GRENADA

TNA- Mitigation

Barrier Analysis and Enabling Framework

Report

April 2018

Disclaimer

Executive summary

The barriers analysis and enabling framework was developed using the guidance from: '*Overcoming barriers to the transfer and diffusion of climate technologies 2nd edition*'. The guide provided a process that emphasizes stakeholder consultation. The process therefore started with a desk top study of relevant country specific and other regional documents, which occurred simultaneously with key stakeholder interviews over a three to four week period. One cumulative workshop was conducted where the final set of barriers and concomitant measures were selected for each of the technologies agreed to under the technology prioritization process. These barriers were screened and decomposed to ensure that the most critical ones were selected. During the workshop it was agreed that all the technologies were market/consumer goods and the market mapping process was used as a tool to aid with the selection of barriers and measures. The barriers were then analyzed under two groups: 'economic and financial' and non-financial barriers.

The technologies assessed were:

1. PV systems
2. Biogas
3. High efficient ACs
4. LEDs
5. Electric vehicles (EVs)

The preliminary objectives for the barrier analysis are premised on the relevant objectives from the climate policy, the NDCs and two key SDGs shown below.

- 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.
- Access climate technologies for mitigation and adaptation along with capacity building and increase external climate fiancé support to Grenada's adaptation and mitigation

The NDCs specifically "… commits to reducing Greenhouse gas emission by 30% of 2010 by 2025, with an indicative reduction of 40% of 2010 by 2030"

Additionally, the GOG also recognizes the important role the Sustainable Development Agenda 2030 and the Sustainable Development Goals (SDGs) that guide the agenda plays in mitigating climate change. The preliminary objectives are further driven by: SDG 7-*ensure access to affordable, reliable, sustainable and modern energy for all*, and SDG 13-*take urgent action to combat climate change and its impacts.* .

The TNA therefore will seek to address these goals and objectives in part. In this regard, by reducing barriers and proposing an enabling framework for the further diffusion of renewable energy and energy efficiency technologies, this process seeks to: increase the share of PV systems and EVs; improve the energy efficiency of buildings through LEDs and high efficiency ACs and increase the share of biogas on farms.

The report then comprehensively addressed the barriers and makes suggestions for the relevant measure that may be implemented to overcome these barriers. For each of the technologies the most critical group of barriers and measures were agreed. Therefore, stakeholders agreed that for EVs; high efficient ACs; LEDs and biogas the economic and financial barriers were most significant. It was generally felt that although the initial cost of PV systems were still relatively high, if the policy, legal and regulatory framework was addressed that these PV systems may become more economically viable. From this perspective, it was agreed that addressing the non-financial barriers for PV will add more value to its diffusion in the market. Grenada has placed significant effort in ensuring that PV systems are diffused and as such has recently agreed (March 2018) to focus its nationally appropriate mitigation action- NAMA on PV. This barrier analysis therefore drew heavily on this work to ensure synergies in suggestions and approach. Moreover, the eventual TAP for PV will seek to support the NAMA ensuring PVs efficient and effective diffusion.

This final sections of this report focuses on an analysis of the linkages that exists among the barriers and the suggestions of enabling frameworks to overcome these barriers. Using the synergies identified through the linkages process three levels of enabling framework inputs were suggested:

Suggested enabling framework inputs for PV systems, high efficient ACs and LEDs (some related inputs for biogas)

The creation of a revolving fund that can be used to provide soft loans to all investors in PV systems, lighting and high AC retrofits. This dedicated fund can be financed by the Grenada Development Bank (GDB) and other financing agencies such as the Caribbean Development Bank (CDB) and the World Bank (WB). Biogas can also be considered. Further incentive schemes that may be employed to provide affordable finance for PV system, ACs and lighting retrofits investments. These include the accelerated depreciation and interest rate drawdown. Establishing energy services companies to absorb with the high up-front cost for investment projects in PV systems, high efficient ACs and LEDs are a critical measure for supporting the diffusion of these technologies.
The NAMA will address the following policy, legal and regulatory issues that will greatly benefit the diffusion of LEDs and high efficient ACs: • Technical assistance and capacity building for the establishment of the Public Utilities and Regulatory Commission Act (PURCA) and training and development for the newly appointed Commissioners; support to further develop appropriate feed-in tariff mechanism for the nature of the market.

Develop a new comprehensive program in ‘sustainable energy systems’, geared towards building the skills at the technical and technological levels that encompasses the technologies addressed here, and including *biogas and EVs*. This comprehensive program will include a suit of courses that can be provided in different modes, as a short course or leading to certification at exit. This enabling input will also address the development of the training institution's capacity to deliver the course.

Additional suggested enabling framework inputs for LEDs and high efficient ACs

There are no import regulations in place to encourage the uptake of high efficient ACs; all systems imported are subject to the same taxes and treatment at the point of importation. High efficiency air conditioners are not subject to VAT exemption. In an attempt to create incentives, a differential tax regime should be put in place, where less efficient systems are subject to higher taxes compared to the high efficient systems. Similarly these systems can be added to the list of VAT exempt technologies and equipment
There is a dearth of energy related standards and codes to assist with diffusion of energy efficient technologies, such as high efficient ACs. Similarly, there is no energy code that suggests or dictates the energy efficiency of a particular building type. Such standards and codes can assist both the end user and the importers of high efficient ACs to make critical decisions on the most affordable and best quality LEDs to achieve energy efficiency.

Suggested enabling framework inputs for EVs

Many officials within government, farmers and other private sector organizations who qualify are granted tax cuts on the import duty for vehicles. These cuts range from 50% to 100%. As a means to encourage the diffusion of EVs, these exemptions can be expanded to include the individuals within the wider population who may wish to invest in an EV. Additionally, many organizations are afforded these tax cuts as part of the policy that encourages their investment. Some of these organizations operate relatively large fleets of vehicles. These organization can be offered a further tax break, say about 20%-25% to encourages the uptake and change-over of fleet vehicles to EVs or other types of vehicles using renewable energy. Alternatively, the government may wish to implement a tax differential based on the type of car imported. For example the taxes on used vehicles are much higher than that of a new vehicle. This higher tax is considered as an ‘environmental levy’ to ensure that the older vehicles are appropriately dealt with at the end of their life. A similar approach can be used, where a high import tax can be imposed on new combustion engine vehicles that have a higher potential to emit carbon dioxide. Here the ‘carbon tax’ may be more attractive to the government.
On the national level, there is a need to provide charging stations powered by renewable energy for charging EVs.

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List of Abbreviations and Acronyms

AC	Air conditioning and refrigeration
DTU	Technical University of Denmark
ESCO	Energy Service Company
EVs	Electric vehicles
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
PV	Photovoltaic
PURCA	Public Utilities Regulatory Commission Act
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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1.1 Preliminary targets for technology transfer and diffusion

The transfer and diffusion of technologies to mitigate climate change in Grenada will be guided by the objectives enshrined in the climate change policy and the Nationally Determined Contributions (NDCs). The overarching relevant objectives from the Climate Change policy are:

- 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.
- Access climate technologies for mitigation and adaptation along with capacity building and increase external climate fiancé support to Grenada's adaptation and mitigation

The NDCs specifically "… commits to reducing Greenhouse gas emission by 30% of 2010 by 2025, with an indicative reduction of 40% of 2010 by 2030"

Additionally, the GOG also recognizes the important role the Sustainable Development Agenda 2030 and the Sustainable Development Goals (SDGs) that guide the agenda play in mitigating climate change. As a result the SDG 7-*ensure access to affordable, reliable, sustainable and modern energy for all*, and SDG 13-*take urgent action to combat climate change and its impacts,* are relevant. The key SDG targets for technology transfer and diffusion are shown in table 1.

Table 1: SDG targets relevant to technology transfer and diffusion in Grenada

SDG #	Relevant targets to technology transfer and diffusion
7	By 2030, increase substantially the share of renewable energy in the global (Grenadian) energy mix
	By 2030, double the global (Grenadian) rate of improvement in energy efficiency
	By 2030, access to affordable, reliable and modern energy services
13	Improve education, awareness-raising and human and institutional capacity on climate mitigation, [adaptation, impact reduction and early warning].

The TNA therefore will seek to address these goals and objectives in part. In this regard, by reducing barriers and proposing an enabling framework for the further diffusion of renewable energy and energy efficiency technologies, this process seeks to: increase the share of PV systems and EVs and thus reduce greenhouse gas emissions (GHGs; improve the energy efficiency of buildings through LEDs and high efficiency ACs and further reducing GHGs and increasing the share of biogas systems on farms.

1.1.1 General approach to barriers selection- a SIDS market view

As a Small Island Developing State, the Grenadian market is generally a technology taker, in that all new technologies are imported into the market or transferred from outside and as such are affected by the market influences external to it. One of the key external factors is the cost of the technology on the international market. Additionally, SIDS markets are generally extremely small and as such suffer from lack of economies of scale. Therefore most of the technologies under consideration are subject to similar barriers.

In this regard, workshop participants were asked to consider in general the barriers that will prevent the transfer and diffusion of the technologies identified by the TNA report: PV- on and off grid; electric plug-in vehicles; high efficiency air conditioners; LEDs and biogas. These barriers were then screened and decomposed. The long list of barriers was selected after screening and decomposition exercises were completed. The long list barriers considered relevant to the entire Grenadian market is shown in table 1.

This list together with results from interviews and questionnaires relevant to the specific technology and using the market mapping technique was used to identify key barriers and possible measures to overcome them for each of the technologies. It was further agreed at the workshop that all the technologies analyzed were consumer goods or goods specifically intended for the mass market, households, businesses and institutions. Key stakeholders through interviews, questionnaires and the final workshop also agreed to the most important barriers for each technology. These are considered in the sections that follow.

Table 2: Long list of barriers for entire RE and EE market

Barrier category	Barrier description
Human skills	Lack of skilled personnel and relevant training to develop skills
	Lack of affordable local experts/consultants or an over reliance on unaffordable local experts
	Inadequate training facilities
Economic and financial	Lack of access to affordable capital- cost of capital and information of source of capital
	Capital in the form of commercial bank loans are much harder to obtain compared to other loans, e.g. for a vehicle
	Cost of maintenance of systems high
	Value of technical skills of local personnel is low
Technical	Lack of energy codes to promote energy efficient buildings
Institutional and organizational capacity	Limited or lack of institutional capacity to monitor and enforce regulations- energy code for energy efficient buildings and monitoring of emissions from vehicles
Information and awareness	Population lacks information on technologies and technology changes occurring hence low uptake of technology
	Lack of awareness by population on the link between climate change and technology

Barrier category	Barrier description
	Cost/benefit analysis of projects not adequately used for decision making
Policy, legal and regulatory	Inadequate regulations for importing new renewable energy and energy efficient technologies
	Lack of differential tariff to encourage high efficient and renewable energy technologies
Network failure	Need for regional body to coordinate energy related issues
	Weak network of connections among actors that are aware of new technologies

1.2 Barrier analysis and possible enabling measures for solar PV- on and off grid

This section describes the barriers analysis and enabling framework that was conducted for the PV- on and off grid technologies. The market mapping technique was used to assist with the selection of barriers and measures. Prior to a one day workshop held on 12 March 2018, that was held to finalize the selection process, a number of stakeholders were interviewed and questionnaires were received. The barriers and measures selection process is fully described in section 1.2.2.

1.2.1 General description

Photovoltaics (PV) is a technology that directly converts solar energy (sun light) into electricity. The output of a PV system mainly depends on the sun light impinging the PV modules or panels. Consequently modules have to be kept clean and unshaded. Another important factor is the PV module temperature; the higher the temperature the lower the output.

Grid tied PV systems feed some or all electricity produced into the public grid. The electricity fed into the grid can replace electricity from other sources like diesel. Grid tied PV systems can be small scale systems on residential roofs, to mainly supply the needs of the household, up to utility scale solar parks owned by Independent Power Producers (IPP) or the utility.

