ASSESSMENT OF JAMAICA’S CLIMATE CHANGE MITIGATION

Potential and Implications for its Updated NDC

SECTORAL REVIEW
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Contents

Executive Summary ........................................................................................................................................ 8
1 Introduction .................................................................................................................................................. 13
2 Energy ....................................................................................................................................................... 16
3 Land Use, Land Use Change, Forestry (LULUCF) ..................................................................................... 33
4 Water ......................................................................................................................................................... 42
5 Waste ......................................................................................................................................................... 48
6 Agriculture ............................................................................................................................................... 54
7 Health ......................................................................................................................................................... 63
8 Industrial Processes and Product Use ....................................................................................................... 67
9 Conclusion ................................................................................................................................................ 68
10 References ............................................................................................................................................... 70
Appendix A – Impacts and Adaptation Priorities ....................................................................................... 73
Appendix B – NDC Renewable Energy Projects ....................................................................................... 76
Appendix C – NWC Projects ....................................................................................................................... 82

List of tables

Table 1 The energy, forestry and waste sectors could be included as part of Jamaica’s quantified emission reduction commitments in its next NDC .................................................................................. 11
Table 2 Energy and Agriculture make the largest contribution to total GHG emissions ......................... 14
Table 3 Summary of relevant policies and plans in the Energy sector ......................................................... 19
Table 4 NREL analysis identifies a number of options for reducing emissions from the transport sector ... 26
Table 5 There are a number of relevant policies, plans, and projects in the LULUCF sector for inclusion in the revised NDC ........................................................................................................ 35
Table 6 The assessment of the LULUCF sector against the guidance questions suggests it can be included in the next NDC ........................................................................................................... 39
Table 7 There are a number of relevant policies, plans, and projects in the water sector of relevance to the revised NDC .................................................................................................................. 43
Table 8 The water sector should be included in the revised NDC, based on the assessment against the guiding criteria ....................................................................................................................... 46
Table 9 There are a number of relevant policies and plans in the waste sector .......................................... 48
Table 10 The waste sector might be included in the revised NDC, based on assessment against the guiding questions ................................................................................................................... 51
Table 11 There are a number of plans and projects of relevance for inclusion in the NDC ......................... 55
Table 12 There are CSA actions that could be scaled up and relevant for NDC revision .......................... 57
Table 13 There are also a number of CSA-related no/low regret options .................................................. 58
Table 14 The assessment of the agriculture sector against the five questions suggests it may be difficult to include this sector in the next NDC ........................................................................ 61
Table 15 Some projects in the health sector may be relevant for inclusion in the revised NDC ............... 63
Table 16 The health sector may be included in the revised NDC, should relevant information become available ......................................................................................................................... 65
Table 17 Current Renewable Electricity Generation Assets incorporated into BAU scenarios .................. 76
Table 18  Current/Planned Renewable Projects incorporated into NDC Scenarios ........................................... 79
Table 19  Technical Facility Profile for Future National Water Commission (NWC) Solar Projects ................. 82
Table 20  Technical Facility profile for NWC Energy Efficiency Projects.................................................... 83

List of figures

Figure 1  Jamaica’s NDC pledges a 7.8% unconditional reduction, and 10% reduction with international support, in GHG emissions .................................................................................................. 13
Figure 2  CO₂ emissions in the energy sector have been falling since 2006 ..................................................... 16
Figure 3  Energy sector emissions are lower compared with the 1990s but up slightly since 2012............... 17
Figure 4  Jamaica’s total electricity generation has decreased substantially since 2006, when it reached its peak, with the share of renewables steadily increasing over time ........................................ 23
Figure 5  The LULUCF sector is a net carbon sink ......................................................................................... 33
Figure 6  The LULUCF sector has reduced overall emissions on average by 10.6% between 2006-12 ........ 34
Figure 7  Emissions trend from water (2014-17) is stable, with water supply and wastewater producing nearly all emissions ............................................................................................................. 42
Figure 8  Agriculture CO₂e emissions have been stable since 2006 ............................................................ 54
Figure 9  IPPU Sector CO₂ Emissions fell by around 10% between 2006 and 2012 ...................................... 67
Figure 10 Key climate impacts .................................................................................................................... 73

List of boxes

Box 1  Policies/Actions underlying the first NDC ............................................................................................. 30
Box 2  Case Study – Agriculture in Southern .................................................................................................. 73
Executive Summary

This report considers the opportunities - based on domestic commitments already made – for Jamaica to enhance the ambition of the mitigation commitments of its future NDC. It makes this assessment along two dimensions:

1. the depth of the emission reductions that it can deliver in the energy sector (the sector covered in the mitigation commitments of its current NDC)
2. the sectoral coverage of the NDC beyond the energy sector.

It also identifies the adaptation co-benefits these opportunities might bring, which could provide an input into the qualitative narrative of the next NDC and specifies the additional technical work that will be needed to confirm these opportunities within a revised NDC. While it is a report that has been written by independent consultants, it has been developed with substantial input from the key stakeholders across the Government of Jamaica, both in terms of participating in stakeholder discussions and in supplying vital information and reports.

There are opportunities to commit to greater emission reductions in the energy sector, both unconditionally and conditionally. The current NDC suggests an unconditional emissions reduction target in the energy sector of 7.8% against BAU in 2030, rising to 10% with international support. Both can be enhanced:

- In relation to the unconditional commitment, the current NDC only considers emission reductions from the delivery of utility-scale renewable energy projects in line with the National Energy Policy and the 10% blending of ethanol into gasoline for transportation. Since the current NDC was submitted, there have been important policy developments and commitments in a wide range of areas including: net billing; reducing losses on the transmission and distribution network; switching from fuel oil to LNG at the Alpart refinery; switching to T8 Fluorescent Lighting in schools and hospitals and smart LED Street Lighting; the deployment of LNG buses in Kingston, biodiesel blending; and the deployment of high-efficiency CHP in the alumina refining sector. In addition, there are important planned improvements in the energy efficiency of the water sector. At the same time, it will be important to assess whether the ambitious renewable power deployment assumed in the current NDC remains plausible.

- It is not clear what assumptions underpin Jamaica’s current conditional emission reduction target. However, there is likely to be scope for further development of this aspect of the NDC by considering the emission reductions that can be delivered by the externally-funded Energy Management and Efficiency Programme (EMEP) and the Energy Efficiency and Conservation Project (EECP), as well as the proposed Nationally Appropriate Mitigation Action (NAMA) in the water sector.

The emission reductions from mitigation actions in the energy sector can provide significant adaptation co-benefits. Reduced reliance on heavy fuel oil for electricity generation can enhance water availability, while greater renewable energy production and energy efficiency makes the country less vulnerable to extreme weather events that damage fuel infrastructure. Reduced fossil fuel combustion can also reduce the negative impacts that higher temperatures will otherwise have on air pollution and health outcomes.

All of the proposed energy-related changes to Jamaica’s NDC can be captured using the LEAP model. As this was the approach used in the first NDC, it will provide analytical continuity that both enhances trust and familiarity as well as expediting the delivery of the work.

There are also opportunities to increase the sectoral scope of Jamaica’s next NDC. Taking account of both data availability and political commitment, the opportunities for including a quantitative mitigation contribution is greatest in the LULUCF sector; it may also be possible in the waste sector. While the energy-related

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1 Clarification is required to identify whether the commitments to increase the energy efficiency of buildings included in Jamaica’s Third National Communication (TNC) is separate from these programmes.
commitments in the water sector could also be included as part of the energy LEAP modelling, efforts to reduce emissions in the agriculture sector are likely to be best included as a qualitative narrative. In addition, most of the mitigation actions in the health sector will likely only be included as part of the qualitative narrative at this stage. There does not appear to be efforts to reduce Industrial Processes and Product Use (IPPU) emissions.

The suggested inclusion in the next NDC of an emission reduction contribution from the forestry sector reflects the presence of both strong policy commitments and reasonable data availability. Jamaica’s Forestry Policy commits it to ensuring no net loss of forest cover. In addition, as part of the UN Global Forest Goals pledges, Jamaica intends, among other commitments, to reforest 300 hectares (ha) of denuded lands, to maintain 1,000ha of forest plantations, and to increase the hectares legally protected as forests with sustainable management plans by 10%. The government has also recently committed to plant 3 million new trees over the next three years which will likely increase the reforestation and maintenance commitments made as part of its Global Forest Goals pledges. An assessment of these policies’ impacts is facilitated by a relatively recent assessment of sectoral emissions and a business-as-usual (BAU) baseline for emissions extending to 2050.

The next NDC will also be able to highlight the adaptation co-benefits associated with these mitigation activities. These include helping to maintain optimal levels of groundwater under increased water stress, reducing soil erosion and hence boosting crop productivity in the face of more challenging climatic conditions, and reducing heat stress. In addition, the maintenance and increase of coastal mangroves can play an important role in preventing coastal erosion in the face of rising sea levels.

The next step is to calculate the emissions impact of these commitments; this assessment will likely need to be updated over time. An initial assessment of these commitments can be made by combining their expected impact on land use patterns and the sequestration potential of different types of land use. However, this analysis may need to be updated when more detailed data on the carbon stock of Jamaica’s forestry estates becomes available following work funded by the European Commission, and the outcome of the REDD+ Readiness Phase. This work will only be concluded after the submission of the next NDC.

While there appears to be sufficient data to include the waste sector within the quantified emission reduction contribution of the next NDC, it is not clear whether this will be matched by sufficiently ambitious policy commitments. The Third National Communication (TNC) provides current and future expected data on GHGs from the sector which can be used as a basis for its inclusion in the next NDC. Future emission reductions in the sector depend on whether and how a pilot project to use tyres as a fuel source in the cement sector is scaled up, and whether this policy delivers the expected GHG emissions; the speed at which the planned PPP arrangements for integrated waste management on the island are developed; and the extent to which the ban on single use plastic delivers material domestic emission reductions that can be quantified. It is understood that decisions on the former are likely to be made in the next few months, which is within the timescale needed for potential inclusion in the next NDC. Decisions on the second, and hence the emission reductions it will deliver, will only be taken beyond the timescale for the submission of the next NDC. Further investigation is required in relation to the impact of the single use plastic ban. All of these actions will also bring adaptation benefits – especially in terms of improved water quality - that can be qualitatively highlighted in the next NDC.

The next analytical step for the waste sector is to quantify the emission reductions that a scaled up tyre incineration project could achieve. This can draw on both results from the pilot as well as international evidence, supported by the development of one or more scenarios and validated by stakeholders.

Despite the importance of the agriculture sector to Jamaica’s emissions, and the mitigation and adaptation benefits of various projects in the sector, it seems difficult to include a quantified emission reduction contribution from this sector in the next NDC. There is no overarching policy commitment to reducing the emissions of the sector, with action instead taking place through discrete bottom-up projects and other activities such as the support for precision agriculture by extension workers. In many cases, the emission reductions these activities deliver are not available. In addition, at the sector-wide level, there are inconsistencies between different sources providing emissions data.
It will still be possible for the next NDC to provide a narrative discussion of the actions being undertaken in the agriculture sector, while there are a number of analytical activities that would support the sector’s inclusion in the quantitative component of subsequent NDCs. The narrative discussion could highlight that CSA-related programmes of substantial value are being implemented in the country such as the Integrated Management of the Yallahs and Hope River Watershed Management Areas; and the Essex Valley Agriculture Development Project. As well as reducing emissions, these activities are providing important adaptation benefits especially in terms of improving health and resilience to drought conditions. In terms of future analytical work, this might focus on identifying the GHG reduction contribution of large projects; documenting/specifying the different measures that are or could be undertaken in the sector and assessing the GHG reduction of each; and analysing the scale up potential of existing pilots. However, these activities are not an immediate priority.

The inclusion of the water and health sector policies would be embedded in the framework for the energy sector. As mentioned above, there are a range of energy related policies in the water sector than can be quantified using the LEAP modelling framework. These include a range of projects relating to renewable energy and energy efficiency that are outlined in the NAMA or identified by the National Water Commission (NWC). In health, most energy-related policies will likely only be included in the NDC qualitatively, given a lack of information available on the impacts of mitigation actions in this sector. However, if more data were to become available, there may be scope to include these policies in the LEAP modelling approach.

The table below summarises the key findings.
Table 1  The energy, forestry and waste sectors could be included as part of Jamaica’s quantified emission reduction commitments in its next NDC

<table>
<thead>
<tr>
<th>Sector</th>
<th>Include as part of the quantified mitigation commitment in the next NDC</th>
<th>Commitments that can be quantified(^1)</th>
<th>Next steps to facilitate inclusion in the next or subsequent NDCs(^2)</th>
</tr>
</thead>
</table>
| Energy (including energy consumption in water and health sector) | Yes (although health sector initiatives may need to be included as a qualitative narrative) | • Net billing  
• Targeted reduction in T&D losses  
• Switch from fuel oil to LNG in the Alpart Refinery  
• Switch to T8 Fluorescent Lighting in schools and hospitals and Smart LED Street lighting  
• Introduction of 136 LNG-fuelled public transport buses by 2025  
• B5 blending commitment  
• Improved CHP in alumina refining  
• Water sector renewable and energy efficiency improvements  
• EMEP and EECP programs  
• NAMA in water sector | • Develop revised version of LEAP model with new inputs |
| Land use, land use change and forestry | Yes | • No net loss forest cover  
• Reforest 300 ha of denuded lands  
• Maintain 1,000ha of forest plantations  
• Increase the hectares legally protected as forests with sustainable management plans by 10%  
• Programme to plant 3 million trees | • Establish the extent to which commitments are additional  
• Calculate emissions impact by reference to expected impact on land use patterns and assessment of sequestration potential |
| Waste | Maybe | • Scale up of pilot program to use tyres as fuel for cement production  
• Impacts from the ban of single-use plastic policy, if available  
• PPP for Integrated Waste Management (IWM), if available | • Calculate emissions potential based on emissions intensity improvement and scale |
<table>
<thead>
<tr>
<th>Sector</th>
<th>Include as part of the quantified mitigation commitment in the next NDC</th>
<th>Commitments that can be quantified&lt;sup&gt;1&lt;/sup&gt;</th>
<th>Next steps to facilitate inclusion in the next or subsequent NDCs&lt;sup&gt;2&lt;/sup&gt;</th>
</tr>
</thead>
</table>
| Agriculture | No – qualitative narrative possible | N/A                                          | • Document measures undertaken, penetration rates and emission reductions delivered  
                  • Assess scale up potential of pilots |
| IPPU    | No                                  | N/A                                          | N/A                                           |

Notes:  
<sup>1</sup> Italics marks those likely to be part of conditional target;  
<sup>2</sup> Italics denotes steps that would be more important for subsequent NDCs.

Source: Vivid Economics
1 Introduction

The purpose of this report is to identify opportunities - based on domestic commitments that Jamaica has already made - to enhance the ambition of its NDC, to identify the adaptation co-benefits the delivery of those opportunities might bring, and to specify the additional technical work that will be needed to confirm those opportunities within a revised NDC.

Jamaica’s current NDC focuses on the energy sector, commits the country to reduce the emissions from this sector by 7.8% by 2030 relative to a business-as-usual (BAU) baseline, rising to 10% by 2030 with international support. This is expected to lead to energy sector emissions of 13,368ktCO\(_2\)e in 2030, or 13,043ktCO\(_2\)e with international support, compared to 14,492ktCO\(_2\)e in the BAU scenario. By 2025, the country’s current NDC is associated with emissions of 12,370ktCO\(_2\)e (or 12,099ktCO\(_2\)e with international support), whereas the emissions under its BAU baseline is expected to be 13,443ktCO\(_2\)e in this year. This data is summarised in Figure 1 below.

Figure 1    Jamaica’s NDC pledges a 7.8% unconditional reduction, and 10% reduction with international support, in GHG emissions

![Figure 1](image.png)

Source: Vivid Economics, based on emissions figures from Jamaica’s NDC

The current NDC was designed to be consistent with Jamaica’s National Energy Policy. Specifically, it is based on, at the time of submission, the ‘current level of implementation of the National Energy Policy and the existing pipeline of renewable energy projects. The additional ambition associated with the conditional commitment is associated with the ‘expansion of energy efficiency initiatives in the electricity and transportation sectors, in line with sector action plans and policies currently under development’ (at the time of writing). This sectoral coverage implies that the NDC covers 94% of CO\(_2\) emissions in the economy, but only 12% of its N\(_2\)O and CH\(_4\) emissions.

Jamaica has now committed to expand the ambition of its next NDC, which it will submit in 2020, as foreseen in the Paris Agreement. This expansion in ambition has two potential dimensions:

- To expand the ambition of emission reduction commitments within the energy sector.
- To expand the sectoral coverage of the NDC beyond the energy sector to other sources of emissions, and potential sinks.
There is good reason to consider that there is scope to expand the NDC along both of these dimensions. Regarding emissions beyond the energy sector, Table 2 shows the key sources of emissions identified in the Third National Communication (TNC), showing that the share of national emissions from the energy sector had fallen to just over half of net GHG emissions by 2012 (from 76% in earlier years). Regarding the depth of emissions in the energy sector, the policy interventions to reduce emissions were focused in a few key areas related to renewable power and fuels policy. Moreover, there have been a range of further policy developments in the energy sector since the NDC was first submitted.

Table 2 Energy and Agriculture make the largest contribution to total GHG emissions

<table>
<thead>
<tr>
<th>Sector</th>
<th>2006 Emissions (Gg CO₂e)</th>
<th>2006 contribution</th>
<th>2012 Emissions (Gg CO₂e)</th>
<th>2012 contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy</td>
<td>10,740</td>
<td>76%</td>
<td>7,013</td>
<td>53%</td>
</tr>
<tr>
<td>IPPU</td>
<td>544</td>
<td>4%</td>
<td>436</td>
<td>3%</td>
</tr>
<tr>
<td>Agriculture</td>
<td>3,997</td>
<td>28%</td>
<td>6,742</td>
<td>51%</td>
</tr>
<tr>
<td>LULUCF</td>
<td>-1,686</td>
<td>-12%</td>
<td>-1,626</td>
<td>-12%</td>
</tr>
<tr>
<td>Waste</td>
<td>592</td>
<td>4%</td>
<td>625</td>
<td>5%</td>
</tr>
</tbody>
</table>

Source: GoJ (2018), Tables 0.2, 0.3 and 0.4.

In order to ensure that its NDC is credible and robust, Jamaica will only include policies that are in line with its domestic policy commitments. It is an important policy decision to focus on delivering Jamaica’s commitments, rather than incorporating more speculative policy ideas, as it helps to maintain the integrity of the international process associated with developing and updating NDCs and thus helps ensure the credibility and legitimacy of that process. It is also in keeping with the approach that Jamaica took in its first NDC.

