Grenada

TNA-Mitigation
Technology Action Plan (TAP)
Report

June 2018

Disclaimer

Executive summary

The Technology Needs Assessment (TNA) is a global project, implemented by the UNEP/DTU partnership. The project is into its second phase. Grenada is one of twenty-six (26) countries participating in the second phase of the project, which started in 2014.

The main aim of the TNA project is to assist countries, which are Parties to the United Nations Framework Convention on Climate Change (UNFCCC), to determine their technology priorities for greenhouse gas emissions reduction and adaptation to climate change pressures. The TNA consists of mitigation and adaptation parts, both of which are executed in three stages and three reports: the technologies prioritization and Technology Needs Assessment Report (TNA); the Barriers Analysis and Enabling Framework Report (BA&EF) and the Technology Action Plan (TAP) report.

This final report- the TAP draws on the work of the preceding reports and also includes stakeholder inputs for key decisions. The main aim of the TAP is to serve as a plan of action for all the prioritized technologies that were selected at stage 1 and further analyzed for barriers to their implementation at stage 2. At this second stage, measures for overcoming the identified barriers for each of the technologies were also addressed. The BA&EF analysis therefore, served as one of the key launching pads for the TAP for each of technologies. In this regard, the measures for overcoming barriers were translated into key actions for implementing the deployment of the technology.

Five technologies were agreed to be analyzed: PV systems; biogas; high efficiency ACs; LEDs and EVs. Since the barriers and measures were similar for LEDs and high efficiency ACs these technologies were merged into one TAP for energy efficiency.

The overall targets for each of the TAPs therefore are guided by the need for inclusive economic growth and development, while ensuring environmental protection. In other words the aim of the TAP is for the sustainable development of Grenada. As was indicated in the TNA and BA&EF Reports, the overall aims of the TNA- Mitigation are to contribute to:

1. sustainable economic development
2. poverty reduction through increased employment or income
3. climate change mitigation and protection of the environment

Two (2) of the sustainable development goals are also critical goals that the TAP can contribute to: SDG 7 which addresses sustainable energy for all and SDG 13 that focuses on climate change can be met by the TAPs described in this report. From the perspective of sustainable development therefore, the TAP contributes to the socio-economic development of Grenada; addresses social inclusion and seeks to reduce on the carbon footprint of the island.

Additionally, the climate change policy 2017-2021 provides the vison and objectives for mitigating climate change on the island. However, the Nationally Determined Contribution

(NDC) provides the tangible greenhouse gas (GHGs) emissions targets that the TAPs will seek to contribute to. The overall target is: to reduce Grenada's GHG emissions by 30% in 2025 based on 2010 emission levels with an indicative target of 40% reduction in GHGs by 2030.

The TAP for each of the technologies is briefly described:

PV systems

The main ambition of the PV system TAP is to contribute about 5 MW of power, with the potential to reduce GHG emissions by 100GT over a 20 year period. The TAP will also contribute to socio-economic development by deploying about 3MW of power to energy impoverished households and communities.

A summary of the key actions and estimated costs for the implementation of the PV TAP is shown below. The estimated funds are US$12,617M to $17,617M.

Biogas

The ambition for the biogas TAP is to introduce small scale biogas systems on farms with the intention of reducing GHG emissions by about 1.5kT of CO2 equivalent. It is also envisioned that biogas systems will assist farms to reduce their operational costs for energy by about 20%.

It is estimate that approximately US$92, 000.00 may be required for this TAP.

Energy efficiency- LEDs and high efficiency ACs

The ambition for the LEDs/high efficiency ACs TAP is to potentially reduce emissions of CO2 equivalent by approximately 20% form high efficiency ACs and a further 10% from lighting is projected. It is also envisioned that a 30% in energy related operational cost can be achieved.

It is estimated that approximately US$1.8M may be needed to implement this TAP.

EVs

The EVs TAP can potentially achieve approximately 6.91 kT of carbon dioxide savings annually. The TAP will therefore seek to up-scale the research conducted by the electricity company (GRENLEC), while contributing to approximately 10% of GHG emissions reduction. The economic viability of EVs will be researched and incentives suggested to support the upscaling.

The estimated costs for implementing this TAP is US$2,338 to $3,338M.

The TAP concludes with one project idea that focuses on EVs and is titled: 'Integrated PV systems and EV plug-in demonstration project (IPEV project). At meetings with key stakeholders, including the Director for Economic and Technical Cooperation; the CEO of GRENLEC and Energy Division personnel it was widely agreed that a project idea focused on

the transportation sector and EVs specifically, can add value to the portfolio of project ideas already existing. Many such ideas address many of the TAPs, for example a World Bank sponsored project for PV systems in government buildings; a CDB implemented project for energy efficiency and a GIZ sponsored biogas project. However, these ideas are not dismissed as the TAP can be drawn upon in the future to develop projects related to the technology.

Therefore the IPEV project will seek to ensure that the transportation sub-sector is adequately addressed and that the 39% of GHGs emissions from that sector is adequately considered.

It is envisioned that this project can be implemented over a three year period commencing in 2018/2019. The estimated budget for the project is US$9,919M to $13,913M. One key source of funding for the project is the Green Climate Fund (GCF).

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List of Acronyms and abbreviations

AC	Air conditioning and refrigeration
BA&EF	Barriers Analysis and Enabling Framework
CDB	Caribbean Development Bank
CDF	CARICOM Development Fund
DTU	Technical University of Denmark
ESCO	Energy Service Company
ESA	Electricity Supply Act
EVs	Electric vehicles
GCF	Green Climate Fund
GDB	Grenada Development Bank
GDBS	Grenada Bureau of Standards
GHGs	Greenhouse gases
GOG	Government of Grenada
GRENLEC	Grenada Electricity Services
GPRS	Growth and Poverty Reduction Strategy
GSWMA	Grenada Solid Waste Management Authority
HFCs	Hydroflourocarbons
HPMP	Hydrofluorocarbon phase-out management plan
IPP	Independent power producer
LPG	Liquid Petroleum Gas
MCA	Multi- criteria Analysis
NDC	Nationally Determined Contributions
NGO	Non-Governmental Organization
NAMA	Nationally Appropriate Mitigation Action
OFID	OPEC Fund for International Development
PV	Photovoltaic
PURCA	Public Utilities Regulatory Commission Act
PURC	Public Utilities Regulatory Commission
RAC	Refrigeration and air conditioning
SIDS	Small Island Developing States
SDC	Sustainable Development Council
SDGs	Sustainable Development Goals
TAP	Technology Action Plan
TAMCC	T. A. Marryshow Community College
TNA	Technology Needs Assessment
UNFCCC	United Nations Framework on the Convention for Climate Change
UNDP	United Nations Development Program

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Chapter 1: Technology Action Plan and Project Ideas for Energy Supply and Consumption

1.1 TAP for energy supply and consumption (Transportation)

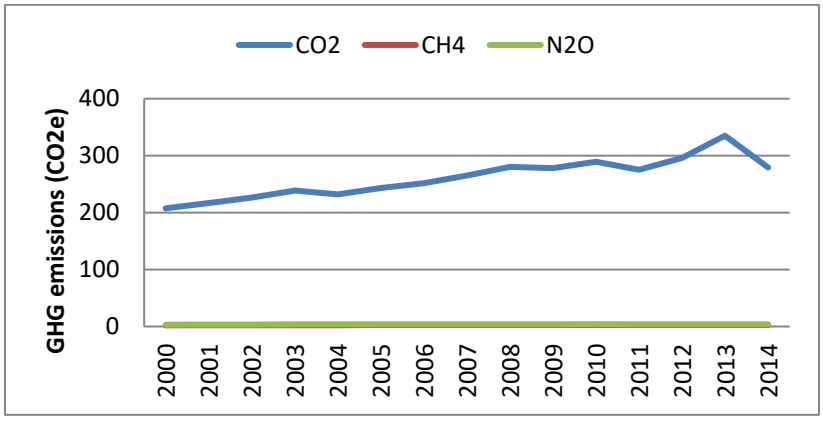
This chapter focuses on the Technology Action Plan (TAP) for the energy supply and consumption/transportation sector. The TAP considers the following technologies: PV systems; biogas; high efficiency ACS; LEDs and Electric Vehicles (EVs).

1.1.1 Sector overview

The energy supply and consumption sector, including domestic transportation sub-sector is based on imported refined hydrocarbon products. In this regard, diesel, kerosene, gasoline, liquid petroleum gas (LPG) are the key products used for the generation of electricity, domestic transportation, and other commercial and domestic activities, including household and commercial cooking. According to the SNC (2017):

"Based on this significant reliance on fossil fuels, the increase in GHG emissions was significant in the period 2000 to 2014. For the Energy (including domestic transport) sub-sector GHG emissions in 2000 was 212.8 Gg CO_2e and rose to 285.5 Gg CO_2e in 2014, an increase of 34.2%. This increase was mainly attributed to Energy industries (power plants)". The emission trends of the three main GHGs are shown in figure 1.

Figure 1: Emission trends of the three main GHGs from the energy (transport) sub/sector



Data from SNC, 2017

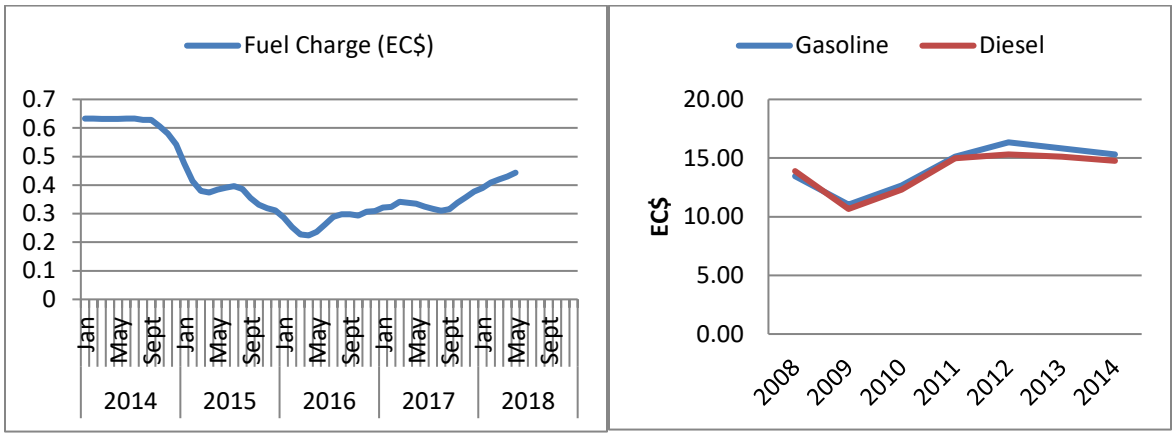
The energy sector is critical to the development of Grenada. However, the high dependence of the sector on imported fossil fuels renders the sector insecure, and especially vulnerable to external economic shocks. One the most import factors affecting the vulnerability of the energy sector is that of the volatile prices for energy on the international market. This high dependence

on imported fossil based fuels not only results in high outflows of capital, but also dictates the price for energy on the local market.

The fuel rate component for the price of electricity and the prices for diesel and gasoline for transportation on the local market are shown in figures 2 (a) and (b), respectively.

Figure 2: Example trends of prices for electricity, gasoline and diesel on the local market

(a) Monthly fuel charge for electricity (b) Average annual prices for gasoline and diesel



Data form GRENLEC and Energy Division

The graphs generally reveal the high prices, but more importantly the fluctuations in prices for these energy services and commodities. The average fuel component rate for electricity was approximately XCD$0.63 (US$0.23) at the beginning of 2014, fell to XCD$0.22 (US$0.08) in April of 2016 and is now tending upwards again to a high of XCD$0.44 (US$0.16) in May of 2018. Using less recent data for diesel and gasoline at the pump, the average price for these services ranged between XCD$13.56/gallon (US$5.02) and XCD$15.31/gallon (US$5.67) for gasoline and XCD$13.90/gallon (US$5.15) and XCD$14.96/gallon (US$5.54) for diesel, between 2008 and 2014.

These economic factors and the relatively high GHG emissions renders the current energy market to be economically and environmentally unsustainable. In recognizing this, the Government of Grenada has agreed to some key policy and legal arrangements to hopefully stimulate the transition of the market to one more reliable on sustainable energy supply. Foremost in this regard, is the promulgation of a new Electricity Supply Act of 2016 that is geared towards creating a more competitive electricity market focused on renewable energy sources. Table 1 provides an overview of key policy and legal directions of the Government of Grenada.

The diffusion of the technologies under assessment should lead to supporting the policy direction of the Government of Grenada as it relates to climate change mitigation and supporting the

future economic development of Grenada. In this regard, the current and future prospects for the uptake of these technologies are discussed. However, the key policy, legal and regulatory drivers of the sector are briefly summarized in table 1.

Table 1: Policy, laws and regulations driving the transition to a renewable energy market

Policy, law, regulations	**Date enacted**	**Description**
Electricity Supply Act 2016	June 2016	• The Electricity Supply Act 2016 replaces the Electricity Supply Act 1994. The main purpose of the new Act is to provide for the regular, efficient, coordinated and economic supply of electricity and to establish a framework for the accelerated development of the supply of electricity from renewable energy sources and for interconnected purposes. • This Act therefore establishes the foundation for 'independent' regulation of the interconnection of independent power providers and the licensing systems for so doing.
National Energy Policy	November 2011	• This policy sets out a number of goals and polices for guiding Grenada's low carbon development strategy. In this regard, the policy covers issues such as: institutional and human capacity development and the legal and regulatory framework. • Policies and goals that address the renewable energy and energy efficiency and the transportation sectors are also enshrined in the national energy policy. • For example, policy drivers for the transportation sector includes: the consideration of mandate quotas for vehicle dealers regarding the importation of hybrid and full electric vehicles…; ensuring the development and introduction of vehicle emissions and fuel efficiency standards; and creating an appropriate tax regime to encourage the importation of fuel efficient vehicles…
Climate Change Policy 2017-2021	November 2017	• The vision of the policy is: "An empowered Grenadian population capable of managing the risks from climate change with emphasis on pursuing a low carbon development pathway and building resilience at the individual, community and national levels".