Off-grid PV systems are usually used in areas without interconnection to the public grid. Consequently, they either use some kind of storage technology or an additional backup source to provide electricity when needed or they supply loads/consumers that don’t require a permanent output like a water pump with a reservoir.

There is an extremely high penetration of electricity distribution in Grenada therefore the uptake of PV off grid systems will be minimal. However, the identified barriers and measures can also be considered for PV- off grid systems. To date there are a number of PV systems installed on roof tops and small scale utility type ground mounted PV systems.

1.2.2 Identification of barriers

Using the long list of barriers that were generated from the workshop, participants were asked to use the market mapping techniques to visualize barriers and measures that were critical to the specific diffusion of PV-systems in in the market. This was furthered compared to interview and questionnaire results from personnel from the Energy Division, Ministry of Finance and Energy; a PV contractor and the Grenada Electricity Services (GENLEC). This process resulted in the selection of key barriers shown in table xx and the market mapping result is shown in the appendix.

The stakeholders agreed that although the economic and financial barriers were significant, the non-economic and financial barriers were more significant. In this regard, the stakeholders noted that there was significant uptake of PV systems by both domestic and commercial entities under a net metering inter-connection policy that was offered by the incumbent utility. However, as the policy was adjusted to net billing, the uptake of PV systems declined. From this perspective, stakeholder concluded that the non-economic and financial barriers, and measured required to overcome them should be furthered analyzed.

PV systems were also chosen as a Nationally Appropriate Mitigation Action (NAMA) for Grenada. The NAM therefore was used to guide the analysis so that consistency in barriers and measures can be maintained.

Table 3: List of barriers identified for PV

Economic and financial barriers	Lack of access to affordable capital
	Insufficient/inadequate incentives
	Uncertain financial environment, e.g. current electricity tariff
Non-economic and financial barriers	Inadequate regulations for importing new renewable energy and energy efficient technologies (now under review)
	Lack of appropriate tariff to encourage RETs, especially PV systems
	Insufficient legal and regulatory framework (now under development)
	Need for regional body to coordinate energy related issues
	Weak network of connections among actors that are aware of new technologies

1.2.2.1 Economic and financial barriers

Due to the small market size, PV technology is comparatively expensive in Grenada. The small volumes imported lead to high prices since there is no leverage for negotiations with wholesalers or manufacturers. Additionally, shipping costs are higher with smaller volumes leading to prices for small scale systems ranging between 2,500 US$/kW and 3,500 US$/kW. This is 50 % to 80 % more than in some parts of Europe or the United States.

Furthermore, the lack of experience and appropriate financial products increases cost of capital makes PV systems less viable. High investment costs and cost of capital result in electricity generation cost (levelized cost of electricity, LCOE) between 0.18 US$/kWh and 0.33 US$/kWh. To put this in perspective the current fuel charge is approx. 0.14 US$/kWh and IRENAs global weighted average LCOE in 2017 was 0.10 US$/kWh.

The stakeholders agreed that, despite the initial costs associated with the installation of PV systems for both household and commercial applications, the policy, regulatory and legal framework is one of the most critical non-financial barriers preventing the uptake of PV systems. Additionally, the stakeholders also concluded that the current tariff structure contributes significantly to the poor diffusion rate for PV systems. From this perspective, the recently adapted Nationally Appropriate Mitigation Action (NAMA), focusing on the mainstreaming of PV systems notes: "… the private sector faces constraints towards adopting PV technology due to unattractive financial viability of the technology (due to present policies and tariff). Moreover the NAMA added: the Government of Grenada is not in a position to provide sufficient financial incentives to spur the widespread adoption of solar PV systems.

1.2.2.3 Non-economic and financial barriers

Until recently (August 2016) the electricity market in Grenada was characterized by a vertically integrated private monopoly. The Electricity Supply Act of Grenada 1994 provided the Grenada Electricity Services with a license to generate, supply and sale electricity in Grenada until 2073. Enshrined in this Act was the tariff structure "or statutory rates" which comprise a fuel and non-fuel charge, plus taxes (value added tax and environmental levy). The structure included four "classes" of users: domestic, commercial, industrial and street-lighting and is shown in table 4. The rates are adjusted based on a formula in the Act, and the fuel rate is adjusted based on the rolling average of the fuel charge of the previous three months. The non-fuel change is due annually for possible adjustment.

The current tariff structure shown in table 4 is used across the board and does not encourage energy efficiency or the uptake of renewable energy technologies, including PV systems. However, prior to 2016, the GRENLEC introduced an interconnection policy to encourage the use of renewable energy technologies. The policy utilized a net-metering approach. However this approach was adjusted and the current payment for electricity generated by customers' renewable energy technologies, including grid tied PV system is shown in table 5.

The key barrier lies in the fact that customers perceive the price they obtain for their electricity makes investment under this arrangement unattractive.

Table 4: Electricity rates in Grenada

Charge	Domestic Customer	Commercial Customer	Industrial Customer	Street Lighting Customer
	Domestic	Commercial	Industrial with electric motors aggregate maximum power output rating of 5 or more horse power and are not normally used between 6.00 p.m. and 10.00 p.m.	Government, local authorities for street lights.
Government Charges (VAT)	15% of non-fuel charge after the first 99 units consumed.	15% of non-fuel charge	15% of non-fuel charge	15% of non-fuel charge
Environmental Levy	> 99 kW/h - $0 99-149 kW/h - $5.00 150 kW/h & above - $10.00	NA	NA	NA
Fuel Charge (*effective 6 Mach 2018*)	$0.4199 per kWh	$0.4199 per kWh	$0.4199 per kWh	$0.4199 per kWh
Non-fuel Charge (*effective 1st January 2016*)	$0.4057 per kWh Minimum - $4.00	$0.4375 per kWh	$0.3207 per kWh	$0.3839 per kWh
Floor Area Charge (per 50 sq. feet of floor area)	NA	2 cents (per month)	NA	NA
Horsepower Charge	NA	NA	$2.00 (per horsepower) Minimum - $10.00	NA

Source: *GRENLEC: http://grenlec.com/InterconnectionProgramme.aspx. rates shown in Eastern Caribbean dollars XCD: $1.00 USD = $2.7 XCD*

Table 5: Rates for renewable energy interconnected to the grid

Fixed Rate / kWh (applicable contracts)	0.45
Variable Rate /kWh (applicable contracts) **Based on the average avoided fuel cost in prior year**	
2017	0.24
2016	0.29
2015	0.50
2014	0.56
2012	0.54

Source: *GRENLEC: http://grenlec.com/InterconnectionProgramme.aspx; rates are in Eastern Caribbean Dollars XCD, $1.00 USD = $2.7 XCD*

Using the domestic customer as an example, the total cost of electricity is July 2016, excluding taxes, was approximately XCD $0.7221 (USD $0.2674). While currently and effective March 2018, the rate charges to the customer is XCD$0.8256 (USD$0.3057). Prior to the decline in oil prices on the market, which makes the price of electricity to all customers in Grenada extremely volatile, the rate to the domestic customer was on average XCD$1.025 (USD$0.38). These figures suggest to the majority of customers that the rates they receive for the energy generated by PV systems tied to the grid is unattractive compared to the prices they pay for electricity to GRENLEC. Even under a low fuel charge rate, as was the case in 2016, customers were receiving payments of below what they were paying to GRENLEC under the net billing interconnection policy.

It was the expressed opinion of the stakeholders at the workshop and some of the stakeholders interviewed that policy and legal changes are required to lift this barrier to the diffusion of PV grid tied systems. The GRENLEC reported that since the interconnection policy was launched in 2007, there were 117 customers owning grid tied systems (the majority of which are PV system). Secondly there are reports of some PV systems installed outside of the interconnection policy. It may be concluded therefore, that with a new enabling policy and legal framework and regulations, that the pricing mechanism for grid tied PV systems can become more attractive. This measure can also result in attractive projects to assist mainly domestic customers who cannot afford the investment in small scale grid tied PV systems.

As was mentioned previously, the Government of Grenada is constrained in offering financial and economic incentives to the uptake of PV systems. However, the GoG has provided some incentives through the exemption of Value Added Tax (VAT), which is currently 15%, on PV panels, inverters and deep cycle batteries.

1.2.3 Identified measures

The GOG has since put in place the necessary measures to rectify the policy, legal and regulatory and barrier and in general other non-financial barriers to the diffusion of PV systems and other renewable energy technologies for electricity generation. In this regard, the Electricity Supply

Act 1994 was repealed and replaced by the Electricity Supply Act of 2016. This new Act set out the legal framework to introduce competition into the market and to promote independent power producers or IPPs. However, the necessary regulations are not in place as yet, including the new Public Utilities Regulatory Commission Act (PURCA) that will be charged with setting prices for electricity generated by licensees under the new Electricity Supply Bill 2016. The PURC will also have the authority for developing appropriate feed-in tariffs for electricity generated from renewable energy technologies including grid tied PV systems.

The NAMAs for Grenada has identified a number of measures that can be put in place by the GOG to address this critical barrier. This report therefore will draw on the proposed measures to ensure that there is cohesion in approach and to hopefully build synergies between proposed projects. In this regard, the measures suggested are adapted from the NAMA.

1.2.3.1 Economic and financial measures

The economic and financial barriers identified, although not considered as the main barriers to the transfer and diffusion of PV systems need to be considered for effective and efficient uptake of the technology. In this regard, one of the most recent and comprehensive analysis this far is enshrined in the NAMA for Grenada, which is focused on solar PV. Thus the suggested measures proposed in table 6 are adapted from the NAMA.

Table 6: Economic and financial measures

Economic and financial	• 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 loansTax incentive e.g. accelerated depreciation to attract investment in solar PV in the private commercial sector

Source: *Adapted from Grenada' NAMA, 2018*

The measures suggested by the NAMA (Table 6) align with the barriers identified above, see Table 5. In this regard, the NAMA suggests two incentive schemes that may be employed to provide affordable finance for PV investments. These include the accelerated depreciation and interest rate drawdown. The first incentive is intended to reduce on the taxes paid early in an investment. This reduction should accrue to more savings for the investor, especially commercial investor in for example the tourism sector. The second option: interest rate drawdown may be attractive to the individual household. In this regard, someone wishing to investment in a small scale PV system will only pay interest on the portion of loans approved for the project. This should accrue to savings for the individual as they may only be required to finance the portion of the loan that they actual use for the project.

These two (2) measures will work in conjunction with an evolving fund that can be used to provide soft loans to all investors in PV systems. This dedicated fund can be financed by the Grenada Development Bank (GDB) and other financing agencies such as the Caribbean Development Bank (CDB) and the World Bank (WB). The NAMA makes reference to the following:

Under the NAMA project a dedicated revolving fund would be created to provide loans for solar PV. This will be done while working with a number of partners, including the Ministry of Finance, Grenada Development Bank (GDB). GDB has some funds (about USD 0.5 million) available from the Caribbean Development Bank which could be leveraged to provide loans at lower rate of interest for implementation of solar PV projects. Under a tripartite agreement between GDB, Caribbean Community Climate Change Centre (5Cs) and the Ministry of Finance, USD 1.6 million can be made available (0.4 million grant plus 1.2 million matching fund by GDB) which can also be leveraged for creating the proposed fund for financing solar PV installations.

Already it appears that the issue of financing for PV systems has been addressed. In this regard, the TNA can lend further support to this effort through its final Technology Action Plan (TAP) for PV systems.

The establishment of ESCOs (Energy Service Companies) is also a novel approach to dealing with upfront financing and the issue of incentives. In this regard, the ESCO provided the financing and is paid by the savings that the client experiences. The ESCO can also be afforded the incentives previously outlined above, thus providing more incentives to the end-users of PV systems.