This report is intended to support the first stages of updating Jamaica’s NDC. It looks, in turn, at each of the four emissions sources defined by the IPCC: energy, AFOLU, waste and IPPU. Given the breadth of policies in the AFOLU sector, the Agriculture and LULUCF sub-sectors are discussed separately. This also allows for different treatment of these sub-sectors when assessing whether they should be included in the next NDC. The report also separately discusses the water and health sectors reflecting their importance to Jamaica’s adaptation efforts, however, the discussion for these sectors identifies how the emissions from these sectors are included in the IPCC categories. For each source it discusses the following information, using a common structure:

- Overall emission trends, to provide a sense of the relative importance of emissions from the sector as well as recent trends.
- The key strategy statements, policies and projects/programmes affecting emissions in the sector (collectively labelled as ‘commitments’), including both those that have been implemented and those where broad announcements have been made but where detailed implementation has not yet begun. In the case of emissions associated with the energy sector, it also identifies the extent to which these commitments were included in the analysis associated with the previous NDC.
In relation to each of these commitments, the adaptation implications of those commitments are also identified (and the extent to which these were recognised in the previous NDC). This builds on an assessment of the climate impacts that Jamaica faces as discussed in Appendix A.

Finally, in relation to the commitments made in each sector, it considers whether there might be scope to include emission reductions and/or adaptation benefits associated with those emissions reduction commitments in the next NDC, the policies/commitments that should be included in the next NDC (where relevant), and the additional analysis that might be undertaken to include the sector within the next, or subsequent, NDCs.

To assess whether or not it is possible to include quantified emission contributions from each sector in the next NDC, we identify five guiding questions, as set out below:

- **Question 1:** Is there a GHG emissions baseline? If there is not a good understanding of the current emissions from a sector, it will not be possible to quantify emission reductions in the sector.

- **Question 2:** Is there a forward-looking BAU baseline? Although such a baseline could be established as part of any future analytical work, an existing agreed baseline can help expedite the analysis, especially in the context of the short timescales available.

- **Question 3:** Are there clear policy commitments that can be converted into commitments and/or quantifiable targets to reduce or avoid emissions? As discussed in the introduction, Jamaica intends to continue the approach that it took to its first NDC of only including contributions from sectors where there is demonstrable policy commitment to actions that will reduce emissions.

- **Question 4:** Have mitigation options/actions been identified? Such options and actions can help either (i) provide further confidence that there is commitment to meet the targets in question three, or (ii) in some cases, could allow for packaging into an emission reduction contribution even in the absence of a clear policy commitment.

- **Question 5:** Have the mitigation options been consolidated into a set of scenarios? This would expedite any future analysis.

These questions are intended to help inform or guide a judgement, rather than be definitive. As the discussion in the chapters below will make clear, there is a degree of ‘substitutability’ between the different answers. Nonetheless, a sector that receives a positive assessment against each of these questions will be easier to include in a future NDC than a sector which receives a more equivocal assessment.
2 Energy

2.1 Emissions Trend

The energy sector makes the largest sectoral contribution to CO₂ and total GHG emissions. Jamaica’s Third National Communication (TNC) shows that the largest contributions to CO₂ emissions from within the energy sector are electricity generation, mining and bauxite and road transport. Since 2009, CO₂ emissions from road transport and electricity generation and have declined slightly: the former fell as a result of lower levels of gasoline consumption; the latter as a result of a reduction in the use of fuel oil and diesel oil for electricity generation as it was displaced by greater wind and solar generation (Francis, 2018). Emissions in mining/ bauxite (which includes aluminium manufacture) have been more volatile than in other sub-sectors, notably experiencing a large fall in 2009 due to the global economic downturn.

Figure 2 CO₂ emissions in the energy sector have been falling since 2006

Note: Mining/Bauxite included aluminium manufacture
Source: Vivid Economics, based on data from TNC (GoJ, 2018)

Additional data from WRI CAIT, shows that total GHG emissions from the energy sector have fallen since the 1990s, but they may have picked up slightly since 2012. The reduction in emissions since the 1990s has been largely driven by lower emissions from electricity and heat generation. The slight increase in emissions from 2012 appears to have been driven by an increase in emissions from the manufacturing and construction sector.
2.2 Relevant Commitments

Policy efforts to reduce GHG emissions have been strongest in the energy sector. This reflects that fact that energy used to be by far the largest source of GHG emissions (estimated at 76% in 2006, see Table 2). In addition, reducing the use of fossil fuels helps to improve Jamaica’s energy security given its otherwise large reliance on imported petroleum in 2009, imported petroleum accounted for 91% of its energy mix (GoJ, 2010d). According to the Energy Ministry, this was down to 87.8% in 2018 and is predicted to fall in the years ahead as Jamaica’s principal electricity provider (JPS) moves from petroleum and onto LNG and renewable energies. As of June 2019, Jamaica generates 17% of its electricity from renewable sources, including wind, solar and hydro. The intention is to increase the percentage of renewable energy in total generation further going forward (Williams, 2019).

The overarching framework for the energy sector is defined in the National Energy Policy (NEP). This aims to provide Jamaica with a modern, efficient, diversified and environmentally sustainable energy sector which provides affordable energy and energy security (GoJ, 2009b). The strategic framework includes seven explicit goals:

- Goal 1: Encourage conservation and energy efficiency improvements in electricity/heat generation, bauxite/aluminium production, transportation, building design and construction
- Goal 2: Modernise energy infrastructure, such as power plants and distribution systems
- Goal 3: Development of renewable energy sources, with an aim to increase the share of renewables to 20% of the energy mix by 2030
- Goal 4: Diversification of the energy source mix to improve energy security

Historically, there have been a number of challenges in reducing energy sector GHG emissions. The power system has low generation efficiency and high losses due to the use of old equipment and infrastructure. In addition, the regulatory framework in the sector is said to be inadequate to address these issues (GoJ, 2009b). However, efforts have been made to improve this situation through legislation, the most recent of which is the introduction of the Electricity Act of 2015.
● Goal 5: Development of a comprehensive governance/regulatory framework for the energy sector
● Goal 6: Enable government ministries and agencies to demonstrate best practice for energy management
● Goal 7: Promote eco-efficiency in industries

Underlying the NEP are a number of sub-policies, although these remain in draft form:

● **Renewable Energy Policy**: This outlines a framework for meeting a 2030 target of increasing the share of renewables in the energy mix to 20% by 2030 (GoJ, 2010d).

● **Energy-from-Waste Policy**: This generates a framework for developing the infrastructure, technologies, partnerships and governance arrangements necessary to generate a larger share of energy from waste, which will contribute to the renewables target of the wider energy sector. The details of this policy are covered in chapter 5.

● **Biofuels Policy**: Aim to develop the biofuels sector, with a specific focus on bioethanol and diesel (GoJ, 2010a).

● **Carbon Emissions and Trading Policy**: This is a commitment by the GoJ to participate in the Clean Development Mechanism (CDM) and provides the guidelines under which Jamaica will participate in carbon markets (GoJ, 2015a).

● **National Energy Conservation and Efficiency Policy (NECEP)**: Aims to improve energy conservation and efficiency through improved regulatory processes and introduction of new technologies.

It is understood that the Ministry of Science, Energy and Technology may look to update aspects of this framework in the future.

In addition to these policies, there are also a wide range of anticipated and actual plans, as well as a wide range of specific projects that are expected to influence the emissions profile of the sector. Given the complexity of the sector, the discussion below explores the policies and other commitments across six key sub-sectors:

● Energy supply: electricity
● Energy supply: other energy sources
● Energy demand: buildings
● Energy demand: transport
● Energy demand: industry
● Energy demand: utilities

Across each of these six subsectors, we describe the various policies, plans and other projects of relevance to the sub-sector, as set out in Table 3 below.
### Table 3: Summary of relevant policies and plans in the Energy sector

<table>
<thead>
<tr>
<th>Sub-sector</th>
<th>Policies</th>
<th>Strategies, plans and policy frameworks</th>
<th>Projects and other specific actions</th>
</tr>
</thead>
</table>
| All Sectors                 | • National Energy Policy 2009 - 2030 (NEP)  
• Renewable Energy Policy  
• Energy-from-Waste Policy  
• Biofuels Policy  
• Carbon Emissions and Trading Policy  
• National Energy Conservation and Efficiency Policy |                                                                  |                                                           |
| Energy supply: Electricity  | • National Energy Policy 2009- 2030 (NEP)  
• National Renewable Energy Policy (NREP)  
• Carbon Emissions and Trading Policy | • Climate Change Policy Framework for Jamaica  
• Integrated Resource Plan (IRP) | • Wind Power Plants  
- Wigton I (20.7 MW; COD 2000)  
- Wigton II (18 MW; COD, 2010)  
- Wigton III (24 MW; COD, 2016)  
- Munro (3MW; COD, 2010)  
- BMR (36MW; COD 2016)  
• Solar Power Plants  
- Content Solar (20MW; COD 2016)  
- Paradise Park (37MW; COD 2019)  
• Hydro Power Plants  
- Magotty (6.4MW; COD 2014)  
• Natural Gas  
- Commissioning of a 190MW natural gas plant by end of 2019  
- Commissioning of a 94MW natural gas plant by end of 2020  
• Storage  
- Installation of a 24.5MW hybrid energy storage solution in 2019 |
### Sub-sector: Energy supply: other energy sources
- National Renewable Energy Policy (NREP)
- National Biofuels Policy
- Energy-from-Waste Policy

### Policies
- Integrated Energy Plan (IEP)

### Projects and other specific actions
- LNG for Alumina Production at Alpart

### Sub-sector: Energy demand: buildings
- National Energy Conservation and Efficiency Policy (NECEP)

### Policies
- Energy Efficiency and Conservation Project (EECP)
- Energy Management and Efficiency Programme (EMEP)
  - Energy efficiency in public sector buildings

### Sub-sector: Energy demand: transport
- Biofuels Policy
- National Energy Conservation and Efficiency Policy (NECEP)

### Policies
- Electric-mobility Framework
- Transportation Greenhouse Gas Reduction Plan
- Energy Management and Efficiency Programme (EMEP)
  - The Urban Traffic Management System
  - Natural Gas buses
  - Global Fuel Economy Initiative (GFEI)
  - Pilot programme for EV charging stations

### Sub-sector: Energy demand: industry
- National Energy Conservation and Efficiency Policy (NECEP)
- Biofuels Policy

### Policies
- Combined heat and power (CHP)

### Sub-sector: Energy demand: utilities
- National Energy Policy 2009-2030 (NEP)

### Policies
- Reducing electricity losses
- Draft NAMA in the water sector
### Sub-sector Policies Strategies, plans and policy frameworks Projects and other specific actions

- EE and RES projects in the water and health sectors

Source: Vivid Economics
2.2.1 Energy Supply: Electricity

**Overall policy framework**

The National Renewable Energy Policy (NREP) aims to increase Jamaica’s share of renewable energy sources in the energy mix, in an effort to improve energy security, enhance its international competitiveness and reduce its carbon footprint. The policy states that by 2030, 20% of Jamaica’s energy mix will come from renewable sources. The government will aim to achieve this through establishing the necessary infrastructure and appropriate financial incentives to encourage the uptake of renewable technologies that generate electricity, increasing R&D in this area and enhancing technical capacity and public awareness through training. The objectives relating to electricity supply mainly focus on encouraging the greater deployment of wind, solar, hydro and biomass technologies. The Climate Change Policy Framework reiterates the goals outlined in the NEP, with reference to promoting the development of efficient and low-cost renewable energy plants with a size of 15 MW or more on a competitive basis (GoJ, 2015a).

Given the commitments outlined under the NREP, a number of renewable power facilities have been developed in recent years, particularly for wind power. Several wind projects have been developed by the Wigton Windfarm Limited (WWF) - a company established by the GoJ in 2000. Wigton 1 began operating in 2004 and has 20.7 MW of installed capacity; Wigton II began operating in 2010 with a capacity of 18 MW; and Wigton III began operating in 2016 with 24 MW (WWF, 2019). Jamaicans now also have the opportunity to invest in the renewable energy sector through Wigton Wind Farm Limited, with 31,000 Jamaican willing to invest some $14 billion when $5.5 billion was on offer (Williams, 2019). In addition, the JPS developed the Munro Wind Project which began operations in 2010, with 3MW of installed capacity, and the BMR Wind Project came online in 2016, with 36MW of capacity (Francis, 2018; BMR Energy, 2019).

There have also been a number of renewable energy developments outside of wind, including solar, hydro, storage and bagasse technologies. The JPS developed the Magotty Hydro Project which began operations in 2014 with 6.4 MW capacity. In 2016, Jamaica’s first utility-scale solar photovoltaic (PV) plant, Content Solar, began commercial operations, with a capacity of 20MW (WRB, 2016). Further, in June 2019, a new Solar PV Plant with 37 MW capacity began generating in Paradise Park Westmoreland, operated by Eight Rivers Energy Company (MPC Capital, 2019). The installation of this plant brings solar energy capacity to 6% of the total installed capacity (Williams, 2019). In relation to energy storage, the JPS is also installing a facility that combines lithium ion battery and flywheel technology, with 24.5MW of storage capacity. While bagasse is also being used by various sugar plants to generate heat and power generation, it is understood that these are currently not exporting electricity to the grid.

In addition to renewable energies, the GoJ is also seeking to reduce GHG emissions by replacing inefficient HFO power plants with natural gas plants. In 2019, a 190MW natural gas plant will be commissioned at Old Harbour, to replace the inefficient power plants used by JPS. Another 94MW natural gas plant will also be commissioned by end of 2020.

In addition to utility-scale power generation, between 2012 and 2015, JPS conducted a National Net-Billing Pilot program to encourage the uptake of small-scale renewable power generation. Net billing allows self-generating electricity customers to supply excess electricity back to the grid in exchange for compensation. The pilot programme enabled self-generating customers with renewable power systems of a certain size (maximum of 10 kW for residential installations and 100 kW for commercial installations) to sell excess

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2 In addition to the commitments discussed below, a further important source of emission reductions from the electricity sector has been from displacing heavy fuel oil with LNG. However, we follow the approach taken in the last NDC that this represents part of the BAU development of the Jamaican energy sector.
power to the grid. In return they received compensation equal to the short run avoided cost of generation rate plus 15% premium (Doris et al, 2015).

In August 2015, the Electricity Act established a legal framework for net billing, alongside wheeling and auxiliary connections. The Net Billing facility provides a statutory basis that allows self-generators to sell excess energy back to the grid (at an agreed level of compensation), the Electric Power Wheeling Facility enables the provision of power to the grid equivalent to that used from the system, and the Auxiliary Connections facility allows a connection for other purposes such as back-up generation (GoJ, 2016a). According to the Ministry of Science, Energy & Technology, there have been 757 licences issued for net billing since it was piloted in 2012 and 16 licences issued for Auxiliary Connections between 2016 and 2019(Williams, 2019).

The deployment of renewable energy projects has led to an increase in the share of electricity generation from renewable sources (Figure 4). According to the IEA World Energy Balances, electricity generation from renewable sources rose from 7.4% in 2009 to 12.6% in 2016 (IEA, 2019). In 2016, wind projects contributed to 4.5% of total generation, while hydro projects contributed 2.8% and solar projects (just Content Solar in this year) contributed 0.3%. Bagasse is also used to generate power for sugar factories and refineries, but it is understood that this has not been exported to the grid to date. Domestic estimates suggest that net billing currently provides a minimal contribution to overall electricity generation (Francis, 2018).

![Figure 4](image_url) Jamaica’s total electricity generation has decreased substantially since 2006, when it reached its peak, with the share of renewables steadily increasing over time

Strategies, Plans and Policy Frameworks

The Ministry of Science, Energy and Technology (MSET) is currently involved in an Integrated Resource Planning (IRP) process for the electricity sector. The Integrated Resource Plan (IRP) will set out the strategic framework for meeting projected electricity demand over the next 20 years, in terms of the generation capacity and technologies needed (World Bank, 2019). The IRP is due to be published in 2019. In particular, it is expected to provide more clarity on statements by the Prime Minister regarding future increases in renewable power generation capacity and would allow for specific estimates of the further emission reductions achievable from the power sector to be calculated. It is understood that, at the time of writing, the IRP is being reviewed by the regulatory authorities prior to finalisation.
2.2.2 Energy supply: Non-power

Overall policy framework

Policies relating to renewable energy supply outside of power are also reflected Jamaica’s NREP and draft Biofuels Policy. The NREP aims to encourage the uptake of renewable energy technologies to generate heat, such as solar water heaters. Further, both the NREP and the Biofuels policy seek to encourage the greater use of biofuels, such as bioethanol and biodiesel, for transportation fuel (and as such is also discussed in section 2.2.4 below). These can be valuable both in reducing GHG emissions and reducing Jamaica’s dependence on oil imports. Similar to other energy policies, this biofuels framework aims to establish the necessary infrastructure and appropriate financial incentives to encourage the production of biofuels and enhance technical capacity through education programmes (GoJ, 2010a; GoJ, 2010d).

Strategies, plans and policy frameworks

The Ministry of Science, Energy and Technology (MSET) is currently developing an Integrated Energy Plan (IEP) for the energy sector as a whole. This will take the outcome of the IRP for the power sector and embed it within a broader strategic framework for the energy sector as a whole. However, this work is not expected to be completed until 2020.

Specific actions and projects

There are also specific actions that Jamaica has recently committed to in order to reduce the emissions intensity of its energy supply outside of the power sector. For example, the TNC also includes within its list of Planned Actions a commitment to switch the energy used for process heat generation at the Alpart refinery from fuel oil to LNG.3

2.2.3 Energy demand: Buildings

Overall policy framework

The (draft) National Energy Conservation and Efficiency Policy 2010-2030 (NECEP) aims to improve energy conservation and efficiency across Jamaica’s economy. The policy objective is to accelerate the introduction of new technologies by improving regulatory processes and addressing barriers to the uptake of energy-efficiency measures (GoJ, 2010b).

The policy targets four main goals:

- Goal 1: Assist consumers to adopt energy conservation and efficiency practices
- Goal 2: Reduce / eliminate barriers to uptake of energy conservation and efficiency technologies
- Goal 3: Lead energy conservation and efficiency through the Governmental sector
- Goal 4: Ensure Jamaica has modern and efficient plants

Ambition related to the building sector is focused within Goals 1 and 2, as well as interactions with Goal 3. Specific policies laid out in the NECEP include:

- Developing minimum energy standards for buildings
- Incentivising developers to undertake energy efficiency improvements in commercial and residential buildings

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3 The Third National Communication states in its headings that the fuel switching will be to Compressed National Gas (CNG) but the detailed calculations in this report, and other press statements, suggest that the conversion will be to liquefied natural gas (LNG).
- Providing and promoting information on energy efficient housing options
- Facilitating retrofits of existing structures by providing tax credits for efficient purchases and incremental cost incentives for overhauls
- Improving the energy performance of existing and new homes through design improvements
- Strengthening the capacity of local authorities to enforce building code on an ongoing basis
- Updating and enforcing the Energy Efficiency Building Code to support efficient energy use in buildings

As the policy remains draft, it is not clear whether the implementation of these policies has begun.

