Nationally Appropriate Mitigation Action (NAMA) in Residential Energy Efficient Lighting in Grenada

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Contents

List of Acronyms and Abbreviations

BAU	Business as usual
BMUB	German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety
BUR	Biennial Update Report
CARICOM	Caribbean Community
CCREE	Caribbean Centre for Renewable Energy & Energy Efficiency
CDB	Caribbean Development Bank
CDM	Clean Development Mechanism
CEELP	Caribbean Energy Efficient Lighting Project
CFLs	Compact Fluorescent Bulbs
CO_2	Carbon Dioxide
CREDP	Caribbean Renewable Energy Development Programme
ECERA	East Caribbean Energy Regulatory Authority
EE	Energy Efficiency
GCF	Green Climate Fund
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GIZ	German Agency for International Development Cooperation
GOG	Government of Grenada
G-RESCP	Reform of the Electricity Sector to support Climate Policy in Grenada
GSEII	Global Sustainable Energy Islands Initiative
GWh	Gigawatt Hours
ICLs	Incandescent Lightbulbs
INDC	Intended Nationally Determined Contribution
IRENA	International Renewable Energy Agency
LED	Light-emitting Diode
MRV	Monitoring, Reporting and Verification
MW	Megawatt
MWh	Megawatt Hours
NAMA	Nationally Appropriate Mitigation Action
NDC	Nationally Determined Contributions
OECS	Organisation of Eastern Caribbean States
OLADE	Latin American Energy Association
REETA	Renewable Energy and Energy Efficiency Technical Assistance
SEEC	Sustainable Energy for the Eastern Caribbean
SE4All	Sustainable Energy for All
TNA	Technology Needs Assessment
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
U4E	United for Efficiency
USD	US Dollar
VAT	Value Added Tax

Introduction

To be written last. The paragraphs below will be incorporated into the text.

The energy savings assessment made by United for Efficiency (U4E) states that, if policies are implemented to promote energy efficiency broadly, the construction of 20 MW generation capacities can be avoided until 2030. The proposed policies would reduce electricity use by 14.2 GWh by 2030, whereof almost 6 GWh can be attributed to efficiency gains in lighting. The annual savings due to the lighting improvements would be worth USD 840,000, and, calculated in reduced CO_2 emissions, 4200 tonnes annually (En.lighten & U4E, 2015).

The work behind this report shows that the major barriers for achieving a faster transition to energy efficient lighting in Grenada are barriers that are the prerogative of the Government of Grenada to solve. This underlines that the success of this NAMA is contingent on firm political support to succeed. There are, fortunately, many excellent reasons for supporting this NAMA: the measures saves money and helps Grenada in its strive towards sustainable development. In phasing out an inefficient technology and speeding up the advance of an efficient one, Grenada sends a strong signal to the international community that it is acting proactively and seriously to mitigate its contribution to climate change.

Alignment with Grenada's Development, Sectoral and Climate Change Policy and Regulations

This section aligns the NAMA with the existing plans and regulations concerning climate change, relevant sectors, and development. This is done as a NAMA is a mitigation action that also brings sustainable development co-benefits. In addition, by aligning the NAMA with existing plans and regulations, a more directed impact could be made. It is also essential ensuring that the NAMA increases the support base from those prioritising mitigation actions to a wider audience. Political buy-in is a crucial factor for a NAMA to be successful.

Alignment of the NAMA is crucial when considering seeking support from international finance bodies. Leading financing institutions such as the Green Climate Fund (GCF), and the NAMA Facility have alignment with other national policies and priorities as central evaluation criteria.

The text below firstly identifies the relevant climate change regulations in Grenada, where the climate change policy and action plan, as well as the National Determined Contribution, are two central documents. Secondly, the sectoral regulation in the energy and building sector is described as these are highly relevant for energy efficient lighting. It should be mentioned that further links are established in the Sustainable Development Co-benefit section, further below.

Climate Change Regulation

The climate change regulation of Grenada consists of a number of policies and action plans. The main focus is on adaptation measures, since Grenada is one of the countries in the world most vulnerable to climate change (see e.g. Kreft, Eckstein, & Melchior, 2017). Grenada has submitted a National Determined Contribution (NDC), as well as developed a 'National Climate Change Policy and Action Plan' which provides a roadmap for various mitigation actions. These are presented below, highlighting the aspects that align with the NAMA.

National Communications and Biennial Update Report

In 2000, Grenada submitted its First National Communication to the UNFCCC. The document describes the framework for environmental management as fragmented, and proposes a more systematic approach towards mitigation policies, therein measures to promote energy efficiency. The First National Communication calls for the introduction of Compact Fluorescent Bulbs (CFLs), the adoption of standards for certification of electrical appliances, as well as public awareness campaigns for energy efficient equipment. One of the measures to increase energy efficiency within the public sector is to retrofit buildings, as well as the procurement of energy efficient lamps for public offices.

Grenada is currently working on its Second National Communication. As a small island developing state, Grenada can submit a biennial update report (BUR) at its own discretion. Up to this point, Grenada has not submitted a BUR.

National Climate Change Policy and Action Plan (2007-2011)

In 2007, the Government of Grenada (GoG) launched the National Climate Change Policy and Action Plan (2007-2011). The plan introduces eight strategies to address climate change, with a focus on adaptation measures. In relation to improving energy efficiency, the plan does not focus on energy efficient lighting specifically but rather on comprehensive incentive packages to promote energy efficiency. This plan suggests using benchmarks for electricity generation equipment, reducing import duties and taxes on energy efficient appliances, and stipulating higher standards for the imported goods. This is to be coupled with, *inter alia*, public education on reducing energy consumption. In addition, the plan emphasises the importance of regional coordination within the Organisation of Eastern Caribbean States (OECS) and the Caribbean Community (CARICOM) in implementing energy efficiency measures (GoG, 2007).

There has been a reduction of import duties and the value added tax (VAT) on energy efficient light bulbs. Currently, the general VAT stands at 15%. In 2010, 'energy saving bulbs' was added to a list of products exempted from VAT. The list does not define criteria for when a bulb saves energy, making it difficult to apply in practices. Moreover, light bulbs often arrive in fixtures rather than individually, resulting in that this exemption does not apply to many products.

In regards to customs, the coordination work to introduce reduction of the customs service charge has yet to start. As the CARICOM region imposes a common external customs charge, a coordinated approach among the member countries is necessary.

These are the issues that are further addressed in the NAMA Action plan below, as they are deemed to be of importance to the current situation, as well as good leverage points to change it.

Nationally Determined Contribution

Grenada's Intended Nationally Determined Contribution (INDC) was submitted to the UNFCCC in September 2015, and now that the country has ratified the Paris Agreement, which entered into force in November 2016, its objectives have become the official NDC of Grenada. The NDC represents the country's approach towards tackling climate change. It focuses mainly on adaptation, but also includes mitigation measures. The NDC sets an unconditional target of reducing GHG emissions by 30% compared to 2010, and a conditional target of 40% by 2025. A varied set of policy instruments are proposed to reach the targets, including informative (public awareness campaigns), economic (fiscal incentives) and regulatory (minimum energy performance standards and building codes) measures.

For example, within the electricity sector, Grenada envisions two-thirds of emission reductions to stem from improvements in energy efficiency, while the remaining third is to be provided through increased renewable energy generation. The NDC proposes to retrofit all buildings to improve their energy efficiency, establish energy efficient building codes, and support the implementation of energy efficiency pilot projects in hotels.

Sectoral Regulation

The sectoral regulation relevant for this NAMA is primarily regulations for the energy sector, including energy efficiency regulation, as well as the building sector.

National Energy Policy

The National Energy Policy from 2011 has as an overarching goal of decoupling economic growth and energy use. To achieve this, the policy discusses specific measures as well as the institutional set-up of the energy related questions.

The specific policies suggested to achieve decoupling include 'comprehensive fiscal incentives' to encourage the import and use of energy efficient technologies, e.g. appliances, vehicles, and power generation equipment.

It also calls for the adoption of energy efficient building codes which should be mandatory for all public sector construction. It suggests providing incentives to financial institutions for them to offer their clients preferential rates for new and retrofitted energy efficient homes. Public information campaigns and education is also echoed as instrumental. All of these measures are suggested to be incorporated into an Energy Efficiency Act (GoG, 2011). The Energy Efficiency Act is currently in the making, and the first draft is to be expected during the spring of 2017.

Targets for renewable energy are not set in the NDC, but are set in other documents. The National Energy Policy specifies that by 2020, 20% of total electricity and transportation energy should be generated from renewable sources (GoG, 2011). The Grenada Vision 2030 sets a goal that by 2030, 100% of all energy should be renewable (IRENA, 2012).