1.2.3.2 Non financial measures

The measures shown in table 7 are all adapted again from the NAMA. All the measures are listed for completeness, but not all will be discussed in this report. In other words, those that the stakeholders felt are most significant, which is policy, legal and regulatory will be treated in detail.

As was mentioned in the barriers section above (section 1.2.2), the necessary amendments for creating a more favorable electricity market are in train. The new Electricity Bill is law. However, as note in the measures table 7, there is still work to be done to address the issues of regulations. These regulations include ones that govern feed-in tariffs, grid management and other issues of license agreements for IPPS and other individual users of the grid. These issues are been addressed by the NAMA and as such opportunities to support this further under the TNA will be addressed under the TAP.

The other institutional/organizational, technical, networking and human skills barriers are also considered under the NAMA and are self-explanatory in table 7. To the extent that these barriers will be considered further will be addressed in section 1.7 and again in the proposed TAP for PV and other related technologies, for example high efficient ACs.

Table 7: Non-financial measures for PV systems

Barriers to be addresses	Proposed measures
Policy, legal and regulatory	• There is a need for further technical assistance and capacity building for the establishment of the Public Utilities and Regulatory Commission Act (PURCA) and training and development for the newly appointed Commissioners. • Support is required to further develop appropriate feed-in tariff mechanism for the nature of the market • Detailed regulations and secondary legislation in support of a new 'Electricity Supply Bill'. Draft Regulations have been already being developed together with the PURCA. Reasonable drafts are available for issues like tariff setting, supply and service. • Regulations on generation expansion and licensing need additional revision to be done • Select and implement financial incentive schemes(e.g. feed-in tariffs, grants) for the initial set of PV system initiatives • Schemes for tax incentives (e.g. accelerated depreciation) to attract private sector investments for solar PV • Regulation to govern the use of the current grid system which is owned by the GRENLC under the new legal framework of the Electricity Supply Act 2016.
Institutional and organizational capacity	• Capacity building of private sector players to establish solar PV supply chain. • Development of curriculum and introduction of a technical course on solar PV at the TAMCC and other training institutions. This will provide training on installation, operation and maintenance of solar PV systems. Training of the initial set of trainers will be required to deliver the proposed training. • The deployment of equipment to support the intended curriculum at the TAMCC • Training and technical support for financial institutions on assessing solar PV projects
Human skills	• Capacity building of the government stakeholders and policy makers on solar PV technology, its potential and advantages • Training of staff from government agencies, development banks, and private banks in assessing / developing

	financial incentives for solar PV and other RET projects
Networking	• Knowledge sharing and dissemination within Grenada and across the Caribbean region
Technical	• Assessment of the capacity of the power distribution grid to absorb solar PV based power at different locations and assessment of the needs for up-gradation of the grid. • Collection of solar irradiation data and preparation of solar map of Grenada

Source: Adapted from NAMA, 2018

1.3 Barrier analysis and possible enabling measures for biogas

1.3.1 General description

Biogas is the product of an anaerobic (without air) process that breaks down biodegradable matter. Various types of microorganisms are involved in the process that finally produces biogas, a mixture of methane and carbon dioxide. Methane is also the main ingredient of natural gas. The methane when oxidized (burned with air) releases thermal energy that can be used for heating and cooking or when burned in a gas engine can produce electricity or propel vehicles. Biogas can be compressed for storage and transportation and it can be purified to increase the methane content to achieve natural gas quality. However, this only makes sense on a large scale as the process is energy intensive.

Methane has a very high global warming potential, which is 28 to 33 times higher than that of carbon dioxide. When burnt however, it becomes carbon dioxide. Since the organic matter can only release as much carbon (dioxide) as it previously took from the atmosphere, it is considered climate neutral and a form of renewable energy. This however, only applies if no more than 3 % to 4 % of the methane leaks from the closed system to the environment.

Digesters and fermenters, in which the biogas is produced, are available in all sizes making the actual production of biogas scalable. Certain utilizations however, are bound to minimum sizes in order to be economic. Gas engines and generators for example are not economic with small scale systems.

1.3.2 Identification of barriers

The key barriers to biogas system uptake, especially for small scale farmers as identified through a current project sponsored by the GIZ. The project sought to determine the market factors that will be necessary for the wide diffusion of biogas as an alternative source of energy for use on animal rearing farms. In this regard, many barriers were discussed and the main barrier identified was that of economic and financial. There were other non-financial barriers however that will need urgent attention if the financial barriers are eventually overcome. The market mapping exercise was also use to visualize key barriers and potential measures to overcome them. The barriers are shown in table 8.

Table 8: Barriers to the diffusion of biogas

Economic and financial barriers	High up-front cost of commercial type systems
	High operational and maintenance cost due to the labor intensive nature of operations
Non-economic and financial barriers	Taboo about nature of the gas generated from waste of animals
	Small size of waste input to make some systems viable
	Labor intensive nature of the system requiring commitment to provide feed stock to the system
	Lack of awareness on the commercial viability of biogas systems

1.3.2.1 Economic and financial barriers

The economic and financial barriers were identified as the more significant barriers preventing the diffusion of biogas systems. This was articulated by the key project stakeholders and agreed to be the participants at the workshop. In a report conducted by the GIZ which commissioned and conducted the pilot project, preliminary financial analysis revealed that the payback period for small scale biogas systems ranged between 6.7 years to 0.5 years on average. The study results on payback period and monthly savings are shown in Table 9.

Table 9: Range of possible payback periods by farms for potential biogas systems

Organic producer	**Savings/month (XCD)**	**Savings/month (~USD)**	**Payback (years)**
A	$205.00	$76.00	2.4
B	$259.00	$95.00	1.9
C	$74.00	$27.00	6.7
D	$192.00	$71.00	2.6
E	$259.00	$95.00	1.9
F	$1,025.00	$379.00	0.5
G	$820.00	$303.00	0.6
H	$641.00	$237.00	0.8

Source: *Adapted from GIZ report*

The wide disparity in range of savings and payback period may be attributed to the initial quantity of LPG consumed by the farms or the nature of fuel used, for example wood fuel (biomass). For example, organic producer C which has the highest payback period of 6.7 years consumes approximately 33 lbs of LPG; while producer F with the lowest payback period consumes about 800 lbs of LPG.

The report further proposed three (3) business models, which included the same initial investment of about XCD$6,000.00; and included the sales of the digestate as organic fertilizer. In these scenarios, the payback period ranged between 4.5 and 0.5 years. The upper range was the scenario in which the consumption of LPG was the lowest. This means that the savings on LPG was not significant and therefore the return on investment will take a longer period.

The high upfront costs therefore can be off-set in certain cases and this will require careful consideration of the demand for the biogas, the current fuel type used and quantity and quality of the waste generated by the farm. LPG varies in price on the market and is sold in three (3) forms: a 100 lb cylinder; a 20-lb cylinder and by bulk. Most of the farms surveyed use the 100-lb cylinder. The average price of the 100-lb cylinder in 2014 was XCD$258.62 (USD$93.00). This relatively high priced commodity lends itself to making biogas economic viable option for producers of high quantities of organic waste.

Additionally, biogas production can be labor extensive and as such can be a relatively costly endeavor. These systems require regular feeding of the system and stirring; regular withdrawal of the digestate from the system and other regular maintenance issues to ensure the most efficient production of the biogas. In this regard, the labor cost associated with the system can be higher than compared to the use of LPG or even using biomass, such as wood especially for poultry and meat production for which the biogas use is intended. This cost can also serve as a barrier that needs consideration when a biogas system is contemplated.

1.3.2.2 Non-financial barriers

There are some key non-financial barriers that need to be considered if biogas will be diffused effectively in the market. Firstly, there is a taboo about biogas as its production is linked to the source of the waste that is used to generate it. For example, some people are of the opinion that the gas produced from say pig waste is unhealthy and unsafe for use in the kitchen. This is a very critical barrier as it can hinder the uptake of an affordable source of energy for communities and individuals who may be energy impoverished.

The limited quantities of the waste stock may also be a barrier, in that this can affect the efficient functioning of the system. In this regard, the small quantities of waste stock and the possible infrequent generation of this stock can adversely affect the production of biogas. This may not be favorable with stakeholders as lack of consistency in biogas will hinder the work flow of cooking and other activities that the gas is used for.

There is an opinion that biogas systems require constant attention to endure that they function. In the case of LPG, end-users simply attach a cylinder to the stove or other equipment and the cylinder only needs to be changed when the LPG. In the case of biogas production, waste has to be fed often, the system needs to be agitated to increase gas production, the waste has to be collected and stored and from time-to-time the system need to be cleaned of the solid particles. This may contribute to making biogas production less attractive for conventional end-use such as cooking, since it appears to be more labor intensive.

The final barrier identified is one of lack of awareness on the commercial viability of biogas. In this regard, stakeholders and end-users are not adequately informed on the benefits of using biogas as opposed to the LPG that is very well known. Thus stakeholders may be hesitant to invest in this technology as it appears to be commercially unattractive.

1.3.3 Identified measures

The measures identified to overcome the suggested barriers were simultaneously selected and debated at the workshop and in interviews with a key stakeholder. The market mapping process also assisted with the process. The identified measures are shown in Table 10.

Table 10: Measures to overcome barriers to biogas diffusion

Economic and financial barriers	Create soft loan facility for farmers' access
	Conduct productivity study to analyze how labor intensity can be reduced
Non-economic and financial barriers	Build awareness on the nature of the gas generated from waste of animals among workers
	Appropriately size systems for waste feed stock
	Conduct productivity study to analyze how labor intensity can be reduced
	Publish results of current project and use for training future investors

1.3.3.1 Economic and financial measures

Soft loans will be an important measure to assist with the diffusion of biogas technologies. These technologies will be generally small scale and can be locally constructed or small scale commercial systems imported. One project report suggests that investment required for the importation of a small unit can range between XCD$4,500.00 to $5,000.00, with a further XCD$1,000.00 required. Therefore an installed cost may range between, $5,500.00 to $6,000.00. Such an investment and up to about XCD$10,000.00 can be considered to be a soft loan and the intent of such a loan should lend itself to lowered interest rates. The financial incentive of accelerated depreciation and interest rate drawdown can be applied.

As shown previously in section 1.3.2.1, the payback period for investments in biogas systems is very attractive. In this regard, the financial institutions, especially the Grenada Development Bank (GDB) may be interested in supporting such investments. Additionally, there is an institution that provides micro-financial services. Micro-finance was conceived to assist such small scale investments that will provide socio-economic and environmental benefits in the long run.

1.3.3.2 Non-financial measures

The non-financial measures associated with biogas range from societal misconceptions on the nature of the gas to that of the awareness on the economic benefits that can be obtained from investing in biogas. Firstly, many stakeholders feel that biogas is a messy gas that should not be used for cooking and other activities associated with food. This misconception can be allayed through careful and convincing information sharing and through visits to existing sites where the gas is actually been used. The evidence is real on such sites as the natural gas produced reveals no such smell. On the other hand though, workers on the farm have a taboo of dealing with such a system where waste has to be fed into the system almost daily.

Workers on the farm see the process of feeding a biogas system with waste as extra work that needs extra compensation. This can be addressed through effective productivity surveys to see where savings in time and effort by workers can be reduced. In other words, the gathering of waste feedstock and the eventual feeding can be done more efficiently and effectively. On small farms where the feedstock is minimal, then this work will not significantly increase costs. In many cases it is now about changing what is done with the waste after pens and plots are cleaned.

It is now possible to invest in appropriately sized commercial grade biogas systems or to construct custom made systems. By so doing, systems can be optimized for the size for the farm, thus providing efficient use of the system. This will also ensure that the load or end-use of the gas can closely match the quantity of the gas produced. The sizing and eventually close matching of supply to end-use will be critical to the success and economic viability of investments in small biogas systems.