Specific actions and projects

The Energy Efficiency and Conservation Project (EECP) involves the design and implementation of measures to improve energy efficiency and conservation in the public sector. The EECP was a project funded by the IDB and launched in 2012, with a budget of around US$20 million. Specific measures include replacing inefficient lighting with more efficient technologies, such as LED, replacing inefficient mini-split Air Conditioning (AC) with inverter-based mini split units and/or AC central units, window tinting, window sealing, roof insulation and automatic door closers. The scheme also encourages demand side management technologies such as smart grid or metering (GoJ, 2011). Between 2013 and 2018, the EECP was involved in the installation of:

- over 80,000 sq. ft. of heat reducing film at 37 public sector facilities;
- over 200,000 sq. ft. of cool roof solutions at 11 public facilities; and
- energy efficient air-conditioning solutions at 25 facilities.

These interventions are said to have saved the Jamaican Government US$2.2 million, lowered carbon dioxide emissions by more than 5,800 tonnes, and reduced oil consumption by 3,500 barrels (Williams, 2019). The energy efficiency improvements from these initiatives are expected to result in a reduction in energy consumption of 6.7% and a reduction in GHG emissions of 16,600 tonnes of CO₂ per year (GoJ, 2019).

Similar actions to the EECP aimed at improving energy efficiency were outlined in the ‘All Planned Actions’ actions scenario of the TNC. For example, there was a commitment to convert all inefficient 40W T12 lighting to 32W T8 fluorescent lighting in hospitals and schools by 2030. In addition, although not explicitly in the buildings sector, there was a planned action relating to lighting which involved upgrading all grid-connected streetlights to LEDs by 2020⁴. These measures may have been part of the EECP, although this was not stated explicitly in the TNC or the EECP policy document.

The Energy Management and Efficiency Programme (EMEP) seeks to promote energy efficiency in government buildings. The programme, launched in 2018, has a budget of around US$40 million and is funded by the Inter-American Development Bank (IDB), the Japan International Cooperation Agency (JICA) and the European Union Caribbean Investment Facility (EU-CIF) (PCJ, 2018). The programme has three main elements of which the first is focused on building retrofits, and the third relates to capacity building.⁵ The retrofitting element aims to upgrade 80 government facilities. Similar to the EECP programme, it funds the purchase, installation and maintenance of more energy efficient technologies and infrastructure, such as LED lighting, upgraded AC units, window seals and automatic door closers. The third component of the programme involves capacity building through the development of information systems, as well as training.

⁴ We include this in this section to facilitate the structure of the document but recognise it is not a buildings measure.
⁵ The second relates to improved urban traffic management systems and is discussed further below.
and technical support. The overall project aims to reduce electricity consumption by up to 30% within selected public health, education and administrative facilities (Acorn International, 2016).

There were also smaller projects aimed at improving energy efficiency in buildings, such as the Energy Security and Efficiency Enhancement Project (ESEEP). The ESEEP project ran from 2011 to 2017 and was funded by the IBRD with a budget of around US$15 million. This project was aimed at strengthening regulations such as electricity sector grid codes and standards for testing the energy efficiency of appliances (World Bank, 2018).

2.2.4 Energy demand: Transport

Overall policy framework

The current National Transport Policy does not have a strong emphasis on reducing greenhouse gas emissions. The current priorities of the policy focus on expanding transport accessibility and inclusion across Jamaica, in addition to improvements in transport infrastructure and regulations and increasing private ownership. Some policy statements have interactions with mitigation objectives, such as reducing fuel importation and encouraging cars with higher fuel efficiency. However, it appears that these objectives are largely justified by their impact in reducing local air pollution and improving Jamaica’s trade balance.

The government is currently revising its National Transport Policy, which among other things, will address the transport sector’s role in meeting Jamaica’s GHG reduction goals. In the context of this revision, a study conducted by NREL for the GoJ generates a BAU emission projection and emissions reductions projection for the transport sector. This is consistent with the conditional NDC target of reducing emissions to 10% below a 2030 BAU scenario (estimated to be equivalent to 353 ktCO$_2$). Each sub goal is outlined below, alongside its estimated emissions reduction impact.

**Table 4**  NREL analysis identifies a number of options for reducing emissions from the transport sector

<table>
<thead>
<tr>
<th>Sub-goal (from 2030 BAU)</th>
<th>Thousand Metric Tons (TMT) CO$_2$e Reduced</th>
<th>Per cent of Overall Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>9% reduction in VKT of LDVs through walking, biking, using public transit, ridesharing, and telecommuting</td>
<td>206.8</td>
<td>58.6</td>
</tr>
<tr>
<td>7% improvement in fuel economy for new LDVs</td>
<td>64.8</td>
<td>18.4</td>
</tr>
<tr>
<td>All diesel contains 5% biodiesel</td>
<td>57.9</td>
<td>16.4</td>
</tr>
<tr>
<td>Traffic-flow is smoothed so that 1.5% of road kilometres are converted from city drive cycle to highway drive cycle</td>
<td>12.9</td>
<td>3.7</td>
</tr>
<tr>
<td>HDV idle time reduced 45 minutes per vehicle per day</td>
<td>6.1</td>
<td>1.7</td>
</tr>
<tr>
<td>12% of new LDV purchases to be electric</td>
<td>4.5</td>
<td>1.3</td>
</tr>
</tbody>
</table>

Source: Johnson et al, 2019
The NREL study then identifies the policies and projects that can be used to achieve these sub-goals. A number of examples are listed below.

- To improve fuel economy, a feebate system could be introduced, whereby higher taxes and duties are levied on heavier vehicles or vehicles with larger engines and subsidies provided to people who register fuel-efficient vehicles.
- To encourage the uptake of biodiesel, price signals could be introduced that catalyse viable markets.
- To reduce VKT, authorities could increase the price of parking in congested areas.
- To encourage the uptake of EVs, public EV chargers could be installed in strategic locations; and
- To improve traffic flow, the government could seek to better coordinate traffic signals.

At present, the GoJ has not made any commitment to introduce these recommended policies.

The draft National Biofuels Policy aims to build on existing progress within the transport sector. In 2009, the Government mandated the use of ethanol blended fuel (E10) for motor engines across Jamaica, creating a guaranteed national market for ethanol of around 70 million litres annually, supporting local producers of ethanol. The biofuels policy also aims to support the production of local feedstock and recycled vegetable oil in order to generate the biodiesel mixture B5. This can then be used for all final end-uses in the transport, industrial, commercial, residential, and agricultural sectors, but not for grid-based power generation. The level of biodiesel production consistent with the B5 mandate was also incorporated into the ‘All Planned Actions’ scenario of the TNC.

In addition, the NECEP includes several policies within the transport sector aimed at improving energy efficiency and reducing emissions. These include to:

- Promote greater vehicle fuel efficiency
- Establish tax on petrol at levels to encourage conservation and higher utilisation of and development of public transport
- Encourage the import and facilitate the use of more fuel-efficient vehicles in the transport sector as well as the use of diesel, biofuels and CNG when it becomes available
- Promote use of alternative fuels in transport sector
- Provide adequate infrastructure for transition to alternative energy vehicles
- Promote carpooling opportunities (preferential tolls, HOV lanes)
- Carry out study of urban transport needs and mass transit options
- Develop and implement appropriate tax and pricing structure for road users that reflect environmental costs and other externalities

It is not clear that all the intentions expressed in the draft NECEP document has been translated into policy execution as it is still in a draft stage.

**Strategies, plans and policy frameworks**

**There is a commitment to have a strategic framework for electro-mobility in place by December 2019.** The proposed framework involves a range of ministries and identifies six key pillars:

1. Tax regime and fiscal considerations to boost adoption
2. Technical, efficiency, and interoperability standards for EVs and ICEs
3. Enhancing energy sector readiness
4. Enhancing transport sector readiness
5. Creating an e-mobility system in Jamaica
6. Implementation and Monitoring of the Strategic Framework/Policy

The framework will identify specific policies, plans or studies under each of these pillars. For example, in the case of pillar 1, the draft of the framework sets out a proposal for tax exemptions or rebates for EVs to boost adoption, although the detailed design of this fiscal measure would only be developed after the completion of the Framework. A further proposed policy action under pillar 3 of the draft is the development of an electric sector regulatory framework for EV charging (IDB, 2019).

The Ministry for Transport and Mining have suggested that there may be a policy to regulate vehicle tailpipe emissions implemented in the next few years. Article 110 (1) of the Road Traffic Act (2018) provides the necessary legal authority for such regulations to be introduced. However, there is no firm commitment particularly as it is understood that this would also require changes to policies regarding imports.

**Specific actions and projects**

In addition, Jamaica’s Third National Communication identified a plan by the Jamaica Urban Transit Company (JUTC) to introduce LNG buses into its fleet. The ‘All Planned Actions’ scenario identifies a plan to install 136 LNG buses to serve the Montego Bay area and St. James Parish in the period between 2020 – 2025. Recent reports suggest that that JUTC currently have five LNG buses that will be used in a pilot this year (Jamaican Observer, 2019).

A range of other projects in the transport sector also seek to directly reduce emissions or have identified policies that could be introduced to reduce emissions in the transport sector.

- The IDB EMEP programme (sub section 2.2.3) funds the purchase and installation of equipment for an Urban Traffic Management System (UTMS) in Kingston. This includes fibre optic cables, traffic lights, cameras, sensors, planning software, communication technology maintenance equipment and training support. This aims to reduce congestion and hence improve the energy efficiency of road transport in the city. Preliminary estimates suggest this could reduce traffic fuel consumption in Kingston corridors by 40% (Acorn International, 2016).

- Jamaica is participating in the Global Fuel Economy Initiative (GFEI) which is an initiative coordinated by UNEP that promotes a more efficient use of fuels in emerging economies. The aim of this initiative is to double average fuel economy of new cars by 2030 and all cars by 2050 through the collection of data to assess fuel economy potential in a given country or region, support for policy-making and stakeholder engagement. In 2015, the Ministry of Economic Growth & Job Creation in Jamaica conducted training sessions with stakeholders and began collecting registration data to develop a fuel economy database. This will aid in establishing a baseline fuel economy for Jamaica and tracking progress on fuel economy in the future. Additional policies that have been proposed to support the scheme’s target include fuel efficiency standards, vehicle labelling schemes and fuel and vehicle tax reform to encourage the purchase of more fuel-efficient vehicles (Potopsingh, 2018). However, as yet, the GoJ has made no commitment to introduce these policies.

- It has been reported that JPS will be installing EV charging stations in selected locations of Jamaica. This will provide the necessary infrastructure to accommodate an uptake in EVs and ultimately assist in the climate mitigation efforts of the transport sector. This pilot programme is expected to begin in the first quarter of 2019 (JIS, 2019).
2.2.5 Energy Demand: Industry

Overall policy framework

The National Energy Conservation and Efficiency Policy (NECEP) outlines policies to assist industry in adopting measures to reduce Jamaica’s carbon footprint. The NECEP focuses on policies to enhance knowledge, skills and capacity to help decarbonise industry, through outreach and support with identifying and implementing projects with high energy saving potential. Strategies associated with these outcomes include helping establish Energy Service Companies (ESCOs), which derive income by generating energy savings for their clients, and promoting best practice and innovation within energy-intensive industry using case studies.

Specific actions and projects

The ‘All Planned Actions’ scenario in Jamaica’s TNC identifies a plan to use combined heat and power (CHP) technologies to improve energy efficiency in the alumina-refining sector. The plan ultimately aims to improve the energy efficiency in the sector from 75% - 85%, to 90% by 2030.

According to NEPA, there are also air quality licences that must be purchased by particular sectors. For the bauxite, power generation, petroleum refinery, cement sectors, there are air pollutant discharge licenses that must be obtained and standards that need to be met, and these may have an indirect impact on the GHG emissions performance of the licensed entities. Producers also need to set up compliance monitoring and submit information to NEPA, in addition to verifications.

2.2.6 Energy demand: Utilities

Specific actions and projects

The ‘All Planned Actions’ in Jamaica’s Third National Communication identifies a plan to reduce losses in electricity transmission and distribution by 4.1% of net generation by 2020. Under this scenario, technical losses decrease by 1.5%, and non-technical losses would be lowered by 2.6%. This would be achieved by upgraded billing, inspection, and enforcement systems and smart meter programmes.

2.3 Adaptation co-benefits

There are a number of potential adaptation benefits expected from Jamaica’s mitigation commitments in the energy sector. As discussed further in Appendix A, Jamaica is both highly exposed and highly vulnerable to the impacts of climate change. This means that commitments that both reduce emissions and allow the country to better adapt to the consequences of climate change are of particular value. In the energy sector, there are a number of such co-benefits. First, the improvements in energy efficiency and a shift away from HFO power generation to less water intensive energy sources (such as renewables and natural gas) will reduce pressure on water resources. In addition, limiting temperature increases by reducing the reliance on HFO and transport fuels can lower local air pollution levels, reducing the health impacts of climate change. Further, reducing the reliance on fossil fuels can make Jamaica less vulnerable to weather-related events that damage fuel infrastructure (such as spillages and contamination) as dependence on fossil fuels reduces ability to recover.

2.4 Further analytical work

2.4.1 Should the energy sector be included in the next NDC?

The energy sector still holds most of the mitigation opportunities and should therefore remain a core part of Jamaica’s next NDC; there is also scope to increase the emission reductions contributions that it can deliver. Unlike other sectors discussed below, which are assessed against a set of explicit criteria, it is clear that the energy sector can definitely be included in the next NDC given the existence of clear policy frameworks and robust modelling procedures. In addition, it is very important to include the energy sector in any future
targets given it still accounts for the largest share of emissions and holds extensive opportunity for further mitigation. An important question for the next phase is whether there is scope for the sector to demonstrate further ambition (see Box 1 for the level of ambition quantified under the first NDC submission).

Box 1 Policies/Actions underlying the first NDC

The energy sector formed the focus of Jamaica’s first NDC. The NDC was developed through a technical partnership between the National Renewable Energy Laboratory (NREL) and the Government of Jamaica (GoJ). The NDC was generated using the Long-range Energy Alternatives Planning (LEAP) system to estimate the impact of the NEP (at its current level of implementation at that time) on emissions and then comparing this to emissions under a BAU scenario.

Only a small number of policies in the energy sector were explicitly modelled in the mitigation scenario. Specifically, the modelling considered two main policies/actions:

- **E10 blending.** As discussed above, in 2006, the Government began phasing out MTBE6 as an octane enhancer in gasoline and replacing it with ethanol creating E10: a mixture of 10% ethanol and 90% gasoline (GoJ, 2009b). To reflect this, the mitigation scenarios include actual E10 consumption from 2008 and the BAU scenario assumes no E10 fuel consumption.

- **Renewable power generation.** The emission reduction impact of current and potential renewable power projects were included (these are listed in Table 18 in Appendix B). This list includes the three Wigton Wind Farm projects, the BMR wind project, the Content Solar project (previously named Kelly’s Pen A), the Paradise Park solar project and the Maggotty hydro project, but not the Munro Wind project.

The LEAP system was used to model the impact of these two policies/actions. The emissions reduction from the modelled policies was estimated to be 1.124 million metric tonnes of CO$_2$e or a 7.8% compared with BAU by 2030. This translated into a 15% share of energy generation for renewable sources and a 49% share of electricity generation from renewable sources.

2.4.2 Which energy sector policies/projects should be included in the next NDC?

There are a number of policies/committed actions outlined under the ‘All Planned Actions’ Scenario in the Third National Communication that were not included in the previous NDC but could be included in a future NDC. These are summarised below along with an initial assessment of whether they would contribute to the country’s unconditional or conditional commitment.

- **Energy supply: Electricity** – *Net billing* is a recently enacted policy that will likely bring additional capacity online and thus reduce the need for electricity generated from fossil fuels. Furthermore, the target to reduce electricity losses could also be incorporated in the revised NDC’s mitigation scenario.\(^6\) These would form part of the country’s unconditional commitment.

- **Energy supply: Non-power** – If the planned switch from fuel oil to CNG in the Alpart Refinery outlined under the TNC is realised (it’s not clear whether this happened), we could capture the resulting decrease in emissions in our modelling framework. These would form part of the country’s unconditional commitment.

- **Energy demand: Buildings** – The energy efficiency improvements from the switch to T8 Fluorescent Lighting in Schools and Hospitals and Smart LED Street Lighting could be captured in the revised NDC.

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\(^6\) We note that there appeared to be a reduction in non-technical electricity losses in both the baseline and the mitigation scenario in the previous NDC modelling.
More discussions are required to understand the funding for these initiatives to identify whether they would be part of the country’s conditional or unconditional commitment.

- **Energy demand: Transport** – The emissions reductions from the introduction of 136 LNG-fuelled public transport buses by 2025 could be included in the revised NDC, as could those from the BS blending commitments. These would form part of the country’s unconditional commitment. Further investigation regarding the likelihood of introducing vehicle emissions testing, as allowed for under recent legislation, will be required.

- **Energy demand: Industry** – The commitment to deploy CHP technologies in the alumina-refining sector in order to increase energy efficiency from 75% - 85% to 90% could also be incorporated into the model. These would form part of the country’s unconditional commitment.

For the policies outlined above, we would seek to draw on the assumptions employed in the TNC modelling framework. However, in consultation with Jamaican stakeholders we may also adjust these assumptions to incorporate new information when developing our modelling framework.

There are also a number of policies that were not explicitly modelled in the TNC’s ‘All Planned Actions’ that could be included in a revised NDC. These are outlined below:

- **Energy demand: Buildings** – Both the EMEP and the EECP could be included as they make commitments to retrofit government buildings in order to reduce their energy usage, although there may be some crossover with the EECP, the T8 Fluorescent Lighting in Schools and Hospitals action and Smart LED Street Lighting action outlined in the TNC as discussed above. We will ensure in our modelling framework that these actions are not double counted. These actions would inform the appropriate conditional target for the country.

- **Energy demand: Transport** – The EMEP commitment to improve traffic management in Kingston could also be incorporated, again as part of the conditional contribution of the country.

In addition, there are further energy policies in the water sector, discussed in chapter 4, that will further reduce energy sector emissions. The draft NAMA in the water sector outlines two sets of interventions that could be included as part of the conditional commitment in a revised NDC. Intervention 1 includes 55 energy efficiency projects expected to lead to GHG emission reduction of 12,078 tCO₂ per annum. Intervention 2 involves the development of 60 solar PV plants (with sizes between 100 and 500 kW) which are projected to reduce annual GHG emission reductions by 13,085 tCO₂. In addition, the National Water Commission (NWC) has identified a number of potential renewable energy and energy efficiency projects. These include a range of solar energy projects and a programme to replace inefficient pumping equipment. These would form part of the country’s unconditional commitment.

