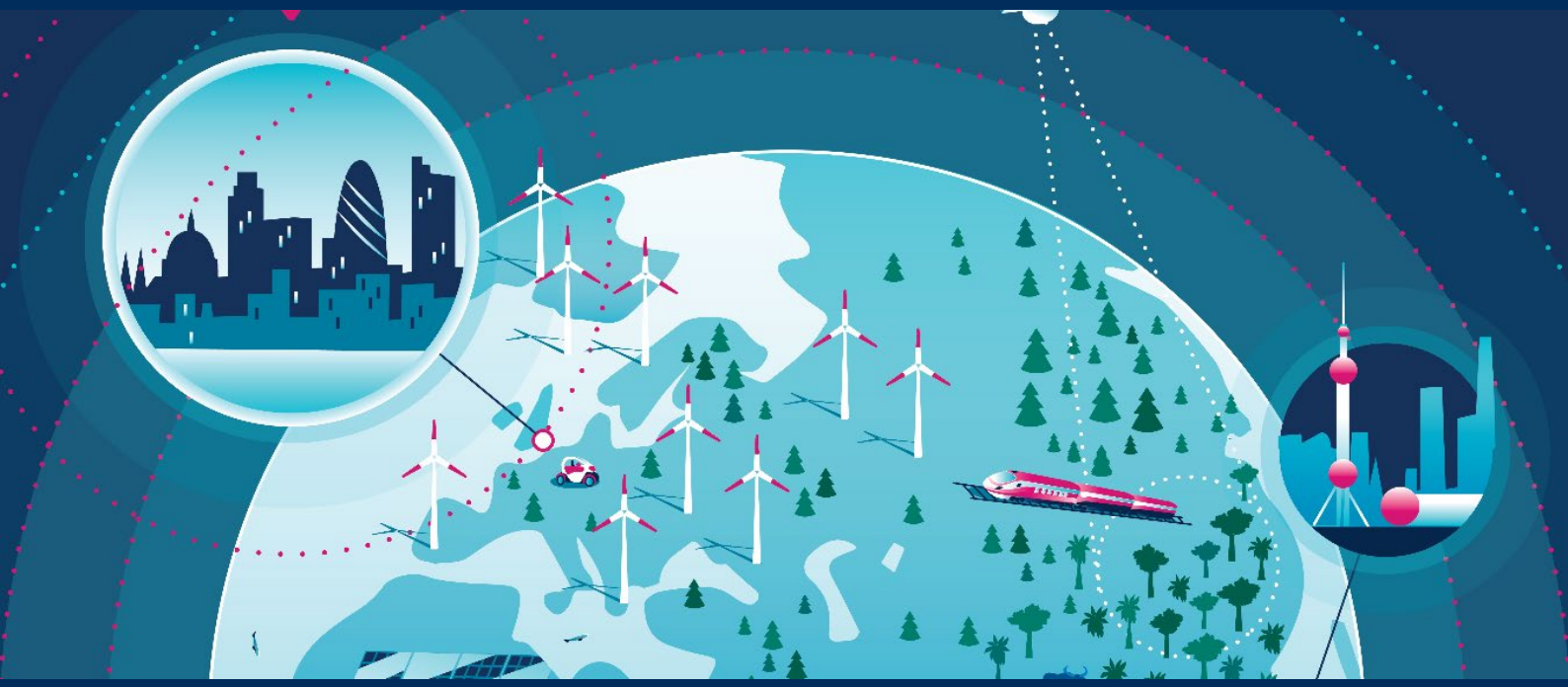
Jamaica's NDC Implementation Plan



Report prepared for the Climate Change Division (CCD) of Jamaica's Ministry of Housing, Urban Renewal, Environment & Climate Change (MHURECC)

Final Report

August 2021

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Jamaica's NDC Implementation Plan

August 2021

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Contents

Glossary 12
1 Implementation Plan 17
2 Financial summary 58
3 Summary 64
4 References 69
Appendix – consultation 74

List of tables

Table 1 16 commitments are discussed in this report 18
Table 2 List of stakeholder engagements conducted 74

List of figures

Figure 1 Key Performance Indicator (KPI) status and investment needs of all 16 key commitments 8
Figure 2 MACC analysis of all sixteen policy commitments 10
Figure 3 Suggested actions to address key barriers identified in the Implementation Plan 11
Figure 4 In 2030, unconditional commitments in the energy and land-use sector could reduce emissions by 25.4%, and conditional commitments by 28.5% 15
Figure 5 Categories considered in Jamaica's Implementation Plan 19
Figure 6 Developing Jamaica's Implementation Plan 20
Figure 7 Integrated Resource Plan (IRP) summary 22
Figure 8 Net billing facility summary 24
Figure 9 T&D losses summary 26
Figure 10 LED Street lighting summary 29
Figure 11 T8 fluorescent lighting in all hospitals and schools summary 31
Figure 12 136 low-carbon buses by 2025 summary 33
Figure 13 B5 blending commitment summary 35
Figure 14 Improved CHP in alumina refining summary 37
Figure 15 LNG in Alpart Refinery summary 40
Figure 16 National Tree Planting Initiative (NTPI) summary 42
Figure 17 No net loss of forest cover summary 44
Figure 18 Reduced non-revenue water distribution loss (Kingston) summary 46
Figure 19 EECP summary 49
Figure 20 EMEP Energy efficiency (EE) in public buildings summary 51
Figure 21 EMEP Urban Traffic Management System (UTMS) summary 53
Figure 22 NAMA in the water sector summary 55
Figure 23 Summary of investment needs 59
Figure 24 MACC analysis of all sixteen policy commitments 61
Figure 25 MACC analysis of all sixteen policy commitments with a higher discount rate (10%) 63
Figure 26 KPI status and investment needs of all 16 key commitments 64
Figure 27 Suggested actions to address key barriers identified in the Implementation Plan 65
Figure 28 Energy emission reductions are led by five key commitments 66

Jamaica is committed to playing an ambitious role as the world continues to address the challenge of climate change. In 2017, Jamaica ratified the Paris Agreement, committing the country to put forward climate efforts in the form of a "Nationally Determined Contribution" (NDC) and to strengthen this commitment over time. Ratification formalised its 'Intended Nationally Determined Contribution' through which the country aimed to reduce its emissions by 25-29% relative to a business-as-usual scenario by 2030 through reductions in emissions in the energy sector.

In July 2020, Jamaica updated its NDC commitments for the first time. The updated submission aims to reduce emissions by 25-29% relative to a business-as-usual scenario by 2030. The updated NDC submission covers emissions from forestry and land use change, reflecting the importance of the forestry sector to Jamaica, which accounts for more than half of the island's total land use. In addition, the updated NDC reflects an increase in emissions reduction ambition in in the energy sector.

Jamaica's updated NDC was developed by identifying and quantifying existing commitments to mitigation. For instance, Jamaica's NDC commitments are in line with the Third National Communication to the UNFCCC (United Nations Framework Convention on Climate Change) [1] which lists a range of energy and forestry sector policies. While this approach provides a framework for identifying which activities can help Jamaica achieve its NDC, the NDC objectives can ultimately be met by any combination of activities within the energy and forestry sectors.

This Implementation Plan (IP) details progress towards Jamaica's NDC to date, along with potential barriers to overcome and actions which can help ensure the underlying commitments are met. It also identifies the costs and funding sources associated with each initiative to help identify potential funding gaps early. By conducting a detailed analysis involving quantitative research and drawing on a range of stakeholder engagement, the IP outlines how Jamaica can prioritise resources in order to achieve its climate goals and associated co-benefits.

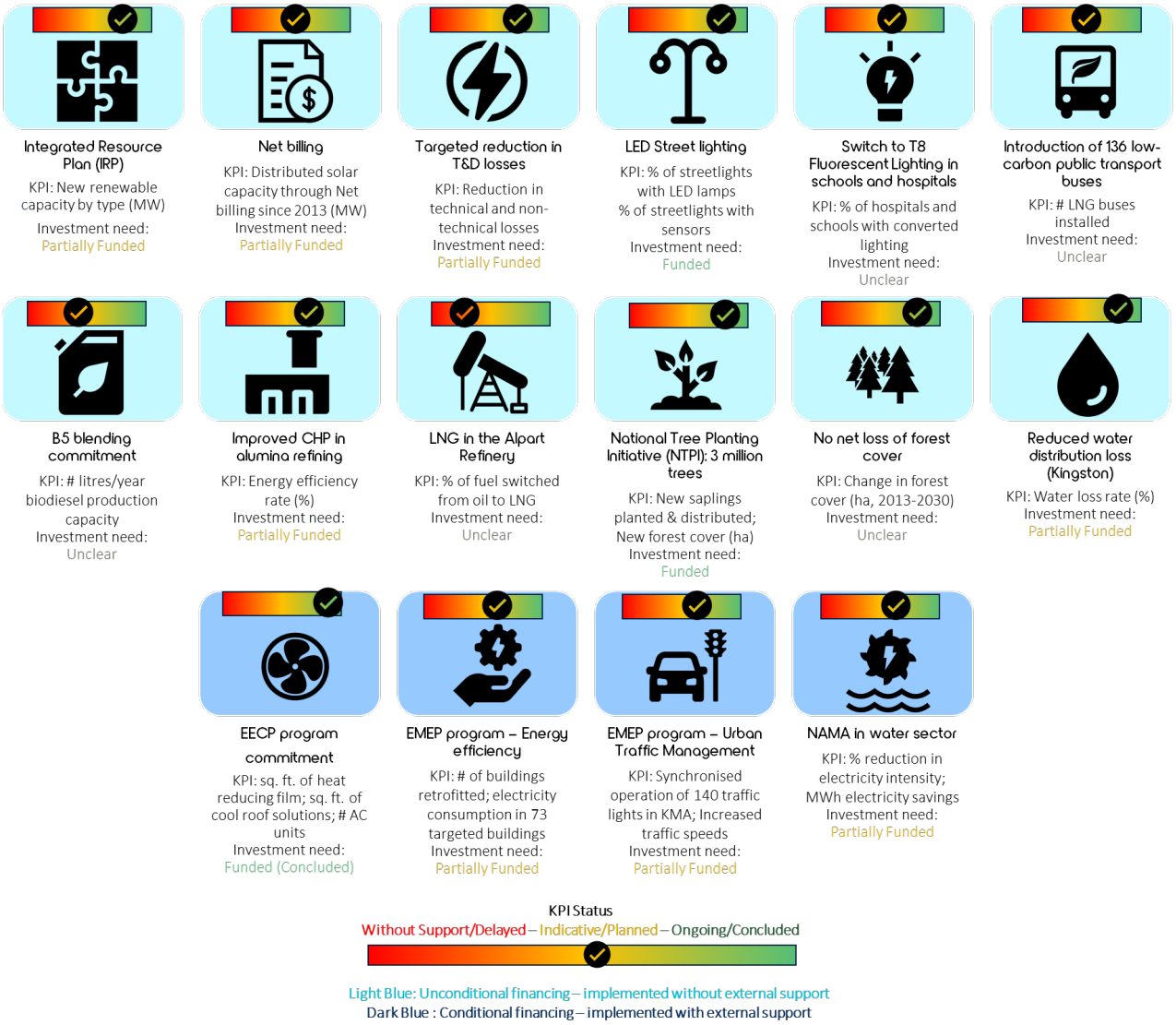
The IP will be used by the Climate Change Division (CCD), responsible for overall monitoring of the NDC, implementation partners, and other stakeholders. The CCD of the Ministry of Housing, Urban Renewal, Environment and Climate Change (MHURECC) in the Government of Jamaica (GoJ) is responsible for coordination Jamaica's NDC activities.

The IP is structured around 16 key commitments which underpin Jamaica's NDC. For each commitment, the IP identifies one or multiple Key Performance Indicators (KPIs), which it uses to set out a trajectory consistent with the NDC and monitor progress to date, as shown in Figure 1. The IP allocates responsibilities for each commitment, such as funding, implementation or coordination to different stakeholders. In addition, the NDC Partnership provides an online tool which has been populated with the analysis provided in this report and which establishes a baseline for all commitments.[2] The NDC Partnership's tool can be updated in real time to provide policymakers with a fast and easy way to track progress in implementing the NDC into the future.

[1] GoJ (2018)

[2] The NDC Partnership is a global initiative that advances the goals of the Paris Agreement and helps countries achieve their national climate commitments. The NDC Partnership's in-country engagement is documented in the Partnership Plan (PP) which presents a country's priorities for support on climate change actions in a framework that allows for tracking progress against results.

Figure 1 Key Performance Indicator (KPI) status and investment needs of all 16 key commitments



Note: KPI status ranking follows the categorisation adopted in the NDC Partnership Plan Template. Investment needs are defined as funded, partially funded, unmet or unclear.

Source: Vivid Economics

As of 2021, most of the 16 commitments are on track to meet their targets. Of the 16 commitments, progress against 13 is ongoing (including those partially funded), one is concluded, one is indicative, and one is without support. The NDC Partnership Plan defines progress on a commitment as follows:

- Ongoing: when projects led by the implementing entity to achieve the KPI are in place and will continue to be active within the umbrella of the Partnership Plan;
- Planned: when projects offered by the implementing entity to achieve the KPI are confirmed but did not start yet;
- Complete: when projects led by the implementing entity to achieve the KPI have been fully completed;
- Indicative: when projects offered by the implementing entity to achieve the KPI are not yet confirmed;
- Without support: when no implementing entity has been identified for the achievement of this KPI.

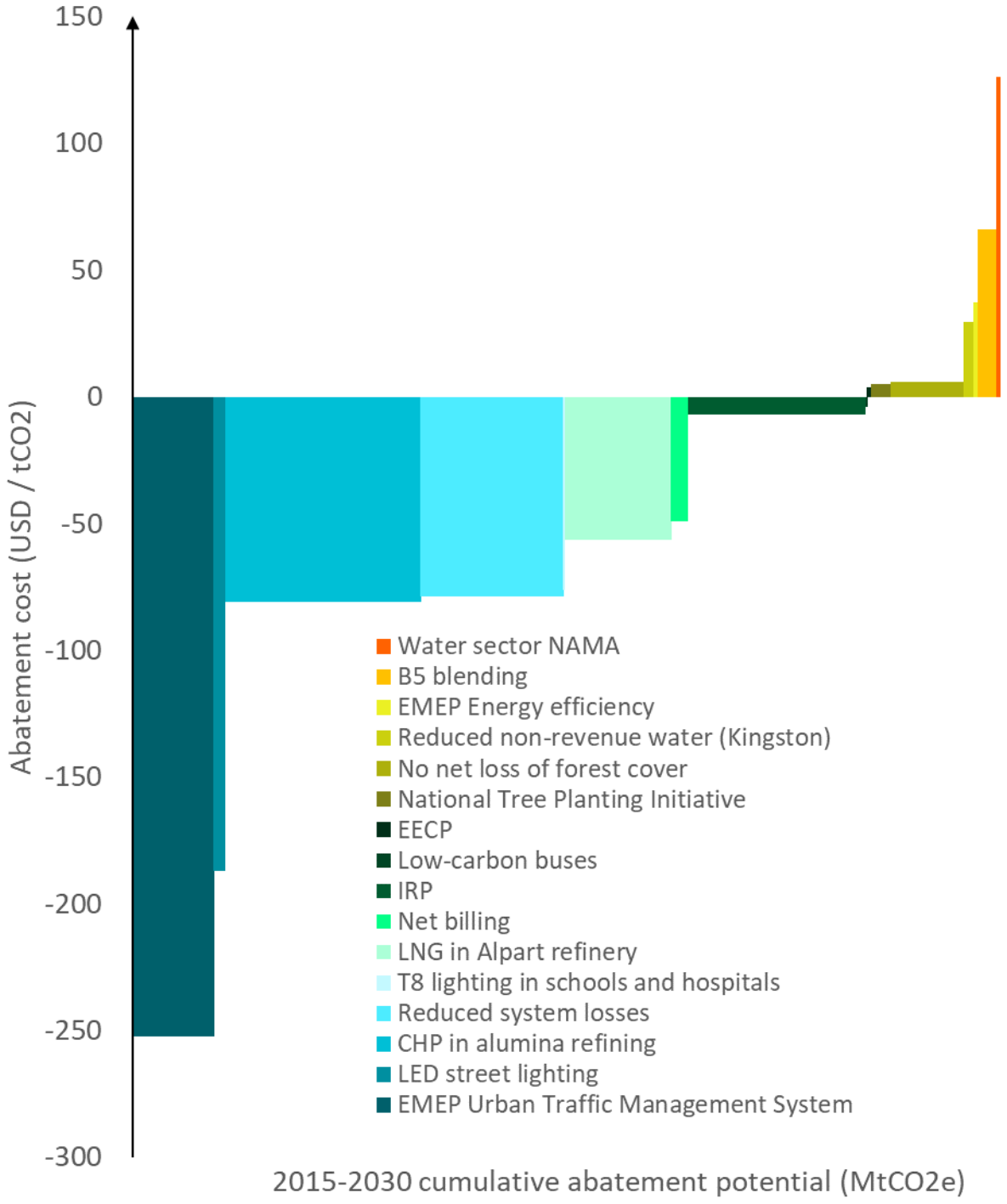
Key barriers include low stakeholder coordination, monitoring and compliance challenges and COVID-19 associated uncertainties. Coordination across partners has been challenging due to difficulties in assigning relevant implementation leads (e.g. B5 blending) and liaising with multiple stakeholders (e.g. National Tree Planting Initiative). In other cases, responsibilities have been assigned across stakeholders but implementation challenges have been encountered, such as ensuring policy compliance (e.g. electricity theft affecting T&D losses) and low knowledge transfer (e.g. risks to the longevity of policies such as NAMA in the water sector). COVID-19 related closures have also delayed commitments (e.g. re-opening of Alpart refinery).

There are some funding gaps in commitments reliant on public funding. In terms of investment needs, eleven commitments are funded or at least partially funded. Five commitments (T8 lighting, B5 blending commitment, 136 low-carbon buses, LNG in the Alpart refinery) have unclear investment needs and require further investigation to update costs and savings. The final commitment is complete.

The total upfront investment need for the sixteen commitments is estimated at US$921.1 million, with around 76% of this funding coming from private sources. The largest investment need relates to the implementation of the Integrated Resource Plan (IRP), under which the investment cost for additional renewable capacity is estimated US$664.86 million. The financing of this commitment will be provided by private power companies. The next largest investment need is for the targeted reduction in system losses (US$64.7 million), which will be funded publicly by MSET. The remainder of commitments will be met by a combination of private, public and international partner funding. While these investment needs are large, they represents only around 0.5% of Jamaica's cumulative GDP during the period from 2021-2030. In addition, much of the economic stimulus provided by these measures can be incorporated as part of Jamaica's recovery from the economic impacts of COVID, providing local jobs and supporting the growth of Jamaica's economy.

The upfront costs should, however, be contrasted with the longer-term cost savings, with many commitments having negative costs per tonne of CO_2 abated. The vast majority of abatement potential is available at negative costs, implying significant operational savings over time. Of the 16 commitments analysed, nine have a negative abatement cost, which means the financial savings outweigh the initial upfront costs associated with these policies. In addition, these commitments are typically larger contributors to Jamaica's overall emission reductions during the 2015-2030 period. As a result, the average cost of all sixteen policy commitments is negative (-$63/t$CO_2$e), meaning that implementing the full NDC package would provide savings over the period to 2030, seen in Figure 2.

Figure 2 MACC analysis of all sixteen policy commitments



Note: Click here to enter note
Source: Vivid Economics

Immediate next steps include securing funding sources, nominating implementation leads, introducing enforcement and Monitoring & Evaluation (M&E) processes and pursuing stakeholder buy-in (seen in Figure 3). Commitments require a range of funding sources and models, including private sector investments and

Public Private Partnerships (PPPs) (e.g. low-carbon buses). Delayed (e.g., B5 mandate, Alpart refinery) and collaborative commitments (e.g., EMEP, NAMA in water sector) require coordination across agencies to nominate appropriate leads. Ongoing commitments necessitate upskilling of staff (e.g., CHP in refining, Net Billing), regulatory enforcement (e.g., T&D, LED) and deployment of tracking technology to conduct M&E (e.g., NNL, Net Billing). External buy-in is required to ensure commitment deployment and uptake. This includes engaging consumers (e.g., low-carbon buses, B5) and the private sector (e.g., Alpart refinery, NTPI). Completed commitments such as EECP can provide lessons for large-scale conditional financed commitments such as the EMEP and NAMA in the water sector.