There are a number of demonstration projects occurring in the market. However, the results of these projects are not widely known or disseminated. In this regard, measures can be put in place that project results be published in user friendly formats, such as information brochures to be used for marketing processes. Additionally, workshops and seminars should also be held to impart the knowledge and skills gained from these projects. Moreover, visits and hands-on training and demonstration of these projects should take place regularly to ensure that potential investors have a comprehensive understanding of the nature of biogas systems.

It must be noted that an important stakeholder in this regard is the financial institutions that are involved with soft loans. Personnel in these institutions should be made aware of the intricacies of these systems and the reasons for not having this as just-an-another investment. For example, an understanding of the dedication required to operate the system, can greatly assist financial personnel with understanding how the system functions and how profits are accrued from biogas systems.

1.4 Barrier analysis and possible enabling measures for high efficiency ACs

1.4.1 General description

High efficiency air conditioning systems (ACs) can be defined as technologies that have the potential to reduce energy consumption, while providing a high quality of service (heating or cooling). In tropical countries such as Grenada, refrigeration and air-conditioning or RAC systems are mostly used for cooling buildings, industrial refrigeration and other commercial refrigeration applications, such as in supermarkets. In the context of this fact sheet the following high efficiency applications are considered: inverter technologies and high efficient refrigerants with low global warming potential.

- Inverter technology constantly regulates the speed of the compressor so as to continually maintain the temperature. With this approach the energy used is reduced as the motor consumes less current, while the temperature for the application, for example comfort cooling is maintained.
- Many refrigerants or the substances used to remove the heat from a space, have high operating efficiencies. For example, hydrocarbons, which are known as natural refrigerants are more efficient than other commercially used refrigerants.

1.4.2 Identification of barriers

The barriers identified in the section were done through interviews and at the stakeholder workshop. The market mapping process was also done to assist with the identification of barriers and the measures, agreed to by a significant market player.

Table 11: Barriers to the diffusion of high efficiency ACs

Economic and financial barriers	High up-front cost of ACs
	Inadequate regulations for importing new renewable energy and energy efficient technologies, including high efficient ACs
	Lack of differential tariff to encourage high efficient ACs
Non-economic and financial barriers	Insufficient institutional capacity to provide training (safety issues with the hydrocarbon technologies)
	Lack of energy codes to promote energy efficient buildings

1.4.2.1 Economic and financial barriers

High efficient air conditioners, both technologies that use the inverter type motors/compressors and hydro-carbons are slightly higher in initial cost than the less efficient technologies. For example, a 4-ton split unit that uses an inverter costs about 20% more than a system of comparable size without the inverter compressor. On the other hand the units that use the more efficient hydrocarbon gases are not yet on the market, but as a relatively new technology on the market, the prices may fall in a similar range to that of the inverter type air conditioners.

However, both technologies have shown to result in energy consumption savings to the end users, ranging between 20% and 30% and maybe as high as 40% some cases. Using a small 1 RT (refrigerant ton) or 12,000 Btu/h unit as an example, estimated savings of approximately 25% can be achieved if a low efficient AC is replaced with a high AC system (inverter system). These savings were calculated using the current electricity rate of XCD$1.00 (USD$0.37). The estimated payback period was calculated as 3.3 years. Such an investment appears to be attractive, although the upfront cost may still be a challenge to some investors.

It must be noted that with Grenada's ratification of the Montreal Protocol and the development and implementation of the hydrofluorocarbon phase-out and management plan (HPMP) the prevalence of less efficient technologies, including hydrofluorocarbons, on the market has declined.. Concomitantly, the market is now trending towards inverter technologies for air conditioning in both the commercial and domestic sectors. This augurs. well since customers are now fully onboard with this 'not-so-new' technology.

The issue of differential tariffs links to the fact that consumers/end-users who are embarking on energy efficiency are still allowed to pay the same tariff as end-users who do not make that investment. In other words, the end-users who consume more electricity by using less efficient air conditioners pay the same rate as those who consume less electricity by using high efficiency ACs. The possibility of a tariff that considers a demand charge based on the load of the consumer will be discussed under the section on measures.

There are no regulations in place to encourage the uptake of high efficiency ACs; all systems imported are subject to the same taxes and treatment at the point of importation. High efficiency air conditioners are not subject to VAT exemption, similar to that of PV system components and to LEDs. In an attempt to create some incentives, it was proposed in the HPMP that a differential tax regime should be put in place, where less efficient systems are subject to higher taxes compared to the high efficient systems. The rationale being that the higher taxes will serve as a disincentive to the importation of less efficient system. This suggestion has not borne fruit to date and can be proposed here as a possible measure to assist further with uptake of high efficient ACs.

1.4.2.2 Non-financial barriers

There is a dearth of energy related standards and codes to assist with diffusion of energy efficient technologies, such as high efficient ACs. Similarly, there is no energy code that suggests or dictates the energy efficiency of a particular building type. Such standards and codes can assist both the end user and the importers of high efficient ACs to make critical decisions on the most affordable and best quality LEDs to achieve energy efficiency.

The hydrocarbon AC technology requires careful and deliberate safety training of technicians, installers and handlers of these systems. Hydrocarbons are extremely flammable and as such extreme care must be taken when these systems are installed and serviced. Therefore, institutional capacity to deliver training and the use of qualified trainers may be insufficient in the current context of the market. In other words there is some training occurring, but more capacity building will be necessary to fully serve the market as this technology begins to become wide-spread in the market.

1.4.3 Identified measures

The measures proposed in this section were suggested and selected during the interviews and the stakeholder workshop. The market mapping process was also used to assist with the selection.

Table 12: Measures to overcome the barriers to the diffusion of high efficient ACs

Economic and financial measures	Encourage government to reduce further on import taxes
	Establish Energy Service Companies to provide upfront investment funds
	Develop policy and regulations for the diffusion of high efficient ACs as an energy efficiency measure, energy standards/codes
	Determine feasibility of developing a demand charge of energy efficient measures
Non-economic and financial measures	Develop capacity (training institutions and curriculum) to deliver training for hydrocarbon technologies

1.4.3.1 Economic and financial measures

The GOG may not be in a position to institute further policy and regulations that will provide the necessary foundation for encouraging the diffusion of high efficiency ACs in particular and this may be a common issue that will be considered further in sections 1.7 and 1.8. However, through possible projects, funded by grants or soft loans, low interest loans may be established and made available for certain important sectors, such as tourism. The Government of Grenada has already embarked on such a project, and this can be replicated.

Establishing energy service companies (ESCOs) are a critical approach to assisting with the uptake of high efficiency ACs. Like the measure suggested for PV, these companies will normally provide the initial capital for the investment and are paid through the accrued savings as a result of this investment. The functioning of ESCOs however, requires effective monitoring and verification of savings and an upfront protocol for so doing. ESCOs can be funded by grants or soft loans in the initial stages and once established they can function from the profits made from energy savings project. They can also benefit from the financial incentives, of accelerated depreciation and tax rate draw-downs similar to that proposed for PV systems.

The establishment of ESCOs was already proffered as a critical measure for the diffusion of PV systems. This can be expanded through the TNA to include high efficiency ACs, for relevant PV projects thus reducing on the load of the PV system for the proposed projects. This will be further discussed in sections 1.7 and 1.8.

A demand charge for encouraging persons to save electricity through high efficiency ACs can be effective for enabling the uptake of these technologies. However, this also hinges on the need for a study to understand the tariff structure and to also adjust, if necessary and practical. Demand charges will require some infrastructural development to measure the demand and to then be able to use it to calculate electricity rates. This will therefore require a project to analyze the feasibility of implementing this measure in the future.

1.4.3.2 Non-financial measures

To further encourage the uptake of high efficiency ACs, energy standards and codes can be very important. The Grenada Bureau of Standards is currently embarking on implementing this measure through a regional project that is looking at labeling standards for air conditioning systems. Additionally, the project is considering codes for energy efficient buildings. At the end of this project therefore the region (CARICOM) may have minimum energy consumption standards, and high efficiency ACs will play a critical role in achieving these standards in both existing and new buildings.

The training and development of AC technicians and contractors, who are involved in the design, installation, operation and maintenance of high efficiency AC technologies that use the flammable hydrocarbon substance, will require specialized training. To achieve this necessary training in safety, the facilities for training, the curriculum used for training and the qualification of the trainers will need to be boosted. This measure therefore will consider further strengthening of the training facilities and trainers at the T. A. Marryshow Community College (TAMCC) and other smaller training facilities. This will be done in conjunction with the National Ozone Unit (NOU) at the Ministry of Energy and Finance, which has already started training in this regard. The unit is also embarking on demonstration project to assist with the uptake of this technology in particular.

1.5 Barrier analysis and possible enabling measures for LEDs

1.5.1 General description

Light emitting diodes (LED) are semiconductors that transform electricity to light in a very efficient manner. Invented in 1962, it took LEDs more than forty years to advance from a niche application to a mainstream light source. Due to their superior efficiency, their longevity, their low environmental concerns, their variability in regard to size (accumulation of diodes), color, and intensity, LEDs have become the fastest growing lighting technology. In 2017 approx. 12 % of all lights installed globally and more than 25 % of newly sold lights have been LEDs. This makes LEDs the only technology with increasing sales numbers while sales of all other technologies are either stagnating or decreasing.

In addition to the undisputed efficiency of LEDs, longevity is often an issue. Depending on the quality of the semiconductor material, the assembly, the environmental conditions (temperature and humidity) as well as the quality of electric supply, LEDs can last up to 100,000 hours of operation; in contrast, incandescent light bulbs usually only last 1,000 hours. However, complaints have been made that normal consumer type LEDs don't fulfill the expectations. Two different types of LED failure have been identified. One is the complete failure of the device, which is usually an assembly problem, and the other one is the reduction of efficacy as a result of the degradation of the semiconductor. Even cheap semiconductors should allow for a lifetime of 10,000 to 15,000 hours of operation. Lifetime in this case means that the devices still emit 50 % of their nominal value. Completely failing devices on the other hand are an indication of either deficient assembly or serious issues with the quality of electricity. This said, customers should be informed and look for certifications and manufacturer guarantees.

1.5.2 Identification of barriers

The barriers identified in the section were done via the market mapping process at the workshop. Consultant knowledge of the market was also used to create the barriers list. The market map in the appendix provided a visual of the market, from which some of the barriers and measures were confirmed.

Table 13: Barriers to the diffusion of LEDs

Economic and financial barriers	High up-front cost of LEDs compared to other lamps
	High cost for retrofitting existing lighting systems, especially change over from fluorescents to LEDs
	Inadequate regulations for importing LEDs
	Lack of differential tariff to encourage high efficient and renewable energy technologies
Non-economic and financial barriers	Poor quality of LEDs
	Lack of standards/energy codes to promote energy efficient technologies in buildings

1.5.2.1 Economic and financial barriers

Currently, standard LED bulbs are available in Grenada at costs between 15 XCD and 40 XCD. Consequently, when compared to incandescent light bulbs they are quite expensive. Furthermore, it has to be assumed that the cheaper once are of lower quality.

However, due to their lower consumption and longer lifespan, lifecycle costs of LEDs are unbeaten. Lifecycle cost means the overall cost including consumption and replacement. For example: a quality LED may cost 40 XCD. It will last 15,000 hours of operation and consume

105 kWh or at today's electricity tariffs 94.50 XCD. Hence the lifecycle cost is 134.5 XCD. An incandescent only costs XCD$2.00. However it will only last 1,000 hours. Consequently you need 15 of them. Furthermore those 15 bulbs will consume 900 kWh costing 810 XCD. The comparable lifecycle cost is 840 XCD.

Depending on quality and price of LEDs their lifecycle cost is between 75 % and 90 % lower than that of incandescent bulbs and between 30 % and 70 % of fluorescent devices.