Moreover, there are several projects in the health sector, covered in more detail in chapter 7, that could be discussed in the revised NDC. The impacts of the Major Improvement of Infrastructure Programme – which includes the retrofit and upgrade of the electrical infrastructure of facilities, such as changing light bulbs, rewiring, changing appliances, upgrading boilers and ACs in health facilities – might also be included as part of the unconditional commitment within the next NDC, provided there is sufficient data to inform the mitigation impacts.

There are also some policies that are still being considered that, if promulgated in the near term, might also be included in the NDC. These include proposed policy actions emerging from the electromobility framework, such as potential tax exemptions or rebates for EVs and parking policy reform. It may also include the potential regulation of tailpipe emissions.

On the other hand, the extent of the renewable energy contribution anticipated in the previous NDC may need to be revisited. It appears that the latest estimates of the share of renewables in the electricity mix is
slightly lower than implied by the NDC projections. IEA estimates suggest that the renewable electricity share in 2016 was around 13% while the NDC analysis suggested it would be around 20% by 2016.\footnote{The IEA estimates also include a contribution from bagasse (as it appears to measure total electricity generation), whereas the NDC analysis does not (as it appears to measure electricity generation from the grid).} In addition, the capacity additions from bagasse plants, that were due to come online in 2018, have not been realised and the additional solar and hydro capacity due to come online in 2020 may be pushed out. These developments suggest the revised trajectory of emissions reductions in 2030 might be slightly lower. It is also worth noting that the trajectory for renewable energy capacity will be subject to what is released in the IRP.

2.4.3 How will we estimate the impact of these actions on emissions?

The next phase of work will use the LEAP model to estimate the emission reductions associated with the energy sector actions outlined above. There are benefits in terms of continuity in using the LEAP modelling framework that was used to generate the first NDC. The Ministries involved will be familiar with this framework and it will be simple to update the inputs that were used in the previous modelling work (e.g. the realised and expected renewable electricity projects).

In practical terms, the LEAP model will estimate the emissions reductions associated with energy policies (against a credible baseline scenario) by adjusting particular model parameters. For example, on policies aimed at improving energy efficiency, this will likely involve setting the efficiency parameters in the NDC scenario in line with the expected improvement in efficiency estimated by other sources. In addition, similar to the previous modelling work, the impact of new renewable energy projects will be estimated by modelling the dispatch of power plants with different energy generation technologies over time. Emissions factors will then be applied to these technologies to estimate the GHG emissions associated with energy generation under the baseline and NDC scenarios, and therefore the impact on emissions from new renewable energy projects.
3 Land Use, Land Use Change, Forestry (LULUCF)

The Land Use, Land Use Change and Forestry (LULUCF) sector is of relevance both to mitigation and adaptation. Of particular importance are ‘wetland forests’, including mangroves and other swamp forests, as they offer particularly strong synergies between mitigation and adaptation (GoJ, 2018).

The importance of this sector, in particular with regard to ocean health, has also been emphasised during the 74th UN General Assembly in September 2019. As part of the High-Level Panel for Sustainable Ocean Economy, Prime Minister the Most Hon. Holness spoke about the importance of cohesive and accelerated ocean action, through the promotion of climate change mitigation and adaptation measures in SIDS.

3.1 Emissions Trends

Overall, the LULUCF sector is a net emissions sink. As Figure 5 below shows, the emissions sink provided by forests, which accounted for more than half of total landcover in 2012, easily offset the emissions released from grasslands. On average, the sector reduced emissions by around 1.7m tCO$_2$e in recent years. The statistics suggest little annual variation but this reflects that land use change is only available for selected years, and interpolation was necessary in the underlying source (the Third National Communication). It should also be noted that there is considerable uncertainty surrounding LULUCF emissions with the potential range of uncertainty being approximately 30% (GoJ, 2018).

This sink of emissions reduced overall national emissions by 10.6% on average between 2006 and 2012. This is shown in Figure 6 below.
40% or around 440,000 hectares of the country is forested and there have been small annual increases in measured forest cover in recent years (GoJ, 2015c). Between 1998 and 2013, the annual gain in forest cover was 0.41%. This is attributed mainly to the increase of secondary (ruinate) forest cover but also reflects improvement in technology and higher resolution satellite images which has allowed more accurate assessments over time.

Of Jamaica’s total forest cover, 59% is classified as broadleaf forest, but the amount of closed (undisturbed) broadleaf forest has been falling. Of the 59% broadleaf forest coverage, 19% comprised closed broadleaf and 40% disturbed broadleaf forests. The Forestry Department notes that there has been a decline in the coverage of closed broadleaf forest due to a number of policy and regulatory deficiencies including: conversion of forest cover for mining and quarrying purposes; fires which are often used to clear land for agricultural activity; unauthorised occupation of land; illegal felling of trees on state-owned land; selective removal of valuable biodiversity including endemic trees; limited awareness of the value of forests and trees as part of Jamaica’s cultural and ecological heritage; and insufficient monitoring of some forested areas, particularly mangroves (GoJ, 2017a). Secondary forest, which has experienced even greater disturbance, accounts for 28% of forest cover. Open dry tall limestone forest makes up 8%, mangrove forests and swamp forests contribute 3% and plantation forest accounts for 2% of forest cover.

3.2 Commitments

There are a number of policies and initiatives within the LULUCF sector of relevance for the next revision of the NDC. These are summarised in Table 5.
Table 5  There are a number of relevant policies, plans, and projects in the LULUCF sector for inclusion in the revised NDC

<table>
<thead>
<tr>
<th>Overarching policy</th>
<th>Strategies, plans and policy frameworks</th>
<th>Projects and other specific actions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• National tree planting programme</td>
<td>• EU budget support activity</td>
</tr>
</tbody>
</table>

Source: Hayman (2019); Vivid Economics

3.2.1 Overall policy framework

The Forest Policy for Jamaica provides a number of priorities for the sector. It consists of three main goals — of which Goal I is of particular importance for inclusion in a revised NDC as it commits to ‘no net loss of forest cover’ — with each further sub-divided into priority elements, as set out below.

1. **Goal I: Improved governance arrangements in relation to the management of the island’s forests.**
   - Improve the legal and institutional frameworks for development, management, and conservation of all forests in Jamaica to achieve no net loss of forest cover.
   - Improve decision-making as it relates to forests within the context of other sectors as well as addressing cross-cutting issues, overlapping mandates, and conflicting policies and practices.

2. **Goal II: Increased forest ecological system conservation and protection.**
   - Protect Jamaica’s biodiversity, particularly ‘national forest treasures’ of cultural, ecological, and historical value.
   - Maintain and restore forest cover by providing appropriate incentives to support the protection of forested lands and the reforestation of denuded lands to address mitigation and adaptation to climate change.
   - Facilitate and encourage the protection and conservation of forests, particularly native and endemic tree species, found on private lands in urban and rural areas.
   - Incentivise the preservation of standing natural forests to enhance ecosystem services, purification of air and water, carbon sequestration, nutrient dispersal, biochemical, and industrial products provided by forests.
   - Improve transparency and accountability in the management and use of Jamaica’s forest resources and enhance capabilities to ensure appropriate enforcement of Jamaica’s Forest laws.

3. **Goal III: Incorporation of socio-economic considerations into forest conservation and preservation.**
● Provide a broader framework to support community and public participation in the planning, policy making and management of forests which may include granting rights of use and management of timber and non-timber forest products and promoting agro-forestry and community forestry programmes.

● Develop greater appreciation of Jamaica’s forests by increasing opportunities for Jamaicans and tourists to access them for recreational and leisure activities as well as for cultural purposes.

● Improve the quality of life of the people who live in close proximity to forests and rely on their resources, by supporting the development of sustainable forest-based activities that create employment and income generation.

3.2.2 Strategies, plans and policy frameworks

The National Forest Management and Conservation Plan (NFMCP) (2016-2026) sets out how the GoJ will meet its Forest Policy commitment to maintaining a ‘no net loss of forest cover’. It identifies four Strategic Forest Management and Conservation Objectives (SOs):

1. Reverse forest degradation, deforestation and the loss of forest biodiversity, through conservation and sustainable forest management, as well as strengthening the legislative, policy and institutional framework of the sector.

2. Enhance economic, social and environmental benefits of forests through the sustainable utilisation of forest resources.

3. Build the capacity within the Forestry Department, its partners and forest communities to manage, protect and conserve the forest resources.

4. Increase public education and awareness to protect, conserve, restore and manage Jamaica’s forests.

These objectives are delivered through five Thematic Areas, each with its own actions and expected outcomes. The Thematic Areas are forest governance and conservation; forest utilisation; capacity for sustainable forest management; education, training and awareness; and monitoring and information management.

The NFMCP is complemented by the Climate Change Policy Framework for Jamaica which identifies a number of actions of relevance to the management of Jamaica’s forestry estate. These include commitments to:

● review and implement policies, legislation, and programmes to improve the management and conservation of Jamaica’s forests and control land use practices in particular the Forest Policy.

● support measures to preserve standing natural forests to enhance ecosystem services (sequestration of carbon) including the development of social forestry programmes and identify and implement appropriate incentives to support the restoration of forest cover on denuded and degraded lands.

● undertake actions to restore and replant mangrove forests in coastlines and rivers

● sustainably manage the burning of charcoal (used primarily in the hospitality sector)

● explore opportunities for the demand for forest carbon offsets and assess the potential to supply forest carbon offsets in Jamaica.

Building on these domestic plans and strategies, Jamaica has made a Voluntary National Contribution to the United Nations Forum on Forests (UNFF) Global Forest Goals (2018). Members of this Forum commit to contribute to share global objectives in relation to reversing the loss of forest cover; enhancing forest-based
economic, social and environmental benefits; increasing the area of sustainably managed forests; and reversing the decline in official development assistance for sustainable forest management and generating new and additional financial resources for sustainable forest management. Jamaica’s contribution to these goals include:

- In support of reversing the loss of forest cover, by 2020 to transfer responsibility for 7,000 ha mangroves to the Forestry Department and, by 2022, to reforest 300 ha of denuded lands and maintain 1,000 ha of forest plantations, to verify 10k ha of forest lands to support protection efforts.
- In support of enhanced forest-based ES&E benefits, including improving the livelihoods of forest dependent people/communities, to secure funding of US$ 2million to support alternative forest livelihood activities and to take action to upscale gender sensitive alternative livelihoods to support the sustainable utilisation of forest resources by local communities.
- In respect of increasing the area of sustainably managed forests, to increase the hectares legally protected as forests with sustainable management plans by 10%, to take action to increase areas of mangroves under protection and to develop a mangrove management and conservation plan to support this initiative.

A national tree planting programme envisages planting three million trees. The initiative, announced by Prime Minister Holness in October 2019, and which will be managed by the Forestry Department, will see the foresting of 3,000 hectares of land with two million timber seedlings, with the remaining one million timber and ornamental seedlings distributed to the public for planting. From discussions with the Forestry Department, it is understood that this initiative will mean that the reforestation and maintenance commitments set out in the Voluntary National Contribution to the UNFF will increase.

Jamaica also intends to revise the Forest Act (1996) and Forest Regulations (2001) to support better governance and protection of forested areas.

3.2.3 Projects and other specific actions

Prime Minister Holness’ speech at the High-Level Panel for Sustainable Ocean Economy at the UNGA in September 2019, focused on the need to ensure healthy oceans, reflecting the important role that mangroves can play in this regard, and thus building on the strategies and plans identified above. In 2020 Jamaica will start an assessment of the health of approximately 7,000 hectares of existing mangroves and swamp forest and the replanting of over 2,000 hectares. 15% of Jamaica’s bio marine resource has been declared legally protected, through 14 special fisheries conservation areas and two marine parks. By 2020 Jamaica aims to increase this to 20%. By 2020, Jamaica will also develop a method to support comprehensive and integrated management of all protected areas, with an effort to determine the true economic value of marine and coastal ecosystems and to aid in decision making.

He also made a call for actions cutting across oceans and other sectors. These include investing in nature-based climate solutions, harnessing ocean-based renewable energy, decarbonising ocean industries, securing sustainable food for the future, advancing the deployment of carbon capture and storage, and expanding ocean observation and research.

Jamaica has received approval for REDD+ Readiness support from Green Climate Fund (GCF) as one element of its strategy to meet its Forest Policy ‘no-net loss of forest cover’ commitment. Jamaica remains at an early stage in relation to REDD+ activities. The readiness support will provide support across a number of dimensions:

- In terms of organisation and consultation, it will help establish a Steering Committee to guide the process for REDD+, establish a roadmap to guide Jamaica to REDD+ Readiness, and establish a Grievance Redress Mechanism
In terms of information sharing, it will facilitate a stakeholder mapping process and the design of a REDD+ Communication and Outreach Strategy to guide engagement with different stakeholder groups.

In relation to the preparation of a REDD+ Strategy, it will allow assessments to determine drivers of deforestation and forest degradation; the review of policy, legal and institutional frameworks to identify gaps that could impact REDD+; an assessment of institutional needs and implementation capacity and associated action plan; and the assessment of REDD+ Strategy Options to support the preparation of a National REDD+ Strategy.

It will support the development of a REDD+ implementation framework including Programme Development and Implementation guidelines, an Environmental and Social Management framework, a National Forest Monitoring System; setting a Forest Reference Emission/Forest Emission Level; and developing a Safeguards Information System.

In addition, the EU is providing budget support to Jamaica to support forestry policy development and implementation. The four-year budget support covers: governance, reforestation, mangrove management plans, livelihoods activities, carbon stock management, boundary protection and conservation of closed broadleaf (primary) forest. Of particular relevance for the NDC development is the work that will be undertaken on carbon stock management. The plans envisage that by June 2020 the carbon stock will have been measured for one forest estate, with the aim to carry out 9 by the end of 2022.

### 3.3 Adaptation co-benefits

It is well recognised that forest conservation, reforestation and afforestation initiatives greatly improve the resilience to climate shocks and trends by providing a range of ecosystem services.

First, these mitigation actions improve adaptive capacity given limited water resources. Ensuring sustainable and integrated land use, including in watershed areas, can help maintain optimal levels of groundwater, increase water availability and improve its quality. Further, restored mangroves provide water filtration services, thereby improving overall water quality and counteracting the effect of saltwater intrusion.

Given the spillovers present between the LULUCF and Agriculture sector, there are a number of adaptation co-benefits in agriculture from mitigation actions undertaken in forestry. Improved maintenance of watersheds and expansion of agroforestry practices can help reduce soil erosion, improving the productivity of land and crop yields in the context of worsening agricultural conditions. Initiatives to promote sustainable livelihood options, in particular in rainforest buffer areas, to take off the pressure on forest exploitation (also taking into account gender balance), as well as decreasing deforestation risks, also improve food security and agricultural resilience.

There are also several benefits to health outcomes. First, reforestation and afforestation actions can help reduce localised heat stress. Further, sustainable forest management decreases soil erosion and water runoff, with reduction in the occurrence and/or impacts of landslides, flooding, and storms – and hence the damaging health impacts these events can cause.

Actions taken in the LULUCF sector to mitigate climate change can also improve the resilience of infrastructure. Reforestation and afforestation can reinforce the soil, reducing susceptibility to landslides and flooding, thereby providing infrastructure protection. In addition, actions to restore and replant mangroves provide additional coastal protection against storms and floods, where most of the country’s infrastructure is situated.

Coastal ecosystems can also benefit from mitigation actions in forestry. Restoring mangroves in coastal regions improves biodiversity and ecosystem services and provides protection for coastal ecosystems.
Mangroves also provide nursery habitats for many marine species, and contribute to sustaining the abundance of local fish stocks and shellfish populations.

3.4 Further analytical work

3.4.1 Should the LULUCF sector be included in the next NDC?

With the exception of the energy sector (which was included in the last NDC), we assess whether each sector should be included in the next NDC based on the five criteria outlined in detail in the introduction. These criteria are:

1. The existence of a GHG emissions baseline.
2. The existence of a forward-looking BAU baseline.
3. Clear policy commitments that can be converted into commitments and/or quantifiable targets to reduce or avoid emissions.
4. The identification of mitigation options/actions.
5. The mitigation options have been consolidated into a set of scenarios.

Table 6 provides this assessment in relation to the LULUCF sector.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Assessment</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GHG emissions baseline</td>
<td>√</td>
<td>Included in TNC, based on updated Forestry Department analysis.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>To note, the LULUCF sector is a net sink.</td>
</tr>
<tr>
<td>Forward-looking BAU baseline</td>
<td>√</td>
<td>TNC includes BAU up to 2050 (in the form of a diagram).</td>
</tr>
<tr>
<td>Clear policy commitments</td>
<td>√</td>
<td>High policy commitment and targets - ‘no net loss forest cover’ in the Forest Policy, and targets as part of the UN Global Forest Goals pledges.</td>
</tr>
<tr>
<td>Mitigation options</td>
<td>~</td>
<td>Numerous priority actions and policies, but no corresponding GHG reduction figures yet. These are expected to be consolidated in REDD+ readiness and further phases.</td>
</tr>
<tr>
<td>Mitigation scenarios</td>
<td>~</td>
<td>No scenarios yet and are expected to be consolidated in REDD+ readiness and further phases.</td>
</tr>
</tbody>
</table>

Source: Vivid Economics

On the basis of this assessment, it seems plausible that the LULUCF sector is included in the next NDC, with corresponding quantified mitigation commitments. Both a GHG baseline and BAU are available. There are clear policy commitments, through the ‘no net loss forest cover’ pledge enshrined in the Forest Policy. There are also quantifiable measures to reach the UN Global Forest Goal pledges, and Jamaica is ready to embark in a REDD+ programme, with the FREL and REDD+ strategy to be developed in the Readiness phase. It should be noted, however, that more detailed carbon stock calculations of Jamaica’s forestry estates will become
available after the next NDC will be submitted, so any initial emissions contribution calculated for the next NDC may need to be qualified as being indicative and subject to more detailed (ongoing) analysis.

3.4.2 Which LULUCF sector policies/projects should be included in the next NDC?

The following policies and projects can be considered for inclusion in the next NDC:

- **Forest Policy for Jamaica** as guiding policy for the commitment to ‘no net loss of forest cover’
- **progress relating to PM Holness’ speech at the UNGA High-Level Panel for Sustainable Ocean Economy**
- **The commitment to plant 3 million trees over the period 2019-2022**

Further discussions are required to understand the interactions between these commitments, although it is understood that the 3 million tree initiative will mean that the reforestation and maintenance commitments made to the UNFF are likely to be understated. At this stage, our understanding is that these would all constitute part of the unconditional contribution the country makes.