Figure 3 Suggested actions to address key barriers identified in the Implementation Plan

Key barrier	Suggested actions	Example commitments
Unmet funding needs	Pursuing Public-Private Partnerships (PPPs) or private sector investments to secure funding sources.	136 low-carbon buses, Reduced non-revenue water distribution loss (Kingston)
Lack of stakeholder ownership	Coordination across agencies to nominate appropriate commitment leads and clarify respective stakeholder responsibilities.	B5 mandate, Alpart refinery, EMEP, NAMA in water sector, T8 Fluorescent Lighting in schools and hospitals
Ensuring longevity of projects	Upskilling of staff, appropriate personnel training and learning lessons from completed commitments.	CHP in refining, Net billing
Monitoring and compliance challenges	Improving regulatory enforcement and deployment of tracking technology to conduct M&E.	T&D losses, LED streetlights, Net billing, No net loss of forest cover
Timely deployment and uptake	Stakeholder buy-in, active engagement with consumers and private financers.	136 low-carbon buses, B5 mandate, Alpart refinery, NTPI

Note: A full list of barriers and specific suggested actions can be found in individual commitment sections.
Source: Vivid Economics

Private sector funding will be critical to ensure the enactment and longevity of commitments. The private sector has been involved at the implementation (e.g., Miya Jamaica in NRW losses) and funding stages (e.g., New Fortress Energy in the deployment of low-carbon buses) of numerous commitments. Leveraging similar models will be important to meet the financing costs of commitments and future project timelines.

Going forward, an iterative approach will help the CCD update commitments on an ongoing basis. Frequent consultation of the IP and the NDC Partnership Plan Tool will enable policymakers to progress commitments in a timely manner. The NDC Partnership Plan Tool, an online platform designed by the NDC Partnership, will serve as a tool for tracking progress and coordinating technical and financial assistance from development partners. For example, suggested actions can be prioritised to address immediate barriers and meet the investment needs of certain commitments. The IP can also be used by stakeholders to recognise synergies across commitments and identify opportunities for collaboration. For example, the IP will help agencies such as JBI understand its role in implementing (e.g. LNG in the Alpart refinery, improved CHP in alumina refining) and facilitating policies (e.g. rehabilitating land as part of the NTPI and NNL) across the energy and forestry sectors.

Glossary

Item	Definition
API	Agricultural Production Index
BAU	Business as usual
BOE	Barrel of oil-equivalent
CFL	Compact fluorescent lamp
CHP	Combined heat & power
CSA	Climate Smart Agriculture
EECP	Energy Efficiency and Conservation Project
EMEP	Energy Management & Efficiency Programme
EU-CIF	European Union Caribbean Investment Facility
FTE	Full-time equivalent
GEF	Global Environment Facility
GNESD	Global Network on Energy for Sustainable Development
GVA	Gross value added
HPS	High-pressure sodium (lamps)
IDB	Inter-American Development Bank
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
IRP	Integrated Resource Plan
IWM	Integrated Waste Management
JCDT	Jamaica Conservation and Development Trust
JICA	Japan International Cooperation Association
JPS	Jamaica Public Service
JUTC	Jamaica Urban Transit Company
KMA	Kingston Metropolitan Area
KPI	Key Performance Indicator
Ktoe	Kilo tonnes of oil equivalent
LEAP	Low-Emissions Analysis Platform
LEDs	Light emitting diodes
LNG	Liquefied natural gas
LPG	Liquid petroleum gas
LUCA	Land Use Change Assessment

Item	Definition
LUCF	Land use change and forestry
MEGJC	Ministry of Economic Growth and Job Creation
MHURECC	Ministry of Housing, Urban Renewal, Environment & Climate Change
MOU	Memorandum of understanding
MSET	Ministry of Science, Energy & Technology
MVL	Mercury vapour lamps
NAMA	Nationally Appropriate Mitigation Action
NDC	Nationally Determined Contribution
NEPA	National Environment and Planning Agency
NSWMA	National Solid Waste Management Authority
NTL	Non-technical loss
NWC	National Water Commission
O&M	Operation & Maintenance
OECD-FAO	Organisation for Economic Co-operation and Development and the Food and Agriculture Organization
PJ	Petajoules
PPP	Public-private partnership
SDGs	Sustainable development goals
T&D	Transmission & distribution
TNC	Third National Communication
UTMS	Urban traffic management system
WACC	Weighted Average Cost of Capital
WVO	Waste vegetable oil

Background and Context

Jamaica is committed to playing an ambitious role as the world continues to address the challenge of climate change. In 2017, Jamaica ratified the Paris Agreement, committing the country to put forward climate efforts in the form of a "Nationally Determined Contribution" (NDC) and to strengthen this commitment over time. Jamaica's NDC originally targeted an unconditional reduction in emissions of 7.8% by 2030 relative to a business-as-usual scenario, increasing to 10% with international support. These emission reductions were to be delivered from the energy sector.

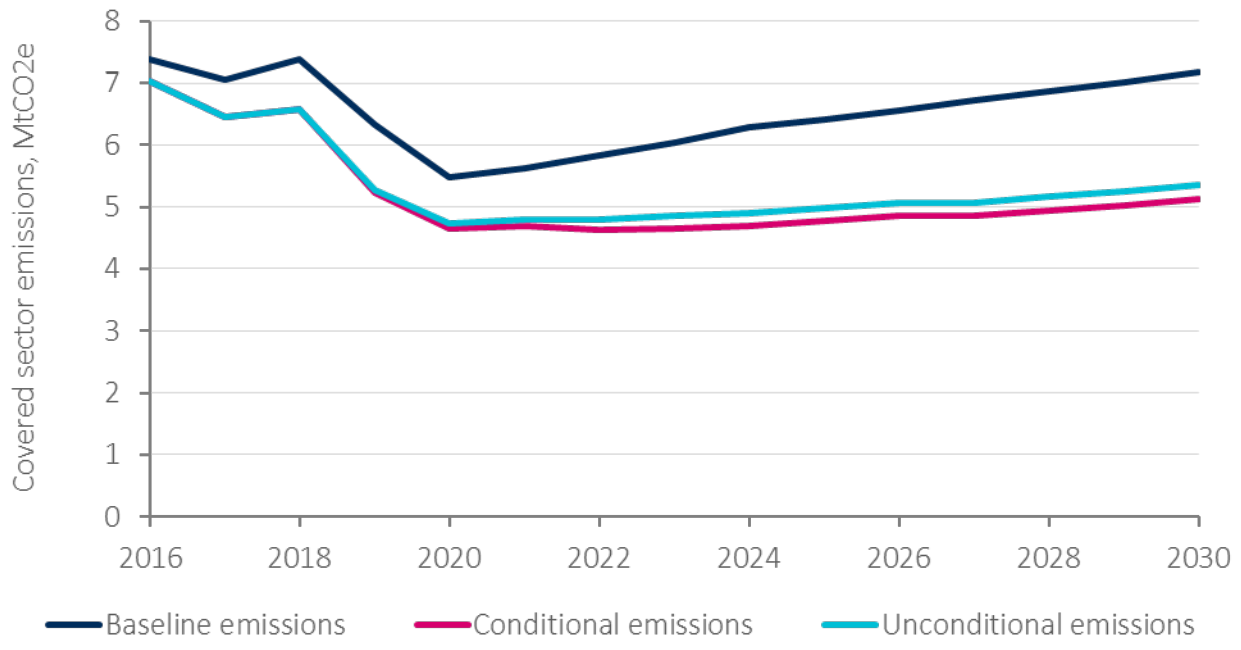
Jamaica submitted an updated NDC to the UNFCCC (United Nations Framework Convention on Climate Change) in July 2020. The updated NDC submission covers emissions from forestry and land use change for the first time, reflecting the importance of the forestry sector to Jamaica, which accounts for more than half of the island's total land use. In addition, the updated NDC incorporates an increase in emissions reduction ambition in the energy sector, reflecting an increasingly comprehensive approach to decarbonising this sector that covers both electricity generation, as well as all major energy user categories.

Jamaica's NDC process interfaces with other national policies and investment planning processes. Jamaica's NDC commitments are in line with the Third National Communication to the UNFCCC [3] which lists most of the listed energy and forestry sector policies. Other plans, such as the water sector Nationally Appropriate Mitigation Action (NAMA)[4] and the Integrated Resource Plan (IRP), are set out in separate documentation. The NDC also aligns with processes such as the National Green Investment Plan and the development of Jamaica's National Adaptation Plan currently under process in collaboration with the Green Climate Fund (GCF).

The NDC targets emissions reductions in the land use change and forestry and energy sectors of between 25.4 % (unconditional) and 28.5 % (conditional) relative to business-as-usual by 2030 (Figure 4). This means that, by 2030, emissions in these sectors will be 1.8 to 2.0 MtCO2e lower than they would be in the business-as-usual scenario. 83% of the unconditional reductions are expected to come from the energy sector, as the Integrated Resource Plan will see a large scale ramp up of renewables in the power sector, as well as improved energy efficiency across all major energy consuming sectors. 17% of these reductions are expected to come from the land use change and forestry sector as policies such as the 'No Net Loss of Forestry' commitment and the initiative to plant 3 million trees are implemented.

[3] GoJ (2018)
[4] CCD and UNDP (2019) – Water sector NAMA

Figure 4 In 2030, unconditional commitments in the energy and land-use sector could reduce emissions by 25.4%, and conditional commitments by 28.5%



Source: Vivid Economics

The mitigation activities required to meet these targets will also provide adaptation benefits for Jamaica. As a Small Island Developing State, the wellbeing and economic security of Jamaica's citizens are vulnerable to the physical risks of climate change. The reduction in emissions in both sectors will provide adaptation co-benefits to Jamaica and therefore enhance the country's resilience. For example, a shift from heavy fuel oil in electricity production, which requires significant amounts of water for cooling, will reduce the pressure on this scarce resource, while reductions in local air pollution will benefit human health, which will become more important as temperatures increase.[5] Similarly, the preservation of forest cover will improve water, soil and air quality, and reduce soil erosion, while coastal mangroves can provide invaluable protection against storm surges and coastal erosion, particularly during hurricanes. Outside of the sectors covered by the quantitative commitment of the NDC, the NDC identifies activities in the agriculture sector which will improve food security while waste sectors efforts will help reduce leaching and air quality concerns.

Jamaica's NDC was developed by identifying and quantifying existing commitments to mitigation in Jamaica. These commitments include policies that had been legislated or communicated, and strategy documents that target the implementation of low-carbon technologies or other means of emissions reductions. The mitigation potential of these commitments was quantified using energy systems and forestry modelling to estimate Jamaica's emissions to 2030 relative to a baseline scenario. The results from this analysis informed the ambition of the updated NDC target. This approach ensures that the NDC is grounded in real life ambition and reflects a realistic decarbonisation pathway for Jamaica. While this approach provides a framework for which activities can help Jamaica achieve its NDC, the NDC objectives can ultimately be met by any combination of activities within the energy and forestry sectors.

This Implementation Plan (IP) details the commitments underpinning the emissions reductions in Jamaica's NDC. This includes progress towards Jamaica's NDC to date, along with identifying potential barriers to overcome and actions which can help ensure the underlying commitments are met. Identifying the costs and funding sources associated with each initiative will help identify investment needs and potential funding gaps early. By conducting a detailed analysis involving quantitative research and drawing on a range of

[5] Climate Central (2019)

stakeholder engagement, the IP outlines how Jamaica can prioritise resources in order to achieve its climate goals.

The IP will be used by the Climate Change Division (CCD), responsible for overall monitoring of the NDC, implementation partners, and other stakeholders. The CCD of the Ministry of Housing, Urban Renewal, Environment and Climate Change (MHURECC) in the Government of Jamaica (GoJ) is responsible for coordination Jamaica's NDC activities. It collaborates with other ministries and agencies nominated to be responsible for individual mitigation commitments.

The rest of this report is structured as follows:

- Chapter 2 introduces the IP framework and details the IP by commitment
- Chapter 3 presents a summary of the financial outcomes of the IP
- Chapter 4 summarises the IP

1 Implementation Plan

An IP can outline the activities, timings, and responsibilities to make NDC commitments actionable.[6] As per the World Resource Institute (WRI), a NDC IP can help in:

- taking stock of progress to date;
- confirming the relevance of the analysis underpinning the NDC;
- identifying the actions and measures to be implemented;
- aligning NDC implementation and the Sustainable Development Goals (SDGs);
- prioritizing policies and measures and sequencing activities;
- assessing capacities, institutions, and regulatory frameworks required for NDC implementation and
- engaging with stakeholders (see Appendix for a full list of stakeholders consulted).[7]

The IP can act as a programme management tool for NDC implementation and link initiatives with wider government objectives. The NDC Partnership recommends using the IP as a live document that is updated on an ongoing basis to monitor progress across commitments and indicate any changes to timelines or funding. Specifically, a NDC Partnership Plan (PP) Tool, an online tool designed by the NDC Partnership to use alongside a country's IP, can be used for mobilizing and coordinating technical and financial assistance from development partners. It can also be used iteratively to propose new work or revisit planned or ongoing commitments.[8] This holistic view can help stakeholders align NDC commitments with government objectives or other sector-specific targets.

The IP outlines implementation activities to support deployment across 16 key commitments as part of Jamaica's NDC. Table 1 outlines the key commitments and initiatives that informed the development of the NDC, alongside a brief description and timelines. Commitments are divided into conditional and unconditional financing. Unconditional financing commitments will be implemented without external support and conditional financing will be implemented with external support.

[6] NDC Partnership (2021)
[7] WRI (2021)
[8] NDC Partnership Plan Online Tool

Table 1 16 commitments are discussed in this report

	Commitment	Description	Sector
	Integrated Resource Plan (IRP)	Jamaica's IRP document lays out planned deployment of electricity capacity between 2020 and 2038, including 412 MW of solar and wind capacity between 2020 and 2030.	Energy
	Net billing	The Net Billing facility provides a statutory basis that allows self-generators to sell excess energy back to the grid at a pre-agreed level of compensation. By 2020, the Ministry of Science, Energy and Technology targets deployment of 12.8 MW of distributed solar capacity through this policy, up from 0.72 MW installed in 2013.	Energy
	Targeted reduction in system losses	This commitment identifies a plan to reduce losses in electricity transmission and distribution by 4.1 percentage points of net generation by 2020.	Energy
	LED street lighting	Upgrade all grid-connected streetlights to LEDs equipped with pedestrian and traffic sensors during 2017 - 2020.	Energy
	Switch to T8 lighting in hospitals and schools	Convert all inefficient 40W T12 lighting to 32W T8 fluorescent lighting in hospitals and schools between 2020 and 2030.	Energy
	Introduction of 136 low-carbon buses	Install 136 low-carbon public transport buses to serve the Montego Bay area and St. James Parish in the period between 2020 – 2025.	Energy
	Biodiesel (B5) blending	In 2020, 189 million litres of annual biodiesel production capacity is deployed to satisfy an impending 5%-by-volume biodiesel blending mandate.	Energy
	Improved use of CHP in alumina refining	Use combined heat and power (CHP) technologies to improve energy efficiency in the alumina-refining from 80% to 90% between 2020 and 2030.	Energy
	LNG in the Alpart refinery	A switch from fuel oil to LNG as the energy used for process heat generation at the Alpart refinery in 2020.	Energy
	National Tree Planting Initiative (NTPI)	The government has committed to planting 3 million trees between 2020 and 2022, including 1 million saplings distributed to the public and 2 million planted centrally on 3,000 hectares.	Forestry
	No net loss (NNL) of forest cover	The government has committed to maintaining at least 30% of the country's land mass as forest, approximately 336,000 hectares.	Forestry
	Reduced water distribution losses (Kingston)	Starting in 2018, water loss in distribution systems operated by NWC is reduced from 53% to 20% within five years. The measure affects 22% of Jamaica's water production.	Energy
	Energy Efficiency and Conservation Programme (EECP)	The Energy Efficiency and Conservation Project (EECP) involved the design and implementation of measures to improve energy efficiency and conservation in the public sector. Between 2013 and 2018, the EECP involved 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.	Energy
	Energy Management and Efficiency Programme (EMEP) – Energy efficiency	Reduces electricity consumption by 30% within public sector health and education facilities between 2017 and 2023.	Energy
	EMEP Urban Transport Management System (UTMS)	This commitment targets the installation of devices and relevant training for implementing the UTMS throughout the Kingston Metropolitan Area (KMA). Reduced congestion in KMA traffic corridors increases average traffic speed from 22km/h to 28km/h, so energy consumption falls by 40% from 2017 to 2023 (104 million litres fuel equivalent).	Energy
	Nationally Appropriate Mitigation Action (NAMA) in the Water Sector	Consists of two interventions deployed continuously between 2020 and 2030: •Intervention 1 reduces final electricity intensity in the water services sector by 10% by 2030 due to the deployment of solar PV plants for captive-use generation. •Intervention 2 includes 55 energy efficiency projects expected to lead to electricity savings of 19,800 MWh per annum by 2030.	Energy

Note: Light blue: Unconditional financing – implemented without external support; Dark blue: Conditional financing – implemented with external support.

Source: Vivid Economics

1.1 Approach

For each commitment, the IP considers a series of issues. Figure 5 outlines the key questions and components considered:

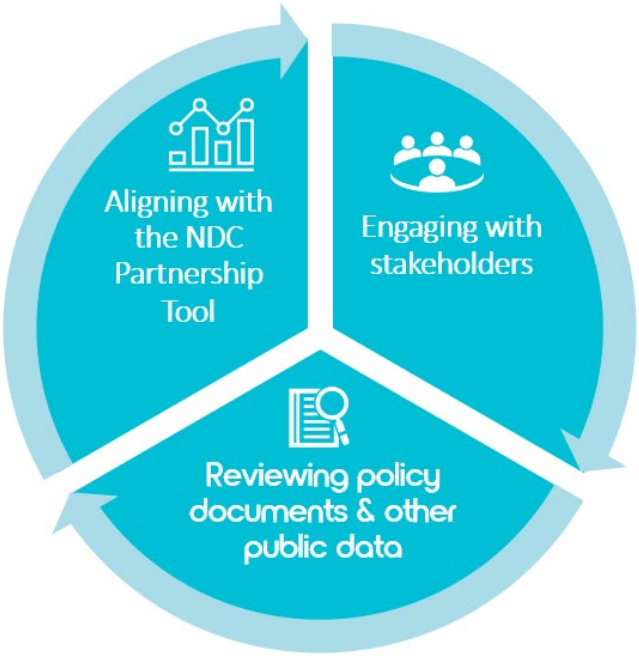
- **Progress to-date:** The IP monitors progress to-date using KPIs associated with each commitment. A baseline and subsequent milestones have been identified which can be used to track progress. For example, in the case of the IRP, KPIs are established for new renewable capacity (MW). Using 2018 baseline figures, milestones are listed as per the IRP's deployment schedule (see section 2.2).
- **Estimated costs and savings:** To support an assessment of financing needs, the IP provides a breakdown of upfront costs, where possible, alongside details of ongoing operational and administrative costs. A summary of investment needs across all commitments is provided in section 3.1, depending on whether a commitment is fully funded or has outstanding funding needs.
- **Barriers and suggested actions:** The IP identifies barriers to implementation such as market barriers, funding gaps, political or administrative processes and behaviour change per commitment. Stakeholder engagements (see Appendix) and cost effectiveness of policy solutions help prioritise barriers and suggested actions.
- **Benefits and contributions to other policies:** For each commitment, the IP captures the estimated mitigation potential by 2030, as well as contributions to other national policies and co-benefits.

Figure 5 Categories considered in Jamaica's Implementation Plan

Note: Categories are aligned with the NDC Partnership Plan reporting tool to monitor NDC commitment progress over time.
Source: Vivid Economics

The IP has been developed iteratively drawing on stakeholder engagement, policy review and using a framework designed to allow for regular M&E updates. A three-pronged approach, explained in Figure 6, was used to develop a comprehensive overview, covering all the sections outlined in Figure 5. By triangulating information from different sources, engaging with stakeholders to draw on suggested actions and making use of a framework for monitoring the evolving nature of activities in a standardised manner, the IP provides a comprehensive assessment of progress to date and the necessary next steps for NDC implementation.

Figure 6 Developing Jamaica's Implementation Plan



Note: The NDC Partnership's online Partnership Plan tool and guidance note are based on the feedback and experience of the NDC Partnership in several countries and is intended to serve as a reference for members elaborating their IPs.
Source: Vivid Economics

- **Engaging with stakeholders (e.g. implementation partners, donors etc.):** The analysis drew on engagement with multiple stakeholders to understand progress on implementation, barriers to, and enabling factors associated with, commitments and related costs and savings (see Appendix). Consultations allowed for the identification of potential interventions. This also enabled information to be disseminated across stakeholders, including commitment details, potential impacts, and immediate next steps, such as nominating appropriate project leads.

- **Reviewing policy documents & other public data**: The analysis draws on local policy documents, official data and global initiatives. For example, we consulted government documents such as the Third National Communication to the UNFCC (2018), NAMA in the water sector policy draft (2020) and Jamaica Public Service Company Limited Rate Review 2019-2024 Determination Notice (2020).[9][10][11] These documents helped understand the progress-to-date, costs and savings, mitigation benefits and related national policies (e.g., National Energy Conservation and Efficiency Policy 2010-2030). Research documents (e.g., Stockholm Environment Institute, Green Climate Fund) and media updates (e.g., The Gleaner, Jamaica Observer) were consulted to validate progress-to-date, barriers faced and changes to costs and savings. Any cost related assumptions made were given a rating (Red, Amber, Green) based on the quality of the source and methodology used in the analysis (see section 3 for details).

