SUSTAINABLE
ENERGY FOR ALL

Rapid Assessment Gap Analysis
Barbados

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Barbados:
Rapid Assessment and Gap Analysis

EXECUTIVE SUMMARY

In Barbados there is significant unrealized potential for sustainable energy gains. The Government of Barbados has recognized the unrealized gains and put in place plans to achieve those gains. These plans are in line with the goals of Sustainable Energy for All (SE4ALL).

Barbados has achieved universal access to energy, the first goal of SE4ALL; but high energy costs restrict the amount of electricity that households and businesses of Barbados have access to. Energy usage in Barbados is inefficient. However, Barbados has a plan in place to increase energy efficiency by 21.9 percent by 2029; which is more than the SE4ALL's second goal of improving energy efficiency by 14 percent. There is currently very little usage of renewable energy for electricity generation in Barbados, but the country is planning to increase the share of renewable energy in Barbados's electricity generation mix, with an objective to supply 29 percent of all electricity consumption by 2029. This figure is in line with SE4ALL's goal of doubling the global share of renewable energy from 15 percent to 30 percent by 2030. The primary objective of the Government of Barbados in achieving an increase in energy efficiency and renewable energy use is to reduce energy costs.

To achieve its goals, Barbados recognizes that it must educate sufficient sustainable energy technicians and engineers; increase awareness among the public through public awareness campaigns and high profile pilots; and continue to provide reasonably priced funding for sustainable energy investments in the public and private sector. In recognition of these needs Barbados has drafted a Plan for Energy Sector Capacity and Institutional Strengthening, Public Education, and Public Awareness; implemented an Energy Smart Fund to ensure sufficient sustainable energy in the private sector; and designed a Public Sector Sustainable Energy Program to promote sustainable energy in the public sector. Barbados is also working to implement a Pilot Project with assistance from the Global Environment Facility for the supply and installation of 15,000 Compact Fluorescent Lights, power monitors, and 28 renewable energy systems in the country, and preparing a new law that facilitates the granting of licences to third party generators. Partnering with SE4ALL will benefit both parties by ensuring that Barbados will have the resources to follow through with its plans and achieve the goals it shares with SE4ALL.

Section I: Introduction

1.1 COUNTRY OVERVIEW

1. Basic socio-economic data: population, GDP/capita, key economic sectors, poverty rate (current and trend)

- Demographics[i]
  - Population: 287,733
  - Age Structure
    - 0-14: 18.9 percent
    - 15-64: 71.3 percent
    - 65 and Over: 9.8 percent

- Economy[ii]
  - GDP: US$4.4 billion
  - GDP per Capital (PPP): US$23,200
  - GDP Breakdown by sector:
    - Services: 83.2 percent

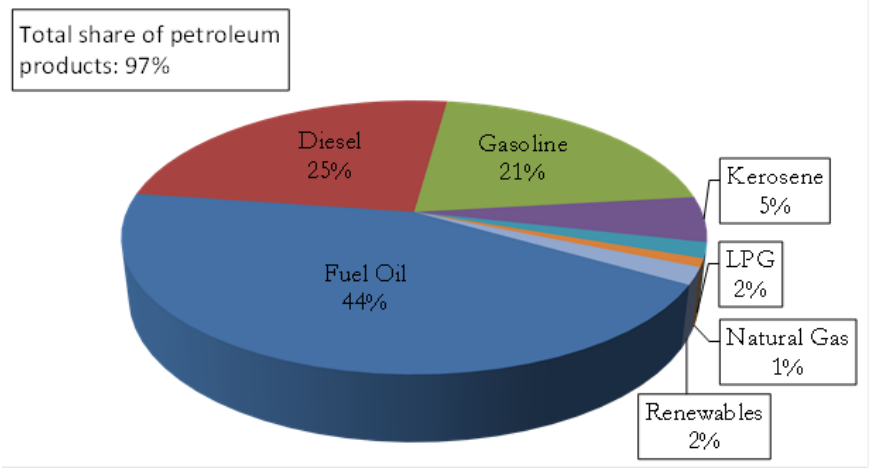
- Industry: 13.4 percent
- Agriculture: 3.4 percent

- Poverty Rate: 19.3 percent of individuals, and 15 percent of households (2010)[iii]
- Inflation Rate: 9.4 percent
- Unemployment: 10 percent.

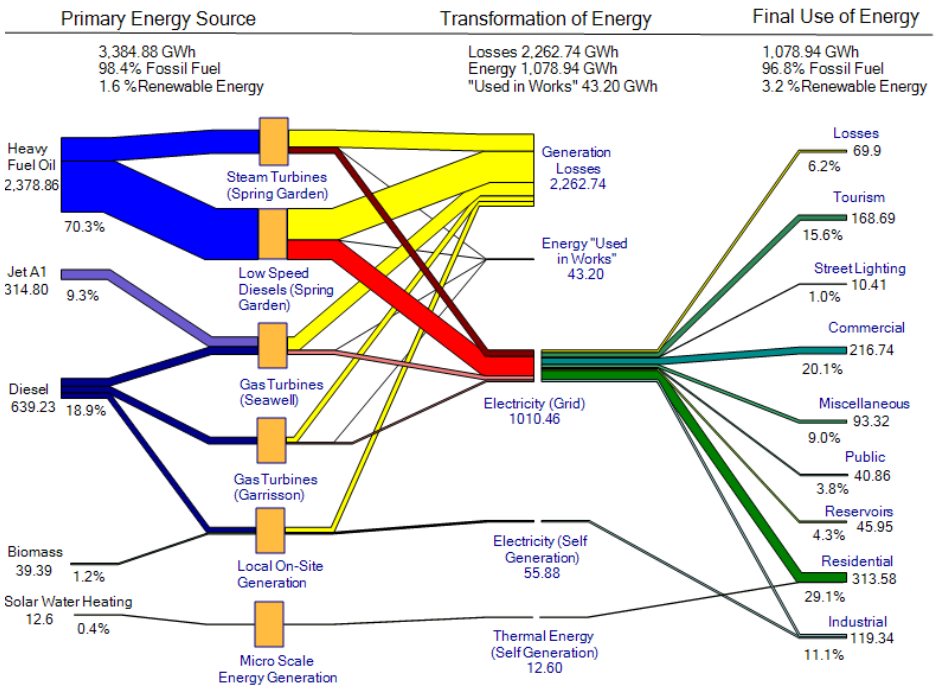
1.2 ENERGY SITUATION

2. Energy supply (energy mix, export/import)

Barbados' Primary Energy Mix, 2010[iv]



Barbados' Current Electricity Matrix for 2010 (GWh)[v]



- Primary energy sources

The figure presented above presents Barbados's primary energy mix in 2010. This figure shows that petroleum products represent 97 percent of primary energy sources (fuel oil about 44 percent, diesel 25 percent, gasoline 21 percent, kerosene five percent, LPG 2 percent). Natural represents about 1 percent; and renewables (solar PV, solar water heating, and bagasse) about 2 percent. The figure showing Barbados's electricity matrix for 2010 (which was prepared by consultants engaged to assist the Government of Barbados in developing a Sustainable Energy Framework for Barbados) shows that in 2010 solar water heating and biomass (for cogeneration) constituted about 1.6 percent of the primary energy sources used for power generation in Barbados.

Barbados meets its primary energy needs by importing approximately 9,000 barrels of oil a day. This is in addition to the 850 barrels of oil a day that it produces, which it has to export to be refined and then reimport.