3.4.3 How will we estimate the impact of these actions on emissions?

The estimation procedure will follow the IPCC 2006 guidelines, as in the Third National Communication, and involve the following steps:

1. **Data collection**
   - **Targets**: The most relevant targets are discussed above. It will be necessary to validate these targets with relevant stakeholders, in particular the Forestry Department, to ensure there are no errors, and to understand whether they are the most recent commitments. Also, it will be important to clarify what the Forest Policy’s target means in the Jamaican context.
   - **Activity data**: (the TNC and Jamaica’s Land Use Cover Assessment (LUCA) 1998 and 2013, appear to contain the most recent data)
     - Categorisation of land: the IPCC (2006) provides categorisation in six land use categories (forest land; cropland; grassland; wetlands; settlements; other land). Within forestland, there are eight categories (Disturbed broadleaf; Closed broadleaf forest; Open dry forest – Tall; Open dry forest – Short; Plantations (forest); Secondary forest: Mangrove Forest; Swamp Forest).
     - Baseline: the TNC and LUCA contain data on land use changes (loss and gain in hectares)
     - BAU projections: the TNC contains projections to 2050 (it is expected that the FRL/FREL developed with the REDD+ readiness support will provide a more rigorous BAU)
   - **Emission factors**: The TNC appears to contain this data for all forest categories, but it will need to be validated with the Forestry Department, given that data uncertainty in the sector is approximately 30%, and Tier 1 was used for most categories.
   - **Mitigation measures**: The Forest Policy and the UN Global Forests Pledge contain indicative measures to achieve the targets

2. **Data consolidation and analysis**
   - **GHG emissions calculation**: this will be the result of activity data * emission factor
3. Stakeholder consultation and finalisation – as part of wider NDC revision

- Presentation: of preliminary data and text to stakeholders
- Stakeholder discussions and revision: feedback on the inclusion of the LULUCF sector in the NDC, in addition to on the data and narrative, will be sought
- Finalisation

It should be stressed that the approach to estimating the contribution this sector makes to Jamaica’s emission reduction commitment in the forthcoming NDC will be relatively rudimentary as a result of limited data and time. For future NDCs, better data is expected to become available as a result of the REDD+ readiness activities and the EU budget support for the sector. Therefore, methods for estimating the contribution of the sector will likely be further refined in the future.
4 Water

The water sector is important from both a mitigation and an adaptation perspective. From a mitigation perspective, it is the largest public service consumer of electricity accounting for around 45-50% of the public sector’s electricity bill. From an adaptation perspective, climate change is expected to result in Jamaica suffering reduced replenishment of underground water sources and groundwater recharge, and in coastal areas, to sea level rise causing seawater intrusion of aquifers, which will reduce freshwater supply for drinking water and irrigation. Given this importance, this section considers the water sector in more detail, although from an emissions accounting perspective, its emissions should be covered in the sections discussed above (especially energy – in relation to the sector’s electricity consumption – and waste).

The water sector comprises of three sub-sectors:

- Water Supply: which accounts for around 93% of reported electricity consumption in the sector.
- Wastewater: Only fragmented data is available. On average, the Central Wastewater Treatment Company (CWTC) reports that it treats around 63,000 m³ volume of wastewater per day.\(^8\)
- Irrigation: Data is only available in relation to the quantity of water extracted, but not electricity consumption.

4.1 Emissions Trend

Emissions from the water sector have been stable between 2014-17 at around 250,000 tCO₂ (around 3.5% of emissions). As Figure 7 shows, water supply and wastewater subsectors are responsible for nearly all emissions.

Figure 7  Emissions trend from water (2014-17) is stable, with water supply and wastewater producing nearly all emissions

Source: Vivid Economics, based on data from UNDP (2019)

\(^8\) No corresponding data was available from the National Water Commission (NWC).
4.2 Commitments

No emission reductions in the mitigation scenario are assumed to come from the water sector, despite the overall importance of water in the NDC. The water sector features strongly in the adaptation section of the current NDC. However, there are a number of policies, strategies, and plans, and projects of relevance to the sector that could be relevant to the future NDC, as summarised below and illustrated in this section.

Table 7: There are a number of relevant policies, plans, and projects in the water sector of relevance to the revised NDC

<table>
<thead>
<tr>
<th>Overarching policy</th>
<th>Strategies, plans and policy frameworks</th>
<th>Projects and other work</th>
</tr>
</thead>
<tbody>
<tr>
<td>• (Draft) updated Water Sector Policy and Implementation Plan</td>
<td></td>
<td>• RE and EE Projects by National Water Commission (NWC)</td>
</tr>
<tr>
<td>• Climate Change Policy Framework of Jamaica (2015)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Vivid Economics

4.2.1 Overall Policy Framework

The Jamaica Water Sector Policy, prepared in 2004, contains a number of elements aimed at increasing energy efficiency in the water sector. These include:

- Improving plant, motor and pump efficiency
- Ensuring that equipment is operated and maintained in accordance with specifications, and monitoring process variables to optimise operations
- Optimising the operation of water pumping equipment including, where possible, taking advantage of off-peak energy rates through installation of additional storage capacity
- Maximising the use of gravity-driven systems by placing facilities at higher elevations, where feasible
- Improving the monitoring and control of water transmission and distribution operations
- Utilising energy efficient lighting and air conditioning systems
- Where feasible, utilising alternative energy sources such as wind, solar, and hydroelectric power
- Ensuring that the most efficient electricity tariff is applied to each facility.

A draft revised Water Sector Policy has been developed to take account of the significant changes the sectors have undergone since preparation of the 2004 policy. The revised Water Sector Policy projects the achievement of universal access to potable water by 2030 as per the goals defined in the Vision 2030 Jamaica. The policy also defines the six main principles guiding the Policy:
The draft Policy reaffirms the importance of energy efficiency in the water sector. It notes, in particular, the importance of energy efficiency for the National Irrigation Commission (NIC), when taking into account billing, and despite emissions from the irrigation sub-sector being relatively small, as indicated above. The tariffs paid by the NIC, in fact, cover less than half of the operating costs of water supply which means that more energy is used to produce and pump water for irrigation than is efficient. This is especially problematic for eight of the ten irrigation systems which rely heavily on energy intensive pumping to abstract groundwater. The NIC’s electricity costs for pumping increased by 145% between 2006 and 2012, to a total of J$265 Million. This problem is further exacerbated by high water losses in some systems, as high as 63% in the Mid-Clarendon irrigation system.

The draft also lists examples of technical measures to be implemented in the water sector. These are broadly similar to those included in the 2004 document and include:

- Promotion of rainwater harvesting systems
- Construction of piped gravity-fed water supply systems
- Use of renewable energy technologies, such as solar PV
- Focus of irrigation during early mornings or late evenings
- Weather stations to optimise irrigation
- Application of other efficient irrigation technologies to improve on farm water use efficiency, such as drip irrigation and fertigation
- Carrying out of energy audits (audits for some plants have already been carried out as part of the USTDA project below, and its overlap, if any, with this needs to be explored further).

4.2.2 Strategies, Plans and Policy Frameworks

The Climate Change Policy Framework for Jamaica identifies a number of actions of relevance to the water sector. These include:

- Incorporate projected changes in climate in watershed management and water resource action planning and develop water adaptation plans for parishes, regions, and nationally.
- Improve and upgrade water infrastructure to aid in water conservation. These measures include upgrading to more efficient pumps, improving piping systems, and enhancing surface and ground water storage (e.g. employing new storage techniques such as artificial recharge of groundwater or rehabilitating and maintaining water storage facilities).
- Develop and use micro-scale water harvesting technologies such as ponds, wells, roof collection systems; enhance drainage systems; and implement water runoff reduction techniques, water
reservoirs and land surface catchment systems to enhance the utilisation of rainwater as a water resource in both urban and rural areas.

- Develop water efficiency measures including adequate wastewater treatment.

### 4.2.3 Projects and other specific actions

The **draft** Water Sector NAMA identifies a reduction of GHG emissions of 20% for the water sector and to increase the share of captive-use renewable power generation to 10% of the sector’s electricity consumption by 2030. To deliver these targets, two suites of intervention have been identified:

- Under the energy efficiency interventions, a total of 55 energy efficiency projects will be implemented in 3 stages. These projects are expected to lead to total electricity savings of 19,800 MWh per annum and GHG emission reductions of 12,078 tCO₂ per annum.

- Under the renewable energy interventions, a total of 60 solar PV plants (with sizes between 100 and 500 kW) will be implemented, generating a total of 21,450 MWh per annum and leading to annual GHG emission reductions of 13,085 tCO₂. Implementation would be continuous between 2020 and 2030.

The **NAMA is still in draft, and implementation has not begun yet.** Respective entities in the Water Sector have however begun small-scaled implementation of selected initiatives which can later be scaled up.

Additionally, the NWC has carried out audits on the twenty largest electricity consumption facilities, leading to the identification of two possible renewable energy projects and four potential energy efficiency projects. The audits were carried out as part of a USTDA US $1M grant funding. Appendix C contains a list of facilities for renewable energy development of approximately 14.0 MW combined capacity and a 40 MW floating solar power plant at the Mona Reservoir.

**The Mona Reservoir project will be the first utility-scale floating solar PV plant in the Caribbean.** Construction is expected to begin in Q1 2020, with an updated installed capacity of 45 MW, and will include grid energy storage system and grid frequency response. It will provide power to the National Water Commission for use at the Mona Reservoir site. The international partnership green Crowd, through its client Derillion Energy, has acquired the development rights, and the UK’s Department for International Trade (DIT) is expected to provide support.

Consistent with aspects of the policies and plans above, NWC also plans to run an energy improvement programme aimed at improving energy efficiency and increasing the use of renewable energy. Over the next 3 years, it intends to:

- Replace some inefficient pumping equipment;
- Establish SCADA (Supervisory Control and Data Acquisition) for selected facilities and systems – which will see the widespread full utilisation of variable frequency drives which are currently installed and those that will be installed to complement the SCADA network;
- Audit the next set of highest twenty (20) electricity energy consuming plants;
- Undertake electromechanical efficiency audits for twenty (20) plants island-wide (plant make up, potable water systems & wastewater systems);
- Benchmark energy consuming equipment.

However, there is no indication of emission reductions or energy savings that these activities would deliver, and it is not clear what degree of overlap there is, if any, with the NAMA.
4.3 Adaptation co-benefits

Many mitigation policies within the water sector also bring adaptation benefits to the sector. Energy efficiency measures will reduce the consumption and wastage of water, which can then be saved or used in more productive ways. For instance, optimising the operation of water pumping equipment, including storage capacity, to take advantage of off-peak energy rates will boost resilience to water shortages. In addition, demand side measures can reduce emissions and the demand for water, ensuring that there are sufficient resources available as climate change makes shortages more likely. An increase of renewable energy in the energy mix will increase the amount of clean energy generated and reduce water pollution, thereby reducing scarcity of clean water.

Mitigation measures in the water sector can also build resilience in agriculture. The utilisation of more efficient irrigation technologies, can improve water use efficiency, allowing the sector to be more resilient to reductions in water availability. When more efficient irrigation methods are coupled with efficient fertiliser use, this can increase crop yields, making production levels more resistant to temperature increases.

Finally, there are adaptation benefits to health from intended mitigation actions within the water sector. First, energy efficiency measures that result in an increase in access to potable water and water quality improvements will have a positive impact on population health, enhancing their adaptive capacity to climate. Further, the development and use of micro-scale water harvesting technologies can reduce storm water runoff and therefore the risks associated with flooding and stagnating water, such as water-borne and vector-borne diseases, both of which are expected to intensify as temperatures increase.

4.4 Further analytical work

4.4.1 Should the water sector be included in the next NDC?

The water sector has been assessed against the five criteria presented in the introduction. Table 8 provides this assessment.

Table 8  The water sector should be included in the revised NDC, based on the assessment against the guiding criteria

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Assessment</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GHG emissions baseline</td>
<td>√</td>
<td>Not water sector specific in TNC, but data in Water Sector NAMA</td>
</tr>
<tr>
<td>Forward-looking BAU baseline</td>
<td>√</td>
<td>Not water sector-specific, but in TNC in interaction with other sectors</td>
</tr>
<tr>
<td>Clear policy commitments</td>
<td>√</td>
<td>Yes, in Water Sector NAMA. Reduction of 20% GHG emissions and increase of share of RE to 10%</td>
</tr>
<tr>
<td>Mitigation options</td>
<td>√</td>
<td>Specific actions identified to achieve the targets in the NAMA, as well as other initiatives carried out, in particular by the NWC</td>
</tr>
<tr>
<td>Mitigation scenarios</td>
<td>√</td>
<td>Yes, in Water Sector NAMA in relation to RE and EE</td>
</tr>
</tbody>
</table>
On the basis of this assessment, it seems plausible for emission reductions from the water sector to be included within the energy sector emission reduction commitments of the next NDC. There are in fact a number of renewable energy and energy efficiency initiatives as part of the Water Sector NAMA, in addition to ones carried out by the National Water Commission, which would reduce GHG emissions. Some of these would help contribute to a more ambitious unconditional target by Jamaica; others would be part of Jamaica’s conditional target.

4.4.2 Which water sector policies/projects should be included in the next NDC?

As discussed above, there a number of actions in the water sector that can reduce energy sector emissions, and can therefore likely be included in the revised NDC through LEAP modelling.

- The (draft) Water Sector NAMA identifies a reduction of GHG emissions of 20% for the water sector and to increase the share of captive-use renewable power generation to 10% of the sector’s electricity consumption by 2030. Intervention 1 includes 55 energy efficiency projects expected to lead to GHG emission reduction of 12,078 tCO$_2$ per annum. Intervention 2 involves the development of 60 solar PV plants (with sizes between 100 and 500 kW) which are projected to reduce annual GHG emission reductions by 13,085 tCO$_2$. These could be part of the conditional contribution that the country makes.

- In addition, the National Water Commission (NWC) has identified a number of potential renewable energy and energy efficiency projects. These include a range of solar energy projects and a programme to replace inefficient pumping equipment. These could be part of the unconditional commitment that the country makes.

At this stage, there are no commitments in the water sector that could only be included in NDC revisions after the current revision.

4.4.3 How will we estimate the impact of these actions on emissions?

The following analysis is recommended, in order to include emission reductions from the water sector in the next NDC.

- Confirm what is being developed and delivered with national resources versus what is in the NAMA, and therefore conditional on international support.

- Incorporation of projects within overall LEAP modelling. This will likely involve incorporating the new renewable energy projects in this sector into the LEAP model and adjusting the energy efficiency parameters.
5 Waste

Waste management is a critical issue in Jamaica. Currently, the country generates an estimated 1kg/per person/per day of solid waste (ESSJ, 2018). Most waste generated in Jamaica is disposed of in managed dumpsites and the availability of land to deal with increasing volumes of waste will become an increasingly important issue to address, especially as the country’s largest disposal site (Riverton) reached its nominal maximum capacity by 2014. However, 69% of the solid waste generated in Jamaica is organic, representing a potentially good source of input into an energy-from-waste sector.

It is also gaining increasing attention, including from the citizens. There are widespread calls to improve the current solid waste management infrastructure, especially after recent landfill fires have raised the profile of the negative health impacts associated with the current approaches to the management of municipal solid waste.

5.1 Emissions Trend

The overall emissions trend in the waste sector is stable, and accounts for around 5% of net GHG emissions. However, the solid waste management sub-sector makes the largest contribution, and emissions from this sub-sector are growing. The sub-sector alone contributes to 3% of CO$_2$eq emissions, primarily CH$_4$. These emissions, primarily from landfills, show a steady increase over time and were 16% higher in 2012 than 2006.

5.2 Commitments

There are a number of policies, plans and projects, particularly relating to energy from waste, which are of potential relevance to Jamaica’s NDC. These are summarised below.

Table 9 There are a number of relevant policies and plans in the waste sector

<table>
<thead>
<tr>
<th>Overarching policy</th>
<th>Strategies, Plans and Policy Frameworks</th>
<th>Projects and other work</th>
</tr>
</thead>
<tbody>
<tr>
<td>• National Energy from Waste Policy (draft) – which includes indication of biogas projects</td>
<td>• Climate Change Policy Framework for Jamaica (2015) • Possible update to solid waste management plan</td>
<td>• Tyre incineration to energy for cement production (2019) • PPP for Integrated Waste Management (in progress)</td>
</tr>
</tbody>
</table>

Source: Vivid Economics

5.2.1 Overall policy framework

Jamaica’s (draft) National Energy-from-Waste Policy, a sub-policy of the National Energy Policy, is designed to ensure that: ‘Jamaica is the regional leader in providing affordable and clean energy from waste contributing to a sustainable future’. It recognises that waste management is an extremely important issue within the country and sets four goals:

1. Goal 1: Jamaica creates economic infrastructure and planning conducive to the development of the energy-from-waste sector
2. Goal 2: Jamaica builds its energy-from-waste sector on the most appropriate technologies that are environmentally friendly, producing a clean and reliable renewable source of energy
3. Goal 3: Jamaica creates partnerships between the energy sector and the waste management and agriculture sectors to facilitate the continuous streams of waste into the energy from waste.

4. Goal 4: Jamaica has a well-defined governance, institutional, legal and regulatory framework for the generation of energy from waste.

The Policy identifies a number of promising technologies for energy-from-waste in Jamaica, including:

- Incineration of municipal solid waste: incineration is environmentally preferred to uncontrolled dumping as it reduces the volume of garbage by over 85%.

- Capture of landfill gas. As noted above, 69% of the municipal waste stream consists of organic matter, which generates large volumes of gas. This can potentially be captured and used as a fuel source.

- Production of biodiesel from cooking oil. At present, while there are some small operations in existence, there is no national system in place for collecting used cooking oil. A pilot project will establish 10 acres of inter-cropped jatropha and castor plants at the Bodles Research Station in Old Harbour, St Catherine. The research will consider the harvest potential under prevailing climatic condition and will seek to determine the productivity of feedstock varieties on marginal lands. This links to the transport policies discussed above.

- Co-generation using bagasse. Approximately 600,000 tonnes of bagasse – equivalent to about 940,000 barrels of oil at a value of US$37.5 million – are used per annum (as of 2003) in cogeneration in Jamaica’s sugar factories.

- Production of biogas using animal wastes. The Scientific Research Council has been involved in the development of biogas plants using animal wastes in the agricultural, small manufacturing, educational and residential sectors. A total of 250 plants are in operation across the island, though cultural barriers need to be overcome to ensure full acceptance of biogas as a fuel for cooking. At present, there is no overall estimate of how much biogas does or could contribute to the energy mix.

- Use of wastewater sludge: Sludge is rich in nutrients such as nitrogen and phosphorous and contains valuable organic matter.

The Policy document notes that there are specific incentives that may be applied to energy-from-waste projects on a case by case basis. These include:

- full duty and tax exemption for importation of machinery and equipment used on the project (excluding motor vehicles);

- tax credits for a number of years (to be negotiated);

- accelerated depreciation benefits allowing full write-off of capital costs associated with the acquisition of new machinery and equipment items for renewable energy projects;

- at concessionary rates (where possible).