- **Aligning with the NDC Partnership Plan Tool and Guidance Note:** The NDC Partnership provides a tool and guidance note to monitor progress across commitments over time. The guidance lists exhaustive categories to investigate, which captures desired outcomes, outputs, KPIs activities, estimated costs, budget breakdown by year, contribution to the NDCs, national or sectoral plans and entities responsible for project delivery and funding of each commitment. Using the guidance ensured consistency across status reporting.

[9] GoJ (2018)
[10] OUR (2020)
[11] CCD and UNDP (2019) – Water sector NAMA

This baseline information will be transferred onto the NDC Partnership's online tool, which will be used to track policies over time.

The IP allocates responsibilities for each commitment, such as funding, implementation or coordination to different stakeholders. Each commitment has multiple different stakeholders involved in funding, management and implementation. For example, in the case of the NAMA in the water sector (see section 2.17), the CCD is acting as the NAMA Approver or the national focal point for the project. However, the NWC and the Water Policy and Monitoring Branch in cooperation with Energy Division are the main coordinating authorities. Execution and funding in entities vary by intervention given the scale of the overall commitment. This can involve international donors and private actors as well as government funds.

Going forward, an iterative approach will help the CCD update commitments on an ongoing basis. Regular use and updating of the IP will enable policymakers to progress commitments in a timely manner. For example, suggested actions can be prioritised to address immediate barriers and meet the investment needs of certain commitments. The NDC Partnership's tool will also provide policymakers a fast and easy way to track progress across Key Performance Indicators (KPIs). For ease of monitoring and reporting, the tool includes a dashboard which shows the composition of the plan by focus (mitigation or adaptation), sector, budget, KPI status and the KPI value chain (i.e., policy, budgeting and investment, M&E, knowledge products). The tool will directly enable implementation partners to adjust commitments (e.g. investment needs, timelines, facilitative activities etc.) on an ongoing basis (see section 4).

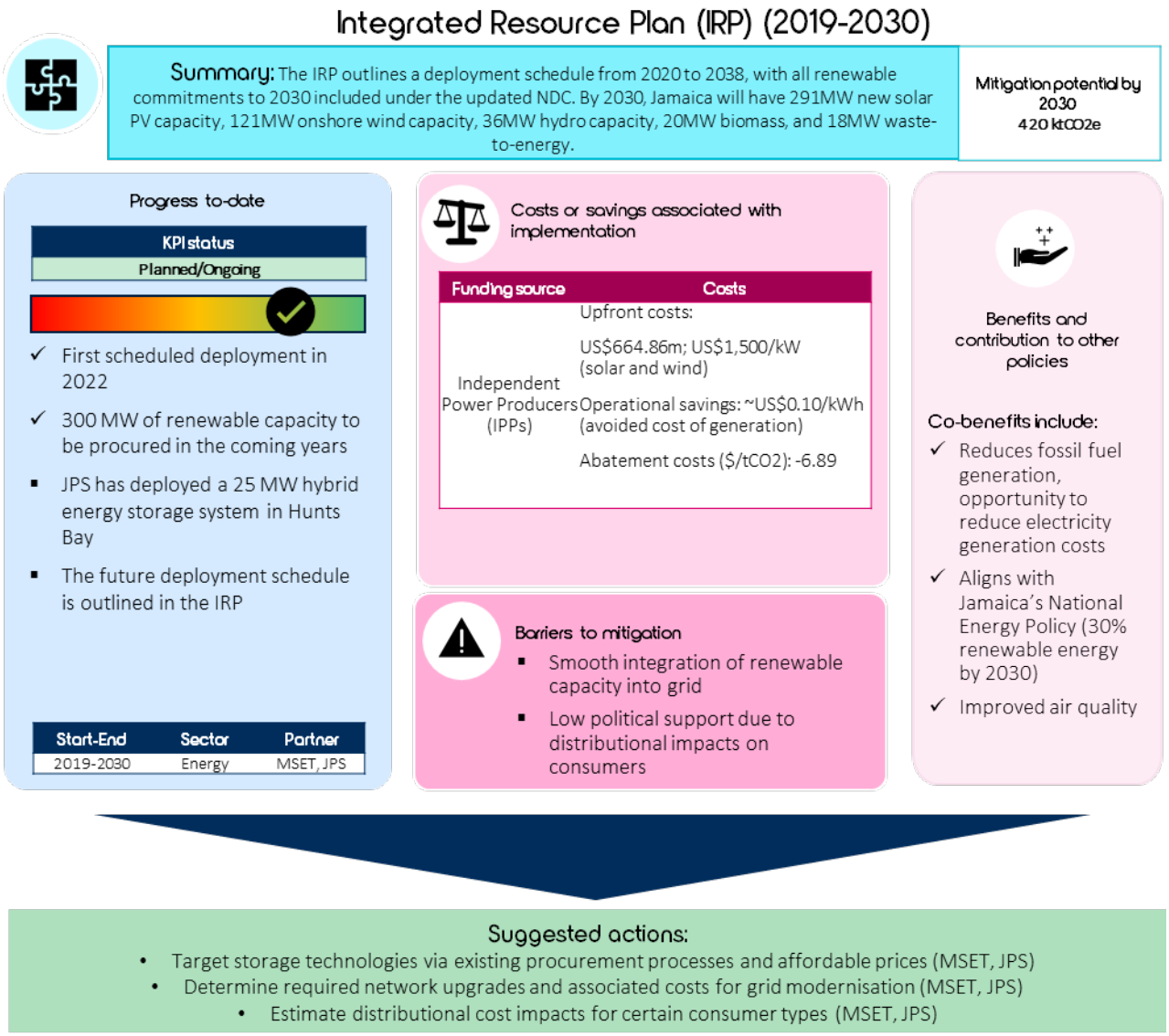
The rest of this chapter provides a summary by commitment of:

- Progress to-date;
- Costs or savings associated with implementation;
- Barriers to mitigation and suggested actions and
- Benefits and contribution to other policies.

1.2 Integrated Resource Plan (IRP)

Jamaica's Integrated Resource Plan (IRP) outlines a roadmap for Jamaica's electricity mix between 2020 and 2038. The IRP, published by the Ministry of Science, Energy and Technology (MSET) in 2020, outlines a deployment schedule for electricity generation assets from 2020 to 2038. Under the plan, an additional 484 MW of renewable capacity is scheduled to be added between 2022 and 2030, split amongst solar PV, onshore wind, hydro, biomass, and waste-to-energy. The IRP is one of the largest contributors to the NDC, reducing emissions by around 420 ktCO2e by 2030, or 21% of the total reduction under the total conditional NDC. A summary of the IRP is presented in Figure 7.

Figure 7 Integrated Resource Plan (IRP) summary



Note: Upfront costs includes administrative costs, procurement costs, testing, standards documents, and connection and inspection costs. Further details can be found in the MSET (2020).

Source: Engagements with MSET and JPS; Doris et al. 2015; The Gleaner (2019a)

Success on this commitment would decrease reliance on fossil fuels for power generation, reducing emissions in the electricity sector. The IRP will introduce a large-scale ramp up of renewables in the power sector, as well as improved energy efficiency across all major energy consuming sectors.[12] In the long term, this could create opportunities for reductions in customer costs and total system generation costs which are lower under renewable generation. The associated decline in emissions can further lead to improvements in air quality.

MSET are responsible for implementing the IRP through the procurement process with JPS, with private entities contracted to deliver renewable capacity. MSET published the IRP in 2020, developing the document in collaboration with JPS, OUR, and a range of other stakeholders impacted by the future of Jamaica's electricity system. The renewable deployment underpinning the IRP is informed by Jamaica's National Energy

[12] It is acknowledged that there is debate in the literature around the total value chain impacts of renewable energy production, including potential adverse impacts on biodiversity and carbon mitigation potential due to mining for metals. However, the attributable upstream costs of renewable energy production were not direct parameters in the energy modelling conducted.

Policy, which targets 30% renewable electricity by 2030. Renewable capacity will be procured from private entities by MSET and JPS.

Investments for renewable capacity will be funded privately, but the prices paid for renewable deployment will influence electricity prices for consumers. The procurement process will determine the offtake price paid to electricity generators, who will be responsible for financing the construction and operation of power plants. The initial cost of financing new renewable capacity is likely to feed into consumer electricity costs. This may impact different electricity tariffs, which could have implications for the distributional impacts of the commitment. However, the reduction in fossil fuel demand and phase out of older, less efficient plants provides an opportunity to reduce the cost of generating electricity. In the longer term, this could subsequently reduce Jamaica's average electricity tariff from the relatively high levels of US$0.27/kWh in 2015, around twice the equivalent U.S. price.[13]

MSET is on track to deliver the 484 MW[14] of renewable capacity required to meet 30% by 2030, with 300 MW already scheduled for procurement in the next few years. MSET has indicated that 300 MW of renewable capacity is due to be procured in the coming few years, which would secure most of the renewable capacity required to achieve the 30% renewable electricity target by 2030. This indicates the IRP is on track to be met by 2030 assuming a further procurement of 184 MW, as calculated under the original IRP, can be achieved in the later years of the commitment period.

Going forward, targeting storage technologies through the procurement process can ensure the increase in intermittent renewable capacity is smoothly integrated into Jamaica's grid. Higher levels of variable renewable generation (solar PV and wind) will lead to a higher degree of fluctuations in electricity supply. One method for incorporating intermittent renewables into the grid is to deploy electricity storage technologies, such as battery storage or pumped hydropower. JPS has already deployed a 25 MW hybrid energy storage system in Hunts Bay, which has helped to improve the reliability of power supply in Jamaica.[15]

Next steps include targeting storage technologies through the existing procurement process and estimating the distributional cost impacts on consumers. Storage technologies, such as battery storage or pumped hydropower, can be targeted during the early-stage procurement process, ensuring markets deliver storage at affordable prices and enabling the efficient scaling up of intermittent renewables. In addition, estimating distributional cost impacts for certain consumer types can help stakeholders devise supporting policies pre-emptively to increase consumer buy-in.

1.3 Net billing facility

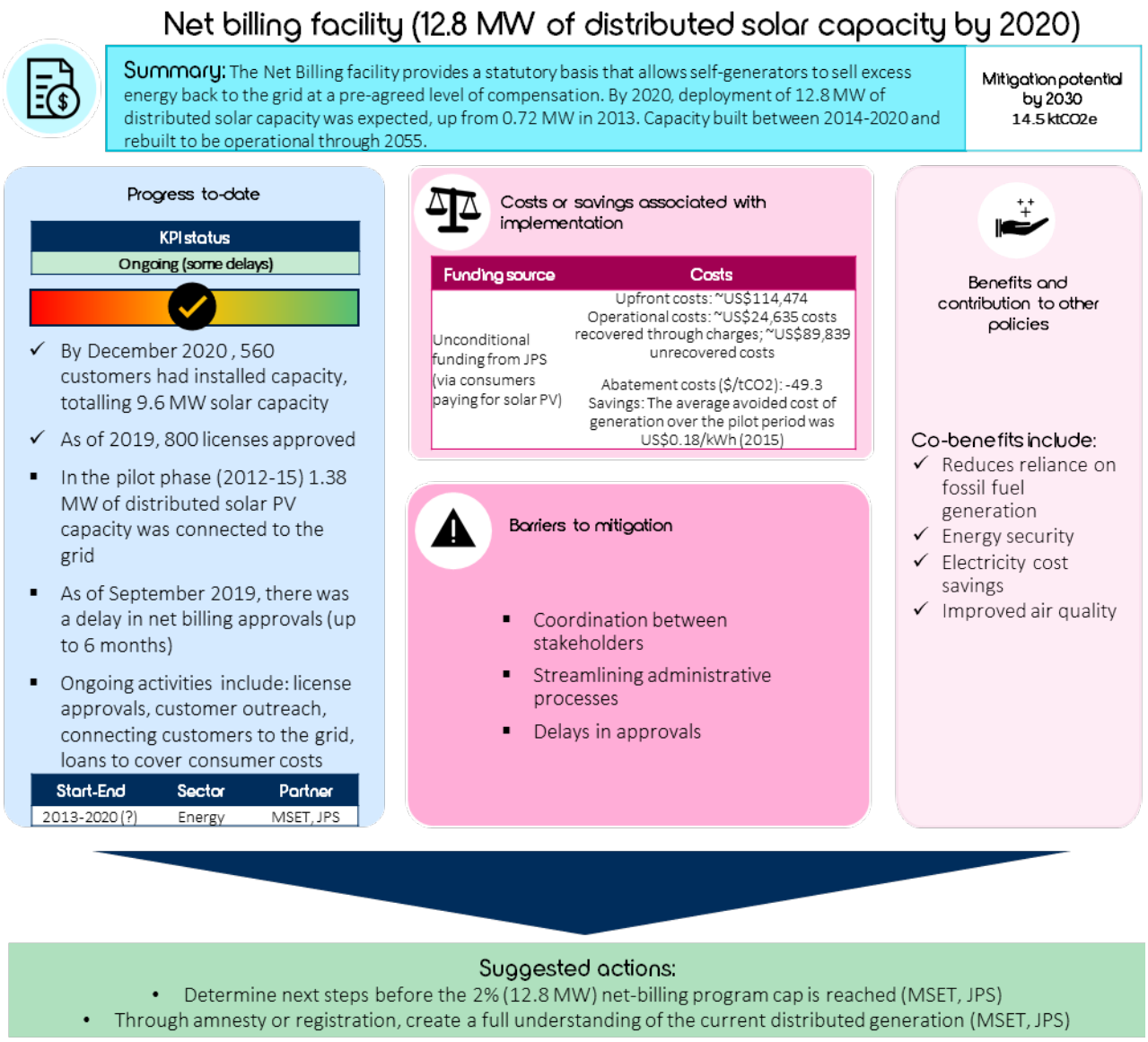
The Net Billing program targets deployment of 12.8 MW of distributed solar PV capacity by 2020, an increase of 12.08 MW relative to 2013 levels. Net billing allows people to sell the excess power generated from renewable sources in accordance with a net billing licence and a contract with the Jamaica Public Service Company (JPS). Excess energy is sold to JPS at wholesale or "avoided cost" prices set by the Office of Utilities Regulation (OUR). The Net Billing program was piloted from 2012-2015, then was updated and resumed in 2016. The net billing commitment will reduce emissions by an estimated 14.5 $ktCO_2e$ by 2030, 0.5% of the total conditional NDC. A summary of the net billing facility is presented in Figure 8.

Electricity generation by net billing installations reduces the need for centrally produced electricity, reducing fossil fuel consumption and associated emissions. The Net Billing programme helps promote energy security through the development of renewable energy sources and provides customers with the opportunity to realise significant savings on their electricity bills by selling excess energy back to the public electricity grid.

[13] Renewable Energy World (2017)
[14] Note that this quantity (484 MW) is likely to vary due to evolutions in energy demand and Jamaica's economic activity relative to original projections.
[15] Gleaner (2019b)

This is an important step in response to growing public calls for the Jamaican government to take action on making energy more affordable.

Figure 8 Net billing facility summary



Note: NDC assumes that that solar capacity stays constant after the programme is complete until 2030.
Source: Engagements with MSET and JPS; SEI (2018); Doris et al. 2015; The Gleaner (2019a); New Energy (2019)

The net billing facility target is set by Jamaica's Ministry of Science, Energy and Technology (MSET), while the JPS oversees implementation. Under the net billing arrangement, JPS is responsible for the installation and maintenance of the meters and meter costs are recovered through the rates charged to the customer for electricity from JPS. The Office of Utilities Regulation (OUR) is responsible for processing all applications for a license to sell electricity to the national grid. The OUR's role is to regulate the generation, transmission, distribution and supply of electricity and consider the requirements of the licence, the government's energy

policy, industrial policy and other relevant policies and issues that impact the electricity sector. The applications are being accepted under similar terms as the previously concluded net billing pilot project, with 239 net billing licences issued since the pilot programme resumed in April 2016.

JPS is funding the programme and reported a total cost of US$114,474. This total includes administrative costs, procurement costs, testing, standards documents, distribution of solar PV equipment, connection and inspection costs.[16] Deployment through net billing is not expected to necessitate any further grid investments relative to the baseline in addition to the aforementioned costs. JPS also reported US$24,635 in costs recovered through charges. These charges, according to JPS, include the direct programme cost, key upgrades and utility disconnect switch payments.

Progress on this commitment is ongoing, but short of the 12.8 MW target due to delays in net billing approvals. As of December 2020, there are 560 customers with installed capacity. This equates to a capacity of 9.6 MW, up from only 120 customers (1.4 MW) that were connected to the utility grid at the end of 2015. Since the 2012 program launch there are now a total of 800 licences for net billing that have been issued to the power supplier, 70 of these since the beginning of 2019.[17] Delays in approvals were up to 6 months in September 2019 and remain persistent.

This commitment carries a range of critical challenges, ranging from market barriers, improving coordination between involved agencies, and streamlining administrative processes. In January 2015, MSET engaged the United States Agency for International Development (USAID) and the U.S. National Renewable Energy Laboratory (NREL) to conduct a study of the Net Billing Pilot Programme. The study showed that the main barriers in Jamaica were the complexity of the process driven by lack of clear equipment, inspection and installer standards, lack of clarity about what happens at the end of the 5-year net billing period, and concerns about the size caps of 10kW for residential and 100kW commercial systems. The reported lack of transparency and standardization of the licensing process contribute to the delays in approvals while the lack of clarity about the end of the net billing period creates market uncertainty and potential financial risk for system owners. These challenges have delayed progress on this commitment.

Immediate next steps include finalizing installations and outstanding approvals and developing a long-term roadmap before the 12.8 MW net billing programme cap is reached. While some progress has been made, ongoing activities include licence approvals, customer outreach, connecting customers to the grid and loans to cover consumer costs. As these processes continue, ensuring a full understanding of the current distributed generation remains critical to the long-term sustainability of the net billing facility after the 12.8 MW penetration goal is reached.

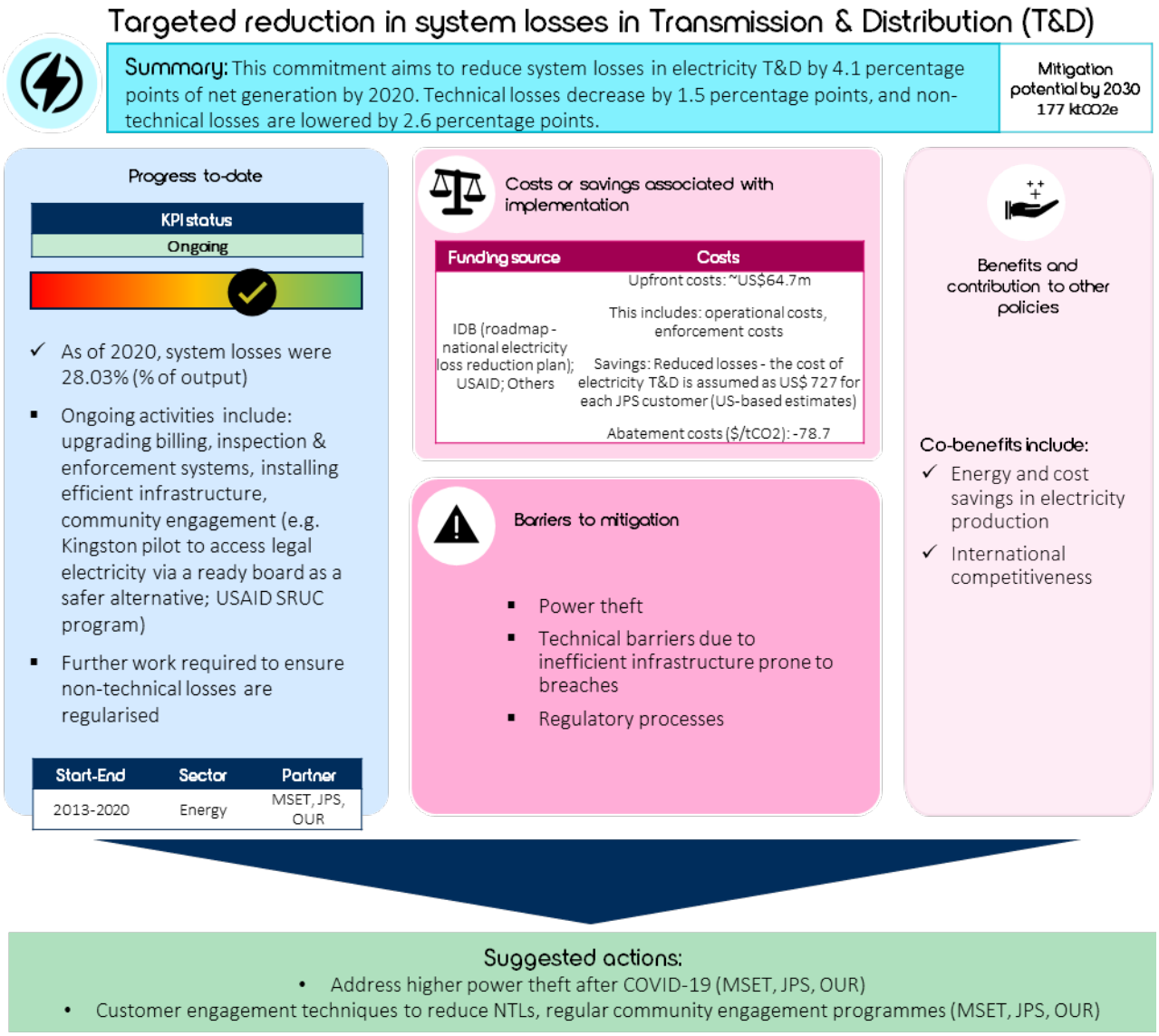
1.4 Targeted reduction in T&D losses

This commitment targets a reduction in electricity system losses of 4.1 percentage points of net generation by 2020. This implies a reduction from 28.5% in 2015 to 24.4% in 2020. Within this, technical losses (TL) which occur in generation, transmission lines, substations, transformers and distribution, are expected to decrease by 1.5% from 10%. Non-technical losses (NTL) - losses that occur due to deficiencies in billing and meter reading, meter by-pass and illegal connections - are expected to be lowered by 2.6%. This commitment is expected to reduce emissions by around 177 ktCO2e, or 8.9% of the total reduction under the conditional NDC. A summary of the T&D losses commitment is presented in Figure 9.