Another project that was conducted in the Organization of Eastern Caribbean States (OECS) compared the economic benefits of using LEDs to that of energy savers such as fluorescent and compact fluorescent lamps (CFLs). The comparison revealed that the LEDs have an overall annual life cycle cost of approximately XCD $10.50 (USD$4.00). Table 14 shows the comparison.

Table 14: Comparison of incandescent, CFLs and LEDs lifecycle cost

Indicators	Incandescent bulb	CFLs	LEDs
Life time in total (and in years assuming 4 hours usage per day)	1,000 hours (0.7 years)	9,000 hours (5.5 years)	25, 000 hours (17 years)
Approximate initial cost (XCD)	$1.00	$15.00	$30.00
Electricity cost over the lamp's lifetime (using Approx. XCD$1.00/kWh) (XCD)	$40.00	$88.00	$160.00
Average annual lamp cost, including lamp and energy cost (XCD)	$58.57	$18.73	$10.59

Source: *Adapted from www.ecelp.org flyer*

The lifecycle cost for LEDs certainly supports the economic viability of using LEDs. However, the initial cost needs to be considered if the market is to find them initially attractive, especially to persons at the lower income level. Like PV systems, LEDs are listed as exempt from VAT (15%). To the extent that the Government of Grenada has the fiscal space to reduce taxes further will be discussed in subsequent section of this report.

Secondly, a significant percentage of households and commercial consumers have fluorescent and other types of higher energy users installed on their facilities. As it specifically relates to the fluorescent fixtures, these can be retrofitted to accept LED bulbs. However, one stakeholder indicted that the cost of retrofitting, especially a large commercial facility can be costly. In this regard, the balance between retrofit and total replacement needs to be considered. The cost of this will vary with facility size, as it relates to the number of fixtures to be retrofitted or replaced. The company that did made the decision, decided for total replacement. There is also the option to replace incrementally, that is as bulbs and fixtures need replacement, that they are replaced with the LED bulbs and fixtures, where required.

Another financial and economic barrier preventing the diffusion of LEDs relates to insufficient incentives to encourage the uptake of LEDs. As it relates to the case of insufficient regulations for imports, it was already noted that the Government of Grenada is already offering incentives for importation in the exemption of these items from VAT. To the extent that further exemptions and reduction in taxes can be afforded by the GOG will be addressed in the section on measures.

Like high efficiency ACs, the issue of differential tariffs relates to the uptake of LEDs. Similarly, end-users who are embarking on energy efficiency are still allowed to pay the same tariff as an end user who does not make that investment. In other words, the end users who consume more electricity by using less efficient light bulbs (incandescent) pay the same rate as the end user who consumes less electricity by using LEDs. To the extent that a tariff that considers a demand charge based on the load of the consumer can be put in place, will be discussed under the section of measures.

1.5.2.2 Non-financial barriers

Two key non-financial barriers were identified: the potential failure of LEDs, which may be due to the poor quality of the LEDs and the LED fixtures that support them and the lack of standards testing facilities to support the importation of high quality LEDs.

The issue of quality was also proffered as a non-financial barrier. In this regard, the possibility of importing poor quality LEDs was of major concern. As shown in the market map, stakeholders felt that the testing of quality of LEDs and their fixtures was lacking and providing this service will be required to assist importers and consumers to make the right choices on the LEDs to import and purchase. The Grenada Bureau of Standards and other regional standard bodies were involved in a project that provided support to achieve this outcome. This measure will be further discussed under measures to be addressed in this section.

There is a dearth of energy related standards and codes to assist with the diffusion of energy efficient technologies, such as LEDs. Similarly, there is no energy code that suggests or dictates the energy efficiency of a particular building type. Such standards and codes can assist both the end user and the importers of LEDs to make critical decisions on the most affordable and best quality LEDs to achieve energy efficiency.

1.5.3 Identified measures

The measures that can be put in place to encourage the uptake and diffusion of LEDs and their fixtures are summarized in table 15. These measures were generally agreed to by the stakeholders, through interviews and workshop.

1.5.3.1 Economic and financial measures

As was presented previously, the GOG may not be in a position to institute further policy and regulations that will provide the necessary foundation for encouraging the diffusion of LEDs in particular and this may be a common issue that will be considered further in sections 1.7 and 1.8. However, through possible projects, funded by grants, low income families may benefit from the uptake of LEDs in the future. The Government of Grenada has already embarked on such projects, and this can be replicated.

Table 15: Suggested measures to overcome barriers to LEDs

Economic and financial measures	Encourage government to reduce further on import taxes
	Conduct comprehensive study to determine most feasible approach for retrofits
	Establish Energy Services Companies (ESCOs) to provide upfront investment funds
	Determine feasibility of developing a demand charge of energy efficient measures
Non-economic and financial measures	Develop a policy and regulations for the diffusion of LEDs as an energy efficiency measure,
	Further develop the test facilities for quality control at the Bureau of Standards and develop/adapt/adopt energy efficiency standards and codes

The feasibility of embarking on a lighting retrofit for existing buildings can be project specific and is based on size of building-directly affecting number of fixtures; the type of fixtures and the use of the building. Therefore, undertaking a comprehensive cost analysis to determine the best approach for a lighting retrofit may be difficult and can send an erroneous message to building owners and users wishing to do so. This measure therefore is suggesting that a cost analysis to determine the most cost efficient manner for a lighting retrofit should be project specific. For new building a similar approach can be used to that shown section 1.5.2.1.

Establishing energy service companies is a critical approach to assisting with the uptake of LEDs. These companies will normally provide the initial capital for the investment and are paid through the accrued savings as a result of this investment. The functioning of ESCOs however, requires effective monitoring and verification of savings and upfront protocol for so doing. ESCOs can be funded by grants or soft loans in the initial stages and once established they can function on profits made from energy savings project. The establishment of ESCOs was already proffered as a critical measure for the diffusion of PV systems. This can be expanded through the TAP to include LEDs for relevant PV projects thus reducing on the load of the PV system for proposed projects. This will be further discussed in sections 1.7 and 1.8.

A demand charge for encouraging persons to save electricity through LEDs can be effective for enabling the uptake of LEDs. However, this also hinges on the need for a study to understand the tariff structure and to also adjust, if necessary and practical. Demand charges will require some infrastructural development to measure the demand and to then be able to use it to calculate electricity rates. This therefore will require a project to analyze the feasibility of implementing this measure in the future.

1.5.3.2 Non-financial measures

The need to ensure quality can be supported by an appropriate test mechanism and standards. This can be done through the Grenada Bureau of Standards that already has some test facilities for lighting. In other word this measure is already in place. However, the testing is a burden in that it adds more cost to the importation process as the tests themselves are quite expensive. This is due mainly to the high electricity consumption of the test bed and the length of use of the bed to ensure proper tests are carried out. In spite of this challenge this quality test will be necessary to ensure customer confidence in the technology.

To further encourage LED diffusion, energy standards and codes can be very important. The Grenada Bureau of Standards is currently embarking on implementing this measure through a regional project that is looking at labeling standards for LEDs and CFLs. Additionally, the project is considering codes for energy efficient buildings. At the end of this project therefore the region (CARICOM) may have minimum energy consumption standards, and LEDs will play a critical role in achieving these standards in both existing and new buildings.

1.6 Barrier analysis and possible enabling measures for electric plug-in vehicles

1.6.1 General description

Generally, electric vehicles use electricity to change a battery and transform that energy to mechanical energy to drive the wheels of the vehicle. The main types of electric vehicles are:

- Hydrogen fuel cell vehicles
- Battery electric vehicles
- Hybrid electric vehicles

The fuel cell electric vehicle obtains its power from the power grid or any other power source. However, the vehicle has a fuel cell which is used to combine oxygen and hydrogen to produce electricity that powers the vehicle.

The battery electric vehicle also gets its power from the power grid, which charges a battery. The power from the battery is used to propel the vehicle.

The hybrid electric vehicle has a small internal combustion engine. This vehicle also obtains its power from the grid, but the internal combustion engine is used to recharge the battery, if needed, thus extending the range of the vehicle.

1.6.1 Identification of barriers

The barriers to the diffusion of electric vehicles focus on both financial and economic and non-financial barriers. All the barriers were obtained from car dealers and the GRENLEC, which is actually operating a small fleet of EVs. The interviewed stakeholders and the stakeholders at the workshop agreed that the most significant barrier to the diffusion of EVs is economic and financial. However, there are other non-financial barriers that must be fixed if the diffusion of EVs is to be effective. Market maps were used at the stakeholder workshops to visualize the barriers and potential measures for overcoming these barriers. Table 16 shows the long list of barriers for EV technologies.

Table 16: Barriers to the diffusion of EVs

Economic and financial barriers	No tax incentives or concessions available
	High initial costs compared with the combustion engine
Non-economic and financial barriers	Range of the car is of a concern
	Charging ports are not available throughout the island
	Dealers are reluctant to import cars
	Lack of trained technicians and institution capacity to provide training (safety associated with high voltage poses an issue for servicing)

1.6.1.1 Economic and financial barriers

The initial cost of an EV in Grenada is generally about 50% more than that of a comparable combustion engine vehicle. In this regard, the high initial cost to obtain an EV is a significant barrier. However, the GRENLEC reports excellent fuel efficiency with 99 miles per gallon equivalent and fuel savings of about 34%. With the price for fuel on the market been about XCD15.00/gallon (USD$5.55/gallon), such savings are significant.

A simple calculation using a four (4) door sedan as an example, shows that an investment of about XCD120, 000.00 (USD$48,000) is required to purchase an EV. The fuel consumption for a combustion engine sedan is estimated at XCD$6,240.00 (USD$2,310.00). Notwithstanding other avoided operational costs such as maintenance which will be reduced, the payback period nay be improved. If this cost is totally avoided by using an EV then the payback period on this investment is approximately 6 years. An investor in EV may find this attractive as the payback period on vehicle loans is normally in that range.

However, the high upfront cost still remains a barrier as the tax regime treats EVs similarly to that of vehicles with combustion engines. In other words, the taxes that are charged on the importation of both vehicles are the same. This barrier exacerbates the high upfront cost for EVs. However, as with other technologies discussed previously, the government may not be in the position to reduce taxes, thus providing further reductions in the cost of EVs. This will be addressed under the measures section below.

1.6.1.2 Non-financial barriers

The non-financial barriers are as important as the financial ones, and these range from capacity building to technical barriers, such as charging infrastructure. The range of EVs were put under scrutiny by the GRENLEC, in that it is felt that based on the model of the EV, the ability to drive long distances and for long periods of time may be a challenge. Coupled with this is the ability of the EV to climb hills, as the terrain in Grenada is generally hilly when driving off the main road that circumvents the island.

The other technical barrier lies in the fact that there is no infrastructure for charging the EVs when charge is needed. Like petrol stations that are strategically placed on the island, there will be a need to ensure that EV customers can have access to ready charging stations if the EV batteries need to be charged. This will be a huge technical barrier as EVs begin to diffuse, for even if some EV users may have their own charging station, there will still be a need for common charging stations. The second issue associated with charging infrastructure will be the source of energy used to power the charging stations. Currently the grid is powered by approximately 90% diesel. If EVs are introduced into the system the demand for power will increase. In this case if the power is generated by diesel, the use of EVs will actually be contributing to climate change, as opposed to mitigating it; thus posing a real barrier to the uptake of EVs as it relates to mitigating climate change. In this regard, EV diffusion must be considered in the context of the Government of Grenada's plans to transition Grenada's energy supply to renewable energy. The current thrust by the Government to legislate this transition through the Electricity Supply Act of 2016 augurs well for the possible diffusion of EVs.

Corporate tax incentives are not normally provided to importers of any vehicles. One reason that dealers may not be inclined to import EVs is because of the generally higher cost on the international market compared to combustion engine vehicles. Therefore incentives to encourage the importation of these vehicles can be encourages through government policy that allows for some kind of temporary tax break for such importers. This will be discussed more fully under the subsequent measures section.

