

National Energy Policy Framework

"Energy By the People ... For the People"



2011



TOWARDS Energy Efficiency, Sustainability and Resilience for BELIZE in the 21st Century

PREPARED for
The GOVERNMENT OF BELIZE

By:

Ambrose Tillett
Jeffrey Locke
John Mencias

November 30, 2011

Disclaimer

This document was prepared specifically at the request of the Government of Belize; *and is intended solely for their use. It represents a work in progress.* The views, opinions and recommendations expressed herein are those of the authors, unless stated otherwise. A number of data and figures presented in this document originate from data and figures published in publicly available presentations or reports or gotten from interviews with various public officials and other persons. Although great care has been taken to ensure the accuracy and factuality of the material, the integrity of calculations, and all other information presented herein, the authors do not assume any responsibility or accept any legal liability for any consequences which may arise from the use of the material.

All costs and prices given in this document are in 2010 US Dollars unless otherwise stated.

“The significant problems we face today cannot be solved at the same level of thinking as when they were created” *Albert Einstein*



Electric vehicles “refilling” at a solar-powered charging station¹

¹ SOURCE: Mukhar, N. (2011). *What do Electric Cars have to do with Solar Energy?* Retrieved April 2011, from getSolar.com: <http://www.getsolar.com>

LIST OF ACRONYMS & ABBREVIATIONS

AC	Alternating Current (Electricity)
A/C	Air Conditioning (or Air Conditioner)
AEI	American Enterprise Institute for Public Policy Research
AEO	Annual Energy Outlook (EIA Publication)
AST	Active Solar Thermal
BAL	Belize Aquaculture Limited
BAT	Best Available Technologies
Bbl, bbl	Barrel
BCCI	Belize Chamber of Commerce and Industry
BECOL	Belize Electric Company Limited
BEEC	Building Energy Efficiency Codes
BEL	Belize Electricity Limited
BELCOGEN	Belize Cogeneration Energy Limited
BELTRAIDE	Belize Trade and Investment Development
BNE	Belize Natural Energy Limited
BPT	Best Practice Technologies
BSI	Belize Sugar Industries Limited
BTB	Belize Tourism Board
BTIA	Belize Tourism Industry Association
BTU	British Thermal Unit
BZ	Belize
BZD	Belize Dollar
°C	Degrees Celsius (Measurement of temperature)
CA	Central America
CARICOM	Caribbean Community
CBA	Central Building Authority (Belize)
CBO	Congressional Budget Office (USA)
CCGT	Combined Cycle Gas Turbine
CCS	Carbon Capture and Sequestration
CDB	Caribbean Development Bank
CDM	Clean Development Mechanism
CER	Certifiable Emission Reduction (per CDM)
CF	Capacity Factor
CFC	Chlorofluorocarbon
CFE	Comisión Federal de Electricidad (Mexico)
CFL	Compact Fluorescent Lamp
CHENACT	Caribbean Hotel Energy Efficiency Action Program
CHP	Combined Heat and Power
CIA	Central Intelligence Agency (USA)
CIF	Cost, Insurance and Freight

CIPS, CIPower	Canadian International Power Services Inc.
CNG	Compressed Natural Gas
CO ₂ , CO ₂	Carbon Dioxide
COP	Coefficient of Performance (Heat Pumps)
CPRSA	Cost of Power Rate Stabilization Account (BEL)
CP	Carbon Pricing
CPV	Concentrator Photovoltaic
CREDP	Caribbean Renewable Energy Development Programme
CRS	Congressional Research Service (USA)
c-Si, C-Si	Crystalline Silicon (Solar PV)
CSP	Concentrating Solar Power
CTZ	Constant-Temperature Zone
DA	Distribution Area (Belize)
DAO	Distribution Area Operator (Belize)
DC	Direct Current (Electricity)
DG	Distributed Generation
DNI	Direct Normal Irradiance (Measured in kWh/square meter/day)
DTI	Department of Trade and Industry (United Kingdom)
€	EU Currency Symbol
EE	Energy Efficiency
EEP	Energy and Environment Partnership with Central America
EER	Energy Efficiency Ratio
EERE	Energy Efficiency & Renewable Energy (of the US DOE)
EGS	Enhanced Geothermal System (or Engineered Geothermal System)
EIA	Energy Information Administration (United States)
EPA	Environmental Protection Agency (United States)
EPC	Energy Performance Contract
ESCO	Energy Service Company
ESMAP	Energy Sector Management Assistance Program (World Bank)
ESP	Energy Supply Provider
ETSAP	Energy Technology Systems and Analysis Programme (IEA)
EU	European Union
EV	Electric Vehicle
°F	Degrees Fahrenheit (Measurement of temperature)
FAO	Forestry Administration Organization
FC	Firm Capacity
FFV	Flex Fuel Vehicle

FIT	Feed-in Tariff
ft	Feet (Measurement of length or distance)
FX	Foreign Exchange
g	Gram (Measurement of weight)
gals	US gallons (Measurement of volume)
GBC	Green Building Certification (Belize)
GCEP	Global Climate & Energy Project
GDP	Gross Domestic Product
GHG	Green House Gas
GOB	Government of Belize
GPD	Geology and Petroleum Department (in the Ministry of Natural Resources, Government of Belize)
g/p-m	Gallons per Passenger-mile
gpm	Gallons per Mile
GSHP	Ground-source Heat Pump (Geothermal Heat Pump)
GST	General Sales Tax (Belize)
GT	Gas Turbine
GW	Gigawatt
GWh	Gigawatt-hour
HCFC	Hydro-chlorofluorocarbon
HDR	Hot Dry Rock (Geothermal Systems)
HEV	Hybrid Electric Vehicle
HFC	Hydrofluorocarbon
HFO	Heavy Fuel Oil
HP	High Pressure (Steam)
HTF	Heat Transfer Fluid
HVAC	Heating, Ventilation and Air-conditioning
Hydro	Hydro-electric Power
IAEA	International Atomic Energy Agency
ICE	Internal Combustion Engine
IDB	Inter-American Development Bank
IEA	International Energy Agency
IPP	Independent Power Producer (Electricity)
ISO	International Organisation for Standardization
kg	Kilogram
KJ	Kilojoule
km	Kilometre
km ²	Square Kilometre
KV	Kilovolt
KW	Kilowatt
KWh	Kilowatt-hour
KW-Yr	Kilowatt-year
LAC	Latin America and the Caribbean

LCODE	Levelized Cost of Delivered Energy
LCOE	Levelized Cost of Energy
LCV	Lower Calorific Value
LED	Light-emitting Diode
LEED	Leadership in Energy and Environmental Design (USA)
LFL	Linear Fluorescent Lamp
LGE	Litre of Gasoline Equivalent
LNG	Liquefied Natural Gas
LP	Liquefied Petroleum (Gas)
LPG	Liquefied Petroleum Gas
LRMC	Long-run Marginal Cost
LSD	Low Speed Diesel
m	Metre (Measurement of length or distance)
m ²	Square Metre
m/s	Metres per Second
MER	Mercado Eléctrico Regional (Regional Electricity Market of SIEPAC)
MIT	Massachusetts Institute of Technology
MJ	Megajoule
MMBTU	Million British Thermal Units
mpg	Miles per Gallon
mph	Miles per Hour
mpk	Miles per Kilowatt-hour
MRV	Measurement, Reporting and Verification (for GHG emissions)
MSD	Medium Speed Diesel
MSW	Municipal Solid Waste
MW	Megawatt
MWh	Megawatt-hour
NECC	National Electricity Control Center (Belize)
NEEPI	National Energy and Electricity Planning Institute (Belize)
NEMS	National Energy Modeling System (United States)
NEP	National Energy Policy (Belize)
NEPD	National Energy Policy Development (Belize)
NETS	National Electricity Transmission System (Belize)
NETSO	National Electricity Transmission System Operator (Belize)
NG	Natural Gas
NGL	Natural Gas Liquid
NGO	Non-Government Organization
NMS	National Meteorological Service (Belize)
NPV	Net Present Value