[16] Doris et al. 2015

[17] Note the total number of licences is distinct from customers with installed capacity due to delays in installations.

Figure 9 T&D losses summary



Note: Upfront costs are assumed to a one-time implementation cost to establish new norms and systems.
Source: Engagements with MSET, OUR and JPS; SEI (2018); Doris et al. 2015; New Energy (2020); World Bank (2020a); CARICOM (2018); MSET (2019); Gleaner (2020c); Gleaner (2021); USAID (2020)

Success on this commitment could help improve Jamaica's economic efficiency and international competitiveness security. The planned policy to reduce distribution losses can result in increased economic output per unit of energy input and thus enhance international competitiveness and provide wider economic benefits. By upgrading billing, inspection and enforcement systems to help achieve the targets, emissions will fall as cost savings are realised.

The commitment is coordinated by JPS, which is in charge of recovering the costs to operate the power system. [18] JPS is also closely working the MSET to implement and OUR to monitor this program.

This commitment has significant upfront cost amounting to approximately US$64.7 million. Upfront costs are assumed to cover one-time implementation cost to establish new norms and systems. In addition, there are ongoing operational costs include monitoring and enforcement costs, which have not yet been quantified by

[18] OUR (2020)

implementing partners. Nonetheless, as noted above, the programme is expected to reduce total costs due to the saved generation costs.

In September 2020, the Inter-American Development Bank (IDB) approved funds to help Jamaica's energy ministry develop a national electricity loss reduction plan. The IDB published a call for project proposals to support the recovery of Jamaica's energy sector from the COVID-19 pandemic. These plans should identify the required investment and technologies, address regulatory and institutional issues and determine the role of stakeholders, such as JPS.

JPS reports an increase in system losses from 26.05% in 2019 to 28.03% in 2020 due to the COVID-19 pandemic. The total system-energy losses were initially reduced from 28.5% in 2015 to 26.6% in 2017, of which around 8.5% were technical losses and 18.1% non-technical losses. According to JPS, of the reported 18.1% of NTL, approximately 9.3% was due to illegal connections of meter-by-pass in 2017. The rise in system losses since 2017 is linked to a deterioration of socio-economic conditions, which is driving up non-technical losses due to power theft.

Progress on this commitment is ongoing, but short of the 2020 target due to delays and disruptions created by the COVID-19 pandemic. However, to ensure that the commitment gets implemented several activities need undertaking in parallel including upgrading billing, inspection & enforcement systems, installing efficient infrastructure, and expanding community engagement.

The key barrier of power theft stems from behavioural reluctance to legally connect to the grid, exacerbated by the economic downturn caused by COVID-19. JPS notes that more than 18% of electricity produced is stolen, and that there are over 200,000 illegal connections to the grid, which represent around a third of the legitimate customer base. The bulk of these unpaid electricity charges are not absorbed by JPS but passed on to legitimate customers, increasing their prices. In 2017, customers paid about US$239 million extra to the JPS to offset the allowable losses. Therefore, electricity theft affects all JPS customers.

JPS has pursued a range of efforts to reduce this theft, which includes collaborating with the Jamaican government and seeking assistance from the police.[19] These efforts include the deployment of technology to help identify and curtail theft, collaboration with the police for the arrest of electricity thieves, removal of illegal throw-up lines, account audits and investigations, public education and social marketing, and community outreach and social intervention projects such as the Community Renewal Programme (CRP) which assists inner city communities in regularizing their energy supply. It is noted that these programmes continue to be reformed based on best practices and lessons learned from previous iterations.

Establishing community programmes can incentivise customers to reduce non-technical losses and regulate illegal consumers. The USAID Sector Reform and Utility Commercialization (SRUC) program has been working with JPS and their NGO partner, the Jamaica Social Investment Fund (JSIF), over the last two years to develop financial, technical, and direct customer engagement techniques to regularise illegal consumers and the reduction of non-technical losses.[20] As part of this effort, the SRUC team organized a workshop bringing utilities and regulators from all around the world to Jamaica; sponsored a direct knowledge exchange on community engagement techniques; and is funding a pilot project that will assist residents of the Majesty Gardens community in Kingston to access legal electricity via a ready board as a safer alternative to illegal power.

Installing a more robust technical infrastructure could increase efficiency (technical losses) and mitigate breaches (non-technical losses). JPS revealed that power theft in 2019 was billed at US$178 million. Other initiatives have been around wiring homes by certified electricians to reduce non-technical losses due to meter errors and installation of automatic metering across the island. A smart metering programme

[19] OUR (2020)
[20] USAID (2019)

commencing in 2017 has seen the placement of 400,000 smart meters to date, according to the Office of Utilities Regulation.

Next steps include continuing work to regulate the power theft surge during the COVID-19 pandemic and the reduction of non-technical losses. This can be achieved through customer engagement techniques and regular community engagement programmes.

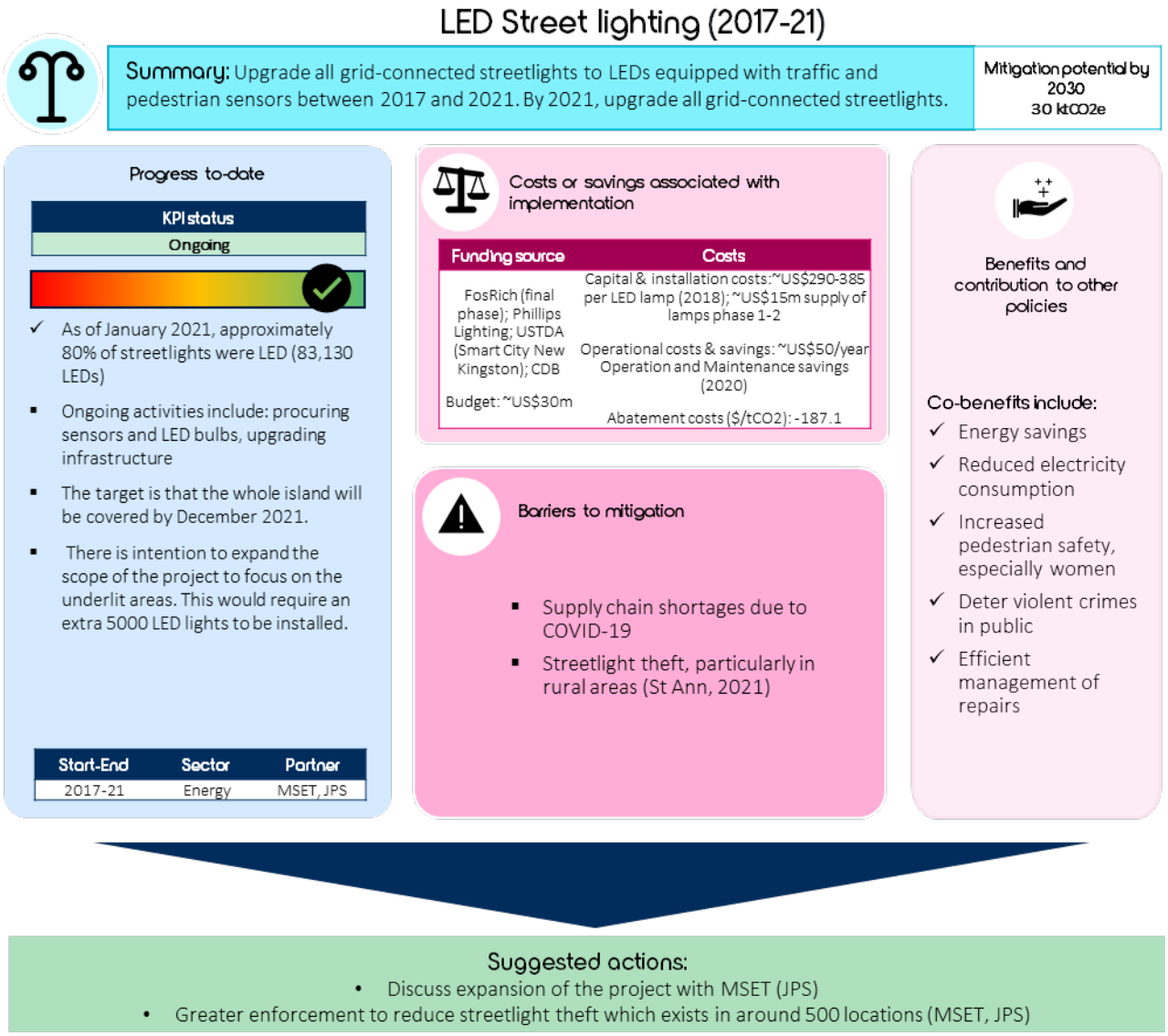
1.5 LED Street lighting

Based on Jamaica Public Service's (JPS) LED program, this planned action involves upgrading all 105,000 grid-connected streetlights to LEDs equipped with traffic and pedestrian sensors between 2017 and 2021, at a rate of approximately 35,000 per year. The programme is facilitated through an agreement between the Government of Jamaica (GoJ) and JPS, as part of efforts to reduce monthly bills which averaged US$280 million or US$2.6 billion annually for each municipal corporation.[21] The commitment is expected to reduce emissions by around 30 $ktCO_2e$ in 2030, or 1% of the total reduction under the conditional NDC. A summary of the LED street lighting commitment is presented in Figure 10.

Enacting this commitment will allow for efficient management of repairs and enhance pedestrian safety, especially for women.[22] A sensor network regulates luminosity as needed depending on pedestrian or motor traffic, reducing the number of hours of daily usage and potentially increasing safety (especially for women) by deterring violent crime in public. Additionally, LED streetlights use less electricity than conventional lamps and have smart controllers that enable remote control and monitoring so that repairs are more efficiently managed, reducing emissions and costs.

[21] Jamaica Observer (2020a)
[22] Painter (1999), SEI (2018)

Figure 10 LED Street lighting summary



Note: Capital and installation costs for HPS and MLV are slightly lower than LED in the range of ~US$177-210 and ~US$320 respectively based on 2018 figures.

Source: Engagements with MSET and JPS; SEI (2018); World Bank (2020b); GoJ (2018); BNAmericas (2020); BNAmericas (2021); Smart Energy (2020); JIS(2020); Jamaica Observer (2020a); Jamaica Observer (2021a and 2021b); The Gleaner (2020d)

JPS is the key implementing body to ensure that the target is achieved. The streetlights network is owned and maintained by JPS.

For this commitment, in July 2017 the JPS received US$25 million in funding from the Caribbean Development Bank (CDB). The capital and installation costs are approximately US$290-285 per LED lamp. In comparison, capital and installation costs for high pressure sodium (HPS) lamps and mercury vapor lamps (MVL) are in the range of around US$177-210 and US$320 respectively, based on 2018 figures. The operation and maintenance savings for LED lamps relative to other technologies are US$50/year[23].

Based on the progress made to date, the commitment is on track to achieve the target. As of January 2021, JPS estimates around 83,130 LED bulbs have been installed to replace high pressure sodium (HPS) bulbs, up

[23] SEI (2018)

from 65,000 in 2019. This represents approximately 80% of the island's 105,000 streetlights.[24] JPS aims for the whole island to be covered by December 2021. Additionally, JPS has been working closely with Councillors in their divisions to ensure that the rate of repair of defective lights is consistent with international standards. Despite the challenges with accessing parts in early 2021, JPS has embarked on an aggressive drive to clear the backlog of approximately 4% non-functioning lights by the end of August 2021.

Key barriers for this commitment have been supply chain shortages due to COVID-19 and reports of stolen lights, particularly in rural areas, which need replacing. There needs to be greater enforcement to reduce streetlight theft, which the JPS estimates exists in around 500 locations. In 2020, for example, St Catherine Parish had 9 stolen lights.

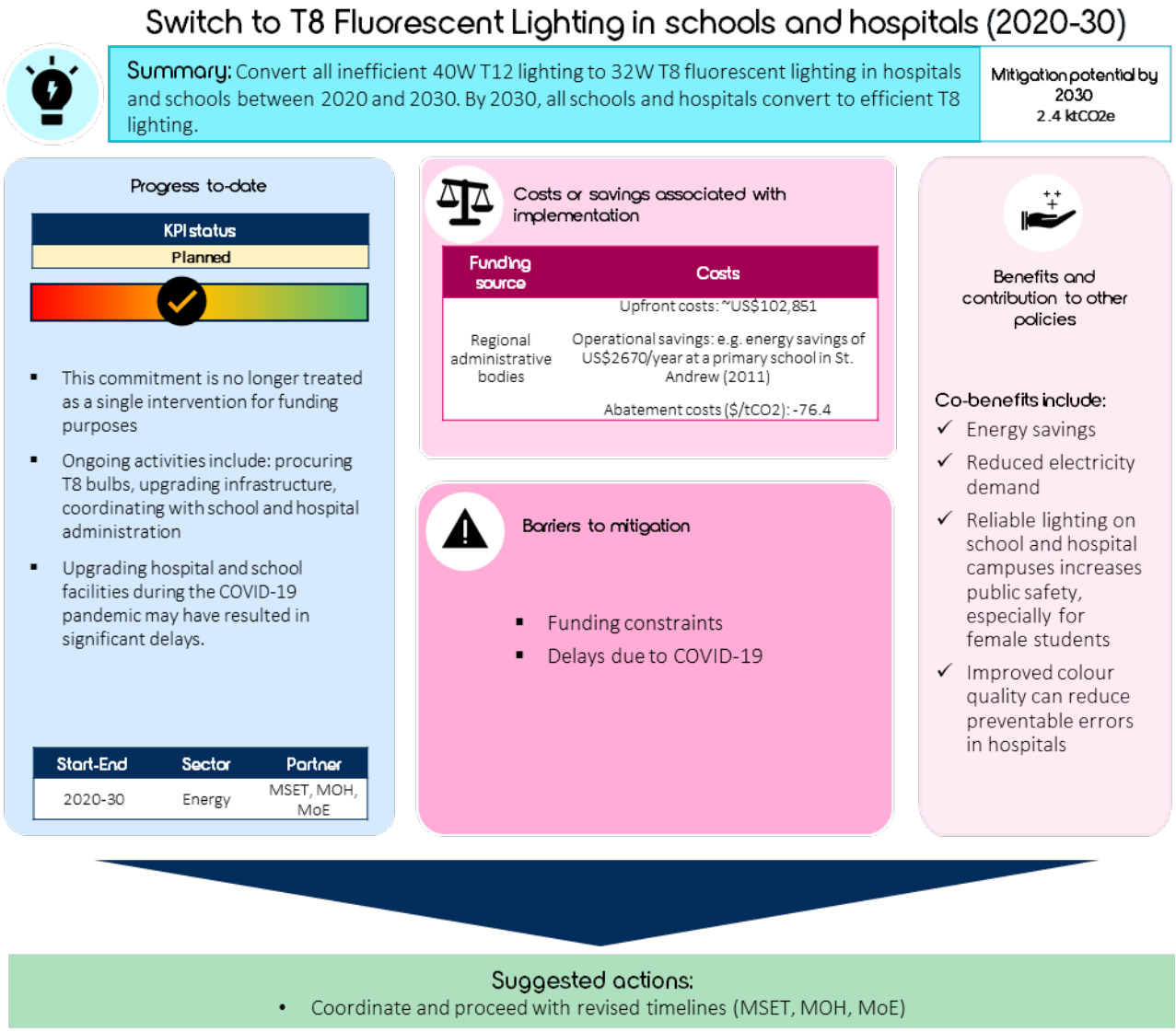
Next steps include MSET considering expansion of the commitment to all underlit areas. There is an intention to expand the scope of the commitment to focus on the underlit areas. This would require an additional 5k lightbulbs. JPS is also working alongside the US Trade and Development Agency to develop a smart city roadmap including additional LED streetlight infrastructure.

1.6 Switch to T8 Fluorescent Lighting in schools and hospitals

This commitment aims to install 32W T8 fluorescent lighting in all hospitals and schools by 2030. As part of this initiative all inefficient 40W T12 lighting will be converted to 32W T8 fluorescent lighting in hospitals and schools between 2020 and 2030. T8 fluorescent lighting in all hospitals and schools will improve energy efficiency and reduce electricity demand. Converting to efficient lighting will lower overall energy use and associated emissions, with emissions falling by 2.4 ktCO2e in 2030 relative to the baseline (0.1% of the conditional NDC reduction). This will also help reduce the overall electricity production and consumption costs borne by the Ministry of Health (MoH) and Ministry of Education (MoE). A summary of the T8 lighting commitment is presented in Figure 11.

[24] Updated based on stakeholder discussions with JPS.

Figure 11 T8 fluorescent lighting in all hospitals and schools summary



Note: Total investment cost also factors in capital and installation cost of switching existing (2010) T12 to T8 bulbs. Cost per saved energy also used for hospitals.
Source: Engagements with MoH; SEI (2018); World Bank (2020b); GoJ (2018); JIS (2011)

The commitment will also result in more reliable lighting and improved colour quality, increasing public safety and reducing preventable errors in hospitals. More reliable lighting on school and hospital campuses will improve public safety, particularly the safety of female students. A study by the Stockholm Environment Institute (SEI) found that improved colour quality can also reduce avoidable errors in hospitals.[25]

The commitment is jointly being led by the MSET, MoH and the MoE. This commitment was based on a pilot study in five hospitals in 2010. Implementation is intended in collaboration with partner sites at the sub-national and regional level.

Given recent funding constraints, the commitment is no longer being treated as a single intervention for funding purposes. Instead, the initiative is being undertaken as part of routine maintenance of subnational facilities. The upfront costs for this commitment are estimated to be approximately US$102,851. The total investment cost also factors in capital and installation cost of switching existing T12 to T8 bulbs. There are no

[25] SEI (2018)

additional operational costs associated with the commitment. Energy savings are expected to be sizeable at around US$2670/year per school, based on a similar project at a primary school in St. Andrew in 2011.[26]

Progress on this commitment is unclear, as it is not being monitored centrally. Since the responsibility for fitting these lights lies at the sub-national level, there is no data on the percentage of T8 lighting conversions in hospitals and schools. Stakeholder engagement with the MoH provided anecdotal evidence of adherence with new bulbs in facilities when changing lights but noted that there was no current way of measuring implementation. The COVID-19 pandemic is likely to result in significant delays in upgrading hospital and school facilities.

Facilitating activities include establishing a secure supply chain to replace lightbulbs on an ongoing basis. Since T8 lightbulbs are not stored in hospital warehouses, supplies may be unavailable when urgently needed. Limited suppliers of T8 bulbs means advance supplier arrangements are required. For example, crediting arrangements can facilitate ongoing replacement of lighting as T8 bulbs become available.