There are no nationwide energy efficiency targets expressed (Ochs, Konold, Auth, Musolino, & Killeen, 2015). There are a few policies in place to favour energy efficient appliances, including lighting. The government provides an exemption of the 15% Value Added Tax (VAT) for investments in energy efficient technology. Moreover, the Ministry of Finance publishes a list of energy efficient equipment that are exempted from VAT; energy saving bulbs are included in this (Nachmany et al., 2015).

National Building Code

Grenada's building code, which was updated in June 2015, stems from the Organisation of Eastern Caribbean States' (OECS) Code from 1992. It is a common code for Grenada, St Vincent & the Grenadines, St Lucia, and Montserrat (OECS, 2015). The main priority is to build structures able to withstand natural disasters such as earthquakes and hurricanes, as with a changing climate, Grenada has become more exposed to especially hurricanes (GoG, 2007). The building code emphasises natural lighting in the first place to avoid unnecessary energy consumption - all rooms need to have windows and/or skylights. The section regulating artificial lighting, 1105a) requires lighting to be "in accordance with the requirements of the electricity regulation in force" (OECS, 2015, p. 161). It is thus the electricity regulation that takes priority in relation to the scope of this NAMA targeting EE

improvements in residential lighting. The current electricity regulation in Grenada does not address energy efficiency, but is to come with the Energy Efficiency Act. As previously mentioned, the NDC, which was published a few months after the building code, also calls for a revision of the building code to incentivise the utilization of energy efficient equipment.

Existing Efficient Lighting Support Projects, Pilot Projects, and Strategic Partnerships

There have been numerous projects on energy efficient lighting in Grenada as well as in the region, showcasing technologies and gaining understanding of how they apply in the local context. This section introduces previous and ongoing projects, and highlights which lessons can be drawn from the projects for the NAMA.

The previous projects can be divided into an earlier and later groups. The earlier group donated CFLs to residents while the latter group focused on both piloting different technologies and creating enabling environments for a market-driven transition to energy efficient lighting. It is difficult to assess the success of these early experiences in detail, as information on the outcomes and impacts is fairly limited. However, the results of the projects in the earlier group seem to be less transformational as there are indications that residents reverted to incandescent light bulbs once the donated ones stopped functioning. One of the projects in the latter group was successful in piloting energy efficient lighting, using it as a base to develop a successful application for a larger scale project - introducing LED street lighting nationwide in Antigua and Barbuda. The following table lists previous EE lighting implemented in the region:

Previous Projects

Table 1. Short Overview of Previous Support Projects

Name	Time period	Where	Project Description in short	Main Actors
Energy Efficient Lighting Project	2004-2008	Primarily St. Lucia, Dominica, and Grenada	Provide CFLs to residents through donation.	Global Sustainable Energy Islands Initiative (GSEII), Climate Institute, Climate Care, various national governments
Cuban Government Distribution of CFLs	2006-2007	The Caribbean and surrounding countries	Distribution of CFLs to households free of charge.	Government of Cuba, Government of Grenada, Governments of numerous other countries in the region.
Caribbean Energy Efficient Lighting Project (CEELP).	2014-2015	Eastern Caribbean	Catalyse the uptake of energy efficient lighting technologies through pilot studies, capacity building, and regional policy development.	UNDP, OECS, CARICOM and representatives from the beneficiaries.
Caribbean Renewable Energy Development Programme (CREDP)	2003-March 2016	Eastern Caribbean	Remove barriers to utilizing renewable energies and energy efficient technologies through specific actions to overcome policy, finance, capacity, and awareness barriers.	GIZ and Energy Unit of CARICOM

In the period of 2006-2007, the Cuban government distributed CFLs to households throughout the Caribbean and some of the surrounding countries. In Grenada, more than 130,000 CFLs were distributed to households. It is calculated to have conserved 10.2 GWh annually in Grenada, which equals 7,000 tCO_2/year (UNEP/GEF en.lighten & REGATTA, 2011). Prior to this, the Global Sustainable Energy Island Initiative (GSEII) also donated CFLs to households and public institutions in the Caribbean (though not on Grenada) (GSEII, 2008).

The Caribbean Energy Efficient Lighting Project (CEELP) was conducted from 2013-2015. It aimed to catalyse the transition to low carbon economies and sustainable energy sectors through the provision of energy efficient lighting to communities in the Eastern Caribbean. The project stood on three pillars - capacity building for civil servants, pilot projects for showcasing and advancing understanding of the technology in the regional context, and regional policy development. The technologies that were included were LEDs and CFLs. It was implemented by UNDP's regional office in Barbados. Seven countries participated in the project, and a pilot project was carried out in each country. Two tested LED street lighting (Antigua and Barbuda and Grenada), while the others tested indoor LED lighting in public and commercial buildings. The Grenada project was initiated, but no results have been published.

The Antigua and Barbuda project was completed. The results of the project formed the basis for a finance application to the Caribbean Development Bank to scale-up the project, which was successful in raising USD 5.9 million (CDB, 2016). The success of this application illustrates that the LED technology works in the regional context and proves the energy and financial savings, at least for public lighting. Even though the experience cannot be directly transferred to residential lighting, it has increased the interest from the public sector to enhance the efforts to expand the application of EE lighting technologies, which has provided a spill over effect into the potential benefits of EE residential lighting.

The Caribbean countries share much of the same characteristics and context, facilitating the transfer of experiences from one case to another. In this light, the results of the indoor lighting projects become interesting for Grenada. As international experiences demonstrate, the retrofitting of LED lights is a profitable investment with a high internal rate of return and a low payback period; this is especially true in a Caribbean context with high energy prices. In terms of lessons learned relevant for the acceptance of the technology by the general population, it was observed that the people of the Caribbean generally prefer a higher coloured temperature of the LED lights than what is usually preferred.

Current Projects in Grenada

The following section presents current ongoing projects relevant to EE lighting in the residential sector in Grenada:

Table 2: Current EE related projects in Grenada

Name	Time period	Where	Project Description in short	Main Actors
Renewable Energy and Energy Efficiency	2012-2016	CARICOM member countries	Aims to creating regional expertise to develop a regional energy strategy through building the	CARICOM Secretariat, CARICOM Energy Unit, GIZ

Technical Assistance (REETA)		and Dominican Republic	capacity of regional establishments within the field.	
'Reform of the Electricity Sector to support Climate Policy in Grenada' (G-RESCP)	2015-2017	Grenada	Support the GoG in restructuring the energy sector through introducing new legal and regulatory frameworks.	GoG, East Caribbean Energy Regulatory Authority (ECERA), GRENLEC
Technology Needs Assessment (TNA)	2016-2017	Grenada	The TNA process priorities suitable mitigation and adaptation technologies for the particular country, and find ways to introduce them.	GoG, UNEP DTU Partnership
Sustainable Energy for the Eastern Caribbean (SEEC)	2015-2018	OECS member countries	Aims to reduce dependence on imported fossil fuels through capacity building, market creating and raising awareness of appropriate renewable and efficient energy technologies.	CDB, financed by EU Caribbean Investment Facility, UK Department of International Development, and GEF.

The Renewable Energy and Energy Efficiency Technical Assistance (REETA) is a GIZ project that aims to develop a regional energy strategy, creating regional expertise and promoting networks between actors. The secretariat is located within the CARICOM secretariat in Georgetown, Guyana, and thus works closely with the CARICOM energy unit (see below). The project has not been active in Grenada, yet (Personal Communication with the GoG, 2016).

Another on-going project is the 'Reform of the Electricity Sector to support Climate Policy in Grenada' (G-RESCP) project, also implemented by GIZ, funded by the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB). The project supports the GoG in their work to reform the energy sector that is based on the reform of the Electricity Supply Act (GIZ, 2015). The current aim of the reform is to diversify electricity generation both by source but also geographically, allowing for own generation as well as distribution.

There are also several existing regional institutions that are working on energy efficiency as a focus area. Examples are the CARICOM Energy Unit and the Caribbean Centre for Renewable Energy & Energy Efficiency (CCREE). The CARICOM Energy Unit supports the different nations in their policy development as well as coordinate common policies in several areas. The unit has participated in capacity building sessions with among others the REETA project (CARICOM, 2016).

There are also global energy initiatives that have activities in Grenada. United for Efficiency (U4E) and Sustainable Energy for All (SE4All) are performing global studies, as well as country assessments, thus producing knowledge products on different aspects of EE.

The previous and current projects in Grenada and the region have helped build the capacity of Grenada to develop a NAMA on this topic. This NAMA also builds on the lessons learned regarding energy efficient lighting that earlier projects have uncovered. The focus of this NAMA is narrowed to

energy efficient lighting in the residential sector. The added value of this NAMA project lies in the transformational change it will have on the residential lighting sector, as well as the experience that Grenada will gain in developing and implementing a NAMA.