Policy, law, regulations	Date enacted	Description
		• Key mitigation objectives that the policy sets out to achieve include: • Strengthen institutional structure to support coordination, mainstreaming and implementation of climate change adaptation and mitigation action and the systematic integration of climate change adaptation into development policies, plans, programs, projects, budgets and processes • Facilitate climate smart (low carbon, climate resilient) infrastructure location, planning, design and maintenance, and sustainable land management and reduce greenhouse gas (GHGs) the electricity, transport, waste and forestry sectors. • Strengthen institutional arrangements for the collection, storage, analysis, sharing and use of climate, GHG emission and pollution/chemical data and information to inform Evidence-Based Decision Making • Access climate technologies for mitigation and adaptation along with capacity building and increase external climate fiancé support to Grenada's adaptation and mitigation
Nationally Determined Contributions	May 2015	• The NDC for Grenada provides the commitment of the Government to reduce its carbon footprint through the following sectors: electricity; transportation; forestry and waste. The NDC therefore commits the Government to reduce its greenhouse gas emission (GHGs) by 30% in 2025 based on 2010 emission levels with and indicative target of 40% reduction in GHGs by 2030. • The NDC further suggests that in the electricity sector, a reduction of 30% in GHG emissions is expected with 25% coming from renewables and 10% from energy efficiency measures. • In the transport sector, a reduction in GHG emissions of 20% is expected by 2025.

Five technologies were selected for further analysis and in this regard an analysis of the barriers to and enabling measures for the uptake-take of each technology was conducted. The

technologies can be considered as energy supply technologies: PV systems and biogas; energy efficiency technologies: LEDs and high energy efficiency air conditioners and mobility: EVs.

The five technology have varying levels of presence on the energy market. PV systems, high efficiency ACs and LEDs are the most prevalent; while biogas and EVs are the least. Overall, the Grenada Nationally Determined Contribution (NDC) envisions a 30% reduction in GHGs by 2030, with 20% coming from renewable energy sources and 10% from the implementation of energy efficiency measures. The diffusion of most of these technologies can contribute to meeting these targets.

According to GRENLEC reports (GRENLC 2016) only 1.12 MW (DC) of power is produced by PV systems. This may account for approximately 3.5% of the company's peak generating capacity. According to the NDC (2015): 10% of the total generating electricity capacity is projected to come from renewable energy technologies, with a projected 10MW coming from solar. The NAMA for Grenada also proposes to increase the current electricity generating capacity by 4.64 MW of solar PV systems to be installed in public buildings, other privately owned buildings, solar pumping for agriculture and households. From this perspective PV technology has a critical role to play in meeting the climate change mitigation targets.

Additionally, the NDC (2015) suggest that a further 20% of the GHG emissions reduction will come from energy efficiency measures. The installation of LEDs and high efficiency AC systems will contribute significantly to meeting these targets. There is no comprehensive study that provides data on the installed capacity of LEDs, but there is anecdotal evidence that LEDs are available on the market. As it relates to high efficiency ACs, one study conducted in 2017 (GOG 2017) estimated that the installation of high efficiency ACs using Refrigerant 410A and inverters increased by 140% between 2012 and 2015. High efficiency ACs can contribute significantly to meeting the GHG targets in the NDC. In this regard, the NDC projects about 20% in GHG emissions reduction from building retrofits; while a further 30% reduction is envisioned from the implementation of energy efficient buildings codes and standards. Both LEDs and high efficiency AC technologies are important to meeting the GHG reduction targets.

Biogas technology is targeted at the agricultural sector. According to a GIZ commissioned report on a survey of the potential for biogas systems uptake in Grenada, the potential for meeting the energy needs of small livestock farms and other industries such as the rum distillery is significant. In this regard, biogas system diffusion can contributed, but limited to the agricultural and light food processing enterprises.

Finally, the all-electric vehicle or EV considered in this report, are virtually non-existent on the market. In this regard, there are only 4-EVs: 3 owned by the electric utility company and 1 by a private citizen. The NDC (2015) suggests that a 20% reduction in GHGs emissions from the transportation sector can be achieved by 2025. In this regard, it is proposed that policies/actions to switch to biofuels, energy efficiency standards and other fuel related taxes will assist in

meeting this target. However, fuel switching or transitioning a part of the transportation system to electric can play a significant role in meeting the target. In this regard, the diffusion of EVs can contribute significantly as the GOG embarks on transitioning the energy market to sustainable energy systems.

The overall targets for the TAP therefore are guided by the need for inclusive economic growth and development, while ensuring environmental protection. In other words the aim of the TAP is for the sustainable development of Grenada. As was indicated in the Technologies Needs Assessment (TNA) and Barriers Analysis and Enabling Framework (BA&EF) Reports, the overall aims of the TNA- Mitigation are to contribute to:

4. sustainable economic development
5. poverty reduction through increased employment or income
6. climate change mitigation and protection of the environment

Two (2) of the sustainable development goals are also critical goals that the TAP can contribute to, SDGs 7 which addresses sustainable energy for all and SDG 13 that focuses on climate change can be met by the TAPs described in this report. From the perspective of sustainable development therefore the TAP contributes to the socio-economic development of Grenada; addresses social inclusion and seeks to reduce on the carbon footprint of the island.

Additionally, the climate change policy 2017-2021 provides the vison and objectives for mitigating climate change on the island. The vision and relevant objectives are summarized in table 1. However, the NDC targets provides the tangible greenhouse gas (GHGs) emissions targets that the TAPs will seek to contribute to. The overall target is: to reduce Grenada's GHG emissions by 30% in 2025 based on 2010 emission levels with an indicative target of 40% reduction in GHGs by 2030.

In summary therefore, the TAPs for each of the technologies will address the socio-economic development, social inclusion and climate change mitigation.

1.1.2 Action plan for PV systems

In this section the technology action plan for PV systems is presented.

1.1.2.1 Introduction

PV systems actually ranked number 1 in the prioritization of the technologies analyzed in the initial technology needs assessment exercise. According to the TNA report, the main criteria for selecting PV systems were: economic, mainly operation and maintenance costs and the potential for GHG emissions reduction. Although the initial investment costs for PV in Grenada is comparatively high, with the low operational and maintenance costs, the long term benefits makes PV systems economically viable. Additionally, if incentives were to be implemented, PV systems costs can be reduced, thus making investments in PV more attractive. The TNA report also notes that due to the small market size, PV systems can be 50% more expensive than in

other parts of the world with larger market sizes and the LCOE is above the global average of US$0.10/kWh. However, with more effective systems in place these costs can be reduced. These incentives as presented in the 'Barriers Analysis and Enabling Framework Report', include revolving funds, interest rate draw-down and the establishment of energy services companies (ESCOs).

Notwithstanding the initial investment costs issues, PV systems provide excellent climate change mitigation potential. In this regard, it is estimated that approximately 80 MW of power can be produced by PV systems, by mounting the PV panels in open space and on available roof tops. This can equate to the generation of approximately 100 GWh of electricity in Grenada, Carriacou and Petite Martinique. With this generation potential it is estimated that approximately 75 GT of GHGs emissions can be avoided.

Although, the diffusion of PV systems in Grenada is slow, the current trends in the market reveals that users for PV systems trust the technology and are aware of its potential to reduce the cost of electricity over time. Additionally as the Government of Grenada has made the bold step to repeal the Electricity Supply Act (ESA) 1994 and replace it with the ESA 2016 provides the signal to investors that investments renewable energy, including PV systems will become more attractive and economically viable. In this regard, regulations to improve the interconnection for PV systems with the grid and attractive feed-in tariffs will support these investments.

1.1.2.2 Ambitions for the TAP

The overall intention of the TNA is to improve the socio-economic situation in Grenada, by moving towards a trajectory of sustainable development. In this regard, there key objectives for sustainable development were adopted: sustainable economic development; reduced poverty through increased employment and incomes and climate change mitigation and protection of the environment. Coupled with these key objectives, SDGs 7 and 13 were also identified as key sustainable development goals SDGs) that the technologies should set out to achieve. Additionally the Nationally Determined Contribution (NDC), proposes a 10 MW of electricity can come from solar. PV systems can therefore support the sustainable development of Grenada as it can deliver affordable electricity to individuals and communities that are energy impoverished. In this regard, these individuals and communities can improve the quality of their lives by enhancing their abilities to increase income.

Therefore this technology action plan will focus on the deployment and diffusion of PV systems in Government premises, individual households and communities that are considered to be energy impoverished and to further complement the NAMA in areas of private sector deployment, especially in the tourism sector. Additionally, the scope for PV system technology will also expand into the EV technology as this is required to ensure that the deployment of EVs can 'truly' mitigate climate change. This will be fully considered in the EV technology section.

Overall, a total deployment of approximately 5MW of PV systems is envisioned. The estimated distribution of this deployment is: 3MW for public buildings, which will also support the proposed TAP for EVs and a further 2 MW for energy impoverished households and communities. In the case of the latter, micro-grid(s) will be considered where applicable. Using a capacity utilization factor (CUF) of 18%, a lifetime of the PV systems of 20 years and an emissions factor of 0.634 tCO2/MWh, the estimated CO2 for 1KW can be estimated. In this regard, a 1KW power rated PV system will generate approximately 1, 577 kWh per year (1 kW x 365 days/year x 24 hrs/day x 18%), with the potential to reduce CO2 emissions by about 1 ton (1,577 kWh x 0.634). Therefore, the proposed deployment of 5 MW of PV system has the potential to avoid 100kT for CO2e into the atmosphere.

Furthermore the TAP will also seek to assist with addressing the issues of capacity building required to design, install and maintain these systems. In this regard, human and institutional capacity will be addressed. In other words, human skills development to design, install and maintain these systems, while including an equitable share of females in this training, will be undertaken. Further, the necessary capacity of the training institution, will be strengthened with appropriate training curriculum, materials, tools and equipment and train-the-trainer sessions. This ambition is closely aligned to the NAMA.

1.1.2.3 Actions and activities selected for inclusion in the TAP

A number of barriers and measures to overcome these barriers to the diffusion of PV technology were considered in the 'Barriers Analysis and Enabling Framework Report. The key economic and financial barriers identified revolved around the current need to make investments in PVs systems more economically attractive to investors. The barriers therefore all influences the high initial cost for PV systems and included therefore the lack of access to affordable capital; insufficient/inadequate incentives and uncertain financial environment, e.g. current electricity tariff. These led to the identification of a number of measures for removing these barriers. The suggested to measures which closely aligned with those suggested by key stakeholders were summed in the NAMA (2018) for Grenada. The measures included:

- Selection and implementation of financial incentive scheme to make solar PV financially viable
- Creation of ESCOs to implement solar PV in the institutions in general and in the government sector in particular
- Creation of a dedicated revolving fund to provide soft loans for solar PV projects. If required a part of the donor funding would be utilized for providing the interest rate draw down support to enable soft loans
- Tax incentive e.g. accelerated depreciation to attract investment in solar PV in the private commercial sector

Additionally, a number of non-economic and financial barriers were also identified. Stakeholders at the workshop to identify barriers and measures agreed that addressing these barriers and

measures were more critical to the deployment and diffusion of PV systems. Foremost amongst these barriers is the need for adequate policy, legal and regulatory environment for the interconnection of PV systems on to the grid. Additionally, a number key institutional and organizational capacity, human skills and technical barriers identified.

The institutional and human skills capacity barriers, included inadequate institutional curriculum, tools and equipment to deliver training in the area PV, while there is a dearth of adequately trained personnel to deal with the design, installation and maintenance of the systems. Although capacity building is addressed in the NAMA it is also considered here as a complement. Moreover, the TAPs for other technologies included in this report will also address capacity building.

The barriers to deployment and diffusion of PV systems and the suggested measures to overcome them provides the foundation for the necessary actions and complementary activities of the TAP. In this regard the following key actions are considered important for the implementation of the PV system TAP.

Action 1: Develop and implement a financial incentive scheme

This action is mainly geared towards complementing the proposed NAMA that addresses this scheme. It is suggested that this action be utilized as it will promote an increase in the deployment and diffusion of PV systems in the private sector, for example hotels and for households that can afford to obtain and service an attractive loan to invest in PV systems.

Action 2: Create and implement a full training program for PV systems

A training program in PV design, install and maintenance is also proposed in the NAMA. This action will also support this program design and will support further the institutional strengthening required to support the delivery of the program. The action will also support scholarships for individuals that cannot afford to attend the training. In this regard, individuals in energy impoverished communities and households will be offered training opportunities. In this way trainees will be able to focus on the effective and efficient functioning of PV systems installed in their communities.

Action 3: Design and implement PV installation project for the energy impoverished

This action is critically important to the success of the diffusion of PV systems. One important issue of concern with the PV system diffusion is the possible marginalization of energy impoverished households and communities. In other words this sector of society may never be able to afford a ‘micro-system’ even with the availability of affordable credit facilities. Additionally, many of these communities are functioning below the poverty line. Therefore, with the possibility of having access to affordable energy increases the chances of these communities been lifted out of poverty. This can be achieved through improvement in the quality of life of

these individuals, by providing opportunities to income and jobs. Another critically important reason for this action is to address households in which the elderly live. Many of these households cannot afford power which may be needed to provide lighting and for a small refrigerator to provide cooling, especially medication are available.

Action 4: Support the promulgation of Electricity Supply Regulations

This action will also support the proposals in the NAMA by ensuring that the proposed regulations to support the ESA 2016 are fully developed and implemented. Of critical importance is the creation of the Public Utilities Regulatory Commission Act (PURCA). The PURCA and the Commission that it is establishes are important to the successful implement of the new ESA 2016. Training of Commissioners and support for the operations of the Authority will be required. This action therefore proposes to complement the support suggested by the NAMA.