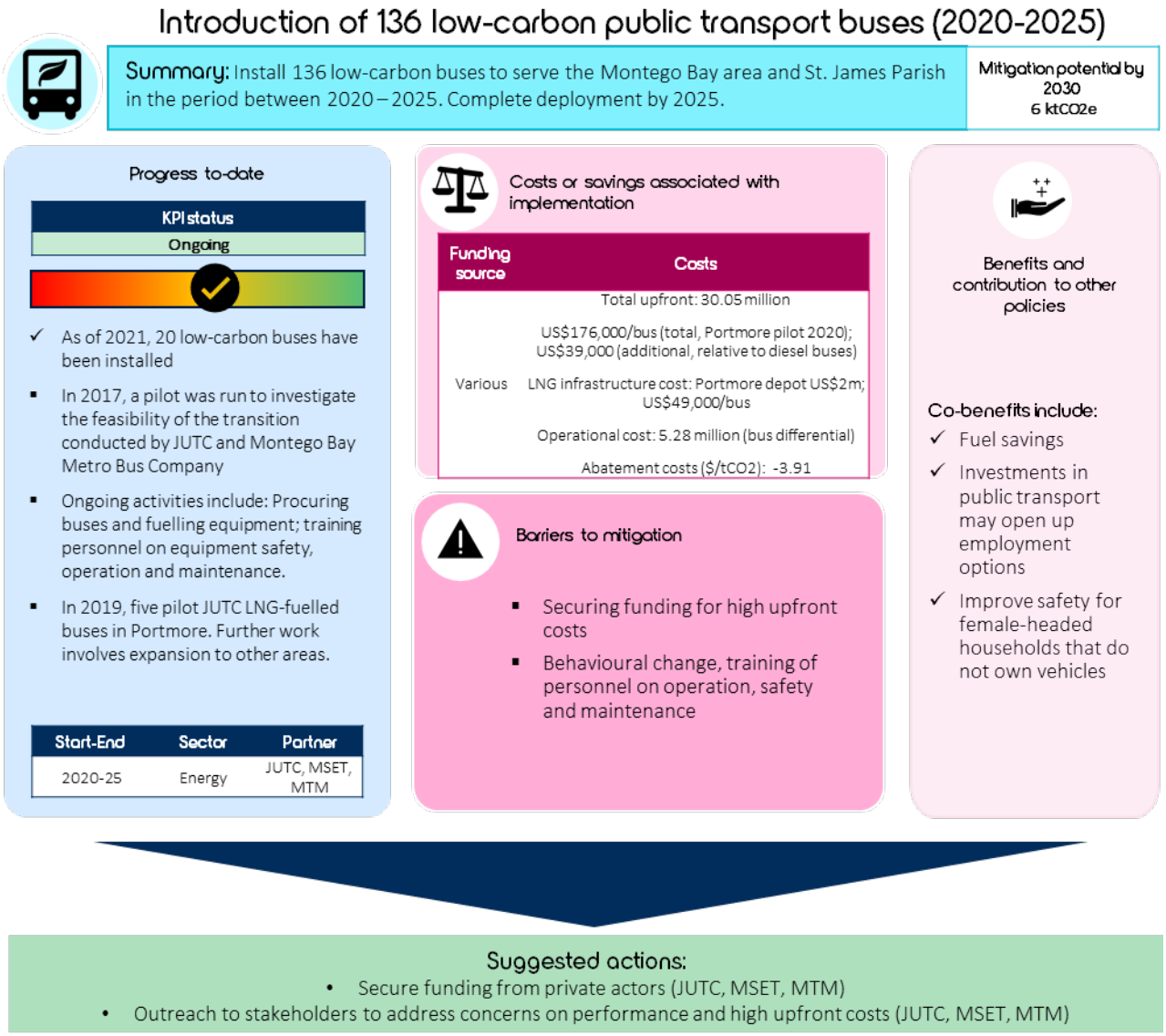
Immediate next steps include coordinating across subnational stakeholders and establishing a uniform reporting process to monitor progress. Coordination and buy-in across hospital and school administration is required to proceed with the initiative and meet national targets. The operational costs for this commitment can be calculated based on the electricity bills incurred by hospitals during the 2010 pilot study, which would account for the energy consumption of T8 bulbs.

1.7 Introduction of 136 low-carbon public transport buses

Between 2020-2025 136 low-carbon buses will be deployed to serve the Montego Bay area and St. James Parish. The commitment requires doubling of Montego Bay Metro Bus Company's fleet and addition of 100 buses in Kingston relative to stocks in early 2017. The deployment of all low-carbon buses is expected to be completed by 2025. Low carbon buses can include compressed or liquid natural gas (CNG/LNG) as well as battery electric buses. The commitment is expected to reduce emissions by around 6 $ktCO_2e$ in 2030, or 0.2% of the total reduction under the conditional NDC. A summary of the low-carbon buses commitment is presented in Figure 12.

[26] JIS (2011)

Figure 12 136 low-carbon buses by 2025 summary



Note: The baseline will require doubling of Montego Bay Metro Bus Company's fleet and addition of 100 buses in Kingston in early 2017. Post 2025 number of low-carbon buses is expected to grow at the same rate as final energy demand for road transport.

Source: Engagements with JUTC; SEI (2018); World Bank (2020b); GoJ (2018); Gleaner (2020); Jamaica Observer (2019a)

Fuel-switching in public transport buses will deliver energy savings and emissions reductions. Although natural gas-powered vehicles tend to be less fuel efficient than their conventional counterparts, the age of JUTC's diesel fleet means that switching from diesel to natural gas buses can reduce energy consumption by up to 50%.[27]

[27]Updated based on stakeholder discussions with JUTC and MTM. Originally 25% as per SEI (2018). Diesel consumption per conventional bus is estimated at 11,242 gallons of gasoline equivalent/year (2016).

Investments in public transport may also create employment opportunities and improve safety for female-headed households that do not own vehicles.[28] Investments in public transport can increase job options through the hiring of trained personnel to maintain the low-carbon infrastructure.[29]

This commitment is led by JUTC, MSET and MTM in conjunction with local partners. For example, in 2017, JUTC and Montego Bay Metro Bus Company conducted a pilot in the Kingston area to investigate the feasibility of the transition. The existing commitments also contribute to the JUTC's wider strategy of fleet and fuel diversification. The actors are also collaborating with private companies, such as New Fortress Energy (NFE) which is responsible for LNG fuel and infrastructure provision.

The key barrier is funding from private actors, which will be critical to meet the high upfront costs associated with the commitment. Based on pilots for LNG fuelled buses to date, the total cost is estimated at US$30.05 million, of which buses cost US$23.8 million (US$176,000/bus) and infrastructure costs US$6.25 million.[30] Of the US$23.8 million cost of buses, US$5.2 million (US$39,000/bus) is additional to the cost of purchasing new diesel buses. In the case of the Portmore depot pilot, the LNG infrastructure amounted to US$2 million. Meeting these costs would require ongoing investments from implementation partners and leveraging private funding. For example, in the Portmore depot pilot, NFE bore infrastructure costs, while JUTC was responsible for set-up and operational costs. The LNG buses were sourced from Von's Motors and the LNG fuel to run the buses was provided by New Fortress Energy.

As of 2021, 20 low-carbon buses have been deployed, indicating the commitment is ongoing. 20 low-carbon buses are operational in the Kingston area (operated on LNG fuel). In the first two years of operations, only two incidents of downtime have occurred. [31]

Ongoing activities to meet this commitment include procuring buses and fuelling equipment (as noted above), training personnel on equipment safety and investing in operation and maintenance of low-carbon infrastructure. The funding need required to purchase the low-carbon bus infrastructure is still unmet. Until this is secured, progress on staff training is also likely to be delayed. However, while there are no electric buses in Jamaica at present, the JUTC has indicated that it is in the process of starting a pilot project with the IDB. This pilot will be conducted using best practices information (tracking software, route selection, infrastructure) and cost estimates from a similar project conducted in Barbados which used electric and CNG buses. The planned pilot will also equip buses with Geotabs, a software for tracking and analytics on fleet performance.

Lessons learned can facilitate the deployment of low-carbon technologies in other vehicle fleets. Following on from this commitment, low-carbon buses are being piloted in other parishes. For example, in 2019, JUTC piloted five LNG- fuelled buses in Portmore. Lessons learned may also facilitate the deployment of LNG in other vehicle fleets, such as the police force.

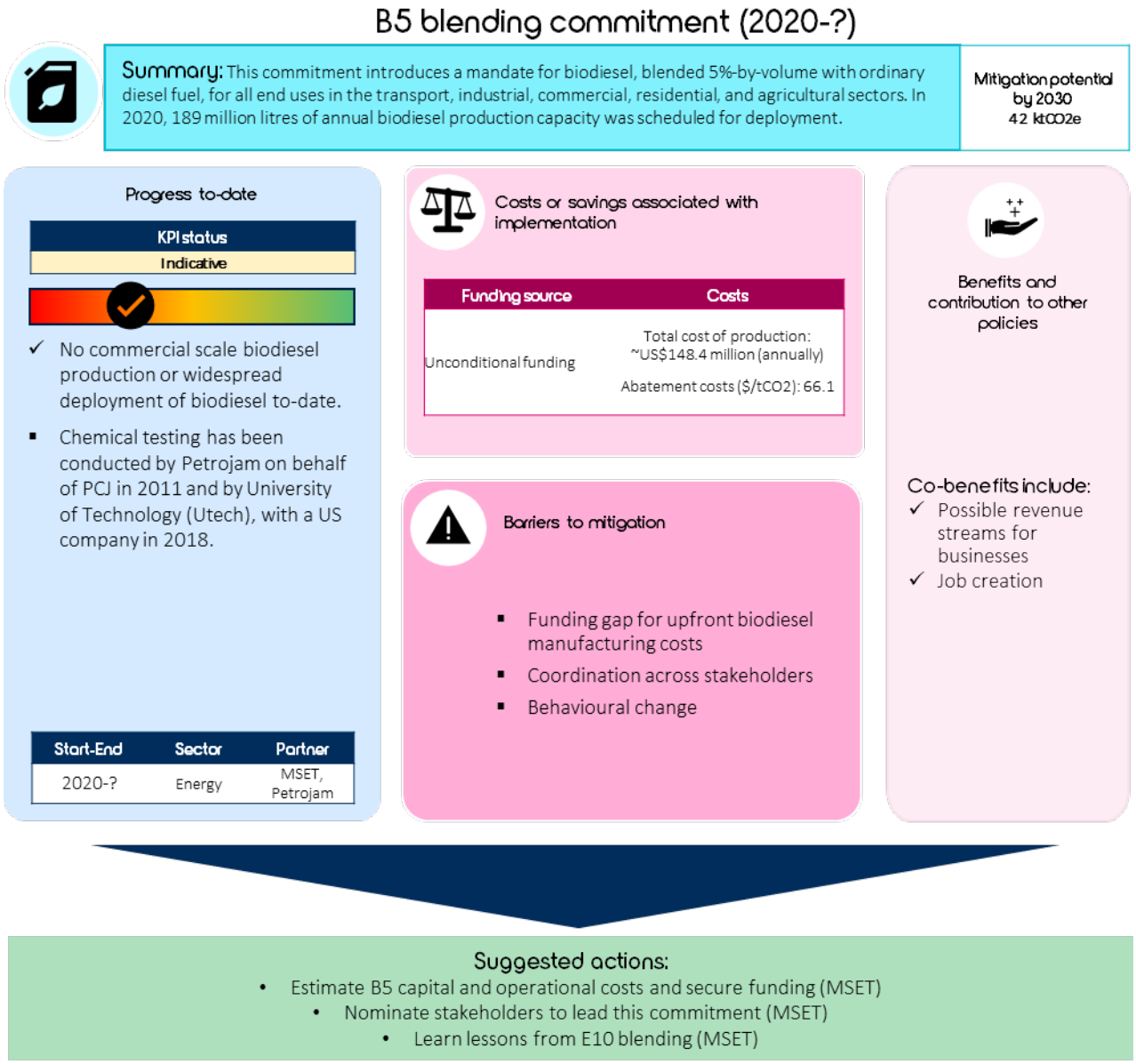
Early outreach to stakeholders can address concerns on performance and high upfront costs of low-carbon technologies. Collaboration across actors is required to ensure adequate route selection and financing for infrastructure is available. For example, buses require adequate stops to ensure sufficient re-fuelling in-between trips.

[28] World Bank (2021): Female headed households refers to households with a female head. An increasing number of female-headed households (FHHs) in developing countries are emerging as a result of economic changes, economic downturns and social pressures, rather than as a product of cultural patterns.
[29] SEI (2018)
[30] Costs per bus as per stakeholder discussions with the JUTC and MTM.
[31] In general, international studies find comparable rates of downtime for diesel vs battery-powered or CNG buses (see for example FTA 2018).

1.8 B5 blending commitment

This commitment introduces a B5 biodiesel blending mandate to be met through domestic biodiesel production. In 2020, 189 million litres of annual biodiesel production capacity were scheduled to be deployed to satisfy a B5 mandate. This would introduce domestic biodiesel, blended 5%-by-volume with ordinary diesel fuel, for all end uses in the transport, industrial, commercial, residential, and agricultural sectors. The commitment is expected to reduce emissions by around 42 $ktCO_2e$ in 2030, or 1.4% of the total reduction under the conditional NDC. The planned commitment has not been realised to-date. A summary of the B5 blending commitment is presented in Figure 13.

Figure 13 B5 blending commitment summary



Note: Total costs of production for diesel include refining costs and profits and distribution and marketing costs.
Source: Engagements with Petrojam and MSET; SEI (2018); World Bank (2020b); GoJ (2018); Biofuel Digest (2018); OAS (2011); NREL (2019); EIA (2020)

The B5 mandate will contribute to energy efficiency and will create possible revenue stream for businesses. The adoption of B5 fuel for end uses in transport, industrial, commercial, residential, and agricultural sectors can give rise to business opportunities by creating a market for compliant vehicles, infrastructure, and

sourcing of feedstock. As of 2017, biodiesel was produced domestically from castor and jatropha feedstock and a small amount of waste cooking oil.[32] A preliminary study undertaken by the PCJ in 2017 suggested that approximately 14 million litres of Biodiesel would be required for a B5 blend to serve the Jamaican market. This would result in suggested expected savings of US$6.4 million annually. [33]

If deployed, the B5 blending commitment is expected to increase employment. The PCJ's 2017 study suggested that castor cultivation on 19,000 hectares of suitable marginal lands (required to produce 14 million litres of biodiesel) could increase local employment in the agricultural sector by approximately 3,275 people.

The B5 blending commitment is led by the MSET, with support from Petrojam. The commitment was initially led by the Petroleum Corporation of Jamaica (PCJ), which was subsumed into the MSET in 2020.[34] PCJ had received support from Petrojam for fuel testing and conducting independent evaluations of engine performance on B5 biodiesel blends.[35] The PCJ undertook the processing of castor oil to biodiesel which was utilized in a vehicular trial completed in June 2017. In 2018, University of Technology (Utech) signed a MoU with a US company on B5 fuel research.[36] The MSET is now in charge of advancing the next stages of this commitment including further research and development, identification of land availability for plantations and establishment of centralized infrastructure for industrial processing.

The commitment was scheduled for deployment in 2020 but has been delayed. A B5 mandate has been in development since 2016, which was scheduled to coincide with the commissioning of the country's first major production facility.[37] As of 2021, there is no commercial scale biodiesel production or widespread deployment of biodiesel as other funding areas are taking priority in the context of the COVID-19 pandemic. There are no strategic of deployment plans for the 2021/22 financial year and no further timelines for commercial B5 production have yet been announced.

Coordination across stakeholders is required to reassess timelines, nominate implementation entities and initiate facilitating activities. A reassessment of timelines is required to nominate relevant entities. Facilitating activities such as testing vehicle performance of B5 blends, scaling-up local biofuel production, securing supply of feedstocks, conducting consumer surveys, manufacturer approval and warranties and constructing and operating biofuel production facilities will all require support from additional implementation partners. For example, securing ongoing supply of feedstocks may require collaboration with the Ministry of Agriculture (MoA).

The key barriers to B5 deployment are the funding needs associated with high upfront capital costs, as well as ongoing O&M costs – the latter estimated at approximately US$148.4 million annually. Discussions with Petrojam suggest that capital costs (e.g. energy infrastructure) are the most significant barrier in biodiesel deployment. Moreover, estimates for ongoing operational and maintenance costs are required, including expenditure on consumer pilots, duties on imported process material and maintenance of technical infrastructure. Similarly, an estimate of projected savings and consumer costs in relation to operations with ordinary diesel fuel will provide a viable business case to secure ongoing funding. These costs are yet to be determined as it is currently unknown which processes will be scaled up for commercial implementation in Jamaica.

The immediate next steps involve nominating stakeholders to lead this commitment and learning lessons from E10 blending. Jamaica has an E10 (10% ethanol blend) mandate for gasoline used in the transportation, industrial, commercial, and agricultural sectors. Lessons from E10 blending led by MSET can help with identification of barriers and suggested actions, such as the potential for funding gaps. Stakeholder discussions are required across MSET, MME and Petrojam to nominate commitment leads. For example,

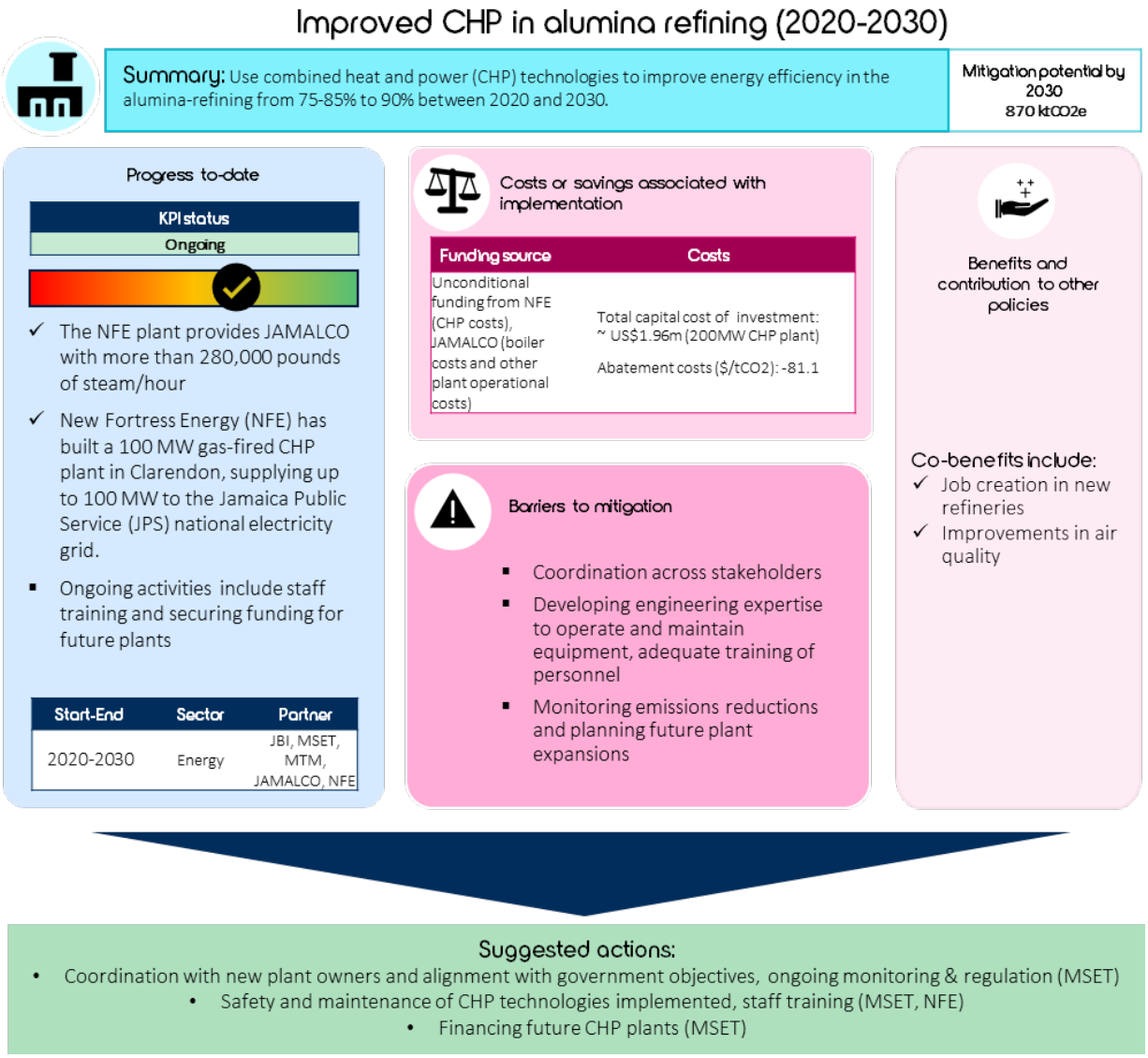
[32] SEI (2018)
[33] Based on information from a 2019 PCJ biodiesel development brief shared during stakeholder engagement.
[34] JIS (2019a)
[35] OAS (2011)
[36] Biofuel Digest (2018)
[37] SEI (2018)

role-mapping is required to investigate transfer of responsibilities from PCJ, to, potentially, the Renewable Solution department of MSET. Ongoing coordination will be needed to create a revised timeline. This will have to take into consideration the required time for procurement, testing, pilots and approvals prior to deployment.

1.9 Improved CHP in alumina refining

MSET has targeted the use of combined heat and power (CHP) technologies to improve energy efficiency in the alumina-refining sector from 75-85% to 90% between 2020 and 2030. Improved CHP in alumina refining will increase efficiency in the alumina sector and reduce emissions associated with electricity demand. Electricity demand in alumina-refining in 2020 was estimated at around 680 GWh, and is likely to reach 875 GWh by 2030. By 2030, emissions reductions associated with the commitment are expected to be 870 ktCO2e annually relative to the baseline scenario, 30% of the total conditional NDC commitment. A summary of improved CHP in alumina refining is presented in Figure 14.

Figure 14 Improved CHP in alumina refining summary



Note: The newer, more efficient equipment is not expected to cause early retirement of existing assets. Instead, the measure is assumed to be introduced gradually as the old equipment naturally retires through 2030.

