalafaqs.htm, 2005.
[112] Energy Information Administration, "Country Analysis Briefs Regional Indicators Central America," http://www.eia.doe.gov/emeu/cabs/centam.html, September 2004.
[113] Data monitor, "Teco Sells Interest in Synfuel Operation and Refinances San Jose Power Venture," May 2004.
[114] Renewable Energy and Energy Efficiency Partnership, "Latin American Regional Meeting: Background Paper," http://www.reeep.org/media/downloadable_documents, 2003.
[115] Ibid, Renewable Energy and Energy Efficiency Partnership, August 2003.
[116] Ministerio de Energía y Minas, "Información General," http://www.mem.gob.gt/hidrocarburos/general.htm, 2004.

0.8% of electric energy generation is isolated.[117] The General Directorate of Energy, a subsidiary of the Ministry of Energy and Mines, is in charge of the policies in the energy sector of Guatemala. The National Energy Commission is the regulatory body responsible for the supervision of compliance with the General Law of Electricity.[118] Investments in the energy sector have been sporadic, but increased after privatization of the sector (see Chart 4).

Chart 4: Cumulative Energy Investments in Guatemala



In an effort to further encourage the use of renewables, the Government of Guatemala approved the Renewable Energy Incentives Law in 2003. This law seeks to incentivize grid-connected renewables, including biomass, wind, and small hydro. It offers developers a variety of incentives, including duty-free imports of equipment and a 10-year holiday on income taxes. Further, an effort is underway to prepare implementing regulations for the Law, as well as a broad national energy strategy that will articulate the government's expectations with regard to renewable energy investments.

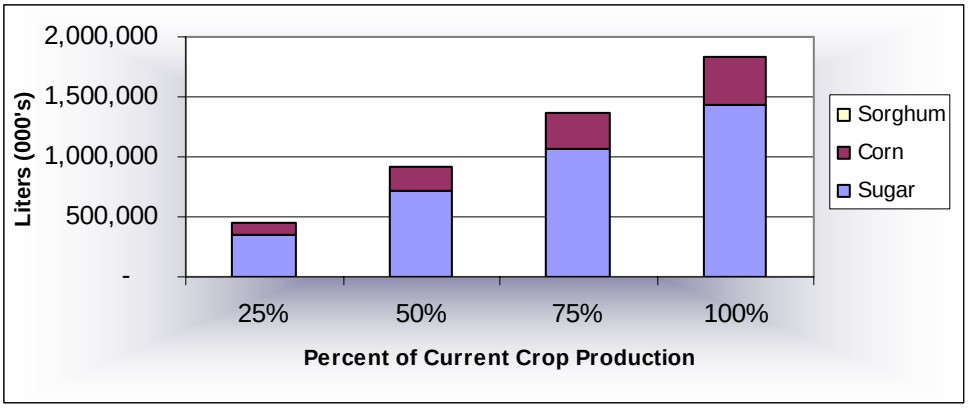
BIOFUELS—ETHANOL AND BIO-DIESEL

Ethanol

Based on the current level of production for the biofuel crops identified, Guatemala may be able to generate up to 1,829 million liters of ethanol. This assumes that 100% of the currently available feedstock is converted to ethanol. As shown in Chart 5, the ability to produce ethanol declines as the percentage of the feedstock used decreases. The majority of this ethanol is from sugar (78%), while the remainder is from corn (22%) and sorghum (less than 1%).

[117] Instituto Nacional de Electrificación, "Energía disponible en el país año 2003," http://www.inde.gob.gt/energia_disponible.htm, 2002.
[118] Dirección General de Energía, "Información General," http://www.mem.gob.gt/energia/general.htm, 2004.

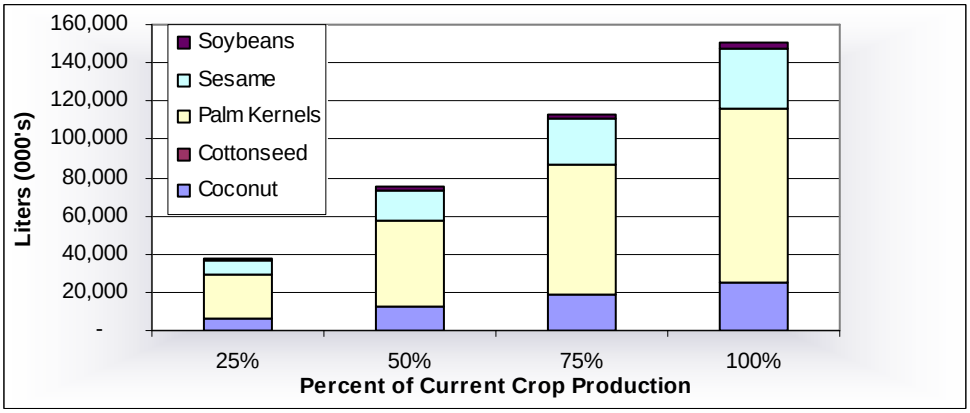
Chart 5: "What-If" Ethanol Production for Guatemala
As a Percent of Current Crop Production



Bio-Diesel

Based on the current level of production for the biofuel crops identified, Guatemala may be able to generate up to 150 million liters of bio-diesel. This assumes that 100% of the currently available feedstock is converted to bio-diesel. As shown in Chart 6, the ability to produce bio-diesel declines as the percentage of the feedstock used decreases. Of this, palm kernels represent 60%, sesame seeds 21%, coconut 16%, soybeans 2%, and cottonseed less than 1%.

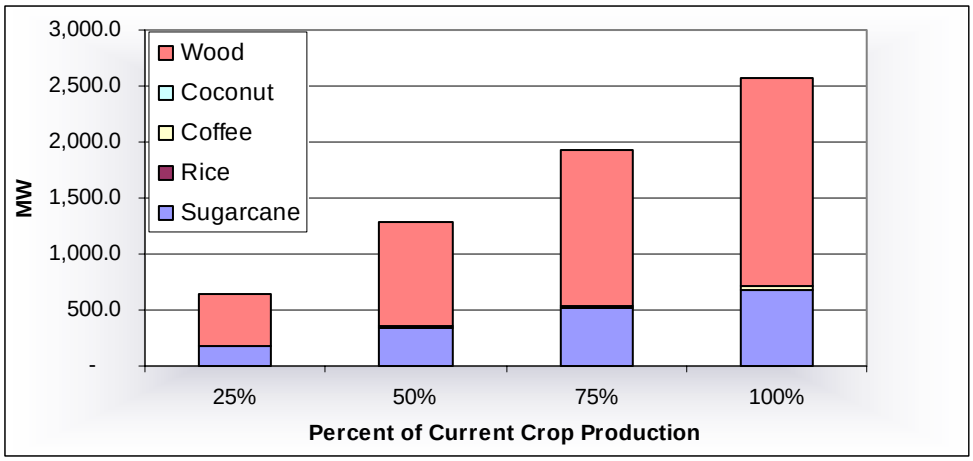
Chart 6: "What-If" Bio-Diesel Production for Guatemala
As a Percent of Current Crop Production



BIO-POWER

Based on the current level of production for the bio-power crops identified, Guatemala may be able to generate up to 2,576 MW of power. This assumes that 100% of current available feedstock is converted to power. As shown in Chart 7, the ability to generate power declines as the percentage of the feedstock used decreases. The majority of this power (72%) is from wood products, while the remainder is from sugarcane (26%), with coffee, coconut and rice accounting for the remainder with less than one 1% each.

Chart 7: "What-If" Bio-Power Production for Guatemala
As a Percent of Current Crop Production



HAITI

COUNTRY OVERVIEW

Haiti at a Glance:

Population: 8.3 million
Human Development Index (HDI): 0.475
Electricity Access: 34%
GDP per capita: $440
Major Agricultural Crops: coffee, sugarcane, rice, corn, sorghum
% of Land under Cultivation: 57%

Haiti is an island nation in the West Indies, located on the western third of the island of Hispaniola; the Dominican Republic occupies the rest of the island. The Atlantic Ocean forms the northern border, the Dominican Republic the eastern, the Caribbean Sea the southern, and the Windward Passage—a channel that separates Haiti from Cuba—the western border. Despite Haiti's small size, it has five mountain ranges inside its borders. Haiti has a total land area of 27,750 km^2. There are no separate geographic regions within the country.[119]

Haiti is considered to have the least developed economy of the Western Hemisphere; there are low levels of productivity and most employment is in the informal sector. Haiti has a GDP per capita of $440, a low HDI score of 0.475, and only a 34% electricity access rate.[120] Its population is 8.3 million with a high population growth rate;[121] the life expectancy is only 52 years. Some of the most pressing issues in Haiti today are slow economic development, violence and social instability, lack of internal political order, corruption, large economic gaps between rich and poor, lack of good arable land, and poor management of energy resources which has resulted in intense environmental degradation.[122] In addition, Haiti's physical infrastructure is poor and basic services are frequently unavailable.[123] The US is Haiti's largest trading partner.

Agriculture is considered the dominant productive sector, and 57% of the land area is under cultivation. Major crops include coffee, sugarcane, mangoes, corn, sorghum, and wood products. Agriculture employs roughly 66% of the population, but the small-scale farming operations are constrained by a number of environmental and infrastructural problems.[124] Only 5% of the country is still forested, and much of the remaining forested land is being cleared for agriculture or used as fuel. Additional environmental concerns include severe soil erosion, lack of potable water supply—less than 45% of the country's citizens have access to potable drinking water[125]—lack of water and waste treatment plants, and illegal dumping of waste.

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[119] Microsoft Encarta Online Encyclopedia, "Haiti-Resources and Regions," http://encarta.msn.com/encyclopedia_761576153/Haiti.html, 2005.
[120] World Bank: Private Participation in Infrastructure Database, http://ppi.worldbank.org/explore/ppi_exploreCountry.aspx?countryId=115, September 2006.
[121] Central Intelligence Agency, "World Fact Book Haiti," https://www.cia.gov/cia/publications/factbook/geos/ha.html, September 2006.
[122] British Broadcasting Corporation, "Aristide's long shadow over Haiti," http://news.bbc.co.uk/1/hi/world/americas/4306663.stm, February 28, 2005.
[123] Market Access & Compliance, http://www.mac.doc.gov/tcc/data/commerce_html/countries/Countries/Haiti/CountryCommercial/2000/, 2005.
[124] Ibid, Central Intelligence Agency, 2006.
[125] Ibid, Central Intelligence Agency, 2006.

ENERGY OVERVIEW

Biomass is the largest source of energy in Haiti, constituting 74% of the total energy supply (see Chart 2). The principal sources of biomass include firewood, charcoal, and bagasse,[126] and the primary use of these materials is for cooking food (see Chart 1). Heavy utilization of firewood and charcoal for fuel has greatly contributed to the country's problems with deforestation. Haiti's main source of energy for electricity is fossil fuels, constituting 52% of the total energy use with the remaining 48% coming from hydro sources (see Chart 3). Haiti consumes 11,000 barrels of oil per day (bbl/day) entirely from imported resources to mainly power thermal plants for the generation of electricity.[127]

Chart 1: Total Primary Energy Consumption by Sector (675.7 KTOE)

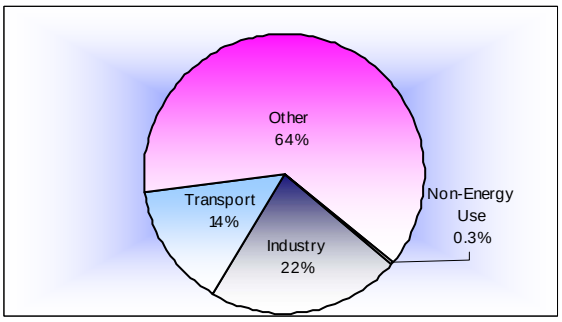
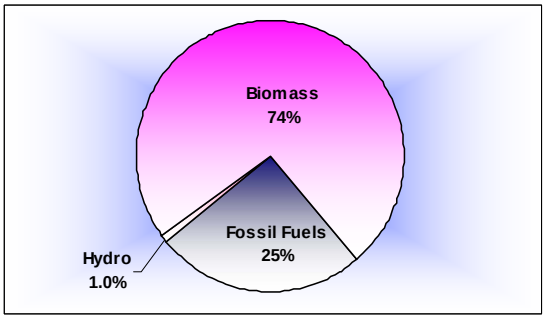
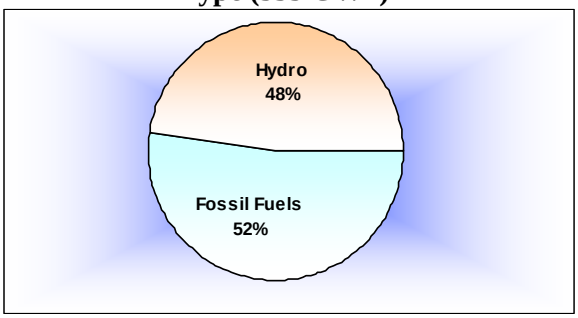


Chart 2: Total Primary Energy Consumption by Fuel (675.7 KTOE)



The use of renewable energy is generally being promoted in Haiti. Biomass is the main source of renewable energy in the country, however more sustainable biomass practices and supplies are required to consider it a renewable resource. Haiti is also looking into using feedstocks like Jatropha, an indigenous plant that exists on the border with the Dominican Republic, for conversion to biofuels. Hydropower is utilized for electricity production. Solar energy is used on a small scale in schools. Haiti also has a small wind park with an installed capacity of 150 kW, although this park is in poor condition.[128]

Chart 3: Electricity Generation by Fuel Type (535 GWh)



Haiti suffers from persistent shortages in power, transportation, and communication.[129] The Government is examining an audit of the state-run electric company, Electricity of Haiti (EDH), in order to develop a reinvestment strategy with a goal of increasing electrical provision.[130] Investment in the energy sector has been extremely low. Despite Haiti's cheap hydroelectric and thermal power resources, EDH has not been efficient in providing sufficient power for the country's needs.[131] In addition, Haiti's vulnerability to tropical storms and hurricanes negatively impacts its electricity use

[126] Office of Mines and Energy Haiti, September 4, 2004.
[127] Economist Intelligence Unit, "Country Profile 2004—Haiti," http://www.eiu.com, 2004.
[128] Cooperation for the Development of the Craft Industry, January 1999.
[129] Ibid, Economist Intelligence Unit, 2004.
[130] Ibid, Economist Intelligence Unit, 2004.
[131] iGreens Individualist Environmentalists, December 11, 2004.

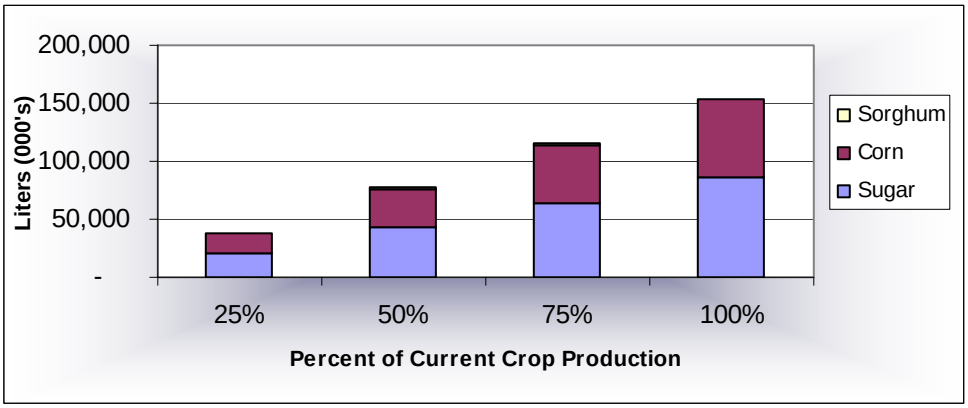
and generation. The high levels of deforestation cause severe flooding and mudslides when powerful storms reach land fall in the country.

BIOFUELS—ETHANOL AND BIO-DIESEL

Ethanol

Based on the current level of production for the biofuel crops identified, Haiti may be able to generate up to 154 million liters of ethanol. This assumes that 100% of the currently available feedstock is converted to ethanol. As shown in Chart 4, the ability to produce ethanol declines as the percentage of the feedstock used decreases. The majority of this ethanol is from sugar (56%) and corn (44%), while a small amount (less than 1%) comes from sorghum.

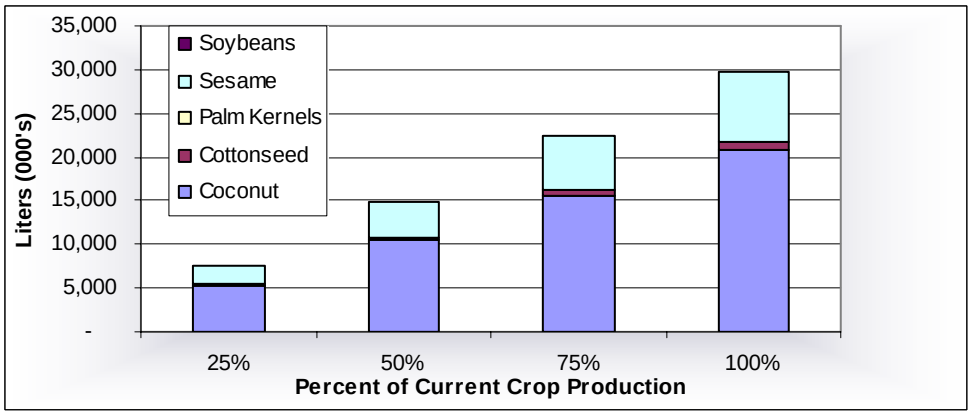
Chart 4: "What-If" Ethanol Production for Haiti
As a Percent of Current Crop Production



Bio-Diesel

Based on the current level of production for the biofuel crops identified, Haiti may be able to generate up to 30 million liters of bio-diesel. This assumes that 100% of the currently available feedstock is converted to bio-diesel. As shown in Chart 5, the ability to produce bio-diesel declines as the percentage of the feedstock used decreases. Almost all of this bio-diesel is from coconut (70%), with the remainder from sesame (27%) and cottonseed (3%).