NREL	National Renewable Energy Laboratory (United States)
OAS	Organization of American States
OECD	Organization for Economic Co-operation and Development
OLADE	Organización Latinoamericana de Energía (Latin American Energy Organization)
O&M	Operations and Maintenance
PDVSA	Petróleo de Venezuela, S.A
PEe	Primary Energy Equivalent
PHEV	Plug-in Hybrid Electric Vehicle
PM	Particulate Matter
PPA	Power Purchase Agreement (Electricity)
ppm	Parts per Million
PTC	Production Tax Credit
PUC	Public Utilities Commission (Belize)
PV	Photovoltaic
R&D	Research and Development
RD&D	Research, Development and Demonstration
RE	Renewable Energy
RFP	Request for Proposal
RFS	Renewable Fuel Standard
RO	Renewables Obligation
ROC	Renewables Obligation Certificate
ROLEDA	Rural or Low-Energy Density Area
RPS	Renewable Energy Portfolio Standard
RSA	Refer to CPRSA above
scf	Standard Cubic Feet (<i>Measurement of volume</i>)
SCGT	Simple Cycle Gas Turbine
SIEN	Sistema de Información Energética Nacional (National Energy Information System of OLADE)
SIEPAC	Sistema de Interconexion Eléctrica de los Países de América Central (Electricity Interconnection System of the Countries of Central America)
SLC	Single Large Consumer (Belize)
SPE	Society of Petroleum Engineers (USA)
sq	Square
SUV	Sport Utility Vehicle
tCO ₂ e	Metric Ton of CO ₂ -equivalent (of GHG emissions)
T&D	Transmission and Distribution
TES	Thermal Energy Storage
TJ	Terajoule
TOE	Tonne (Metric Ton) of Oil Equivalent
TOR	Terms of Reference (for this Report)

TOU	Time of Use
TPES	Total Primary Energy Supply
TSDF	Tropical Studies and Development Foundation (Belize)
UB	University of Belize
UK	United Kingdom
UNEP	United Nations Environment Programme
UNFCCC, FCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organization
US, USA	United States (of America)
USD	United States Dollar
US DOE	United States Department of Energy
USGBC	United States Green Building Council
VAFE	Vehicle Average Fuel Economy
W	Watt (Measurement of power)
WBCSD	World Business Council for Sustainable Development
WEC	World Economic Council
WEO	World Energy Outlook
WHO	World Health Organization
WPD	Wind Power Density
WTE	Waste-to-Energy

TABLE OF CONTENTS

List of Acronyms & Abbreviationsiv

EXECUTIVE SUMMARY..... 1

Background 1

Main Study Outputs.....2

 Proposed Goals and Strategies for Belize’s Energy Sector2

 Energy Plans4

 Policy Recommendations5

 Energy Planning 6

 Energy Sector Restructuring 6

 Indigenous Energy Supply..... 7

 Energy Imports and Exports..... 14

 Energy Distribution Infrastructure & Pricing..... 15

 Financing for Indigenous Energy Development 21

 Energy Efficiency and Conservation..... 22

 Financing for Energy Efficiency and Recoverable Energy Projects..... 28

Implementation Plan.....29

 A National Database of Energy Data and Information..... 29

 An Organizational Structure to Move Us Forward..... 29

DRAFT

EXECUTIVE SUMMARY

“If I am asked today what is the most important issue for global security and development - the issue with the highest potential for solutions, but also for serious problems if we do not act in the right way - it is Energy and Climate Change.”

Jose Manuel Barroso, President of the European Commission (EC), Opening Speech at World Energy Congress held in Rome, Italy on November 2007

BACKGROUND

How can we make the most of the energy resources available to us to serve our economic and social needs in the present and in the foreseeable future as cost-efficiently as practicable, while simultaneously mitigating the ravages of energy price volatility and the environmentally-damaging effects of fossil fuel use? What part can we play to ensure that future generations are not relegated to diminished lifestyles or even mass calamity because of the way we harness and use energy now, but that they are instead bequeathed stable supplies of efficient and clean energy? What opportunities can we forge to take advantage of our unique position as a relatively energy abundant country in the midst of burgeoning demand all around us in the Central American mainland? The short answer is that we must transition to a path of **efficient** and **sustainable energy**, and build **resilience** within our energy supply chain(s) by using “effective rules and smart policy frameworks”.

This Draft National Energy Policy Framework (NEPF) is a recommended roadmap that puts Belize on a path to energy efficiency, sustainability and resilience over the next 30 years. It provides policy recommendations to policy-makers and decision-makers, and – where appropriate - discusses the pros and cons of various policy instruments that can be used to achieve policy objectives.

The approach taken in formulating this draft NEPF comprised of six main activities:

- 1) Assessing the major factors driving energy policy-making in the 21st Century.
- 2) Carrying out a brief overview of the main trends and players that are currently impacting and that may continue to impact the global and regional energy market, followed by a fairly in-depth analysis of the current state of Belize’s energy sector in terms of the inter-relationships between supply and demand, the cost of energy, and the related GHG emissions of the different sub-sectors.
- 3) Conducting a comprehensive assessment of the main supply options, both indigenous and external to Belize, available now and in the near future to meet our energy needs.

- 4) Analyzing various end-use efficiency and conservation measures that can be put in place to reduce local demand for energy.
- 5) Developing goals and strategic objectives for Belize’s energy sector, and formulating and evaluating various plans for meeting these strategic energy objectives, and which utilize, to varying extents, the supply options and end-use efficiency measures referred to above.
- 6) Recommending specific policies for ensuring the realization of the optimal energy plan (from above) which best achieves the proposed strategic objectives over the planning horizon, as well as general policies and a supporting organizational framework for administering and guiding the development of the energy sector as a whole in line with these strategic objectives.

MAIN STUDY OUTPUTS

Proposed Goals and Strategies for Belize’s Energy Sector

Goals

- To foster the sustainable production, distribution and use of energy as a critical resource needed to achieve the overarching national goals of economic growth and long-term prosperity, security, poverty reduction and social equity.
- To minimize the cost of energy in the local economy:
 - The *cost of energy* referred to is the net present cost of energy use by final end-users, and should take into account all capital, O&M and fuel costs of primary energy capture and conversion, including conversion losses and costs of environmental impacts; all capital and O&M costs of secondary energy distribution, including distribution losses and costs of environmental impacts; and all capital and O&M costs of secondary energy conversion to end-use energy, including conversion losses and costs of environmental impacts.
 - The benchmark for this goal could be the average *cost of energy* in those emerging economies with similar socio-economic structure to Belize or countries who are our major competitors. However, this may be too low or too high depending on our own unique circumstances relative to theirs, and it is best that energy cost minimization be subject only to availability of resources and technologies and other uncontrollable factors. Moreover, the cost of energy is very dependent on the nature and composition of a nation’s produce. Countries like Belize that feature mainly light industries such as Tourism generally consume less energy per dollar of GDP than energy-intensive countries that engage in heavy industries like cement making and steel production. For this

reason, the *energy intensity*, which is the total primary energy supply per dollar of GDP, may also be used as a reliable indicator of the cost of energy.

- To mitigate the impacts of uncontrollable events such as external market price and supply shocks and natural disasters on the cost of energy and on the reliability of energy supply.
- To create a national energy-efficiency-focused culture that is fully aware of how its actions (or inactions) affect energy use and that is pro-active about the conservation and efficient use of energy.

Strategies

- 1) Elevate and promote the importance of planning for energy efficiency in all sectors of the economy.
- 2) Promote and support the production of energy from indigenous renewable resources in order to promote sustainability, increase resilience and engender local participation in the energy industry
- 3) Preserve, develop and manage the Agriculture, Agro-Processing and Forestry Sectors as a major source of biomass feedstock for energy production.
- 4) Pursue both resource and geographic *diversity* of the supply mix in order to maximize the *resilience* of the energy sector.
- 5) Develop an *energy-for-export industry* aimed at supplying the regional and other foreign markets over the long term.
- 6) Build a modern and robust electricity distribution infrastructure to foster greater energy efficiency and resilience and provide infrastructural support for the electricity-for-export industry.
- 7) Nurture the crude oil industry as a for-export industry.
- 8) Put in place measures to maximize the production of non-crude oil products from petroleum extraction activities.
- 9) Develop a local electricity micro-generation market where small producers, such as individual households, communities, commercial establishments and even small industrial participants, can sell electricity into local distributions systems and the national grid.
- 10) Promote and support *local participation* in the energy supply industry in order to build support for renewable energy initiatives, increase local input and control over the local petroleum industry, and generate employment and economic opportunities locally.