Action 5: Support the installation of PV systems on additional government buildings

This action will also support the PV installation proposals for government building in the NAMA. However, this proposed action will seek to further diffuse PVs in the parishes outside of St. Georges' and will include building such as police stations, health centers, agriculture extensions offices. The intent in this regard is to support a pilot project (proposed later in this TAP), for the diffusion of EVs into the fleet of vehicles owned by the government.

All the actions proposed for PV systems are important to the success of PV system diffusion. However, actions 2, 3 and 5 which address capacity development, the support for providing PV systems to energy impoverished households and communities and support for the installation of PV in government buildings, respectively, may be considered as the most important. It is noted that the NAMA addresses all of these actions and these proposed here are intended to complement and close the gaps identified by the proposed components in the NAMA. In this regard, although the NAMA addresses households, it does not specifically focus on the energy impoverished, which is a very vulnerable group in Grenada that will need support if PV systems are to be equitably diffused. This project will also provide support for the key socio-economic and sustainable development direction of the TNA. Therefore, in addition to the climate change mitigation, the wider diffusion of PVs will meet the socially sensitive goal of poverty reduction. In this regard, persons may be able to use the new source of power to support micro-scale activities that will allow them to improve their income.

As it relates to the capacity building action, this will further support the technical aspects of the proposed capacity building project in the NAMA but will also seek to support training of vulnerable youth, including women in the communities. However, capacity building is a common theme throughout many of the technologies in this TAP and so a specific project on capacity building will be considered, including a comprehensive curriculum of sustainable energy systems.

Finally, the action on the installation of PV systems on government buildings is intended to support the installation of charging ports in support of a proposed pilot project for introducing EVs into the fleet of government vehicles. The intent is to further consider buildings outside of the main parish-St. George's including police stations where a number of such vehicles are housed. Any further installations on public buildings already identified will be covered by this proposed action to ensure that the charging ports can adequately be supplied with power from renewable energy source.

Table 2: Activities for implementing selected actions for PV

Action #	Action	Activities
1	Develop and implement a financial incentive scheme	1.1: Research and select appropriate financial incentive measures 1.2: Hold workshops with key stakeholders to select appropriate schemes 1.3: Train key personnel in financial institutions (commercial, government, credit unions) to use the schemes 1.4: Implement and support schemes
2	Create and implement a full training program for PV systems	2.1: Engage key stakeholders on the needs for training 2.2: Design program and identify list of supporting materials, equipment, tools and lab space upgrades 2.3: Pilot program with scholarships for participants 2.4: Assess pilot and revise course where applicable
3	Design and implement PV installation project for the energy impoverished	3.1: Conduct a comprehensive analysis of the energy impoverished households and communities 3.2: Assess the requirements for PV systems and design appropriate systems for households and communities 3.3: Procure systems (panels; batteries, where needed and balance of system components 3.4: Install and commission systems 3.5: Monitor performance of systems (up to 12 months)
4	Support the promulgation of Electricity Supply Regulations	4.1: Provide complementary assistance to the activities of the NAMA
5	Support the installation of PV systems on additional government buildings	5.1: Conduct a comprehensive analysis of appropriate public buildings, including policy stations, 5.2: Assess the requirements for PV systems and design, including the loads for charging stations for EVs 5.3: Procure systems (panels; batteries, where needed and balance of system components 5.4: Install and commission systems 5.5: Monitor performance of systems (up to 12 months)

1.1.2.4 Stakeholders and timelines for implementation of TAP

The following key stakeholders and their proposed roles in relation to this TAP are briefly described. The table identifies their interaction with the various actions and activities previously identified.

The Energy Division (ED)- will be the implementing agency for all the actions and proposed projects proposed in the TAP. They will providing technical and procurement coordination and management of project implementation activities.

The Ministry of Climate Resilience, Environment, etc (MCRE)- is the focal point for climate change and will interact with the project at various levels, including design and implementation to ensure that climate mitigation issues are adequately addressed when the actions are implemented.

The Grenada Development Bank (GDB)- a publicly owned financial and development institution in Grenada, which provides concessionary financing for development projects. The GDB will be involved with financial based actions in the TAP.

The T. A. Marryshow Community College (TAMCC)- the only publicly financed post-secondary institution in Grenada. The TAMCC is a comprehensive institution offering a wide range of courses and programs including technical programs. The TAMCC will be involved with the capacity building projects as it related to training.

The Grenada Electricity Company (GEENLEC)- the sole provider of electricity on the island and the owner of the grid. The company is integral to any proposed interconnection policy and feed-in tariff design.

Solar Energy Companies- these companies currently act as a form of ESCOs as they provide technologies that result in electricity savings. They also provided contracting services for installing and maintaining renewable energy systems.

Households and Communities- these are the recipients of PV systems. A proper analysis of their needs will result in a more effective project implementation.

Ministry of Social Development- this ministry is concerned with the development and understanding social needs at the community level. The ministry can assist with providing data and information on the energy needs of vulnerable households and communities.

Economic and Technical Cooperation Division in the Ministry of Finance and Economic Development- has the role of coordinating all projects from project design to implementation. The department also has the responsibility for developing full project proposals and serves as the pivot between GOG and potential funding agencies.

Ministry of Finance- is responsible for the fiscal policies.

Table 3: Indicative activities implementation plan for PV

Actions	**Activities**	**Timelines (Planning to implementation**	**Responsibilities**
Develop and implement a financial incentive scheme	1.1: Research and select appropriate financial incentive measures 1.2: Hold workshops with key stakeholders to select appropriate schemes 1.3: Train key personnel in financial institutions (commercial, government, credit unions) to use the schemes 1.4: Implement and support schemes	Sept 2018 to Aug. 2019	**Ministry of Finance; GDB;** Energy Division; Consultant
Create and implement a full training program for PV systems	2.1: Engage key stakeholders on the needs for training 2.2: Design program and identify list of supporting materials, equipment, tools and lab space upgrades 2.3: Procure materials and equipment 2.4: Pilot program with scholarships for participants 2.5: Assess pilot and revise course where applicable	Sept. 2019 to Jan. 2020	**TAMCC;** Energy Division; Social Development;
Design and implement PV installation project for the energy impoverished	3.1: Conduct a comprehensive analysis of the energy impoverished households and communities 3.2: Assess the requirements for PV systems and design appropriate systems for households and communities 3.3: Procure systems (panels; batteries, where needed and balance of system components 3.4: Install and commission systems 3.5: Monitor performance of systems (up to 12 months)	Jan. 2019 to Dec. 2021	**Energy Division;** Economic & Technical Cooperation; Social Development; GRENLEC
Support the promulgation of Electricity Supply Regulations	4.1: Provide complementary assistance to the activities of the NAMA	Sept. 2018 to Aug. 2019	**Energy Division;** GRENLEC

Actions	Activities	Timelines (Planning to implementation	Responsibilities
Support the installation of PV systems on additional government buildings	5.1: Conduct a comprehensive analysis of appropriate public buildings, including policy stations, 5.2: Assess the requirements for PV systems and design, including the loads for charging stations for EVs 5.3: Procure systems (panels; batteries, where needed and balance of system components 5.4: Install and commission systems 5.5: Monitor performance of systems (up to 12 months)	Jan. 2019 to Dec. 2021	**Energy Division;** GRENLEC; Economic & Technical Cooperation;

Notes: *The bolded entity is identified as the primary stakeholder; the indicative timelines is suggested for the implementation of all the activities under the action.*

1.1.2.5 Estimation of resources needed for action and activities

The resources required for the actions above are estimated in this section. Action 1, 2 and 4 required funding that supports a number of experts and other stakeholders to implement. The activities under these action include the design of laws, regulations and curriculum. In this regard, some estimates have already been done under the NAMA. The estimated costs to achieve these actions are as follows:

To develop and implement a financial incentive scheme: USD$28, 850.00. This item is a matching item in the NAMA

The added support to the NAMA to implement the regulations and other supporting mechanisms to ensure that the Electricity Supply Act is estimated to be: US$28,850.00. This is item is also matching the estimates in the NAMA.

To create and implement a training program, the estimates include further supporting the purchasing of equipment for delivering the training, which is US$21,000.00 under the NAMA and the support of at least 20 scholarships worth US$1,000.00 or US$20,000.00.

The total estimated cost is: US$41,000.00

The human resource requirement is that for conducting the feasibility study and project design for the PV install systems. This item includes the engagement of an expert at a rate of US$750.00/day for a total of 25 working days.

The estimate for this component is therefore: US$18,750.00

The key resources requirements are one (1) renewable energy financial expert; one (1) renewable energy training expert and one (1) renewable energy project development expert.

The other types of resources include the design and install of two sets of PV systems on government buildings and on small households in energy impoverished communities. The total installation proposed for the two actions is 5MW. It was previously noted that the installation cost for PV in Grenada ranges between US$2,500.00 and US$3,500.00. The estimated costs for these actions is: US$12.5M to US$17.5M.

The total estimated total implementation cost of the further diffusion of PV systems is:

US$12,617,450.00 toUS$17,617,450.00

Table 4: Summary of cost and resources for PV systems

Actions	Activities to be supported	Total costs (US$)
Develop and implement a financial incentive scheme	Expert to implement all activities including workshops Workshop support	$28,850.00
Support the promulgation of Electricity Supply Regulations		$28,850.00
Create and implement a full training program for PV systems	Purchase for training equipment and materials Provide scholarships	$21, 000.00 $20,000.00
PV system installation on government buildings and for energy impoverished societies	Project feasibility studies and design Procurement and installation of systems	$18,750.00 $12,5 to $17,5M
Total		$12,617M to 17,617M

1.1.2.6 Management planning

The possible risk and some suggestions for mitigating these risks are described in the table.

Table 5: Possible risks and proposed contingency actions for PVs

Risk item	Description	Contingency action
Cost of implementation	The costs for implementing the actions and activities above can increase due to factors such as the cost of equipment increasing over time and consultancy fees	The total costs indicated in the summary above has a range of approximately US$5M. This wide range may mitigate any fluctuations in costs for

Risk item	Description	Contingency action
	increasing due to inflationary problems	procurement of equipment and fees.
Implementation of activities takes longer than estimated	Many projects may overrun the scheduled time for implementation due to time delays in delivery of equipment, contracts and non-performance of consultants.	To mitigate this risk, adequate project planning should be instituted especially for the two installation projects. These schedules should include adequate lead times for delivery of imported equipment and ensuring that the critical path on the schedule is identified and managed. Consultants should include locals who are available on-island to mitigate delays that may be associated with international consultants.
Performance risks	PV system quality should can be an issue as many systems are sourced for countries where the quality of such systems range from low to high	To mitigate this risk quality specifications of equipment must be explicitly written into the procurement documents. All terms of reference must include minimum performance requirements and commissioning requirements. The project should also include maintenance manuals for ensuring on-going maintenance of the systems after installation.

Table 6: Next steps for PVs

Immediate requirements	The key implementation department must be adequately staffed to ensure that the major installation projects can be effectively and efficient implemented.
Critical steps	Key to the success of the PV installation project is the implementation of regulations and other institutional requirements to ensure that the energy market is ready to accept the diffusion of renewable energy technologies, and PV systems in particular. Foremost is the regulation for interaction connections and feed-in tariffs.

1.1.2.7 TAP overview table

Table 7: TAP overview table for PV

Energy supply and consumption							
PV systems							
Ambitions	To deploy about 5 MW of power, with the potential to reduce GHG emissions by 100GT over a 20 year period. The TAP will also contribute to the socio-economic by deploying about 3MW of power to energy impoverished households and communities.						
Benefits	1. Carbon footprint of pilot building is reduced 2. Cost of operation of government buildings reduced 3. Livelihoods and quality of life of energy impoverished households and communities improved 4. Institutional and human skills capacity improved for dealing with PV systems 5. PV systems become more economically viable enabling their future diffusion						
Actions	**Sources of Funding**	**Responsible Body**	**Timelines**	**Risks**	**Success Criteria**	**Monitoring Indicators**	**Budget for action (US$)**
Develop and implement a financial incentive scheme	CDB, GDB	Ministry of Finance	Sept 2018 to Aug. 2019	High costs for consultancy Options for tax reform cannot be implemented	PV systems are more economically viable	Report completed on schedule Options implemented	$28,850.00
Create and implement a full training program for PV systems	GIZ, World Bank	TAMCC	Sept. 2019 to Jan. 2020	High cost for training materials High cost for train the trainer	Program designed and implemented	No of persons trained Institution equipped to conduct training No of persons working in the filed	$41,000.00
Design and implement PV installation project	GCF, DFID, World Bank	Energy Division	Jan. 2019 to Dec. 2021	High cost of consultancy	Fleet of EVs contribute to the reduction	EVs reduce carbon footprint by 10%	$12,518M to 17.518M

Energy supply and consumption							
PV systems							
Ambitions	To deploy about 5 MW of power, with the potential to reduce GHG emissions by 100GT over a 20 year period. The TAP will also contribute to the socio-economic by deploying about 3MW of power to energy impoverished households and communities.						
Benefits	1. Carbon footprint of pilot building is reduced 2. Cost of operation of government buildings reduced 3. Livelihoods and quality of life of energy impoverished households and communities improved 4. Institutional and human skills capacity improved for dealing with PV systems 5. PV systems become more economically viable enabling their future diffusion						
Actions	**Sources of Funding**	**Responsible Body**	**Timelines**	**Risks**	**Success Criteria**	**Monitoring Indicators**	**Budget for action (US$)**
for the energy impoverished and government buildings				High costs of equipment Poor performance of equipment PV systems cannot be installed on poor house and community infrastructure	in operations cost and carbon footprint	Operational cost reduced by 10% Households' and communities' quality of life improved	
Support the promulgation of Electricity Supply Regulations	World Bank	Energy Division	Sept. 2018 to Aug. 2019	High cost of consultancy	ESA is adequately supported by all required regulations PURC is implemented	All regulations are passed into law and promulgated Effective interconnection policy results in	$28,850.00

Energy supply and consumption							
PV systems							
Ambitions	To deploy about 5 MW of power, with the potential to reduce GHG emissions by 100GT over a 20 year period. The TAP will also contribute to the socio-economic by deploying about 3MW of power to energy impoverished households and communities.						
Benefits	1. Carbon footprint of pilot building is reduced 2. Cost of operation of government buildings reduced 3. Livelihoods and quality of life of energy impoverished households and communities improved 4. Institutional and human skills capacity improved for dealing with PV systems 5. PV systems become more economically viable enabling their future diffusion						
Actions	**Sources of Funding**	**Responsible Body**	**Timelines**	**Risks**	**Success Criteria**	**Monitoring Indicators**	**Budget for action (US$)**
						increase in the uptake of PV systems	

1.1.3 Action plan for biogas

1.1.3.1 Introduction

Biogas systems were considered in the context of agriculture and were ranked fifth in the technology selection process. The systems ranked high in terms of initial costs and on the cost for operations and maintenance. From this perspective, biogas systems have the potential to reduce on the overall operational cost associated with energy consumed on farms.