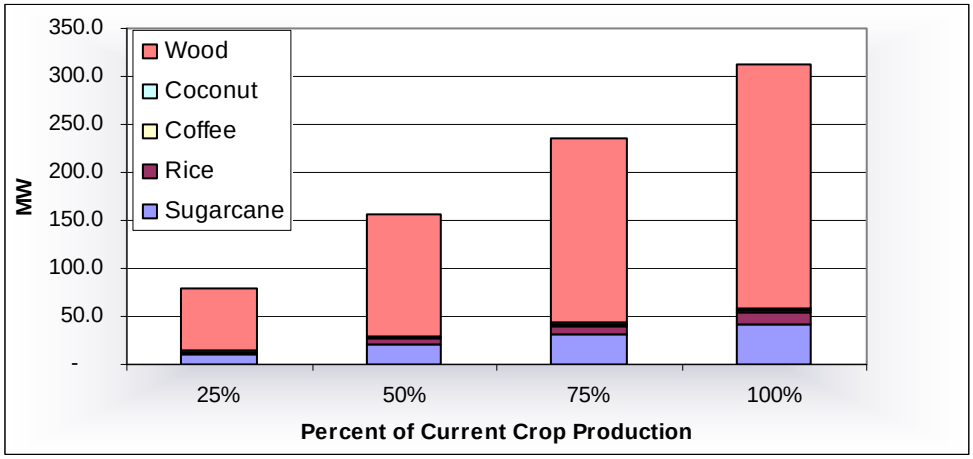
Chart 5: "What-If" Bio-Diesel Production for Haiti
As a Percent of Current Crop Production



BIO-POWER

Based on the current level of production for the bio-power crops identified, Haiti may be able to generate up to 313 MW of power. This assumes that 100% of the currently available feedstock is converted to power. As shown in Chart 6, the ability to generate power declines as the percentage of the feedstock used decreases. The majority of this power (81%) is from wood products, while the remainder is from sugarcane (13%), rice (4%), and coconut and coffee (less than 1% each).

Chart 6: "What-If" Bio-Power Production for Haiti
As a Percent of Current Crop Production



HONDURAS

COUNTRY OVERVIEW

Honduras at a Glance:

Population: 7 million
Human Development Index (HDI): 0.667
Electricity Access: 55%
GDP per capita: $ 950
Major Agricultural Crops: sugarcane, coffee, corn, bananas
% of Land under Cultivation: 26%

Honduras is the second largest Central American republic with a total area of 112,000 km^2. Its northern boundary is the Caribbean coast; it also borders Guatemala, El Salvador, and Nicaragua. Honduras has a 153 km coastline at the Gulf of Fonseca, which merges into the Pacific Ocean.[132] The majority of Honduras's land consists of mountains and hills—it is the most mountainous country in Central America and among the most mountainous countries in the world. The mountains are generally covered with vegetation and have mineral resources like gold and silver.[133]

Honduras is the least developed and most impoverished country in Central America. In 2000, it was listed as one of the Heavily Indebted Poor Countries, as designated by the International Monetary Fund (IMF) and the World Bank.[134] It has a GDP per capita of $950, a middle-low HDI score of 0.667, and only 55%[135] of the population of 7 million has access to electricity. The Honduran economy has experienced instability due to lowered prices for the chief export, coffee. Honduras has also had issues with civil unrest, violent crime, drug trafficking, and increased poverty.[136] In 2004, Honduras was approved for a 15-year debt relief program valued at US$960 million by the IMF to help with poverty reduction.[137] The US is Honduras's main trading partner in both imports and exports; the US accounted for 40% of non-maquila exports and over 90% of maquila exports in 2002. Honduras is a member of CAFTA. The Honduran infrastructure is frequently affected by natural disasters, especially the enormous destruction caused by Hurricane Mitch in 1998.

Forests cover the majority of the land (54%), except in places where they have been cleared to plant crops. About 26% of the country is cropland and major crops include bananas, corn, coffee, sugarcane, and tropical fruits. Agricultural commodities such as these made up the bulk of the export economy until the mid 1980s, when the market diversified to include other non-traditional agricultural exports such as shrimp and palm oil. However, the forest and marine resources are threatened by adverse agricultural practices.[138] Other environmental issues include deforestation (clearing for agricultural land and urban growth), and the negative effects of mining such as water and land contamination.

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[132] Country Studies, "Honduras," http://countrystudies.us/honduras, 2005.
[133] Peace Corps, "Honduras," http://www.peacecorps.gov/wws/guides/honduras/honour.html, 1992.
[134] Bureau of Western Hemisphere Affairs, "Background Note Honduras," http://www.state.gov/r/pa/ei/bgn/1922.htm, September 2004.
[135] World Bank: Private Participation in Infrastructure Database, http://ppi.worldbank.org/explore/ppi_exploreCountry.aspx?countryId=116, September 2006.
[136] European Commission, "Country Strategy Paper–Honduras 2002-2006," http://europa.eu.int/comm/external_relations/honduras/csp/02_06_en.pdf, 2002.
[137] Ibid, European Union External Commission, May 2004.
[138] Ibid, Bureau of Western Hemisphere Affairs, September 2004.

ENERGY OVERVIEW

Honduras's power generation capacity mainly comes from fossil fuel energy and hydroelectric power. Fossil fuels compose about 54% of overall energy supply (see Chart 1), and about 50% of electricity supply—with hydropower supplying roughly the other half (see Chart 2). As of September 2002, it was reported that Honduras had an installed capacity of 30 MWof biomass cogeneration.

Although Honduras has reported several initiatives on renewable energy, power generation from renewable energy sources contributes to a very small percentage of the total installed capacity. Honduras is a net importer of fossil fuels to meet energy demands—it has no reserves and it does not produce crude oil or natural gas.[139] Trends show Honduras's dependency on thermal electricity will increase based on new investments in this energy source and the lack of investments in alternative energy sources.[140] For energy demand by sector see Chart 3.

Chart 1: Total Primary Energy Consumption by Fuel (2,539 KTOE)

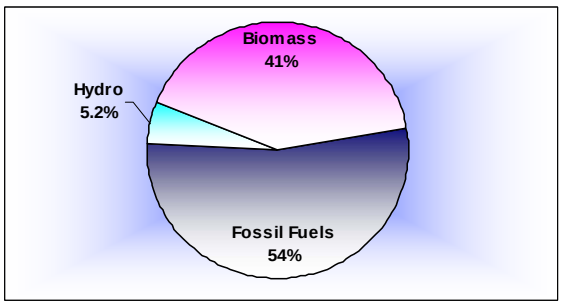
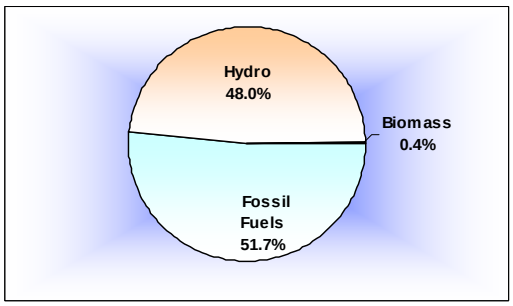
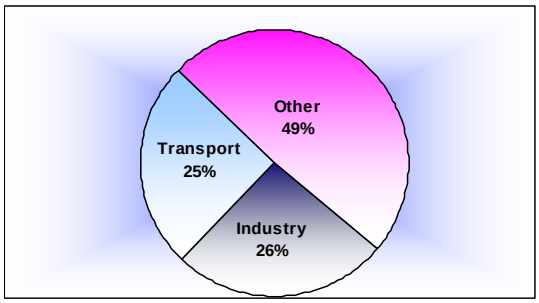


Chart 2: Electricity Generation by Fuel Type (4,530 GWh)



Renewable energy (other than hydroelectric power) represents less than 2% of the total installed capacity in Honduras. Electricity generation from biomass is the most prevalent power generation source in the country. However, the potential for use of solar, wind, and geothermal energy has also been reported on a minor scale. Major sources of biomass are sugarcane bagasse, wood, and sawmill wastes produced by the sugar and forest industries.

Chart 3: Total Primary Energy Consumption by Sector (2,539 KTOE)



The General Directorate of Energy (DGE), through the Hydrocarbon Department, is in charge of generating policies, managing imports, and the commercialization of all activities related to hydrocarbons in Honduras.[141] The Secretariat of the Environment and Natural Resources (SERNA) is the principal governmental entity in charge of national environmental laws, protection, conservation, restoration, and sustainable handling of the environment.[142] The state-owned National Electric Energy Company (ENEE) oversees the

[139] Energy Information Administration, "Central America Environmental Issues," http://www.eia.doe.gov/emeu/cabs/centamenv.html, 2001.
[140] La Prensa, "Honduras Condenada a las Térmicas al Descartar Proyectos Hidroeléctricos Honduras: The Country Depends of Thermal Energy," June 2002.
[141] Dirección General de Energía, "Información General," http://www.serna.gob.hn/recursosnaturales/energia/energia.htm#, 2004.
[142] Secretaría de Recursos Naturales y Ambiente, http://www.serna.gob.hn, 2005.

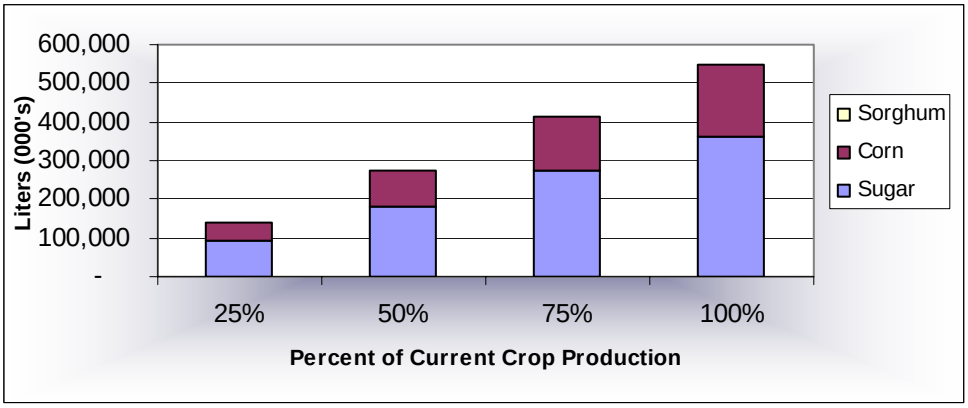
production, transmission, and distribution of electricity in Honduras, with the National Commission for Electric Energy (CNEE) as the regulatory body.[143] The ENEE controls the hydroelectric sector, while 100% of the electricity produced from biomass and about 94% of thermoelectricity is generated by the private sector.[144]

BIOFUELS—ETHANOL AND BIO-DIESEL

Ethanol

Based on the current level of production for the biofuel crops identified, Honduras may be able to generate up to 549 million liters of ethanol. This assumes that 100% of the currently available feedstock is converted to ethanol. As shown in Chart 4, the ability to produce ethanol declines as the percentage of the feedstock used decreases. The majority of this ethanol (66%) is from sugar, with the remainder (34%) coming from corn.

Chart 4: "What-If" Ethanol Production for Honduras
As a Percent of Current Crop Production

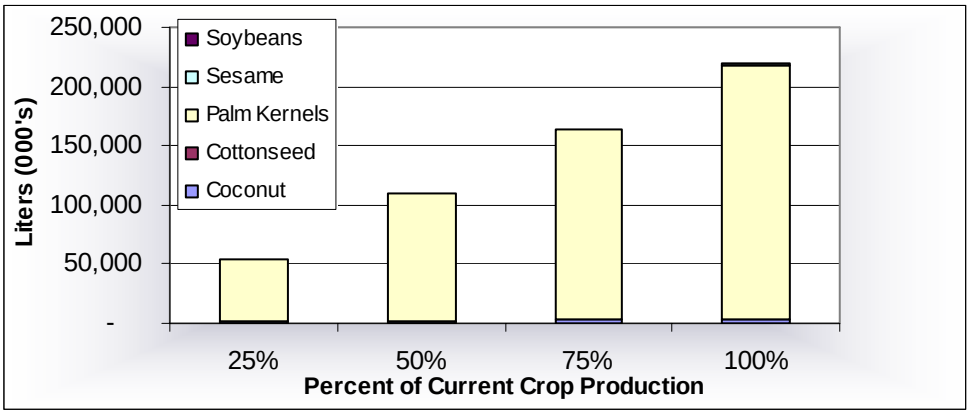


Bio-Diesel

Based on the current level of production for the biofuel crops identified, Honduras may be able to generate up to 220 million liters of bio-diesel. This assumes that 100% of the currently available feedstock is converted to bio-diesel. As shown in Chart 5, the ability to produce bio-diesel declines as the percentage of the feedstock used decreases. The majority of this bio-diesel (98%) is from palm kernels. The remainder is from coconut (less than 2%); cottonseed, sesame, and soybeans make up less than 1% combined.

[143] Empresa Nacional de Energía Eléctrica, "Quienes Somos," http://www.enee.hn/quienes.htm, 2000.
[144] Ibid, Empresa Nacional de Energía Eléctrica, 2000.

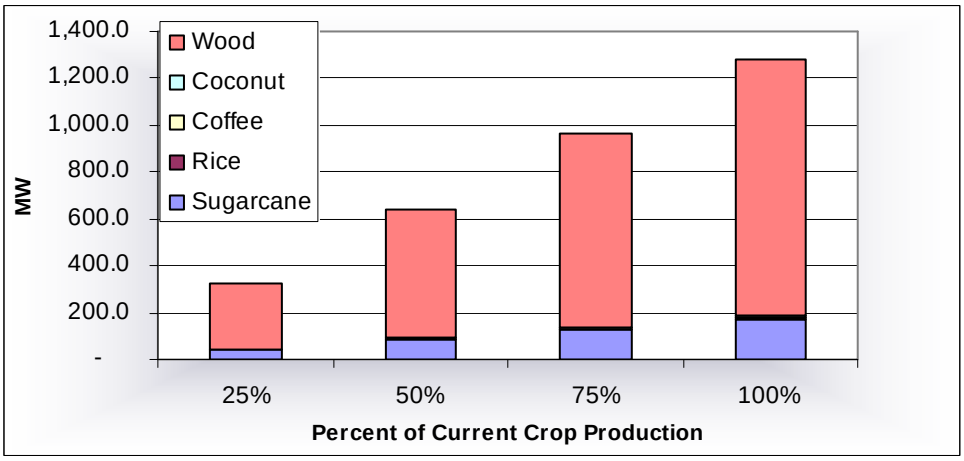
Chart 5: "What-If" Bio-Diesel Production for Honduras
As a Percent of Current Crop Production



BIO-POWER

Based on the current level of production for the bio-power crops identified, Honduras may be able to generate up to 1,283 MW of power. This assumes that 100% of current available feedstock is converted to power. As shown in Chart 6, the ability to generate power declines as the percentage of the feedstock used decreases. The majority of this power (86%) is from wood products. The remainder is from sugarcane (14%), and coconut, coffee, and rice (less than 1% combined).

Chart 6: "What-If" Bio-Power Production for Honduras
As a Percent of Current Crop Production



JAMAICA

COUNTRY OVERVIEW

Jamaica at a Glance:
Population: 2.6 million
Human Development Index (HDI): 0.74
GDP per capita: $3,150
Electricity Access: 90%
Major Agricultural Crops: sugarcane, coffee, bananas
% of Land under Cultivation: 47%

Jamaica is an island nation in the Caribbean Sea south of Cuba. The country's terrain is mostly mountainous except for lowlands along the south coast. Although there are no active volcanoes on the island, there are still many natural hot springs. Jamaica has a total land area of 10,991 km^2, and 1,022 km of coastline. There are no separate geographical regions.[145]

Jamaica is considered a fairly developed country in the region with a GDP per capita of $3,150 and an HDI of 0.74 (medium-high). Approximately 90% of the island has electricity access.[146]

The Jamaican economy traditionally centered on production of bauxite, sugar, and refined sugar, and export-oriented manufacturing. However, the economy is transitioning to a service economy, focused on tourism. Agricultural output declined between 1995 and 2002, but still accounts for approximately 20% of total employment.[147] Agricultural products (sugar and derived products, bananas, coffee), along with alumina and bauxite, made up the bulk of the US$1.7 billion export market in 2004. Major export destinations included the US (29.2%) and European nations (32.2%).[148] Jamaican imports for 2004 were estimated at US$3.6 billion consisting of food and consumer goods, industrial supplies, fuel, capital goods, and construction materials; major importing partners included the US (39.8%), and Trinidad and Tobago (9.7%).[149] Jamaica has a stable government and good international relations; however, the country has issues with crime and violence as well as illegal drug trafficking.[150] The population is 2.6 million with a stable growth rate. Due to the tourism sector, Jamaica has fairly good infrastructure, but is at risk from hurricanes.

Forty-seven percent of land is under agricultural cultivation (sugarcane is the major crop), and 17% is forested. Jamaica receives substantial rainfall, so irrigation is generally not required for agriculture. Although the agriculture industry is in decline, forested land is still being cleared at a high rate for forest products, development, and small-scale agriculture. Jamaica's rich biodiversity has suffered greatly due to this deterioration. Other environmental conditions include polluted coastal waters from industrial waste, poor sewage control, damaged coral reefs, and heavy air pollution over Kingston, the country's capital.[151]

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[145] Microsoft Encarta Online Encyclopedia, "Jamaica—Resources and Regions," http://encarta.msn.com/encyclopedia_761561054/Jamaica.html, 2005.
[146] World Bank: Private Participation in Infrastructure Database, http://ppi.worldbank.org/explore/ppi_exploreCountry.aspx?countryId=117, September 2006.
[147] Economist Intelligence Unit, "Country Profile Jamaica," http://www.eiu.com, 2004.
[148] Central Intelligence Agency, "The World Fact Book," http://www.cia.gov/cia/publications/factbook/geos/jm.html, 2005.
[149] Ibid, Economist intelligence Unit, 2004.
[150] US Department of State, "Background Note—Jamaica," http://www.state.gov/r/pa/ei/bgn/2032.htm, 2005.
[151] Ibid, Central Intelligence Agency, 2005.

ENERGY OVERVIEW

Jamaica imports almost all of its oil and is highly susceptible to international prices, which have fluctuated in the last decade, creating an oil import bill estimated at US$529 million in 2003. Jamaican oil imports account for 24% of the country's total imports. In 2004, oil imports cost the equivalent of two-thirds of merchandise export earnings. The alumina/bauxite industry accounts for more than 48% of oil imports[152] (see Chart 1). To decrease its dependence on imported oil, the Government of Jamaica is actively looking at alternative thermal sources such as LNG, biomass gasification cogeneration technologies able to utilize agricultural waste from sugar production, and increasing oil exploration on the island.[153] In addition, an Energy Efficiency and Conservation program is being placed in Jamaica's national agenda and Jamaica's Energy Sector Policy proposes introducing natural gas as well as renewable energy into the mix.[154] At this time, the majority of total primary energy consumption and electricity consumption are from imported oil (see Charts 2 and 3).