- Power sector (installed capacity, annual generation, import/export)

  Barbados' power sector includes an installed capacity of 255 MW.[vi] Electricity generation amounted to 1,078 GWh for the year 2010.[vii]

  Barbados' electricity grid is not interconnected with any other country, therefore it neither imports nor exports electricity.

3. Energy demand (overview of main consuming sectors, industry, residential, agriculture, transport)

Power generation accounts for 48 percent of the primary energy supply in Barbados. The remainder of the primary energy supply is consumed as follows:

- Transportation—31 percent
- Commercial (including the public sector)—three percent
- Industry—nine percent
- Residential—four percent
- Other—five percent.[viii]

4. Energy and economic development

- Share of energy sector in GDP

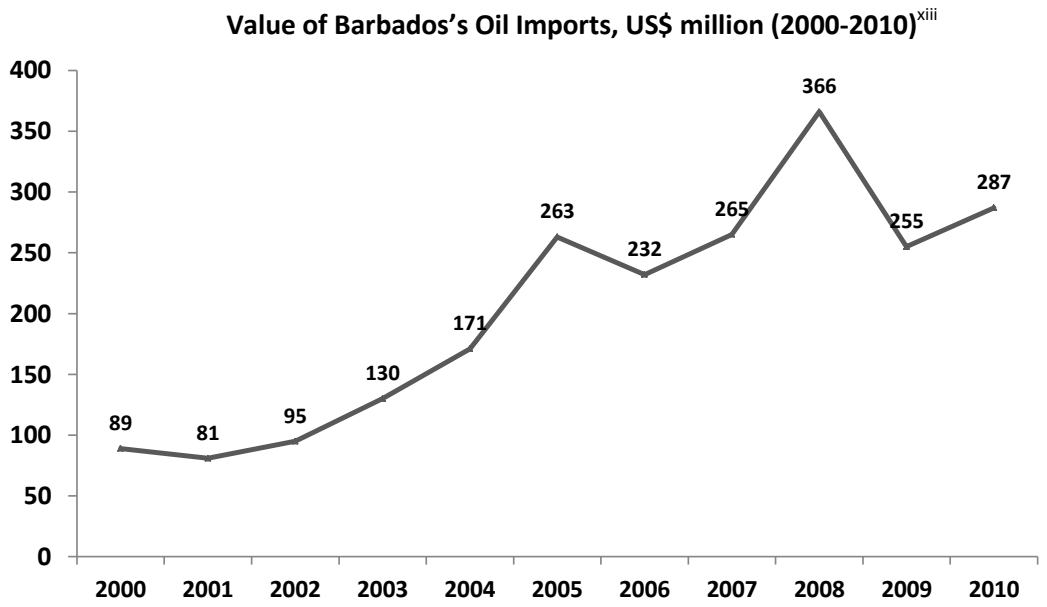
  Oil imports alone represented 7.5 percent of GDP in 2010.[ix]

- Share and absolute amount of public spending on energy, including for energy subsidies

  The Government's average electricity bill is US$9.7 million,[x] which includes buildings and public lighting. Since 2008, the Government has been subsidizing diesel prices for various sectors, including electricity production, as well as the agricultural, manufacturing, and fisheries sectors, and private-public sector vehicles such as buses and route taxis. The Government provided an estimated US$25.2 million of subsidies for diesel between June 2008 and December 2011.[xi]

- Energy security (share of energy imports in balance of payment)

  The figure below shows the value of oil imports to Barbados between 2000 and 2010. In 2010, oil imports represented about 23 percent of total imports and 90 percent of the negative current account balance.[xii]



5. Energy strategy and relevant targets (access, capacity, generation, energy security)

Physical access to energy in Barbados is universal. However, high costs constrain the amounts of energy available to citizens. Energy consumption under a 'business as usual (BAU)' scenario is expected to continue to grow and the cost of energy is expected to remain high. For example, electricity consumption across the various sectors is expected to grow at roughly two percent per year on average.[xiv] Under the 'BAU' scenario, an increase in demand would be met by an increase in capacity from fossil fuel fired plants, thereby continuing to restrict energy usage through high energy costs.

In response, the Government of Barbados has embarked in the development of a Sustainable Energy Framework, a comprehensive analytical and reform effort funded by the Inter-American Development Bank. Within this effort, the Government has drafted a National Sustainable Energy Plan (NSEP), and is close to approving the final draft. The Draft NSEP calls for:

- Producing and consuming fossil fuels more sustainably
- Using more renewable energy
- Using electricity more efficiently, and conserving it.

All sustainable energy initiatives are guided by five principles: a 'win-win' approach where projects are given priority if they both decrease oil dependence and energy costs; the use of cost-benefit analysis to ensure economic viability; international support; technology neutrality; and building on existing strengths.

The Draft NSEP lays out specific targets for increasing capacity through renewable energy, increasing the share of electricity generation from renewable energy, and increasing energy efficiency. However, these targets are indicative, they are not fixed targets to be achieved at any cost—this would be counter to the primary objectives of lowering energy costs and increasing energy security. The targets are to:

- Increase the proportion of renewable energy to 29 percent of all electricity consumption by 2029
- Achieve 22 percent of savings in Barbados's electricity consumption by 2029 compared to a 'BAU' scenario.

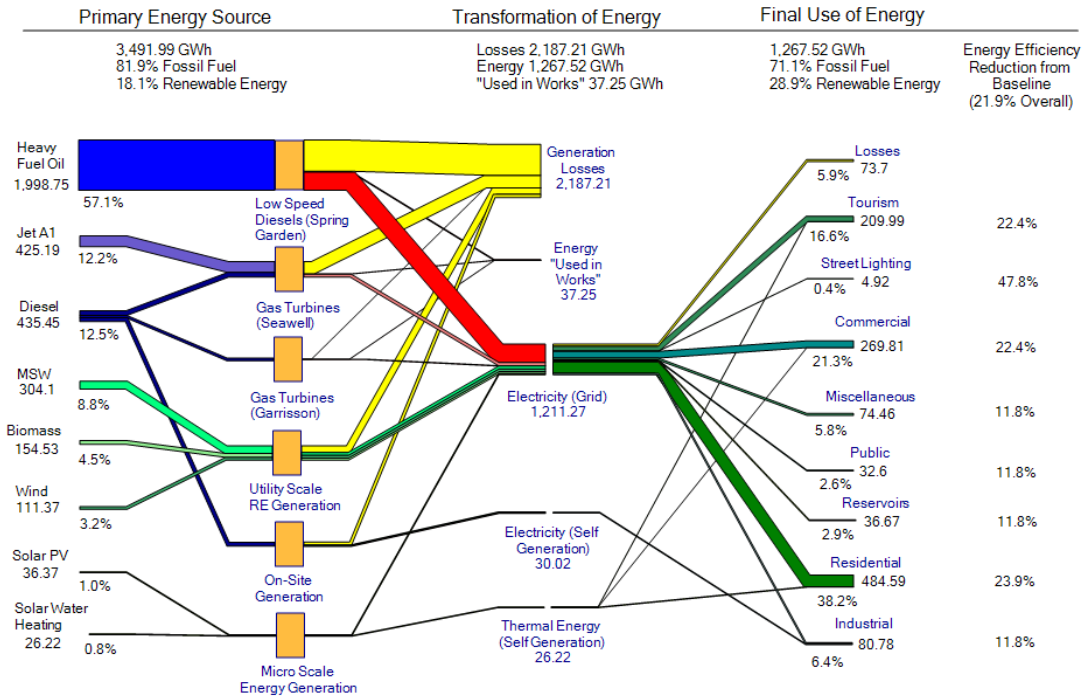
Consultants engaged to assist in developing the Sustainable Energy Framework estimated that achieving these targets could lead to savings in electricity costs totalling US$283.5 million over a period of 20 years

(the net effect of an increase in capital cost of US$386.5 million, and a decrease in fuel costs of US$670 million)[1].[xv]

As a result of the investments in energy efficiency, average annual growth in electricity demand is expected to fall to by about one percent.[xvi] This reduced demand will translate into a lower dependence on fossil fuels, and therefore an improvement in energy security.