Additionally, biogas systems have the potential to reduce on the overall carbon footprint as they reduce and/or avoid the emissions of carbon dioxide in to the atmosphere. In this regard, it is estimated that the use of biogas can replace the burning of diesel and LPG and as a result avoid the emissions of approximately 1.5kT to 1.9kT of CO2 equivalent into atmosphere.

Therefore the socio-economic benefits of biogas augurs well for its diffusion and deployment on farms in Grenada. There are projects that are focused on this diffusion, including the GIZ project that seeks to investigate the market requirements for upscaling these systems. The inclusion of this TAP will provide further support for this project and other projects with similar intentions.

1.1.3.2 Ambitions for the TAP

The overall intention of the TNA is to improve the socio-economic situation in Grenada, by moving towards a trajectory of sustainable development. In this regard, there key objectives for sustainable development were adopted: sustainable economic development; reduced poverty through increased employment and incomes and climate change mitigation and protection of the environment. Coupled with these key objectives, SDGs 7 and 13 were also identified as key sustainable development goals SDGs) that the technologies should set out to achieve.

Furthermore, the NDC indicates that approximately 10% of Grenada's emissions are from the waste sector. This estimate is significantly influenced by the solid waste disposal at the central landfill. However, with the introduction of small scale biogas systems, it is envisioned as above that about 1.5kT of CO2 equivalent can be avoided. It is also envisioned biogas systems will assist farms to reduce their operational costs for energy by about 20%.

1.1.3.3 Actions and activities selected for inclusion in the TAP

The barriers to the diffusion of biogas the potential measure to overcome them were already selected and discussed in the Barrier Analysis and Enabling Framework Report. These are summarized in table 8.

Table 8: Barriers to and measures to overcome the diffusion of biogas

Categories	Barriers	Measures
Economic and financial	High up-front cost of commercial type systems	Create soft loan facility for farmers' access
	High operational and maintenance cost due to the labor intensive nature of operations	Conduct productivity study to analyze how labor intensity can be reduced

Categories	Barriers	Measures
Non-economic and financial	Taboo about nature of the gas generated from waste of animals	Build awareness on the nature of the gas generated from waste of animals among workers
	Small size of waste input to make some systems viable	Appropriately size systems for waste feed stock
	Labor intensive nature of the system requiring commitment to provide feed stock to the system	Conduct productivity study to analyze how labor intensity can be reduced
	Lack of awareness on the commercial viability of biogas systems	Publish results of current project and use for training future investors

In the barriers and measures selection process stakeholder unanimously agreed that the economic and financial barriers and the requisite measures to overcome them were the most critical. In this regard, attempting to ensure that investments in biogas are made attractive to the farming community and looking at ways to improve the productivity of the operations of the system are most important. In the case of the latter ways to reduce of on the labor intensive nature of operating the systems will also be addressed. Since there are only two measure both will be considered for further action.

As it relates to the non-economic and financial barriers the need to raise awareness of the technology was also considered important. From this perspective stakeholders also agreed that if the results of current 'in-country' projects are appropriately published and disseminated that the deployment of the technology can be up-scaled. An action therefore to 'gather, publish and disseminate information' is also considered for the TAP. The country-specific publications will be more attractive for local farmers thus boosting the confidence in the performance of the systems.

Table 9 provides the results of the selection of the measures to be taken forward as actions for this TAP.

Table 9: Actions and activities for implementing biogas

Action #	Action	Activities
1	Create a soft loan facility to expand access to capital	1.1: Develop the parameters for the loan facility 1.2: Seek out funding that can be used to support the facility 1.3: Train financial personnel to assess projects 1.4: Market the facility

Action #	Action	Activities
2	Conduct and implement a productivity survey	2.1: Develop terms of reference and scope of works for the survey 2.2: Engage a consultant to conduct survey 2.3: Conduct survey 2.4: Publish report on the survey 2.5: Implement findings, where appropriate
3	Gather, publish and disseminate information	3.1: Develop terms of reference and scope of works for the research 3.2: Engage a consultant to conduct research 3.3: Conduct research on current systems 3.4: Publish report on the research and develop appropriate marketing materials 3.5: Design dissemination plan 3.6: Implement a pilot dissemination project

1.1.3.4 Stakeholders and timelines for implementation of TAP

The following key stakeholders and their proposed roles in relation to this TAP are briefly described. The table identifies their interaction with the various actions and activities previously identified.

The Energy Division (ED)- will be the implementing agency for all the actions and proposed projects proposed in the TAP. They will providing technical and procurement coordination and management of project implementation activities.

The Ministry of Climate Resilience, Environment, Disaster Preparedness, etc (MCREDP)- is the focal point for climate change and will interact with the project at various levels, including design and implementation to ensure that climate mitigation issues are adequately addressed when the actions are implemented.

The Grenada Development Bank (GDB)- a publicly owned financial and development institution in Grenada, which provides concessionary financing for development projects. The GDB will be involved with financial based actions in the TAP.

The T. A. Marryshow Community College (TAMCC)- the only publicly financed post-secondary institution in Grenada. The TAMCC is a comprehensive institution offering a wide range of courses and programs including technical programs. The TAMCC will be involved with the capacity building projects as it related to training.

Renewable Energy Companies- these companies currently act as a form of ESCOs as they provide technologies that result in electricity savings. They also provided contracting services for installing and maintaining renewable energy systems.

Farmers and communities- these are the recipients of PV systems. A proper analysis of their needs will result in a more effective project implementation.

Ministry of Social Development- this ministry is concerned with the development and understanding social needs at the community level. The ministry can assist with providing data and information on the energy needs of vulnerable households and communities.

Ministry of Agriculture and Lands- this ministry has a direct interaction with famers through its Extension Division and can assist with the identification and implementation of biogas systems.

Economic and Technical Cooperation Division in the Ministry of Finance and Economic Development- has the role of coordinating all projects from project design to implementation. The department also has the responsibility for developing full project proposals and serves as the pivot between GOG and potential funding agencies.

Table 10: Implementation plan for biogas- timeline and responsibilities

Actions	**Activities**	**Timelines (Planning to implementation**	**Responsibilities**
Create a soft loan facility to expand access to capital	1.1: Develop the parameters for the loan facility 1.2: Seek out funding that can be used to support the facility 1.3: Train financial personnel to assess projects 1.4: Market the facility	Sept 2018 to Dec. 2019	**GDB;** Energy Division; Ministry of Finance; Consultant
Conduct a productivity survey	2.1: Develop terms of reference and scope of works for the survey 2.2: Engage a consultant to conduct survey 2.3: Conduct survey 2.4: Publish report on the survey 2.5: Implement findings, where appropriate	Dec. 2018 to Dec 2021	**TAMCC;** Energy Division; Social Development;
Gather, publish and disseminate information	3.1: Develop terms of reference and scope of works for the research 3.2: Engage a consultant to conduct research 3.3: Conduct research on current systems 3.4: Publish report on the research and develop appropriate marketing materials 3.5: Design dissemination plan	Sept. 2018 to Feb. 2019	**Energy Division;** Economic & Technical Cooperation; Social Development; GRENLEC

Actions	Activities	Timelines (Planning to implementation	Responsibilities
	3.6: Implement a pilot dissemination project		

1.1.3.5 Estimation of resources needed for action and activities

The resources required for the implementation of the actions and activities are mainly expertise in the areas of renewable energy finance and research. It is anticipated therefore that two consultants, preferably local, will be engaged to execute the actions and activities. Other requirements will be internal to the agency/organization that is executing the actions, and these will include the development of terms of references and scope of works and the management of the work during its implementation.

Table 11 provides a summary of the estimates of costs for each of the actions and the activities.

Table 11: Cost and resources for biogas diffusion

Actions	Activities to be supported	Total costs (US$)
Create a soft loan facility to expand access to capital	1.1: Develop the parameters for the loan facility 1.2: Seek out funding that can be used to support the facility 1.3: Train financial personnel to assess projects 1.4: Market the facility	$34,500.00
Conduct a productivity survey	2.1: Develop terms of reference and scope of works for the survey 2.2: Engage a consultant to conduct survey 2.3: Conduct survey 2.4: Publish report on the survey 2.5: Implement findings, where appropriate	$22,500.00
Gather, publish and disseminate information	3.1: Develop terms of reference and scope of works for the research 3.2: Engage a consultant to conduct research 3.3: Conduct research on current systems 3.4: Publish report on the research and develop appropriate marketing materials 3.5: Design dissemination plan	$35,000.00

	3.6: Implement a pilot dissemination project	
Total		$92,000.00

To develop parameters of the soft loan facility a consultant working for 15 days @ US1, 200/day for a total of US$18,000.00. The consultant will have the responsibility for training persons in financial institutions and fees include other expenses of the consultant, travel, lodging, etc, where applicable.

Workshop support (venue, meals, etc) estimated at US$500.00/day for 3 days for a total of US$1,500.00

Marketing estimates at US$15,000.00 (including video, print and audio materials)

To conduct the productivity survey a consultant will be engaged to carry out all the activities for 30 days at a rate of US$750.00/day for a total of US$22,500.00

Similarly for the promotional actions a consultant engaged for 20 day at US$750.00/day for a total of US$15,000.00.

The execution of the marketing is estimated to cost US$20,000.00 (including video, audio and print materials)

1.1.3.6 Management planning

Table 12: Risk identification and contingency plan for biogas

Risk item	Description	Contingency action
Cost of implementation	The costs for implementing the actions and activities above can increase due to factors such as the cost of consultancy fees increasing due to inflationary issues	The total costs indicated in the summary above has a built in contingency to account for this issue. Secondly as far as is possible local consultants will be engaged thus eliminating charges for lodging etc.
Implementation of activities takes longer than estimated	Many projects may overrun the scheduled time for implementation due to time delays in delivery of contracts and non-performance of consultants.	Consultants should include locals who are available on-island to mitigate delays that may be associated with international consultants.

Table 13: Next steps for biogas

Immediate requirements	The key implementation department must be adequately staffed to ensure that personnel with the requisite skills are in place to develop TORs and scope of works and to implement the required marketing and promotional activities.
Critical steps	

1.1.3.7 TAP overview table

Table 14: TAP overview table for biogas

Energy Supply and Consumption							
Biogas							
Ambition:	To introduce small scale biogas systems on farms with the intention to reduce GHG emissions by about 1.5kT of CO2 equivalent. It is also envisioned biogas systems will assist farms to reduce their operational costs for energy by about 20%.						
Benefits:	1. Carbon footprint of farms using biogas systems is reduced 2. Livelihoods and quality of life of energy farms improved 3. Biogas systems are more economically viable enabling their future diffusion						
Actions	**Sources of Funding**	**Responsible Body**	**Timelines**	**Risks**	**Success Criteria**	**Monitoring Indicators**	**Budget for action (US$)**
Create a soft loan facility to expand access to capital	GDB, CDB, World Bank, GIZ	GDB	Sept 2018 to Dec. 2019	High cost of consultancy Loan conditions still unacceptable to customers	Loan facility instituted	No of persons utilizing facility No of biogas systems installed Operational cost reduction	$34,500.00
Conduct a productivity survey	GIZ, CDB	TAMCC	Dec. 2018 to Dec 2021	High cost of consultancy Options for improving productivity are not viable			$22,500.00
Gather, publish and disseminate information	GIZ, CDB	Energy Division	Sept. 2018 to Feb. 2019	High cost of consultancy	Report on performance of biogas	Promotional materials developed	$35,000.00

Energy Supply and Consumption							
Biogas							
Ambition:	To introduce small scale biogas systems on farms with the intention to reduce GHG emissions by about 1.5kT of CO2 equivalent. It is also envisioned biogas systems will assist farms to reduce their operational costs for energy by about 20%.						
Benefits:	1. Carbon footprint of farms using biogas systems is reduced 2. Livelihoods and quality of life of energy farms improved 3. Biogas systems are more economically viable enabling their future diffusion						
Actions	**Sources of Funding**	**Responsible Body**	**Timelines**	**Risks**	**Success Criteria**	**Monitoring Indicators**	**Budget for action (US$)**
				Performance results unacceptable	systems completed	No of persons using attend workshop No of persons using promotional materials	

1.1.4 Action plan for high efficiency ACs and LEDs

1.1.4.1 Introduction

The TAPs for LEDs and high efficiency ACs are presented together for the following and is regarded as the TAP for energy efficiency. Firstly they both technologies contribute to the efficient consumption of electricity in buildings. In this regard, they have the potential to contribute to achieving the targets in the NDCs which will be addressed in the ambitions section 1.1.4.2. In this regard, both technologies were selected by the stakeholders for their high potential to reduce the emissions of GHGs. Moreover, the technologies were ranked relatively high on the initial investment costs and operations and maintenance costs, with LEDs ranking highest of the two. LEDs also ranked 2 in the prioritization of the all the technologies considered.