Institutional Arrangements

Appropriate institutional arrangements are key to make the NAMA successful. The institutional arrangements delineate the different roles and responsibilities of the key stakeholders in the design and implementation of the NAMA, and establishes decision-making hierarchies and communication channels. Having clear and strong institutional structures in place facilitates, therefore, the implementation of the NAMA activities greatly.

NAMA Steering Committee

The NAMA Steering Committee's task is to coordinate the relevant stakeholders and make overall decisions regarding the NAMA, ensuring that the NAMA is being implemented, and that eventual corrective actions are taken in case implementation does not go according to the established and agreed upon NAMA Action Plan. The following stakeholders are proposed to take part in the NAMA

Association of Electrical Engineers
Bureau of Standards Grenada
Chamber of Industry and Commerce
Grenada Customs & Excise Division
Department of the Environment
Economical and Technical Cooperation
Energy Division
GRENLEC
Inland Revenue Department
Ministry of Education
Ministry of Legal Affairs
Ministry of Trade
Ministry of Works (Electric Department)
Physical Planning Unit
Social Development and Housing
Solid Waste Management Authority
Statistics Division

Steering Committee. Their selection is based on the suggestions that came out of the NAMA Managing Entity (Energy Division), and through a consultation process in a national workshop with the relevant stakeholders (17-18 January 2017). The list of relevant stakeholders is shown above in alphabetical order. Those in bold also form the NAMA Steering Committee.

It is important to consider the potential synergies between this NAMA, other NAMAs under development[1] and future NAMAs in the institutional arrangement. As Grenada does not currently have a NAMA Steering Committee, the formation of one is an opportunity to create an overall structure that is not only suitable for this particular NAMA, but includes actors that are strategically important for other NAMAs as well.

Furthermore, when creating these institutional structures, it is useful to build on existing arrangements. If there are ways in place to create inter-ministerial working groups, or if an inter-ministerial group on energy or climate change already exists, utilising this would be a good start.

[1] There is currently a NAMA on Energy Efficient Lighting in the Commercial Sector being developed as a cooperation between UNDP and the Government of Grenada.

Technology Analysis

This section introduces the technological options that exist for lighting in Grenada as well as a cost-benefit analysis of the different technologies.

Introduction of Technology Options

Within residential lighting, there are three relevant technological options to be considered in the analysis in the Grenadian context. These are incandescent lightbulbs (ICLs), compact fluorescent lightbulbs (CFLs) and light emitting diodes (LEDs). There are many different varieties of each of the three technologies; for the purpose of this comparison, three lamps that perform the same function have been chosen. The function is to provide light in a residential setting. Thus, the three chosen technologies emit approximately the same number of lumens. The three chosen products are also among the most commonly sold within the respective technologies.

The technological specifications are shown in the table below.

Technical assumptions per lamp type	ICL	CFL	LED
Watts	60	18	6
Lifetime (hours)	1500	8000	40000
Use per day (hours)	3.5	3.5	3.5
Purchasing price per lamp (XCD)	0.8	4.3	29

The technical specifications are taken from a report by the U.S. Department of Energy, where it conducts a life-cycle analysis on LED lights compared to CFLs and ICLs (U.S. Department of Energy, 2012). The comparison in this publication is between lamps that carry out the same function. The average use time per day is based on the Clean Development Mechanism (CDM) methodology on residential energy efficient lighting (UNFCCC, 2016b). The purchasing price of the lamps was estimated to this by the participants in the workshop. Attempts have been made to verify it with local suppliers, but so far without success.

Cost-Benefit Analysis of Technologies

The different technologies have different purchasing prices, maintenance costs, and lifespans, resulting in different replacement rates and operational costs. This allows for a payback period to be calculated. The formulas for each calculation are specified below:

- Replacement rate [lamp/year]:

$$\frac{Lamp\ use\ per\ day\ \times days\ in\ year}{Lifetime\ in\ hours}$$

  - This number specified how many lamps are needed per year.

- Annual operational cost (XCD/year):

$$Replacement\ rate \times price\ per\ lamp + \frac{(Watts \times lamp\ use\ per\ day\ \times days\ in\ a\ year)}{1000} \times price\ of\ electricity$$

- This number specifies the annual operation cost per year. The purchasing price is spread out over the time period. The annual operation cost is also calculated, excluding the purchasing price to allow for the payback period to be calculated without spreading the purchasing price of the lamp on its lifetime.

- Payback period (years):

$$\frac{Annual\ operational\ costs}{Annual\ operational\ costs\ (ICLs)}$$

  - Calculated in comparison to the ICL, i.e. how long it takes for the investment of buying a more energy efficient lightbulb at a higher price has generated enough savings for it to go break-even. It is also calculated with the purchasing price not accrued, thus incurring the entire cost at the time of purchase.

Cost-Benefit Analysis of Technological Options	Units	ICLs	CFLs	LEDs
Replacement rate	Lamps/year	0.9	0.2	0.03
Annual operational cost	XCD/year	26.8	7.2	3.5
Payback period	Years	NA	0.3	0.1
Annual operational cost, excluding purchasing price	XCD/year	26.1	6.5	2.6
Payback period, purchasing price not accrued	Years	NA	0.4	1.2

The cost-benefit analysis shows that ICLs have the highest annual operational cost of the three technologies, with CFLs having an operational cost of less than a 1/3, and LEDs slightly more than a 1/9 of that of ICLs. If we look at the payback period of buying a CFL or LED lightbulb instead of an ICL, a CFL pays back after 0.3 years, thus roughly four months; the LED bulb is paid back already after a bit more than a month. If the entire purchasing price is incurred in the first year, the payback period does increase, especially for the LED as it is considerably more expensive than the ICL. However, it only increases to 0.8 years, or around nine months.

NAMA Objective and Targets

The NAMA Objective and Targets presented below were discussed at the workshop in Grenada with relevant stakeholders, including representatives of what will form the future NAMA Steering Committee[2]. The objective is to set the direction of the NAMA, whereas the targets concretise the direction through setting specific measurable targets.

[2] The stakeholders present at the workshop were the following: Representatives from the Policy Unit, Technical Cooperation and Energy Division under the Ministry of Finance. Representatives from the Environment Division under the Ministry of Agriculture Lands, Forestry, Fisheries and the Environment. Representatives from the Grenada Bureau of Standards, Customs & Excise Division, GRENLEC, UNDP Regional Office, GIZ-CIM, the RCC of the UNFCCC, OLADE and UNEP DTU Partnership.

NAMA Scope

The scope of the NAMA is defined both in terms of focus area and geography. The area of focus is lighting within the residential sector of Grenada. The geographical scope is nationwide, encompassing all three islands of Grenada.

It should be mentioned that there are parallel processes of NAMA formulation which go hand in hand with this NAMA. The Energy Division of Grenada is, together with UNDPs regional office in Barbados, developing a NAMA for Renewable Energy and Energy Efficiency in the commercial sector. The work to develop the NAMA on EE lighting in the residential sector has and continues to be coordinated with the newly initiated NAMA efforts supported by UNDP, in order to ensure that they create synergies, building upon each other's analysis and results and both streamlining their objectives with the intent to mutually contribute to the overall policy objectives of Grenada, while avoiding duplicating work.

NAMA Objective

The objective of the NAMA is as follows:

> Achieving energy savings and GHG emission reductions through increased accessibility to energy efficient lighting technologies in the residential sector.

The key phrase in the objective is 'increased accessibility'. During recent years, a significant of Grenadians has started adopting energy efficient lighting technologies, and in the BAU scenario, proportion is set to increase, why the NAMA aims at increasing the expected rate of adoption of technologies. There was no data available to do a more detailed analysis of how the adoption would look in different socio-economic groups. However, given that one of the major identified barriers is high-upfront costs for the more efficient technologies (this barrier is described in more detail in the

Barrier Analysis), the adoption of the cost-saving technologies is often slower in the low-income segments, due to the lack of funds to cover higher up-front costs. Thus, the objective of the NAMA is not only to increase the rate of adoption of the energy efficient technologies, but it is also to facilitate access to the lower income segments.

The objective above is derived from the consultation process in the workshop on Grenada. 'Energy savings' is added in this proposal to the previous focus on achieving just GHG emission reductions. While the estimated reductions are modest, the combination with the results of energy savings can strengthen the NAMA by contributing to both lower electricity bills as well as a decreased fossil fuel dependency.

NAMA Targets

The overall NAMA objective is accompanied by three targets which specify the objective. The first target, which is divided into a and b, sets out the ambition level of the phasing out of ICLs as well as the pace to increase energy efficient lighting. The second specifies the emission reduction, while the third target specifies the financial savings, which will later be related to sustainable development co-benefits.