Chart 1: Total Primary Energy Consumption by Sector (3,871 KTOE)

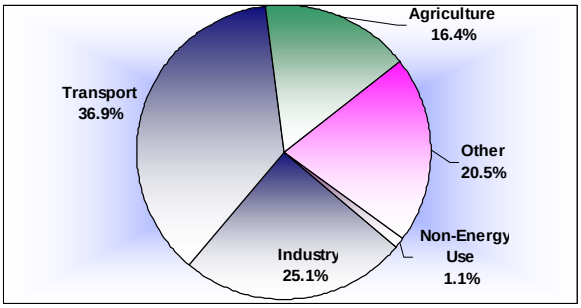
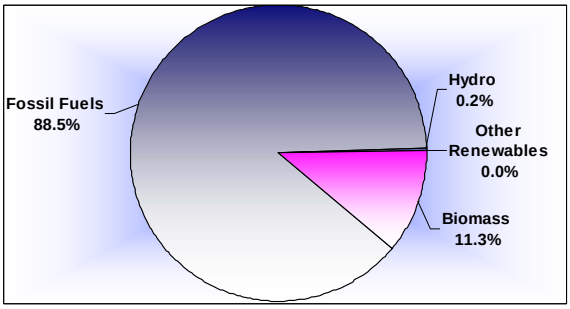
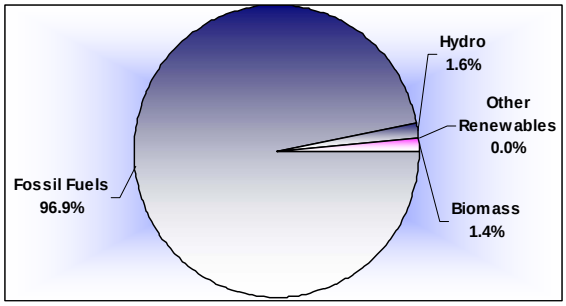


Chart 2: Total Primary Energy Consumption by Fuel (3,871 KTOE)



Jamaica has power generation from wind, hydro (24 MWe of run-of-river capacity in eight plants), and some solar power (15 kWp of PV). It is home to the region's largest wind farm (Wigton, 21 MW) and additional capacity is being considered. There are also about 5,000 solar water heaters in the country. Jamaica currently has the capacity[155] to convert 110 million gallons (440 million liters) of hydrated ethanol annually to the anhydrous form at dehydration plants located at Rockfort and Petrojam in Kingston. The Petrojam Ethanol plant was reopened in 2005 in partnership with the Brazilian entity Coimex Trading, and is supplied by feedstock (hydrous ethanol) imported from Brazil, with the output exported primarily to the US market. However, it is anticipated that these plants also can accept locally produced feedstock of wet ethanol from the Jamaican cane industry in the future.

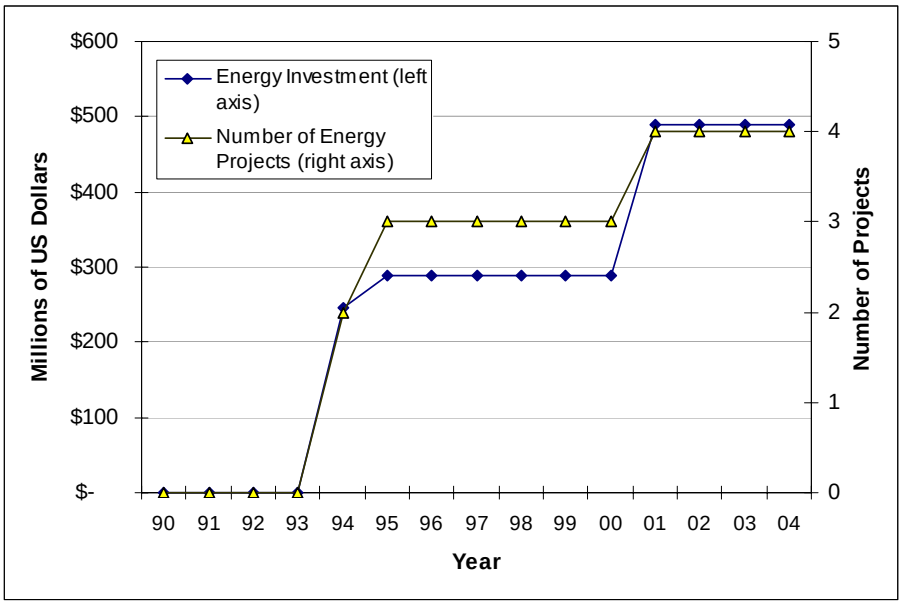
Chart 3: Electricity Generation by Fuel Type (7,146 GWh)



[152] Petroleum Corporation of Jamaica, "Petroleum Industry Statistics," http://www.pcj.com/industry_stat.htm, no date available.
[153] Economist Intelligence Unit, "Country Profile Jamaica," http://www.eiu.com, 2004.
[154] Business News Americas Oil and Gas News, "Ministry Looking for Oil and Exploration Partners–Jamaica," http://dialogpro.dialog.com, July 2004.
[155] Government of Jamaica, "The Jamaica Country Strategy for the Adaptation of the Sugar Industry, 2006–2015," January 2006.

The majority of the country's power generation facilities are owned by the Jamaica Public Service (JPS) Company. The Petroleum Corporation of Jamaica (PCJ) is responsible for the exploration of oil and the development of Jamaica's petroleum resources.[156] Government ministries that focus on energy and agriculture include the Ministry of Agriculture; Ministry of Commerce, Science, and Technology; and the Ministry of Land and Environment. Overall, investment in the energy sector has been sporadic since 1990 with only a couple of larger energy investment projects (see Chart 4).

Chart 4: Cumulative Energy Investments in Jamaica



Jamaica's National Energy Policy proposes an increase in renewable energy-based generation to 12% by 2012. Further, Jamaica recently published guidelines for net billing licenses on offer to individuals to sell electricity to the national grid. Renewable energy producers who opt onto the net billing program will get a 15% premium on the proposed 5-9 cents price, in line with the national energy policy's target to boost renewable energy supplies to 15% of capacity by 2015. JPS currently sells electricity at about 23 cents per kilowatt/hour (US) to residential customers, but proposes to buy from net billing licensees at much lower prices of 5 cents per kWh for long-term contracts and 9 cents per KWh for persons/entities who sell to the grid on a per-month basis. Customers are billed if their consumption exceeds supply to the grid, or credited when supply exceeds use.[157]

BIOFUELS—ETHANOL AND BIO-DIESEL

Ethanol

Based on the current level of production for the biofuel crops identified, Jamaica may be able to generate up to 167 million liters of ethanol. (In 2004 Jamaica produced about 184,000 MT of sugar.) This assumes that 100% of the currently available feedstock is converted to ethanol. As shown in Chart 5, the ability to produce ethanol declines as the percentage of the feedstock used decreases. The majority of this ethanol is from sugar, while a small amount (less than 1%) is from corn.

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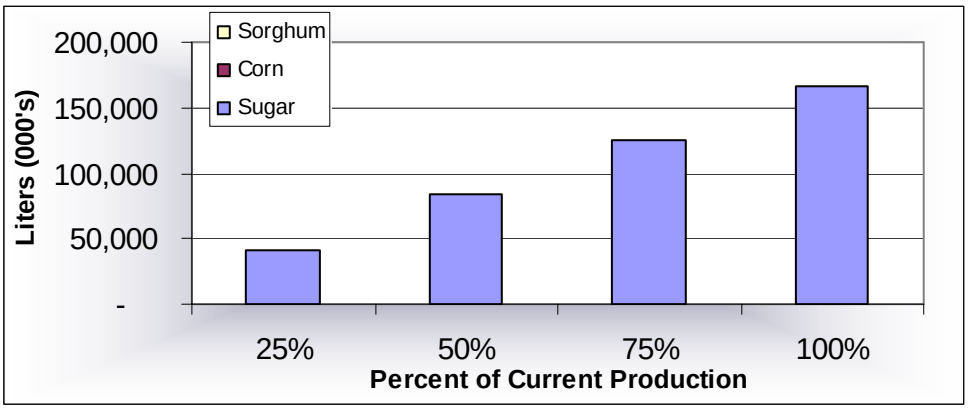
[156] Ibid, Petroleum Corporation of Jamaica, no date available.
[157] Caribbean Energy Information Services (CEIS), "Caribbean Energy News Highlights," http://www.comnet.mt/ceis/news.htm.

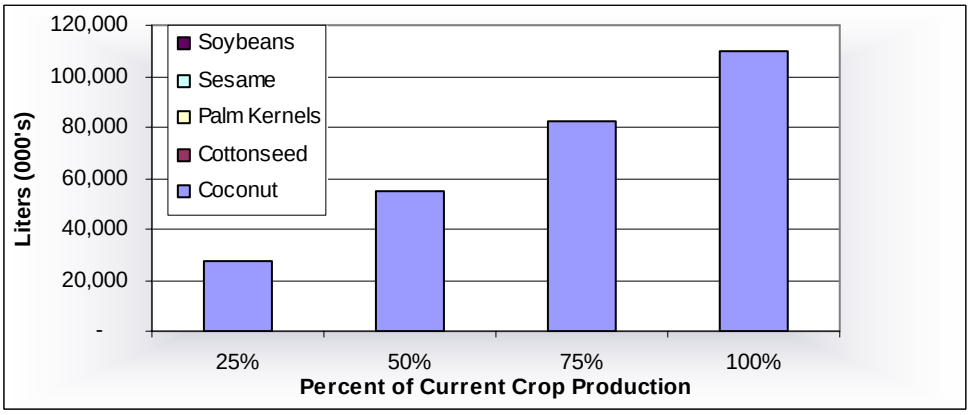
Chart 5: "What-If" Ethanol Production for Jamaica
As Percent of Current Production



Bio-Diesel

Based on the current level of production for the biofuel crops identified, Jamaica may be able to generate up to 110 million liters of bio-diesel. This assumes that 100% of the currently available feedstock is converted to bio-diesel. As shown in Chart 6, the ability to produce bio-diesel declines as the percentage of the feedstock used decreases. All of this bio-diesel comes from coconut.

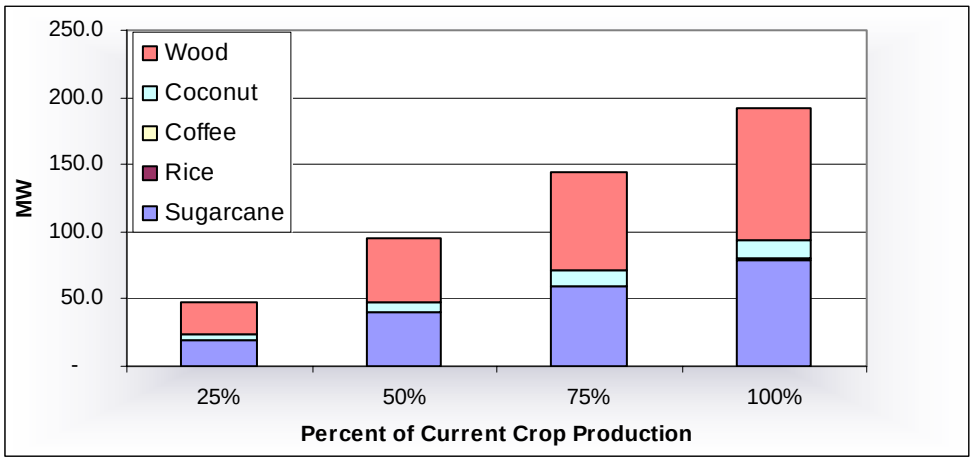
Chart 6: "What-If" Bio-Diesel Production for Jamaica
As a Percent of Current Production



BIO-POWER

Based on the current level of production for the bio-power crops identified, Jamaica may be able to generate up to 192 MW of power. This assumes that 100% of current available feedstock is converted to power. As shown in Chart 7, the ability to generate power declines as the percentage of the feedstock used decreases. The majority of this power (51%) is from wood products, while the remainder is from sugarcane (almost 42%), coconut (almost 8%), and coffee (less than 1%).

Chart 7: "What-If" Bio-Power Production for Jamaica
As Percent of Current Production



NICARAGUA

COUNTRY OVERVIEW

Nicaragua at a Glance:

Population: 5.4 million
Human Development Index (HDI): 0.69
Electricity Access: 48%
GDP per capita: $770
Major Agricultural Crops: sugarcane, groundnuts, coffee, bananas, corn
% of Land under Cultivation: 58%

Nicaragua is the largest country in Central America, bordered by Honduras to the north, the Caribbean Sea to the east, Costa Rica to the south, and the Pacific Ocean to the west. It covers a total area of 129,494 km^2. Nicaragua experiences earthquakes, hurricanes, and volcanic eruptions. In 1998, Hurricane Mitch seriously affected the northern regions of the country. Nicaragua has three distinct geographical areas—the Pacific Lowlands, the North-Central Mountains, and the Caribbean Lowlands (also called the Mosquito Coast).[158]

Nicaragua is one of the poorest countries of the Central American region, and receives debt relief through the IMF, as well as significant development aid; foreign assistance dependence is equivalent to 25% of the 2001 Nicaraguan GDP.[159] Nicaragua has a GDP per capita of $770, an HDI score of 0.69, and only 48% of the population of 5.4 million has access to electricity.[160] In Nicaragua, 68.7% of the rural population lives below the poverty line (30.5% in urban areas).[161] The US is Nicaragua's largest trading partner, accounting for 25% of imports, and is the destination of 60% of Nicaraguan exports. The largest sectors of US investment are energy, communications, and manufacturing, which also accounts for the growth in maquiladoras.[162] The countries of the Central American Common Market are the second largest trading partners; Nicaragua is also a member of CAFTA. Nicaragua's largest sector is services (accounting for 54% of GDP), followed by industry (26%), and agriculture (18%).[163] Nicaragua had political unrest from 1979 to 1990 where much of the country's infrastructure was destroyed; this left the country vulnerable during the severe natural disasters of Hurricane Mitch in 1998 and the massive flooding and earthquakes in 2002.[164]

Roughly 58% of the country's land is under agricultural cultivation, with 25% forested. Agriculture plays a major role in the export economy; major crops include sugarcane, bananas, coffee, ground nuts, rice, and corn. Environmental concerns for Nicaragua are deforestation, soil erosion, and water pollution. Water pollution, for example, has destroyed the fishing industry in Lake Managua and

[158] Central Intelligence Agency, "The World Factbook--Nicaragua," http://www.cia.gov/cia/publications/factbook/geos/nu.html, 2005.
[159] Economist Intelligence Unit, "Country Monitor Main Report," February 2004.
[160] World Bank: Private Participation in Infrastructure Database, http://ppi.worldbank.org/explore/ppi_exploreCountry.aspx?countryId=119, September 2006.
[161] European Commission External Relations Directorate General, "Country Strategy Paper 2002-2006," http://europa.eu.int/comm/external_relations/nicaragua/csp/index.htm, 2002.
[162] Bureau of Western Hemisphere Affairs, "Background Note Nicaragua," http://www.state.gov/r/pa/ei/bgn/1850.htm, 2005.
[163] Ibid, Central Intelligence Agency, 2005.
[164] Economist Intelligence Unit, "Country Profile Nicaragua," www.eiu.com, November 2004.

elsewhere. Access to clean water is a particular problem in western Nicaragua, where many people have no sanitation, and sewage treatment is inadequate for urban areas with large populations.[165]

ENERGY OVERVIEW

Since 1999, Nicaragua has consistently had the highest energy intensity in Central America.[166] It relies on petroleum for about 42% of overall energy needs (see Chart 1), and uses a mixture of fossil fuels, hydropower, geothermal, and waste energy for electricity production (see Chart 2). As of September 2002, it was reported that Nicaragua had 122 MW of biomass cogeneration installed.

Nicaragua is a net importer of oil and gas, having no oil production; it has one oil refinery with a capacity of 16,000 bbl/day. Most of Nicaragua's oil imports come from Venezuela—imported petroleum satisfies roughly half of the country's energy needs.[167] See Chart 3 for energy demand breakouts by sector.

Chart 1: Total Primary Energy Consumption by Fuel (1.614 KTOE)

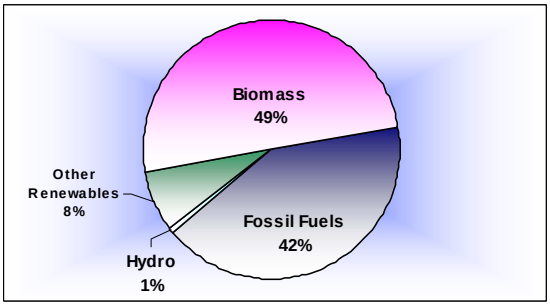
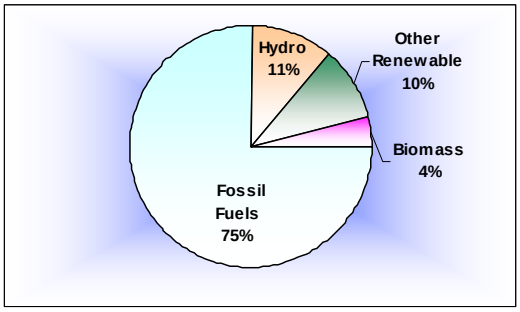
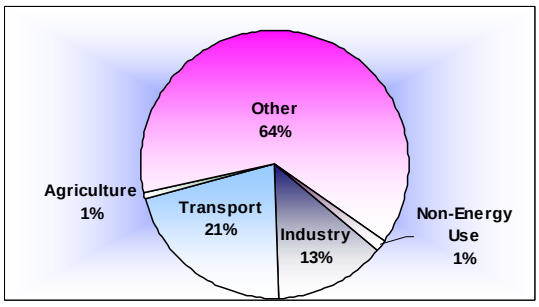


Chart 2: Electricity Generation by Fuel Type (2,707 GWh)



Nicaragua has a total installed capacity of roughly 104 MW from hydroelectricity, and plans to expand its hydroelectric resources at a small scale by constructing 30 mini-hydroelectric power stations.[168] The government is looking to further exploit renewable energy through development of more hydropower, wind, geothermal, and biomass. In April 2005, the law for the Promotion of Electric Generation based on Renewable Resources (Law No. 532, April 2005) mandates the following: (1) a 10-year period with tax benefits for investors; (2) a property tax exemption for seven years; (3) local tax exemptions for ten years; and (4) secure payments for renewable energy of 5.5-6.5 cents/kWh. In May 2005, the Parliament reformed the Hydro Sub-Sector

Chart 3: Total Primary Energy Consumption by Sector (1,614 KTOE)



[165] Ibid, Central Intelligence Agency, 2005.
[166] Energy Information Administration, "Central America: Environmental Issues," http://www.eia.doe.gov/emeu/cabs/centamenv.html, 2002.
[167] AllRefer, "Nicaragua: Electric Power and Energy," http://reference.allrefer.com, 1993.
[168] Comisión Nacional de Energía, "Potencial Hidroeléctrico en Nicaragua," www.cne.gob.ni, 2002.