More importantly, during the barriers analysis and enabling framework stakeholders' meetings the barriers and measures to overcome the technologies were in the main similar (as shown in table below). Additionally, the stakeholders also agreed that the economic and financial barriers were more important.

High efficiency ACs considered in the TAP include ACs that use the inverter technology and ACs that use high efficiency refrigerants such as hydrocarbons. These technologies have the potential to reduce on the direct emissions of GHGs due to the emissions of the refrigerants that has a global warming potential (GWP) and indirectly through the consumption of electricity generated by fossil fuels. LEDs of a high quality are required for this TAP as they have much better efficacies, better quality lumens and longer life spans.

1.1.4.2 Ambitions for the TAP

The overall intention of the TNA is to improve the socio-economic situation in Grenada, by moving towards a trajectory of sustainable development. In this regard, there key objectives for sustainable development were adopted: sustainable economic development; reduced poverty through increased employment and incomes and climate change mitigation and protection of the environment. Coupled with these key objectives, SDGs 7 and 13 were also identified as key sustainable development goals SDGs) that the technologies should set out to achieve.

Additionally, the TAP can contribute to the following targets proposed in the NDC: 20% reduction in GHGs form building retrofits; a further 30% reduction from energy efficiency building codes and 30% reduction by implementing energy efficiency measures in buildings such as hotels.

This energy efficiency TAP will seek to contribute directly to the NDC targets by implementing actions and activities that will reduce on energy consumption in buildings, by retrofitting the air conditioning and lighting systems. Additionally, the TAP further aims for GHG emissions from these buildings will be reduced. In this regard, a potential reduction in CO2 equivalent of approximately 20% form high efficiency ACs and a further 10% from lighting is projected.

One metric used to estimate the CO2 reduction potential of ACs is the Total Equivalent Warming Impact (TEWI). Using a small AC unit with cooling capacity of 1.93 KW; operating for 3,120 hours per year for 20 years, with a leakage rate of 8%, reveals that by replacing a unit using refrigerant 22 (R22) with a GWP of 1810, with a similar unit using refrigerant 290 (HC 290), GWP of 20, the incremental reduction in emissions of CO2 is approximately 136GT (TEWI = Refrigerant charge x Leakage rate x life of equipment x GWP + Cooling performance x operating hours x emissions factor x life of equipment x GWP). This index suggests that there is enormous climate change mitigation potential with high efficiency ACs. However, the significant reduction is accounted for by the indirect impact which is approximately 90% of the TEWI. Additionally, with the reduction in electricity consumed, the operational cost can be reduced by as much as 30%.

Similarly, it was shown in the Barriers Analysis and Enabling Framework Report, that LEDs have a much longer life than CFLs and incandescent bulbs, with annual operating cost of five times less than that of an incandescent. Further analysis also shows that the incremental reduction in carbon dioxide emissions from LEDs is approximately 3 times less than that of an incandescent bulb over the approximate life of an LED of 17 years. This is much less compared to compact fluorescent (CFL).

These indicative calculations suggest that the ambition of the energy efficiency TAP is achievable. In this regard, both climate mitigation and economic targets can be met, thus contributing to meeting SDGs 8 and 13 and contributing to the sustainable development of Grenada as a whole.

1.1.4.3 Actions and activities selected for inclusion in the TAP

The actions and activities selected to meet these targets are derived from the barriers and measures selected by stakeholders during the barriers analysis and enabling framework stage of the TNA. Table 10 summarizes the barriers and measures for both high efficiency ACs and LEDs. An investigation of these shows that the barriers and measures are similar for bot technologies.

As it relates to the economic barriers, high up-front costs; inadequate or lack of regulations for cost reduction on importation of these technologies and a lack of differential tariffs to encourage the use of these technologies were identified for both technologies. Although high cost for retrofitting was identified for LEDs only, this can be equally applied to the cost for retrofitting AC systems. These economic and financial barriers and measures to overcome them were identified as the most important barriers and the measures needed to overcome the diffusion of the technologies. Key among the measures was the establishment of ESCOs to provide upfront financing. This measure was also suggested for PV systems and as such similar actions and activities can be suggested for this TAP. Due to the small nature of the market it is more economically viable for ESCOs to focus on both renewable energy and energy efficiency. This

also demonstrates the common threads that link the TAPs together and which supports the development of project ideas that will support the diffusion of multiple technologies.

Table 15: Barriers to and measures to overcome the diffusion of high efficiency ACs and LEDs

Categories	Barriers	Measures
High efficiency ACs		
Economic and financial	High up-front cost of commercial type systems	Encourage government to reduce further on import taxes
		Establish Energy Service Companies to provide upfront investment funds
	Inadequate regulations for importing new renewable energy and energy efficient technologies, including high efficient ACs	Develop policy and regulations for the diffusion of high efficient ACs as an energy efficiency measure, energy standards/codes
	Lack of differential tariff to encourage high efficient ACs	Determine feasibility of developing a demand charge of energy efficient measures
Non-economic and financial	Insufficient institutional capacity to provide training (safety issues with the hydrocarbon technologies)	Develop capacity (training institutions and curriculum) to deliver training for hydrocarbon technologies
	Lack of energy codes to promote energy efficient buildings	Develop policy and regulations for the diffusion of high efficient ACs as an energy efficiency measure, energy standards/codes
LEDs		
Economic and financial	High up-front cost of LEDs compared to other lamps	Encourage government to reduce further on import taxes
	High cost for retrofitting existing lighting systems, especially change over from fluorescents to LEDs	Conduct comprehensive study to determine most feasible approach for retrofits
	Inadequate regulations for importing LEDs	Establish Energy Services Companies (ESCOs) to provide upfront investment funds
	Lack of differential tariff to encourage high efficient and renewable energy technologies	Determine feasibility of developing a demand charge of energy efficient measures
Non-economic and financial	Poor quality of LEDs	Develop a policy and regulations for the diffusion of LEDs as an energy efficiency measure

Categories	Barriers	Measures
	Lack of standards/energy codes to promote energy efficient technologies in buildings	Further develop the test facilities for quality control at the Bureau of Standards and develop/adapt/adopt energy efficiency standards and codes

Table 16: Measures to be taken forward as actions to implement high efficiency ACs and LEDs diffusion

Categories	Identified measures to overcome barriers	Measures taken forward as actions
Economic and financial	Encourage government to reduce further on import taxes	Conduct import tax regime and impact study
	Establish Energy Service Companies to provide upfront investment funds	Support integration of energy efficiency into ESCOs
	Develop policy and regulations for the diffusion of high efficient ACs as an energy efficiency measure, energy standards/codes	Support the promulgation of the regional energy efficient standards
	Determine feasibility of developing a demand charge of energy efficient measures	Conduct demand charge feasibility study
	Conduct comprehensive study to determine most feasible approach for retrofits	Implement a lighting and AC retrofit for Government building(s)
Non-economic and financial	Develop capacity (training institutions and curriculum) to deliver training for hydrocarbon technologies	Design and implement a pilot training for high efficiency ACs
	Further develop the test facilities for quality control at the Bureau of Standards and develop/adapt/adopt energy efficiency standards and codes	Create test facilities for energy efficiency equipment (ACs and LEDSs)
	Develop a policy and regulations for the diffusion of LEDs as an energy efficiency measure	

The non-economic and financial barriers and measures were also similar for the two technologies. Lack of energy codes to ensure that the efficiency measures are achieved by the technologies was identified as a key barrier and it was suggested that such codes should be supported. In this regard, it was identified in the Barriers Analysis and Enabling Framework Report that such codes and standards are now been developed regionally. This TAP therefore can

focus on actions and activities to ensure that the codes and standards and used. Additionally, a key measure also considered the development of test facilities to support the importation of high quality LEDs. The measures also included the need for institutional and human capacity building for dealing with high efficiency ACs that are using flammable refrigerants. Again the synergies existing with the technologies in the TAP is revealed as capacity building is a common theme for the technologies.

Table 14 shows all the measures that were suggested by the stakeholder in the BA&EF stage of the TNA. Five out of the eight measures are considered to be developed for crossing cutting actions. These actions will have a profound impact of meeting the ambitions of the TAP, especially the demonstration project which will install equipment that will reduce energy use and CO2 emissions. The addition of energy efficiency to ESCOs will also encourage investments as funding from ESCOs will be made available. The promotion of the codes and standards already under development will go a long way in ensuring that high quality LEDs and ACs are imported. The creation of test facilities will support this further. Capacity training and institutional strengthening to support this training will ensure that technicians are adequately prepared to operate and maintain the influx of high efficiency ACs. A study to investigate the possible 'best' tax regime to encourage retrofits and importation of high efficiency ACs is also suggested as an action.

It is noted that all proposed measures are considered as many of these are support studies and investigations that will inform critical decision such as fiscal policy and regulations and tariff structures, which is also required for PV systems and also the diffusion or EVs.

Table 17: Actions and activities for implementing the LEDs and high efficiency ACs

Action #	**Action**	**Activities**
1	Conduct import tax regime and impact study	1.1: Develop terms of reference and scope of works for the study 1.2: Engage a consultant to conduct survey 1.3: Conduct survey 1.4: Implement findings, where appropriate
2	Support integration of energy efficiency measures into ESCOs	2.1: Engage consultant 2.2: Design an implementation plan 2.3: Research possible sources of funding to support the start up 2.4: Design and implement a monitoring and verification protocol 2.5: Train ESCO personnel in M&V 2.6: Pilot the up-take of a retrofit in the private sector, a hotel 2.7: Document results

Action #	Action	Activities
		2.8: Promote the replication in other entities using the revolving fund
3	Support the promulgation of the regional energy efficient standards	3.1: Engage consultant (TORs and scope of works) 3.2: Design an implementation plan for the standards with the Bureau of Standards 3.3: Provide institutional training to implement standards 3.4: Conduct sensitization workshops and materials 3.5: Produce implementation results
4	Conduct demand charge feasibility study	4.1: Develop terms of reference and scope of works for the study 4.2: Engage a consultant to conduct survey 4.3: Conduct survey 4.4: Implement findings, where appropriate
5	Implement a lighting and AC retrofit for Government building(s)	5.1: Conduct a feasibility study for the project 5.2: Design the project 5.3: Develop TORs and Scope of Works for equipment installation 5.4: Procure equipment, with minimum performance standards specifications 5.5: Install retrofit 5.6: Document project results and best practice, including costings 5.7: Commission system and produce report 5.8: Deliver operations and maintenance manuals, where applicable
6	Design and implement a pilot training for high efficiency ACs	6.1: Engage key stakeholders on the needs for training 6.2: Design program and identify list of supporting materials, equipment, tools and lab space upgrades 6.3: Procure materials and equipment 6.4: Pilot program with scholarships for participants 6.5: Assess pilot and revise course where applicable
7	Create test facilities for energy efficiency equipment (ACs and LEDSs)	7.1: Conduct a feasibility study for the project 7.2: Design the project 7.3: Develop TORs and Scope of Works for design and equipment installation 7.4: Procure equipment, with minimum performance standards specifications 7.5: Install equipment 7.6: Carry pilot tests for retrofit project, if practical 7.7: Document project results and best practice, including costings 7.8: Commission system and produce report

Action #	Action	Activities
		7.9: Deliver operations and maintenance manuals, where applicable

1.1.4.4 Stakeholders and timelines for implementation of TAP

The actions and activities in table 15 can be actioned through the proposed implementation plan in table 16. The key responsible entities are also described and appears in the table. The bolded entities are suggested as the lead; while the timelines are for the overall implementation of the actions and not separate activities.

Table 18: Indicative implementation plan timelines and responsibilities for LEDs and high efficiency ACs

Actions	Activities	Timelines (Planning to implementation	Responsibilities
Conduct import tax regime and impact study	1.1: Develop terms of reference and scope of works for the study 1.2: Engage a consultant to conduct survey 1.3: Conduct survey 1.4: Implement findings, where appropriate	Sept 2018 to Aug. 2019	**Ministry of Finance; Economic and technical Cooperation;** GDB; Energy Division; Consultant; MCRE
Support integration of energy efficiency measures into ESCOs	2.1: Engage consultant 2.2: Design an implementation plan 2.3: Research possible sources of funding to support the start up 2.4: Design and implement a monitoring and verification protocol 2.5: Train ESCO personnel in M&V protocol 2.6: Pilot the up-take of a retrofit in the private sector, a hotel 2.7: Document results 2.8: Promote the replication in other entities using the revolving fund	Sept. 2019 to Jan. 2020	**Energy Division;** MCRE; GDB
Support the promulgation of the regional energy efficient standards	3.1: Engage consultant (TORs and scope of works) 3.2: Design an implementation plan for the standards with the Bureau of Standards	Jan. 2019 to Dec. 2021	**GDBS;** Energy Division; Economic & Technical Cooperation; Social

Actions	Activities	Timelines (Planning to implementation	Responsibilities
	3.3: Provide institutional training to implement standards 3.4: Conduct sensitization workshops and materials 3.5: Produce implementation results		Development; GRENLEC
Conduct demand charge feasibility study	4.1: Develop terms of reference and scope of works for the study 4.2: Engage a consultant to conduct survey 4.3: Conduct survey 4.4: Implement findings, where appropriate	Sept. 2018 to Aug. 2019	**Energy Division;** GRENLEC; Economic and Technical Cooperation
Implement a lighting and AC retrofit for Government building(s)	5.1: Conduct a feasibility study for the project 5.2: Design the project 5.3: Develop TORs and Scope of Works for equipment installation 5.4: Procure equipment, with minimum performance standards specifications 5.5: Install retrofit 5.6: Document project results and best practice, including costings 5.7: Commission system and produce report 5.8: Deliver operations and maintenance manuals, where applicable	Jan. 2019 to Dec. 2021	**Energy Division;** GRENLEC; Economic & Technical Cooperation;
Design and implement a pilot training for high efficiency ACs	6.1: Engage key stakeholders on the needs for training 6.2: Design program and identify list of supporting materials, equipment, tools and lab space upgrades 6.3: Procure materials and equipment 6.4: Pilot program with scholarships for participants 6.5: Assess pilot and revise course where applicable	Sept.2018 to Dec. 2019	**TAMCC;** Energy Division; Energy Companies, Economic and technical Cooperation; MCRE
Create test facilities for energy efficiency	7.1: Conduct a feasibility study for the project 7.2: Design the project	Dec. 2018 to Dec. 2021	**GDBS;** Energy Division; Economic and

Actions	Activities	Timelines (Planning to implementation	Responsibilities
equipment (ACs and LEDSs)	7.3: Develop TORs and Scope of Works for design and equipment installation 7.4: Procure equipment, with minimum performance standards specifications 7.5: Install equipment 7.6: Carry pilot tests for retrofit project, if practical 7.7: Document project results and best practice, including costings 7.8: Commission system and produce report 7.9: Deliver operations and maintenance manuals, where applicable		Technical Cooperation, MCRE

The following key stakeholders and their proposed roles in relation to this TAP are briefly described. The table identifies their interaction with the various actions and activities previously identified.