However, it is understood that, at present, these policies and incentives are not being used systematically and that the Policy may be revised in the near future.

Jamaica has introduced a single use plastics ban. Since the start of 2019, the government has imposed a ban on the importation, manufacture, distribution and use of single use plastic bags (of certain sizes) as well as plastic straws. From January 2019, there has been a ban on the importation of polystyrene foam (‘Styrofoam’) for use in the food and drink industry, while from the start of 2020 the ban will be extended to cover the domestic manufacture of these items as well.
5.2.2 Strategies, Plans and Policy Frameworks

The Climate Change Policy Framework calls for the implementation of the Energy from Waste policy, especially the importance of exploring the feasibility of landfill gas recovery and utilisation. It also stresses the importance of implementing and enforcing regulatory standards and measures to reduce waste including re-use, recycling and composting. However, it is not clear that specific standards or measures have been introduced in this regard, and stakeholders interviewed have recognised that discussions on options to reduce the waste on unmanaged dumpsites are biased towards a focus on waste to energy projects.

There are calls to update the National Solid Waste Management Plan and to develop other policies and regulations. The current Management Plan is outdated (2001) and consultations are underway for its update. One of the potential regulations that may be enacted relate to the segregation of waste at source and to the disposal of PET bottles – at present, only 50% of bottles in the country are collected and the remaining ones are often burnt. There are also calls to develop a National Hazardous Waste Policy and an Organic Waste Policy. The latter originates in particular from pressures from the sustainable tourism sector, and could also regulate and provide incentives for the development of biodigestors for food and farm waste.

5.2.3 Projects and other specific actions

The Waste Enterprise Team is currently developing proposals for a country-wide Integrated Waste Management (IWM) PPP concession. The concession will cover multiple sources of waste across the country through a PPP for waste collection, transfer and disposal. It is expected that the focus will be on energy from waste, as the waste will be primarily organic, so as to improve the footprints of landfills and reduce unmanaged dumping. Other methods, such as recycling, are expected to be favoured for other types of waste, such as metal and plastic. A timeline of 16 months to operation is envisaged.

Tyre disposal in Jamaica is a critical problem due to the large amount of waste and the country being an island (Jamaican Observer, 209; JIS, 2019). An average 1,000 tyres are deposited at the Riverton landfill per day, and the Hill Run facility has also amassed about one million tyres. The tyres pose a serious threat to the environment, mainly due to fire hazard, which, when they arise, cause toxins to be released into the atmosphere.

The Government is partnering with the Caribbean Cement Company to remove between 1.5 and 2.0 million tyres from the Riverton City landfill for incineration and energy generation. The removal and disposal have been formalised with the signing of a memorandum of understanding (MOU). Under the terms of the MOU, the National Solid Waste Management Authority (NSWMA) will supply five truckloads of old tyres per day from the Riverton City disposal site in Kingston for incineration at the Caribbean Cement Company plant in Rockfort in east Kingston. The pilot project will be undertaken on 40 non-consecutive days, over a period of three months from August 2019.

NEPA expects that the pilot will result in a small reduction in CO₂ emissions. Very preliminary theoretical data points to a GHG reduction of 5%, assuming that it displaces coal as the fuel used for thermal heat generation in cement production.

An assessment will follow the pilot – including on whether the project has reduced emissions in line with expectations. It is hoped that the pilot will lead to a larger project and emulation at other landfills and sites. Prime Minister Holness has asserted that, moving forward, he would want to see collection points being established in closer proximity for ease in transporting and delivering to the kiln, as well as protocols being developed around the disposal of tyres at these collection points.

Jamaica is also implementing a number of small biodigester projects. There is limited information on the characteristics of these projects, and consequently on the potential to reduce emissions in the sector, apart from mention in the National Energy from Waste Policy.
5.3 Adaptation co-benefits

There are a number of potential adaptation benefits expected from Jamaica’s mitigation initiatives and commitments in the waste sector. Sustainable and integrated waste management initiatives have the potential to contribute to a number of Sustainable Development Goals (SDGs), including Goal 3 (improved health and wellbeing), and Goal 6 (clean water and sanitation), in addition to Goal 13 (Climate Action, primarily mitigation, with some adaptation impacts).

First, mitigation actions in the waste sector can address the negative impacts on water. These might occur from existing waste management practices, such as uncontrolled dumping. In addition, initiatives to reduce waste generation, encourage recycling and increase incineration will reduce the negative effects on water quality which will become more important as climate change reduces water resource availability.

An integrated waste management system and land use system could provide benefits to agriculture. For example, reducing the land currently used for landfills could free it up for other more productive uses, such as agriculture, to increase crop production, and improve yields. Improved waste management practices, including the use of wastewaster sludge, can also improve soil quality, with positive impacts on crop yields.

Mitigation actions in waste can also lead to positive outcomes on health and infrastructure. The incineration of waste and capture of landfill gases can reduce atmospheric pollution and landfill fires, thereby improving air quality and reducing respiratory diseases that are expected to worsen as a result of climate change. In addition, wastewater sludge management can reduce the occurrence of stagnant water, thereby reducing the spread of vector-borne diseases which are exacerbated by higher temperatures. The reduction of unmanaged waste (mostly through incineration) can also reduce the blockage of roads and waterways. In the occurrence of floods, landslides and severe storms, this can decrease the negative health impact on the population.

Finally, the reduction of unmanaged waste (mostly through incineration) can provide benefits to coastal areas. In particular, it can increase the regeneration capacity of natural habitats, including fish stocks and mangroves which will become increasingly important as climate change threatens these ecosystems.

5.4 Further analytical work

5.4.1 Should the waste sector be included in the next NDC?

The waste sector has been assessed against the five criteria presented in the introduction. Table 10 provides this assessment in relation to the waste sector.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Assessment</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GHG emissions baseline</td>
<td>✓</td>
<td>Included in the TNC. To note, solid waste disposal on land contributes to 3% total.</td>
</tr>
<tr>
<td>Forward-looking BAU baseline</td>
<td>✓</td>
<td>TNC includes BAU up to 2050 (in the form of a diagram).</td>
</tr>
<tr>
<td>Clear policy commitments</td>
<td>~</td>
<td>There is strong political commitment to improve the country’s waste management system, as indicated through the planned development of a country-wide Integrated Waste Management (IWM) PPP. Strong bias towards energy from waste generation, less</td>
</tr>
</tbody>
</table>
on other waste management areas (such as reduce, reuse, recycle).
No quantified commitments as yet.

<table>
<thead>
<tr>
<th>Mitigation options</th>
<th>~</th>
<th>Feasible technologies for energy from waste identified. Outcomes of the IWM process and findings from tyre incineration to waste pilot to be known in the next 3 months.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mitigation scenarios</td>
<td>x</td>
<td>Not identified</td>
</tr>
</tbody>
</table>

Source: Vivid Economics

On the basis of this assessment, emission reductions from the waste sector might be included within the quantified mitigation commitments of Jamaica’s next NDC. There has been important progress in the waste sector in recent years, in particular with the drafting of the National Energy from Waste Policy, the single use plastics ban, the planned Integrated Waste Management PPP, and the piloting of the tyre incineration to power cement factories. The single use plastics ban could be included in the NDC if it is established that this results in a change in emissions in the local refining sector, as could the tyre project depending on whether GHG impacts can be measured and whether the pilot scales up to allow a meaningful contribution to emissions reductions to be quantified. In the longer term, improvements in waste management from the PPP deal could reduce emissions, but this is not yet sufficiently developed to consider at this stage.

5.4.2 Which waste sector policies/projects should be included in the next NDC and future NDCs?

As indicated above, there is potential to include emission reductions from a number of projects including:

- The tyre incineration to energy project, depending on whether GHG impacts can be measured and whether the pilot scales up to allow a meaningful contribution to emissions reductions to be quantified.
- Impacts from the ban of single-use plastic policy (if material for domestic emissions and available in time).

Both of these would form part of the country’s unconditional commitment.

In subsequent NDCs, there is potential to include improvements in waste management from the PPP deal. The financing arrangements of this deal, as yet undecided, would influence whether any associated emission reductions would be part of the country’s conditional or unconditional commitment.

5.4.3 How will we estimate the impact of these actions on emissions?

The following analysis is recommended, in order to include the waste sector in the next NDC.

- Indicative calculation of GHG reduction for tyre incineration project

  ◊ There are numerous case studies internationally that assess the impact of utilising discarded tyres for energy that can be used as basis for an assessment in Jamaica, should data not be available in time. Analysis for Jamaica would include assumptions on the scale that the project could reach beyond the pilot phase, and a set of scenarios would be developed and then discussed and validated with relevant stakeholders. An assessment of the impacts of the plastics ban would depend on obtaining a robust understanding of its impact on the domestic refining sector.

- If available, inclusion of GHG reduction from the IWM deal.
Subsequent NDCs can include the following.

- Validation of mitigation potential of tyre incineration project beyond pilot – the assumptions that will have been used for the 2nd NDC will be tested, and real project data will be used for the GHG calculations beyond 2020.

- Inclusion of measures in economy-wide modelling – this analysis is expected to be part of a wider Transparency/MRV process.
6 Agriculture

Agriculture is a priority in the Government’s mid-term policy plans due to its importance for employment and its vulnerability to climate change. Agriculture’s weight in Jamaica’s GDP is moderate, but with 18% of the active population employed in agriculture and 46% of the total population living in rural areas, it is an important contributor to the country’s economic and social development. The agriculture sector is very decentralised, with over 170,000 farmers. Its farming practices are mid-way between South America (extensive farming) and North America (intensive). Traditional agricultural exports, especially coffee and citrus, are in decline, and the government is making efforts to promote non-traditional export commodities such as yams, papaya, Jamaican ackee, sweet potatoes, and marine products (IDB, 2017).

The sector is very vulnerable to climate change, compounding a series of other challenges that it faces. For example, in 2012 the agriculture sector suffered damage of almost Jamaican $1.5bn from the effects of Hurricane Sandy. As well as this vulnerability to extreme weather events, the sector faces problems from water deficiency (which will be further exacerbated by climate change); high energy costs; limited market access due to an absence of a modern fresh-produce quality compliance system; and inefficient production (CDB, 2017).

6.1 Emissions Trend

The emissions trend in Jamaica’s agriculture sector has stabilised, after a dip in 2005-6. The emissions trend and contributions presented below are from the FAO as the TNC does not present annual sectoral emissions from the agriculture sector on a CO₂ equivalent basis.

Figure 8  Agriculture CO₂ e emissions have been stable since 2006

![Graph showing CO₂ e emissions for agriculture from 1990 to 2016.](image)

Source: Vivid Economics, based on data from FAOSTAT (2019)

The TNC indicates that agriculture emissions from main sub-sectors contribute to 50% of net emissions. These are mainly from CH₄ and N₂O, with manure management (chicken broilers), organic N fertiliser, and manure being the largest contributors.
6.2 Commitments

There are a number of actions of relevance enshrined in various policies, strategies and plans, and projects, of potential relevance to the NDC revision. Table 11 summarises these, with further discussion below. However, overwhelmingly most activity of potential relevance takes place on a project-by-project basis, with minimum quantification of mitigation potential. It should also be noted that agriculture is a critical component of Vision 2030 Jamaica, and consequently on Jamaica’s implementation of the Sustainable Development Goals (SDGs).

Table 11: There are a number of plans and projects of relevance for inclusion in the NDC

<table>
<thead>
<tr>
<th>Overall policy framework</th>
<th>Strategies, plans and policy frameworks</th>
<th>Projects and other specific actions</th>
</tr>
</thead>
</table>
| - Food and Nutrition Security Policy (2013)  
  - Climate Change Policy Framework for Jamaica (2015) | - Agriculture Strategy Action Plan (2009) - 10-year agriculture development strategy underway (to include a vulnerability assessment and an agri-business strategy)  
  - Essex Valley Agriculture Development Project (EVADP) (2017)  
  - GoJ/Adaptation Fund - Enhancing the Resilience of the Agricultural Sector and Coastal Areas to Protect Livelihoods and Improve Food Security (2015)  
  - Government extension projects |

Source: Source: Hayman (2019); Vivid Economics

6.2.1 Overall policy framework

There is no one policy that guides all the priorities for the agriculture sector in Jamaica, but there are a number of thematic policies that address different aspects within it. Stakeholders indicate that initiatives in the sector are designed and implemented through a bottom-up and donor-led approach. Despite numerous attempts to develop a sector-wide policy, there has been limited progress so far.

The 2013 Food and Nutrition Security Policy is the closest to an overarching policy of relevance to climate change, and aims to improve food and nutrition security in Jamaica through actions across four interlinked pillars. These are: (i) food availability; (ii) food access; (iii) food utilisation; and (iv) stability of food supply.

The objective of the Food Stability pillar is to improve the food and nutrition security resilience of the national community to natural and socio-economic shocks and climate change. In this regard, the pillar emphasises the implementation of adaptation and mitigation strategies as a means of enhancing the stability of food security, with the following policy intent:

- Promote the creation of an Information System for Food and Nutrition Security (ISFNS) for food security development, as well as food crisis prevention and risk management and the construction of adequate risk profiles for the main crops
- Pursue climate resilient development which focuses on adaptation as well as mitigation strategies for the food and agriculture sector
• Enhance the capacity of relevant institutions to provide climate related information in collaboration with relevant regional bodies

• Integrate climate management considerations into the National Agricultural Disaster Risk Management Programme

• Reduce the impact of climate change on food production

• Utilisation of vulnerability analysis and mapping to provide timely nutrition and socio-economic information on vulnerable population groups to decision-makers to enable the design of more effective emergency and relief responses

• Develop comprehensive agricultural insurance and risk transfer schemes

• Subscription to a national and regional disaster fund.

6.2.2 Strategies, Plans and Policy Frameworks

The Agriculture Strategy Action Plan provides a means for delivering on the intent of the Food and Nutrition Security Policy, but it does not have a specific climate change lens. It does, however, note the impact of the sector on the environment, and includes some measures that are expected to have a positive impact on soil conservation, improved soil fertility, carbon sequestration, and improved water availability. These include:

• Integrated farm management and organic agriculture

• Management of low-intensity pasture systems

• Preservation of landscape and historical features such as woods, marshes and mangroves, rivers and streams

• Conservation of natural habitats and their associated biodiversity.

The Agriculture Strategy Action Plan is expected to be revised in the next two years, which provides an opportunity for stronger direction and climate change focus. Stakeholders suggest that the initiatives identified above have not been taken forward in a systematic way, and there is no comprehensive monitoring of progress. Both of these weaknesses could be addressed in a revised Strategy. The revised Strategy is also expected to include a vulnerability assessment and an agri-business strategy, both of which are already under development.

The Climate Change Policy Framework for Jamaica (2015) also contains a number of actions of relevance to the agriculture sector. Under this overarching framework policy, agriculture is a priority sector, and it provides the impetus for consideration of the following in the articulation of policies and plans by the sector:

• Develop climate change resilient crop varieties and systems that are tolerant of flooding, drought and salinity, and based on indigenous and other varieties suited to the needs of resource poor farmers, fisheries and livestock systems to ensure local and national food security.

• Facilitate the use of water efficient agricultural methods including using permaculture technologies, intercropping, and terracing, and improved irrigation technology and water harvesting techniques.

• Facilitate the improvement of flood and heat management techniques to protect poultry and cattle from changes in climate (e.g., improve animal housing).

• Improve ecosystem resilience by implementing measures related to soil conservation, fire management, flood and erosion control, mangrove restoration and rehabilitation, and reforestation and forest conservation.
- Improve food storage systems.
- Establish an agricultural insurance system.
- Diversify food production techniques by expanding the use of agroforestry, aquaculture, mariculture, and aquaponics as potential adaptation measures.

In addition, while there are no quantified agriculture measures in the mitigation commitments of the NDC, this document does include a number of actions related to agriculture, some of which may generate direct or indirect emission reductions. However, the link to emission reductions has not been clearly articulated, nor any attempt made to quantify the emissions impact. These include:

- Capacity development – for extension service providers, smallholders, financial institutions, private sector
- Installation of agrometeorological (agromet) equipment
- Use of agromet data for decision-making, including development of early warning systems for pests and diseases
- Public-private partnerships
- CSA implementation
- Research, development and implementation – e.g., effects of climate change on crops and livestock, impacts of temperature on apiculture, drought-tolerance, disease-resistance, climate smart production.

6.2.3 Projects and other specific actions

A study undertaken under the ‘Accelerating the Uptake of Climate-Smart Agriculture (CSA) in selected ACP countries (2019)’ project is of particular relevance to an assessment of Jamaica’s future NDC (Hayman, 2019). The overall project seeks to promote the resilience of smallholder farmers in three ACP countries (Jamaica, Ethiopia, and Mali through the accelerated uptake of a bundle of CSA practices especially (i) ICT-enabled climate information and advisory services and (ii) improved climate-smart farming practices and agricultural inputs (drought-tolerant seeds). The project is funded by the CTA in partnership with the GoJ, from 2018 to 2020.

Within this overall project, a specific study explored the potential within Jamaica for including scaled up CSA actions within future NDCs. The study found that there are a number of CSA actions that could be scaled up, and hence are of relevance to the NDC, but that practice is still at the project level, so near term inclusion of these actions within an NDC could be challenging. Table 12 illustrates these options, divided into those that deliver primarily adaptation benefits and those that could deliver adaptation and mitigation benefits.

Table 12: There are CSA actions that could be scaled up and relevant for NDC revision

<table>
<thead>
<tr>
<th>Successful CSA Actions that could be scaled up</th>
<th>Adaptation/Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Development and implementation of a drought forecast tool for farmers (penetration level of approx. 80%)</td>
<td>Adaptation</td>
</tr>
</tbody>
</table>

9 It is not clear, however, what these could include.
Successful CSA Actions that could be scaled up | Adaptation/Mitigation
---|---
Early warning systems for pests and diseases (including training farmers to combat beet armyworm through disease forecasting tools; establishment of a collaborative system to reduce coffee leaf rust) | Adaptation/Mitigation
R&D into drought-tolerant, disease-resistant and high-yielding varieties | Adaptation/Mitigation
Fertigation technology – expansion of irrigation schemes. Including drip irrigation, that promote more efficient use of fertilisers | Adaptation, mitigation co-benefits
Agroforestry for small ruminants and dairy | Adaptation, mitigation co-benefits
Increased use of conservation and good livestock management practices | Adaptation, mitigation co-benefits
Fodder production | Adaptation, mitigation co-benefits
Promotion of aquaponics (integrated agriculture/aquaculture technique) | Adaptation, mitigation co-benefits
Innovations: Land husbandry practices/good agricultural practices, such as individual basin, composting, firebreaks, live and trash barriers, check dams, gully plugs, hillside ditch, contours, minimum tillage, crop rotation, mulching, and water harvesting and storage | Adaptation, mitigation co-benefits

Source: Hayman (2019)

Additionally, the study identified a number of other actions, considered ‘low-hanging fruits’ (or ‘no/low-regret options) that have the potential to support Jamaica’s NDC efforts. The actions, some with corresponding examples of initiatives, are summarised in Table 13, as reported in the study – although it is not clear how they relate to the above, so a consolidation would be advisable.