Source: Engagements with JBI, MSET and MTM; SEI (2018); World Bank (2020b); GoJ (2018); Power Engineering (2017); New Energy (2020); International District Energy Association (2020)

In addition to emissions reductions, the commitment is also resulting in job creation and improvements in air quality. The commitment is resulting in job creation due to the opening of new refineries. For example, 425 construction jobs were created as part of the New Fortress Energy (NFE) CHP plant in Clarendon.[38] Emissions reductions resulting from use of CHP technologies can also improve air quality. Improvements in air quality was suggested as a supplementary Key Performance Indicator (KPI) for this commitment during stakeholder engagements with Ministry of Transport & Mining (MTM) and Jamaica Bauxite Institute (JBI). Air quality data is currently monitored by the JBI.

The initiative is led and coordinated by MSET in collaboration with MTM and JBI. While MSET is leading this commitment, new policies are developed and communicated to companies in association with MTM. JBI provides ongoing technical support by receiving, processing and analysing emissions data from CHP plants.

The commitment is implemented by JAMALCO and NFE (New Fortress Energy). JAMALCO, a bauxite mining company, and New Fortress Energy (NFE), a natural gas company, are currently implementing this commitment. Currently the incorporation of the JAMALCO Joint Venture between the Government of Jamaica (GOJ) and the Noble Group, a Hong Kong-based operating partner, is proceeding. This will convert JAMALCO from a partnership to a company, with further progress expected in June 2021.[39] A change in organisational structure has implications for operations, funding and energy efficiency targets.

Current CHP costs are borne by NFE and other plant operational costs are covered by JAMALCO. The CHP costs are borne by NFE, whereas the JAMALCO bear the costs of the rest of the plant. Boiler costs, for example, are borne by JAMALCO. The total capital cost of investment of the NFE plant was approximately US$1.96 million. Since energy generally accounts for 22% - 40% of the production cost per tonne of alumina, any commercially viable opportunities to reduce energy use and cost are generally realised. This incentive means CHP can attract private financing to realise revenue opportunities while improving energy efficiency.

As of March 2020, the commitment is on track, with a NFE CHP plant providing JAMALCO with more than 280,000 pounds of steam/hour.[40][41] JAMALCO in conjunction with New Fortress Energy (NFE) has built a 100 MW gas-fired CHP plant in Clarendon, which is expected to result in energy efficiency improvements. As needed, CHP is replaced by provision of natural gas for JAMALCO, with the most economic fuel at the time chosen for boiler operations.

Ongoing activities include staff training and ensuring the safety and maintenance of the CHP technologies. Currently MSET is responsible to ensure access to appropriate CHP technology and for developing engineering expertise to operate and maintain equipment. Other activities conducted by plant owners include training of personnel on operation and meeting safety and maintenance requirements. In time there is also the potential for expansion. JAMALCO had originally received a planning permit to construct a 200 MW power plant. It may therefore elect to build the remaining 100 MW of capacity, leading to increased capacity for energy generation.

Monitoring emissions reductions and planning future plant expansions is a key challenge. A streamlined process for environmental permits is needed to efficiently track progress in emissions reductions. Similarly, expansions beyond the current site could face regulatory (e.g. planning permit) and financial (e.g. upfront costs) constraints.

Coordination with plant owners is required to ensure continued alignment with government objectives and to secure funding for future plants. CHP plant owners such as JAMALCO operate based on private sector principles and intend to raise funding without government support. While this is beneficial for financing future plants, alignment is required with government objectives. For instance, a preference has been noted

[38] Power Engineering (2017)
[39] Gleaner (2020b) and stakeholder engagement with JBI
[40] Ibid.
[41] New Energy (2020); International District Energy Association (2020)

amongst some new plant owners for diesel and gas operations. Early stakeholder engagement is required to ensure buy-in to CHP technologies.

1.10 Liquefied Natural Gas (LNG) in the Alpart Refinery

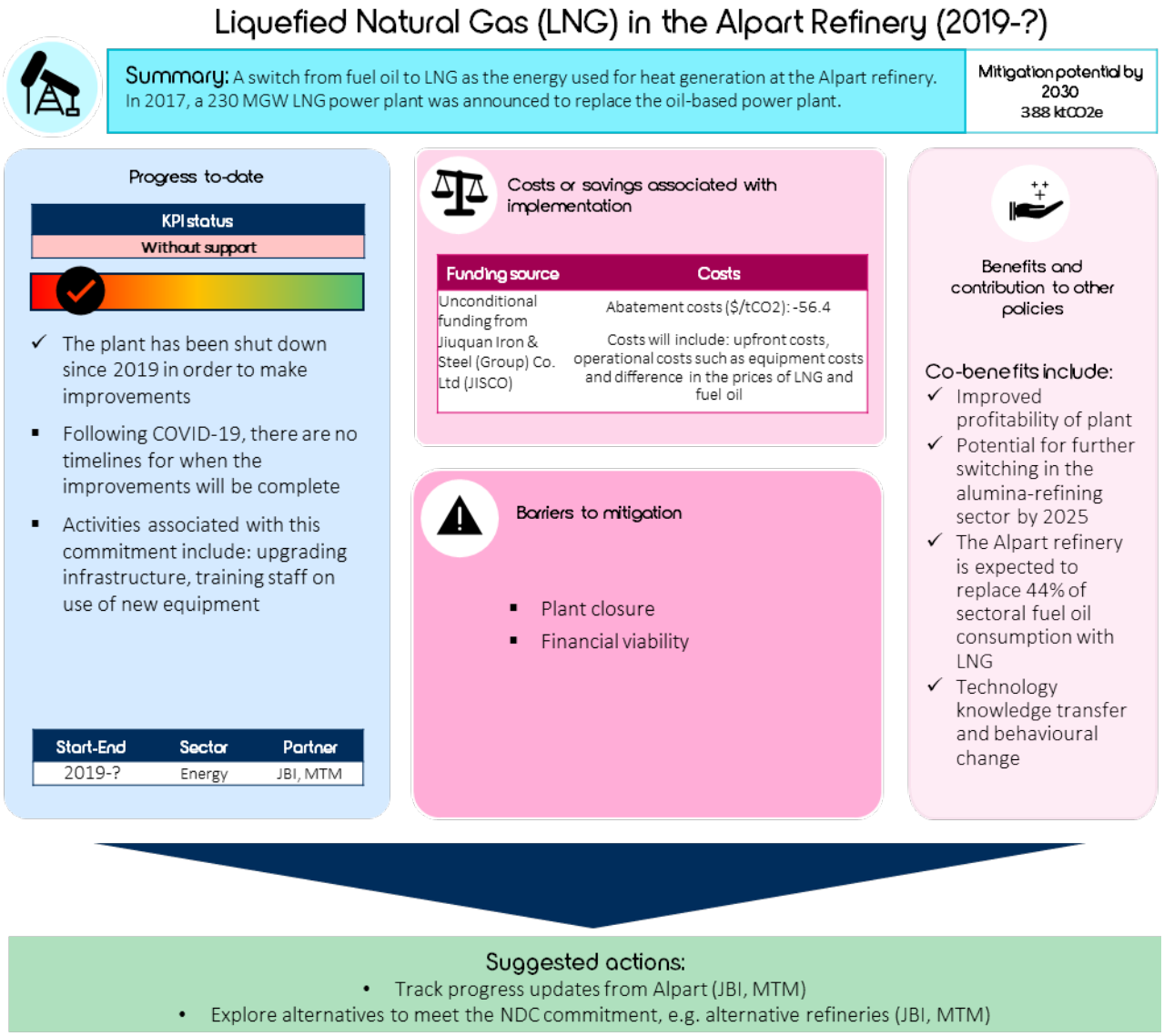
This commitment concerns the Alpart Refinery, which has announced a commitment to switch from fuel oil to LNG as the energy used for heat generation. JISCO (Jiuquan Iron and Steel (Group) Company), the owner of Alpart's alumina refinery in Nain, St Elizabeth, announced in November 2017 that a 230 MGW Liquefied Natural Gas (LNG) power plant will replace the oil-based power plant.[42] By 2030, emissions reductions associated with the commitment are expected to be 388 ktCO2e, or 13% of the conditional NDC reduction. A summary of LNG in the Alpart Refinery is presented in Figure 15.

The commitment is expected to reduce emissions, improve plant profitability and increase the potential for fuel-switching in the alumina-refining sector. Switching to LNG in the Alpart refinery is expected to replace 44% of sectoral fuel oil consumption with LNG. The Jamaica Bauxite Institute (JBI) suggests that this could incentivise wider technology sharing and behavioural change in the alumina industry.

The initiative is being led by JISCO which has owned Alpart Refinery since 2016.[43] JISCO bought 100% stakes in the Alpart refinery after its sale by former owner UC Rusal. Following acquisition, JISCO re-opened operations at Alpart refinery in mid-2017. JISCO is also expected to finance scheduled plant upgrades.

[42] Gleaner (2017)
[43] Aluminium Today (2016)

Figure 15 LNG in Alpart Refinery summary



Note: In the baseline scenario, LNG is used exclusively for electricity generation (certain mitigation scenarios add other uses in industry and transport).

Source: Engagements with JBI and MTM; SEI (2018); Jamaica Observer (2018); JIS (2020a); Gleaner (2017); Jamaica Observer (2020c); GoJ (2020); Jamaica Observer (2020c)

As of 2021, plant upgrades have been delayed due to COVID-19 and the re-opening of the refinery is uncertain. Operations at the JISCO/Alpart alumina refinery were set to be suspended for up to two years to facilitate the plant's modernisation and expansion by 2020.[44] In February 2020, scheduled upgrades at the Alpart refinery were put on hold due to COVID-19.[45] As a result, the plant has not been operational since 2019, when the refinery suspended operations to undertake modernization activities.[46] There is no indication of when these will resume.

Future operations and financial viability of Alpart refinery will depend on analysis from JISCO. Following stakeholder engagements with JBI and Ministry of Transport and Mining (MTM), the financial viability of plant upgrades remains unclear. Engagement with JISCO is required to obtain information on plant status,

[44] JIS (2020a)
[45] Jamaica Observer (2020c)
[46] JIS (2020a)

including planned activities (e.g. infrastructure upgrades, procurement of equipment, retraining staff, knowledge transfer etc.) and the costs associated with them (e.g. upfront costs, operational and maintenance costs etc.). This would include the opportunity costs related to fuel conversion (i.e. the difference in the prices of LNG and fuel oil) to ensure the commitment remains financially viable.

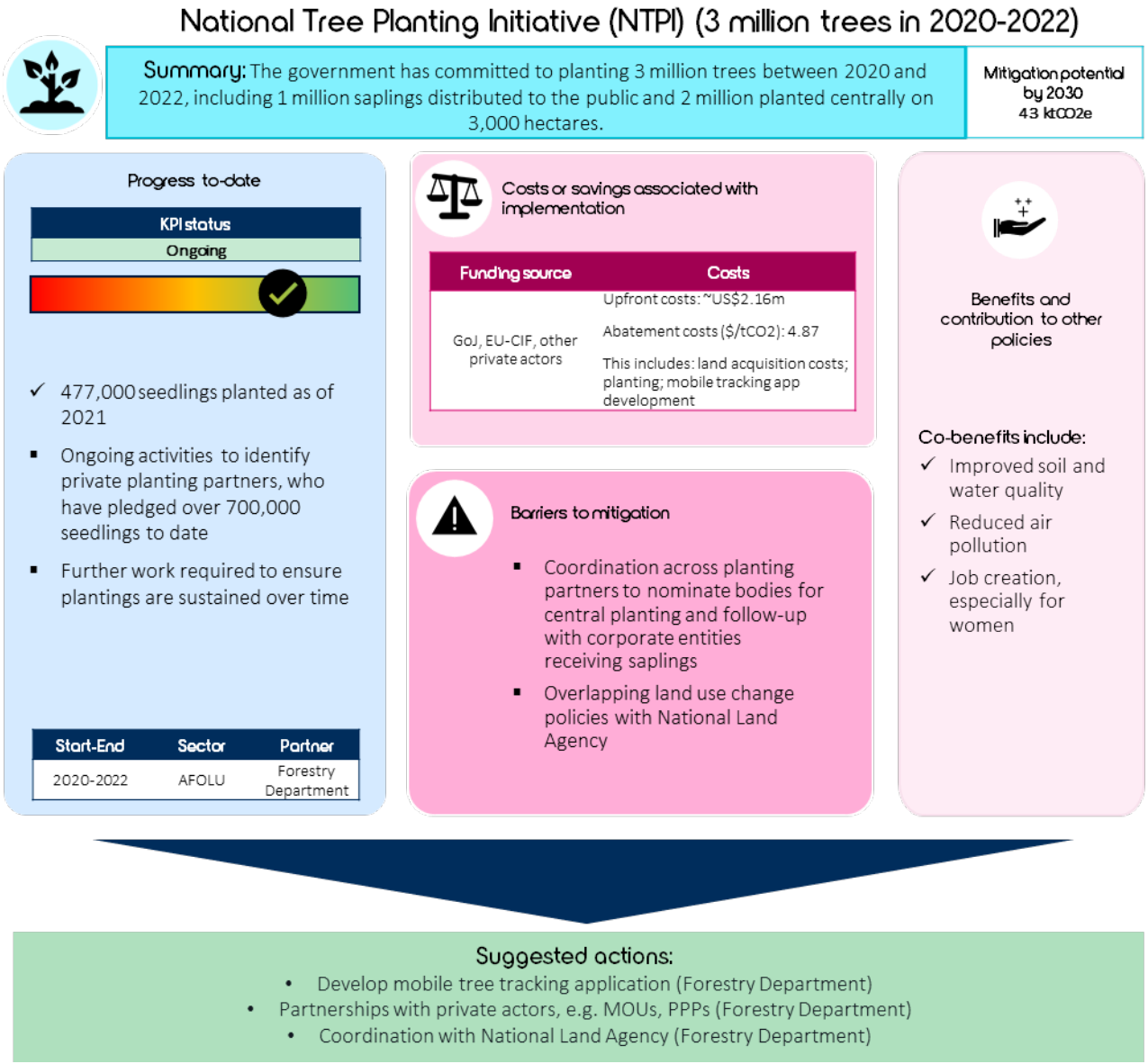
Immediate next steps are liaising with JISCO to assess timelines, operational costs and savings, and determine whether the NDC target will be met. Stakeholder engagement between JBI, MTM, CDC and JISCO is required to track progress and reassess commitment targets. COVID-19 has resulted in significant uncertainties regarding the reopening of the Alpart refinery, and whether the relevant upgrades will be implemented to comply with the commitment. While these upgrades are on hold, alternative ways to reduce emissions or interface with other NDC commitments could be pursued. For example, bauxite mined lands are being used to achieve the No Net Loss (NNL) of forest cover commitment, as discussed in section 2.10.[47] Collaboration with private actors, such as JISCO, can help achieve this target. It is worth noting that if the plant remains permanently closed, the associated emissions reduction will be greater than anticipated relative to the baseline.

1.11 National Tree Planting Initiative (NTPI)

The NTPI aims to plant 3 million trees between 2020 and 2022. The NTPI was launched by Prime Minister Andrew Holness in October 2019. Under the initiative, 3 million trees will be planted across Jamaica, with one million saplings distributed to the public and 2 million planted centrally by Government Departments and private organisations. The commitment will conclude by the end of 2022. Planted seedlings include forestry and ornamental and fruit trees, with urban and semi-urban lands designated for the programme. By 2030, emissions reductions associated with the policy are expected to be 43 ktCO2e, or 2.2% of the conditional NDC reduction. A summary of the NTPI is presented in Figure 16.

[47] Jamaica Observer (2018a)

Figure 16 National Tree Planting Initiative (NTPI) summary



Note: Costs estimated from ~US$1 per tree.
Source: Engagements with Forestry Department; JIS (2019b); JIS (2020b)

The commitment aims to increase additional forest cover by around 3000 ha by 2022 leading to increased sequestration. The seedling types will require different management techniques to be adopted in rural and semi-urban or urban areas.

The NTPI aims to also provide adaptation benefits for Jamaica and create jobs. The NTPI will provide adaptation benefits such as decreased land degradation and improved soil quality. The NTPI will also generate jobs in partnership with local forest management communities that are part of the seed planting process. As of 2019, approximately 1393 people were involved with the NTPI and the Forestry Department is in the process of collecting data on percentage of women employees, building toward meeting Sustainable Development Goal (SDG) 5 of gender equality and women's empowerment. The initial NTPI policy draft had a capacity building component to target young people, however, this aspect of the initiative is currently on hold.

The Forestry Department of Jamaica is responsible for ensuring the target is achieved. The Department is identifying private partners to coordinate planting activities. The Department is currently in the process of finalising a memorandum of understanding (MOU) with the private sector to plant 500,000 seedlings. For example, Noranda Bauxite company in St Ann is restoring previously mined lands by planting seedlings across approximately 3600 ha of land. These seedlings will be in addition to the Department's other commitments, and do not count towards the 'no net loss' target (see section 2.12).

The commitment is largely funded by private individuals, with the Forestry Department facing some costs.[48] The costs of the commitment are expected to be approximately US$2.16 million. The Department will bear the costs of seedlings and technical oversight, with the remaining costs borne by private actors. For instance, the Forestry Department is working towards a Memorandum of Association (MOA) with Bauxite mining companies, with Noranda Jamaica Bauxite Company in the process of formalising their MOA to plant 200,000 seedlings. In FY 2020/21 the Department registered 620 private farmers and is targeting 620 private planters to increase the number of tree seedlings by FY 2021/22. The Department is also incurring some administration and operational costs, such as the cost of seedlings, the development of the mobile application and subsequent tracking of seedlings.

Utilising number of trees as a performance indicator, the commitment is on track as of June 2021. Since 2019 an estimated 477,000 million trees have been planted, which is roughly equivalent to 1050 ha. Private partners are playing a key role, with 700,000 plantings pledged by corporates as of 2019.[49]

Identifying land and private partners to support plantings is crucial to ensure the target is achieved. Currently, 75% of forest land in Jamaica is owned by private owners. As a result, the Forestry Department is working closely with private partners to incentivise plantings. For example, the Forestry Department and the National Land Agency (NLA), are considering adopting market-based instruments to incentivise action under Article 6 of the Paris Agreement or through voluntary carbon markets. Similarly, not all publicly forested land is currently owned by the Forestry Department, requiring the Department to work alongside the NLA, the custodian of all public land in Jamaica, to ensure the NTPI and the no net loss of forest cover (see section 2.12) can be achieved. For example, if a request is made to lease or buy forestry land, the NLA shares a letter of intent with the Forestry Department before proceeding with land use conversion.

The NTPI may lead to further tree planting initiatives in Jamaica through collaboration with the Ministry of Agriculture and Jamaica Conservation and Development Trust (JCDT). The Forestry Department is currently working with the JCDT to design a separate one million tree planting initiative. The JCDT is a non-governmental organization which manages approximately 41,200 hectares which make up the Blue and John Crow Mountains National Park.[50] Similarly, the Ministry of Agriculture has expressed support to plant 42,000 seedlings, equivalent to 67 ha.

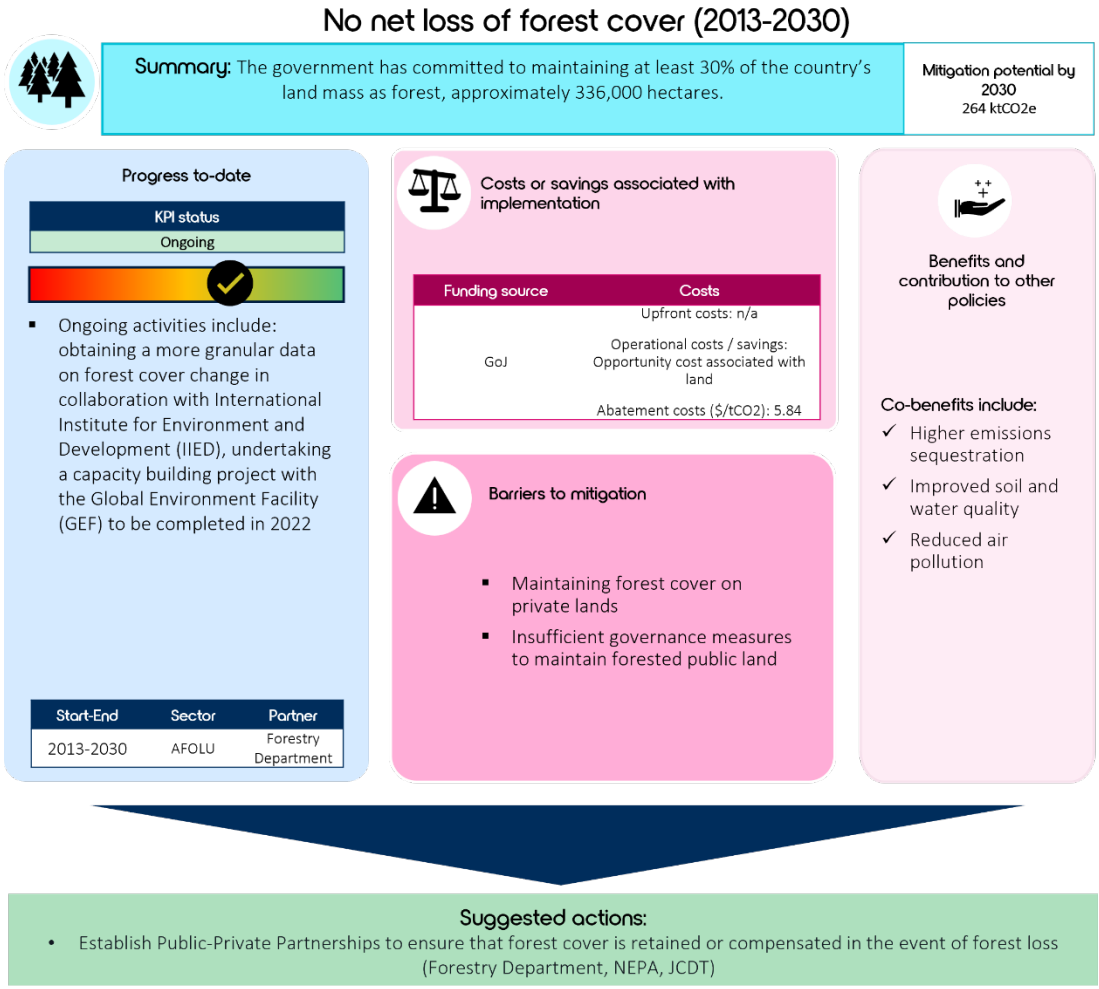
Immediate next steps include developing a mobile application to monitor seedlings over time. A key consideration is tree maintenance and survival over time. The Forestry Department is in the process of developing a mobile application which will indicate the geospatial distribution of all new seedlings. The mobile application will help track the survival of planted seedlings over time. The intended objective is to have 85 – 95% seedlings survive. The Department would also need to investigate additional sequestration mechanisms to compensate for the potential loss in seedlings planted.