Target 1: Adoption of EE lighting technologies in the residential sector

A

The first target aims to increase the use of energy efficient lighting in the residential sector by 30% by 2025 compared to the baseline of 2017.

B

In order to increase the accessibility to energy efficient lighting, it is also important to make the alternative, ICLs, less attractive. This is especially true given the initial price difference between the technologies which constitutes a substantial barrier. The gap cannot only be closed by decreasing the price of the EE technologies, but needs to be coupled with price increases of the inefficient technology as well. Moreover, such an approach also draws on the polluter pay's principle, enshrined in the Rio Declaration of 1992 which Grenada is a party to (UN, 1992).

This is captured in a target to phase out the ICL completely by 2025. This target will be achieved by decreasing the use of ICLs with 25% in first annual and later bi-annual intervals, as shown here to the side. This is from the base year of 2017.

Target 1b: Phasing out ICLs by 2025

25% less use by 2018
50% less use by 2021
75% less use by 2023
100% less use by 2025
(Base year: 2017)

Target 2 GHG emission reductions & Energy Savings

Target two specifies that the emission reduction, as well as energy savings, should be 30% by 2025 compared to the BAU scenario. As there is a linear relationship between the GHG emissions and the energy savings in this particular NAMA, the same development of both parameters can be expected.

Target 3 Financial Savings

Target three specifies that the financial savings should be 25% by 2025 compared to the BAU scenario.

NAMA Baseline and Mitigation Scenarios

The following section presents the NAMA Baseline and Mitigation Scenarios. The Baseline Scenario, also called the Business-as-Usual (BAU) Scenario, is first presented. It builds on the current energy system, and through a historical trend extrapolation approach through which the future technological trends are sketched. The NAMA Mitigation Scenarios are what is projected to happen if the NAMA is implemented. There are two NAMA Mitigation Scenarios, Scenario 1 (S1) and Scenario 2 (S2).

Baseline Scenario

The baseline scenario builds on two components - the present energy system and its projected development, as well as the technological development and adoption rate of lighting technologies. The text below first describes the energy sector with a strong emphasis on electricity. Secondly, a set of key figures and assumptions are presented from which the BAU scenario is drawn.

Energy and Electricity in Grenada

Energy generation in Grenada is, as in most Caribbean island states, heavily dependent on imported diesel (Energy Transition Initiative, 2016; GoG, 2011). This has a direct impact on the price ~~for~~ of electricity, as more than 50% of the electricity price depends on the fuel price, making the economy and households sensitive to fuel price fluctuations (GRENLEC, 2016). Moreover, this makes the Grid Emission Factor (tCO_2 emitted per MWh produced) high in an international comparison. The GoG reports to the UNFCCC that its grid emission factor is 0.634 tCO2/MWh on the island of Grenada, while it is slightly higher on Carriacou (0.675) and considerable higher in the much smaller electricity plant on Petit Martinique (0.890) (UNFCCC, 2016a).

Grenada has one utility company named GRENLEC. It was founded in 1961 as a public company, and was granted the sole and exclusive license to generate, transmit, distribute and sell electricity in Grenada until 2041. In 1994, GRENLEC was privatised by the GoG selling 50% of its shares to a Canadian company (GRENLEC, 2015).

The current installed capacity is 48.6 MW, and the peak load is 30.9 MW, making brownouts rare (GRENLEC, 2015). There is a very high degree of access to energy, as Grenada has a 99.5 % national electrification rate. However, the high energy prices limit actual access as it becomes unaffordable for many families (SE4All, 2012).

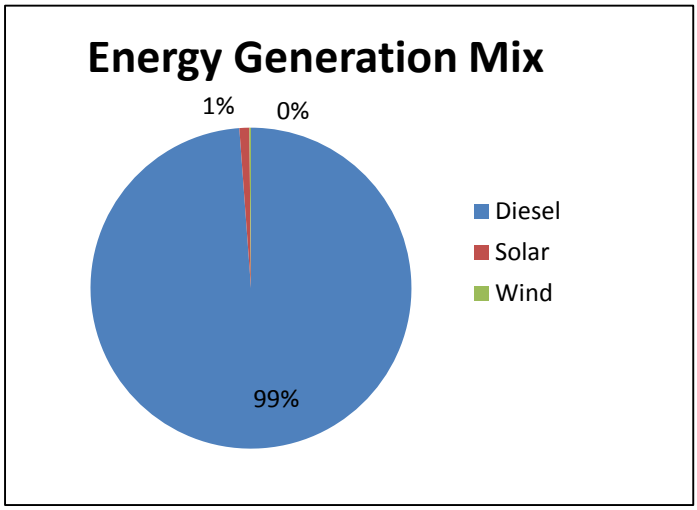


Figure 1. Source: (Energy Transition Initiative, 2016)

Figure 1 illustrates that there is currently a small portion of renewable energy sources, mainly solar, followed by wind power. The share of renewables is expected to grow in the future aligned with efforts to diversify the energy matrix, improve energy security and transition towards low carbon development. As was described above, the goal set out in the National Energy Policy is that 20% of electricity and transport energy should come from renewable sources in 2020. In the workshop consultation held in Grenada, it was stated that this goal will not be achieved - the current penetration

rate of renewable energy is 1.85%. Given that there is an uncertainty of this development, this NAMA assumes that the Grid Emission Factor will remain the same for this time period.

The second component rests on a number of figures and assumptions which are specified below.

Key Figures and Assumptions	Value	Unit	Comment/Source

Number of households	41400	Number	Assumed to be constant throughout the period[3]. Changes would result in positively correlated changes in energy use, GHG emissions, and financial savings.
Average lightbulbs per household	10	Number	The estimation is derived from discussion with the workshop participants. Needs verification. Changes in this would affect the energy use, GHG emissions, and financial savings.
Lamp use per day [hours]	3.5	Hours	The assumption used in CDM baseline calculations for energy efficient lighting in residential settings (UNFCCC, 2016b).
Days in a year	365	Days	
Grid Emission Factor	0.634	tCO2/MWh	Taken from (RCC St. George, n.d.). The grid emission factor for the island of Grenada is used, as the lion share of the population lives there, and to maintain a conservative approach.
Economic assumptions			
Purchasing Price ICLs CFLs LEDs Price of electricity Exchange rate, XCD to USD	 0.3 1.6 10.75 0.34 2.7	 USD/bulb USD/bulb USD/bulb USD/kWh XCD/USD	The prices of the bulbs are kept constant over the period. The prices matters most for the more energy efficient technology, that also have very long life times. As the time period of the NAMA only is eight years, the impact of the prices is neglectable. Sources: Prices are verified with the workshop participants. The price of electricity is taken from (Energy Transition Initiative, 2016), and the exchange rate from (XE Currency, 2017).

Table 3. The source is (GRENLEC, 2015), except the USD price/kWh which comes from (Energy Transition Initiative, 2016), and the GDP/capita figure comes from (UN Data, 2017).

Year	ICLs	CFLs	LED
20094	95	5	0
20175	55	30	15
2018	50	33	17
2019	45	36	19
2020	40	39	21
2021	35	43	22
2022	30	46	24
2023	25	49	26

[3] This assumption will be dropped and population growth will be taken into account (based on the historic population growth).
[4] (UNDP, 2014), numbers from Barbados extrapolated for the OECS.
[5] Modified estimation given by workshop participant in Grenada, 17-18 January 2017.

The construction of the BAU scenario has in the lack of data to perform alternative analyses taken a~~n~~ historical trend extrapolation approach, where the point of departure in how the adoption of the different lighting technologies has developed over time in the past, and the trends are then projected into the future. The data on the use of the different lighting technologies is derived from two sets of data at different points in time. The development between these two time periods is then simply projected into the future, assuming a linear development. The result can be seen in the table below.

2024	20	52	28
2025	15	55	30
2026	10	58	32
2027	5	61	34
2028	0	64	36

Table 4. The Projection of Use of Different Lighting Technologies.

According to the BAU, ICLs will be phased out completely by 2028. There is a steady growth of CFL and LED use, with both types growing their share at an equal pace. The technological development results in lower energy use, GHG emission reductions and generates financial savings. Comparing the final year to the base-year, these three parameters have decreased by respectively 69% (for GHG emissions and energy savings) and 68% (for financial spending).