The figure below shows Barbados's Sustainable Energy Matrix for the electricity sector, which summarizes the country's renewable energy and energy efficiency targets for the long term. This matrix was developed by consultants engaged to assist the Government in developing the Sustainable Energy Framework for Barbados.

Barbados' Sustainable Electricity Matrix for 2029 (GWh)[xvii]



Section 2: Current situation with regard to SE4ALL goals

2.1 ENERGY ACCESS vis-à-vis GOAL OF SE4ALL

6. Overview and assessment

Of the three main objectives of SE4ALL, Barbados scores highest on access to energy. Both thermal and electric energy access are universal in Barbados. Costs, however, are high relative to larger countries. This represents a burden for families and businesses that may curtail usage, reducing quality of life and production because of prohibitively high costs.

7. Modern energy for thermal applications (cooking, heating)

- Physical access: share of households without access to modern cooking/heating, industrial/agricultural use

[1] Figures in net present value terms, calculated using a six percent discount rate.

- Physical access to modern cooking appliances is universal. However, only 20 percent of households are connected to the natural gas grid
- Heating for the home is not applicable in Barbados where the lowest average monthly temperature is 23 degrees Celsius.[xviii] However, solar water heaters—a modern and cost-effective sustainable energy technology—are applicable, and are widely physically accessible.

- Availability/quality of supply: status of domestic supply chain

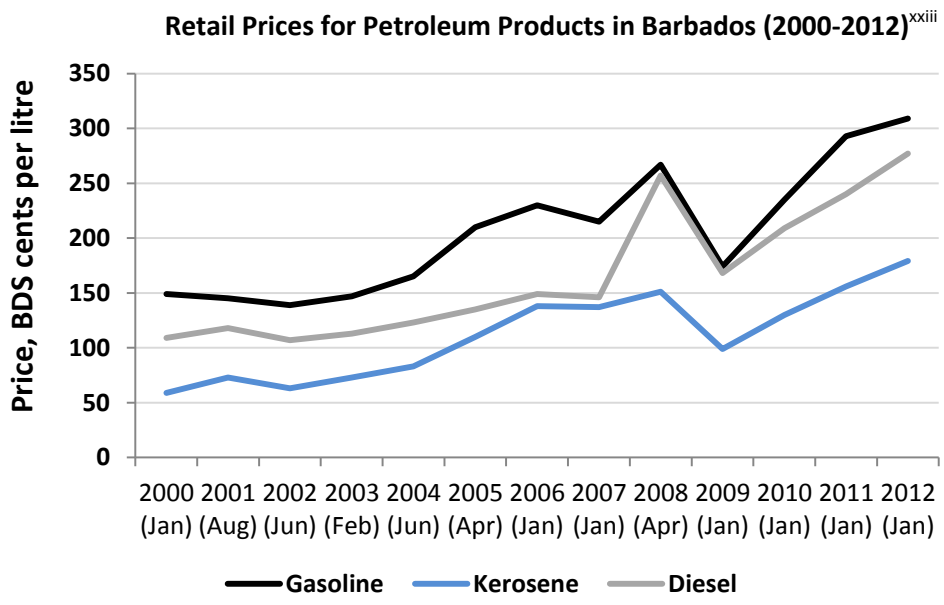
  There is universal availability of quality cooking and heating appliances in Barbados. This includes solar water heaters, many of which are manufactured in Barbados.

- Affordability: fuel prices, cost/affordability of efficient cooking stoves and fuel supplies (e.g. percent of household monthly income)

  Efficient cooking stoves are nearly universal; hence their cost has not proven a barrier for their uptake. Fuel prices, however, are a concern, affecting households' expenditure on cooking (for those that have electric stoves) or heating (for those that do not have a solar water heater) through high electricity prices.

  In August 2008 the cost of the fuel used per kWh of electricity generated—the Fuel Clause Adjustment—alone reached an all-time high of US$0.25. This translated into a monthly electricity bill of about US$106 for a residential household consuming 253kWh per month (the average consumption of residential customers in 2008)[xix], a portion of which would be for the use of an electric stove or heating water.[xx] This represents about 9 percent of a monthly household income of US$1,225 (assuming that the average household comprises two people that earn the average income per capita in Barbados).[xxi] However, residential customers were cushioned from the full impact of the increase through a government subsidy on fuel oil used for electricity generation. This subsidy cost the Government about US$18 million over less than one year.[xxii]

  The figure below shows retail prices for gasoline, kerosene, and diesel in Barbados between 2000 and 2012.



  For households with gas burning stoves, being connected to the natural gas grid can result in significant savings. The price for natural gas delivered on the natural gas grid is US$0.65 per

cubic meter.[xxiv] The average citizen in Barbados using gas to cook, uses 150 cubic metres per year.[xxv] This means spending about US$8 per month on natural gas—this represents less than one percent of monthly income. Meanwhile, a twenty five pound cylinder of natural gas that has to be refilled monthly costs about BDS$53[xxvi], or about two percent of the average household monthly income (assuming that the average household includes two people that are in the workforce, each earning the equivalent of Barbados's average income per capita).

- Sustainability: share of sustainable biomass and other RES, % household with access to efficient stoves

  - Households have universal access to efficient stoves.
  - Solar Water Heaters have reached a forty percent penetration rate for households nationally.[xxvii]

8. Access to electricity:

- Physical access: grid connection, urban/rural areas, target group: areas/category of population with minimum level of physical access

  Barbados is a densely populated island. Physical access to the electricity grid is universal.

- Availability and reliability of supply: frequency/duration of black-outs, load shedding (if officially practiced)

  The utility—Barbados Light and Power, BL&P—has maintained sufficient generating capacity to meet peak demand.[xxviii] Load shedding is not necessary, and blackouts are uncommon, with the possible exception of during or after extreme weather events.

- Affordability: tariffs, share of utility bills in household incomes, subsidies

  The average residential tariff, assuming an oil cost of US$100 per barrel, is US$0.30 per kWh. Given an average residential consumption of 253kWh per month (this corresponds to average consumption in 2008), this translates into a monthly electricity bill of US$82.5—representing seven percent of a household's monthly income (for a household with two people in the workforce, each earning the equivalent of Barbados's average per capital income). This cost is highly volatile due to the cost of oil.

  The Government of Barbados typically does not subsidize electricity tariffs. However, as stated in question seven, the Government does provide subsidies for diesel used in electricity production.

- Sustainability: share of renewable energy sources (RES) in power mix

  As shown in the figure above, currently RES represent less than two percent of the current power mix.