[48] JIS (2019b)
[49] JIS (2020b)
[50] JCDT (2021): The JCDT receives 30% of its annual budged from the Government of Jamaica through the National Resources Conservation Authority and the National Environment and Planning Agency.

1.12 No net loss of forest cover

The government has committed to maintaining at least 30% of the country's land mass as forest cover between 2013 – 2030. The government has committed to maintaining a 'no net loss' forest cover policy in its 2017 Forest Policy and its most recent National Forest Management and Conservation Plan (NFMCP), which details policies to 2026.[51]As per the 1998 baseline level, approximately 30% of land area is forest-covered, or approximately 336,000 hectares. However, recent studies from 2015 show that approximately 40% or 439,938 ha of Jamaica's land is covered by forests.[52] This increase from the 1998 baseline is mainly due to the increase of secondary forest cover and improvements in technology and higher resolution satellite images resulting in more accurate estimates. Maintaining land cover at the recent estimate of 40% of Jamaica's total land would lead to emissions reductions associated with the commitment of 264 ktCO2e, or 13.2% of the conditional NDC reduction.[53] A key decision point for the Forestry Department, would be agreeing on the baseline used when calculating emissions reductions. A summary of the no net loss of forest cover commitment is presented in Figure 17.

Figure 17 No net loss of forest cover summary



Note: Costs include opportunity costs or the foregone revenue from not converting land.
Source: Engagements with Forestry Department; Forestry Department (2017)

[51] Green Climate Fund (2020)
[52] Forestry Department, Jamaica's Land Use Cover Assessment: A comparative assessment of Forest Change between 1998 & 2013 (Forest Resource Information Management Branch, GIS Unit, 2015).
[53] This calculation excludes additional afforestation attributed to the NTPI initiative.

No net loss of forest cover is expected to increase emissions sequestration and improve air, soil, and water quality. More accurate satellite imagery can influence the ratio of afforestation to deforestation in the country, since land use changes can be identified at a higher level of granularity, ensuring greater degree of law enforcement. Increased forest cover could in turn result in higher levels of emissions sequestration than previously expected. No net loss of forest cover will also contribute to adaptation benefits such as improved soil and water quality and reduce air pollution.

The costs of the commitment are borne by the Government of Jamaica, with alternative uses of land, being compensated through private replanting initiatives. Ongoing monitoring and evaluation costs will be borne by the Government. The cost of replanting for any forest cover that is lost will be borne by private actors. For example, forest cover loss resulting from future highway projects, such as the Montego Bay bypass and the extension of the East-West Highway will be offset by the commensurate replanting initiatives (in other locations) by developers and sponsors. If the loss is on public forest estates, private actors are expected to compensate for the full replanting cost of commensurate acreages as well.

The Forestry Department is on track to achieve this commitment through deforestation prevention and re-planting initiatives. The Forestry Department is closely coordinating with other actors, such as the International Institute for Environment and Development, to obtain more granular data on forest cover change over the last 35 years. This will help monitor deforestation trends spatially and lead to better enforcement. The Forestry Department is also undertaking a project with the Global Environment Facility (GEF) expected to be completed in 2022. The GEF project will facilitate capacity building activities that quantify levels of disturbance in forest cover, help identify drivers of deforestation and indicate deforestation rates. The Forestry Department also intends to annually increase the number of Crown lands, or state-owned forest areas, that are protected legally.

Addressing institutional barriers requires strengthening governance arrangements and working with private organisations to manage Jamaica's forests. Jamaica's Forestry Act has been amended after a series of public consultations and will include measures to strengthen tree preservation. Other proposed, but not yet legislated recommendations during the consultation process included empowering local forest management committees to strengthen regulatory capacity and giving more power to wardens from the National Environment and Planning Agency (NEPA) and Jamaica Conservation and Development Trust (JCDT). The aim of these suggested changes is to ensure that all public estates with little or no disturbance are retained. However, not all public forested land is currently owned by the Forestry Department. Therefore, the Forestry Department is aiming to work alongside private owners of land of 10 ha or more to incentivise forest retention via annual tax rebates.

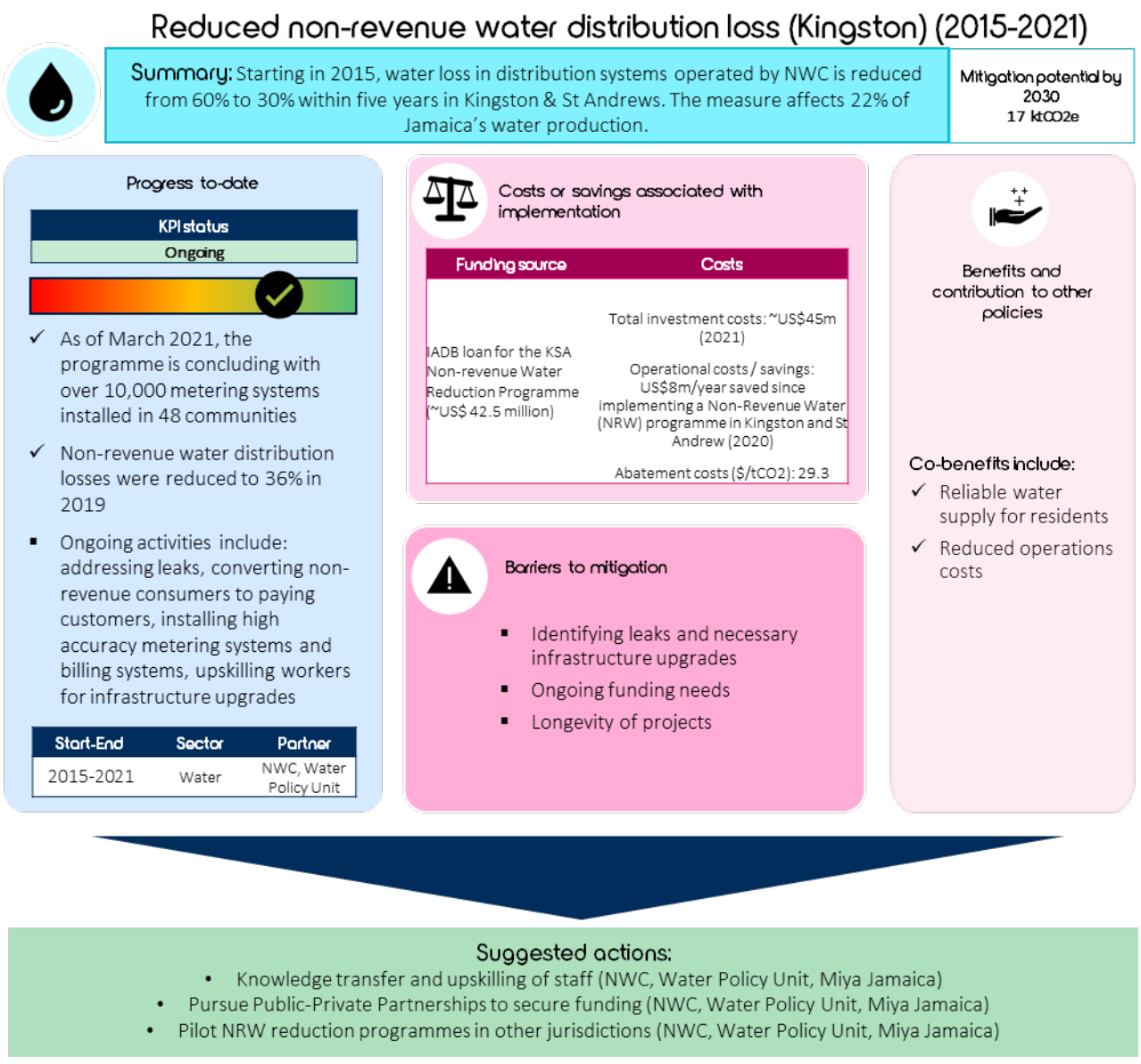
Key next steps for the Department are agreeing on its current forest cover target and securing public-private collaboration to further incentivize forest maintenance by private organisations. Given that better forest cover data has become available between when the target was set and today, a key decision point is how new data is incorporated into the target. For instance, given that recent studies indicate a 40% forest cover, as compared to the 30% baseline, the Department may decide to strengthen its overall 'no net loss' ambition. A new land use and land cover dataset is also being developed in 2023 taking advantage of cloud processing, open access data, and machine learning techniques. The Department will have to decide how this data is used to calculate any forest cover change, and what baseline is used to assess progress against the policy. The Forestry Department has also prioritised leveraging Public-Private Partnerships (PPPs), to ensure that forest cover is retained or compensated in the event of forest loss.

1.13 Reduced non-revenue water distribution loss (Kingston)

This commitment aims to reduce Non-Revenue Water (NRW) loss in Kingston & St Andrews (KSA) to 30% by 2021 - a 30 percentage point reduction from 2015. The Kingston and St. Andrew (KSA) NRW Reduction Programme was introduced in 2015 and is being implemented over six years by the National Water

Commission (NWC) and Miya Jamaica. Starting in 2015, water loss in distribution systems operated by NWC will be reduced from 60% to 30% by 2021. The measure affects 22% of Jamaica's water production. By 2030, emissions reductions associated with the commitment are expected to be 17 ktCO2e, or 0.6% of the conditional NDC reduction. A summary of the reduced NRW loss in KSA is presented in Figure 18.

Figure 18 Reduced non-revenue water distribution loss (Kingston) summary



Note: Implementation costs are not specific enough for annualization, so they are spread equally among six commitment years.

Source: Engagements with NWC and Water Policy Unit; SEI (2018); World Bank (2020b); GoJ (2018); Jamaica Observer (2018b); The Gleaner (2019c); The Gleaner (2020a) ; JIS (2020c); Jamaica Observer (2019b)

The original target of a reduction to 20% in NRW loss has been revised upwards to 30% following practical experience of NRW reduction activities. Following discussions within the NWC and practical experience of NRW reductions, the original target of a 40-percentage point reduction from 60% to 20% was revised to a 30-percentage point reduction. This was based on the financial viability of the initial target, as the costs and challenges associated with meeting the 20% target were deemed too expensive to be funded in the short-term.

The NRW Reduction Programme intends to improve water and energy efficiency, increase water supply reliability and reduce operational costs. The Programme directly addresses challenges outlined in the Water Sector Policy and Implementation Plan 2019 which include high levels of NRW losses, high energy consumption, climate change vulnerability and inadequate water infrastructure.[54] Water efficiency will provide a stable water supply to residents. NWC is the single largest user of electricity in Jamaica, and most of its consumption is for water pumps, motors, and drives. Given that the share of NWC electricity used for water distribution is 90%, this programme will significantly contribute to energy efficiency improvements.[55] Therefore, reductions in water distribution losses can have a sizeable impact on NWC's electricity consumption. This is in line with energy efficiency objectives outlined in Jamaica's National Energy Policy 2009-30 and National Renewable Energy Policy 2009-30. The Programme is also expected to result in cost savings since NWC's electricity consumption comprises approximately 30% of its total operating costs.

The NWC is implementing the NRW Programme in collaboration with Miya Jamaica and the Water Policy Unit, MEGJC. The NRW Programme is being executed by Miya Jamaica, a European middle market private equity firm and the NWC. As part of the NRW programme, the NWC has implemented high accuracy metering systems and billing systems. For example, in March 2021, over 10,000 metering systems were installed in 48 communities in the KSA parish. Infrastructure upgrades and the upskilling of workers facilitated the process. In 2018, 300 staff received specialised NRW training, 3,000 km of pipelines were checked for leaks and 1,300 new valves were installed.

The success of the KSA programme has led to NRW reduction programmes in other jurisdictions. This includes the NRW loss reduction programme in Portmore launched in 2020, costing US$30 million.[56] Similar programmes are being planned in the parishes of St James, Trelawney and St Ann. A business case has been developed with a target of 30% reduction in NRW losses over five years in these locations. Projects are expected to cost between US$30-60 million with contractual agreements expected to be in place by 2022.

Future funding gaps are a key barrier which can be addressed by Public Private Partnerships (PPPs). Total estimated investment costs of the KSA commitment are estimated to be US$45 million, as of May 2021. This is slightly higher than previous estimates of US$37 million and US$42 million in 2015 and 2020, respectively.[57][58] Costs are being met through various sources, such as a loan from the Inter-American Development Bank (IDB) amounting to US$42.5 million. However, given that the NWC cannot borrow without funding guarantees, the organisation has been actively seeking PPPs to meet future maintenance costs. While no PPPs have been established to-date, some of NWC's PPP projects are at the business case preparation and pre-feasibility stages.

Following a one-year extension to 2021, the commitment is on track to meet its target. The NRW loss rate was reduced to 36% in 2019. This amounted to a reduction of NRW losses by a third from its baseline of 2015 (60% NRW losses).[59] It is estimated that since its implementation, the KSA programme is delivering savings of approximately US$8 million annually.[60] Given the NRW loss reduction rate has gone from 49% in 2018 to 36% in 2019, it is expected that the NWC is on track to meet its target of less than 30% NRW by 2021.[61]

The NWC's efforts are focused on addressing leaks, converting non-revenue consumers to paying customers, and installing new meters that accurately measure consumption. Active leak detection measures have helped identify more than 1,000 leaks monthly, six times more leaks than estimated at the start of the

[54] GoJ (2019)
[55] SEI (2018)
[56] JIS (2020c)
[57] SEI (2018)
[58] JIS (2020c)
[59] Gleaner (2020a)
[60] Ibid.
[61] Equivalent of NRW 95,184 m3/day or 789 Lt/Conn/day in 2018 as per OUR stakeholder engagements.

programme.[62] This has required substantial efforts in addressing leaks. In 2018, 4,500 visible and non-visible leaks were identified, and 5,240 leaks were repaired.[63]

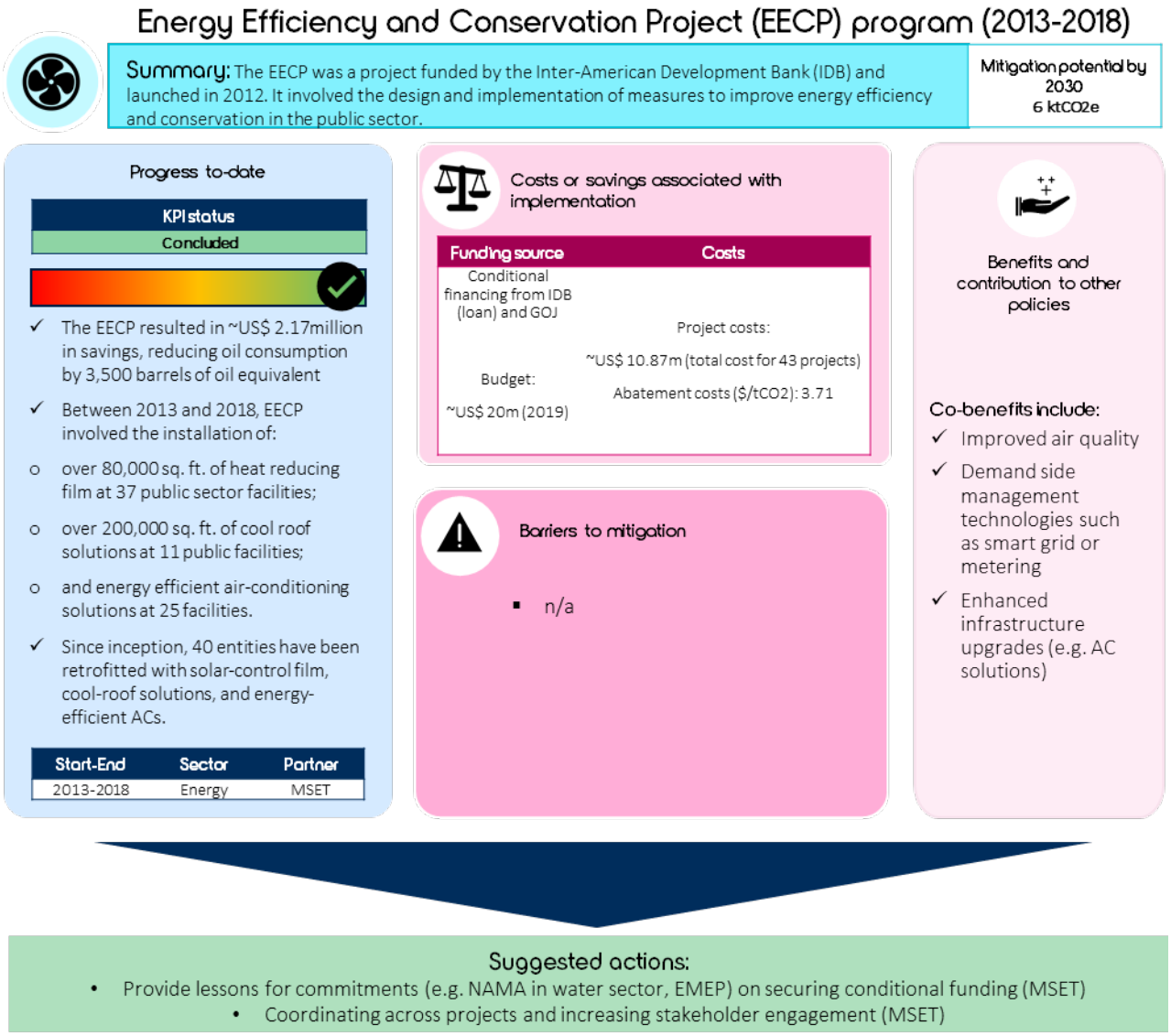
Knowledge sharing and ongoing funding are important next steps to ensure the sustainability of the KSA commitment. At present, most audits of existing systems are conducted by contractors. The NWC is therefore prioritising upskilling staff through knowledge transfers. This will ensure longevity of upgraded systems. Coordination between the NWC, funding bodies and implementation partners, such as Miya Jamaica, has also been essential to meet funding requirements. Securing funding to cover human resources, electrical licences and data gathering is important to maintain current NRW loss rates.

1.14 Energy Efficiency and Conservation Project (EECP) program

The EECP involved the design and implementation of measures to improve energy efficiency and conservation in the public sector. The EECP was a commitment funded by the Inter-American Development Bank (IDB) and launched in 2012. Specific measures include replacing inefficient lighting with more efficient technologies, such as LEDs, 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. By 2030, emissions reductions associated with the commitment are expected to be 6 ktCO2e, or 0.2% of the conditional NDC reduction. A summary of the EECP commitment is presented in Figure 19.

[62] Gleaner (2020a)
[63] Jamaica Observer (2018b)

Figure 19 EECP summary



Note: 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.

Source: Engagements with MSET; SEI (2018); World Bank (2020b); GoJ (2018); The Gleaner (2019d); JIS (2019c) MSET (2018); JIS (2019); Jamaica Observer (2020b); Williams (2019)

The EECP improved energy efficiency in the public sector, reduced emissions and improved air quality. Beyond energy efficiency and reduced emissions, the scheme also encouraged demand side management technologies such as smart grid or metering. These resulted in ongoing energy savings at sites. Enhanced infrastructure upgrades, such as air-conditioning solutions, have also improved air quality in selected sites.

The commitment was led by the MSET and administered in collaboration with other administrative bodies. Since inception, 40 entities from the health, finance, education, and security sectors have benefitted from their facilities being retrofitted with solar-control film, cool-roof solutions, and energy-efficient ACs. Between 2013 and 2018, EECP involved 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.