Finally, and maybe a second reason why dealers may not import EVs is due to the lack of capacity to services and/or maintain these vehicles into the future. Most car dealerships are vertically integrated, in that their import, sell and service the vehicles they import. The fact is that EVs require little maintenance, but this will require new human skills and equipment. It follows therefore that EV dealers will have to re-tool their service centers and personnel to provide these skills. The training institutions on the island and especially the TAMCC will also have to re-tool their training facilities and personnel. Curricula will have to be created to ensure that that required competencies are developed. This new type training will be offered to service mechanics that work for the car dealers or on their own as small mechanic shop owners and their employees.

1.6.2 Identified measures

The following measures are suggested as possibilities for overcoming the barriers discussed previously.

Table 17: Measure to overcome the barriers to the diffusion of EVs

Economic and financial measures	Provide tax incentives or concessions available
Non-economic and financial measures	Consider type of vehicle with high range
	Design a medium project to demonstrate and develop charging ports in strategic locations on the island
	Encourage dealers to import EVs
	Develop institutional and individual capacity to provide training to technicians

1.6.2.1 Economic and financial measures

Many officials within government, farmers and other private sector organizations who qualify are granted tax cuts on the import duty for vehicles. These cuts range from 50% to 100%. As a means to encourage the diffusion of EVs, these exemptions can be expanded to include the individuals within the wider population who may wish to invest in an EV. For example, someone who feels that the EV will be best suited for their circumstance will can be offered this cut as an incentive. This tax break can be seen as ‘non-carbon tax’ that encourages individuals to reduce on their carbon footprint and to make a positive contribution to mitigating climate change. However, this measure must be integrated with electricity supplied by renewable energy sources.

Additionally, many organizations are afforded these tax cuts as part of the policy that encourages their investment. Some of these organizations operate relatively large fleets of vehicles. These organization can be offered a further tax break, say about 20%-25% to encourages the uptake and change-over of fleet vehicles to EVs or other types of vehicles using renewable energy. Vehicle importers should ensure that the EVs imported can achieve a certain comfortable range that is suitable for Grenada. GRENLEC can provide some evidence from their experiments for the two sedans and sport utility van (SUV) that they are currently using.

Alternatively, the government may want to implement a tax differential based on the type of car imported. For example the taxes on used vehicles are much higher than that on new vehicles. This higher tax is considered as a ‘environmental levy’ to ensure that the older vehicles are appropriately dealt with at the end of their life. A similar approach can be used, where a high import tax can be imposed on new combustion engine vehicles that have a higher potential to emit carbon dioxide. Here the ‘carbon tax’ may be more attractive to the government.

These measures above point towards fiscal policy and may equally be seen as policy, legal and regulatory in nature, but with financial implications. Therefore, further policy direction may be needed to deal with the importation of EVs. For example, dealers can be provided with some relief on corporate tax through a further ‘non-carbon tax’. This time a rebate on annual taxes paid by vehicle importers may be reduced by say 10% to 15% for the EVs imported. Dealers can be encouraged to import a certain annual quota of EVs and other types of EVs, with a promise of rebate on corporate tax. This can be done for fixed period of time to ensure that a certain quantity of the fleet of vehicles imported into the country is climate friendly. This will also extend to used vehicles of a certain age say 5-year and below.

1.6.2.2 Non-financial measures

However, the critical technical and capacity issues must simultaneously be addressed. The need for charging infrastructure using renewable energy sources has be addressed. GRENLEC again has done that and use PV technology to charge their vehicles. However on the national level, a pilot project to introduce this can be done. The government owns and operates a large fleet of vehicles and also owns many building in strategic locations all over the country. The government may also wish to partner with private entities, for example, supermarkets which have large parking lots to install such systems. In the future and when the diffusion becomes entrenched, areas such as the three (3) relatively large bus terminals can also be solarized, with charging station attached. This may be suggested as a project component under the technology action plan stage of the TAP. In this regard, an approach to the diffusion of EVs must be considered in the context of electricity supplied from renewable energy sources.

Both institutional and personnel capacity building can be addressed by first upgrading and updating the automotive technology program at the TAMCC. This will require the collaboration between the TAMCC, vehicle importers and other key stakeholders to review and design the training, agree on training materials required and re-train current faculty at the TAMCC to deliver the training. Additionally vehicle importers who agree to import EVs may also be assisted to upgrade their facilities to provide appropriate service for these types of vehicles. This again will be further elaborated under the TAP.

1.7 Linkage of the barriers identified

Many of the barriers identified for all the technologies are linked and this section provides a comprehensive overview of these linkages. In considering these linkages, the nature of the market and especially the small market size with few or no opportunities for economies of scale must be considered. Therefore and as all the technologies are market or consumer goods, the barriers may be similar in nature. In other words, all the technologies are imported, with the exception of biogas, for which local materials can be used to construct a system.

Form this point of departure, the economic and financial barriers are intricately linked, and workshop participants agreed that for biogas; electric vehicles; high efficiency air conditioners and LEDs these barriers were the most significant. Although this discussion can apply to PV systems, workshop participant agreed that the ‘policy, legal and regulatory’ issues were more significant for PV and this will be addressed subsequently.

A review of the barriers for the technologies in question shows that: ‘high upfront cost’ and ‘insufficient/inadequate incentives’ were the two main economic barriers. These barriers are linked from the perspective that lack of tax based incentives can contribute to the high cost of the technologies in question. In other words, the price of an LED bulb or fixture comprises the cost of the items at the source market+ insurance and freight or (CIF) and other relevant taxes: VAT, General consumption tax (GCT) and charges at the port. The importer and retailer will then have a mark-up, which is based on the business model of the importer and retailer. The importer and the retailer pass on all costs to the end user, however, they only have control of the mark-up and profits that they intend to accrue from the sale of the product.

Therefore retailers and importers may have limited control over the final price to the end-user. The retailer/importer pricing will be done in such a manner that they maintain a viable, successful and competitive business. Secondly, importers may also source more affordable technologies on the global market. For example, many importers of items such as high efficient ACs and LEDs find their products in China and Latin America. Biogas systems are also imported from China and Germany. Prices on the local market can also be controlled through importers finding discounts for bulk purchases and other market mechanisms to reduce the cost of technologies. However, this is limited as the market is small and bulk buys in the true sense may be still relatively small quantities. But taxes and other charges are fixed.

The other option for controlling or even lowering the ‘high upfront cost’ identified can be achieved through government interventions. This will address the issue of incentives to encourage the uptake of these technologies. However, it was suggested that government may not be in a position to afford tax incentives through tax exemptions. It was also discussed that the government is already offering exemptions for VAT on PV panels, deep cycle batteries, inverters and LEDs. This removes about 15% of the price of these technologies from the cost to the consumer.

Therefore the non-financial barriers and especially the ones associated with ‘policy, legal and regulatory’ are also linked to the two economic barriers discussed above. Firstly, using the PV system barriers, which focused mainly on the insufficiency of regulations to drive the further diffusion of PV system technologies, is closely linked to the barriers associate with: EVs, high efficient ACs and LEDs. The Government of Grenada has already made significant strides towards fixing the legal system by passing the new Electricity Supply Act of 2016. However, the much needed regulations to ensure that the act is appropriately implemented still needs development. From this perspective the lack of appropriate tariffs to encourage the interconnection of PV systems comes into question. With appropriate feed-in tariff, investment in PV and other energy efficiency technologies such as LEDs and high efficient ACs will be encouraged.

The issue of capacity building both institutionally and human skills development are barriers that are also linked across technologies. In effort to strengthen institutions to deal with PV projects the other technologies must be considered. Projects relating to biogas and loans for individuals and organizations wishing to invest in EV technology should also be considered. In a similar manner, projects for lighting retrofits using LEDs and high efficient ACs should also be giving special consideration. The idea of ESCOs will be relatively new concept to financial institutions and these institutions will need to be developed to deal with the potential ESCO that may need financing for RET and energy efficiency projects.

Requisite human skills are always a challenge for technology diffusion, especially in SIDS. These barriers include both building the institutional capacity to offer training and delivering the training to technicians. These barriers are intricately linked to each other and are also common to all the technologies in this report. Capacity building barriers are often forgotten, but are a part of the triangle of the concept of technology. They fall with the organizational or org-ware and software or know-how apexes of the triangle. Many projects in SIDS focus on the hardware and very little attention is paid to these critical pillars. Projects with a high focus on the hardware, for example biogas, which may need more focus on the org-ware may be doomed to fail. How the structure to manage and operate a biogas system is set-up, may be more important than the installation of the 'hardware' of the technology itself.

Another import link between barriers exists between the technical barriers for the diffusion of PV systems and charging systems for EVs. It was mentioned previously that with the diffusion of EVs more renewable energy sources should be introduced into the electricity generation mix. Therefore with the uptake of PV systems into the mix, the viability of EVs contributing to the mitigation of climate change is enhanced. In other words, avoiding the use of fossil based fuels to power charging stations is a requirement for the efficient and effective diffusion of EVs.

The Government of Grenada has made significant strides in transitioning the electricity supply sector from fossil fuels to renewable energy sources. In this regard, a new Electricity Supply Act 2016 with the focus on encouraging renewable energy supply technologies was passed into law in 2016. This law promotes distributed energy supply from possible sources such wind and solar. It also supports investments by independent power producers (IPPs). Additionally, the GOG has received funding to embark on the proof of geothermal energy as a base load source of power supply. The use of geothermal and the enabling legal framework, will contribute to the uptake EVs as a climate mitigation technology in the transportation sub-sector.

1.8 Enabling framework for overcoming the barriers

The enabling framework focuses on two levels: the first level addresses the common barriers and concomitant measures to overcome these barriers to the diffusion of PV systems, high efficient ACs and LEDs and then at the individual technology level for biogas and EVs. To a certain extent the barriers associated with EVs will also be addressed at the first level.

The economic barriers associated with the diffusion of PV systems, high efficiency ACs and LEDs was shown to be linked above. Also, these may be linked to the EVs. This link is grounded in the facts of high initial costs and lack or inadequate incentive to encourage the further diffusions of these technologies. The enabling framework suggested herein, will seek to provide key measures that will address these critical barriers for all the technologies.

Table 18: suggested enabling framework for PV systems, ACs, and LEDs

Suggested economic and financial enabling inputs	The creation a revolving fund that can be used to provide soft loans to all investors in PV systems, lighting and high AC retrofits. This dedicated fund can be financed by the Grenada Development Bank (GDB) and other financing agencies such as the Caribbean Development Bank (CDB) and the World Bank (WB). Further incentive schemes that may be employed to provide affordable finance for PV system, ACs and lighting retrofits investments. These include the accelerated depreciation and interest rate drawdown. The first incentive is intended to reduce on the taxes paid early in an investment. This reduction should accrue to more savings for the investor, especially commercial investor in for example the tourism sector. The second option: interest rate drawdown may be attractive to the individual household. In this regard, someone wishing to investment in a small scale PV system will only pay interest on the portion of loans approved for the project. This should accrue to savings for the individual as they may only be required to finance the portion of the loan that they actual use for the project. Establishing energy services companies to absorb with the high up-front cost for investment projects in PV systems, high efficient ACs and LEDs are a critical measure for supporting the diffusion of these technologies. These companies will normally provide the initial capital for the investment and are paid through the accrued savings as a result of this investment. The functioning of ESCOs however, requires effective monitoring and verification of savings and upfront protocol for so doing. ESCOs can be funded by grants or soft loans in the initial stages and they can also benefit from the financial incentives, of accelerated depreciation and tax rate draw-downs described above.
Suggested non-financial enabling inputs	**The NAMA will address the following policy, legal and regulatory issues that will greatly benefit the diffusion of LEDs and high efficient ACs:**

	• Technical assistance and capacity building for the establishment of the Public Utilities and Regulatory Commission Act (PURCA) and training and development for the newly appointed Commissioners; support to further develop appropriate feed-in tariff mechanism for the nature of the market.
	Develop a new comprehensive program in 'sustainable energy systems', geared towards building the skills at the technical and technological levels that encompasses the technologies addressed here, and including *biogas and EVs*. This comprehensive program will include a suit of course that can be provided in different modes, as short course or leading to certification at exit. This enabling input will also address the development of the training institutions capacity to deliver the course.