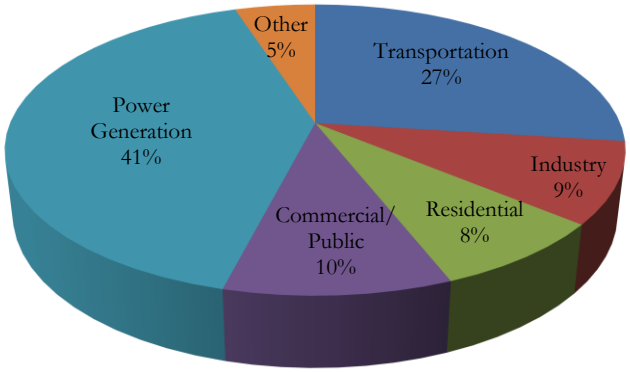
9. Modern energy for productive uses:

- Energy needs and access: energy demand in productive sectors; share of enterprises, industrial/agricultural, with access to modern energy sources

  The productive sectors (Industrial and Commercial) in Barbados have universal access to electricity. The figure below shows that together, the industrial, commercial, and public sectors

consumed 19 percent of Barbados's primary energy and electricity in 2010. In that year, these sectors consumed about 51 percent of the electricity generated in Barbados.[xxix]

End Uses of Primary Energy (including Electricity) in Barbados (2010)[xxx]



- Availability: quality of local supply chain and availability of required technologies for productive applications

  The productive sectors in Barbados are universally connected to a high quality electric grid. The grid rarely suffers interruptions (which would constrain productivity) and power quality is sufficient for operating machinery optimally. In addition, productive sector businesses are able to generate their own electricity using renewable energy technologies, and sell excess electricity to the grid.

- Affordability and access to capital: fuel prices, cost/affordability of technology

  Businesses in Barbados have limited access to credit for investment in RES, so expensive RES are unaffordable for them, even if the equipment would pay for itself overtime. Access to credit has been limited by the fact that the technologies are new and unfamiliar, so that banks have been unwilling to lend against them, and equipment suppliers have not yet developed their own financing schemes.[xxxi]

2.2 ENERGY EFFICIENCY vis-à-vis GOAL OF SE4ALL

10. Overview and Assessment

Many energy efficiency technologies have been identified in Barbados as economically and commercially viable ways to reduce the cost of energy for businesses and households. Technologies include:

- Energy Efficient lighting (including intelligent lighting)
- Premium Efficiency Motors
- Efficient Air-Conditioners
- Efficient Refrigerators
- Efficient LCD Computer Monitors and Television Monitors.

Despite these technologies having been identified as energy efficient, consultants procured by the Government found that only LCD computer monitors are in wide use in Barbados.[xxxii] This represents a low uptake of energy efficient equipment, and vast room for improvement.

The Government of Barbados is planning to implement two programs to increase the use of energy efficiency technologies in Barbados: an Energy Smart Fund that provides grants and loans at favourable

rates to private sector businesses and households for energy efficiency retrofits and technologies, and a Public Sector Smart Energy Program that funds energy efficiency retrofits for public lights and public buildings (starting with 85 percent of Barbados's public lights, and 12 public buildings).

11. Energy intensity of national economy:

In 2009, TPES was 350,280 Barrels of Oil Equivalent (BOE).[xxxiii] This corresponds to US$12,561 of GDP per BOE in 2010. There is not any sign of decoupling. For example, for the period of 2000-2008 total electricity usage increased by 3.6 percent annually on average[xxxiv]; GDP growth over the same period was 1.2 percent.[xxxv] The following are based on estimates provided by consultants engaged by the Government to assist in developing Barbados's Sustainable Energy Framework:

- Industrial energy use and potential for energy saving

  Industry represents 14 percent of TPES and has the potential for up to 11.8 percent energy efficiency savings. Savings could be realized through more efficient:

  - Motors—52 percent improvement potential
  - Air Conditioning—12 percent improvement potential
  - Lighting—5 percent improvement potential
  - Refrigeration—30 percent improvement potential.

- Household energy use and potential for energy saving

  Households represent 20 percent of TPES in and have a potential savings of 23.9 percent. Savings could be realized through:

  - Air Conditioning—5 percent improvement potential
  - Lighting—39 percent improvement potential
  - Refrigeration—47 percent improvement potential.[xxxvi]

2.3 RENEWABLE ENERGY vis-à-vis GOAL OF SE4ALL

12. Overview and Assessment

The current uptake of renewable energy in Barbados is low despite many commercially and economically viable options for utility scale and distributed scale RES, and the possibility of distributed scale RES to connect to the grid. There is much room for improvement.

13. On-grid and off-grid renewable energy

There is no utility scale renewable electricity generated in Barbados[2], despite the fact that several options would be economically and commercially viable. Distributed renewable generation is almost non-existent, despite the utility offering a Renewable Energy Rider (RER) for a limited number of systems. The RER allows distributed scale RES to connect to the grid and sell excess power to the utility. There are a few small-scale wind units, but these are used mostly for experimental purposes. Similarly, solar photovoltaic is limited to just a few installations.[xxxvii]

14. Use of renewable energy sources (RES) for thermal applications (cooking/heating)

[2] Note: As shown in Barbados's electricity matrix for 2010, there is one bagasse cogeneration plant currently operating, but it is not connected to the grid

Solar water heaters, with an estimated penetration of about 40 percent of households, are the only significant distributed RES in Barbados.

15. Use of RES for productive activities

A few solar water heating systems have been used in hotels and in the industrial sector to provide hot water for hotel guests and for productive processes. Additionally, several productive sector businesses are considering commercial scale solar PV projects.

16. Consolidated Summary: problem statements with regard to energy access, energy efficiency and renewable energy

Barbados is fortunate to have universal physical energy access. However, how much an individual can consume is limited by the high cost of energy. This in turn limits productivity and quality of life for citizens and businesses. To confront this problem, Barbados intends to increase energy efficiency and renewable energy usage, both of which have significant room for improvement in uptake of technologies that are proven commercially and economically viable.

2.4 SE4ALL GOALS

17. Goals

- Energy access

  Energy access is universal in Barbados. The objective of the Government is to improve affordability of energy in the country. As stated above, the Government intends to achieve this by unlocking economically and commercially viable investments in renewable energy and energy efficiency, through the implementation of the NSEP.[xxxviii] In a report on Barbados's Sustainable Energy Framework, which formed the basis for the NSEP, consultants estimated that investing in viable renewable energy and energy efficiency technologies would lead to an increase capital costs in electricity supply by US$386.5 million, but a decrease fuel costs by US$670 million over a period of 20 years, thereby resulting in overall savings of US$283.5 million[3] in electricity costs.

- Energy efficiency

  It is the Government's goal to achieve savings in electricity consumption, with an indicative target of 22 percent overall savings by 2029 compared to a business-as-usual scenario.[xxxix]

- Renewable energy

  It is the Government's goal to increase the share of economically viable renewable energy in Barbados' energy mix, with an indicative target of about 29 percent of all electricity consumption to be generated from renewable sources by 2029.[xl]

Section 3: Challenges and opportunities for achieving SE4ALL goals

3.1 INSTITUTIONAL AND POLICY FRAMEWORK

18. Energy and development:

[3] Figures expressed in net present value terms, calculated using a six percent discount rate.