As described in the table above, the BAU is based on a number of assumptions; these leave room for further investigations and revisions to increase the accuracy of the BAU scenario, as data is gathered during the NAMA's implementation. An additional implicit assumption has been built into the model, namely that the number of lamps, and the light they produce, is constant. The assumption disregards the risk of a 'rebound effect'. The 'rebound effect' has been documented in many different circumstances where financial savings due to improved energy efficiency actually lead to a higher energy consumption by users (see e.g. Greening, Greene, & Difiglio, 2000). This is one example of circumstances that require a more detailed analysis in the context of Grenada, and should be investigated as part of the NAMA implementation monitoring process.

Furthermore, a BAU scenario based on two observations transposed from other countries does not constitute a robust basis for scenario creation. Further efforts should be made to retrieve data on the current as well as historical development of the use of lighting technology, and should be included in the monitoring reporting and verification (MRV) design of the NAMA.

Mitigation Scenario

Based on the targets that are established for the NAMA, two mitigation scenarios are presented below, and compared to the BAU scenario. The targets of the NAMA are to phase out ICLs by 2025, and to achieve energy efficiency gains and GHG emission reductions of 30% respectively, and financial savings of 25% compared to the BAU scenario. The two scenarios are created as there are uncertainties of the rate of adoption of the two alternative more efficient technologies. The creation of two scenarios illustrates potential future situations, enabling decision makers to identify which future outcome is more attractive, and devise actions to direct development towards the more attractive end results. Neither scenario complies fully with the parameters set up by the NAMA stakeholders during consultation; NAMA Scenario 1 follows the target of phasing out ICLs by 2025, but takes a conservative approach regarding the rate of adoption of the most EE technology, leading to a modest reduction of GHG emissions, energy use, and financial savings. NAMA scenario 2, on the other hand, takes a fast implementation approach, achieving a phase-out of ICLs by 2023, and a higher adoption rate of the most efficient technology.

Scenario 1 is a scenario where actions introduced by the NAMA lead to a phase out of ICLs by 2025, leading to a higher adoption of CFLs and LEDs to fill the space of the phased out ICL. A linear growth is assumed, resulting in both reduced energy use for the same provision of light as well as the GHG emissions. This projects an increased use of both CFLs and LEDs as a result of the NAMA, and a corresponding decrease of ICLs. The scenario is continued to 2028 for the sake of comparison with the BAU scenario. In 2025, when the ICLs have been phased out, the distribution between CFLs and LEDs is assumed to be constant for the foreseeable future, as the policies introduced will benefit both technologies, even though it is expected that over time, technological development and decreasing LED prices, LEDs will slowly take shares of the CFLs. Scenario 1 is illustrated in figure 3 below.

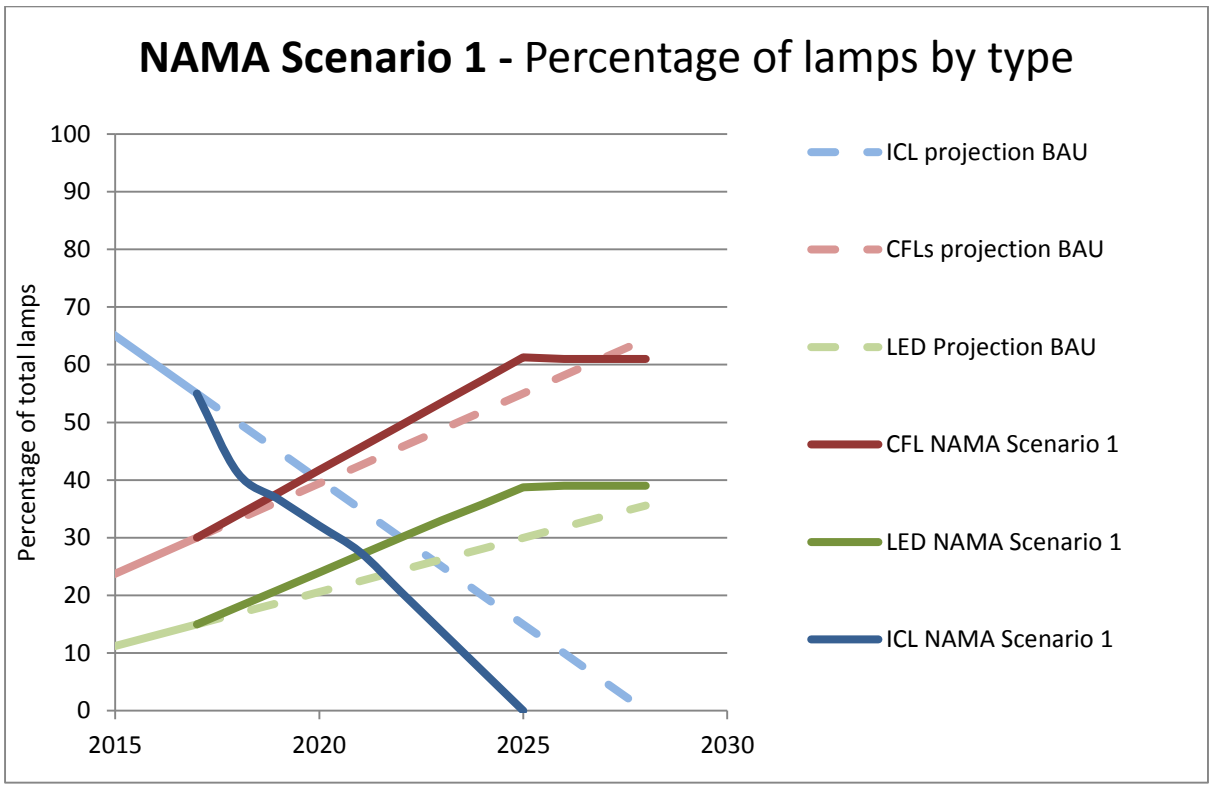
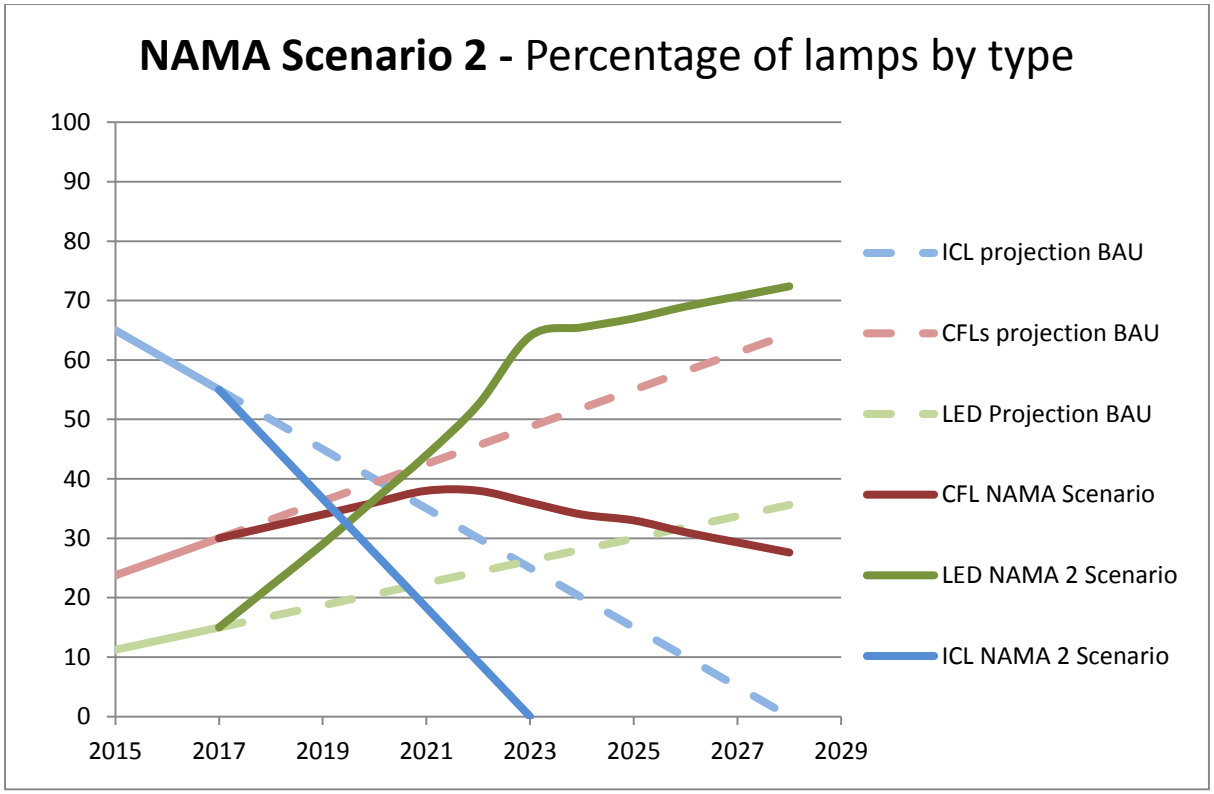


Figure 2. NAMA Scenario 1 - Illustration of the development of the shares of the three technologies under the NAMA Scenario 1.