Table 19: Additional enabling framework input for high efficiency ACs and LEDs as energy efficient technologies

Suggested economic and financial enabling inputs	There are no import regulations in place to encourage the uptake of high efficiency ACs; all systems imported are subject to the same taxes and treatment at the point of importation. High efficiency air conditioners are not subject to VAT exemption. In attempt to create some incentives, it was proposed in the HPMP that a differential tax regime should be put in place, where less efficient systems are subject to higher taxes compared to the high efficiency systems. Similarly these systems can be added to the list of VAT exempt technologies and equipment
Suggested non-financial enabling inputs	There is a dearth of energy related standards and codes to assist with diffusion of energy efficient technologies, such as high efficiency ACs. Similarly, there is no energy code that suggests or dictates the energy efficiency of a particular building type. Such standards and codes can assist both the end user and the importers of high efficiency ACs to make critical decisions on the most affordable and best quality LEDs to achieve energy efficiency.

Table 20: Additional suggested enabling framework inputs for EVs

Suggested economic and financial enabling inputs	Many officials within government, farmers and other private sector organizations who qualify are granted tax

	cuts on the import duty for vehicles. These cuts range from 50% to 100%. As a means to encourage the diffusion of EVs, these exemptions can be expanded to include the individuals within the wider population who may wish to invest in an EV. For example, someone who feels that the EV will be best suited for their circumstance will can be offered this cut as an incentive. This tax break can be seen as ‘non-carbon tax’ that encourages individuals to reduce on their carbon footprint and to make a positive contribution to mitigating climate change. Additionally, many organizations are afforded these tax cuts as part of the policy that encourages their investment. Some of these organizations operate relatively large fleets of vehicles. These organization can be offered a further tax break, say about 20%-25% to encourages the uptake and change-over of fleet vehicles to EVs or other types of vehicles using renewable energy. Vehicle importers should ensure that the EVs imported can achieve a certain comfortable range that is suitable for Grenada. GRENLEC can provide some evidence from their experiments for the two sedans and sport utility van (SUV) that they are currently using. Alternatively, the government may wish to implement a tax differential based on the type of car imported. For example the taxes on used vehicles are much higher than that of a new vehicle. This higher tax is considered as a ‘environmental levy’ to ensure that the older vehicles are appropriately dealt with at the end of their life. A similar approach can be use, where a high import tax can be imposed on new combustion engine vehicles that have a higher potential to emit carbon dioxide. Here the ‘carbon tax’ may be more attractive to the government.
	On the national level, a there is a need to provide charging stations powered by renewable energy for charging EVs. The government owns and operates a large fleet of vehicles and also owns many building in strategic locations all over the country. The government may also wish to partner with private entities, for example, super markets which have large parking lots to install such systems. In the future and when the diffusion becomes entrenched, areas such as the three (3) relatively large bus terminals can also be solarized, with charging station attached.

References

Aggarwal, D (2018). NAMA Document: Mainstreaming solar PV at Grenada. Government of Grenada, St. George's, Grenada

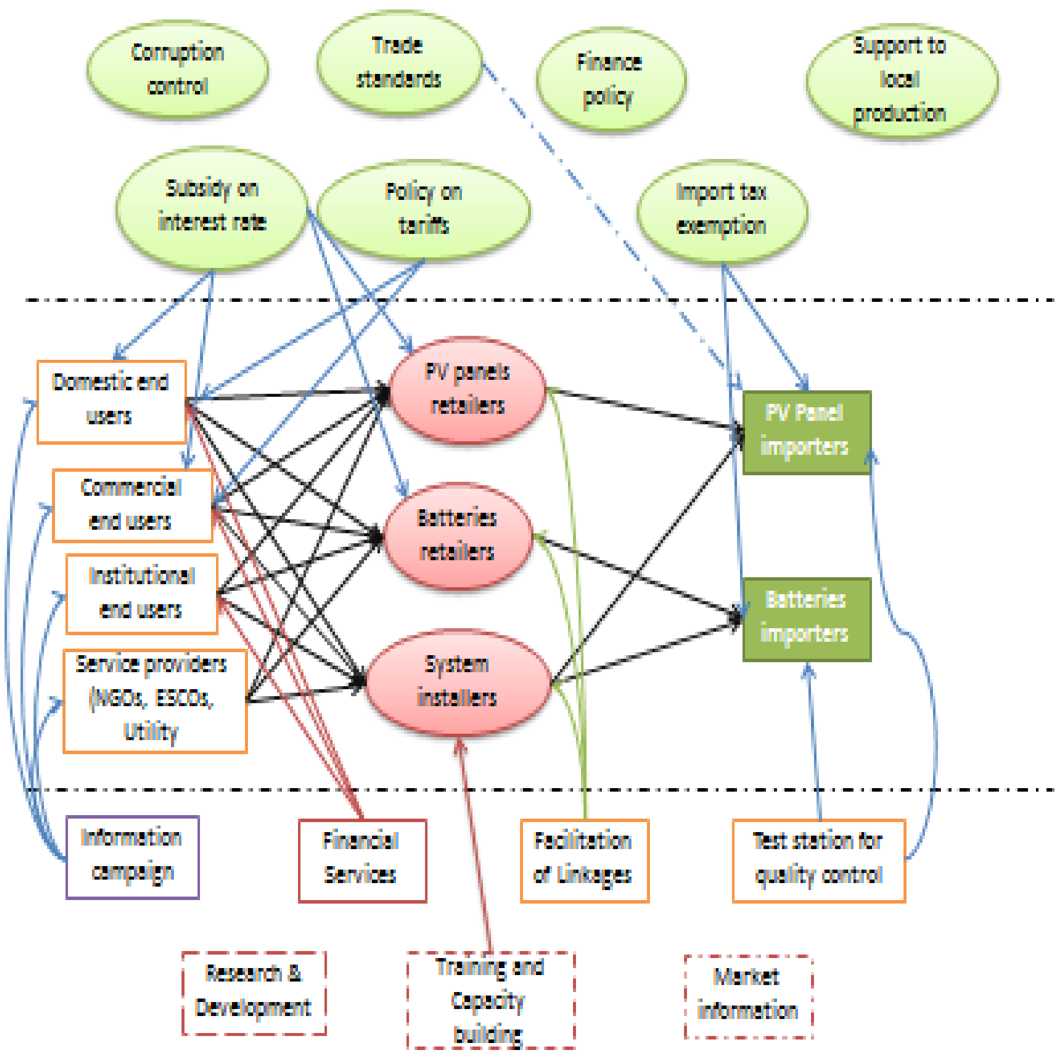
GIZ (2015). HoMethan Biogas Project: Conceptual Design Study- Anaerobic Digestion in Grenada for the Agri-food-sector. GIZ, Germany

IRENA (2017). Electric Vehicles- Technology Brief. International Renewable Energy Agency, Abu Dhabi.

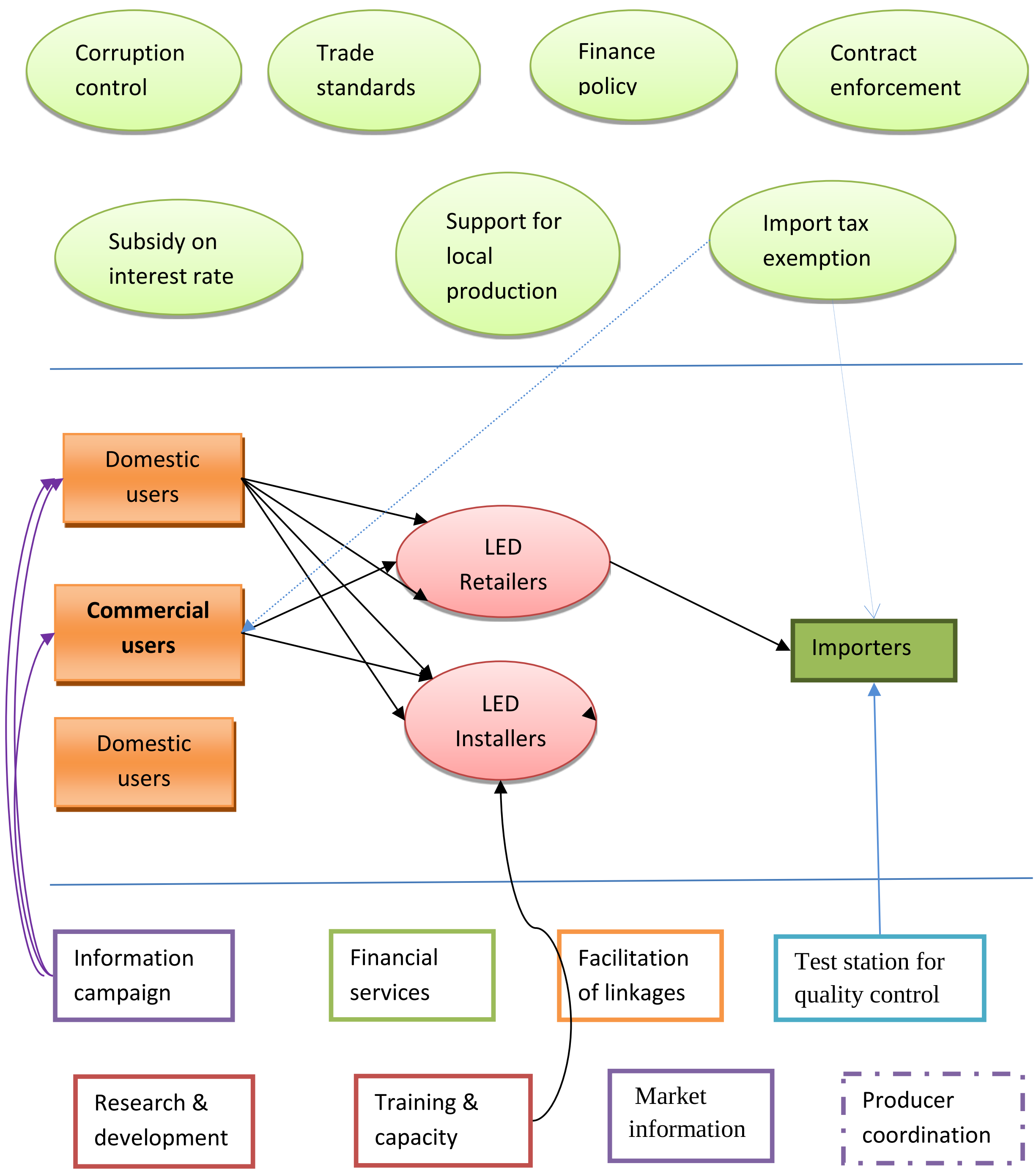
Nygaard, I. and Hansen, U. (2015). Overcoming Barriers to the Transfer and Diffusion of Climate Technologies, 2nd Edition. UNEP DTU Partnership, Copenhagen.