Promotion Law. The Ministry of Industry allowed the use of water for the purpose of energy generation (from 1 MW until 30 MW).[169] Nicaragua has the largest geothermal potential in Central America coming from the Marrabios range of volcanoes, which run parallel to the Pacific coast.[170] In addition to geothermal, Nicaragua has an installed capacity of about 30 MW from biomass including a 1.432 MW (net) rice husk fired plant, a 1.136 MW (net) peanut shell fired plant, and 5 MW sawmill waste and forestry residue fired plants.

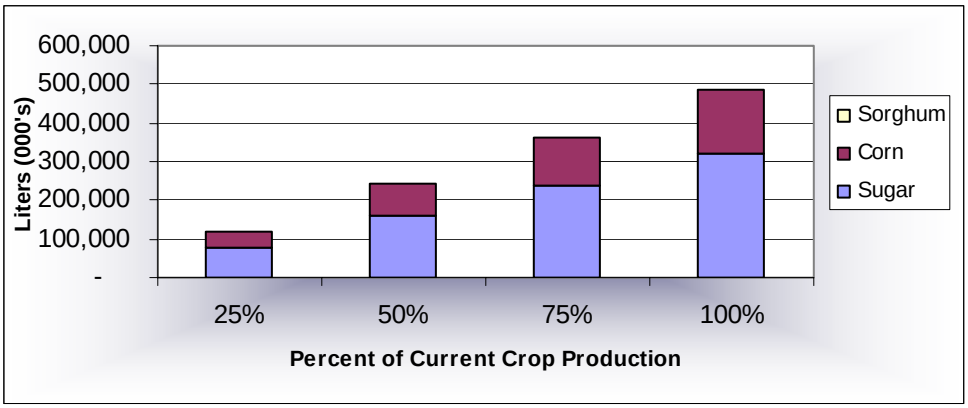
The National Energy Commission (CNE) is the governing organization in charge of policy and planning for the energy sector. The Nicaraguan Institute for Energy (INE) is the independent regulatory body of the Nicaraguan power sector. Most of the country's electrical generation is provided by the private sector—even the state-owned Nicaraguan Electricity Company (ENEL) is undergoing privatization. Nicaragua's generating capacity is traded with its neighbors, Panama and Honduras, depending on the consumption demand of the local market.[171]

BIOFUELS—ETHANOL AND BIO-DIESEL

Ethanol

Based on the current level of production for the biofuel crops identified, Nicaragua may be able to generate up to 486 million liters of ethanol. This assumes that 100% of the currently available feedstock is converted to ethanol. As shown in Chart 4, the ability to produce ethanol declines as the percentage of the feedstock used decreases. The majority of this ethanol is from sugar (66%), with the remainder from corn (34%) and sorghum (less than 1%).

Chart 4: "What-If" Ethanol Production for Nicaragua
As a Percent of Current Crop Production



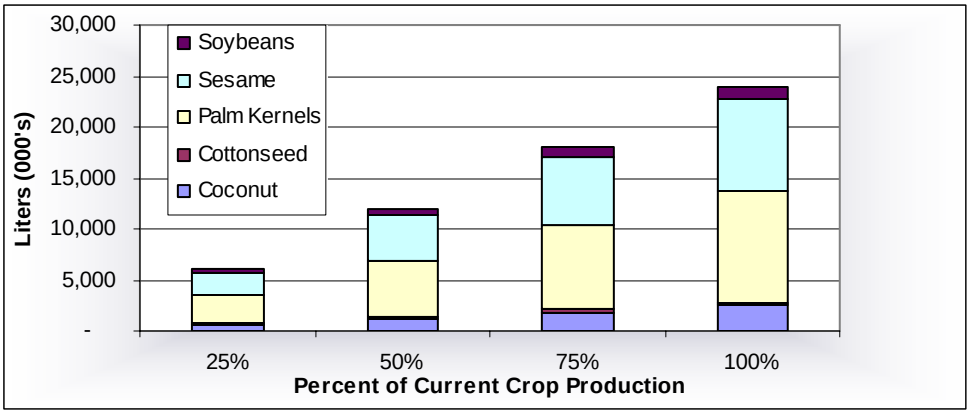
Bio-Diesel

Based on the current level of production for the biofuel crops identified, Nicaragua may be able to generate up to 24 million liters of bio-diesel. This assumes that 100% of the currently available

[169] Coveillo, M.F., ECLAC, United Nations, "Energias Renovables en America Latina y el Caribe: Barreras y Avances", no date available.
[170] International Geothermal Development, "Geothermal Nicaragua," http://www.geothermal.org/articles/nicaragua.pdf, 2003.
[171] Centro Nacional de Despacho de Carga, "Asamblea Nacional de la Republica de Nicaragua," http://www.cndc.org.ni/links/ley.html, no date available.

feedstock is converted to bio-diesel. As shown in Chart 5, the ability to produce bio-diesel declines as the percentage of the feedstock used decreases. The majority (46%) of this bio-diesel is from palm kernels with the remainder coming from sesame (38%), coconut (10%), soybeans (5%), and cottonseed (1%).

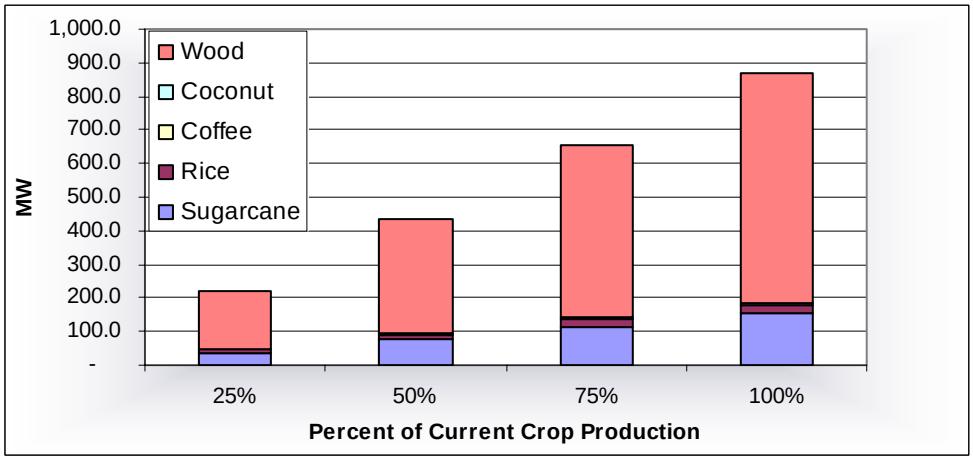
Chart 5: "What-If" Bio-Diesel Production for Nicaragua
As a Percent of Current Crop Production



BIO-POWER

Based on the current level of production for the bio-power crops identified, Nicaragua may be able to generate up to 872 MW of power. This assumes that 100% of current available feedstock is converted to power. As shown in Chart 6, the ability to generate power declines as the percentage of the feedstock used decreases. The majority of this power (79%) is from wood products, while the remainder is from sugarcane (18%), rice (3%), and coffee and coconut (less than 1% combined).

Chart 6: "What-If" Bio-Power Production for Nicaragua
As a Percent of Current Crop Production

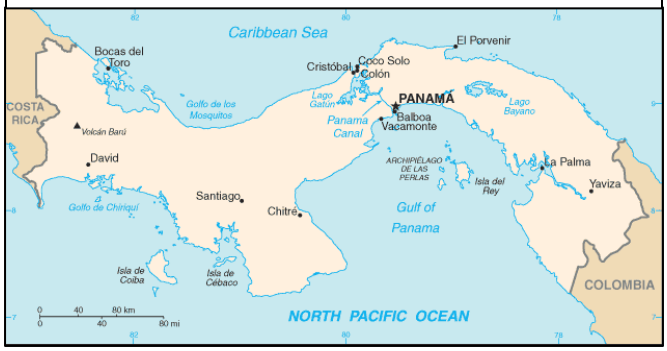


PANAMA

COUNTRY OVERVIEW

Panama at a Glance:

Population: 3.18 million
Human Development Index (HDI): 0.804
Electricity Access: 76%
GDP per capita: $3,990
Major Agricultural Crops: sugarcane, rice, bananas
% of Land under Cultivation: 30%



Panama is located on the narrowest and lowest part of the Isthmus of Panama that links Central America and South America. This S-shaped part of the isthmus is situated between Colombia to the east and Costa Rica to the west. Panama is approximately 77,082 km^2 in area. It possesses a number of small islands in both the Caribbean and the Pacific oceans. Panama's territory is characterized by a Caribbean coastline, Pacific shallow coasts, a central spine of mountains and hills that runs east and west almost the full length of Panama, and several main rivers.[172] Panama is split in half by the Panama Canal—the major shipping route connecting the Atlantic and Pacific Oceans.

Panama's economy is tied in many ways to operation and management of the Canal—about 75% of the economy is in the services sector. Panama is fairly developed with a good overall infrastructure; GDP per capita is $3,990, the HDI score is high at 0.804, and 76% of the population has access to electricity.[173] Panama's exports include bananas, shrimp, sugar, coffee, and manufactured goods to the US (51%), Sweden (7%), and Spain (5%). The majority of imports come from the US.[174] Additionally, half of the US-imported oil is from Western Hemisphere countries; the Panama Canal is considered a "choke point" for these oil imports, meaning that its potential for closure could significantly impact world oil prices.[175] Panama's politics have not been stable throughout the years, which have resulted in military interventions that prompted the deterioration of diplomatic relations with other countries, especially the US.[176] The population of Panama is 3.18 million with a fairly high growth rate.

Panama has 30% of its land under agricultural cultivation and about 43% of the land is forested. Agricultural crops include sugarcane, rice, corn, bananas, and coffee. Increased agriculture has led to a high deforestation rate; Panama has relatively more tropical forest cover than any other country in Central America, but is clearing its forests the fastest at a rate of 148,200 acres per year.[177] Since 1940, Panama has lost approximately 50% of its forests.[178] An additional environmental issue is the heavy pollution in the Panama Bay and along the Canal.

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[172] Country Studies, "Panama--Geography," http://countrystudies.us/panama/24.htm, no date available.
[173] World Bank: Private Participation in Infrastructure Database, http://ppi.worldbank.org/explore/ppi_exploreCountry.aspx?countryId=120, September 2006.
[174] Ibid, Central Intelligence Agency, 2006.
[175] Energy Information Administration, "Country Analysis Brief World Oil Transit Chokepoint," http://www.eia.doe.gov/emeu/cabs/choke.html, 2004.
[176] The Economist Intelligence Unit, "Panama risk: Political stability risk," 2004.
[177] The Christian Science Monitor, http://csmonitor.com/cgi-bin/durableRedirect.pl?/durable/1997/10/23/intl/intl.2.html, October 1997.
[178] Michael L. Connif, "Panama," Microsoft Encarta Reference Library, 2003.

ENERGY OVERVIEW

Panama's energy is mainly from fossil and hydroelectric sources (see Charts 1 and 2). Panama does utilize biomass for cogeneration with fossil fuels. Panama has almost no hydrocarbon energy reserves; virtually all oil and refined products (mainly diesel) for power generation are imported.[179] The country neither produces nor consumes natural gas;[180] however, one proposed strategy to reduce market volatility and improve the thermoelectric sector in Panama is to switch from liquid fuels to natural gas.[181] Although Panama has fairly good infrastructure, only 76% of the population has access to electricity. Most of the regions that do not have access are in isolated rural areas,[182] and the government plan calls for increased electricity coverage to 95% in the coming decade.[183] The transport sector has the highest energy demand (see Chart 3).

Chart 1. Total Primary Energy Consumption by Sector (5,026 KTOE)

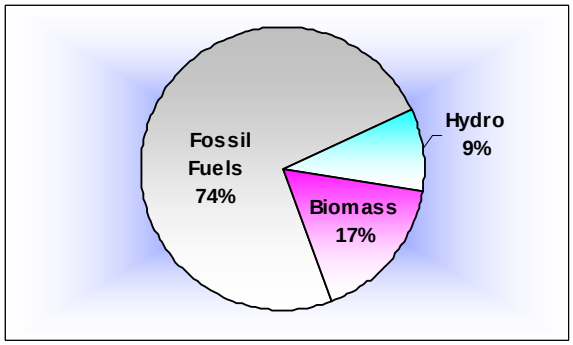
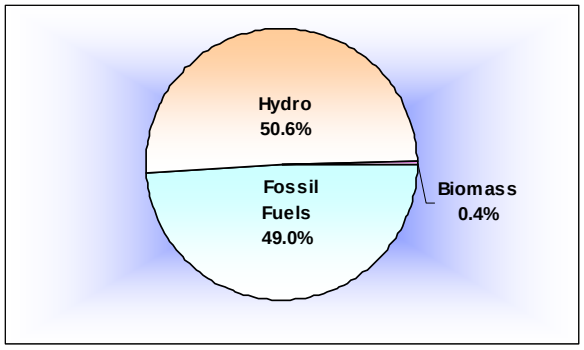
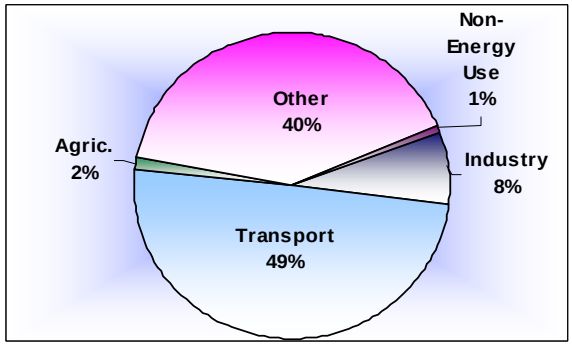


Chart 2. Electricity Generation by Fuel Type (5,576 GWh)



Although Panama is looking at more renewable energy development, current subsidies in the energy market are impeding the attraction of investments.[184] At this time, renewable energy initiatives (excluding hydropower) are in the early stages of development or are very small scale for rural applications. However, it is estimated that Panama has approximately 10 MW of generation capacity as biomass cogeneration,[185] and there is investment interest in additional waste-to-energy, small-scale hydropower, and wind projects.[186]

Chart 3. Total Primary Energy Consumption by Sector (5,026 KTOE)



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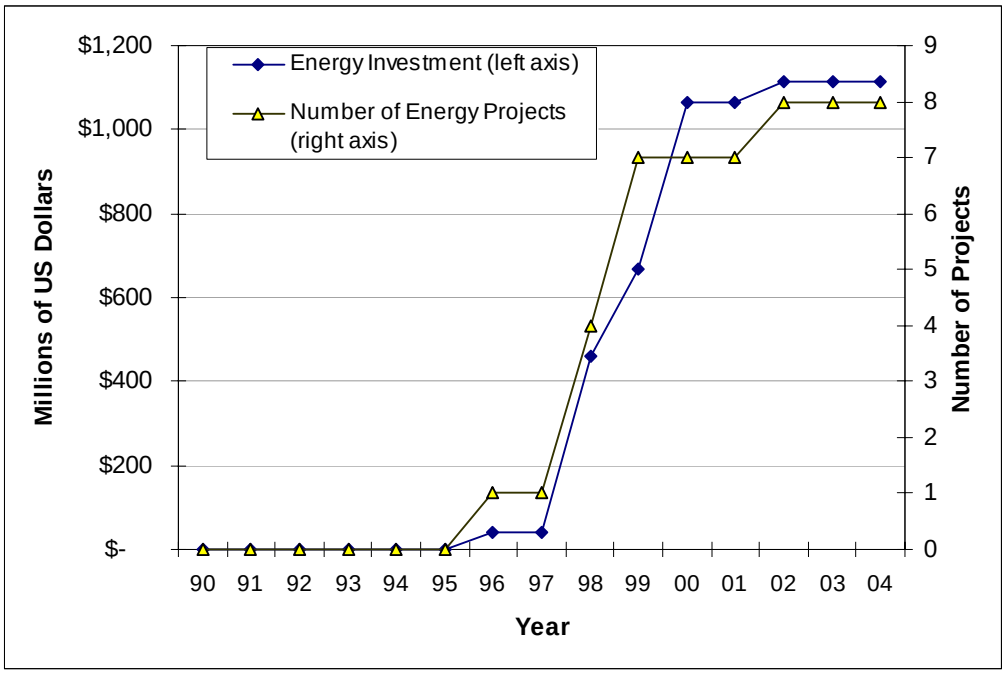
[179] Energy Information Administration (EIA), "Country Analysis Brief, Panama," http://www.eia.doe.gov/emeu/cabs/panama.html, 2003.
[180] Portafolio, "Colombia Wants to Export Power to Central America/Mexico," http://dialogpro.dialog.com, 2003.
[181] Ibid, Portafolio, 2003.
[182] Ente Regulador de los Servicios Publicos, "Transmision Anuario Estadistico del Sector Electrico," http://www.ersp.gob.pa/electric/Anexos/Estadisticas/03transmision.pdf, 2002.
[183] Ibid, Energy Information Administration, 2003.
[184] Oscar Coto-Chinchilla, "Renewable Energy and Energy Efficiency (REEES) in Central America," Renewable Energy & Energy Efficiency Partnership (REEEP), 2003.
[185] Ibid, Coto-Chinchilla, 2003.
[186] Ibid, Energy Information Administration, 2003.

Growing interest in renewable energy development is expected in the near future as Panama prepares to host the General Assembly for the Organization of American States (OAS) in June 2007. Per the suggestion of the Government of Panama, the special theme of the meeting will be sustainable energy, primarily renewable energy and energy efficiency issues.

The regulatory oversight for the electric, telecommunication, and water sectors are under the Public Services Regulation Board (ERSP); the National Commission for Energy Policy (COPE), which is under the Ministry of Economy and Finance (MEF), is in charge of defining strategies and policies for the energy sector and proposes new laws to provide proper energy supplies to meet the country's demand.[187] In October 1998, the state-owned electricity company (IHRE) privatized energy generation and distribution companies, leaving only the transmission company under the government's control through the Electricity Transmission Board (ETESA).[188] Investments in energy projects have leveled since 2000 (see Chart 4), and the Panamanian government is working to increase the attractiveness of these investments from FDI.