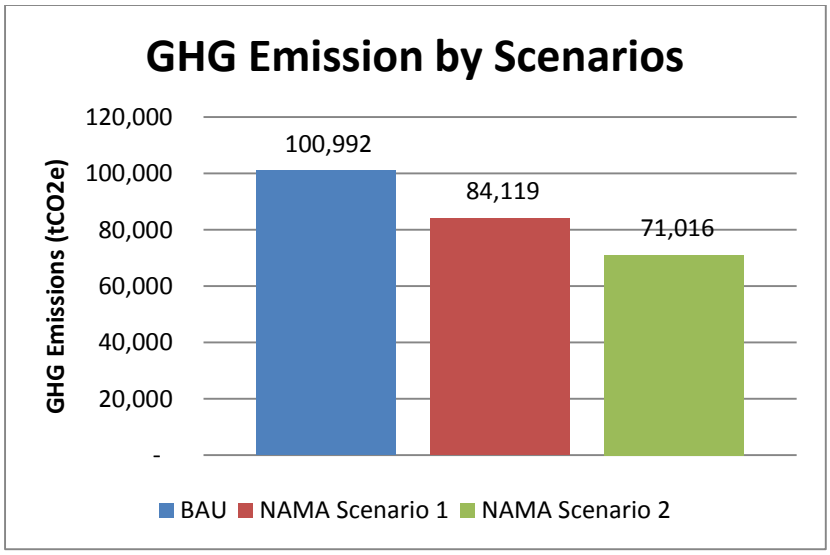
Scenario 2 sees a quite different development for all three types of technologies. The introduced measures are tougher on ICLs in order to phase them out faster, and the support provided will be stronger targeted to the most energy efficient technology, which thus excludes CFLs. This results in a faster expansion of LEDs, and a faster decline of ICLs. Furthermore, while the share of CFLs initially continues to grow, the expansion of LEDs soon take shares from CFLs as well.

Moreover, the policies which have been introduced have favoured LEDs more, and will continue to do so. Thus, after 2025 when ICLs are phased out, the introduced policies will continue to favour LED lights, pushing them towards grabbing market shares from CFLs as well.



The two NAMA scenarios result in decreases in electricity use and GHG emissions[6], but of varying degree. Figure 3 shows the aggregated GHG emissions in the BAU and two NAMA scenarios. S1 results in a GHG reduction of 16,883 tCO_2, or 16% compared to BAU, while S2 reaches a reduction of 29,976 tCO_2, equivalent to a 30% reduction compared to the BAU.

Figure 3: GHG Emissions by scenario



[6] As the energy use, GHG emissions, and the cost of electricity are linearly correlated in this NAMA, as neither the grid emission factor nor the electricity price changes no matter how much electricity that is consumed, the changes in one of these parameters are reflected 100% in the other.

The reduced energy use would also result in financial savings of a similar magnitude. While the electricity cost accounts for the lion's share of the total cost, the cost of the lightbulbs is taken into account as well. This means that in S1, there is a 15% financial saving while there is a 28% financial saving in S2. Expressed in XCD, this represents a saving of respectively 740 XCD in S1 and almost 1400 XCD in S2 per household. It should be mentioned that this way of calculating distributes the purchasing cost of the lamps over its entire life-time, which does not accurately represent the reality faced by households in the lower income strata as it is the high upfront costs which prevent~~s~~ many from making the switch.

There has been no accessible data to calculate the decline of the ICLs for either scenario. In general, one can say that the price elasticity of demand of ICLs is a decisive factor, and also the cross-price elasticity of demand to CFLs and LEDs. A brief search for data shows that the price elasticity of demand for lighting is -0.6 (Fouquet & Pearson, 2011), which means that a 1% increase on the price of the light bulb results in a 6% drop in demand. As this value is transposed from studies based on UK data, this needs to be monitored during the NAMA implementation to implement corrective actions, if the demand for EE lighting technologies does not respond according to this assumption.

Summarizing, the two NAMA Scenarios comply with different aspects that the participants in the workshop identified as important. S1 keeps to the time plan of phasing out the ICLs by 2025, as a faster phase-out was perceived as unrealistic from some of the consulted stakeholders, and also as potentially risky as it could result in residents hoarding ICLs. S2 sets a tighter time plan for this, and is in line with potential achievements expressed by other stakeholders, thus achieving a GHG emission and increase in energy efficiency of 30%.

Barrier Analysis

The following two sections, the Barrier Analysis and the Action Plan, are heavily based on the workshop held in Grenada in January 2017. The Action Plan, in particular, is crucial that it is well-grounded with the stakeholders who are to develop and implement it.

The Workshop participants were divided into three groups - Policy, Finance, and Technology - depending on their area of expertise. They were encouraged to address the following tasks from these perspectives to ensure that the barrier analysis and prioritisation are based on a comprehensive analysis of the present situation.

Each group had to prioritise the top barriers across all the categories. The resulting list forms the basis for the Action Plan that is presented in the next section.

Political Barriers

There are two sub-headings under Political barriers; one concerns the institutional and organisational structures while the other focuses on the framework created by policies and regulations. There are considerable barriers in both groups.

Institutional and Organisational Barriers

The barriers under this heading fall under two major categories - a danger of missing political commitment and lacking coordination between the ministries. The workshop participants see a political commitment to the NAMA measures as a key to a successful NAMA. With this background, the participants raise a concern that it is difficult to secure political commitment to the measures that are necessary. Usually, a champion is needed to ensure that the regulations are developed and implemented, and some participants raised the concern that as the scope of the NAMA is limited to only residential lighting, it might be too small an issue for anyone to invest political capital into. Furthermore, political decisions are based on a multitude of reasons, where the technological reality does not have a history of being the most prominent in Grenada.

The participants identify several barriers relating to the governmental institutions and their processes. There is a lacking coordination between different ministries. For the purpose of this NAMA, the coordination and cooperation between the Department of Environment (which pertain to the Ministry of Education, Human Resources and The Environment) and the Energy Division (that pertains to the Ministry of Finance and Energy) is especially highlighted as a barrier due to its importance in implementing this NAMA. Moreover, there is a complicated bureaucratic process to approve regulations in Grenada, which burdens the process further.

Policy and Regulatory Framework

The policy framework constitutes a barrier in so far as that it is mostly lacking to promote energy efficient lighting. The participants identify a lacking framework both in relation to the relative prices of the lighting options, as well as in relation to quality. There are no taxes providing incentives for the energy efficient options, nor any dis-incentivising conventional lighting. This underlines what has been mentioned above regarding the current VAT exemption for energy efficient lightbulbs - that it is not sufficiently specific.

There is also a lack of quality assurance of the products that currently enter the market. This fuels the underlying scepticism of energy efficient lighting that was established when many free EE bulbs where

distributed which later failed. Furthermore, there is a general lack of enforcement of the existing regulation which would constitute a challenge for new regulation as well.

There is lacking capacity within the Ministries. This is both in regards to drafting new laws, as well as enforcing existing ones. This also risks creating a so-called positive feedback loop where the lacking ability to develop coherent regulation makes it difficult to enforce them properly, which further strains resources, making implementing new regulation even more difficult.

Economic Barriers

The subsections of the economic barriers are economic, financial and market conditions. A similar pattern to the situation emerges here as well, where its rather the lack of elements that constitute a barrier than the opposite.

Economic Barriers

The barrier identified is high upfront costs for the technology. As described above, switching to more energy efficient lighting saves costs as the energy use decreases considerably, but these come in increments over time. The purchasing of the lightbulb, on the other hand, occurs at one time. As the price of a more efficient light bulb is substantially higher than for an ICL, and both satisfy the same immediate need (providing light), many consumers opt for the ICL in the purchasing moment.

This is especially true for the lower income segments, where the more limited disposable income might mean that one has to choose between necessities if one goes for the CFL or LED. If a person then is forced between buying an energy efficient lightbulb (thus providing light) or another necessary commodity, it is likely that they would opt for a cheaper light bulb, allowing them to retrieve both.

Financial Barriers

The participants perceive a lack of interest from financial institutions regarding this issue, which results in a lack of finance to solve it; this is especially true in relation to the upfront cost mentioned above. There is currently only one financial institution that offers a product that includes financing for energy efficient lighting, and that is the Grenadian Development Bank (GDB) which provides loans for energy efficient renovation of houses, within which lighting can be a component. It is discussed if the lacking interest is due to the very small scale of each investment, and whether it can be bundled so as to achieve larger volumes.