Annex 1: Market mapping results

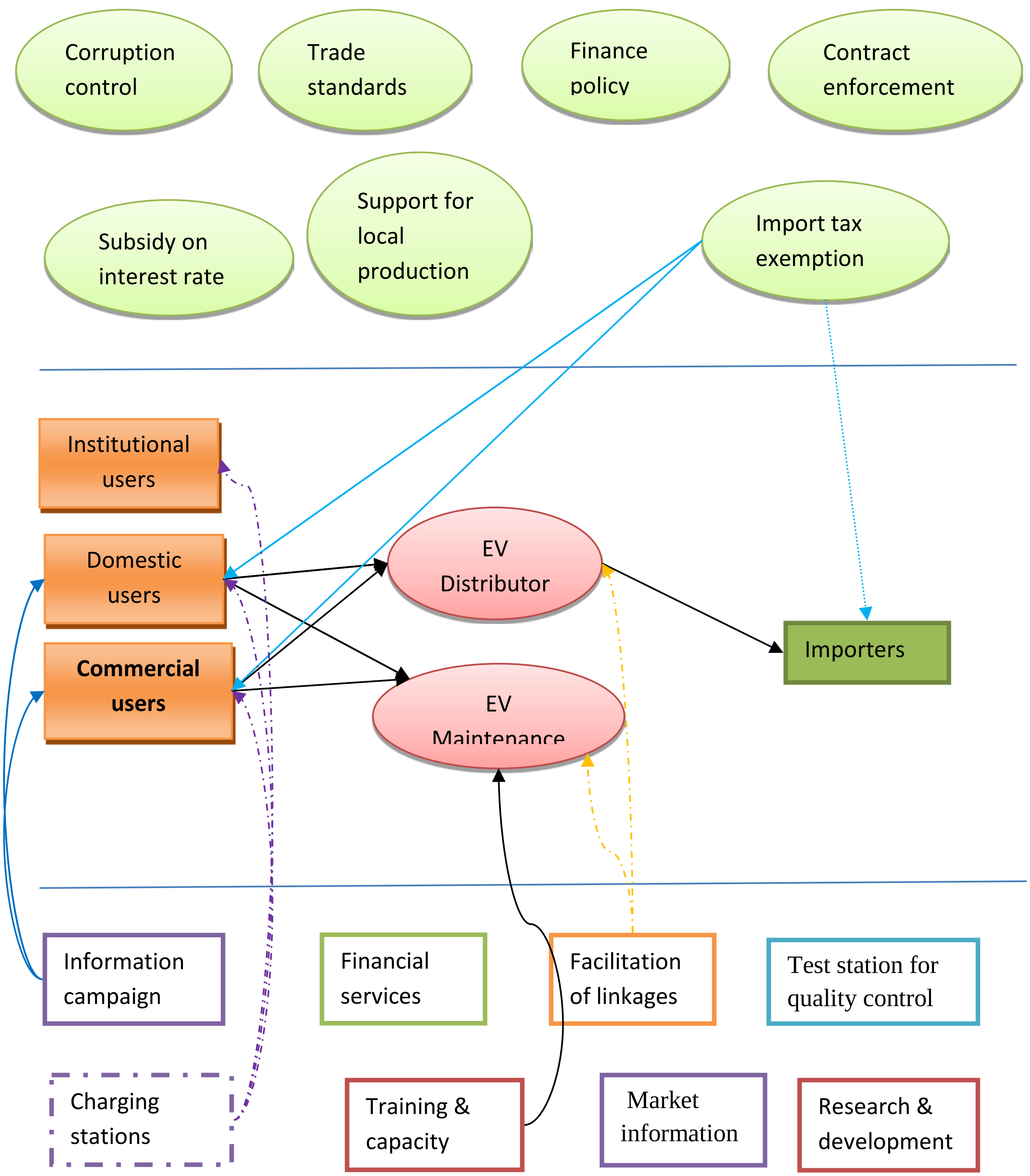
PV systems market map



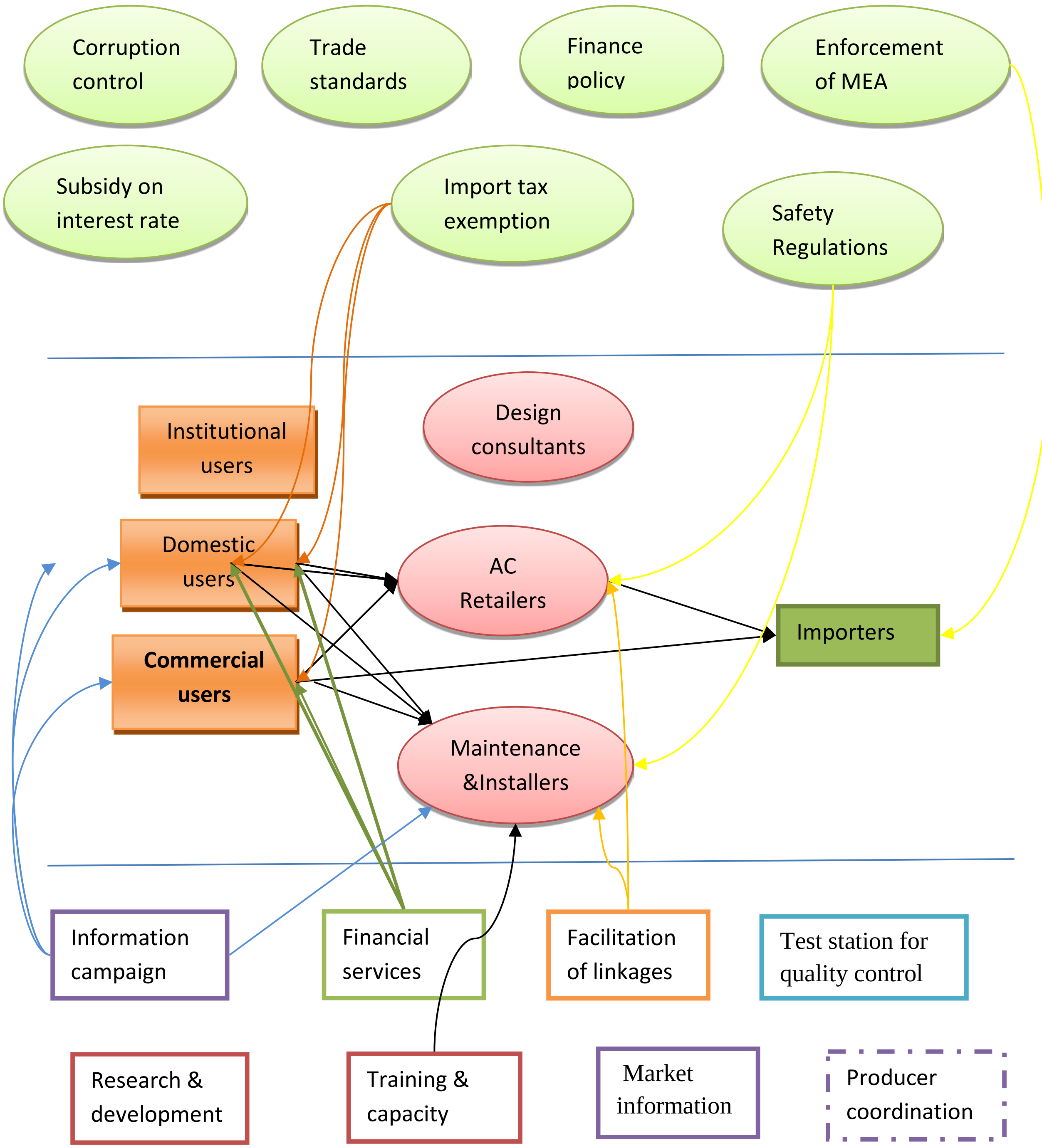
LEDs market map



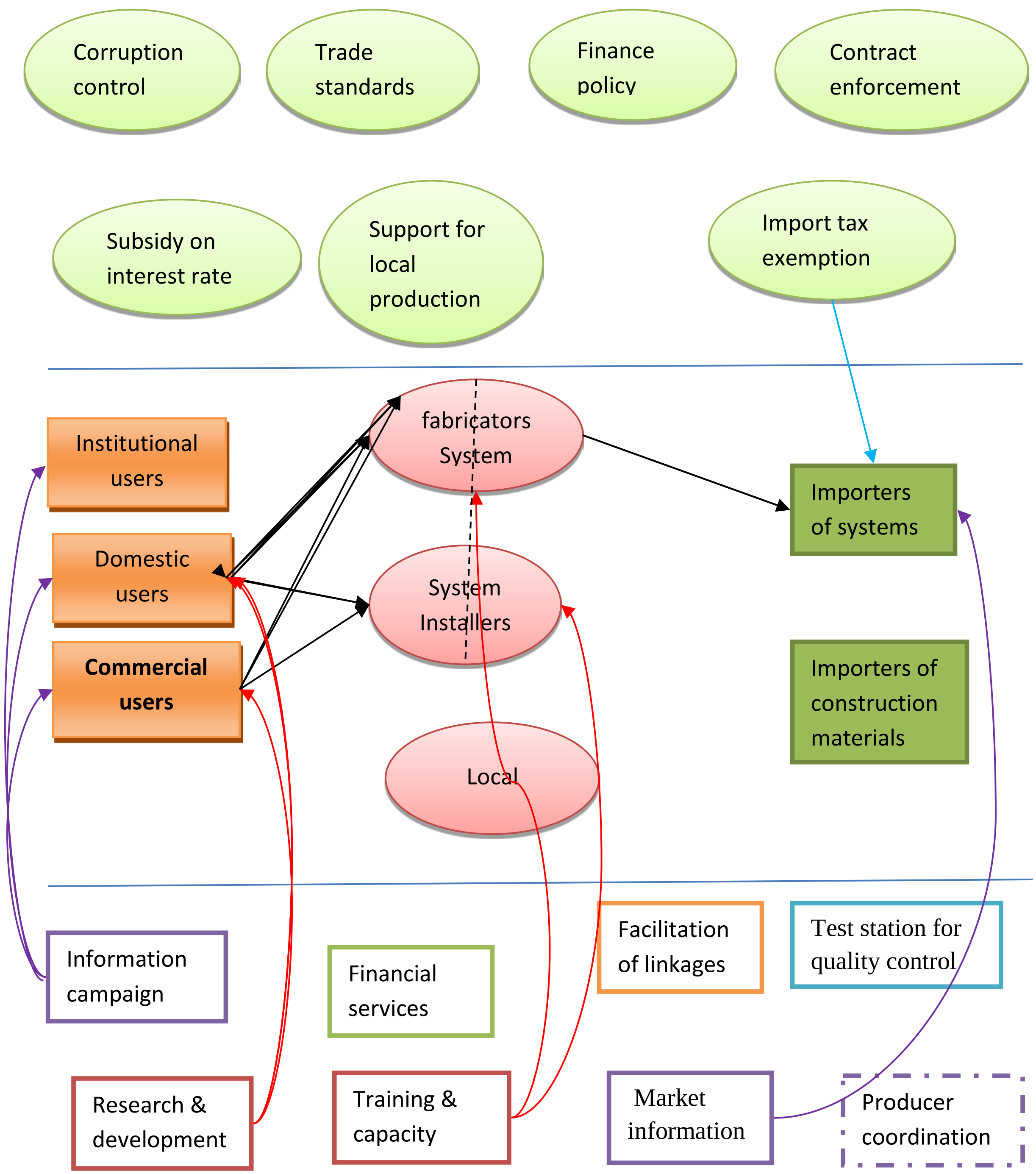
EVs market map



High efficiency AC systems market map



Biogas market map



Annex 2: List of Stakeholders

Organization	Names of persons	Designation
Grenada Electricity Services (GRENLEC)	Mr. Colin Cover	General Manager
Car Dealer	Mr. Crawford	Head of Sales
Cooling Tech Ltd	Mr. Erwin Roden	Engineer
	Mr. Lance Simpson	Operation and Assistant General Manager
NADMA		
GREII (PV system provider)	Mr. Earle Roberts	Consultant/Owner
Ministry of the Environment	Mrs. Aria St. Louis	Head of Environment Division
GIZ	Mr. Dieter Rothenberger	Head of GIZ Projects
GIZ/Energy Division	Mr. Curllan Bhola	Technical Consultant
Ministry of Finance and Energy/Energy Division	Mr. Philipp Vanicek	Energy Policy Advisor