Table 13 There are also a number of CSA-related no/low regret options

<table>
<thead>
<tr>
<th>Action</th>
<th>Examples of initiatives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expanded use of biodigester technology (reduction of emissions of methane and nitrous oxide)</td>
<td>SRC – over 500 units, Carron Hall High School (energy for irrigation), Swift River Farm (energy for slaughterhouse)</td>
</tr>
<tr>
<td>Increased use of low carbon, renewable energy and energy efficient technology along agriculture value chain</td>
<td>• Irrigation systems using solar (SCCA -EFJ, Essex Valley, ACP I (Hounslow) Cold storage: over 1.5 MW of Solar PV -Rainforest), ACP I Solar PV for chicken houses (Jamaica Broilers)</td>
</tr>
<tr>
<td>Increased fodder production</td>
<td>IICA</td>
</tr>
</tbody>
</table>
The report also identifies the need for the sector to develop an investment plan. It recommends that the plan should include an assessment of climate change vulnerability and low emission development potential and develop budgeted and prioritised climate actions for building resilience and reducing GHG emissions.

As suggested by Table 13, there are a number of specific projects being undertaken in the agriculture sector that are contributing to both emissions reductions/sequestration and/or enhanced climate resilience.

- The Integrated Management of the Yallahs and Hope River Watershed Management Areas (Yallahs-Hope) Project, which accounts for around 7% of the island’s farmlands, is being implemented by the National Environment and Planning Agency (NEPA). It is a five-year programme, which started in October 2014. Grant funding totalling US$3,909,441 was provided by the Global Environment Facility (GEF) through the Inter-American Development Bank (IDB). The Government of Jamaica (GoJ) has also provided co-financing of US$ 8,872,357. The project aims to improve the conservation and management of biodiversity and the provision of ecosystem services within the region by implementing sustainable agriculture (including renewable power generation), forestry, land management and livelihood practices within targeted communities. There is a particular focus on introducing farmers to new practices to ensure increased productivity, while minimising soil erosion, so as to reduce sedimentation and increase water quality. Farming practices in these areas have the potential to affect 40% of the potable water supplied to the Kingston Metropolitan Area (KMA). An initial rough estimate suggests that the avoided deforestation, reforestation and sustainable land management outcomes of the project could yield emission reductions in the order of 556,061 tCO₂e for the 4 years of the project implementation. Over a 10-year time frame, this would increase to 647,571 tCO₂e. The cost-effectiveness analysis identifies a cost of US$ 6.7/tCO₂e.

- The Essex Valley Agriculture Development Project, funded by the Caribbean Development Bank (with £35.5m provided by the UK Caribbean Infrastructure Partnership Fund to CDB), focuses on ‘Enhanced production and productivity of farmers in Essex Valley in a socially inclusive gender equitable and climate sensitive manner’. It comprises the following components:

  1. Improved Irrigation Systems (IIS): This aims to provide infrastructure and systems with the capacity to supply water to the farm gate of all farms on the approximately 700 hectares (ha) of arable land in Essex Valley in a sustainable manner.

  2. Enhanced Agricultural Production and Marketing Facilities and Systems (EAPMFS): This component focuses on improving farmer compliance with food safety standards and climate smart agriculture (CSA) practices.

  3. Energy Efficiency (EE)/Renewable Energy (RE): This intends to develop the necessary infrastructure and systems for EE/RE solutions aligned to the requirements of the project.

  4. Technical Assistance (TA): This component will include (i) a climate vulnerability assessment (CVA) study to enhance the sustainability of the systems developed under the project; (ii) capacity-building support to develop gender-responsive guidelines for mainstreaming economic inclusion of...
vulnerable groups in agriculture; (iii) a tariff study for the National Irrigation Commission (NIC); and (iv) an operational plan to enhance the viability and sustainability of the facilities and services to be provided in the Essex Valley Area.

The proposed renewable power system for the project – a 3.1 MW solar system with an 850 kWh battery storage – will offset around 47% of the grid-electricity consumption of the irrigation system, leading to annual electricity cost reductions of JMD67m and avoided carbon dioxide (CO₂) emissions of 2,374 tons per year.

Of relevance, the ‘Enhancing the Resilience of the Agricultural Sector and Coastal Areas to Protect Livelihoods and Improve Food Security’ programme has been supported through a US$ 9.965 million grant by the Adaptation Fund. It was approved in 2012 for a duration of 3.5 years. The programme sought to protect the livelihoods and food security of people living in seven of the country’s 14 parishes by improving water harvesting and management, as well as erosion and flood control. The programme also supported climate resilient coastal management in Negril.

In addition to the above, extension workers are already incorporating practices which support adaptation and/or mitigation. These practices include:

- Precision agriculture
- Protected agriculture
- Supporting development of drought tolerant crops
- Drip irrigation
- Regeneration of bauxite mines using solar pumps.

However, there is no detailed analysis of the scale of these activities, or their effectiveness in changing farmer practices. This means that an estimate of their impact in reducing emissions is challenging.

### 6.3 Adaptation co-benefits

First, there are adaptation co-benefits for water resources from mitigation actions in agriculture. More energy efficient permaculture technologies, intercropping, terracing, improved irrigation technology and water harvesting techniques can all support the more efficient use of water resources. This contributes to offsetting the impacts of climate change on water resources (e.g. drought), thereby improving water availability and quality.

Adaptation co-benefits are also clear in agriculture, given the Climate Smart Agriculture (CSA) initiatives prioritise both reducing emissions and supporting adaptation. Agroforestry practices that increase the country’s carbon sink also promote the sustainable use of land through soil conservation and improvement in soil fertility, making it more resilient to drought conditions. In addition, Aquaculture and aquaponics can diversify food production away from animal rearing (especially cattle, small ruminants and poultry), with positive effects on overall soil health and reduced vulnerability to drought conditions. Further, reducing (carbon intensive) fertilisers through capacity building, and their replacement by crop rotation and reduced tillage techniques, as well as an increase in the use of drip irrigation can also improve soil health, again making the sector more resilient to droughts. The installation of agrometeorological equipment for efficient decision-making can also assist with mitigation while enabling farmers to better prepare for negative climate impacts such as flooding and early warning systems for pests and diseases.

The health sector is also likely to see adaptation co-benefits from mitigation actions in agriculture. Improved food production techniques will increase productivity and crop yields, reducing the severity of
food shortages and improving food security, with positive impacts on nutrition. More sustainable agriculture land use, especially through a reduction in the use and wastage of water, can reduce the risk of spreading of vector-borne diseases and reduce localised heat stress.

Finally, there are benefits to infrastructure and coastal ecosystems from agricultural policies aimed at mitigation. Better land management reduces sedimentation and runoff (e.g. diversion ditches) which can have a positive impact on infrastructure downstream. In coastal areas, agroforestry techniques can interact with mangrove systems. Salt-tolerant crops (such as tomatoes and jackfruits) can be grown alongside mangroves, which increase the country’s carbon sink while also providing protection against the impacts of sea level rise.

6.4 Further analytical work

6.4.1 Should the agriculture sector be included in the next NDC?

The agriculture sector has been assessed against the five criteria presented in the introduction. Table 14 provides this assessment in relation to the agriculture sector.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Assessment</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GHG emissions baseline</td>
<td>~</td>
<td>Included in TNC. Agriculture emissions from main sub-sectors contribute to around 50% of net emissions according to the TNC. However, there are some inconsistencies between TNC and FAOSTAT data on sources of emissions in the sector.</td>
</tr>
<tr>
<td>Forward-looking</td>
<td>✓</td>
<td>BAU baseline TNC includes BAU up to 2050 (in the form of a diagram)</td>
</tr>
<tr>
<td>BAU baseline</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clear policy commitments</td>
<td>X</td>
<td>High policy commitment due to importance to sustainable development (employment especially), but no overarching policy as yet, nor targets.</td>
</tr>
<tr>
<td>Mitigation options</td>
<td>X</td>
<td>Numerous priority actions, policies and projects. However, according to stakeholder interviews, these are developed ‘bottom-up’ based on the needs of farmers, or are donor-led, with no corresponding GHG reduction figures (apart from projects).</td>
</tr>
<tr>
<td>Mitigation scenarios</td>
<td>X</td>
<td>No comprehensive scenarios existing</td>
</tr>
</tbody>
</table>

Source: Vivid Economics

This assessment suggests that agriculture should not be included in the quantified mitigation component of Jamaica’s next NDC. Although the sector is an important source of emissions in Jamaica – accounting for approximately 50% of its net emissions – there are limited overarching policy guidance and related commitments, quantified mitigation measures, and corresponding mitigation scenarios.
6.4.2 Which agriculture sector policies/projects should be included in the next NDC?

Despite there not being sufficient evidence to include quantified mitigation actions from the agriculture sector, there is still scope to provide a qualitative narrative regarding the actions that are and will be undertaken within the sector. Agriculture is extremely important for Jamaica’s sustainable development objectives, and CSA practices can contribute both to mitigation and adaptation, providing no or low-regret options. CSA-related programmes of substantial value are being implemented in the country such as the Integrated Management of the Yallahs and Hope River Watershed Management Areas; and the Essex Valley Agriculture Development Project. A comprehensive articulation of these programmes and the other initiatives that Jamaica is undertaking in the sector will help demonstrate the credibility of Jamaica’s intent to take climate action across its economy, and provide a segue to including the sector in NDCs in the 2020s and beyond.

6.4.3 What analysis could be carried out for inclusion of the agriculture sector in future NDCs?

Although this assessment concludes that it will be difficult to include this sector in the next NDC, there are a number of pieces of analysis that can be carried out to facilitate its inclusion in subsequent NDCs. It is advisable to carry out these analyses as soon as possible and in parallel to the NDC revision work, in order to build evidence to be used for the next NDC, given the high contribution of the agriculture sector to overall emissions, but also the relative long timelines of implementing GHG mitigation measures in the sector.

- Identification of GHG reduction contribution of large projects
- Consolidation and increased specification of CSA and mitigation measures
- (extensive) feasibility assessments of measures, including through reference to international case studies
- Prioritisation of mitigation measures through multi-criteria analysis
- Identification of GHG reduction of each option
- Analysis of scale up potential of pilots

However, these are not immediate priorities given the assessment above.
7    Health

In a similar way to the water sector, the health sector is also a priority for its role in climate change mitigation and adaptation. Its facilities and operations utilise water and energy to function, in addition to disposing of chemical and hazardous materials. At the same time, the infrastructure is directly vulnerable to climate shocks and trends, which also impact the population and the environment, thereby increasing the usage of health services. Hence, the initiatives of relevance to mitigation are illustrated in this section, even though from a GHG accounting perspective they fall within the energy sector.

7.1    Emissions Trend

There is no data available on the emissions that might be directly attributable to the health sector. The emissions associated with the sector derive from its energy consumption – in hospitals, primary care facilities and so on – are included within the energy sector source of emissions. There is no known assessment of the energy emissions associated specifically with the health sector.

7.2    Commitments

The health sector features strongly in the adaptation section of the NDC, and mitigation measures would be captured, to a certain extent, within the energy sector. Additional strategies and projects of relevance to the inclusion in the revised NDC are summarised in Table 15.

Table 15    Some projects in the health sector may be relevant for inclusion in the revised NDC

<table>
<thead>
<tr>
<th>Overarching policy</th>
<th>Strategies, plans and policy frameworks</th>
<th>Projects and other work</th>
</tr>
</thead>
<tbody>
<tr>
<td>(No overarching policy for the sector yet)</td>
<td>• Climate Change Policy Framework for Jamaica (2015)</td>
<td>• Smart Initiative</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Energy Efficiency and Conservation project</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Major Improvement of Infrastructure Programme</td>
</tr>
</tbody>
</table>

Source: Vivid Economics

7.2.1    Overall policy framework

There is no overarching policy that relates the health sector with climate changes issues.

7.2.2    Strategies, Plans and Policy Frameworks

The Climate Change Policy Framework for Jamaica recognises that Jamaica’s natural vulnerability to extreme hazards and its location in the tropics means that climate change will pose risks to human health. The following impacts are anticipated:

- An increase in the incidence of vector-borne diseases (such as dengue fever, malaria and yellow fever) as higher temperatures favour the proliferation of mosquitoes and other disease carriers: a threefold increase in dengue transmission is anticipated in Jamaica
A higher occurrence of respiratory diseases and heat and stress-related illnesses and conditions caused by the ‘heat island effect.’ This could directly increase morbidity and mortality rates, particularly among the elderly.

An increase in water-related diseases, especially water borne diseases such as dysentery, typhoid and cholera, is likely, particularly following extreme rainfall events, and exacerbated by poor sanitation, unplanned settlements and pollution to watersheds and water sources.

The impacts of climate change on coastal and terrestrial resources, food supply, water production and the various economic sectors are likely to have indirect and significant effects on human health.

More frequent extreme weather events can lead to potentially more deaths and injuries caused by storms, floods and landslides.

Given the vulnerability of the agricultural sector to climate variability, rising temperatures and more frequent droughts and floods can compromise food security. This could result in increases in malnutrition, given the high dependency on rain-fed subsistence farming.

The Policy does not, however, contain any climate change mitigation information.

7.2.3 Projects and other specific actions

Jamaica’s Smart Initiative is aligned with the Pan American Health Organisation’s (PAHO) commitment of a ‘resilient health system by 2030’, through the promotion of health and infrastructure resilience. PAHO commits to reducing carbon emissions in SIDS to protect the most vulnerable from climate risks, and to gain the health co-benefits of mitigation policies. The project in Jamaica targets 150 health facilities (50% of Jamaica’s total) and monitors water and fuel usage, waste production, and overall air quality. These measurements are then used to calculate the facility resilience index and to create areas of intervention. The priority so far has been given to electricity and water metering, in addition to waste management, with less focus on GHG reductions and air quality. In parallel, a Smart Policy is being developed which is expected to follow PAHO guidance (PAHO/WHO, 2013). This guidance promotes an integrated approach for disaster risk reduction, climate change adaptation, environmental management, and conservation.

The Energy Efficiency and Conservation Project (EECP), as discussed in section 2.2.3, has also a focus on the health sector. The health sector is benefitting from the first tranche of the intervention, with targeting of three of the largest hospitals with high energy consumption. Outcomes of this project were not available yet, nor detailed implementation information.

The Major Improvement of Infrastructure Programme comprises improvements in standards, water usage, air quality, and energy efficiency. It includes technology infrastructure improvement to 5 facilities in 2019, reaching 12 in the next 5 years. It is related to the EECP, but is separate, with the government looking to achieve greater alignment between the two initiatives. The Programme includes interventions on water efficiency, including ensuring there is water and energy supply in case of emergencies. Efficiency measures include retrofitting and upgrading the electrical infrastructure of facilities, such as changing light bulbs, rewiring, changing appliances, upgrading boilers and ACs.

Another small project in the health sector was The Deployment of Renewable Energy and Improvement of Energy Efficiency in the Public Sector initiative, funded by the UNDP. This project had a budget of around US$12 million and was aimed at improving the energy efficiency in six Jamaican hospitals through retrofits (UNDP, 2016).
7.3 Adaptation co-benefits

Mitigation measures in a number of end-use sectors can have adaptation benefits, including the health sector. First, energy efficiency improvements and monitoring of water usage as part of the commitment to a resilient health system can reduce water consumption in the health sector, allowing it to better deal with water resource constraints. This can also free up more land for more productive sectors such as agriculture. Further, an increase in renewable energy in the energy mix, and improvement in waste management, can improve air and water quality, with positive impacts on health, in particular respiratory, water, and vector-borne diseases. Hospitals and health facility infrastructure with self-generated renewable energy and water storage systems will be more resilient following extreme weather event. Finally, waste management improvements in the health sector, especially hazardous and chemical waste, can improve the regeneration of coastal habitats, including mangroves and fish stocks.

7.4 Analytical next steps

7.4.1 Should the health sector be included in the next NDC?

The health sector has been assessed against the five criteria presented in the introduction. Table 16 provides this assessment in relation to the health sector.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Assessment</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GHG emissions baseline</td>
<td>~</td>
<td>Not health sector-specific, but an emissions baseline for energy emissions, which will include emissions resulting from energy consumption in the health sector, is available</td>
</tr>
<tr>
<td>Forward-looking BAU baseline</td>
<td>~</td>
<td>Not health sector-specific, but a forward-looking baseline for energy emissions, which will include emissions resulting from energy consumption in the health sector is available</td>
</tr>
<tr>
<td>Clear policy commitments</td>
<td>~</td>
<td>PAHO/WHO calls for resilient health systems in Caribbean SIDS by 2030, but limited application so far in Jamaica</td>
</tr>
<tr>
<td>Mitigation options</td>
<td>~</td>
<td>Some projects, but no corresponding GHG reduction figures</td>
</tr>
<tr>
<td>Mitigation scenarios</td>
<td>~</td>
<td>Not health sector-specific, but through (assumed limited) interaction with other sectors</td>
</tr>
</tbody>
</table>

Source: Vivid Economics

On the basis of this assessment, it seems plausible that emission reductions from the health sector (as a whole) can be included in the NDC only if additional information becomes available. Currently, there is no GHG emissions baseline nor BAU scenarios specific to the health sector, although this need not be a constraint as the sector’s emissions will be embedded within those of the energy sector. However, a greater challenge is that while there are some projects in the renewable energy, energy efficiency and waste management space being implemented in Jamaica, no information on their mitigation impact has been sourced to date. Stakeholder interviews suggest that some data might be available in due course.

7.4.2 Which health sector policies/projects should be included in the next NDC?

There are several projects in the health sector that could be discussed in the revised NDC. Actions such as the SMART initiative could be discussed qualitatively. Further, as indicated in section 2.4.2, the impacts of
the Major Improvement of Infrastructure Programme could be included within the quantitative component of the next NDC if sufficient data is available. We will explore the feasibility of including such policies in our modelling framework. This would most likely form part of the country’s unconditional commitment.

Otherwise the sector can feature as an action-based target. If the data above does not become available in time, climate change mitigation interventions in the sector can be included in an overall narrative as an action-based contribution.