- Energy in national development and poverty reduction strategies and plans

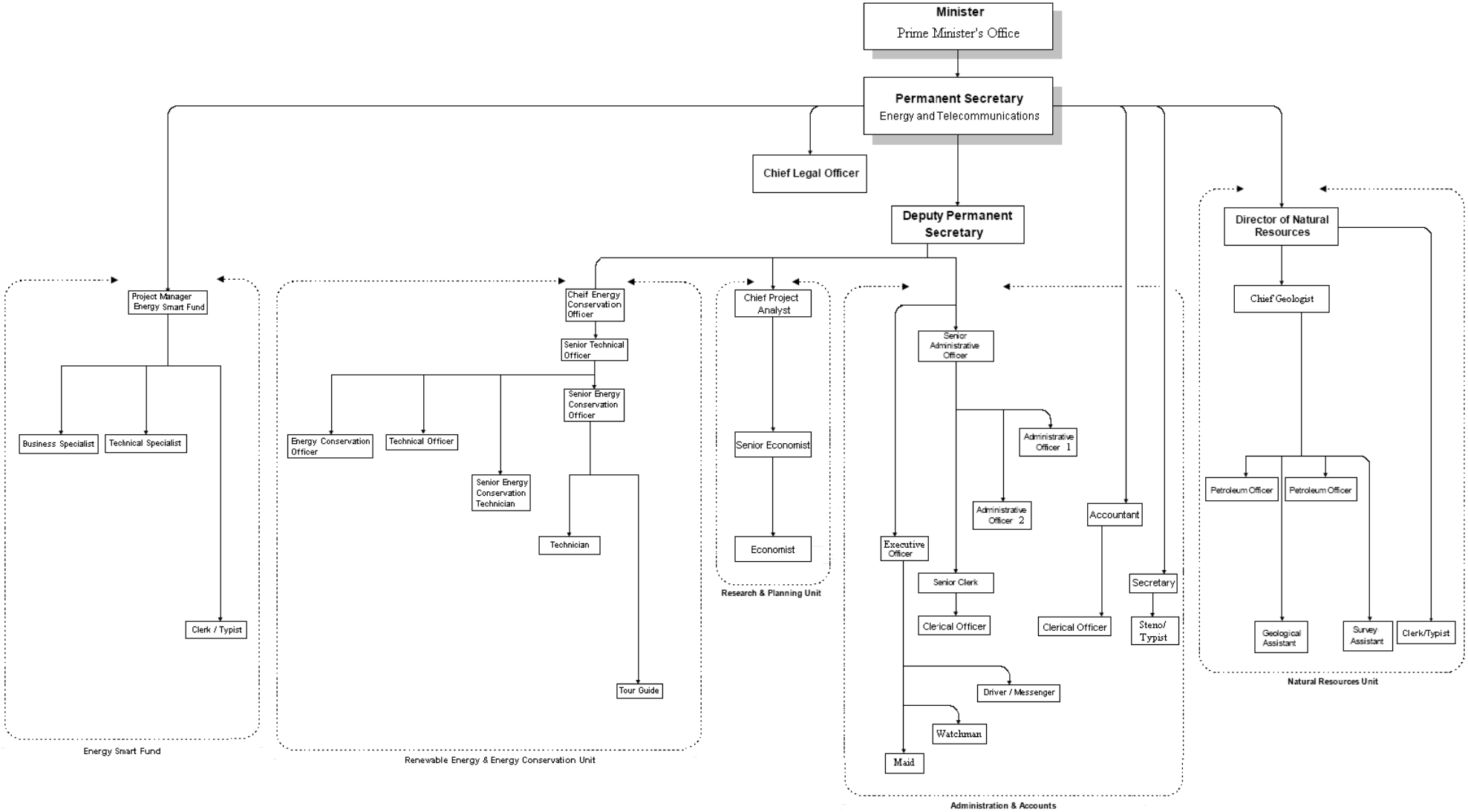
  The Draft National Sustainable Energy Plan (NSEP) lays out the Government's plans for improving sustainability of all facets of the Energy sector. The Draft NSEP is the result of significant study; it is intended to correct weaknesses in the existing policy framework. It is divided into four policies parts:

  - **Policy on Renewable Energy Generation**—contains policies for the supply side of the power sector including: utility scale renewable power generation; distributed renewable energy generation; grid operations; and renewable energy permitting and planning
  - **Policy on Electric Energy Efficiency**—contains policies for measures related to the consumption of electricity including: power utility regulation for energy efficiency; energy efficiency in new buildings and facilities; energy efficiency in existing buildings and facilities; import duties and tax incentives for energy efficient equipment; efficient lighting; and efficient transmission and distribution of electricity
  - **Policy on Sustainable Supply and Demand of Fossil Fuels** —contains policies for measures related to the efficient exploration, production, storage, distribution, and consumption of fossil fuels, in various sectors: power generation; transportation; industrial; commercial; and residential
  - **Policy on Energy Education, Awareness, and Innovation**—contains policy measures to inform people about sustainable energy, enabling them to make better choices; and to increase the professional skills in Barbados' public and private sector in the field of sustainable energy.[xli]

- Energy governance: institution(s) in charge of energy sector within the context of economic and social development in the country

  Energy policy is the responsibility of the **Energy Division within the Office of the Prime Minister**. This division has the responsibility for monitoring and regulating energy supply. Particular responsibilities include promoting the use of renewable energy technologies, and promoting the efficient use of energy. Broadly, energy policy in Barbados over the past few years has aimed at ensuring the security of energy supply, and making the further development of these supplies sustainable. The figure below shows how the Energy Division is organized:

Organizational Chart of the Energy Division (March 2012)



Source: Energy Division

19. Thermal energy for households:

- Relevant targets, policies, strategies, plans

  The Government's policy has encouraged solar water heaters for households with fiscal and customs incentives, as well as financial incentives. These policies have been successful, as the high rate of penetration of solar water heaters in the country demonstrates. However, the remaining unrealized potential is significant. It is the Government's policy to continue supporting solar water heating manufacturing, use, and export.[xlii]

  The only plan currently under consideration for thermal energy is a plan to expand the natural gas transmission and distribution network of the National Petroleum Company.[xliii]

- National institutions/capacities (mandate/capacities of relevant governmental institutions and market regulators, fuel tariffs, specifically for households)

  The Fair Trading Commission (FTC) is responsible for regulating natural gas prices. The FTC was established in January 2001 under the Fair Trading Commission Act. The FTC is an independent government entity. It obtains budgetary support from Government budget, and from levies on the entities regulated by the Commission. A recent World Bank study of regulatory authorities ranked the FTC among the top group due to its mechanisms and procedures for guaranteeing its autonomous administration. [xliv]

  The **National Petroleum Corporation (NPC)** sells piped natural gas for domestic, commercial, and industrial use. Its mission is to provide an adequate, reliable, safe, and efficient gas service to customers at a reasonable cost.

20. Power sector:

- Relevant targets, policies, strategies, plans

  As stated above, the government's target in the power sector is to generate 29 percent of all energy from renewable energy generation by 2029. In pursuit of that goal, the Government's policy is that the regulator will require the electric utility to show that its generation expansion plan is least cost (while also taking into account a prudent diversification of the generation portfolio, including consideration of renewable energy options), within an Integrated Resource Plan that identifies the combination of new firm and non-firm generation capacity and energy efficiency that satisfies forecast demand at least cost.