Market Conditions

There are several barriers nested within the market conditions as well, many of which are related to the barriers mentioned above. The lack of standards mentioned under the 'Policy and Regulatory Framework' also creates issues on the market, as it becomes difficult to know with certainty that the products uphold a certain standard. A related issue is that the labelling of the products sometimes are in languages that are spoken by few in Grenada. This further decreases the information that the consumer can access in the purchasing moment.

Capacity Barriers

Capacity barriers are divided into two categories - 'Human' and 'Data and information'. Similar to the barriers identified above, they most often consist in the lack of competencies or systems.

Human Capacities

The workshop participants identify that there are lacking human capacities in many different aspects of the Grenadian society in relation to EE lighting. This stretches from a lack of training of technicians to install CFLs and LEDs instead of ICLs, to the personal in stores where lighting is being sold as they are not aware of the benefits of EE lighting for the customers.

There is also a lack of capacity within state institutions such as the Customs and Excise Division to monitor imported products. There is also a lack of knowledge within the Ministries to advice the political decision makers. This adds to the issue raised above with a potential unwillingness to champion this politically. If there is lacking knowledge of the merits of these measures, it is even less likely that it will be championed.

The lacking human capacity is not limited to lacking knowledge, but also to having sufficient staff resources. Moreover, while some of the earlier mentioned programmes have targeted public officials to build their capacity within these areas, the participants identify lacking procedures to retain knowledge when staff leaves. The participants also noted that there is a lack of finance to build the necessary capacity.

Data and Information

There is a general lack of data which makes the justification as well as monitoring and evaluation of measures difficult. This is related to lacking human and institutional capacities in terms of establishing data collection routines and reporting routes for the data.

Social Barriers

The social barriers are within two categories: 'cultural' and 'public awareness'.

In general, there is no focus on energy efficiency within the communities in Grenada; it is not considered to be one of the more important topics. The lacking human capacity identified above goes hand in hand with this, as if it is not seen as a prioritised area, there is no need to build capacity in it. This is coupled with a general negative perception of new (and expensive) technology, as well as that many already have experience with low quality energy efficient light bulbs; these experiences have left traces, as many in the population are sceptical of it. Moreover, the participants describe that there is not a large openness to change in Grenada, especially not if there is not a concrete reason to do so.

The negative perception is further fuelled by the fact that there are issues surrounding the handling of the disposed bulbs. As CFLs contain harmful chemicals, this is labelled on them. However, as there is a general low level of public awareness surrounding this, the harmful chemicals in CFLs easily become harmful chemicals in all energy efficient lights.

Prioritisation of Barriers

The following step in the workshop was to prioritise the identified barriers. Each of the groups - Finance, Policy, Technology - choose the top five barriers from all groups. This produced a list which was further discussed, resulting in the following list.

#	Barrier	Type
1.	High up-front cost	Economic
2.	Lack of adoption/enforcement of standards for import of EE lights	Regulative
3.	Lack public awareness on benefits and costs of EE lighting	Social

4.	Lack of an institutional and organizational coordination	Institutional
5.	Lack of policies and regulation to promote EE lighting	Regulative
6.	Lack of human capacities and equipment and technology to carry out necessary tasks	Capacity
7.	Lack of finance to implement the NAMA	Economic
8.	Lack of capacity in the public and financial institutions	Institutional
9.	Lack of data and data management	Institutional
10.	Lengthy and complicated political processes for decision making	Institutional

If one sees the top barrier, high-up front cost, as a consequence of lacking incentives for EE lighting/dis-incentives for ICLs, then the majority of the most important barriers are due to lacking institutional or regulative measures. This underlines the importance as well as the potential that this NAMA has, as the only actor to can address these barriers is the government of Grenada. The political as well as institutional commitment is decisive for this to happen, and the measures presented below are contingent on this.

NAMA Action Plan

The action plan lists the specific measures proposed to address the prioritised barriers above. The workshop participants discussed. In that it was national experts on Grenada that partook in the workshop, those suggestions are likely well aligned with the current context. The Plan also specifies who is responsible for carrying out the action, and the estimated cost. The total estimated cost is 120,000 USD, where the lion's share is for a public awareness campaign; much of the rest of the work is provided in-kind.

High upfront costs

Introduce a temporal lowering of the Value Added Tax (VAT) on the energy efficient lightbulbs. An important distinction between the two scenarios need to be made here, as in S2, the lowering would only apply to LED lights. The time period of the lowering should be announced before-hand, and be between 9 months to 1 year.

There are also other measures that can be taken. These goods can also be exempted from the Customs Service Charge (CSC) of 6%. A longer process includes lowering the Common External Tariff of 20%. However, as this is common for the CARICOM region, it is not the prerogative of the Grenadian Government, but a joint decision needs to be taken at the Ministerial Meeting of Trade Ministers. As this is a longer process, only an encouragement to bring it up at the next meeting is proposed as an action point.

The lowering of the costs of the energy efficient lights should be coupled with a price increase of the ICLs, so as to decrease the price gap between them. Increasing the VAT of the ICLs could be a straight forward way to do this. However, to keep differentiating such a general tax as the VAT decreases the transparency and predictability of the economic system in general; there is a risk that those within the system start to perceive it as arbitrary.

Another option would be to introduce an environmental levy. This would be a new type of tax, which the government could specify the criteria for when it would come under consideration. In this way, it

could also become a useful tool for future NAMAs. In S2, it is suggested that it would start to apply to CFLs as well after 2022, to ensure a higher shift to the LEDs.

Responsibility: Ministry of Finance, Inland Revenue Department

Timeline: The implementation would be in two steps: the incentives are to be introduced as soon as possible. The tax increase should first be introduced in 2018.

Cost: 6000 USD, which includes staff time and 2000 USD for holding one or two consultations. There would be additional time allocated in-kind from the government for this.

Lack of adoption/enforcement of standards for imports of EE lights

The representative from the Customs and Excise Division points to that when energy efficient light bulbs are imported into Grenada, they usually arrive in fixtures. The current VAT exemption described above does only apply to individual light bulbs - a further differentiation of the categories of imports is needed. This categorisation, however, is made on the CARICOM level, and is thus connected to the same time-line that is described above for the exemption of the Common External Tariff.

The capacity to carry out an investigation and develop a proposal that complies with the necessary regulation, and achieves what is intended, is not held within the Government. The agreed solution is thus for the relevant government body to call for applications for a consultant to conduct a study, and deliver a proposal that the Government of Grenada is to propose for the CARICOM Ministerial Meeting.

Responsible: Grenada Bureau of Standards, CRSQUE (a CARICOM body).

Timeline: 2019 (24 months).

Cost: 7000 USD for a consultancy.

Lack of Awareness on Benefits and Costs of EE Lighting

Given the lack of public awareness of the benefits and costs of EE lighting, a public awareness campaign needs to be launched. This is to be developed and implemented by the government official. The following steps need to be taken:

- Identification of target group (school children and retailers are two suggested groups)
- Identify media for communication
- Develop stories, texts, public service announcements, as well as skits educating about the topic
- Develop and carry out demonstration activities throughout the country (show how different lamps uses energy, and translate this to costs)
- Have a targeted programme towards retailers

Responsibility: The Energy Division is responsible for identifying who can develop and implement such a strategy.

Timeline: 18 months.

Costs: 100,000 USD as a minimum. Add space on TV and other media outlets are expensive. The cost is if one does all of this without any prioritisation. The government would also add in-kind contributions, such as that they have TV channels.

Institutional and organisation structure for coordination

The way forward here is to establish the NAMA Steering Committee, which is described above. The Committee is to oversee the development and implementation of this NAMA, but the structure could also be used for other NAMAs, though with other relevant actors.

Responsibility: The Energy Division. The establishment of a Steering Committee requires a cabinet decision, but it is the Energy Division which should develop the proposal.

Timeline: Within the first half year of 2017.

Cost: Covered in-kind.

Lack of policies and regulation to promote EE lighting

The Energy Efficiency Act that is currently being worked on will be an important tool to promote EE in general - it is within in this act that measures to regulate EE likely will be found. A first draft of the EE act is to be expected this April - if there is a consultation process, actors should suggest to include measures relevant for this NAMA. This responsibility lies primarily with the Energy Division, but the message will be stronger if it comes from many actors.

The participants also pinpoint that there is a need to phase out the ICLs consistently with the objectives of the NAMA. While the changing of the relative prices through differentiating the VAT, duties, and taxes will achieve some of it, more regulative measures are likely needed as well. It is proposed to introduce legislation to introduce quotas for ICLs, and to gradually decrease these over time. The gradual decrease would be equal to what is suggested in target 1b, as shown here.