- 11) Provide access to *cleaner and more versatile energy carriers* in rural areas and populations living on the margins of the socio-economic fabric *as part of broader initiatives of the GOB and NGOs* to improve the standard of living and productivity in these areas.
- 12) Promote the adoption of energy efficiency and conservation measures in energy applications throughout all sectors of the economy.
- 13) Promote the adoption of energy efficient equipment and devices throughout all sectors of the economy.
- 14) Institute a price on carbon in line with binding covenants such as the Kyoto Protocol and in harmony with the evolution of the global carbon market.

Energy Plans

The team formulated three plans designed to follow the path directed by the strategies introduced above. These plans are not optimal but are rather indicative and can serve as starting points for further *more optimal* variations that can be explored in a future study if so required.

- An **‘end-use-centric’** plan that seeks to reduce demand via the least-cost mix of end-use efficiency and conservation measures *without* further development of any of our renewable energy resources.
- A **‘supply-centric’** plan that seeks to put in place the least-cost supply mix to meet all our energy demands *without* concern for end-use efficiency or conservation.
- A **‘comprehensive’** plan that uses *both* the least-cost mix of end-use efficiency and conservation measures to minimize energy use, and the least-cost supply mix, with further renewable energy development.

Each plan was formulated to achieve the following measurable objectives, which are for the most part derived directly from the strategies above:

Plan Objectives

- ✓ Minimize the cost of energy use
- ✓ Minimize the amount of GHG emissions
- ✓ Maximize the renewability index (RI); that is, the percentage of indigenous renewable energy in the total primary energy supply mix
- ✓ Maximize production of energy from indigenous sources (Minimize dependence on foreign energy sources)
- ✓ Maximize the diversity of the energy supply mix
- ✓ Maximize the use of electricity in the secondary energy supply mix

Overview of Results – Plan Performance

The table below gives the results of key aggregated performance indicators for the various plans over the 30-year planning horizon. It should be borne in mind that these plans are *fairly conservative* and do not take into consideration any possible gains from energy exports or other spinoff effects on the energy sector or the wider economy or society as a whole.

PERFORMANCE INDICATORS	Baseline Plan	Plan A	Plan B	Plan C
Net Present Cost of Energy Supply (USD)	\$3,206,418,586	\$3,073,966,847	\$2,961,116,791	\$2,798,608,329
Net Present Cost of Emissions (USD)	\$468,891,516	\$433,438,097	\$414,976,848	\$340,433,237
Net Present Cost of Energy Supply inc. Emissions (USD)	\$3,675,310,102	\$3,507,404,944	\$3,376,093,638	\$3,139,041,565
Total Foreign Oil and Electricity Imports (BOE)	17,226,531	15,449,375	15,161,820	12,106,393
Average Dependence on Foreign Imports	68.72%	67.17%	55.78%	52.72%
Average Renewability Index	28.57%	31.67%	40.1%	46.15%
Average Resource Diversity Index	42.67%	38.52%	35.66%	33.7%
Average Electricity as % of Secondary Energy Consumption	16.74%	17.79%	17.45%	17.79%

Table A: Comparison of Plans - Results of Key Aggregated Performance Indicators

The results clearly show that all three alternative paths – Plan A, Plan B and Plan C – are improvements on the ‘Continue-Business-As-Usual’ (Baseline) Plan.

Plan C for instance would yield the following improvements over the Baseline Plan:

- A 14.6% reduction in net present cost, which works out to nearly \$57 million USD per year or nearly 4% of GDP.
- 30% reduction in foreign imports of fuel (including electricity imports).
- Over 60% increase in use of renewable energy.
- 21% increase in the diversity of energy supply sources.
- Just over 6% increase in the permeation of electricity within the secondary energy supply mix.

Policy Recommendations

The plans introduced above chart possible courses forward, given the data and information on hand, that should enable us to realize our goals for Belize’s energy sector over the planning horizon. Plans, especially, of such a broad scope and which potentially involve hundreds of projects distributed over a wide cross-section of the economy, can

only be brought to fruition if proper policies are in place to stimulate, guide and coordinate action.

The policy recommendations highlighted below are intended to serve two main purposes:

- To support the plans formulated in the previous section or subsequent iterations of or updates to these plans;
- To generally administer and guide the development of Belize’s energy sector along the path of efficiency, sustainability and resilience and towards meeting the goals and supporting the strategies proposed in the previous chapter.

It is important to note that these policies are in most cases co-dependent and mutually-reinforcing; and so the effectiveness of any individual policy will largely depend on how it fits into the entire portfolio of policies being put forward.

Energy Planning

- **Establish a National Energy and Electricity Planning Institute**
 - The NEP Team recommends that GOB set *as its first and immediate priority* the establishment of a *National Energy and Electricity Planning Institute (NEEPI)*, with responsibility for formulating energy plans and policies in coordination with relevant stakeholders, for disseminating these plans and policies to relevant stakeholders (after the requisite approvals have been gotten), and for monitoring and enforcing – where applicable – adherence to these plans and policies by the bodies charged with administering them.
- **Setup an Energy Sector Planning Framework**
 - The NEP Team recommends that a robust standardized planning framework be setup and adopted by the NEEPI to guide the process of formulating a least-cost long-term plan(s) for the further development of Belize’s Energy Sector along the path of sustainability and resilience.

Energy Sector Restructuring

- **Re-structure the Electricity Industry to cater for Clearer Lines of Responsibility and to prepare for the Evolution of an Export Market as follows:**
 - The center of the new structure will be the National Electricity Transmission System (NETS); consisting of transmission and sub-transmission lines and cables, transmission substations, and a National Electricity Control Center (NECC).
 - Each load center will be regarded as a Distribution Area (DA). DAs will be connected to and purchase power and energy from the NETS via one or more

connection points (substations) for on-selling to final consumers, or they may supply energy from their own generation facilities if not connected to the NETS.

- One or more Single Large Consumers (SLCs), who require a separate and exclusive high-voltage connection to the NETS, may also be directly connected to and purchase power and energy from the NETS via one or more connection points (substations). An SLC may be located outside of Belize’s national borders.
- Generating stations or energy supply providers (ESPs) will be connected to and sell power and energy to the NETS via one or more connection points. These ESPs will bid for and enter into contracts with the NETSO to provide power and energy as required. An ESP may be located outside of Belize’s national borders.
- **Establish Roles and Responsibilities for Electricity Supply and Transmission Planning**
- **Put in place framework for Leasing of Electricity Transmission Capacity and Wheeling**
- **Put in place framework for Electricity Buyback between Distribution Area Operator and Customer**
- **Formulate and Implement a Regulatory Framework for Petroleum Fuel Supply and Distribution**
 - In order to prepare for a possible transition from a monopolistic to an oligopolistic supply arrangement in petroleum fuel supply into Belize, given the opportunity to take advantage of the Petro-Caribe offer and also the prospect of introducing biofuels and blended fuels into the local market, Government should set up a formal regulatory framework to regulate and preserve (the viability of the) downstream fuels sector, including issuing licenses, setting and enforcing quality standards and setting prices.
 - This responsibility for putting this regulatory framework into effect should be assigned to the PUC, and a Director of Fuel Supply should be hired to work on setting up the new regulatory framework.

Indigenous Energy Supply

Optimal Utilization Land and Natural Resource for Energy Supply

- **Enact Legislation to Vest Ownership of Natural Resources in People of Belize**
- **Review and Revision of All Energy Supply Contracts that use the Natural Resources of Belize to reflect the Provisions of the Policy Recommendation Above**
 - Particular attention is hereby drawn to one such clause that currently exists in the contracts for the supply of hydropower from BECOL. This clause states that

Fortis/BECOL has the right of first refusal for all contemplated hydro developments along the Macal River and for that matter all other rivers of Belize, and is clearly a contravention of the spirit of the proposed requirement that ownership of Belize’s natural resources should at all times remain vested in the People of Belize.