  Furthermore, the regulator will allow the electric utility to securely recover the costs of investments in renewable generation and fuel efficiency. Additionally, the regulator will require the electric utility to purchase renewable and cogenerated power from third party suppliers, where additional power is required under the Integrated Resource Plan (including the decommissioning and replacement of old plants), and where third party supply is cheaper than the electric utility providing the power itself, and does not create risks to power quality or reliability, nor any unreasonable financial risk.[xlv]

  Finally, it is the Government's policy that utility scale electricity generation should be stable and reliable, while encouraging the electric utility to invest in energy efficient generation; and that the regulatory process be such as to enable the electric utility to recover any capital investment it makes for efficient generation or efficient consumption, and to make a reasonable return on such investment.[xlvi]

- National Institutions/capacities (Ministry of Energy/Power, existence/capacity/mandate of market regulator for power sector, market structure in power sector, power tariffs)

  The Fair Trading Commission (FTC) is responsible for regulating the power sector. It took over utility regulation from the previous Public Utilities Boards. [xlvii]

21. Modern energy for productive sectors:

- Relevant targets, policies, strategies, plans

  The Policy on Renewable Energy Generation and the Policy on Electric Energy Efficiency will enable the productive sectors to sell power generated with RES back to the grid, and benefit from incentives for energy efficiency. In addition, there are specific policies for efficient use of fossil fuels for the productive sectors:

  - **Policy on Efficient Use of Fossil Fuels in Industry**—supports efficiency in industry by:
    - Offering well publicized customs and fiscal incentives for efficient industrial heating equipment powered by fossil fuels
    - Conducting a review of Government-owned industrial facilities to ensure that its fossil fuel powered heating equipment is up to date with best practices in energy efficiency
    - Encouraging the sugarcane industry to produce ethanol, which can be added to fossil fuels to increase their efficiency, and be used to generate electricity.
  - **Policy on Efficient Use of Fossil Fuels in the Commercial Sector**—ensures that the commercial sector, which includes the non-industrial elements of the public sector in this context, uses natural gas (the main fossil fuel used by the commercial sector) efficiently. It will ensure this by:
    - Working with relevant commercial organizations that can help spread information to their members about efficient practices for natural gas use
    - Ensuring that air-conditioning and refrigeration units that are driven by natural gas receive the same treatment as electrically driven appliances with regards to encouraging energy efficiency
    - Developing tax, customs, and building codes that promote efficiency in commercial use of fossil fuels.

- Institutions/capacities

  The **Energy Division within the Office of the Prime Minister** has responsibility for overseeing these plans.

22. National monitoring framework for SE4ALL:

- Proposed indicators to measure and monitor achievement of national SE4ALL goals.

  The following indicators are proposed to monitor SE4ALL goals, and are consistent with those used to monitor progress under the Sustainable Energy Framework:

  - Electricity Generated from RE Systems (MWh/year, MWh to date generated)

- Electricity Saved through EE Projects (MWh/year, MWh to date saved)
- Fossil Fuels Saved (barrels of oil equivalent)
- Policy documents and legislation for sustainable energy approved (documents)
- Institutional Strengthening (number of positions filled and created)
- Increased Awareness (number of events or programs)
- Diversification of primary energy sources in Barbados's energy matrix (including percentage share of RE, broken down by RE source, and bio-diesel)
- Energy intensity in Barbados's energy matrix (broken down by sector)
- Increased access to finance for sustainable energy.

In addition, the following indicators are proposed to monitor SE4ALL goals:

- Total investment in RE
- Propensity to invest in RE
- Household income spent on fuel and electricity
- Household energy use by income, broken down by energy source
- Electricity access (percentage of population with access to electricity)
- Average energy use per household.

- Data requirements, gaps and associated capacity development needs

  The Energy Division of the Prime Minister's Office already collects sufficient data to assess most of the proposed indicators. To administer the program the Energy Division plans to hire five additional employees.

3.2 PROGRAMS AND FINANCING

23. Thermal energy: programs and financing to improve access, efficiency and use of RES for cooking and other household needs

- Supply: programs and investment to develop domestic manufacturing capacities, including access to capital and know-how for supply chain stakeholders

  As described above, the Government has encouraged and will continue to encourage solar water heater manufacturers with fiscal and customs incentives, as well as financial incentives. In addition to local incentives, Barbados is benefiting from international trade and partnership agreements, such as the Economic Partnership Agreement between the CARIFORUM States and the European Community, which provide financial assistance to energy.

  As mentioned above also, the Government is also investing in sustainable energy education for technicians and engineers.

  The government is also financing a study on a plan currently under consideration to expand the natural gas transmission and distribution network by the National Petroleum Company.[xlviii]

- Demand: financial support schemes to improve affordability of modern energy for end-users, as well as build their knowledge and capacity

  The Government does not provide subsidies for thermal energy to end-users at this time.

- Sustainability: programs aimed at improving environmental sustainability of energy supply for cooking, such as forest plantation and sustainable charcoal production

  No current plans.

24. Power sector: programs and financing to improve access, efficiency and use of RES for power supply

- Physical access (electrification)

  Access to electricity is universal in Barbados.

- Availability (new capacity)

  As mentioned above, it is the Government's policy is that the regulator will require the electric utility to show that its generation expansion plan is least cost (while also taking into account a prudent diversification of the generation portfolio, including consideration of renewable energy options), within an Integrated Resource Plan that identifies the combination of new firm and non-firm generation capacity and energy efficiency that satisfies forecast demand at least cost. Given that the regulatory system for electricity supply in Barbados is designed for the utility to recover its costs and earn a reasonable return on investment, the electric utility is required to pass savings in electricity costs to its customers through lower tariffs. Therefore, a lower cost of electricity supply translates into a lower electricity cost to consumers.

- Reliability (grid maintenance/upgrade)

  It is the Government's policy that the electric utility retain control of the electricity grid, ensuring safety, reliability, and power quality, while at the same time allowing third parties to generate cost-effective power.

  To this end, the Government recognizes that it is a duty for the electric utility to develop a Grid Code—that is, a set of reasonable technical and operating standards and requirements to apply to all generators, both utility scale and distributed, that interconnect to the grid. The electric utility should be the primary policy responsible for developing the Grid Code, but it will also consult with the Government Electrical Engineering Department and the Barbados National Standards Institution in doing so.

  This Grid Code is subject to approval by the electricity regulator to ensure that it does not impose restrictions on third party generators beyond those that are necessary to ensure safety, reliability, and power quality across the grid. The electricity regulator may obtain assistance from the Government Electrical Engineering Department and the Barbados National Standards Institution, and if necessary procure external consultants, to review the Grid Code, and shall conduct a public consultation before approving the Grid Code.

  Additionally, the Government will give consideration to procuring a study that assesses net costs and benefits to the country of maintaining the current network voltage and frequency, or adopting a different one.[xlix]

- Sustainability (investment in renewable energy, on-grid and off grid, and energy efficiency)

  As described above, the utility is required to consider all sustainable energy options in its least cost expansion plans for new capacity. This guarantees that the utility will invest in renewable energy and energy efficiency whenever it is economically justified.

  Also, the Government has two programs for supporting sustainable energy investment outside of the utility. One program supports sustainable energy in the public sector, the second supports sustainable energy in the private sector.