Chart 4. Cumulative Energy Investments in Panama



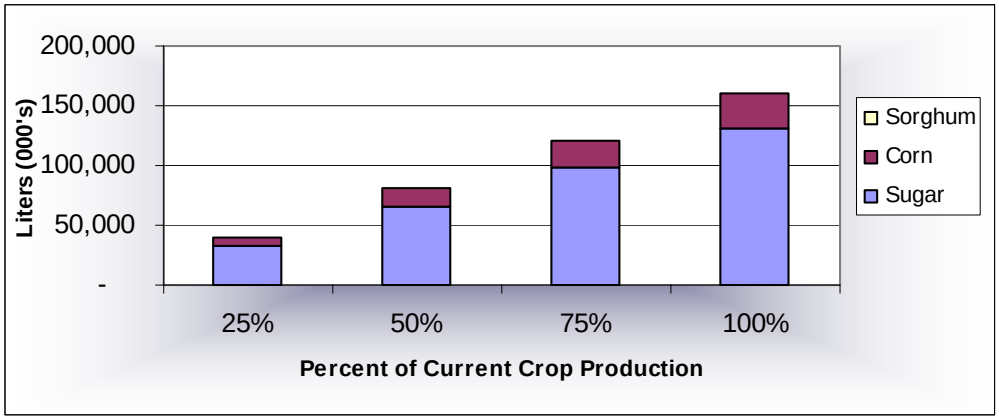
BIOFUELS—ETHANOL AND BIO-DIESEL

Ethanol

Based on the current level of production for the biofuel crops identified, Panama may be able to generate up to 161 million liters of ethanol. This assumes that 100% of the currently available feedstock is converted to ethanol. As shown in Chart 5, the ability to produce ethanol declines as the percentage of the feedstock used decreases. The majority of this ethanol is from sugar (81%), with the remainder from corn (19%) and sorghum (less than 1%).

[187] The Power Sector in Panama, "Profiles of Power Sector Reform in Selected Latin American and Caribbean Countries," www.iadb.org/sds/doc/1832eng.pdf, 2002.
[188] Empresa de Transmision Electrica, "Quienes Somos?," http://www.etesa.com.pa/index01.html, no date.

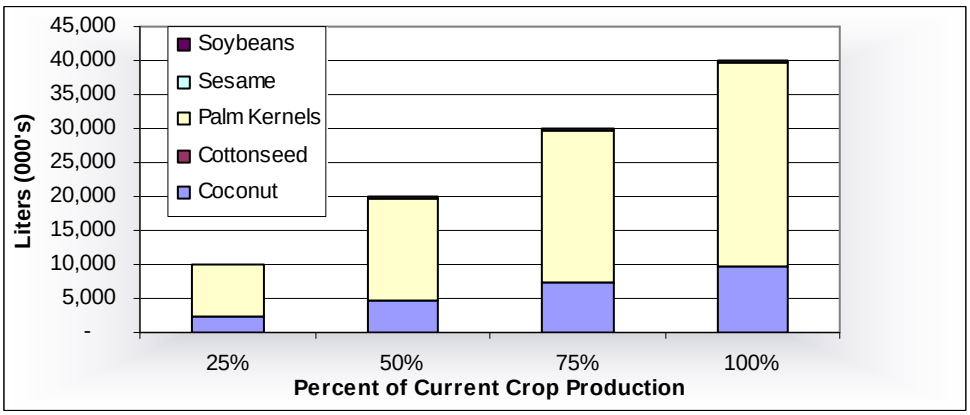
Chart 5: "What-If" Ethanol Production for Panama
As a Percent of Current Crop Production



Bio-Diesel

Based on the current level of production for the biofuel crops identified, Panama may be able to generate up to 40 million liters of bio-diesel. This assumes that 100% of the currently available feedstock is converted to bio-diesel. As shown in Chart 6, the ability to produce bio-diesel declines as the percentage of the feedstock used decreases. The majority of this bio-diesel is from palm kernels (75%), while the remainder is from coconut (24%), and sesame and soybeans (less than 1% combined).

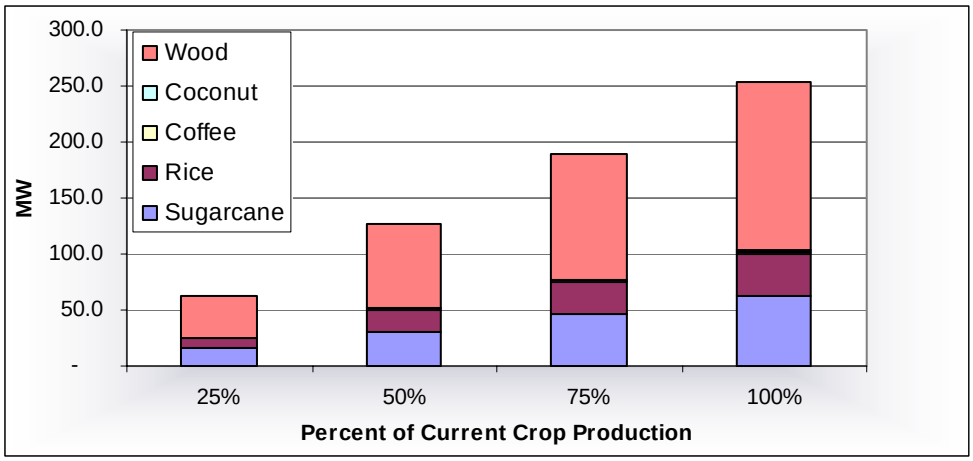
Chart 6: "What-If" Bio-Diesel Production for Panama
As a Percent of Current Crop Production



BIO-POWER

Based on the current level of production for the bio-power crops identified, Panama may be able to generate up to 253 MW of power. This assumes that 100% of current available feedstock is converted to power. As shown in Chart 7, the ability to generate power declines as the percentage of the feedstock used decreases. The majority of this power is from wood products (59%), while the remainder is from sugarcane (25%), rice (15%), and coffee and coconut (less than 1% combined).

Chart 7: "What-If" Bio-Power Production for Panama
As a Percent of Current Crop Production



SAINT KITTS AND NEVIS

COUNTRY OVERVIEW

St. Kitts and Nevis at a Glance:

Population: 42,000
Human Development Index (HDI): 0.834
Electricity Access: 98-100%
GDP per capita: $8,660
Major Agricultural Crops: sugar, coconuts, vegetables, rice
% of Land under Cultivation: 27.8%

The Federation of St. Kitts and Nevis is among the easternmost countries in the Caribbean Sea. These islands were formed by volcanic upheaval from the sea, leaving a group of mountains on St. Kitts that tower above the surface of the water. This volcanic activity has left the island with soil so fertile that crops require almost no irrigation. However, this is not the case for nearby Nevis, which sits across a small channel, where the land is more clay based and not nearly as fertile. This is partly due to the soil's composition but also due to the fact that there is more soil erosion than on St. Kitts.[189] St. Kitts' volcanic activity is not completely dormant; the minimal level of activity has left the island with many natural hot springs,[190] and hot air/water vents. The total land area of St. Kitts and Nevis is 261 km^2, 168 km^2 for St. Kitts and 93 km^2 for Nevis. The length of both of the coastlines put together is 135 km.

St. Kitts and Nevis is considered a comparatively highly developed country for the region with a GDP per capital of $8,660, an HDI of 0.834, and electricity access of 98-100%. Until recently, the economy of St. Kitts and Nevis was dominated by sugarcane production; however, in 2005 the national sugar industry ceased operations.

The majority of current economic activity in the country is service industry oriented, stemming from the prevalence of tourism and financial services which attract offshore investments.[191] The economy transitioned to tourism during the late 1980s when it became the major source of foreign exchange earnings, and is currently the largest sector of the economy.[192]

Nearly 28% of the land is under agricultural cultivation (sugarcane is a major ground cover), and nearly 31% is forested. With the sugar industry currently closed, the future of the sugarcane plantations and farms is unclear. In an effort to diversify away from sugarcane, production tax incentives and duty-free imports of capital equipment have been created to attract offshore financial activities.[193] Another attempt at diversification from agriculture is the development of an export-oriented manufacturing sector.[194]

[189] Microsoft Encarta Online Encyclopedia, 2005.
[190] Country Studies, 2005.
[191] Bureau of Western Hemisphere Affairs, August 2004.
[192] Bureau of Western Hemisphere Affairs, August 2004; Central Intelligence Agency, May 17, 2005.
[193] Bureau of Western Hemisphere Affairs, August 2004.
[194] Central Intelligence Agency, October 4, 2005.

The main environmental issues of St. Kitts and Nevis are:

- Deforestation: The average annual deforestation rate in St. Kitts and Nevis was 0.6% between 1990 and 2000, mainly due to sugarcane cultivation. Although this rate may seem insignificant, it represents a sizable issue for a small island state.[195]
- Soil Erosion: Intensive agriculture on slopes in the upper watershed has resulted in extreme soil erosion and uncontrolled water runoff.[196]
- Beach erosion: Since 1995, several dramatic events—led by hurricanes—caused the erosion of beaches. Human activities such as sand removal used for construction, the erection of structures too close to the coastal line, and the removal of beach vegetation and sand dunes are other causes of erosion.[197]
- Habitat loss: This is primarily a consequence of deforestation and soil erosion and is also related to unplanned real estate and tourism industry development.[198]

The main environmental law of St. Kitts and Nevis is the National Conservation and Environmental Protection Act (NCEPA) of 1987. The NCEPA established the principle guidelines for sustainable development in the country.[199]

ENERGY OVERVIEW

St. Kitts and Nevis is a net energy importer and does not produce any fossil fuel. Secondary liquid fuels including natural gas liquids, gasoline, and jet fuel are imported for local consumption.[200] In St. Kitts, the St. Kitts Electricity Department supplies electricity by diesel-fired generators with an installed capacity of 33.5 MW. Nevis Electric Company Limited (NEVLEC) supplies electricity in Nevis. The Nevis power plant is capable of producing 13.9 MW of power with seven diesel-fired generators. In the last five years, the demand for electrical energy in St. Kitts has increased an average of 7% per year.[201]

In response to the complete dependency on imported fuels for energy generation and the high costs and poor reliability that result, the Government of St. Kitts and Nevis has expressed its commitment to identifying and securing access to alternatives to fossil fuel-based energy. A first step in this process involves the government's collaboration with the Global Sustainable Energy Islands Initiative (GSEII), which includes support from the Organization of American States (OAS), the Climate Institute, and the Energy and Security Group, for the preparation of a Sustainable Energy Plan (SEP). This SEP will outline courses of action for a transition to sustainable energy supplies including the use of renewable energy and energy efficiency services.

One key renewable energy opportunity for St. Kitts and Nevis lies in its volcanic origins. The country, particularly on the island of Nevis, possesses geothermal resources which are most likely commercially exploitable. St. Kitts and Nevis, along with St. Lucia and Dominica, are participating in the Eastern Caribbean Geothermal Energy project, or Geo-Caraibes. Geo-Caraibes receives funding from the Global Environment Facility (GEF), is managed by the OAS,[202] and is designed to prepare the market conditions and explore the geothermal resources for commercial development.

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[195] Mongabay, no date available.
[196] United Nations Framework Convention on Climate Change.
[197] United Nations Educational, Scientific and Cultural Organization.
[198] Mongabay, no date available.
[199] Organization of Eastern Caribbean States.
[200] International National Communication, 2005.
[201] St. Kitts and Nevis National Assessment of BPOA+10, October 2004.
[202] Nevis Historical and Conservation Society Newsletter, April 2004.

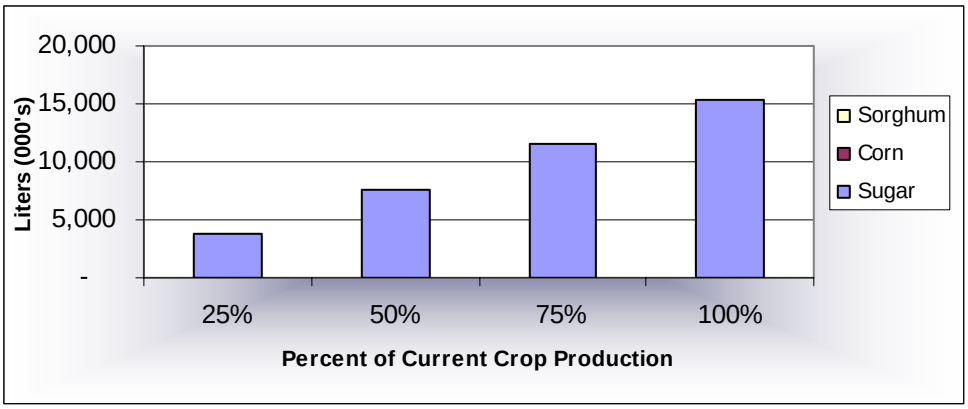
Further, St. Kitts and Nevis have asked the GSEII partners to assess the potential for the conversion of sugar crops to bio-energy. This study is currently underway, and is expected to outline the most appropriate approach to using sugar and waste materials for electricity and/or biofuels.

BIOFUELS—ETHANOL AND BIO-DIESEL

Ethanol

Based on the current level of production for the biofuel crops identified, St. Kitts and Nevis may be able to generate up to 15 million liters of ethanol. This assumes that 100% of the currently available feedstock is converted to ethanol. As shown in Chart 1, the ability to produce ethanol declines as the percentage of the feedstock used decreases. All of this ethanol is from sugar.

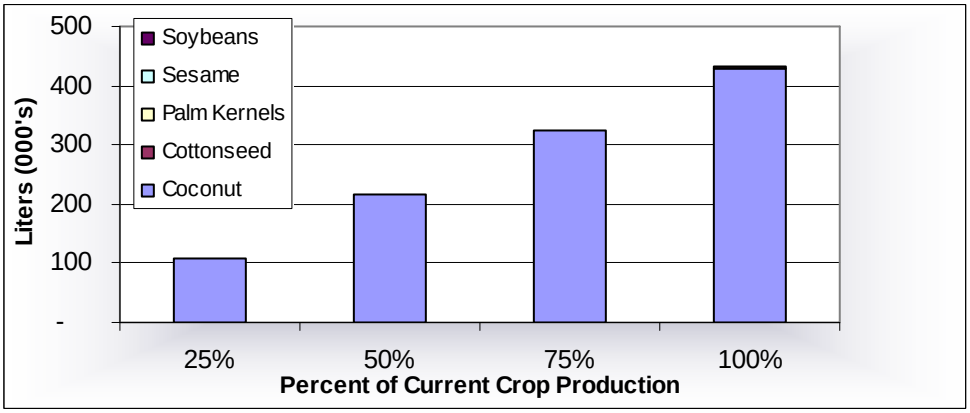
Chart 1: "What-If" Ethanol Production for St. Kitts and Nevis
As a Percent of Current Production



Bio-Diesel

Based on the current level of production for the biofuel crops identified, St. Kitts and Nevis may be able to generate up to 432 thousand liters of bio-diesel. This assumes that 100% of the currently available feedstock is converted to bio-diesel. As shown in Chart 2, the ability to produce bio-diesel declines as the percentage of the feedstock used decreases. Almost all of this bio-diesel is from coconut, with less than 1% being from cottonseed.

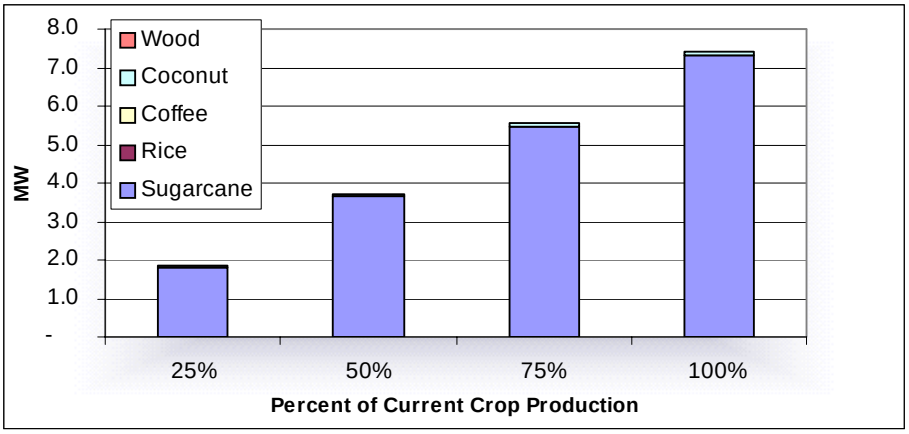
Chart 2: "What-If" Bio-Diesel Production for St. Kitts and Nevis
As a Percent of Current Production



BIO-POWER

Based on the current level of production for the bio-power crops identified, St. Kitts and Nevis may be able to generate up to 7 MW of power. This assumes that 100% of current available feedstock is converted to power. As shown in Chart 3, the ability to generate power declines as the percentage of the feedstock used decreases. The majority of this power (99%) is from sugarcane, while the remainder is from coconut (1%).

Chart 3: "What-If" Bio-Power Production for St. Kitts and Nevis
As Percent of Current Production



SAINT LUCIA

COUNTRY OVERVIEW

St. Lucia at a Glance:

Population: 159,000
Human Development Index (HDI): 0.772
Electricity Access: 98-100%
GDP per capita: $4,580
Major Agricultural Crops: coconuts, bananas, vegetables, citrus
% of Land under Cultivation: 32.8%

St. Lucia is a small island state in the southeastern area of the Caribbean Sea. The island was formed by volcanic activity. The middle of the island is covered with a forested mountain range that runs from north to south. Hot sulfur springs rise from the volcanic crater Soufriere, which is found on the southern portion of the island.[203] There are 30 km^2 of irrigated land on the island; 23% of St. Lucia's irrigated land is used for permanent crops, whereas 6.5% of the irrigated land remains unused. A total of 49% of the land remains undeveloped. The island's natural resources include its forests, mineral springs, and its geothermal potential.[204]

St. Lucia is considered a moderately developed country, with a GDP per capita of $4,580 and an HDI of 0.77 (medium-high). At least 98% of the population has electricity access. The primary economic activities in St. Lucia include tourism, agriculture, and a small manufacturing sector.[205] Historically, agriculture has been the dominant industry, enabling development for the society and causing real incomes to rise. From the 1960s through the early 1990s bananas accounted for approximately 80% of the export earnings. Since the 1990s, however, the production of bananas has been cut in half due to changes in the EU import preference regimes, which increased competition from other Latin American countries.[206] Export diversification has become a necessity in order to attract foreign exchange earnings. Agricultural diversification has included the development of mango and avocado crops for export, and various vegetable crops for local consumption.[207] Foreign investment attraction has been successful through offshore banking activities and tourism, while the manufacturing sector is considered to be the most diverse in the Eastern Caribbean region.[208]

Nearly 33% of the land is under agricultural cultivation, with coconut the major crop, and 13% is forested. Plant species diversity is relatively high, with over 1,300 species. Many of these species are useful for food, timber, and medicines, while others serve as ornamentals.[209] The primary environmental issues in St. Lucia are:

- Deforestation: St. Lucia's average annual deforestation rate was 4.9% between 1990 and 2000, due in large part to an increase in banana cultivation.[210]

[203] Microsoft Encarta Online Encyclopedia, "St. Lucia-Resources and Regions," 2005.
[204] Central Intelligence Agency, "The World Fact Book," 2005.
[205] Bureau of Western Hemisphere Affairs, October 2004.
[206] International Monetary Fund, May 9, 2003.
[207] Bureau of Western Hemisphere Affairs, October 2004.
[208] Central Intelligence Agency, May 17, 2005.
[209] St. Lucia Ministry of Agriculture Forestry and Fisheries.
[210] Ministry of Agriculture Forestry and Fisheries, no date available.