Promote Local Content in Indigenous Energy Projects

- **Maximize Local Benefit from and Local Control of Undertakings that process Belize’s Indigenous Resources**

Renewable Energy Development

- **Commission Natural Resource Use Planning Study**
 - A natural resource inventory study should be commissioned under the direction of the Ministry of Natural Resources in order to catalog the types, quantities and locations of Belize’s natural resources both terrestrial and marine areas. The results of this study should be documented in a database such as a GIS and used to produce resource contour maps.
- **Conduct Inventory of Energy Production Potential of Natural Resources**
 - The following projects should be given special priority as part of the inventory study:
 - 1) Country-wide Wind Speed Mapping Project
 - 2) Country-wide Hydrological Data Collection and Monitoring Project
 - 3) Geological and Hydro-geological Inspection of the Most Promising Sites for Future Utility-Scale Hydropower Development
- **Conduct Pre-Feasibility Assessment of Implementing GSHP-based Cooling for Buildings in Selected Urban Areas**
- **Ensure Optimization of Indigenous Energy Conversion Processes**
 - The pre-feasibility or feasibility study of any project that exploits our natural resources should include an investigation into the expected output of the resource site using best available technologies and optimum project parameters compared with the expected output using the proposed technology and project parameters, and also a benefit-cost analysis of the optimum versus the proposed project. The results of the investigation and analysis should be reviewed by the NEEPI in order to determine if the project as proposed should be approved, assuming that it is feasible, or if an effort should be made to undertake a project with parameters that are closer to those of the optimum project.

- Renewable energy-based facility owners should be required to take the necessary steps to improve the efficiency of energy conversion processes if found to be below the currently-applicable required standard or benchmark. If a significant new technology improvement has become commercially available after the initial deployment of the project facility, the NEEPI will investigate the economic and technical feasibility of upgrading the facility with the new technology, and if found to be feasible, the facility owner will be required to upgrade the facility with the new technology.

Facilitate Renewable Energy Development Process

- **Demarcate and Designate Renewable Energy Zones**
 - These zones should be the *best available sites* for renewable energy development with minimal environmental impact, and should be afforded the same protections, under law, which are currently given to nature reserves.
 - Licenses should only be approved for renewable energy projects which are to be developed within the renewable energy zones. Such a map will be useful as a guide for potential investors who would normally have to spend an inordinate amount of time doing investigative research.
- **Promulgate Best Practices for Renewable Energy Projects**
- **Setup facility to Provide Assistance to Potential Renewable Energy Developers**
 - The NEEPI should setup a facility within its organization to provide full assistance to potential renewable energy developers from project idea and feasibility study, through acquiring the necessary financing, to final licensing by the relevant authority. This facility will provide information on relevant policies and the permitting process in general, give advice on best available sites for renewable energy development, and expedite the acquiring of necessary permits and licenses.
- **Introduce Transmission Network for Renewable Energy Development Credit Incentive**
 - In order to further encourage the development of renewable energy projects, GOB should setup a Transmission Network Development Credit Incentive: giving a fixed amount of tax credit (to the NETSO) for every mile of transmission network that passes through any of the designated renewable energy zones.
- **Introduce Annual Renewable Energy Portfolio Standards for Each Renewable Energy Type**
- **Introduce Annual Minimum Feed-In Tariffs for Each Renewable Energy Type**

Build Public Awareness and Acceptance of Renewable Energy Projects

- **Introduce Renewable Energy Technologies in School Curricula**
- **Setup Renewable Energy Projects for Demonstration and Educational Purposes**

Manage impacts of Indigenous Energy Projects on Local Communities

- **Institute Measures to Mitigate Visual and Environmental Impacts of Renewable Energy Projects on Local Communities**
- **Encourage Participation of Local Communities in Renewable Energy Projects**
 - Where a renewable energy project is to be sited within or near to a particular community (or communities), then the project developer will be required to source as much of its unskilled labor requirement as possible from the particular community (or communities).
 - At least 10% of the ordinary shares of the business vehicle carrying the renewable energy project should be made available to members of the local community in which the project is sited.
 - At least 25% of the ordinary shares of the business vehicle carrying the renewable energy project should be made available to citizens of Belize as a whole.

Indigenous Petroleum

- **Apportion Petroleum Royalties to Areas That Could Be Most Negatively Affected by Petroleum Production-Related Activities**
 - Government could build support for petroleum exploration and subsequent production activities by pledging allocation of a portion of petroleum royalties for use in areas that could be most negatively affected by petroleum-related activities as follows:
 - When production occurs onshore or in lakes or rivers:
 - a) 50% to be committed to the Government for financing projects and paying obligations as it sees fit;
 - b) 10% to the Ministry of Natural Resources and the Environment for financing programs supporting scientific research, technology development and capacity building applied to the petroleum industry;
 - c) 10% to be allocated to a special Environmental Risk Management and Oil Spill Mitigation Fund (ERMOSM) used for financing programs supporting scientific research, technology development and capacity building applied to environmental risk management and oil spill prevention and mitigation activities;

- d) 15% to the Ministry of Tourism and the BTB for financing terrestrial infrastructure and capacity building projects;
 - e) 10% to be used for financing projects aimed in the district where the production occurs;
 - f) 5% to be used for financing projects in the municipalities where the production occurs.
- When production occurs offshore:
 - a) 40% to be committed to the Government for financing projects and paying obligations as it sees fit;
 - b) 10% to the Ministry of Natural Resources for financing programs supporting scientific research, technology development and capacity building applied to the petroleum industry;
 - c) 15% to be allocated to a special Environmental Risk Management and Oil Spill Mitigation Fund (ERMOSM) used for financing programs supporting scientific research, technology development and capacity building applied to environmental risk management and oil spill prevention and mitigation activities;
 - d) 15% to the Ministry of Tourism and the BTB for financing marine infrastructure and capacity building projects;
 - e) 20% to be used for financing projects in the district or caye fronting the area where the production occurs;
- **Earmark Local Crude Oil and its Products for International Markets**
 - Locally-produced crude oil and any locally-refined oil products should be earmarked for international markets, with the exception of crude oil, HFO and diesel that can be used in the industrial sector. Promoting the sale of oil and oil products locally could potentially cause policy conflicts with the NEP Team’s recommendations for reducing dependence on fossil fuels in general.
- **Maximize Processing of Associated Gas of Crude Oil Extraction**
 - Government should commission the GPD to conduct a study of the potential for further processing of the associated gas from Belize’s current petroleum extraction operations into useful hydrocarbons (particularly for electricity generation, transport, cooking and for use as a refrigerant fluid for cooling) using best practice technologies and best available technologies, and to prepare a cost-benefit analysis of the various options available.
- **Enact Legislation to ensure that Government Royalties should be tied to Full Production Potential of the Petroleum Production Site**

- The calculation of the total royalties attributable to the GOB should be based on the full production potential of the extracted petroleum resources using best practice technologies applicable to the particular petroleum production site. On-site usage and resource losses - such as flaring of associated gas - that exceed industry benchmarks applicable to the site, given its characteristics and the nature of its operations, should be counted in this production potential.
- Current legislation should be updated to reflect this principle.
- **Demarcate an Offshore No-Drill Zone with Barrier Reef as Center-line**
 - An offshore no-drill zone should be demarcated to maintain the barrier reef and cayes at a sufficiently “safe” distance from any offshore oil drilling rigs in order to mitigate the visual impacts of oil rigs on the natural seascape in the area of the barrier reef and cayes and to reduce the probability of the spread of effluent from potential oil spills into these areas.
- **Formulate a National Petroleum Safety and Oil Spill Mitigation Standard**
 - A National Petroleum Safety and Oil Spill Mitigation Standard should be formulated to guide action to prevent and mitigate the impacts of oil spills, accidents and other environmental disasters, and should reflect the latest post-Gulf of Mexico Oil Spill mandates put into effect by the USA.
- **Form a National Petroleum Safety and Oil Spill Mitigation Authority**
 - A National Petroleum Safety and Oil Spill Mitigation Authority should be setup with responsibility for enforcing adherence by all operators to the National Petroleum Safety and Oil Spill Mitigation Standard and for formulating, directing and coordinating the Spill Mitigation and Containment Emergency Response Plan.