  In the public sector, The Government of Barbados is designing a Public Sector Smart Energy Program (PSSEP). The PSSEP will fund renewable energy (RE) and energy efficiency (EE) projects implemented in public buildings and facilities. Projects funded will include, in particular, energy

efficiency retrofits of street lights, traffic lights, and public buildings; solar photovoltaic (PV) systems; a pilot electric vehicle projects; and a study on ocean power. In addition, the Program will fund institutional strengthening, and educational and public awareness activities, as well as monitoring and evaluation of the Sustainable Energy Framework.[l]

For the residential and commercial sector, the Government has established an Energy Smart Fund to provide financial and technical support to renewable energy ('RE') and energy efficiency ('EE') projects in Barbados. The Energy Smart Fund is comprised of six facilities; three of those facilities apply directly to residences:

- **Pilot Consumer Finance Facility** (BDS$1 million)—this facility provides interest rate rebates or rebates on retail prices (subsidies) to selected retailers that have experience in the 'hire-purchase' consumer finance scheme, and that thanks to the rebates offer better hire-purchase terms to their customers for purchasing RE and EE equipment at their stores
- **CFL Distribution Facility** (BDS$1 million)—this grant facility provides free compact fluorescent lamps ('CFLs') to a limited number of residential customers of Barbados Light and Power ('BL&P'), through the issuance of vouchers
- **A/C Rebate Trade-In Facility** (BDS$3 million)—this grant facility provides a 50 percent instant rebate for households and businesses to purchase energy efficient air conditioners, also through the issuance of vouchers.[li]

25. Modern energy for productive use: programs and financing to improve access, efficiency and use of renewable resources in productive sectors

- Supply: programs and investment to develop domestic manufacturing capacities, including access to capital and know-how for productive applications

  As described above, the Government has encouraged and will continue to encourage solar water heater production with fiscal and customs incentives, as well as financial incentives.

- Demand: financial support schemes to improve affordability of modern energy technologies for industrial and agricultural enterprises, as well as build their knowledge and capacity

  As mentioned above, for the residential and commercial sector, the Government has established an Energy Smart Fund to provide financial and technical support to renewable energy ('RE') and energy efficiency ('EE') projects in Barbados. The Smart Fund is comprised of six facilities. In addition to the facilities listed above that productive sector businesses will have access to, two of those facilities apply exclusively to productive sector businesses:

  - **Technical Assistance (TA) Facility** (BDS$1 million)—this facility provides grants to businesses for funding pre-investment studies of RE and EE projects, to assess their technical and financial viability and support their implementation (especially with funding by the EE Retrofit and RE Finance Facility)
  - **EE Retrofit and RE Finance Facility** (BDS$12 million)—this facility provides subsidized loans to businesses for financing the implementation of viable RE and EE projects (including, but not limited to, projects assessed by studies funded by the TA Facility).[lii]

  Additionally, the Government intends to ensure, through a **Policy on Energy Education, Awareness, and Innovation** that individuals who work in the field of sustainable energy, or who wish to do so in the future, may acquire satisfactory knowledge and skills to do so successfully, whether in the public or the private sector. It will do so by working with primary, secondary,

and tertiary educational institutions to guarantee that appropriate technical and theoretical instruction on sustainable energy is available at all levels.[liii]

- Sustainability: programs aimed at improving environmental sustainability of energy supply, such as demand-side energy efficiency and use of renewable energy

  To encourage renewable energy in the supply of energy, it is the Government's policy that the electric utility should have the option of obtaining the electricity regulator's approval of a proposed renewable investment. The electricity regulator should approve the investment if it is satisfied that the investment is reasonably likely to lower the total cost of electricity generation. Once an investment has been approved and as soon as it is operating, the fuel cost component of the tariff should be reduced by the amount of fuel saved, and in its place the electric utility should be allowed to recover the cost of the renewable investment. This cost should be set at a fixed amount per year, sufficient to recover the capital cost of the plant (including a reasonable return on investment) as well as the operating and maintenance costs.

  The same mechanism should be allowed for any capital investment that reduces the total cost of electricity by reducing the amount of fuel used. Fuel efficiency investments could include, but not be limited to, investing in combined cycle equipment for new or existing power generation plants; or funding energy efficiency measures for the electric utility's customers under a demand side management program.[liv]

3.3 PRIVATE INVESTMENT AND ENABLING BUSINESS ENVIRONMENT

26. Thermal energy for households:

- Private sector actors involved in supply chain (energy supply companies, technology providers, financiers)

  There are several prominent companies involved in supplying thermal energy. They include the NPC**,** which sells piped natural gas for domestic, commercial, and industrial use, as well as several companies that produce solar water heaters. Those companies include:

  - Solar Dynamics
  - Sun Power
  - Solaris Global Energy (formerly known as AquaSol).

- Barriers to private investment in modern energy supplies and technologies for cooking and other thermal applications

  Technologies for thermal applications such as solar water heaters have a high upfront cost. Many households in Barbados have limited access to credit, so that expensive equipment is unaffordable for them, even if the equipment would pay for itself overtime. Access to credit is made worse by the fact that the technologies are new and unfamiliar, so banks are unwilling to lend against them. However, there are a number of solar water heater retailers in the private sector that offer hire purchase schemes to households and businesses.

27. Power sector

- Private sector actors involved in supply chain (power generation and distribution companies, Independent Power Producers (IPPs), financiers, technology providers)

  The country's sole commercial electricity provider is the Barbados Light & Power Company Limited (BL&P). BL&P is a vertically integrated electric utility company responsible for the

generation, supply and distribution of electricity. Apart from a change in name and some changes in the shareholder and corporate structure, the utility has an unbroken history going back to before 1909. The ultimate shareholders in the utility are Emera, Inc. with 80 percent of the shares, the Barbados National Insurance Board with 13 percent of the shares, and approximately 1,700 other Barbadian investors.[lv]

- Barriers to private investment in new on-grid and off-grid power generation capacity (especially for RES), grid extension/maintenance, demand-side management (DSM) and energy efficiency

  In the past there have been two main barriers to renewable energy and energy efficiency investment in the power sector in Barbados—both relate to a lack of incentives to adopt renewable energy in the regulatory regime under which BL&P operates. The National Sustainable Energy Policy seeks to remove these barriers:

  - By requiring that the utility demonstrate that its generation expansion plans (within an integrated resource plan) are least-cost, and include a consideration of renewable energy. This is a gap in the policy and regulatory framework, not in practice—since BL&P's expansion plans are indeed based on least cost, and have indeed considered renewable energy options at the utility and distribution scale
  - By ensuring that the electric utility may safely recover the efficiently incurred costs of investing in sustainable energy—just like it recovers the cost of oil through the fuel clause adjustment.[lvi]

28. Modern energy for productive sectors:

- Private sector actors on the demand and supply side (SMEs/agricultural enterprises, technology providers, financiers)

  There are an increasing number of technology providers that supply modern energy equipment and services in Barbados.

- Barriers to private investment in modern energy for productive and socio-economic uses with a focus on energy efficient and renewable energy technologies and solutions

  The main barriers to the uptake of RES in the private sector energy are:

  - Although the Rider for Renewable Energy approved by the FTC is a useful first step towards allowing businesses to invest in RES, the term of the Rider agreement needs to be extended to allow private investors to recover the cost of their investments
  - Distributed technologies have a high upfront cost, and many households in Barbados have limited access to credit, so that expensive equipment is unaffordable for them, even if the equipment would pay for itself overtime. Access to credit is made worse by the fact that the technologies are new and unfamiliar, so banks are unwilling to lend against them. However, some equipment suppliers have developed hire purchase schemes
  - Customers are unfamiliar with distributed renewable technologies—these technologies are relatively new and unknown to the public. Familiarity with the true costs and benefits of solar water heaters—thanks to Government programs—has been essential to their high penetration in Barbados. Other technologies—particularly solar PV—are more complex, and customers will be slow to adopt technologies they do not know. Costs and performance of solar PV technologies have improved significantly only in recent years, and customers may not be convinced of their commercial viability.