The Energy Division (ED)- will be the implementing agency for all the actions and proposed projects proposed in the TAP. They will providing technical and procurement coordination and management of project implementation activities.

The Ministry of Climate Resilience, Environment, Disaster Preparedness, etc (MCRE)- is the focal point for climate change and will interact with the project at various levels, including design and implementation to ensure that climate mitigation issues are adequately addressed when the actions are implemented.

The Grenada Development Bank (GDB)- a publicly owned financial and development institution in Grenada, which provides concessionary financing for development projects. The GDB will be involved with financial based actions in the TAP.

The T. A. Marryshow Community College (TAMCC)- the only publicly financed post-secondary institution in Grenada. The TAMCC is a comprehensive institution offering a wide range of courses and programs including technical programs. The TAMCC will be involved with the capacity building projects as it related to training.

Renewable Energy Companies- these companies currently act as a form of ESCOs as they provide technologies that result in electricity savings. They also provided contracting services for installing and maintaining renewable energy systems.

Grenada Bureau of Standards (GDBS)- responsible for the quality and standards and will play an integral role in leading the related actions for this TAP.

Ministry of Social Development- this ministry is concerned with the development and understanding social needs at the community level. The ministry can assist with providing data and information on the energy needs of vulnerable households and communities.

Economic and Technical Cooperation Division in the Ministry of Finance and Economic Development- has the role of coordinating all projects from project design to implementation. The department also has the responsibility for developing full project proposals and serves as the pivot between GOG and potential funding agencies.

1.1.4.5 Estimation of resources needed for action and activities

The estimated resources required for the implementation of the actions and activities are described below and are summarized in table 17. The resources include both capacity to conduct studies and to conduct project feasibility analysis and develop project documents. Two of the actions require the procurement of contractor and equipment for larger scale type projects.

For action 1 only a consultant will be engaged to conduct a comprehensive survey of current tax regime and to analyze the impact differential tax options on income etc. This requires the engagement of one consultant for 15 days at US%1,200.00 per day for a total of: US$18,000.00

Action 2 requires the engagement of a consultant to carry-out most of the activities. This is envisioned to cost approximately US$30,000.00 for 25 days at US$1,200.00 per day.

Training for ESCOs to cover materials, room rent and other overheads for 3 days: US$1,500

The promulgation of regional standards require the engagement of consultant and training and sensitization workshops:

Consultant fees: US$1, 200/day for 10 days for a total of US$12,000.00

Training and workshop support: US$ 2,400.00 for six days

The demand charge feasibility study activities requires the engagement of a consultant for 10 day at US$1,200/day at a total of US$12,000.00

Table 19: Summary of required resources for high efficiency ACs and LEDs

Actions	Activities to be supported	Total costs (US$)
Conduct import tax regime and impact study	Expert to implement all activities	$18,000.00

Actions	Activities to be supported	Total costs (US$)
Support integration of energy efficiency measures into ESCOs	Consultant activities Training workshop	$30,000.00 $1,500.00
Support the promulgation of the regional energy efficient standards	Consultant activities Workshop and training support	$12, 000.00 $2,400.00
Conduct demand charge feasibility study		$12, 000.00
Implement a lighting and AC retrofit for Government building(s)	Consultant activities Equipment procurement and install	$36,000.00 $1M
Design and implement a pilot training for high efficiency ACs	Training materials and equipment Scholarships	$50,000.00 $20,000.00
Create test facilities for energy efficiency equipment (ACs and LEDSs)	Consultant activities: Test facility equipment and installation Pilot testing	$24,000.00 $500,000.00 $100,000.00
Total		$1.8M

The retrofit action consists of the following activities:

Consultant for feasibility study, project design and management of implementation for 30 days at US$1.200/day for a total ofUS$36,000.00

Equipment and materials (ACs and LEDs where applicable): US$3,000/ton of cooling for 300 tons of cooling for a total of US$900,000.00; plus lighting retrofits at US$50.00 per fixture for 2000 fixtures for a total of US$100,000.00

Equipment installation total: US$1,000,000.00

The training requires the procurement of training equipment and materials estimated at approximately US$50,000.

Scholarships for 20 person at US$1,000.00 including tool kits for a total of US$20,000.00

The final activities can be grouped into three:

Consultant activities for 20 days at US$1,200/day for a total of US$24,000; procurement of test equipment and installation at US$500,000.00 and pilot testing at US$100,000 for various sizes of AC systems and LEDs

1.1.4.6 Management planning

Table 20: Risk and contingency plan for LEDs and high efficiency ACs

Risk item	Description	Contingency action
Cost of implementation	The costs for implementing the actions and activities above can increase due to factors such as the cost of equipment increasing over time and consultancy fees increasing due to inflationary problems	The total costs indicated in the summary above contingency margins added to mitigate these risks.
Implementation of activities takes longer than estimated	Many projects may overrun the scheduled time for implementation due to time delays in delivery of equipment, contracts and non-performance of consultants.	To mitigate this risk, adequate project planning should be instituted especially for the two installation projects. These schedules should include adequate lead times for delivery of imported equipment and ensuring that the critical path on the schedule is identified and managed. Consultants should include locals who are available on-island to mitigate delays that may be associated with international consultants.
Performance risks	LED and high efficiency systems quality can be an issue as many systems are sourced from countries where the quality of such systems range from low to high	To mitigate this risk quality specifications of equipment must be explicitly written into the procurement documents. All terms of reference must include minimum performance requirements and commissioning requirements. The project should also include maintenance manuals for ensuring on-going maintenance of the systems after installation. Additionally it is hoped that the test facilities will be in place to assist with quality testing for any systems procured for the retrofit.

Table 21: Next steps for LEDs and high efficiency ACs

Immediate requirements	The key implementation department must be adequately staffed to ensure that the major installation projects can be effectively and efficient implemented.
Critical steps	Key to the success of the energy efficiency, high efficiency ACs and LEDs installation action is the implementation of regulations and other institutional requirements to ensure that the energy market is ready to accept the diffusion of renewable energy technologies, and PV systems in particular. Foremost is the regulation for interaction connections and feed-in tariffs.

1.1.4.7 TAP overview table

Table 22: TAP Overview Table for LEDs and high efficiency ACs

Energy Supply and Consumption							
Energy Efficiency- high efficiency ACs and LEDs							
Ambition:	To potentially reduce emissions of CO2 equivalent by approximately 20% form high efficiency ACs and a further 10% from lighting is projected. It is also envisioned that a 30% in energy related operational cost can be achieved.						
Benefits:	6. Carbon footprint of pilot building is reduced 7. Cost of operation the building reduced 8. Quality test facilities implemented and used 9. Institutional and human skills capacity improved for dealing with high efficiency ACs 10. High efficiency ACs and LEDs become more economically viable enabling their future diffusion						
Actions	**Sources of Funding**	**Responsible Body**	**Timelines**	**Risks**	**Success Criteria**	**Monitoring Indicators**	**Budget for action (US$)**
Conduct import tax regime and impact study	GIZ; World Bank	Ministry of Finance	Sept 2018 to Aug. 2019	High costs for consultancy Options for tax reform cannot be implemented	High efficiency ACs and LEDs are more economically viable	Report completed on schedule Options implemented	$18,000.00
Support integration of energy efficiency measures into ESCOs	CDB; World Bank; GDB	Energy Division	Sept. 2019 to Jan. 2020	ESCOs not interested in the program LEDs cannot deliver significant savings	ESCOs engaged for a pilot program Monitoring and evaluation protocol implemented by ESCOs	No of ESCOs offering services for energy efficiency No of customers using he services of ESCOs	$31,500.00
Support the promulgation of the	World Bank; CDF	GDBS	Jan. 2019 to Dec. 2021	High costs for consultancy	Implantation plan designed	Materials distributed to	$14,400.00

Energy Supply and Consumption							
Energy Efficiency- high efficiency ACs and LEDs							
Ambition:	To potentially reduce emissions of CO2 equivalent by approximately 20% form high efficiency ACs and a further 10% from lighting is projected. It is also envisioned that a 30% in energy related operational cost can be achieved.						
Benefits:	6. Carbon footprint of pilot building is reduced 7. Cost of operation the building reduced 8. Quality test facilities implemented and used 9. Institutional and human skills capacity improved for dealing with high efficiency ACs 10. High efficiency ACs and LEDs become more economically viable enabling their future diffusion						
Actions	**Sources of Funding**	**Responsible Body**	**Timelines**	**Risks**	**Success Criteria**	**Monitoring Indicators**	**Budget for action (US$)**
regional energy efficient standards					Sensitization materials developed One workshop delivered	key stakeholders At least 20 key stakeholders attend workshop	
Conduct demand charge feasibility study	GIZ; World Bank	Energy Division	Sept. 2018 to Aug. 2019	High costs for consultancy Options for tax reform cannot be implemented	Electricity rate options presented	Demand charge option integrated into electricity rates	$12,000.00
Implement a lighting and AC retrofit for Government building(s)	CDB; GDB	Energy Division	Jan. 2019 to Dec. 2021	High cost for equipment High implementation cost	Savings in energy use	Retrofit completed on scheduled Savings in energy	$1,036M
Design and implement a pilot	World Bank; GIZ, CDB	TAMCC	Sept.2018 to Dec. 2019	High cost for training materials	Program designed and implemented	No of persons trained	$70.000.00

Energy Supply and Consumption							
Energy Efficiency- high efficiency ACs and LEDs							
Ambition:	To potentially reduce emissions of CO2 equivalent by approximately 20% form high efficiency ACs and a further 10% from lighting is projected. It is also envisioned that a 30% in energy related operational cost can be achieved.						
Benefits:	6. Carbon footprint of pilot building is reduced 7. Cost of operation the building reduced 8. Quality test facilities implemented and used 9. Institutional and human skills capacity improved for dealing with high efficiency ACs 10. High efficiency ACs and LEDs become more economically viable enabling their future diffusion						
Actions	**Sources of Funding**	**Responsible Body**	**Timelines**	**Risks**	**Success Criteria**	**Monitoring Indicators**	**Budget for action (US$)**
training for high efficiency ACs				High cost for train the trainer		Institution equipped to conduct training No of persons working in the filed	
Create test facilities for energy efficiency equipment (ACs and LEDSs)	CDB; CDF;	GDBS	Dec. 2018 to Dec. 2021	High cost of equipment Equipment does not function effectively High costs of testing	Equipment installed and functioning	No of test carried out	$624,000.00

1.1.5 Action plan for EVs

1.1.5.1 Introduction

As was discussed in the TNA Report, EVs were included as in the TNA-Mitigation based on a decision by the TNA Committee at a meeting held on the 28-02-2018. Since there are four (4) electric plug-in vehicles on its roads, and the performance reported by the owners of these vehicles appears to be favorable, the committee agreed that a TAP and full project idea for EVs should be considered. The company that owns three of the vehicles has conducted key research and in this regard, EVs appear to be a viable option for transitioning the current fleet of vehicles in Grenada. Therefore EVs were not considered at the technologies prioritization workshop but is considered as the sole technology for further analysis in the transport sub-sector.

EVs have the potential to mitigate climate change once the source of charging is from renewable energy technologies. In this regard, as the GOG has signaled its intention to transition to sustainable energy, by passing the new ESA into law, EVs will become a viable option for the fleet of vehicle in Grenada. The technology also has the potential to reduce on the cost of fuel as the company reported that an EV can achieve approximately 90 miles/gallon of fuel equivalent and with 34% fuel savings.

However, the initial cost for EVs may be prohibitive and as such this can be addressed through incentives and other fiscal policies to encourage the up-scaling. This is further discussed in the TAP for EVs.

1.1.5.2 Ambitions for the TAP

The overall intention of the TNA is to improve the socio-economic situation in Grenada, by moving towards a trajectory of sustainable development. In this regard, there key objectives for sustainable development were adopted: sustainable economic development; reduced poverty through increased employment and incomes and climate change mitigation and protection of the environment. Coupled with these key objectives, SDGs 7 and 13 were also identified as key sustainable development goals SDGs) that the technologies should set out to achieve.

More specifically EVs will contribute significantly to the mitigation of climate change as they have the potential to contribute to the 20% GHG reduction by 2025 target in the transportation sub-sector. According to the GRENLEC, the EV can achieve approximately 6.91 KT of carbon dioxide savings annually. The TAP will therefore seek to up-scale this research, while contributing to approximately 10% of GHG emissions reduction.