Biofuels

- **Pursue Biofuels Development within Broader National Development Context**
 - Following in the footsteps of other developing countries, Belize should develop its biofuels industry to contribute to larger environmental and social objectives such as rural development, land rehabilitation and waste treatment apart from GHG emissions reduction.
 - Biofuels development initiatives that target the use of semi-arid soils and other marginal lands should be promoted to enhance biodiversity, revitalize natural ecosystems, support the development of rural populations in poorer regions, and hence maximize the efficiency of the utilization of our natural resources.
- **Promulgate National Biofuel Product Standards**

- As a first step toward creating a viable market for biofuels in Belize, the NEEPI should prepare a set of biofuel standards for the major classes of biofuels, bio-ethanol and bio-diesel, as well as standards for feedstock inputs into biofuel production.
- The development of these standards should be guided by international and regional standards such as those currently being prepared by the ISO.
- **Develop the Biofuels Industry along the lines of the Most Efficient Bio-Energy Chains**
 - In keeping with long-term energy supply development plans, the Government should focus on using biomass residues, including bagasse and other agricultural and forestry wastes (except wood fuel), for electricity generation, sugar cane for ethanol production, and jatropha, other local oil-producing plants and , in the future, alga-culture for biodiesel production.
 - Ethanol production should be focused on supplying the local blended fuel market, for use in the transesterification process of local biodiesel production, and for export to the USA and Europe. Given our comparative advantages in biomass-based electricity generation and biodiesel production, these bio-energy chains should be optimized for sufficing local requirements and for export.
- **Promulgate Biofuel Production Technologies that cater to Multiple Feedstocks and Small Scale Deployment**
- **Conduct a Cost-Benefit Analysis of Upgrading BSI’s Refinery Infrastructure for Dual Sugar/Ethanol Production**
- **Promote Local Biofuels Research**
 - The Government should actively promote and support research into ways to improve the productivity and sustainability of biofuel feedstocks: by seeking improved yields from conventional feedstocks through better agricultural and forestry practices, by exploring the potential for cultivation of native perennial lingo-cellulosic crops (e.g. jatropha) throughout the districts, and by developing breeding programs for higher-yielding species and novel energy crops, such as algae.
 - Belize, through the Ministry of Agriculture, UB and the TSDF, is already party to a 2009 Memorandum of Understanding signed with Mexico, the rest of Central America, Colombia, and the Dominican Republic for further collaboration and research in the biofuels field. The GOB is strongly encouraged to use this platform as a launch pad to start up an International Biofuels Research Center within the University of Belize, in conjunction with the National Coordination Committee for Agricultural Research and Development (NCCARD), to attract the inflow of

international funding, best available technologies and technical expertise into Belize.

- **Seek Technical Assistance for Biofuels Industry Development from Industry Leaders, particularly Brazil and the USA**
- **Encourage Public-Private Investment Partnerships to support Smallholder Participation in Biofuel Value Chains**
 - The GOB should encourage public-private sector investment partnerships in the commercial scale production of biofuels in order to facilitate smallholder participation as much as possible in biofuel value chains. This may be mandated by requiring that say 20% of the shareholdings in such partnerships are open to take up by such smallholders.
- **Introduce Annual Renewable Fuel Standards for Each Biofuel Type**
- **Introduce Annual Minimum Feed-In Tariffs for Each Biofuel Type**

Micro-Generation

- **Commission Study on Impacts of Micro-Generation on Grid Electricity Supply Operation, Reliability and Cost**
- **Establish Formal Energy Buyback Pricing and Payment Scheme for Micro-Generation**
 - The NEP Team recommends the adoption of two pricing schemes for energy buyback from micro-generation sources:
 - Micro-generation from residential premises that have a maximum power output up to 200 KW should be priced on the basis of a basic net metering-based energy buyback scheme.
 - Pricing for micro-generation from sources with a maximum power output above 200 KW should be based on a gross metering (two-meter) arrangement, where the total quantity of energy exported can be tracked separately.
- **Formulate Interconnection Standards for Micro-Generation Sources**
- **Establish Energy Buyback Rules**
 - The NEP Team recommends that the PUC draft and, after consultations with the relevant energy stakeholders, implement *Energy Buyback Rules* to underpin agreements for energy buyback between electricity providers and micro-generators and that are based on the following principles:

Energy Imports and Exports

Electricity Imports

- **Investigate the Technical and Economic Feasibility of Upgrading the Interconnection with Mexico**
 - BEL is currently unable to take more than 50 MW of power from Mexico without experiencing voltage regulation problems at certain load center bus bars. CFE has indicated that it is prepared to supply up to 60 MW to Belize as long as certain power flow conditions are met.
 - The NEP Team recommends that BEL urgently look into the technical and economic feasibility of making the necessary transmission system upgrades to overcome these problems so that full advantage can be taken of the supply from CFE.
- **Limit Maximum Amount of Total Foreign Electricity Imports**
- **Limit Maximum Term of Contracts for the Import of Electricity**

Electricity Exports

- **Seek Membership or Direct Involvement in SIEPAC**
 - BEL and the GOB should vigorously pursue membership or direct involvement in SIEPAC as a long term measure in order to enhance the security of electricity supply but *more importantly* to be in a position to sell energy to the SIEPAC market in the future.
 - In the short-term, access to the SIEPAC market can be arranged by supplying excess energy to Mexico and/or Guatemala. The GOB and BEL should immediately pursue this opportunity by writing a formal letter to CFE asking if this arrangement (with Mexico) can be setup. **This action is critical to the development of an electricity-for-export industry.**
- **Limit Participation in Contracts to export Electricity to ESPs only**
 - Only authorized ESPs should be allowed to enter into contracts with foreign entities to export electricity. The authorization to enter into such contracts should be conferred as a special provision of the terms and conditions of the license of the particular ESP at the request of the ESP and must be approved by the GOB acting on the advice of both the NEEPI and the PUC.
 - All other non-authorized ESPs and all DAOs and SLCs should be expressly excluded from participating in such contracts with foreign entities to export electricity. The NETSO can be a party to such a contract only to extent that it is required to provide facilities for transmission of the power and associated energy from the ESP to the connection point with the foreign entity.

Energy Distribution Infrastructure & Pricing

Transmission & Distribution Lines

- **Revise Transmission Line Construction and O&M Standards in anticipation of and in preparation for further connection of the NETS with regional electricity transmission networks to accommodate electricity importation and exportation transactions with regional partners**
- **Formulate plans for the Transition to a Smart Grid Electricity System in order to facilitate and foster grid connection of utility-scaled renewable energy sources such as wind and solar energy plants and micro-generation sources in general**
- **Prepare an Updated Transmission Grid Code to accommodate Variable Power and Micro-Generation Sources**

Rural Electrification

- **Demarcate and Declare Rural or Low-Energy Density Distribution Areas (ROLEDA)**
 - Once an area is so declared, it is subject to rural standards for energy supply and distribution; and is eligible for certain special funding, subsidies and tariffs applicable to ROLEDAs.
- **Formulate Separate Rural Electricity Distribution Standards, which minimize the cost of construction while maintaining adequate service reliability concomitant with the purposes of electricity use in ROLEDAs**
- **Setup a Special Rural Electricity Pricing Mechanism**
- **Influence pattern of development of Rural Energy Services to maximize use of renewable energy-based community-managed distributed generation sources**

Electricity Pricing

- **Conduct a study should be undertaken to derive formulae, and to develop a software tool that uses the formulae, for calculating the LRMC and the SRMC of electricity supply.**
- **Implement a New Consumer Electricity Tariff-Setting Methodology**
 - A study should be undertaken to investigate and assess the current electricity tariff-setting methodology employed by the PUC and to come up with a new methodology that removes price distortions and that reflects key pricing principles, including cost reflexivity, revenue adequacy, stability, flexibility and transparency.
- **Introduce Special Electricity Tariffs for SLCs**

- Electricity tariffs charged to SLCs, who are connected directly to the NETS, should only bear their share of costs related to energy supply, transmission and connection to the NETS, and should not bear any distribution-related costs.
- Likewise, high-voltage consumers who are connected directly to the high-voltage distribution network of the DA in which they are located should only bear their share of costs related to energy supply, transmission, high-voltage distribution, and connection to the high-voltage network, and should not bear any low voltage distribution-related costs.
- **Introduce a Two-Part Electricity Tariff for All Consumers**
 - In keeping with the principles of transparency and revenue adequacy in tariff-setting, a two-part electricity tariff, consisting of a periodic fixed charge and a volumetric energy charge, should be applied to all customers. The periodic fixed charge should reflect the provider’s fixed costs, while the volumetric energy charge is the cost of energy.
- **Introduce a Time-of-Use Electricity Tariff for Major Electricity Consumers**
- **Introduce a Seasonal Electricity Tariff for Major Consumers**
 - BEL’s cost of energy supply is higher during the “dry season” because of reduced output from the hydro plants and BELCOGEN, which are currently its lowest cost energy supply sources, resulting in greater dependence on supply from electricity imports and diesel generation.
 - Due consideration should be given to implementing a seasonal electricity tariff schedule - comprising a relatively lower energy charge for electricity during the “wet season” and a relatively higher energy charge during the “dry season” – initially for customers who consume electricity above a certain threshold level and later for all consumers. This would have the effect of communicating the correct price signal to such consumers; who could change their consumption habits in step with the energy charges. It could also provide a steadier stream of cash flows into BEL.
- **Remove Rate Stabilization for High-Consumption Customer Accounts**
 - Rate stabilization *should not be* applicable to customers who consume electricity above a certain threshold level – particularly SLCs, high-voltage, commercial and industrial customers – and who can therefore have a significant impact on overall cost borne by other consumers if they suddenly close their electricity accounts. Moreover, this is the class of consumers that is best able to respond – and whose response yields the most significant economic impacts - to the correct price signals that tend to be distorted by rate stabilization mechanisms.
- **Commission a study of the impact of rate stabilization on electricity prices and consequent consumer behavior should be commissioned with a view to**

determining if rate stabilization, as currently implemented, is efficacious; and to consider alternative methodologies for effecting rate stabilization.