Although there are several RES that would be economically and commercially viable, there are several barriers that have held back widespread uptake of these technologies in Barbados. Incomplete information about the benefits of RES has prevented customers from investing in them, as they are uncertain about their benefits. As a result, in a small island country like Barbados, the result of a lack of demand means that the technologies are not widely available, and therefore price has not been driven down by economies of scale.[lvii]

3.4 GAPS AND BARRIERS

29. Thermal energy for households:

There are sufficient Government programs in place to support thermal energy for households in Barbados—including tax deductions of up to BDS$10,000 for renewable energy and energy conservation investments.

30. Power sector:

- Governance (existence of enabling regulatory framework for investment, enforcement capacities)

  The existing governance structure is expected to be appropriate when the NSEP is fully adopted.

- Supply chain (access to grid, capital, technologies, and know-how)

  Access to grid and technologies is sufficient. However, there is an identified lack of capital and sustainable energy technicians and engineers for RES. Additional support is necessary for providing capital to invest in sustainable energy and better educating sustainable energy technicians. The Government is planning to provide support in these areas under the Draft NSEP.

- End-users (affordability and access to capital)

  End-users face significant barriers with regards to affordability and access to capital. This problem is exacerbated by the short two-year term of the RER, which does not allow for full cost recovery.

  The Smart Fund, described above, provides some support for energy efficiency in the residential sector, which lowers costs. However, the funding provided under the Energy Smart Fund is limited relative to the size of the market, and the scope of its activities could be expanded.

  Additionally, limited awareness of the benefits of RES has held back uptake of commercially and economically viable RES. There is a program being designed for awareness, however, it could be expanded to include more pilot projects and educational material.

31. Modern energy for productive sectors:

- Governance (existence of enabling regulatory framework for investment, enforcement capacities). 'Governance' consists of the accountability mechanisms by which a government ensures that there is good service at reasonable costs in the interest of consumers, towards which a government is ultimately accountable.

- Barbados has a solid, effective, and successful tradition of government setting policy, public and private investment for service provision, and independent regulation. There are governance mechanisms in place in respect to the regulation of the provision of electricity in Barbados. This includes the Barbados Light and Power Renewable Energy Rider, approved as a pilot project by the Fair Trading Commission, governing the connection and sale of electricity generated by RE the grid as well as the Electric Light and Power, Act, Cap 278. Based, inter alia, on the vintage of Cap 278 and the expected finalization of a National Sustainable Energy Policy, that Act is being reviewed.

- Supply chain (access to capital, technologies, and know-how):

  Similar to the supply chain for the power sector, access to technologies is sufficient. However, there is an identified lack of capital and sustainable energy technicians and engineers for RES. Additional support is necessary for financing projects and educating technicians.

- End-users, agricultural and industrial enterprises, SME (capacities and access to capital)

  The Energy Smart Fund described above provides significant support to businesses for RES. However, as noted, its funding is limited relative to market size and its scope could be expanded.

32. Summary: key gaps, barriers and additional requirements

The main barriers preventing uptake of renewable energy in Barbados are imperfect information, inertia, and access to capital, which create a negative feedback loop. Citizens in Barbados are not fully aware of the financial benefits of renewable energy and energy efficiency. Naturally, citizens are unwilling to pay high upfront costs for renewable energy systems and energy efficiency retrofits, when they do not understand the benefits of buying them and banks are unwilling to lend to finance new technologies that they do not fully understand. As a result, there is not a sufficient amount of qualified technicians and companies installing sustainable energy technologies. This limits information about available technologies, and prevents economies of scale from driving the price down. Finally, customers that may be interested in paying the upfront costs for a RES are troubled by the short term of the RER offered by the utility. The RER only offers a guarantee of payment for energy put into the grid of two years. This is not long enough for citizens to receive a return on their investment.

Annex 1 –Matrix of existing programs and required financing for achievement of SE4ALL goals

1.1 On-going initiatives by the Government and development partners

Title	Lead Agency	Financier	Relevant SE4ALL Goal(s) (Access/Efficiency/Renewable Energy)	Brief description and time frame	Value, US$
Sustainable Energy Framework for Barbados	Inter-American Development Bank (IDB)	IDB	Renewable Energy and Energy Efficiency	(2009-Present) This project has been supporting Barbados's main efforts for a more sustainable energy framework since 2009. The project conducted a comprehensive analysis of the country's energy sector, and provided a strategy and detailed policy, financial, and regulatory recommendations to increase the uptake of economically viable renewable energy and energy efficiency (including the development of the NSEP, the design of the Energy Smart Fund and the PSSEP)	Government obtained policy based loans in the amount of US$45m and US$70m for general budget support thanks to implementing the Sustainable Energy Framework
Energy Smart Fund	Inter-American Development Bank	IDB	Renewable Energy and Energy Efficiency	(2010-Present) The project designed and operationalized a multi-tiered fund to support sustainable energy in the private sector	US$10 Million
Public Sector Sustainable Energy Program (PSSEP)	IDB	IDB	Renewable Energy and Energy Efficiency	(2012-Present) The program will support renewable energy and energy efficiency in the public sector.	US$20 Million
The Caribbean Hotel Energy Efficiency Action Program	Caribbean Tourism Organization	IDB, German Technical Cooperation, Center for Development of Enterprise, United Nations Environmental Program (UNEP), and Barbados Light & Power (BL&P)	Energy Efficiency	The Objective is to improve the competitiveness of small and medium sized hotels (<400 rooms) in the Caribbean Region through improved use of energy, with the emphasis on Renewable Energy and Micro-Generation. The Pilot project is in Barbados.	US$1 Million

Sustainable Energy For the Eastern Caribbean (Pending)	Global Environment Facility (GEF)	IDB, Department For International Developent (DFID), and the European Union	Renewable Energy and Energy Efficiency	(2012-Present) The program will support sustainable energy policy reform, pilot projects, and programmatic implementation of sustainable energy in the Barbados and OECS countries	Estimate of US$ 25 Million

1.2 An estimate and order of magnitude, if available, of the costs and investment requirements for making progress on the three goals of SE4ALL. It is understood that these are only rough estimates and using available data. A more detailed analysis would follow during the phase of preparation of the Action Plan for SE4ALL.

In the process of preparing the Sustainable Energy Framework for Barbados, the Government hired consultants to estimate how much investment would be required to meet the tentative targets for sustainable energy laid out in the Draft NSEP—which are in line with SE4ALL's overall goals. The consultants estimated that achieving these tentative targets would require US$552.5 million[4] for expenditure on renewable energy capacity and energy efficiency investments over a period of 20 years.[lviii]

Thus far, the Government has received funding of US$10 million and US$20 million from the IDB for the Energy Smart Fund and PSSEP, respectively. Additionally, the Government has received US$1.2 million dollars from the GEF for financing energy efficiency and renewable energy pilot projects, and US$1million for supporting energy efficiency and renewable energy in hotels in Barbados from a consortium of donors.

The total support received thus far from the international community is therefore US$22.2 million. This leaves a gap of over five hundred million dollars in funding for realizing identified sustainable energy improvements in Barbados. While it is expected that some of the investments will be made by private firms (for example, third party generators wishing to sell electricity to the utility), there is ample room for SE4ALL to help close that gap.

[4] In Net Present Value terms, calculated using a six percent discount rate.

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