1.1.5.3 Actions and activities selected for inclusion in the TAP

Table 23: Barriers to and measures to overcome the diffusion of EVs

Categories	Barriers	Measures
Economic and financial	High initial costs compared with the combustion engine	Provide tax incentives or concessions available
Non-economic and financial	Range of the car is of a concern	Consider type of vehicle with high range
	Charging ports are not available throughout the island	Design a medium project to demonstrate and develop charging ports in strategic locations on the island
	Dealers are reluctant to import cars	Encourage dealers to import EVs
	Lack of trained technicians and institution capacity to provide training (safety associated with high voltage poses an issue for servicing)	Develop institutional and individual capacity to provide training to technicians

Table xx summarizes the barriers to and potential measures to overcome the deployment and diffusion of EVs. At the BA&EF stakeholder workshop and with interview with key stakeholders it was widely agreed that the economic and financial barriers and concomitant measures were the more critical. In this regard, measures fiscal measures to encourage the up-take EVs were suggested. It is shown in the summary that tax incentives may be a suitable measure for so doing.

Other non-economic and financial barriers and measures were included. Foremost among these is the concern for adequate charging ports powered by renewable energy sources. In his regard, the suggestion to introduce charging ports at government owned buildings through a pilot project is the suggested measure to deal with this barrier. Additionally, the human and institutional capacity need to deal maintain EVs was also identified as a barrier. Like previous TAPs, improving training institution's capacity to deliver training and the provision of requisite training materials, train-the-trainer and curriculum will be adequate measures to overcome this barrier.

Other barriers dealt with the dealers' reluctance to import EVs and the technical performance of EVs in terms of its range. Investigating the impacts of providing tax incentives to dealers and reaching the performance of various brands of EVs are the suggested measures to be considered.

Table 24: Measure to become actions for implementing EVs

Categories	Measures to overcome barriers	Measures to be taken forward as actions
Economic and financial	Provide tax incentives or concessions available	Conduct import tax and regime, tax concessions and impact study
Non-economic and financial	Consider type of vehicle with high range	Publish studies on EV performance
	Design a medium project to demonstrate and develop charging ports in strategic locations on the island	Develop a demonstration project for EVs in the government fleet
	Encourage dealers to import EVs	Provide tax incentives for car dealers
	Develop institutional and individual capacity to provide training to technicians	Develop a training module for EVs

All the measures proposed are considered to be taken forward as actions. As with the previous TAPs the actions are all considered important to meeting the overall objectives of the TAP and more specifically meeting the ambitions established for the EV tap. For example, the economic and financial action is required as it will make an investment in EV attractive to the average car purchaser. In this regard, the more persons owning and operating EVs will contribute to the overall GHG reduction target. Additionally though, these EV owners will reduce on their expenditure for fuel over the life of the vehicle, thus improving their financial position. This will give the EV owner access to some more disposal income that can be used to improve the quality of life, hence achieving the socio-economic intent of the TAP.

Another key example, is demonstrated in the need to improve the skills based of current and future vehicle technicians and to strengthen the capacity of the training institution to deliver such training. This action has the potential to improve the socio-economic development of Grenada as persons are trained in skills required for the green economy. The capacity of trainers in the training institutions will be upgraded, while the institution will be in a position to provide on-going training to support the wider diffusion of EVs.

The demonstration project action, also demonstrates a key synergy between the energy supply and consumption that is required to ensure that EVs are contributing to climate change mitigation. In this regard, this action supports charging ports that will provide a diffused charging network for the EVs. By installing PVs on government owned buildings in strategic locations on the island, these building will now become more sustainable as their carbon footprints will be reduced.

The activities to support these actions are shown in table xx.

Table 25: Actions and activities to implement the EVs

Action #	Actions	Activities
1	Conduct import tax regime, tax concessions and impact study	1.1: Develop terms of reference and scope of works for the study 1.2: Engage a consultant to conduct survey 1.3: Conduct survey 1.4: Implement findings, where appropriate
2	Publish studies on EV performance	2.1: Engage consultant 2.2: Conduct desk survey and other relevant local survey with current EVs 2.3: Document findings 2.4: Develop promotional materials 2.5: Conduct relevant workshops and meetings to promote EVs
3	Develop a demonstration project for EVs in the government fleet	3.1: Conduct a feasibility study for the project 3.2: Design the project 3.3: Develop TORs and Scope of Works for equipment installation 3.4: Procure and install charging stations powered by PV on government buildings 3.5: Procure EVs for demonstration 3.6: Document project results and best practice, including costings 3.7: Commission system and produce report 3.8: Deliver operations and maintenance manuals, where applicable
4	Provide tax incentives for car dealers	4.1: Develop terms of reference and scope of works for the study 4.2: Engage a consultant to conduct survey 4.3: Conduct survey 4.4: Implement findings, where appropriate
5	Develop a training module for EVs	5.1: Engage key stakeholders on the needs for training 5.2: Design program and identify list of supporting materials, equipment, tools and lab space upgrades 5.3: Procure materials and equipment 5.4: Pilot program with scholarships for participants 5.5: Assess pilot and revise course where applicable

1.1.5.4 Stakeholders and timelines for implementation of TAP

The following key stakeholders and their proposed roles in relation to this TAP are briefly described. The table identifies their interaction with the various actions and activities previously identified.

The Energy Division (ED)- will be the implementing agency for all the actions and proposed projects proposed in the TAP. They will providing technical and procurement coordination and management of project implementation activities.

The Ministry of Climate Resilience, Environment, Disaster Preparedness, etc (MCRE)- is the focal point for climate change and will interact with the project at various levels, including design and implementation to ensure that climate mitigation issues are adequately addressed when the actions are implemented.

The Grenada Development Bank (GDB)- a publicly owned financial and development institution in Grenada, which provides concessionary financing for development projects. The GDB will be involved with financial based actions in the TAP.

The T. A. Marryshow Community College (TAMCC)- the only publicly financed post-secondary institution in Grenada. The TAMCC is a comprehensive institution offering a wide range of courses and programs including technical programs. The TAMCC will be involved with the capacity building projects as it related to training.

Renewable Energy Companies- these companies currently act as a form of ESCOs as they provide technologies that result in electricity savings. They also provided contracting services for installing and maintaining renewable energy systems.

Grenada Bureau of Standards (GDBS)- responsible for the quality and standards and will play an integral role in leading the related actions for this TAP.

Vehicle dealers and repair technicians and enterprises- vehicle dealers operate a vertically integrated company as they import, sell and provide after sales services for new vehicles. There are number of privately owned repair shops and other individuals that operate in the non-formal sector of the market.

Economic and Technical Cooperation Division in the Ministry of Finance and Economic Development- has the role of coordinating all projects from project design to implementation. The department also has the responsibility for developing full project proposals and serves as the pivot between GOG and potential funding agencies.

Ministry of Finance- responsible for the fiscal policies in Grenada.

Table 26: Implementation plan for EVs- timelines and responsibilities

Actions	**Activities**	**Timelines (Planning to implementation**	**Responsibilities**
Conduct import tax regime, tax concessions and impact study	1.1: Develop terms of reference and scope of works for the study 1.2: Engage a consultant to conduct survey 1.3: Conduct survey 1.4: Implement findings, where appropriate	Sept, 2018 to Dec. 2019	**Ministry of Finance;** GDB; Energy Division; Vehicle Dealers; Consultant
Publish studies on EV performance	2.1: Engage consultant 2.2: Conduct desk survey and other relevant local survey with current EVs 2.3: Document findings 2.4: Develop promotional materials 2.5: Conduct relevant workshops and meetings to promote EVs	Sept. 2018 to Aug. 2019	**Vehicle Dealers;** TAMCC; Energy Division; Economic and Technical Cooperation Division;
Develop a demonstration project for EVs in the government fleet	3.1: Conduct a feasibility study for the project 3.2: Design the project 3.3: Develop TORs and Scope of Works for equipment installation 3.4: Procure and install charging stations powered by PV on government buildings 3.5: Procure EVs for demonstration 3.6: Document project results and best practice, including costings 3.7: Commission system and produce report 3.8: Deliver operations and maintenance manuals, where applicable	Jan 2019 to Dec 2022	**Energy Division;** Economic & Technical Cooperation; Social Development; GRENLEC
Provide tax incentives for car dealers	4.1: Develop terms of reference and scope of works for the study 4.2: Engage a consultant to conduct survey 4.3: Conduct survey 4.4: Implement findings, where appropriate	Sept. 2018 to Dec. 2019	**Ministry of Finance;** GDB; Economic and Technical Division. Energy Division

Actions	Activities	Timelines (Planning to implementation	Responsibilities
Develop a training module for EVs	5.1: Engage key stakeholders on the needs for training 5.2: Design program and identify list of supporting materials, equipment, tools and lab space upgrades 5.3: Procure materials and equipment 5.4: Pilot program with scholarships for participants 5.5: Assess pilot and revise course where applicable	Sept. 2018 to Sept. 2020	**TMACC;** Energy Division; Renewable Energy Companies; Vehicle Dealers

1.1.5.5 Estimation of resources needed for action and activities

Table 26 summarizes the indicative resources and costs for implementing the suggested actions and activities.

The tax researches require the engagement of 2 experts for 15 days each at a rate of US$1,200.00/day for a total of US$18,000.00 for each expert.

The desk survey on the performance of EVs requires the engagement of an expert to conduct the survey same as above (US$1,200.00 x 15 days = $18,000.00).

Workshop support: US$1,500.00

Promotional materials (video, audio and print); US$15,000.00

The demonstration project may include the following resources:

Consultant/expert to carry out several activities for 40 days at US$1,200.00/day for a total of US$48,000. 00. These activities include feasibility study, project design and management.

Procurement and installation of charging stations: US$1.5 to $2.0M, this is a ball park figure and will depend on the number of stations required determined during the feasibility study

Procurement of EVs: US$0.5 to $1.0M, this will also be determined during the feasibility study

The capacity building includes training modules (including a training vehicle); train-the-trainer; curriculum design and training delivery: US200, 000.00

Scholarships for cohort of 20 at US1, 000.00/trainee for a total of $20,000.00

Table 27: Summary of costs and resources for EVs

Actions	Activities to be supported	Total costs (US$)
Conduct import tax regime, concessions and impact study	Expert to implement all activities	$18,000.00
Publish studies on EV performance	2.1: Engage consultant 2.2: Conduct desk survey and other relevant local survey with current EVs 2.3: Document findings 2.4: Develop promotional materials 2.5: Conduct relevant workshops and meetings to promote EVs	$18,000.00 $15,000.00 $1,500.00
Develop a demonstration project for EVs in the government fleet	3.1: Conduct a feasibility study for the project 3.2: Design the project 3.3: Develop TORs and Scope of Works for equipment installation 3.4: Procure and install charging stations powered by PV on government buildings 3.5: Procure EVs for demonstration 3.6: Document project results and best practice, including costings 3.7: Commission system and produce report 3.8: Deliver operations and maintenance manuals, where applicable	$48,000.00 $1.5 to $2M $0.5 to $1M
Provide tax incentives for car dealers		$18,000.00
Develop a training module for EVs	Training materials and equipment Scholarships	$200,000.00 $20,000.00
Total		$2.338M to 3,338M

1.1.5.6 Management planning

Table 28: Contingency plan for EVs

Risk item	Description	Contingency action
Cost of implementation	The costs for implementing the actions and activities above can increase due to factors such as the cost of equipment increasing over time and consultancy fees	The total costs indicated in the summary above contingency margins added to mitigate these risks.

Risk item	Description	Contingency action
	increasing due to inflationary problems	
Implementation of activities takes longer than estimated	Many projects may overrun the scheduled time for implementation due to time delays in delivery of equipment, contracts and non-performance of consultants.	To mitigate this risk, adequate project planning should be instituted especially for the two installation projects. These schedules should include adequate lead times for delivery of imported equipment and ensuring that the critical path on the schedule is identified and managed. Consultants should include locals who are available on-island to mitigate delays that may be associated with international consultants.
Performance risks	LED and high efficiency systems quality can be an issue as many systems are sourced from countries where the quality of such systems range from low to high	To mitigate this risk quality specifications of equipment must be explicitly written into the procurement documents. All terms of reference must include minimum performance requirements and commissioning requirements. The project should also include maintenance manuals for ensuring on-going maintenance of the systems after installation. Additionally it is hoped that the test facilities will be in place to assist with quality testing for any systems procured for the retrofit.

Table 29: Next steps for EVs

Immediate requirements	The key implementation department must be adequately staffed to ensure that the major installation projects can be effectively and efficient implemented. An expert on transportation should be considered as an immediate addition to the Ministry of Transportation to ensure that appropriate measures are in place to deal with the fleet transition.
Critical steps	Key to the success of the EVs diffusion, is the need for regulations and other institutional requirements to ensure that the energy market is ready to accept the diffusion of EVs, this include the appropriate tax regime.