Fuel Industry Regulation & Pricing

▪ Re-evaluate Belize’s Future with Petro-Caribe

- Regardless of any ulterior motives on the part of Venezuela, Belize can benefit significantly from the low cost financing terms offered under the Petro-Caribe Agreement: gaining nearly \$15,000,000 USD per year if all our gasoline and diesel requirements are supplied from Venezuela.
- Petro-Caribe represents an opportunity for Belize to gain substantial revenues from favorable financing terms, diversify its imported petroleum fuel supply sources, and establish a significant relationship with an important petroleum-rich regional partner.
- Government should revitalize this now defunct arrangement on the conditions that GOB is completely satisfied that the supply from Venezuela will be reliable and that importers can make their own shipping arrangements in order that the costs of freight and insurance can be sufficiently reduced so that the benefits obtained from the low cost financing are not negated.
- Once the arrangement has been revived, a portion of the gains from the favorable financing terms made available to the Government should be used to offset the per-unit CIF cost differential, if any, between the supply from Petro-Caribe and the traditional supply from Esso on a month-by-month basis, in order to equalize the CIF cost borne by the various importers in each month.

▪ Establish a Temporary Methodology for the Stabilization and Rationalization of Fuel Prices

- In keeping with the principle of stability, transparency and simplicity, fuel prices should *in the meantime and pending the outcome of a Fuel Price-Setting Methodology Study* be fixed on a month by month basis (from the 1st day through to the last day of the month). The price for the next month should be based on the average CIF cost of all fuel received over the last 10 days of the previous month and the first 20 or 21 days of the current month, and should be advertised at least five days before the start of the next month. Importers should be required to standardize order amounts as much as possible.
- Given the relatively small cost of transportation as a percentage of total fuel price, a country-wide standard transportation charge should be introduced to cover the cost of transportation. While transportation companies will still be remunerated according to the current schedule of charges, final consumers will see one fixed charge regardless of where fuel is purchased.

▪ **Implement a New Refined Petroleum Products, Biofuels and Fuel Blends Price-Setting Methodology**

- A study should be undertaken to investigate and assess the current refined petroleum products price-setting methodology employed by the GOB and to come up with a new methodology that also provides for pricing of biofuels and fuel blends, removes price distortions and that reflects key pricing principles, including cost reflexivity, revenue adequacy, stability, flexibility and transparency.

Internalization of the Costs of GHG Emissions and Other Pollutants

▪ **Implement GHG Pricing in Local Economy**

- Government should, through its membership on regional and international bodies and participation in regional and international forums, vigorously lobby for agreement on adopting a fair and consistent global carbon pricing regime, that is implemented incrementally so as to give less developed countries sufficient time to make required adjustments, and where developing countries are required to pay a proportionate part of the cost of making these adjustments.
- In the meantime, Belize must begin the process of preparing our local economy for the inevitability of the adoption – or imposition – of this global carbon pricing regime in a way that does not cause undesirable distortions and without putting our export-oriented industries at a disadvantage to other countries - especially direct competitors - that are slower to introduce a carbon-pricing regime. We recommend three complementary courses of action:
 - Setting up of a pilot baseline-and-credit regime with the following parameters:
 - 1) This pilot should be regarded as a test run for a possible future regime and should therefore cause no financial or economic consequences on the companies involved. The main objective is to develop the institutional structures required, to instill the required institutional discipline in the administrators and participants for measuring, reporting and verifying relevant emissions data, to get the actors accustomed to operating – particularly trading credits - within the new regime, and to document the actual trends in carbon intensity.
 - 2) A baseline should be set for each industry/sector – on an annual basis - according to regional benchmarks and historical trends.
 - 3) It should be setup with no formal ties to any other global, regional or otherwise extra-national carbon emissions reduction regimes. It should initially cover only the major GHG-emitting sectors including electricity, petroleum, transportation, and major industries.

- Implementing a carbon tax on petroleum and other fossil fuels used in transport and for electricity generation.
 - 1) The level of such a carbon tax should be dictated by the global GHG emissions market price. The main focus of the tax at this juncture is to curb domestic consumption from – and hence production of - products with a relatively higher carbon footprint to products with a relatively lower carbon footprint.
 - 2) The tax must be accompanied by an appropriate rebate for all export-oriented industries in order to ensure that the competitiveness of our exports is not adversely affected by the additional cost (tax burden).
 - 3) It is not to be used as a revenue generator for government, but as an economic price signal: the proceeds, less the rebates, are therefore to be re-distributed back to tax-payers – particularly the lower income classes - in the form of a lower income tax or subsidy. Redistributing the carbon tax proceeds as a flat dividend (e.g. x dollars per person or household) will diminish the negative income distribution effect of the tax on lower-income classes.
- Belize must continue to take advantage of the CDM and any other beneficial opportunities for obtaining carbon finance for undertaking economically feasible renewable and energy efficiency projects. Aside from the institutional structures being put in place to prepare us for an impending global carbon regime, the CDM should, at this time, be used solely as a source of low-cost finance and subsidies for eligible RE and EE projects; and not as a framework directly dictating any national or sectoral strategy.
- **Evaluate Cost of Impacts of Non-GHG Pollutants on Belize’s Economy**

Energy Supply Resilience

- **Establish Strategic Petroleum Stock Levels for all refined fuel types at the national level and at each major population center level to better manage the uncertainty of supply and the price volatility of petroleum imports and to protect against extended disruptions of fuel supply due to disasters**
- **Establish Requirement for Geographic Diversity of Electricity Supply Sources in evaluation criteria of RFPs for electricity supply**
- **Build Resilience into the National Electricity Supply Network by developing a smart grid overlay of the national electricity system in order to mitigate disruptions of electricity supply**
- **Setup standards to ensure that Power Lines, Wind Turbines and Solar Panels are built and installed to withstand Extreme Weather Conditions**
- **Setup a Self-Insurance Scheme of the National Electricity Supply Network against Potential Loss from Natural and Other Disasters**

Financing for Indigenous Energy Development

Our analyses of the various energy supply options – wind power, solar PV, hydro, biomass, biofuels, solar thermal energy for water heating, GSHP for cooling and heating – have shown that, based on the project economics alone and without taking potential carbon savings into account, almost all of these renewable energy forms are ready for deployment in Belize. **There is no need therefore for any preferential above-market price incentives to be given to any renewable energy development projects, except perhaps for PV and offshore wind.** What is needed are supporting frameworks and financing mechanisms that cater to the unique characteristics of such renewable energy investments, namely: more costly feasibility and siting studies, high upfront capital costs, output variability, and carbon savings.

- **Sponsor country-scoped studies to gauge the energy production potential of our natural resources (wind, hydro, geothermal, biomass, biofuel etc) and prepare resource potential maps so as to defray costs that individual project developers would have had to bear on their own if they had to search for optimum areas for renewable energy development from scratch. This is also important for securing the necessary financing:**
 - These studies should also include undertaking pilot/demonstration projects for technologies that have not so far been deployed on a commercial scale in Belize to gain a better understanding of the particular challenges that could be faced when deploying and operating plants based on such technologies under local conditions.
- **Provide non-traditional innovative financing mechanisms for RE developers that incorporate flexibility in repayment schedules or government guarantees to bridge the gap between the fixed repayment commitments and varying energy revenues**
- **Use revenues derived from redeeming CERs earned through participation in the CDM and other GHG reduction programs to offset operational expenditures and debt servicing costs.**
- **Set up a Green Investment Bank is to vest the decision-making process for financing renewable energy projects and the expertise for making such decisions in a single entity**
 - Through this arrangement, Government will also be able to implement innovative financing models such as packaging smaller projects into one proposition for greater management efficiency and taking advantage of special financing streams such as programmatic CDM; streamline and provide better oversight and control of the renewable energy project financing process; and attract and aggregate equity and debt capital from various sources into one pool. Importantly, one such

source (of capital) could be the local populace: thus providing yet another avenue for them to participate in the new renewable energy economy.