- Soil Erosion: Intensive agriculture on slope lands in the upper watershed has resulted in extreme soil erosion and uncontrolled water runoff. It is estimated that for every ton of bananas produced, some 2-3 tons of soil is eroded.[211]
- Solid and liquid waste management: For the last ten years, the two main disposal sites for St. Lucia have received approximately 200,000 tons of waste per year.
- Habitat loss and coastal pollution: These are emergent issues related to the unplanned development of the real estate and tourism industries.[212]

ENERGY OVERVIEW

St. Lucia imports all of its energy resources, in the form of petroleum products (primarily oil and gasoline). The largest foreign investment in St. Lucia is the development of a petroleum storage and shipment facility by Hess Oil.[213] St. Lucia's total installed electric capacity of 66.4 MW is derived from three diesel-powered generating plants. The installed capacity for 2010 is forecasted to be 91 MW (33.3 MW of additional diesel-powered generating capacity). The peak demand for 2010 is expected to be at 65.6 MW. The electric utility company of St. Lucia is called St. Lucia Electricity Services Ltd (LUCELEC) and its customer base is comprised of industrial, commercial, and residential users.[214] Oil consumption in the country for 2003 totaled 2,400 barrels per day (bbl/day).

In an effort to reduce the nation's dependence on imported oil and make the energy sector more sustainable, the Government of St. Lucia approved a Sustainable Energy Plan (SEP) in 2003. The SEP, prepared with the support of the GSEII, outlines a series of actions designed to stimulate the development and use of renewable energy and energy efficiency. The initial renewable energy sources that are being explored include geothermal, wind, biomass, and solar. St. Lucia has entered into a Memorandum of Understanding (MOU) with a geothermal power project developer and efforts are currently underway to assess the feasibility of this resource. St. Lucia also participates in the Geo-Caraïbes Project, with funding from the GEF.[215] Plans for wind power development include a 5 MW wind farm. A potential site has been identified, and the government and LUCELEC are currently negotiating for access to the required land. Solar hot water heating systems have been encouraged through the removal of import duties and the establishment of a loan program for their purchase.

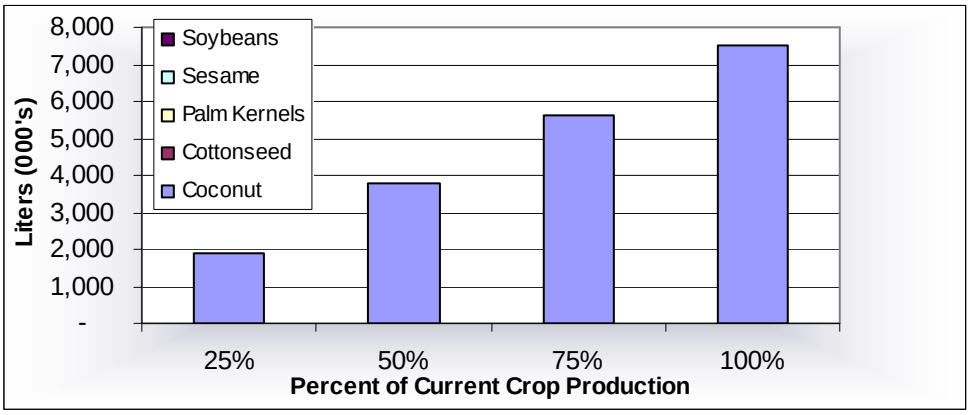
BIOFUELS—BIO-DIESEL

Bio-Diesel

Based on the current level of production for the biofuel crops identified, St. Lucia may be able to generate up to 7.5 million liters of bio-diesel. This assumes that 100% of the currently available feedstock is converted to bio-diesel. As shown in Chart 1, the ability to produce bio-diesel declines as the percentage of the feedstock used decreases. All of this bio-diesel is from coconut.

[211] Ministry of Agriculture Forestry and Fisheries.
[212] School of Biological Sciences University of California Irvine.
[213] Bureau of Western Hemisphere Affairs, October 2004.
[214] Saint Lucia Sustainable Energy Plan Final Draft, May 3, 2001; Caribbean Update, n7, August 1, 2004.
[215] Energy Information Administration, July 2004.

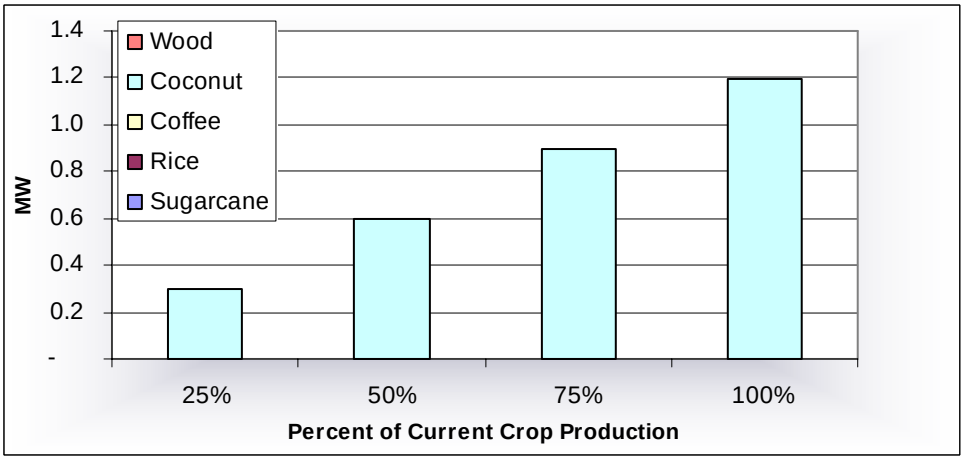
Chart 1: "What-If" Bio-Diesel Production for St. Lucia
As Percent of Current Production



BIO-POWER

Based on the current level of production for the bio-power crops identified, St. Lucia may be able to generate up to 1.2 MW of power. This assumes that 100% of current available feedstock is converted to power. As shown in Chart 2, the ability to generate power declines as the percentage of the feedstock used decreases. All of this power is from coconut.

Chart 2: "What-If" Bio-Power Production for St. Lucia
As Percent of Current Production

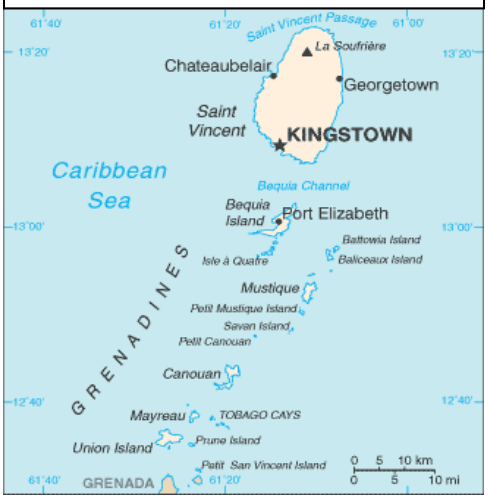


SAINT VINCENT AND THE GRENADINES

COUNTRY OVERVIEW

St. Vincent and the Grenadines at a Glance:

Population: 118,000
Human Development Index (HDI): 0.755
Electricity Access: 98-100%
GDP per capita: $3,020
Major Agricultural Crops: bananas, coconuts, spices
% of Land under Cultivation: 41%



St. Vincent and the Grenadines, an independent nation in the West Indies, is the third smallest nation in the Western Hemisphere. The capital and main port of the country is Kingstown, located on the main island of St. Vincent; the Grenadines is composed of numerous small islands.[216] The country has a total land area of 389 km^2, with the main island of St. Vincent comprising about 88% of this amount. Natural resources on the island consist of croplands and hydropower/drinking water from the country's many rivers.[217] Due to the small size of St. Vincent and the Grenadines, there are no separate geographical regions.

St. Vincent and the Grenadines is considered a lower-middle–income country, with a GDP per capita of $3,020 and an HDI score of 0.755. Electricity access is nearly universal. Economic activity is based on agriculture and tourism, both of which are seasonal and dependant on weather conditions. Banana production accounts for 60% of the labor market, one-third of the total export market,[218] and the majority of the agricultural sector.[219] Tourism is the second largest industry, and the government places high importance on this for future economic growth and development. The country exported US$38 million in 2002, mainly in agricultural products, to the UK, Caribbean Community nations, and the US.[220] Imports consist of food commodities, capital equipment and machinery, and chemicals (including fertilizers and fuels estimated at US$174 million in 2002).[221] The government is stable but confronts a number of challenges including reliance on banana exports and vulnerability to hurricanes.[222]

In addition to bananas, other agricultural crops include coconuts, vegetables, and spices. The country has 41% of its land under cultivation and 36% is forested. In St. Vincent and the Grenadines, environmental protection is directly related to tourism industry development. Key environmental issues are deforestation, polluted water from ship waste and runoff, and lack of proper regulations to

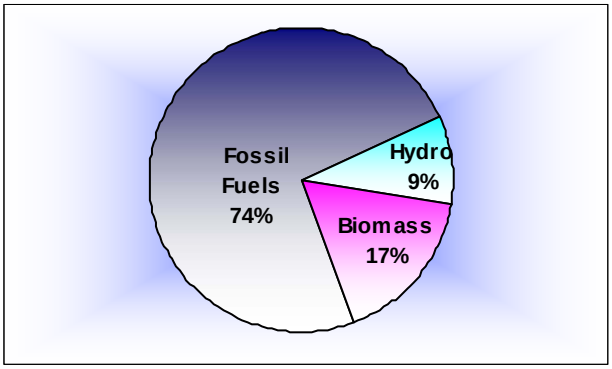
[216] Microsoft Encarta Online Encyclopedia, "Saint Vincent-Resources and Regions," http://encarta.msn.com/encyclopedia_761559060/Saint_Vincent_and_the_Grenadines.html, 2005.
[217] Central Intelligence Agency, "The World Fact Book," http://www.cia.gov/cia/publications/factbook/geos/vc.html, 2005.
[218] British Broadcasting Corporation, "Country profile: St. Vincent and the Grenadines," http://news.bbc.co.uk/1/hi/world/americas/country_profiles/1210689.stm, 2005.
[219] Bureau of Western Hemisphere Affairs, "Background Note Saint Vincent and the Grenadines," http://www.state.gov/r/pa/ei/bgn/2345.htm, 2005.
[220] Ibid, Bureau of Western Hemisphere Affairs, August 2005.
[221] Ibid, Central Intelligence Agency, 2005.
[222] Ibid, British Broadcasting Corporation, 2005.

protect pristine environments. The Grenadines' thriving coral reefs have a tremendous biodiversity of marine life that is not found in other areas.[223]

ENERGY OVERVIEW

St. Vincent and the Grenadines is dependant on imported fossil fuel supplies for most of its energy needs.[224] About 74% of its total energy demand is met by petroleum—the remaining amount is from hydropower for electricity production (see Chart 1). In 2001, the country consumed 1,250 bbl/day of oil bought under the Caracas Energy Accord, through which countries in the Caribbean and the Americas purchase petroleum products from Venezuela under concessionary terms.[225] This heavy reliance on imported petroleum leaves St. Vincent and the Grenadines susceptible to external world price fluctuations. In response, the country is conducting preliminary studies to assess the feasibility of alternative energy, such as wind.[226] The country is also investigating opportunities for the development of geothermal power, having entered into contracts with private developers on several occasions. To date, however, there has been no successful exploration or development of geothermal energy. The country's power generating utility is St. Vincent Electricity Services Ltd. (VINLEC), which is the sole electric provider for St. Vincent and the Grenadines. VINLEC has a generating capacity of 31 MW. It operates diesel power stations on St. Vincent and several islands of the Grenadines, as well as five hydropower stations on St. Vincent.[227]

Chart 1. Total Primary Energy Consumption by Fuel (73.1 KTOE)



BIOFUELS—ETHANOL AND BIO-DIESEL

Ethanol

Based on the current level of production for the biofuel crops identified, St. Vincent and the Grenadines may be able to generate up to 1.7 million liters of ethanol. This assumes that 100% of the currently available feedstock is converted to ethanol. As shown in Chart 2, the ability to produce ethanol declines as the percentage of the feedstock used decreases. The majority of this ethanol is from sugar (86%), while the remainder (14%) is from corn.

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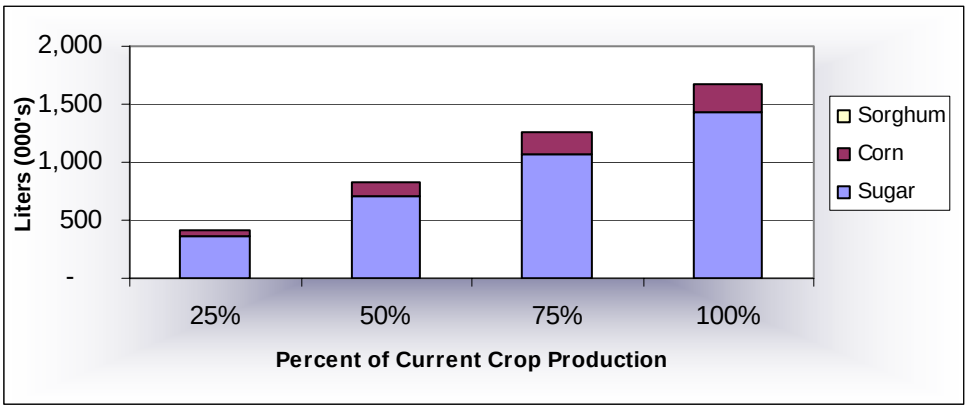
[223] Parks in Peril, "Grenada, St. Vincent & the Grenadines," http://parksinperil.org/wherewework/caribbean/grenada/, 2005.
[224] Caribbean Planning for Adaptation to Global Climate Change, "Initial National Communication on Climate," http://www.cpacc.org/download/SvgNCfinal.pdf, 2000.
[225] BBC International Reports, "St. Vincent and the Grenadines: Further report on oil deal with Venezuela," http://dialogpro.dialog.com, 2001.
[226] Caribbean Net News, "St. Vincent power utility cannot cushion consumers against rising fuel prices," http://www.caribbeannetnews.com/2005/04/22/power.shtml, 2005.
[227] Caribbean Update, "Lowmans Bay Generation Expansion," http://dialogpro.dialog.com, 2004.

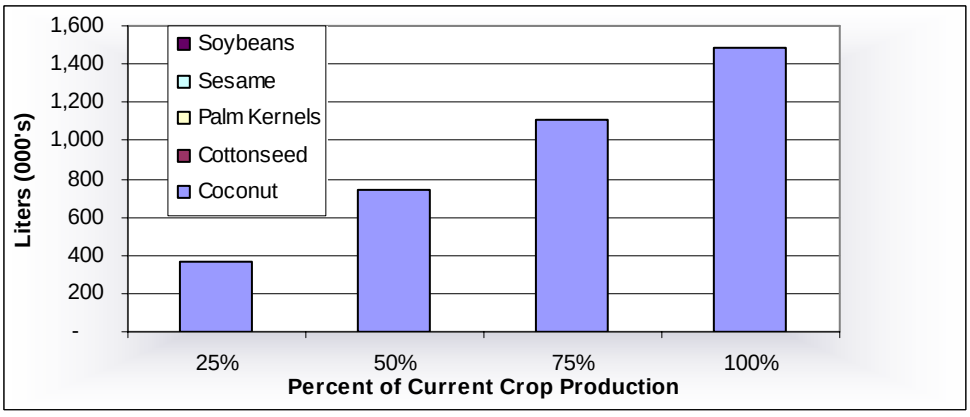
Chart 2: "What-If" Ethanol Production for St. Vincent and the Grenadines As a Percent of Current Crop Production



Bio-Diesel

Based on the current level of production for the biofuel crops identified, St. Vincent and the Grenadines may be able to generate up to 1.5 million liters of bio-diesel. This assumes that 100% of the currently available feedstock is converted to bio-diesel. As shown in Chart 3, the ability to produce bio-diesel declines as the percentage of the feedstock used decreases. All of this bio-diesel is from coconut.

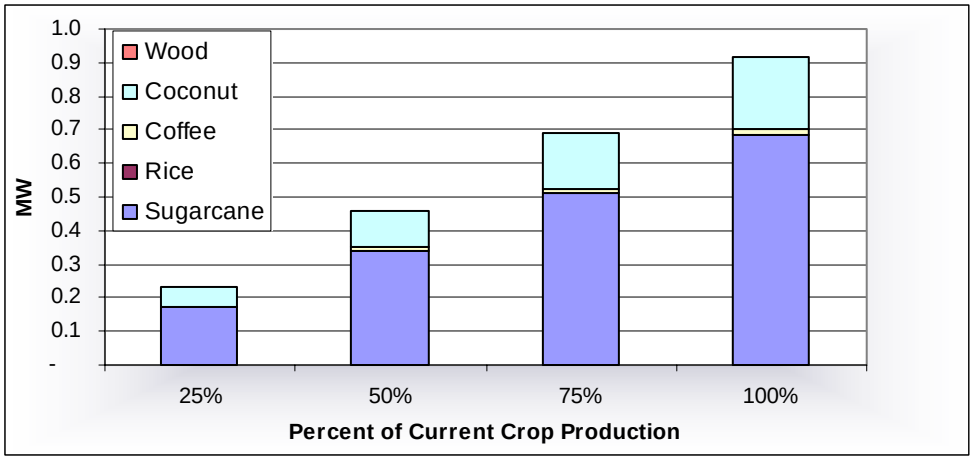
Chart 3: "What-If" Bio-Diesel Production for St. Vincent and the Grenadines As a Percent of Current Crop Production



BIO-POWER

Based on the current level of production for the bio-power crops identified, St. Vincent and the Grenadines may be able to generate up to 0.9 MW of power. This assumes that 100% of current available feedstock is converted to power. As shown in Chart 4, the ability to generate power declines as the percentage of the feedstock used decreases. The majority of this power (74%) is from sugarcane, while the remainder is from coconut (24%) and coffee (2%).