1.1.5.7 TAP overview table

Table 30: TAP overview table

Energy Supply and Consumption							
Transportation							
EVs							
Ambition:	The TAP seeks to up-scale the research conducted by the electricity company (GRENLEC), while contributing to approximately 10% of GHG emissions reduction. The economic viability of EVs will be researched and incentives suggested to support the upscaling.						
Benefits:	1. Carbon footprint of the government fleet of vehicles reduced 2. Cost of operation the fleet reduced 3. Institutional and human skills capacity for operating and maintaining EVs improved 4. EVs are more economically viable enabling their future diffusion 5. PV systems are installed on government buildings not targeted by other projects, thus reducing operations cost						
Actions	**Sources of Funding**	**Responsible Body**	**Timelines**	**Risks**	**Success Criteria**	**Monitoring Indicators**	**Budget for action (US$)**
Conduct import tax regime, tax concessions and impact study	GIZ; World Bank	Ministry of Finance	Sept. 2018 to Dec. 2019	High cost for consultancy Tax reform options cannot be implemented	EVs are more economically viable	Report completed on schedule A favorable option implemented	$18,000.00
Publish studies on EV performance	GIZ; CDB	Vehicle Dealers	Sept. 2018 to Aug. 2019	High cost of consultancy Performance results unacceptable	Report on performance of EV brands completed	Promotional materials developed No of persons using attend workshop No of persons using	$34,500.00

Energy Supply and Consumption							
Transportation							
EVs							
Ambition:	The TAP seeks to up-scale the research conducted by the electricity company (GRENLEC), while contributing to approximately 10% of GHG emissions reduction. The economic viability of EVs will be researched and incentives suggested to support the upscaling.						
Benefits:	1. Carbon footprint of the government fleet of vehicles reduced 2. Cost of operation the fleet reduced 3. Institutional and human skills capacity for operating and maintaining EVs improved 4. EVs are more economically viable enabling their future diffusion 5. PV systems are installed on government buildings not targeted by other projects, thus reducing operations cost						
Actions	**Sources of Funding**	**Responsible Body**	**Timelines**	**Risks**	**Success Criteria**	**Monitoring Indicators**	**Budget for action (US$)**
						promotional materials	
Develop a demonstration project for EVs in the government fleet	World Bank; GIZ; CDB	Energy Division	Jan 2019 to Dec 2022	High cost of consultancy High costs of equipment and EVs Poor performance of charging ports	Fleet of EVs contribute to the reduction in operations cost and carbon footprint	EVs reduce carbon footprint by 10% Operational cost reduced by 10% Drivers are satisfied with the performance of the EVs	$2,048M to $3.048M
Provide tax incentives for car dealers	CDB; GBD	Ministry of Finance	Sept. 2018 to Dec. 2019	High costs for consultancy Options for tax reform	EVs are more economically viable	Report completed on schedule Options implemented	$18,000.00

Energy Supply and Consumption							
Transportation							
EVs							
Ambition:	The TAP seeks to up-scale the research conducted by the electricity company (GRENLEC), while contributing to approximately 10% of GHG emissions reduction. The economic viability of EVs will be researched and incentives suggested to support the upscaling.						
Benefits:	1. Carbon footprint of the government fleet of vehicles reduced 2. Cost of operation the fleet reduced 3. Institutional and human skills capacity for operating and maintaining EVs improved 4. EVs are more economically viable enabling their future diffusion 5. PV systems are installed on government buildings not targeted by other projects, thus reducing operations cost						
Actions	**Sources of Funding**	**Responsible Body**	**Timelines**	**Risks**	**Success Criteria**	**Monitoring Indicators**	**Budget for action (US$)**
				cannot be implemented			
Develop a training module for EVs		TAMCC	Sept. 2018 to Sept. 2020	High cost for training materials High cost for train the trainer	Program designed and implemented	No of persons trained Institution equipped to conduct training No of persons working in the filed	$220,000.00

1.2 Project ideas for energy supply and consumption (transportation)

1.2.1 Brief summary of the project ideas

During brief consultations with key stakeholders it was agreed that a project idea focused on EVs should be considered under the TAP. This project will focus on the deployment and diffusion of EVs and with PV systems for charging to ensure that climate mitigation is achieved. With a number of projects already focused on the supply side of renewable energy, for example the World Bank project that is implementing PV systems on government buildings, the transportation sub-sector has taken a back seat. However, with the focus on transitioning the energy supply sector to one based on renewables, the up-scaling of EVs into the transportation sector can become a key climate change mitigation strategy.

EVs have the potential to reduce on fuel consumption and to smooth the fluctuating prices for diesel and gasoline used to fuel the transportation system. Moreover, the NDC projected a reduction of GHGs of 20% by 2025 from transportation. In this regard, it was previously indicated that EVs were not considered as a possible technology as a climate change mitigation strategy. However, coupled with the GOG's thrust towards energy supply from renewable energy sources, EV has the potential to contribute to GHG reduction. This potential was demonstrated by the project conducted by the GRENLEC, the sole electricity company on the island. It is therefore prudent to consider a detailed project that will further support the diffusion of EVs.

Additionally, the project will also integrate human and institutional capacity development. This will include training of trainers, scholarships for a first cohort of trainees and the provision of training materials and equipment. This equipment will hopefully include a small vehicle that can be used for training demonstration.

The proposed project ides therefore will bring together actions from the PV and EV TAPs, thus demonstrating the utility of the TAPs. In other words this approach can be implemented in the future to develop more projects for funding out of the TAP.

1.2.2 Specific project ideas

Project title: Integrated PV systems and EV plug-in vehicle demonstration project (IPEV Project)

Introduction

This project idea/concept seeks to address the dearth in activity on transitioning the transportation sub-sector to one mainly fueled by renewable energy sources. As the NDC indicates domestic transportation accounts for approximately 40% of GHG emissions into the atmosphere, making the sub-sector the second highest emitter in Grenada. This relatively high emissions is due mainly to the fact that motive power in Grenada is provided by fossil based fuels- diesel and gasoline.

Added to this high carbon footprint is the high prices for these fuels at the pump or on the local market. It was previously shown in the TAP that fuel prices were in the region of US$5.00 per gallon. These high prices are exacerbated by its volatile nature. Due to the dependence on the importation of these fuels, the prices fluctuate, sometimes violently with the prices of these fuels on the international market. As a Small Island Development State, Grenada faces these economic shocks head on. As a result the development or even sustainable development of Grenada is stymied as high outflows financial resources are sent out of the country to support the transportation sector. These resources can be used in other areas of development such as health an education.

This project therefore will seek to demonstrate how vehicles for transportation in the commercial, domestic and institutional settings can be transitioned towards a sustainable sector. In this regard, switching the fuel for transportation to electricity generated from sustainable or renewable energy sources provides an option. The electric vehicle is finding its share on the international market and here in Grenada there is an on-going project that demonstrates the viability of these vehicles. Thus far the project has produced good results that augurs well for the environment and the economy.

As the TNA-mitigation project evolved and during the first approval stage of the TNA report, the TNA committee agreed that EVs should be considered as an option for barriers analysis and for further consideration as a project idea for the TAP. At further meetings with key stakeholders, including the Director for Economic and Technical Cooperation; the CEO of GRENLEC and Energy Division personnel it was widely agreed that a project idea focused on the transportation sector and EVs specifically can add value to the portfolio of project ideas already existing. Some of these existing projects address many of the TAPs, for example a World Bank sponsored project for PV systems on government buildings; the NAMA that is focused on mainstreaming PV; a CDB implemented project for energy efficiency and a GIZ sponsored biogas project. However, these ideas are not dismissed as the TAP can be drawn upon in the future to develop projects related to these technology.

This proposed ‘Integrated PV systems and EV plug-in demonstration project (IPEV project) will attempt to fill the gap and to further upscale the research conducted by the GRENLEC while systematically removing from government owned fleet conventional combustion engine vehicles. Additionally, it is hoped that with this demonstration that the deployment of EVs into the transportation sector in Grenada can occur. It is envisioned that approximately 10% of GHGs can be avoided from entering the atmosphere, while economic measures can be researched and implemented to make EVs more economically viable.

Scope of project

The project shall seek to include at least 10 EVs to the fleet of government vehicles and assess their economic viability and climate mitigation impact. This shall be achieved by conducting

comprehensive research on the operation of the vehicles and the impact of fiscal options to improve the uptake of EVs. PV systems shall be installed where required to ensure that the EVs are powered from a sustainable energy resource. Institutional and human skills capacity shall also be developed.

Objectives

The main objectives of the project idea are to:

1. Add at least 10 EVs into the government fleet of vehicles
2. Assess the economic and environmental viability of EVs
3. Equip a number of government owned building throughout Grenada, Carriacou and Petite Martinique with charging ports for EVs
4. Ensure that adequate power from PV is available to power the charging stations
5. Train a minimum of 20 technician in public and private enterprises to service and repair EVs and maintain PV systems
6. Equip a training institution with necessary training equipment and materials and train at least two trainers to deliver training in the operation and maintenance of EVs

Outputs

1. A minimum of ten (10) EVs added to the fleet of government vehicles
2. Reports on the economic and financial viability of EVs
3. Charging ports installed on selected government building throughout Grenada, Carriacou and Petite Martinique
4. PV systems installed on government buildings where charging ports are installed
5. Twenty (20) technician each, trained to operate and maintain EVs and PV systems
6. A training institution equipped to deliver training to operate and maintain EVs and PV systems

Deliverables

This proposed IPEV project is the first its kind in the public sector of Grenada. As was previously indicated a private company is conducting research into the operations and maintenance of three EVs. It is hoped that this project will upscale this research thus supporting the excellent results received from the private company's research. The Government of Grenada (GOG) owns and operates a number of vehicles to support services such as policing, delivery of supplies and equipment and other general motive requirements. Therefore the government fleet presents an excellent place to further research the sustainable development impacts of EVs.

Therefore the key deliverables from this proposed project idea are socio-economic and environmental. As it relates to the economic outcome, it is envisioned that a comprehensive analysis of economic and financial incentives to increase the uptake of EVs will be delivered. It

is hoped that these incentives can be implemented to increase diffusion potential. In this regard, tax incentives options and fiscal impact will be researched.

The environmental deliverable is grounded in the potential of EVs powered by a renewable energy resource to reduce the carbon footprint of buildings where such sources are installed. In this regard, this project will further demonstrate the climate mitigation potential of EVs. In other words, quantifying the GHGs emissions avoided as a result of the addition of EVs will be considered.

The third deliverable from the project idea concerns institutional and human skills capacity development. It is envisioned that a number of green skilled technicians will be developed, thus improving their capacity to meet the demands for these new jobs as EVs and PV systems are further diffused. Additionally, the training institution will be adequately equipped to deliver this training.

Indicative project implementation plan

Actions	Activities	Timelines	Budget (US$)	Responsible entity
Develop a demonstration project for EVs in the government fleet	Conduct a feasibility study for the project Design the project Develop TORs and Scope of Works for equipment installation Procure and install charging stations powered by PV on government buildings Procure EVs for demonstration Document project results and best practice, including costings Commission system and produce report Deliver operations and maintenance manuals, where applicable	Jan 2019 to Dec 2022	$2,048M to $3,048M	Energy Division; Economic and Technical Coop.
Support the installation of PV systems on additional government buildings	Conduct a comprehensive analysis of appropriate public buildings, including policy stations, Assess the requirements for PV systems and design, including the loads for charging stations for EVs Procure systems (panels; batteries, where needed and balance of system components Install and commission systems Monitor performance of systems (up to 12 months)	Jan. 2019 to Dec. 2022	$7,518M to $10,518 M	Energy Division, Economic and Technical Coop.

Actions	Activities	Timelines	Budget (US$)	Responsible entity
Conduct import tax regime, tax concessions and impact study	Develop terms of reference and scope of works for the study Engage a consultant to conduct survey Conduct survey Implement findings, where appropriate	Sept, 2018 to Dec. 2019	$18,000	Ministry of Finance
Provide tax incentives for car dealers	Develop terms of reference and scope of works for the study Engage a consultant to conduct survey Conduct survey Implement findings, where appropriate	Sept. 2018 to Dec. 2019	$18,000	Ministry of Finance
Develop and implement training module for EVs	Engage key stakeholders on the needs for training Design program and identify list of supporting materials, equipment, tools and lab space upgrades Procure materials and equipment Pilot program with scholarships for participants Assess pilot and revise course where applicable	Sept. 2018 to Sept. 2020	$270,000	TAMCC, Energy Division
Create and implement a full training program for PV systems	Engage key stakeholders on the needs for training Design program and identify list of supporting materials, equipment, tools and lab space upgrades Procure materials and equipment Pilot program with scholarships for participants Assess pilot and revise course where applicable	Sept. 2018 to Sept. 2020	$41,000	TAMCC, Energy Division
	Total Budget		$9,913M to $13,913 M	

Notes: *The indicative timelines are for the implantation of all the activities in the plan; the responsible entities are suggested and other key entities can be involved as the project is developed; the training modules can be integrated into a renewable energy program over time.*

It is envisioned that this project can be implemented over a three year period commencing in 2018/2019. The estimated budget for the project is US$9,919M to $13,913M. One key source of funding for the project is the Green Climate Fund (GCF). If this project finds favor with this fund it may be up scaled to increase the number of vehicles and charging stations in more strategic

locations. An up scaled project may include an expansive green transportation plan which can be implement over time.

Monitoring and evaluation

The following key indicators may be used to measure the success of the project.

- A diffused number of charging at least type 11 charging ports are deployed including in the sister island of Carriacou;
- PV systems are installed to ensure that the charging stations are powered by renewable energy source;
- The carbon footprint reduction in the fleet and buildings where PV systems are installed;
- The number of EVs that are eventually deployed in the market over a two to three period are increased as EVs become more economically attractive;
- The number of persons trained and upskilled to meet the demands of the green economy are increased over time as the training institution is now adequately equipped to deliver new green skills to trainees;

Potential challenges

Key challenges may be encountered with this project; these include:

- Source of funding difficult to achieve as the project may not be attractive to the funding agency or the parameter of the project are not
- EVs may not be capable of meeting all the demands of the government; as heavy duty vehicles such a trucks may not be adequately replaced by EV plug-ins, especially for use on mountainous terrain;
- Cost of EVs on the international market may not be practical at the time of implementing the project;
- Vehicle dealers may oppose the diffusion of the EVs into the market as they pose a challenge to the maintenance arm of their business; this is due to the fact that EVs require little or no maintenance compared to the conventional combustion engine vehicle.

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List of stakeholders

Organization	**Names of persons**	**Designation**
Grenada Electricity Services (GRENLEC)	Mr. Colin Cover	General Manager
Car Dealer	Mr. Crawford	Head of Sales
Economic and Technical Cooperation, Ministry of Finance and Economic Development	Mr. Ruel Edwards	Head
	Mr. Fitzroy James	Immediate pass Head
GREII (PV system provider)	Mr. Earle Roberts	Consultant/Owner
Ministry of the Environment	Mrs. Aria St. Louis	Head of Environment Division
Ministry of Finance and Energy/Energy Division	Mr. Philipp Vanicek	Energy Policy Advisor