7.4.3 How will we estimate the impact of these actions on emissions?

The following analysis is recommended, in order to include emission reductions from the health sector in the next NDC:

- Identification of GHG reduction contribution of projects (if available in time)
- Incorporate within LEAP modelling. Inclusion of the Major Improvement of Infrastructure Programme would likely involve adjusting the energy efficiency parameters in the model.
8 Industrial Processes and Product Use

Industrial Processes and Product Use (IPPU) covers emissions resulting from industrial applications or from the use of products. In Jamaica, industries such as cement and lime are the largest emitters of CO\textsubscript{2} during the manufacturing process. In addition to cement and lime production, other emissions sources in the IPPU sector include lubricant use, the use of solvents and emissions from refrigeration and air conditioning (although these are small in comparison). The emissions of this sector as a whole are very small in relative terms, estimated to contribute just 3\% of total GHG emissions (See Table 2).

8.1 Emissions Trends

CO\textsubscript{2} emissions from cement and lime production fell by around 20\% between 2006 and 2012. This was driven by a reduction in emissions from lime manufacture. Large quantities of lime are used in the production of alumina and bauxite, and since 2008, this sector has been in decline due to lower global demand and the high cost of energy in Jamaica. In addition, lime is used in sugar refining, which has also been in decline in Jamaica. As a result, lime production has decreased from around 300,000 tonnes in 2006 to 130,000 tonnes in 2012, resulting in lower emissions from this source. By contrast, emissions were relatively stable in cement, reflecting more stable production.

However, overall emissions from this source are modest compared to those from other sectors.

Figure 9. IPPU Sector CO\textsubscript{2} Emissions fell by around 10\% between 2006 and 2012

Source: Vivid Economics, based on data from TNC (GoJ, 2018)

8.2 Commitments

Research suggests that there are no policies of significance affecting this source of emissions. For instance, Jamaica has not yet ratified the Kigali Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer.\textsuperscript{10}

As such, this report does not consider this source of emissions further.

\textsuperscript{10}See list of signatories as at 7 October 2019: https://ozone.unep.org/all-ratifications
9 Conclusion

The analysis in this report suggests that quantified emissions reduction targets for the energy and LULUCF sectors, in combination, should be included in Jamaica’s next NDC. While the energy sector was included in the previous NDC, we recommend enhanced ambition for this sector in the next NDC, through the inclusion of policy commitments outlined in the TNC, initiatives such as EMEP and EECP, and energy related policies in the health and water sectors (where possible). In addition, we recommend including the LULUCF sector in the next NDC given there is available data on current GHG emissions, a forward-looking BAU baseline and clear policy commitments. The policy actions in this sector that will be considered for the next NDC include the Forest Policy for Jamaica (including the commitment for ‘no net loss of forest cover’), the voluntary contribution to the UNFF Global Forest Goals, progress on goals relating to a Sustainable Ocean Economy and a commitment to plant 3 million trees over the period 2019-2022.

This assessment suggests there may be scope to include the waste sector in the quantified emissions component of the next NDC. Despite progress in the waste sector on improving management systems, greater clarity will be required regarding the GHG emissions impacts of mitigation actions in order to include this sector quantitatively in the next NDC. Further, for those actions at pilot stage, inclusion will depend on whether the pilot scales up to allow a meaningful contribution to the emissions reductions of the sector. If more information regarding these impacts is obtainable, actions that could be incorporated into this NDC include the tyre incineration to energy project and the ban of single-use plastics. There may also be potential in subsequent NDCs to include the impact of improved waste management from the PPP deal.

This work does not recommend for the agriculture or IPPU sectors to be included in the quantified element of the next NDC. Although the agriculture sector is an important source of emissions in Jamaica – accounting for approximately 50% of its net emissions – there are a number of limiting factors. First, due to the difficulty in measuring emissions in the agriculture sector, there are inconsistencies between different data sources on the level of GHG emissions in the sector. In addition, overarching policy guidance and related commitments, quantified mitigation measures, and corresponding mitigation scenarios are lacking. Finally, we deem it unnecessary to include the IPPU sector in the quantified component of the next NDC given there appear to be no policies of significance affecting this source of emissions.

For those sectors that will be included in the quantified component of the next NDC, we outline a number of estimation frameworks. For the energy sector, we suggest employing the LEAP model to estimate the mitigation impact of various mitigation policies. Energy-related policies in the water and health sectors that can be quantified will also be incorporated into the LEAP modelling framework. For the LULUCF sector, an initial assessment of commitments can be made by combining their expected impact on land use patterns and the sequestration potential of different types of land use. For future NDCs, this method can be further refined, as improved data becomes available from the REDD+ readiness activities and EU support for the sector. If the waste sector were to be included in the next NDC, we would draw on international evidence and information from stakeholders to estimate the emission reductions from the relevant mitigation actions. In estimating Jamaica’s targets for the next NDC, we will also differentiate between unconditional and conditional commitments, with the former based on domestically funded policy actions and the latter based on actions funded by both domestic and external sources.

In addition to the quantitative component of the next NDC, there is also potential to include a qualitative narrative on mitigation actions. Despite insufficient evidence to include quantified mitigation actions from the agriculture sector, an articulation of programmes such as the Integrated Management of the Yallahs and Hope River Watershed Management Areas and the Essex Valley Agriculture Development Project will help demonstrate the credibility of Jamaica’s intent to take climate action across its economy. Energy-related
initiatives in the health sector that cannot be quantified could also be mentioned in the general narrative of the next NDC.

**Both those mitigation contributions that can be quantified and those that will need to be described in more qualitative terms can bring important adaptation co-benefits.** This adaptation discussion can also form an input of Jamaica’s next NDC. The main areas highlighted would be the impact on water resources, human health, agriculture, infrastructure and coastal ecosystems. For example, replacing the use of heavy fuel oil with renewables to generate electricity can reduce GHG emissions while also enhancing water availability and can make the country less vulnerable to extreme weather events that cause infrastructure-related disruptions. A decrease in fossil fuel combustion can also reduce the negative impacts that higher temperatures will otherwise have on air pollution and health outcomes. Further, the development of particular crops in coastal areas can increase the country’s carbon sink while also providing protection against the impacts of rising sea levels.
10 References


ESSJ (2018), Selected Indicators 2013-2018, Planning Institute of Jamaica


GoJ, (n.d). UNFF-FI Voluntary National Contributions (VNC) for Jamaica, Forestry Department


GoJ (2010a), National Biofuels Policy 2010-2030, Ministry of Energy and Mining


Potopsisng, R. *UNEP-GFEI Jamaica Project National Stakeholders Meeting: Towards a Fuel-Efficient Economist for Jamaica*, UTech, Jamaica. Apr 4, 2018


UNDP, (2019). *Nationally Appropriate Mitigation Action (NAMA) for Jamaica*

Appendix A– Impacts and Adaptation Priorities

As a small island developing state, Jamaica faces considerable threats from climate change; some of the identified mitigation commitments may help the country to adapt to the expected impacts. This section identifies some of the most significant climate impacts that the country is already facing, and that are expected to worsen in future. These are summarised below in Figure 10:

Figure 10  Key climate impacts

![Climate Projections Diagram]


Rising sea levels, reduced annual precipitation and increased variability in weather conditions pose a threat to Jamaica’s water resources. As an island nation, groundwater is the primary water source; it supplies 80% of the country’s water demands and represents 84% of exploitable water in Jamaica. Rising temperatures, increased evaporation and decreasing precipitation are reducing replenishment of underground water sources and groundwater recharge. In coastal areas, sea level rise leads to seawater intrusion of aquifers, reducing freshwater supply for drinking water and irrigation. In response to these threats, the 2015 Policy Guideline on Rainwater Harvesting provides information, standards and requirements for mandatory rainwater harvesting and use. This is expected to reduce the groundwater requirements of Jamaica, reducing exposure to variability in water resources resulting from climate change.

The agriculture sector is also at risk due to changes in precipitation, higher temperatures and extreme weather events. Increasing temperatures and droughts can lead to crop failure, heat stress and reduced livestock productivity. As rainfall variability and storm intensity increase, farmers face erosion, flooding, landslides, stronger winds, new diseases and pests. These impacts threaten yields and farmer incomes, while increasing food security risks. In 2012, Hurricane Sandy causes damages to crops, livestock and irrigation systems concentrated in the eastern parishes, resulting in losses of $11 million. Several mitigation policies have adaptation co-benefits, such as the Improved Irrigation Systems project in Essex Valley, which supplies water to 700 ha of arable land in a sustainable manner, and the Yallas-Hope project which aims to improve productivity while minimising soil erosion. Box 2 highlights a third example, good practice in reducing exposure to drought hazard in Southern St Elizabeth.

Box 2  Case Study – Agriculture in Southern
Southern St. Elizabeth has the highest crop production in Jamaica at 22% of total domestic food production (GoJ, 2018).

- Farmers in southern St. Elizabeth have demonstrated considerable fortitude in coping with a series of droughts in recent years. They have employed a number of damage-reducing coping strategies to lessen their exposure to drought hazard. Principal among these are: proactively introducing a variety of planting methods; proactively employing a range of moisture loss reduction techniques; varied responses to stress during the drought itself, including sacrificing a part of the growing crop in order to enhance survival of the remainder; and a variety of strategies to aid recovery, ranging from cutting back on the area farmed, seeking off-farm employment and a temporary exit from farming.

- This case study showed that small farmers need help to adapt to changes in rainfall patterns brought on by climate change. They are doing their best to cope with the changes by utilising the rich body of local knowledge available to them. However, the implementation of future policies and programmes that complement these existing traditional coping mechanisms will be essential in alleviating stresses as well as preventing further degradation of the local knowledge base that supports the survival of these farming communities. Since most farm incomes are either stagnant or in decline, the impacts of droughts are presumed to be profound and far-reaching.

Increasing temperatures, flood risk and storm intensity pose risks for Jamaican health outcomes. More intense rainfall events along with standing flood waters attract mosquitoes; along with higher ambient temperatures, this can stimulate growth and reproduction, increasing mosquito-borne disease. In 2014, the Chikungunya virus affected 60% of the island’s population. Heavy rainfall and flooding can also contaminate groundwater sources, increasing waterborne diseases. In addition, as temperatures increase, the negative effects of air pollution on health outcomes for people with respiratory ailments or heart problems are exacerbated. Increased temperatures can also cause heat stress, which can have a particularly strong impact on the elderly. Recent promotion of a ‘resilient health system’ monitors water and fuel use, waste production and overall air quality through the Smart Initiative to identify priority areas for intervention. Improvements in air quality and waste management as a result of this program can offset some of the negative health impacts that may arise due to climate change.

Much of Jamaica’s infrastructure and settlements are along the country’s 1,200km shoreline, which poses risks associated with rising sea levels and coastal erosion. Given that development activities increasingly take place within the coastal zone, Jamaica’s infrastructure is increasingly under threat from natural disasters. The national building code establishes new guidelines for construction of hurricane resistant buildings across the island, including the use of hurricane straps and water tanks. However, as settlements outside the formal physical planning system and those which do not meet building standards are most threatened, there is more to be done on enforcement and development of these building codes to improve adaptation in the infrastructure sector.

Jamaica’s coastline and marine resources are also under physical threat, with shoreline erosion and coastal ecosystems under threat. Beaches have experienced accelerated erosion in recent decades and are projected to disappear within the next five to ten years due to shoreline erosion and retreat. Higher sea surface temperature can increase incidence of coral bleaching; along with increased sedimentation this threatens the survival of coastal ecosystems like coral reefs, mangroves and fisheries. A decline in marine and terrestrial biodiversity can have a multiplier effect, posing risks to tourism, the economy and livelihoods. Warmer temperatures provide favourable conditions for toxic algae blooms that can increase shellfish
poisoning, putting a key export at risk. By building on the existing work in land use planning and enforcing building code legislation, Jamaica can reduce the threats to its coastline.

**Jamaica’s tourism industry will be affected by several climate impacts, such as damage to infrastructure and altered seasonality.** As most tourism infrastructure is located in coastal regions at risk of tropical storms, increasing storm intensity and frequency could be severely damaging to Jamaican tourism. Sea level rise will magnify these vulnerabilities and accelerate coastal erosion, putting key tourist infrastructure at risk. In 2007, Hurricane Dean resulted in an estimated US$43.7 million loss to the sector. In addition, altered seasonality and reduced attractiveness of facilities due to coastal erosion and degradation of marine temperatures could lead to reduced visitor arrivals. Mitigation measures in other sectors can provide adaptation benefits in the tourism sector, particularly those in the infrastructure and coastline sectors. For instance, ensuring coastline infrastructure is built to a hurricane-resistant standard can reduce insurance payments in the case of natural disasters.
## Appendix B – NDC Renewable Energy Projects

### Table 17  Current Renewable Electricity Generation Assets incorporated into BAU scenarios

<table>
<thead>
<tr>
<th></th>
<th>Capacity</th>
<th>Technology</th>
<th>Fuel</th>
<th>Year Online</th>
<th>Merit Order</th>
<th>Efficiency</th>
<th>Max Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Old Harbour</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Unit No.1</td>
<td>28.5</td>
<td>Steam</td>
<td>HFO</td>
<td>1968</td>
<td>3</td>
<td>0.268</td>
<td>0.9</td>
</tr>
<tr>
<td>Unit No.2</td>
<td>57</td>
<td>Steam</td>
<td>HFO</td>
<td>1970</td>
<td>3</td>
<td>0.268</td>
<td>0.9</td>
</tr>
<tr>
<td>Unit No.3</td>
<td>61.8</td>
<td>Steam</td>
<td>HFO</td>
<td>1972</td>
<td>3</td>
<td>0.268</td>
<td>0.9</td>
</tr>
<tr>
<td>Unit No.4</td>
<td>65.1</td>
<td>Steam</td>
<td>HFO</td>
<td>1973</td>
<td>3</td>
<td>0.268</td>
<td>0.9</td>
</tr>
<tr>
<td>UNIT B6</td>
<td>65.1</td>
<td>Steam</td>
<td>HFO</td>
<td>1976</td>
<td>3</td>
<td>0.268</td>
<td>0.9</td>
</tr>
<tr>
<td><strong>Rockfort</strong></td>
<td></td>
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<td>Unit No.1</td>
<td>28.5</td>
<td>Steam</td>
<td>HFO</td>
<td>1968</td>
<td>3</td>
<td>0.268</td>
<td>0.9</td>
</tr>
<tr>
<td>Unit No.2</td>
<td>57</td>
<td>Steam</td>
<td>HFO</td>
<td>1970</td>
<td>3</td>
<td>0.268</td>
<td>0.9</td>
</tr>
<tr>
<td><strong>IPPs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>JEP (74MW)</td>
<td>74.4</td>
<td>MSD</td>
<td>HFO</td>
<td>1995</td>
<td>3</td>
<td>0.419</td>
<td>0.9</td>
</tr>
<tr>
<td>JEP (50MW)</td>
<td>50.1</td>
<td>MSD</td>
<td>HFO</td>
<td>1995</td>
<td>3</td>
<td>0.419</td>
<td>0.9</td>
</tr>
<tr>
<td>RFPP-JPPC</td>
<td>60</td>
<td>LSD</td>
<td>HFO</td>
<td>1996</td>
<td>3</td>
<td>0.374</td>
<td>0.9</td>
</tr>
<tr>
<td>JAMALCO</td>
<td>5</td>
<td>CC</td>
<td>HFO</td>
<td>1990</td>
<td>3</td>
<td>0.407</td>
<td>0.9</td>
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## New Combined Cycle Turbines

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## Hydro

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## Gas Instead of Wind
### Hypothetical Gas Unit 1
- **Capacity:** 20.7
- **Technology:** LSD
- **Fuel:** HFO
- **Year Online:** 2005
- **Merit Order:** 2
- **Efficiency:** 0.374
- **Max Availability:** 0.9

### Hypothetical Gas Unit 2
- **Capacity:** 18
- **Technology:** LSD
- **Fuel:** HFO
- **Year Online:** 2011
- **Merit Order:** 2
- **Efficiency:** 0.374
- **Max Availability:** 0.9

Source: NREL and GoJ (2015)

### Table 18  Current/Planned Renewable Projects incorporated into NDC Scenarios

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Source: NREL and GoJ (2015)
## Appendix C – NWC Projects

### Table 19  Technical Facility Profile for Future National Water Commission (NWC) Solar Projects

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<th>Payback Period (Yrs)</th>
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Note: Additional capacity for sites selected from either previous tender or from USTDA energy audited report.

Table 20  Technical Facility profile for NWC Energy Efficiency Projects

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<th>Annual Savings USD</th>
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<tr>
<td></td>
<td>Site Name</td>
<td>Estimated cost</td>
<td>Project Status</td>
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</tr>
<tr>
<td>1</td>
<td>Agualta Vale pump station</td>
<td>$1,860,862</td>
<td>Project ready for implementation</td>
</tr>
<tr>
<td>2</td>
<td>Spur Tree pump station</td>
<td>$1,447,276</td>
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</tr>
<tr>
<td>3</td>
<td>Gutters pump station</td>
<td>$1,622,926</td>
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<tr>
<td>4</td>
<td>Comfort pump station</td>
<td>$892,780</td>
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<tr>
<td>5</td>
<td>Broadleaf lift station</td>
<td>Estimated cost</td>
<td>Estimated cost: $36,107.00</td>
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<tr>
<td>6</td>
<td>Grants level Water Treatment Plant (WTP)</td>
<td>Estimated cost</td>
<td>Estimated cost: $21,621.00</td>
</tr>
<tr>
<td>7</td>
<td>Great River WTP</td>
<td>Estimated cost</td>
<td>Estimated cost: $93,821.00</td>
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<tr>
<td>8</td>
<td>Logwood WTP</td>
<td>Estimated cost</td>
<td>Estimated cost: $41,790.00</td>
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<tr>
<td>9</td>
<td>Malvern # 1 lift station</td>
<td>Estimated cost</td>
<td>Estimated cost: $67,576.00</td>
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<tr>
<td>10</td>
<td>Malvern # 2 lift station</td>
<td>Estimated cost</td>
<td>Estimated cost: $9,024.00</td>
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<tr>
<td>11</td>
<td>Martha Brae WTP</td>
<td>Estimated cost</td>
<td>Estimated cost: $21,392.00</td>
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<tr>
<td>12</td>
<td>New Forrest</td>
<td>Estimated cost</td>
<td>Estimated cost: $21,753.00</td>
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<td></td>
<td>Park Lee</td>
<td>Estimated cost</td>
<td>Estimated cost: $28,058.00</td>
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Sites selected from NWC largest energy consuming facility project ready for implementation

<table>
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<tr>
<th></th>
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<th>Estimated cost</th>
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<tbody>
<tr>
<td>13</td>
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<tr>
<td>14</td>
<td>Porus Well</td>
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<td>$28,527.00</td>
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<tr>
<td>Total</td>
<td>Estimated cost</td>
<td>$882,315.00</td>
<td>TOTAL</td>
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The investment cost for the remaining ten (10) energy efficiency (EE) from the preliminary audited facilities is estimated to be approximately US $9,000,000.00.