- **Bolster the Green Bank’s mission by providing interest rate and other subsidies for initial feasibility and siting studies and mandating special financial incentives (FITs, PTCs etc) for early demonstration of near-commercial technologies.**

Energy Efficiency and Conservation

- **Incorporate planning for energy efficiency beyond the energy sector and at the very highest levels of national strategy formulation by avoiding the building of unnecessary energy loads into long-lived assets and hence our way of life**
 - The *macro-level energy efficiency* impact – that is, the effect of a project on the energy efficiency of the nation as a whole - should therefore be a fundamental criterion and determinant in all major economic investment decisions. Planning
- **Establish Requirement of Cost Neutrality of Imposed Efficiency Standards**
 - That is, the projected energy savings resulting from energy efficiency upgrades should *as a minimum* cover the estimated incremental cost of the upgrade plus any associated incremental costs of O&M *on a net present value basis* measured over the lifetime of the upgrade.
- **Limit Total Financial Incentives & Penalties Applicable to Energy Efficiency Projects**
 - The policy planning process must therefore ensure that the total financial/economic incentives that can be applied to a specific project for achieving a particular EE target do not exceed the total net energy savings that can be gained from achieving the target.

Transportation

Instigate change-over to More Energy-Efficient and Environmentally-Friendly Vehicles and Modes of Transport

- **Adopt Vehicle Average Fuel Economy (VAFE) Standards**
 - The NEEPI should *each year* prepare the Recommended and Minimum VAFE Standards (miles per gallon or miles per KWh for EVs) for brand-new vehicles classified by class – for example, light-duty pickup trucks or large buses - and fuel type. *The VAFE for mass transport vehicles should be expressed in person-miles per gallon.*

- **Require that Permission for Vehicle Importation and Vehicle Licensing be tied to the Minimum VAFE Standard**
- **Introduce Cash-for-Scrap Program**
 - Once permission to license a vehicle is denied on the basis of its assessed fuel economy, then the owner of the vehicle would be eligible to receive a cash rebate in return for scrapping the vehicle.
- **Require that Vehicle Import Duties and Vehicle Licensing Fees be tied to the Recommended VAFE Standard**
- **Promote VAFE Standards to Lending Institutions for Inclusion in criteria for Approval of Vehicle Loans**
- **Commission Research into Use of Biofuels and Fuel Blends as Alternative Vehicle Fuels**
- **Launch a Country-wide Campaign to promote the Benefits of Walking, Cycling, Carpooling and Mass Transport**
- **Do Study on Urban and Interurban Mass Transport System in Belize to determine Required Service Standards, Required Service Infrastructure, Costs and Pricing Policies**

Build Driver Awareness of Factors influencing Vehicle Efficiency

- **Revise Driver Licensing Examination Content and Other Requirements**
- **Prepare and Disseminate Vehicle Fuel Efficiency Handbook**
- **Implement a Smart Driver Training Workshop for Heavy-Duty and Mass Transport Vehicle Drivers**
- **Implement a Smart Fleet Manager Training Workshop**

Influence Behavior towards More Efficient Vehicle Operations and Maintenance Practices

- **Launch an EE in Transport Rating Program underpinned by Mandatory Audits of Mass Transport and Freight Carriers Companies**
- **Revise Pre-requirements for Vehicle Licensing**
 - The pre-requirements for vehicle licensing should be upgraded to include a pre-requirement that the condition of the vehicle *assessed at the time of the licensing* – such as condition of lube oil and tires (rolling resistance) – as it affects the overall fuel economy of the vehicle should meet minimum acceptability levels.
- **Enforce Vehicle Speed Limits on Highways for all vehicles *including mass transport buses* by instituting highway traffic patrols on the major highways**

Build Mobile Efficiency into Urban Plans

- **Restrict Heavy Vehicle Traffic through Urban Areas**
- **Reduce Traffic Congestion within Belize City and along the Main Routes leading into Belize City during Rush Hours**
 - Investigate various options for reducing traffic congestion within Belize City itself and along the main routes leading into Belize City during rush hours. Some of these options could be:
 - 1) Converting the main highways and arteries into Belize City into four-lane routes (two-lanes in each direction) with each of the incoming lanes joining a different main street within Belize City.
 - 2) Setting up a tolling system for *incoming* traffic along the Northern Highway Entrance. The toll fee should vary by time of day – higher during rush hours - and should not be applicable to mass transport vehicles. Eventually, this tolling system can be upgraded to enable electronic operation, where electronic sensors installed at the tolling booth identify a vehicle and automatically charge the owner’s credit or debit card.
 - 3) Carving out or reclaiming (from the seashore) a right-of-way going completely around Belize City’s shoreline to be used for a free way that segues from the main highways and arteries, before their entrance into Belize City proper, and joins into its main streets along the circular route. The right-of-way should also provide for large-scale parking space along the shoreline outside of the central Belize City areas.
 - 4) Building an Urban Electric Tram Transport System through Belize City and concomitantly banning vehicle traffic along the tram routes.
 - 5) Building motor-cycle and bicycle paths along with pedestrian walkways along tram routes to encourage less energy-intensive and healthier forms of mobility.

Buildings, Lighting & Cooling

Stimulate (consumer) investment in energy efficient homes and buildings

- **Update Building Codes to reflect Mandatory Energy Efficiency Provisions**
- **Establish a Mandatory Green Building Certification Program for Domestic and Commercial Buildings to encourage a shift towards low-carbon, zero-energy or even energy-plus buildings.**

- The certification rating awarded could be based on a building’s score in a number of categories, including: provision for day-lighting and natural light sensors in lighting systems, incorporation of occupancy sensors in lighting systems, use of solar lighting technologies, provisions for passive cooling using natural ventilation, provision of energy-efficient window glazing and frames, insulation of roofs and walls, air-tightness of the building envelope, provisions for use of geothermal cooling and solar cooling technologies, provisions for use of solar water heating technologies, use of indigenous materials, adequacy of internal electrical wiring, provisions for water conservation, and proximity to urban centers.
- **Require New Government Buildings to be Zero-Energy or Energy-Plus Buildings**
- **Promote Green Building Certification to Lending Institutions as a part of Lending Criteria for Home and Commercial Building Mortgages**
- **Require that Property and Property Sale Taxes be tied to Green Building Certification Rating**
- **Introduce a Voluntary Energy Efficiency Improvement Program for Commercial & Services Sector**
 - This program will entail conducting energy audits of the facilities and buildings each of the participating companies to be conducted every two years. These audits should cover mainly lighting, cooling and heating systems with a view to detecting inefficient components and systems and system leakages, evaluating maintenance practices, and seeking opportunities for renewable and recoverable energy use.
- **Encourage Provision for Vents in Rural Households where Wood Fuel Cooking is done**

Stimulate (consumer) investment in energy efficient appliances

- **Implement a Country-wide Project to Change-over from Electric Incandescent to Solar and Electric Fluorescent and LED Lamps**
- **Implement a Country-wide Project to Change-over to Hybrid Solar-Electric Street Lights**
- **Lower Import Duties on Solar and Electric Fluorescent and LED Lamps relative to Incandescent Lamps**
- **Introduce Energy Labeling of Appliances**
 - The intention is to increase consumer’s awareness of the real energy use of household appliances at the point of purchase through a liable and clear labeling.