Chart 4: "What-If" Bio-Power Production for St. Vincent and the Grenadines As a Percent of Current Crop Production



TRINIDAD AND TOBAGO

COUNTRY OVERVIEW

Trinidad and Tobago at a Glance:

Population: 1.3 million
Human Development Index (HDI): 0.801
Electricity Access: 99%
GDP per capita: $6,910
Major Agricultural Crops: sugar, cocoa, coffee, citrus, and flowers
% of Land under Cultivation: 26%

Trinidad and Tobago is the southernmost island nation in the Caribbean Sea, situated off the northern coast of South America. The capital and largest city, Port of Spain, is located in Trinidad, the larger of the two islands. The island of Trinidad lies 11 km north of the Venezuelan coast, and Tobago lies 32 km northeast of Trinidad. The country has a total land area of 5,128 km^2.[228] The island geography is diverse—Trinidad is composed mainly of fertile agricultural land, except for the sandy terrain on the south, and Tobago is forested.[229]

Trinidad and Tobago is considered the most industrialized country in the English-speaking Caribbean.[230] The GDP per capita is $6,910, the HDI ranking of 0.801 is high, and 99% of the 1.3 million people have access to electricity.[231] The nation is considered an excellent investment site for international businesses and FDI, particularly for expanded capacity in the energy sector. Natural resource products include petroleum, natural gas, and asphalt.[232] The country's economic policy encourages export-led growth, and works to improve the investment climate by further development of the hydrocarbon/petrochemical sector while also focusing on the service sector, tourism, and agriculture.[233] Exports were estimated at US$6.67 billion for 2004, mainly in petroleum, chemicals, and agricultural products (including sugar, cocoa, and coffee). The major export partner is the US (65% of the export market in 2003).[234] Politically, Trinidad and Tobago is stable, but the country has an increasing crime rate. Infrastructure is well developed and the country has reliable utilities.

Agricultural land makes up about 26% of the country. Trinidad has many flat central plains used for growing sugarcane, and rice is grown in the wetlands. Other major crops include cocoa, citrus, coffee, and vegetables. Roughly 46% of the land is forested and the islands have a strong record of conservation of natural resources and biodiversity. Nonetheless, outstanding environmental issues include water pollution from agricultural runoff, industrial waste, and desertification.[235]

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[228] Microsoft Encarta Online Encyclopedia, "Trinidad and Tobago-Resources and Regions," http://encarta.msn.com/encyclopedia_761561556/Trinidad_and_Tobago.html, 2005.
[229] Central Intelligence Agency, "The World Fact Book," http://www.cia.gov/cia/publications/factbook/geos/td.html, 2005.
[230] Bureau of Western Hemisphere Affairs, "Background Note Trinidad and Tobago," http://www.state.gov/r/pa/ei/bgn/35638.htm, August 2004.
[231] World Bank: Private Participation in Infrastructure Database, http://ppi.worldbank.org/explore/ppi_exploreCountry.aspx?countryId=127, September 2006.
[232] Ibid, Central Intelligence Agency, 2005.
[233] Ibid, Bureau of Western Hemisphere Affairs, 2004.
[234] Ibid, Central Intelligence Agency, 2005.
[235] Ibid, Central Intelligence Agency, 2005.

ENERGY OVERVIEW

Trinidad and Tobago's strong economy is based principally on oil and natural gas. It is one of three Caribbean countries that have large reserves of these fossil fuels, but is the only sizable producer for export production. Trinidad and Tobago is the only oil exporter to the US in the Caribbean region. In 2003, the oil and natural gas sector was reported to account for 40% of GDP, 83% of the island's exports, and more than 40% of government revenues. Estimated reserves are reported to be sustainable for up to 40 years based on current reserve and production statistics.[236]

Chart 1: Total Primary Energy Consumption by Fuel (13,384 KTOE)

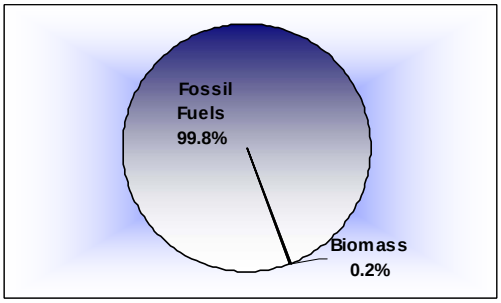
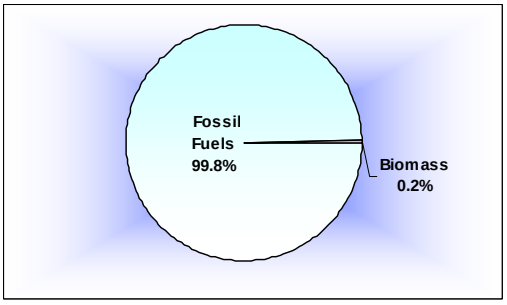
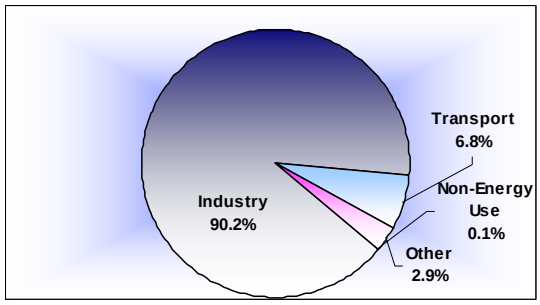


Chart 2: Electricity Generation by Fuel Type (6,437 GWh)



The country's main source of both primary energy and electricity generation are fossil fuels (see Charts 1 and 2), with the industrial sector having the highest energy demand (see Chart 3). In 2002, Trinidad and Tobago consumed 88.1% natural gas and 11.8% petroleum.[237] The remaining 0.1% of energy consumed was from non-hydro renewable sources, primarily solar, geothermal, biomass, and wind.[238]

Chart 3: Total Primary Energy Consumption by Sector (13,384 KTOE)



The Ministry of Energy and Energy Industries (MEEI) in Trinidad and Tobago is the government agency that regulates the energy and mineral sectors.[239] The only electricity retailer is the Trinidad and Tobago Electricity Commission (T&TEC), which transmits power and distributes electricity throughout the islands.[240] As a result of the nation's abundant fossil fuel reserves, it is able to offer electricity and gasoline for prices that are among the lowest in the Americas. Likewise there is little discussion regarding incentives for alternatives, including renewables.

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[236] Energy Information Administration, "Country Analysis Briefs—Caribbean Fact Sheet," http://www.eia.doe.gov/emeu/cabs/carib.html, 2004.
[237] Ibid, Energy Information Administration, 2004.
[238] Earthtrends, "Energy and Resources: Trinidad & Tobago," http://earthtrends.wri.org/pdf_library/country_profiles/Ene_cou_780.pdf, 2003.
[239] Ministry of Energy and Energy Industries, "Home Page," http://www.energy.gov.tt/, 2005.
[240] Ibid, Energy Information Administration, 2004.

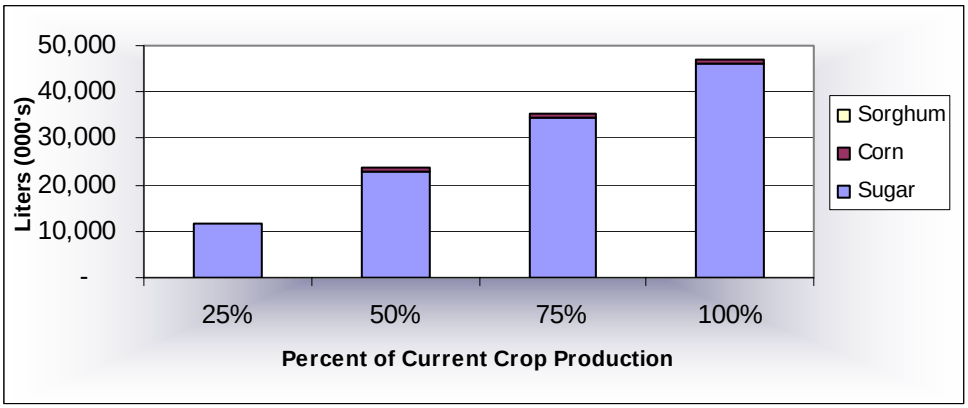
Most of the energy sector is diversified amongst international companies; however, there are some government-owned companies. These include Petroleum Company of Trinidad and Tobago (PETROTRIN), the Natural Gas Company (NGC), and the National Petroleum Marketing Company (NPMC), all involved in extracting and refining. The NGC of Trinidad and Tobago is the sole purchaser, transporter, and seller of natural gas to the energy industry.[241]

BIOFUELS—ETHANOL AND BIO-DIESEL

Ethanol

Based on the current level of production for the biofuels crops identified, Trinidad and Tobago may be able to generate up to 47 million liters of ethanol. This assumes that 100% of the currently available feedstock is converted to ethanol. As shown in Chart 4, the ability to produce ethanol declines as the percentage of the feedstock used decreases. The majority of this ethanol is from sugar (98%), while the remainder is from corn (2%).

Chart 4: "What-If" Ethanol Production for Trinidad and Tobago
As a Percent of Current Crop Production

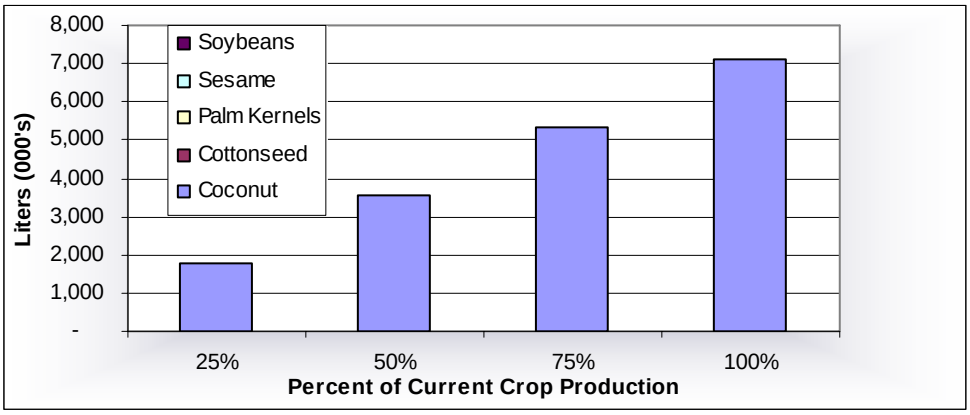


Bio-Diesel

Based on the current level of production for the biofuel crops identified, Trinidad and Tobago may be able to generate up to 7 million liters of bio-diesel. This assumes that 100% of the currently available feedstock is converted to bio-diesel. As shown in Chart 5, the ability to produce bio-diesel declines as the percentage of the feedstock used decreases. All of this bio-diesel is from coconut.

[241] Ibid, Energy Information Administration, 2004.

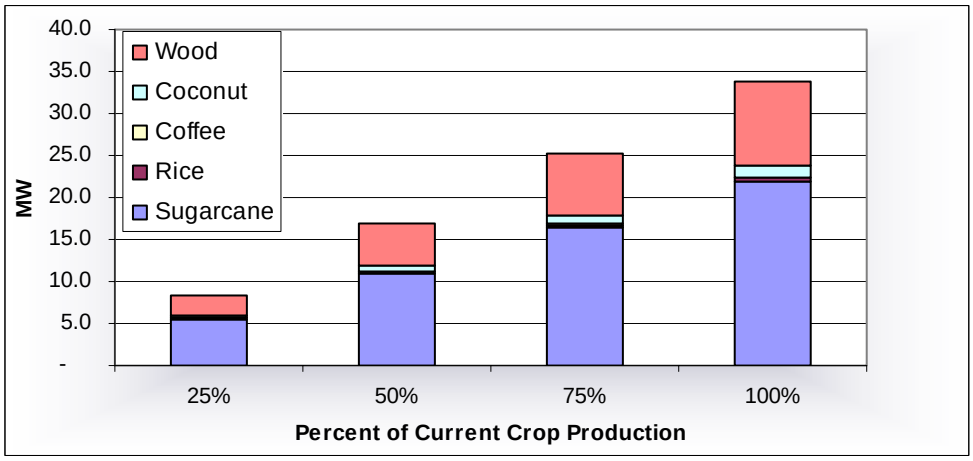
Chart 5: "What-If" Bio-Diesel Production for Trinidad and Tobago
As a Percent of Current Crop Production



BIO-POWER

Based on the current level of production for the bio-power crops identified, Trinidad and Tobago may be able to generate up to 34 MW of power. This assumes that 100% of current available feedstock is converted to power. As shown in Chart 6, the ability to generate power declines as the percentage of the feedstock used decreases. The majority of this power (65%) is from sugarcane, while the remainder is from wood products (29%), coconut (5%), rice (1%), and coffee (less than 1%).

Chart 6: "What-If" Bio-Power Production for Trinidad and Tobago
As a Percent of Current Crop Production



4. SUPPORTING DATABASE

This chapter contains spreadsheets that provide the supporting data used to conduct the country assessments. The spreadsheets contain statistical information on bio-energy feedstocks, agriculture sector data, energy balances, and environmental, economic, demographic, and human development information.