Target 1b: Phasing out ICLs by 2025

25% less use by 2018
50% less use by 2021
75% less use by 2023
100% less use by 2025
(Base year: 2017)

It is also worth to point out that an import restriction based on this would ensure that industry and commercial actors as well shift away from ICLs. This measure should thus be coordinated with the NAMA under development for energy efficient lighting in the commercial sector.

Responsible: Energy Division

Timeline: Energy Efficiency Draft is due in April, and the responsibility to partake in the consultation process rests upon everyone. The timeline for the import quotas is to be introduced first in 2018.

Cost: Funded mainly through in-kind work.

Lack of Human Capacity and Equipment

This barrier refers both to technical capacity, as well as within the ministries. It also relates to the issue identified above regarding the difficulty to create and maintain an institutional memory as employees leave their positions for other jobs.

There is a general agreement that this is a central issue, and that special training of the personal is necessary. The earlier projects have increased the capacity, but more is needed. This proposal suggests for key personnel within selected ministries to get access to funds and resources, including time, to seek out training in the areas they deem necessary. This should be done according to a pre-determined plan agreed on with the supervisor.

The entire cost of this will not be covered in this NAMA, but should form part of a wider programme. However, the cost to develop a plan could be financed as part of this NAMA.

Responsibility: Ministry of Finance

Timeline: 1 year to develop a plan, the implementation will be continuous.

Cost: 5000 USD, part of it is in-kind work as well.

Lack of Finance to Implement the NAMA

The workshop participants perceived this as a barrier as to how to pay for the technology, and its distribution, especially to low-income households. The issue of this is that no actor responsible for such a coordination - purchasing of the bulbs, distribution and also finding ways to retrieve payments from the households - was identified. This way forward is thus not examined further in this proposal.

There is, however, a lack of finance for many of the capacity building measures that are needed to overcome the rest of the barriers. The way to finance this is to be further developed in a later deliverable.

Lack of Capacity in the Public and Financial Sector

The role of the financial institutions is in focus here, and what role they potentially could play. As the investment for lightbulbs does not concern large sums, financing these with bank loans is implausible as the transaction costs simply would be too much.

However, a proposal could be to collaborate with micro-credit organisations, which are used to handling loans with small sums. A possibility could be to create an incentive for the micro-credit organisations to add an extra loan on-top of their usual loan for investments in energy efficient lighting. The pay-back period of this loan should be adjusted to comply well with the payback period of the technology, and it could also be guaranteed from the government, enabling the micro-credit organisation to take a substantially lower interest rate.

The merit of such a suggestion is that it requires little extra work for the micro-credit organisation - they will visit their clients anyway - but they gain another product in their portfolio. The target group gets the information handed to them through a channel that they trust. The government gains as described below. Such a suggestion naturally needs to be investigated further; is it feasible, what rate of penetration would it have, what risks are entailed and so on.

Lack of Data and Data Management

The solution to this barrier will go hand-in-hand with the MRV system, and will thus be further elaborated there.

Lengthy and Complicated Decision-Making Process

This is an institutional issue that will not be solved easily. The workshop participants perceive the best way to solve this is through 'piggybacking' on existing or coming legislation. The 'Supply Trade Act and Licencing' is one example. Such an approach would require coordination between the different departments, potentially through the Steering Committee.

Later Actions

There are other actions that are necessary to consider, which will become necessary as the NAMA is implemented. For example, as there is a shift towards CFLs rather than ICLs, there will be an increased need for a waste handling system. This is particularly important for CFLs as they contain mercury.

It is not within this proposal's scope to suggest how such a waste management strategy should look like. This is due to several reasons: earlier projects in Grenada have targeted and built the capacity to deal with the waste issue resulting from changing lightbulbs. Moreover, the BAU scenario already contains a significant increase of CFLs in the next years, which means that this capacity needs to come in place in any situation. What can be noted, though, is that if the Government of Grenada chooses to opt for S2, there will be fewer CFLs generating less hazardous waste in terms of mercury.

MRV Action Plan

To be completed in deliverable 3. The proposed MRV system builds on existing structures. There are multiple benefits of this.

Monitoring

The essential parameter to monitor is the change of use of light bulbs in the country. As it is not feasible to measure this directly, a proxy is to track the different type of light bulbs which are imported into the country. The Customs and Excise Division already records the import of different goods, meaning that this should not constitute a significant extra expense.

Based on this data, it is possible to calculate the energy and financial savings, as well as GHG emissions. The other inputs for these variables are less variable, and accessible from other actors.

Starting to monitor this also provides the possibility to improve the baseline of this NAMA. The first numbers will provide an estimate of how the distribution of use of different light bulbs looks today, which can be compared to the baseline of this NAMA. The major benefit of this is that it does not let the lack of data to create a baseline constitute a barrier to take action.

Reporting

The reporting line of the NAMA is simple: it is illustrated in the figure above. The Customs and Excise Division provides the number of imported lightbulbs to the Energy Division. The Energy Division uses this input to calculate which percentage of the households have adopted energy efficient lightbulbs,

the progress on phasing out the ICLs, as well as the energy and financial savings and the GHG emission reduction. These calculations build on the expertise and information the Energy Division have. The information flow also adds the opportunity for the Energy Division to overview how the situation develops over time, and, as the main implementing actor, tweak or suggest additional measures if needed.

The final reporting step is to the NAMA Focal Point, which is the Permanent Secretary of the Ministry of Environment, Mr Andall. The office of Mr Andall is responsible for coordinating the reporting to the UNFCCC.

Verifying

The verification process needs to check that the population is actually using the imported energy efficient lightbulbs in their homes. As the Central Statistical Office of Grenada has as an objective 'to generate social and environmental indicators for the formulation, pursuit and evaluation of the policies that government can execute' (Central Statistical Office of Grenada, 2017), this lies squarely within their area of competence. When conducting household surveys, it could be possible to include questions regarding the type of lighting they use at home and their average use time.

Moreover, such a review would also allow seeing which socio-economic groups that are using the energy efficient lightbulbs, and shedding light on if more measures are needed to overcome the barriers identified above.

Sustainable Development Co-Benefits

Increasing the energy efficiency of lighting is not only motivated by the mitigation potential, but also by its sustainable development impact. This goes hand-in-hand with the ambitions of the government of Grenada. Within the current Growth and Poverty Reduction plan of 2014-2018, increasing energy efficiency is seen as a priority area to develop a sustainable energy system, which in turn is seen as important to reduce poverty and stimulate growth (Antoine, Taylor, & Church, 2014).

Table 5. Overview of Annual Electricity Use and Spending Per Household

Annual total sale of electricity to households [kWh]	70,080,000
Annual electricity use per household [kWh/year]	1,693
Annual spending on electricity per household [USD]	576
Annual spending on electricity per household [XCD]	1,554
Per capita GDP [USD/year/capita]	8313
Persons per household	2.6
Spending on Electricity as Share of GDP per Household	3%

Target 3 of the NAMA is to generate 25% financial savings compared to the BAU scenario within residential lighting. This will have an impact on all income segments, but it will likely have a stronger impact in the lower segments. This is for various reasons.

Table 5 shows an overview of the annual electricity use and spending broken down to a household[7] level. The cost of electricity makes up 3% of the GDP per household. While increasing energy efficiency does not affect the unit cost of, in this case, electricity, it does decrease the overall spending on electricity. This increases the disposable income for all households, but as energy costs form a proportionally larger part of the disposable income for low-income segments, increased energy efficiency has the potential to decrease the vulnerability of these households.

Another point to make is that the potential savings, first of all, presume an even distribution of the types of lamps across all households; that is most likely not the case. As the most significant barrier to the technology diffusion is its high upfront costs, it is likely that the technology has diffused faster in the higher income segments; especially as the investment generate savings fast, and thus make economic sense if one has the means available. Lower income houses, however, are trapped by the higher upfront costs, and likely have most of the ICLs in use in the country. Their move to more efficient lighting would thus generate higher savings than the average number presented above, as it would replace more inefficient lighting technology than on average.

The NAMA will contribute to gender inequality as well, which constitutes another focus in Grenada's Growth and Poverty Reduction Strategy (Antoine, Taylor, & Church, 2014). 44% of female-headed urban households are within the bottom three quintiles, as opposed to 18.6% of the male-headed households.

Other sustainable development impacts are within the economic sphere. The National Energy Policy describes high energy costs as threats to the economic growth (GoG, 2011); lowering these would free resources for other consumption and strategic investments. Managed well, an increased economic growth could lead to sustainable development. Another threat mentioned is the high dependency on fossil fuel imports which compromises energy security. Increased energy efficiency reduces the dependency as fewer imports are needed.

[7] GDP per household is here calculated by taking the population estimate divided by the estimated number of household, arriving at an estimation of 2.6 people per household. This is then multiplied with the GDP per capita.

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