- **Introduce Recommended and Minimum Appliance Energy Efficiency Standards**
- **Require that Appliance Import Duties be tied to the Recommended Appliance Efficiency Standard**
- **Require that Permission for Appliance Importation be tied to the Minimum Appliance Energy Efficiency Standard**
- **Rationalize Import Duties on Solar and Geothermal Cooling and Heating Equipment relative to Electric Air-conditioners and Water Heaters**
- **Require Mandatory Use of Solar Water Heaters**
 - Government should mandate that all water heating used in residential and commercial buildings should be provided by solar technology. The importation of electric-only water heaters should be halted immediately.
- **Setup Program to Replace Traditional Wood Stoves with New Improved Wood Stoves for Cooking and Water Heating**
- **Set up of a National Laboratory for Testing of Appliance and Equipment Energy Performance**

Influence Consumer End-Use Energy Consumption Patterns

- **Initiate a Country-wide Campaign to Install Occupancy Sensors in Government Office Buildings, Commercial Buildings and Hotels**
- **Initiate a Country-wide Campaign to Install Natural Light Sensors in Government Office Buildings, Commercial Buildings and Hotels**
- **Encourage Use of Energy Monitors in High Energy Consumption Residential and Commercial Buildings**
- **Prepare and Disseminate a Residential and Commercial Energy Efficiency Handbook and Website**

Industry

- **Encourage Participation in Voluntary Certification Programs for Energy Efficiency Improvement**
- **Introduce Voluntary Target-Setting Agreements for Energy Efficiency Improvements**
 - The GOB should setup a *Voluntary Energy Efficiency Improvement Program* whereby an individual industrial company can voluntarily enter into an agreement with the GOB to achieve certain energy efficiency targets within a certain time frame, in return for receiving technical and financial support and other economic incentives such as tax breaks and import duty reductions.

- BSI/BELCOGEN is currently Belize’s single largest consumer of energy, and the single largest producer of energy. This company must therefore be singled out for special immediate attention for energy efficiency improvements, and should be required to enroll in the Efficiency Improvement Program.
- **Implement Mandatory Energy Audits that are tied to Licenses, Concessions and Other Economic Incentives**
 - The GOB should mandate that all companies operating within certain high-priority industries, and that are not engaged in its *Voluntary Energy Efficiency Improvement Program*, be required to undergo regular energy audits as a condition of their license to operate or for the continued receipt of other economic incentives and concessionary benefits.
- **Place a High Priority on Exploitation of Opportunities for Waste Heat Recovery and Waste Reuse as Feedstock**
- **Require that Energy Manager/Coordinator Position be setup within Certain Industrial Companies**
- **Foster a Corporate Culture focused on Energy Efficiency**
- **Establish a Leadership in Energy Efficiency Recognition Program**
 - An annual recognition program should be launched to honor the top-performing companies and executives who had a transformational impact on energy efficiency improvement in their enterprise or in Belize as a whole.

Agriculture & Forestry

- **Launch a Renewable Energy for Agriculture Program**
 - The GOB should launch a *Renewable Energy for Agriculture Program* to encourage the use of renewable energy technologies in farms and agro-processing: including solar crop dryers; solar water heating for dairy operations and pen and equipment cleaning; solar PV solutions for small motors, lighting and water pumping, especially in remote off-grid farms; and wind-pumping solutions for irrigating agricultural fields with surface water and pasturelands from underground aquifers.
- **Support Local Research of and Education of Farmers in Low-Energy Agricultural Practices in order to wean the modern agricultural production systems off their heavy dependence on fossil fuels for energy, fertilizers and pest management**
- **Measure Biomass Production Potential of Forestry, Agro-Processing and Industrial Activities**

- This study should also classify these biomass-producing sites by output potential, determine the locations of these sites and come up with more precise costs for collecting biomass from dispersed locations to central locations.
- **Commission a Cost-Benefit Analysis of Commercialization of Dried Fuelwood Processing and Distribution**
 - The GOB should commission a study into the commercial arrangements that can be implemented to collect and deliver wood to a central facility for proper drying and controlled distribution in the communities that are dependent on its use for cooking and water heating.

Education and Information Dissemination

- **Ensure that Government plays a Visible Leadership Role in Promulgating Policies issued by NEEPI**
- **Disseminate Success Stories to Gain Support for and Encourage Participation in Programs**
 - Successful outcomes of programs as whole, especially voluntary programs, and of individual instances should be publicized so as to gain support for and encourage participation in programs.

Capacity Building

- **Build Strong Technical and Scientific Education Foundation to support Local Energy Development**

Financing for Energy Efficiency and Recoverable Energy Projects

Government Programs

- **Provide full subsidies for initial energy audits particularly for larger commercial and industrial EE projects on the condition that, once these companies are made aware of the potential for savings and hence for increasing profits, they should find ways to access the capital needed for the upfront investment.**
- **Provide residential consumers or even smaller commercial consumers with free technical assessments of the retrofits needed to upgrade the buildings they own in order to meet the minimum GBC rating**

Financial Institutions

- **Encourage lending institutions to factor energy cost savings into interest rates (to reduce them) and building worth valuations (to increase them), and to formulate and promote mortgage packages with clear links to GBC levels**
- **Provide a GOB guarantee for the energy efficiency portion of the loans on the condition that this guarantee is also factored into the overall mortgage interest rate for the particular loan application**

ESCOs

- **Put in Place Institutional and Legal Framework to Foster the Development of ESCOs in Belize**
- **Encourage the Use of Programmatic CDM Financing for ESCOs**
 - Programmatic CDM allows for a single entity to manage and coordinate a number of smaller CDM-eligible projects under a single program manager. ESCOs should be encouraged to consider signing up as CDM program managers in order to take advantage of carbon credits earnable by EE projects included as part of a registered CDM program that otherwise could not be cost-effectively earned by the project owner on his own. The CERs earned may be used to help finance the initial investments needed for the EE projects, resulting in further benefits for both ESCO and participant.

Implementation Plan

A National Database of Energy Data and Information

The number one priority of the NEEPI must be to develop a vast compendium of continuously-updated data and technical knowledge that form the basis of an energy-economic model and that can be fed into a computer-based tool – whether a basic home-grown spreadsheet tool or a more advanced analytical framework such as NEMS (EIA) or SIEN (OLADE) or LEAP that is then used to analyze the impact of energy policy proposals on key economic performance areas.

The resultant energy information system should also be used to produce energy intelligence and reports for dissemination to the various industries and other energy stakeholders.

An Organizational Structure to Move Us Forward

The collection, compilation, collation and updating of this data; the subsequent analyses of the data; the derivation of plans and policy proposals from the results of these analyses; and the assessment of the impact of proposed plans and policies on other sectors of Belize’s economy require a concerted, focused and consistent effort. In our

view, such an effort can best be channeled and managed through a *National Energy and Electricity Planning Institute (NEEPI)*.

TOR of NEEPI

The NEEPI should be charged with the responsibility for formulating energy plans and policies in coordination with relevant stakeholders, for disseminating these plans and policies to relevant stakeholders (after the requisite approvals have been gotten), for monitoring adherence to these plans and policies through the bodies charged with administering them, and for providing information feedback to stakeholders.

NEEPI Outputs

The major outputs of the NEEPI should be the following:

- Policy proposals
- *Energy plans* on which the policy proposals are based
- Annual energy reports, similar to the Annual Energy Outlook produced by the US DOE
- *Quarterly energy reports*, following the same format as the annual energy report
- Aggregate energy statistics by sector

Relationship with Government and Other Organizations

The NEEPI should be setup as an autonomous statutory body under the auspices of the Ministry of Public Utilities or the Ministry of Natural Resources or a new Ministry of Energy. The NEEPI should not directly report to any particular Ministry or other Government department. Government exerts its control over the direction of the NEEPI through the representatives it appoints on the NEEPI’s board and, more importantly, through Government’s stated national priorities and objectives, which the NEEPI should be bound to follow.

Proposed Technical Organizational Structure

The technical responsibilities of the NEEPI should be assigned to units on the basis of area of energy supply or consumption sector: upstream petroleum, agriculture and upstream biofuels, transport (which would include downstream petroleum fuels and biofuels), renewable electricity, buildings, and industry (including agro-processing). Technical responsibilities assigned to each unit may be further re-assigned to sub-units within the unit.

A separate technical planning and policy-formulation unit should be setup to receive the results of analyses and recommendations from each of the other units, and to collate these results and recommendations into the energy plan and final policy proposals. The technical planning unit should be headed by a technical planning committee, made up of the heads of each of the other units and technical planning experts. The

recommendations of this technical planning committee are then submitted to the Board of the NEEPI for their approval, before submission to the Cabinet or appropriate Ministry for final ratification and follow-up action.