	Measure	Year	Source	Antigua and Barbuda	Bahamas	Barbados	Belize	Costa Rica	Cuba	Dominican Republic	El Salvador	Grenada	Guatemala	Haiti	Honduras	Jamaica	Nicaragua	Panama	Saint Kitts and Nevis	Saint Lucia	Saint Vincent/ Grenadines	Trinidad and Tobago
BioEnergy Feedstocks (1)																						
1) Agricultural																						
Land Under Production																						
Sugar Cane	(1000 Ha)	2004		-	2.25	6.99	23.89	49.21	700.00	136.00	57.11	0.16	186.00	18.00	112.33	48.00	45.29	35.00	3.50	-	0.71	12.00
Corn	(1000 Ha)	2004		0.04	0.17	0.02	12.77	6.48	145.21	27.00	234.59	0.30	603.00	270.00	349.02	0.86	323.19	69.47	-	-	0.20	1.20
Rice	(1000 Ha)	2004		-	-	-	3.14	53.12	157.83	117.00	3.99	-	14.50	53.00	3.04	0.01	73.64	135.00	-	-	-	1.02
Sorghum	(1000 Ha)	2004		-	-	-	3.65	1.80	0.89	2.90	92.33	-	42.50	138.00	0.03	-	47.42	1.70	-	-	-	-
Coffee	(1000 Ha)	2004		-	-	-	0.04	113.39	62.00	141.00	160.78	-	245.00	57.00	200.53	5.00	115.20	16.50	-	-	0.43	3.00
Coconut	(1000 Ha)	2004		-	-	0.60	0.34	4.00	25.34	38.00	7.90	2.30	11.50	9.70	1.84	51.00	1.15	4.50	0.20	3.50	0.69	3.30
Other Energy Producing Crops	(1000 Ha)	2004		1.02	2.30	0.76	1.20	78.94	147.74	174.54	11.70	1.97	128.41	139.91	62.01	8.73	55.24	14.99	0.37	0.20	2.80	13.85
Quantity Produced																						
Sugar Cane	(1000 tons)	2004		-	55.50	361.24	1,149.47	3,804.65	24,000.00	5,547.15	5,280.40	7.20	18,000.00	1,080.00	4,577.80	2,100.00	4,027.00	1,650.00	193.00	-	18.00	580.00
Corn	(1000 tons)	2004		0.06	0.35	0.25	30.54	12.65	398.70	37.70	648.04	0.30	1,072.31	180.00	498.47	1.00	443.73	80.00	-	-	0.65	3.00
Rice	(1000 tons)	2004		-	-	-	10.68	246.87	488.90	576.62	26.52	-	34.93	102.00	6.89	0.01	232.62	318.00	-	-	-	3.00
Sorghum	(1000 tons)	2004		-	-	-	8.15	1.63	0.19	5.42	147.63	-	52.16	85.00	11.98	-	96.58	5.00	-	-	-	-
Coffee	(1000 tons)	2004		-	-	-	0.23	126.00	12.90	51.00	78.51	-	216.60	28.00	85.93	2.70	55.86	8.70	-	-	0.17	0.54
Coconut	(1000 tons)	2004		-	-	1.80	1.10	19.50	119.27	181.53	112.00	6.50	40.00	24.00	16.01	170.00	5.80	15.00	1.00	14.00	2.55	18.00
Other Energy Producing Crops	(1000 tons)	2004		1.88	75.88	367.80	1,186.39	5,025.45	26,708.42	6,041.39	6,017.98	15.49	20,099.79	1,753.61	6,302.73	2,147.24	4,569.47	1,862.43	193.93	1.29	32.92	597.27
Yield per hectare																						
Sugar Cane	(Tons per Ha)	2004		-	24.67	51.66	48.12	77.31	34.29	40.79	92.45	45.00	96.77	60.00	40.75	43.75	88.91	47.14	55.14	-	25.17	48.33
Corn	(Tons per Ha)	2004		1.58	2.15	10.42	2.39	1.95	2.75	1.40	2.76	1.00	1.78	0.67	1.43	1.16	1.37	1.15	-	-	3.25	2.50
Rice	(Tons per Ha)	2004		-	-	-	3.41	4.65	3.10	4.93	6.64	-	2.41	1.92	2.27	1.00	3.16	2.36	-	-	-	2.94
Sorghum	(Tons per Ha)	2004		-	-	-	2.23	0.90	0.22	1.87	1.60	-	1.23	0.62	477.75	-	2.04	2.94	-	-	-	-
Coffee	(Tons per Ha)	2004		-	-	-	5.63	1.11	0.21	0.36	0.49	-	0.88	0.49	0.43	0.54	0.48	0.53	-	-	0.40	0.18
Coconut	(Tons per Ha)	2004		-	-	3.00	3.19	4.88	4.71	4.78	14.18	2.83	3.48	2.47	8.70	3.33	5.04	3.33	5.00	4.00	3.72	5.45
Other Energy Producing Crops	(Tons per Ha)	2004		14.54	8.70	14.33	25.55	50.64	43.44	43.65	46.21	28.12	86.64	17.13	53.66	40.24	42.89	34.49	10.37	19.67	24.06	25.34
Other Crop Production with BioDiesel Potential																						
Land Under Production																						
Coconuts (incl. copra)	(000's Ha)	2004		-	-	0.60	0.34	4.00	25.34	38.00	7.90	2.30	11.50	9.70	1.84	51.00	1.15	4.50	0.20	3.50	0.69	3.30
Cottonseed	(000's Ha)	2004		0.70	-	-	-	0.30	-	-	2.24	0.14	1.40	3.71	1.10	-	1.60	-	0.01	-	-	-
Palm kernel equivalents	(000's Ha)	2004		-	-	-	-	58.00	-	10.06	-	-	19.10	-	45.00	-	2.30	6.30	-	-	-	-
Sesame seed	(000's Ha)	2004		-	-	-	-	0.20	-	-	2.17	-	56.00	14.50	1.62	-	16.28	0.41	-	-	-	-
Soybeans	(000's Ha)	2004		-	-	-	0.24	-	-	-	1.10	-	11.00	-	0.58	-	3.69	0.13	-	-	-	-
Quantity Produced																						
Coconuts (incl. copra)	(tons)	2004		-	-	1.80	1.10	19.50	119.27	181.53	112.00	6.50	40.00	24.00	16.01	170.00	5.80	15.00	1.00	14.00	2.55	18.00
Cottonseed	(tons)	2004		0.06	-	-	-	0.16	-	-	2.80	0.02	1.50	0.72	1.20	-	1.86	-	-	-	-	-
Palm kernel equivalents	(tons)	2004		-	-	-	-	1,080.00	-	154.33	-	-	580.00	-	1,135.00	-	56.00	63.75	-	-	-	-
Sesame seed	(tons)	2004		-	-	-	-	0.12	-	-	1.69	-	35.05	3.80	0.82	-	9.04	0.20	-	-	-	-
Soybeans	(tons)	2004		-	-	-	0.32	-	-	-	2.50	-	35.50	-	1.11	-	7.86	0.10	-	-	-	-
2) Forestry																						
Round Wood Products	(tons/m3)	2004		**-**	**17,000**	**5,000**	**187,600**	**5,132,330**	**3,575,232**	**562,300**	**4,854,610**	**-**	**16,323,542**	**2,231,557**	**9,619,212**	**852,496**	**5,999,111**	**1,312,137**	**-**	**-**	**-**	**85,856**
Agriculture Overview (2)																						
1) Agricultural																						
Total Area	(1000 Ha)	2003		44.00	1,388.00	43.00	2,297.00	5,110.00	11,086.00	4,873.00	2,104.00	34.00	10,889.00	2,775.00	11,209.00	1,099.00	13,000.00	7,552.00	36.00	62.00	39.00	513.00
Land Area	(1000 Ha)	2003		44.00	1,001.00	43.00	2,281.00	5,106.00	10,982.00	4,838.00	2,072.00	34.00	10,843.00	2,756.00	11,189.00	1,083.00	12,140.00	7,443.00	36.00	61.00	39.00	513.00
Agricultural Area	(1000 Ha)	2003		14.00	14.00	19.00	152.00	2,865.00	6,655.00	3,696.00	1,704.00	13.00	4,652.00	1,590.00	2,936.00	513.00	6,976.00	2,230.00	10.00	20.00	16.00	133.00
Arable and Permanent Crops	(1000 Ha)	2003		10.00	12.00	17.00	102.00	525.00	3,788.00	1,596.00	910.00	12.00	2,050.00	1,100.00	1,428.00	284.00	2,161.00	695.00	8.00	18.00	14.00	122.00
Arable Land	(1000 Ha)	2003		8.00	8.00	16.00	70.00	225.00	3,063.00	1,096.00	660.00	2.00	1,440.00	780.00	1,068.00	174.00	1,925.00	548.00	7.00	4.00	7.00	75.00
Permanent Crops	(1000 Ha)	2003		2.00	4.00	1.00	32.00	300.00	725.00	500.00	250.00	10.00	610.00	320.00	360.00	110.00	236.00	147.00	1.00	14.00	7.00	47.00
Permanent Pasture	(1000 Ha)	2003		4.00	2.00	2.00	50.00	2,340.00	2,867.00	2,100.00	794.00	1.00	2,602.00	490.00	1,508.00	229.00	4,815.00	1,535.00	2.00	2.00	2.00	11.00
Forest and Woodland	(1000 Ha)	1994		5.00	324.00	5.00	2,100.00	1,570.00	2,608.00	600.00	105.00	3.00	5,212.00	140.00	6,000.00	185.00	3,200.00	3,260.00	11.00	8.00	14.00	235.00
All Other Land	(1000 Ha)	1994		25.00	665.00	19.00	38.00	676.00	1,688.00	598.00	403.00	19.00	1,119.00	1,021.00	1,669.00	385.00	2,560.00	2,048.00	15.00	32.00	11.00	145.00
Non-arable and non-permanent	(1000 Ha)	2003		34.00	989.00	26.00	2,179.00	4,581.00	7,194.00	3,242.00	1,162.00	22.00	8,793.00	1,656.00	9,761.00	799.00	9,979.00	6,748.00	28.00	43.00	25.00	391.00
Forest/Total	percent	~		11.4%	23.3%	11.6%	91.4%	30.7%	23.5%	12.3%	5.0%	8.8%	47.9%	5.0%	53.5%	16.8%	24.6%	43.2%	30.6%	12.9%	35.9%	45.8%
Forest/Land	percent	~		11.4%	32.4%	11.6%	92.1%	30.7%	23.7%	12.4%	5.1%	8.8%	48.1%	5.1%	53.6%	17.1%	26.4%	43.8%	30.6%	13.1%	35.9%	45.8%
Agricultural/Land	percent	~		31.8%	1.4%	44.2%	6.7%	56.1%	60.6%	76.4%	82.2%	38.2%	42.9%	57.7%	26.2%	47.4%	57.5%	30.0%	27.8%	32.8%	41.0%	25.9%
Total renewable water resources (3)	(Cubic km)	2000						112.40	38.12	21.00	25.23		111.27	14.03	95.93	9.40	196.69	147.98				
Irrigation water requirements (3)	(Cubic km)	2000						0.36	1.41	0.56	0.19		0.40	0.18	0.17	0.01	0.30	0.05				
Water withdrawal for agriculture (3)	(Cubic km)	2000						1.43	5.64	2.24	0.76		1.61	0.93	0.69	0.02	1.08	0.23				
% of Renewable used for AG irrigation (3)	(%)	2000						1%	15%	11%	3%		1%	7%	1%	0%	1%	0%				
Average precipitation 1961-1990 (3)	(km3/year)	Average		0.50	17.90	0.60	39.10	149.50	148.00	68.70	36.30		217.30	40.00	221.40	22.50	310.90	203.30	0.50			11.30

	Measure	Year	Source	Antigua and Barbuda	Bahamas	Barbados	Belize	Costa Rica	Cuba	Dominican Republic	El Salvador	Grenada	Guatemala	Haiti	Honduras	Jamaica	Nicaragua	Panama	Saint Kitts and Nevis	Saint Lucia	Saint Vincent/ Grenadines	Trinidad and Tobago
Energy Balances (3) and Prices																						
Primary Input/Consumption/Demand																						
Total Primary Energy Consumption	(Quads)	2003		0.007	0.048	0.022	0.013	0.170	0.471	0.291	0.119	0.004	0.174	0.027	0.101	0.154	0.064	0.199	0.001	0.005	0.003	0.531
Total Petroleum Consumption	(Quads)	2003		0.007	0.048	0.021	0.012	0.080	0.449	0.262	0.083	0.004	0.135	0.024	0.078	0.149	0.055	0.170	0.001	0.005	0.003	0.059
Petroleum % of Total	percent	2003		100%	100%	95%	94%	47%	95%	90%	69%	100%	77%	90%	77%	97%	86%	85%	100%	100%	89%	11%
Primary Input/Consumption/Demand																						
Total Primary Energy Consumption	ktoe	2003		187.60	1,218.07	556.67	317.71	4,286.23	11,876.33	7,331.35	3,005.59	89.48	4,380.95	675.74	2,538.96	3,871.92	1,613.65	5,025.94	36.31	127.96	73.09	13,383.47
Total Petroleum Consumption	ktoe	2003		187.60	1,218.07	529.49	297.06	2,021.54	11,307.75	6,608.52	2,083.24	89.48	3,392.32	611.23	1,956.51	3,761.55	1,387.22	4,281.38	36.31	127.96	65.35	1,482.70
Petroleum % of Total	percent	2003		100%	100%	95%	94%	47%	95%	90%	69%	100%	77%	90%	77%	97%	86%	85%	100%	100%	89%	11%
Renewable and Conventional Sources																						
Production	Ktoe	2003						1,626	6,661	1,546	2,390		5,469	1,673	1,659	468	1,805	689				28,842
Imports	Ktoe	2003						2,179	4,634	6,425	2,290		3,351	564	2,202	3,785	1,358	2,112	38.00			4,757
Exports	Ktoe	2003						(121)	-	-	(185)		(1,403)	-	-	(127)	(51)	(215)				(21,427)
TPES	Ktoe	2003						3,675	11,216	7,971	4,487		7,293	2,237	3,597	4,059	3,099	2,607				11,096
Fossil Fuels	Ktoe	2003						2,055	8,710	6,425	2,062		3,224	564	1,910	3,591	1,295	1,934	38.00			11,073
Nuclear	Ktoe	2003						-	-	-	-		-	-	-	-	-	-				-
Hydro	Ktoe	2003						509	9	103	125		213	22	187	10	26	243				-
Geothermal, Solar, etc.	Ktoe	2003						817	-	-	830		-	-	-	-	233	-				-
Biomass	Ktoe	2003						300	2,498	1,443	1,441		3,890	1,651	1,472	458	1,546	446				23
Sectoral																						
Industry sector	Ktoe	2003						527	3,715	1,057	728		992	449	829	621	325	159	12			7,649
Transport sector	Ktoe	2003						1,314	1,028	1,906	965		1,599	283	790	911	514	1,046				575
Agriculture	Ktoe	2003						115	357	63	7		61	-	2	405	17	32				-
Other sectors	Ktoe	2003						644	1,571	2,153	1,424		3,746	1,262	1,544	507	1,525	850	26.31			248
Non-Energy Use	Ktoe	2003						58	103	-	23		35	5	-	27	34	20				7
Electricity Generated-GWh	GWh	2003					404	7,566	15,909	13,507	4,077		6,561	535	4,530	7,146	2,707	5,576	169		158	6,437
Fossil Fuels	GWh	2003					336	133	15,010	12,262	1,632		3,237	280	2,340	6,927	2,035	2,732	169		132	6,425
Nuclear	GWh	2003						-	-	-	-		-	-	-	-	-	-				-
Hydro	GWh	2003					68.276	5,923	99	1,200	1,459		2,477	255	2,174	117	298	2,823			26	-
Geothermal, Solar, etc.	GWh	2003						1,226	-	-	966		-	-	-	-	271	-				-
Combustibles Renewables and Waste	GWh	2003						284	800	45	20		847	-	16	102	103	21				12
Installed Generating Capacity																						
Conventional (Thermal)	(Million kW)	2004		0.027	0.401	0.2095	0.027	0.3956	3.9013	4.1842	0.5146	0.032	1.3528	0.181	0.5783	1.325	0.5107	0.491	0.02	0.0568	0.018	1.416
Hydroelectric	(Million kW)	2004		0	0	0	0.025	1.29563	0.0574	0.5421	0.442	0	0.6273	0.063	0.4657	0.024	0.1044	0.833	0	0	0.006	0
Nuclear	(Million kW)	2004		0	0	0	0	0	0	0	0	0	0	0	0	0.000	0	0	0	0	0	0
Other Renewables	(Million kW)	2004		0	0	0	0	0.2478	0.0004	0.804	0.2624	0	0.029	0	0	0.120	0.0775	0.2312	0	0	0	0
Total	(Million kW)	2004		0.027	0.401	0.2095	0.052	1.93903	3.9591	5.5303	1.219	0.032	2.0091	0.244	1.044	1.469	0.6926	1.5552	0.02	0.0568	0.024	1.416
Conventional (Thermal)	% of Capacity	2004		100%	100%	100%	52%	20%	99%	76%	42%	100%	67%	74%	55%	90%	74%	32%	100%	100%	75%	100%
Hydroelectric	% of Capacity	2004		0%	0%	0%	48%	67%	1%	10%	36%	0%	31%	26%	45%	2%	15%	54%	0%	0%	25%	0%
Nuclear	% of Capacity	2004		0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Other Renewables	% of Capacity	2004		0%	0%	0%	0%	13%	0%	15%	22%	0%	1%	0%	0%	8%	11%	15%	0%	0%	0%	0%
Electricity Prices (4)	USD/kWh	2003-4		0.280	0.176	0.188	0.180	0.065	0.138	0.150	0.129	0.221	0.156	0.060	0.045	0.187	0.140	0.121	0.137	0.150	0.697	0.036
Environmental (5)																						
CO2 Emissions	Mt of CO2	2003		0.399	1.873	1.192	0.78	5.31	25.19	17.7	5.73	0.221	9.85	1.64	5.84	10.3	3.94	5.86	0.126	0.326	0.194	21.18
CO2/Population	t CO2/capita	2003		5.0134	5.9564	4.4444	3.0131	1.33	2.22	2.03	0.88	2.1683	0.8	0.19	0.84	3.9	0.72	1.96	3.0235	2.0609	1.6469	16.13
CO2 Emissions based on Population	Mt CO2	2003	-		1.8881788	-	0.8255894	5.3333	25.1526	17.7422	5.7464	-	9.848	1.6036	5.8548	10.296	3.9456	5.8408	0.4867835	-	2.1113258	21.1303
Economic & Demographic																						
Population (6)	Millions	2005		0.081	0.319	0.269	0.264	4.253		8.407	6.762	0.102	12.295	n.a.	7.048	2.639	5.376	3.175	0.042	0.159	0.118	1.301
Energy Intensity (Primary Energy/$GDP) (3)	(Btu per 2000 US$)	2003		10,792.65	10,692.06	8,675.32	12,853.78	9,631.76	66,583.57	13,674.90	8,578.23	8,778.88	8,436.08	7,400.04	15,333.76	18,421.66	15,284.59	16,001.84	4,159.74	7,388.84	8,007.98	59,130.32
GDP Per Capita (3)	(000's 2000 US$)	2003		10.16	14.58	9.43	3.77	4.23	0.63	2.43	2.13	5.06	1.67	0.44	0.95	3.15	0.77	3.99	8.66	4.58	3.02	6.91

	Measure	Year	Source	Antigua and Barbuda	Bahamas	Barbados	Belize	Costa Rica	Cuba	Dominican Republic	El Salvador	Grenada	Guatemala	Haiti	Honduras	Jamaica	Nicaragua	Panama	Saint Kitts and Nevis	Saint Lucia	Saint Vincent/ Grenadines	Trinidad and Tobago
Human Devlopment (7)																						
Human Development Index (6)	Index	2003		0.797	0.832	0.878	0.753	0.838	0.817	0.749	0.722	0.787	0.663	0.475	0.667	0.738	0.690	0.804	0.834	0.772	0.755	0.801
Literacy rate, youth total	(% of ages 15-24)	2004		0.0	0.0	0.0	0.0	98.0	100.0	95.4	0.0	0.0	78.4	0.0	90.9	0.0	88.8	95.6	0.0	0.0	0.0	0.0
Literacy rate, adult total	(% of ages 15 and up)	2004		0.0	0.0	0.0	0.0	94.9	99.8	87.0	0.0	0.0	69.1	0.0	80.0	79.9	76.7	91.9	0.0	0.0	0.0	0.0
Prevalence of HIV, total	(% of population ages 15-49)	2004		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Immunization, DPT	(% of children ages 12-23 months)	2004		97.0	93.0	93.0	95.0	90.0	88.0	71.0	90.0	83.0	84.0	43.0	89.0	77.0	79.0	99.0	96.0	91.0	99.0	94.0
Immunization, measles	(% of children ages 12-23 months)	2004		97.0	89.0	98.0	95.0	88.0	99.0	79.0	93.0	74.0	75.0	54.0	92.0	80.0	84.0	99.0	98.0	95.0	99.0	95.0
Improved sanitation facilities	(% of population with access)	2004		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Poverty gap at $1 a day	(PPP) (%)	2004		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unemployment, total	(% of total labor force)	2004		0.0	10.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.4	0.0	0.0	0.0	0.0	0.0	0.0
Life expectancy at birth, total	(years)	2004		0.0	70.5	75.4	71.9	78.7	77.0	67.8	71.1	0.0	67.6	52.2	68.2	70.8	70.1	75.1	0.0	73.4	71.3	69.9
Urban population	(% of total)	2004		0.0	0.0	0.0	0.0	98.0	100.0	95.4	0.0	0.0	78.4	0.0	90.9	0.0	88.8	95.6	0.0	0.0	0.0	0.0
Girls to boys ratio, primary level enrolment	(ratio)	2004		38.1	89.7	52.3	48.5	61.2	75.8	59.7	59.8	41.5	46.8	38.1	46.0	52.2	57.7	57.5	32.0	30.9	59.3	75.8
Women to men parity index, as ratio of literacy rates,	(aged 15-24 (UNESCO))	2004		0.0	0.0	0.0	0.0	98.0	100.0	95.4	0.0	0.0	78.4	0.0	90.9	0.0	88.8	95.6	0.0	0.0	0.0	0.0
Infant mortality rate	(per 1,000 live births)	2004		0.0	0.0	0.0	0.0	98.0	100.0	95.4	0.0	0.0	78.4	0.0	90.9	0.0	88.8	95.6	0.0	0.0	0.0	0.0
Reported Maternal Mortality		2004		0.0	0.0	0.0	0.0	98.0	100.0	95.4	0.0	0.0	78.4	0.0	90.9	0.0	88.8	95.6	0.0	0.0	0.0	0.0
Cereal yield	(kg per hectare)	2004		1,578.9	2,151.5	10,416.7	2,523.9	3,803.1	2,921.1	4,218.8	2,484.7	1,000.0	1,759.5	796.1	295.1	1,160.0	1,739.8	1,954.7	-	-	3,250.0	2,702.7

Data Sources:

FAOSTAT	1
FAO AQUASTAT	2
EIA International Energy Annual	3
EIA - 2004 Residential	
CARILEC 2003 Sectoral Average	4
International Energy Agency (IEA)	5
UNDP Development Report	6
World Development Indicators	7