The EECP was financed in collaboration with international financers. EECP had an initial budget of US$20 million which was financed via a loan from the IDB. Project costs varied based on scale of infrastructure upgrades. The total cost for 43 projects implemented within this commitment was US$10.87 million.

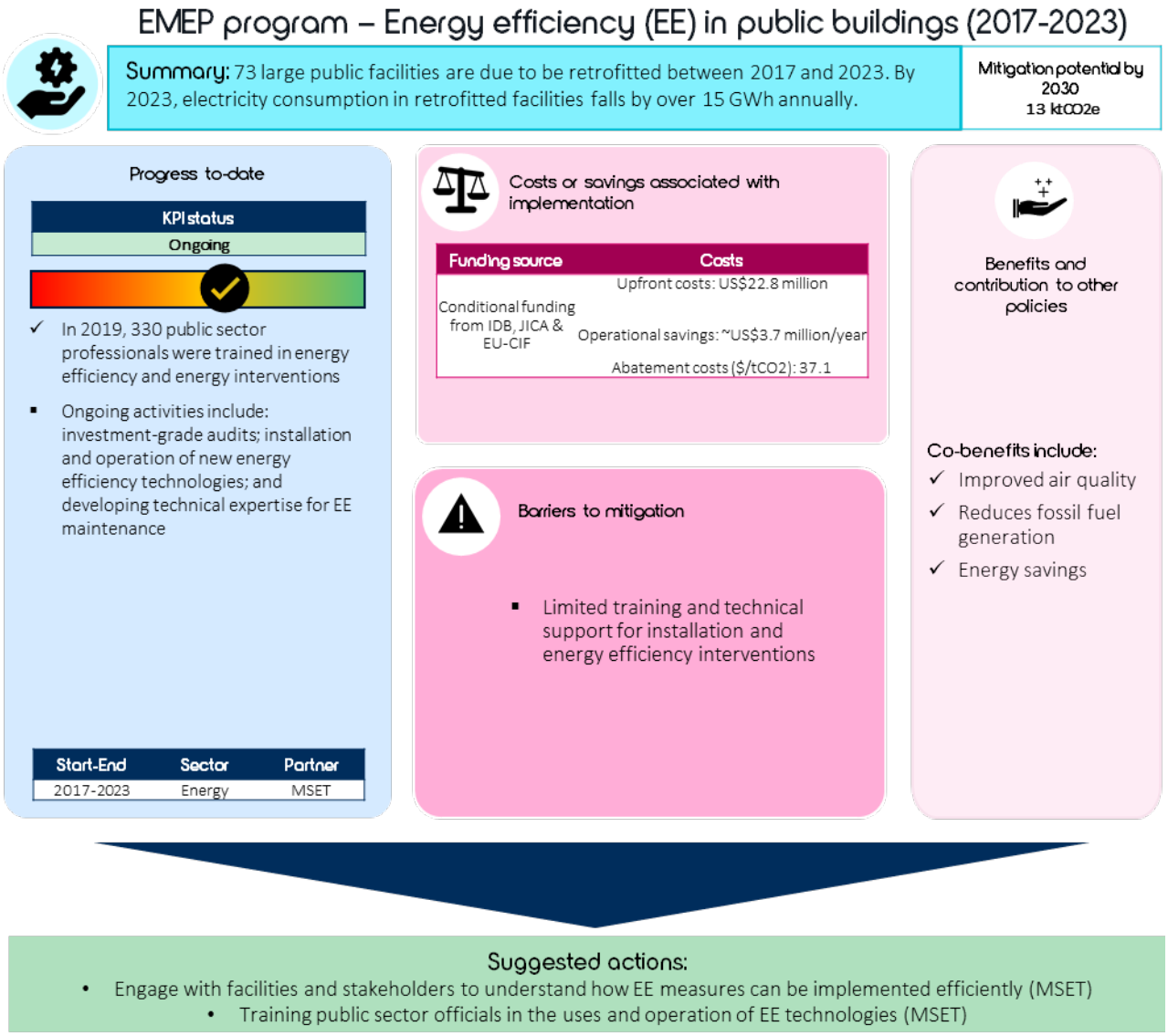
The EECP successfully concluded in 2020, resulting in approximately US$2.17 million in savings, reducing oil consumption by 3,500 barrels of oil equivalent.[64] Most projects were completed by 2018, with a final three projects finished in 2020.

1.15 Energy Management and Efficiency Program (EMEP) – Energy efficiency (EE) in public buildings

The energy efficiency component of the EMEP aims to retrofit 73 large public facilities between 2017 and 2023. The EMEP identifies two key areas for reducing fossil fuel use, energy efficiency (EE) in public buildings and energy conservation in the transport sector. As of 2016, the EMEP contributed to the government's National Energy Conservation and Efficiency Policy 2010-2030 (NECEP) target of 70% reduction in energy intensity and to the 10% reduction of greenhouse gas emissions below the business-as-usual case by 2030 target. The EE component aims to reduce electricity consumption in retrofitted facilities by over 15 GWh annually by 2023. Activities include investment-grade audits; installation and operation of new energy efficiency technologies; and developing technical expertise for EE maintenance. By 2030, emissions reductions associated with the commitment are expected to be 13 ktCO2e, or 0.4% of the conditional NDC reduction. A summary of the EMEP EE is presented in Figure 20.

[64] (MSET, 2018); (MSET, 2019)

Figure 20 EMEP Energy efficiency (EE) in public buildings summary



Note: Upfront costs includes administrative costs, procurement costs, testing, standards documents, and connection and inspection costs.

Source: Engagements with MSET and JPS; IADB (2016); JICA (2018); PCJ (2019)

By reducing electricity consumption, the Energy Efficiency commitment is expected to deliver savings associated with fuel expenditure. In 2015, 7.4% of all electricity generated was consumed by Public Sector Facilities, equivalent to 393 GWh. This cost the Government of Jamaica around US$102 million in electricity bills. If electricity consumption is reduced by 15 GWh, as targeted in the commitment, it would provide a reduction in annual expenditure of around US$3.7 million.

The Petroleum Corporation of Jamaica (PCJ) was originally designated as the Project Executing Agency, with MSET subsequently taking over responsibility. The PCJ has been closed as of March 2020, with the entity subsumed into MSET.[65] This has left the responsibility for implementation with MSET.

[65] Jamaica Observer (2020b)

The EMEP is jointly funded by the Inter-American Development Bank (IDB) and the Japan International Cooperation Agency (JICA). IDB indicated that the EMEP is budgeted at US$30 million, with US$15 million being provided by IDB, and US$15 million being provided by the Japan International Cooperation Agency (JICA). An additional US$10 million is being sought from the EU, either to supplement the above, or to replace, in part, the contributions being made by IDB and JICA. Of this total budget, US$22.8 million is allocated to the EE component.

Progress to date is ongoing, with staff training completed. As of 2019, training in technical support for energy efficiency and energy interventions has been completed for 330 public sector professionals. The remaining activities on this commitment include the facilitation of investment-grade audits, the installation of new energy efficient technologies and devices, and development of the technical expertise required for the maintenance of energy efficient public buildings.

The rollout of EE measures will require training for public sector individuals and engaging with facilities to encourage uptake. Implementing EE measures can present costs to entities, especially around the disruption associated with retrofitting activities. MSET should engage with facilities to understand how EE measures can be implemented efficiently to reduce barriers to implementation. Training public sector officials in the uses and operation of EE technologies could help increase engagement with the measures.

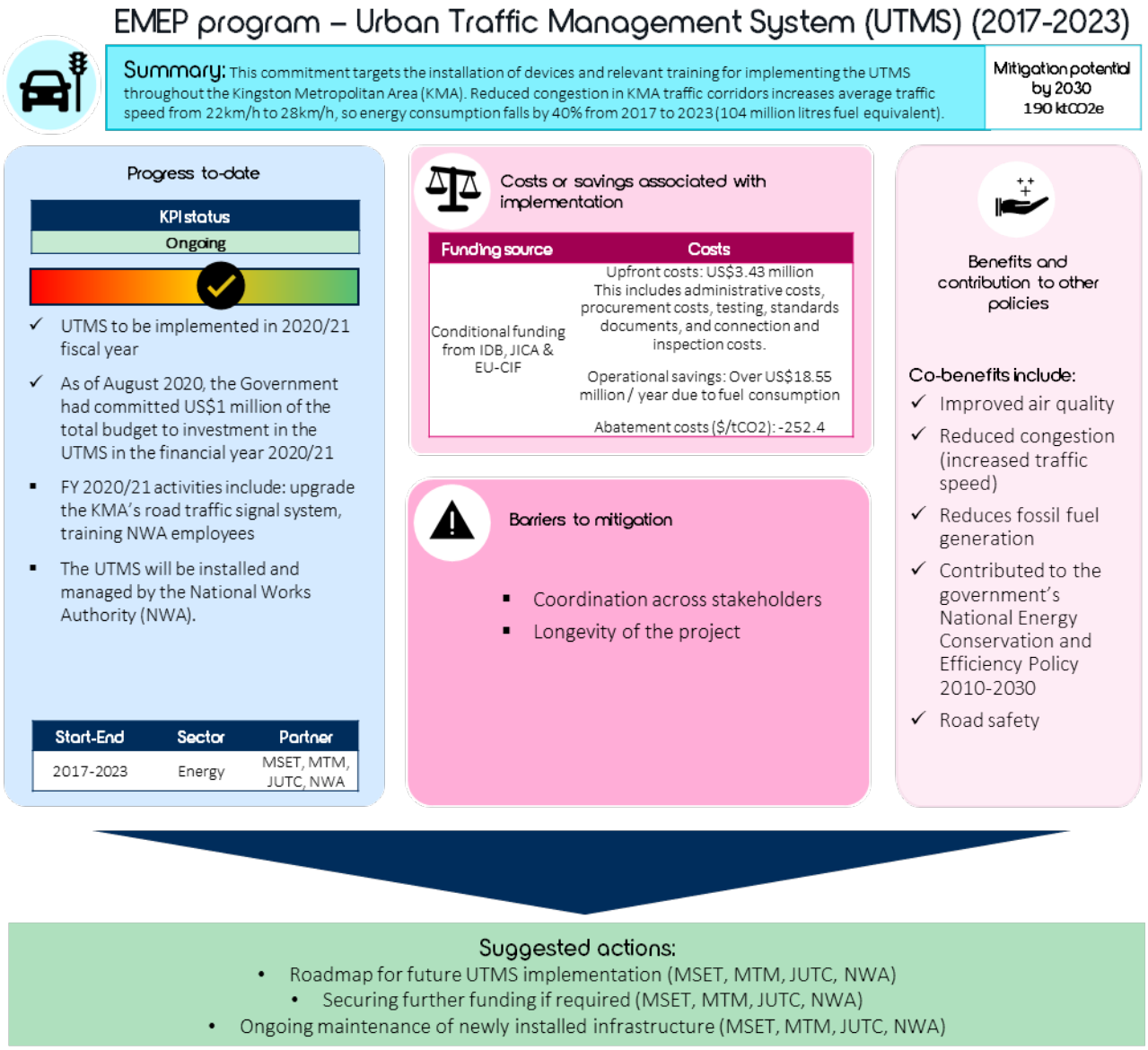
Immediate next steps include the retrofitting of energy efficient technologies and securing ongoing funding for maintenance costs. The upfront funding costs and budgeting needs remain to be finalized. MSET should also engage with stakeholders to determine the location of buildings to be retrofitted and finalize the schedule for installations. To achieve this, it could draw on lessons from the completed EECP program (see section 2.14) which involved a similar decentralized planning approach.

1.16 Energy Management and Efficiency Program (EMEP)– Urban Traffic Management System (UTMS)

The Urban Traffic Management System (UTMS) targets the installation of devices and relevant training for reducing congestion throughout the Kingston Metropolitan Area (KMA). It is one of two initiatives within the wider EMEP which aims to reduce Jamaica's GHG emissions and reduce energy intensity. The commitment focuses on the installation of equipment including optical fibre cables, traffic lights, cameras, sensors, software, and training officials to operate equipment and support the KMA traffic corridor. Reducing congestion in KMA traffic corridors is expected to increase average traffic speed from 22km/h in 2017 to 28km/h by 2030, reducing energy consumption by 40% during the same period (104 million litres fuel equivalent). The commitment will also improve road safety, especially for vulnerable road users such as pedestrians, cyclists and motorcyclists, who account for half of all road traffic deaths in Jamaica.[66] By 2030, emissions reductions associated with the commitment are expected to be 190 ktCO2e, or 6.4% of the conditional NDC reduction. A summary of the EMEP UTMS is presented in Figure 21.

[66] Jamaica Observer (2020d)

Figure 21 EMEP Urban Traffic Management System (UTMS) summary



Note: Upfront costs includes administrative costs, procurement costs, testing, standards documents, and connection and inspection costs.

Source: Engagements with MSET and JUTC; IADB (2016), Jamaica Observer (2020d)

By reducing fuel consumption, the UTMS is expected to deliver savings associated with fuel expenditure. In 2015, Jamaica imported an estimated 6.12 million barrels of oil equivalent for use in the transport sector, costing the Government of Jamaica and private actors around US$300 million. If energy consumption in the KMA traffic corridor, which accounts for 24% of transport demand, is reduced by 40% as targeted, this could provide a reduction in annual imports of up to US$18.55 million.

The UTMS will be installed and managed by the National Works Authority (NWA), while MSET will coordinate stakeholder responsibilities. The NWA are responsible for managing all aspects of the road network of Jamaica, including its safety, reliability, availability, efficiency and growth. To meet these objectives, NWA conducts routine maintenance, develops new roads, and optimizes the road network to reduce congestion.

The UTMS is mainly funded by the Inter-American Development Bank (IDB) and the Japan International Cooperation Agency (JICA). IDB indicated that the EMEP is budgeted at US$30 million, with US$15 million being provided by IDB, and US$15 million being provided by the Japan International Cooperation Agency (JICA). An additional US$10 million is being sought from the EU, either to supplement the above, or to replace, in part, the contributions being made by IDB and JICA. Of this total budget, US$3.43 million is allocated to the UTMS commitment.

As of August 2020, the Government had committed US$1 million of the total budget to investment in the UTMS in the financial year 2020/21.[67] This was specifically allocated to upgrade the KMA's road traffic signal system, and will include a centrally controlled intelligent transportation system, an integration platform for traffic monitoring, operation, planning and modelling, as well as traffic controllers, detectors and other equipment to provide real-time traffic counts and patterns. In addition, training will be provided for NWA employees who will be involved in the operation and maintenance of the system. This funding was provided by MSET's budget.

The rollout and longevity of UTMS measures will require continuous stakeholder coordination and further investments for ongoing operations costs. Securing ongoing funding will be essential for ongoing maintenance of newly installed infrastructure.

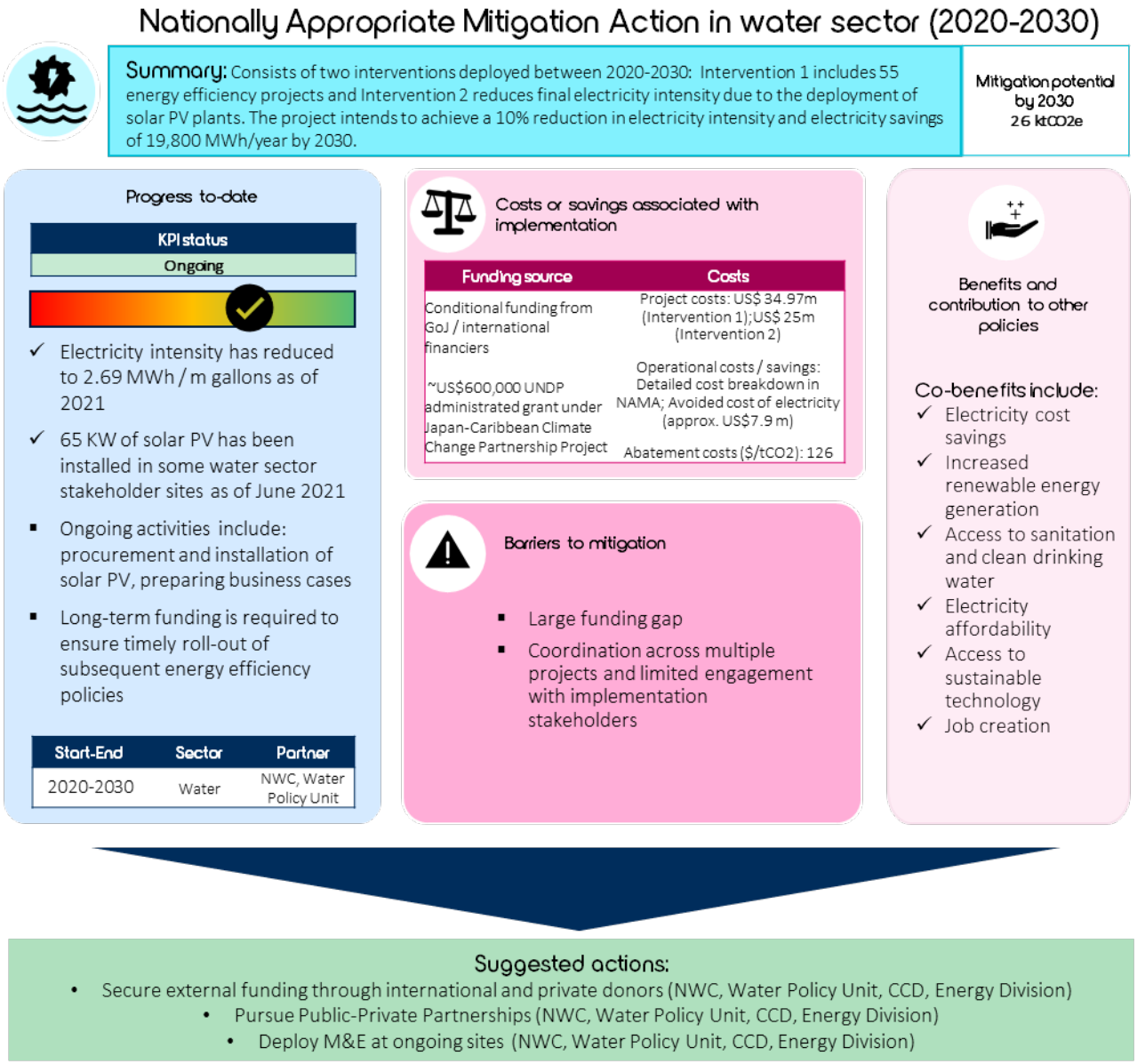
Next steps include facilitating a clear roadmap for UTMS implementation and exploring funding options for anticipated maintenance costs. At present, there is limited communication between stakeholders and uncertainty about the agency in charge of UTMS progress supervision. Transparent identification of stakeholder responsibilities and institutional strengthening of progress monitoring are crucial for the completion of this commitment.

1.17 Nationally Appropriate Mitigation Action (NAMA) in water sector

The water NAMA lays out two interventions to reduce electricity consumption in the water sector. The NAMA has been specifically designed to meet Jamaica's GHG emissions reduction targets in the water and energy sector. The water NAMA covers all sub-sectors of the water sector, which include water supply, sewerage and irrigation. The water sector NAMA was finalised in July 2019, outlining two key interventions.[68] Intervention 1 includes 55 energy efficiency projects expected to lead to electricity savings of 19,800 MWh/year by 2030. Intervention 2 involves the development of 60 solar PV plants, increasing the share of captive-use renewable generation to 10% in the water sector. The NWC is aiming to reduce this to 2.3 MWh million gallons by 2030, which would meet the NAMA's target of a 10% improvement from the 2020 baseline. The 60 solar PV plants will only be used to reduce electricity consumption and excess electricity will not be sold to the grid.[69] By 2030, emissions reductions associated with the commitment are expected to be 26 ktCO2e, or 1% of the conditional NDC reduction.[70] A summary of the NAMA in the water sector is presented in Figure 22.

[67] Jamaica Observer (2020d)
[68] CCD and UNDP (2019) – Water sector NAMA
[69] SEI (2018)
[70] Note that these emissions reductions are additional to those targeted by the NRW commitment in Section 2.13.

Figure 22 NAMA in the water sector summary



Note: Intervention 1 involves the development of 60 solar PV plants. This assumes that the 60 solar PV plants are solely used to reduce the water sectors electricity consumption and excess electricity is not sold to the grid.

Source: Engagements with NWC and Water Policy Unit; SEI (2018); World Bank (2020b); GoJ (2018); JIS (2019); Green Climate Fund (2019)

The commitment aims to increase energy efficiency, reduce emissions and increase renewable energy generation. Intervention 1 is expected to gradually reduce electricity intensity in the sector between 2020-30, reaching electricity savings of 19,800 MWh/year by 2030. Intervention 2 additionally targets a 10% reduction in energy intensity through the deployment of solar PV plants for captive-use generation. Both interventions are expected to contribute to emissions reductions as part of Jamaica's NDC (10% reduction) and contribute to the target of 20% of renewable energy in the total energy mix by 2030 as per the National Energy Policy. Across both projects, the avoided costs of electricity are estimated to be US$7.9 million.

The NAMA in the water sector has additional sustainable development targets, such as increased access to sanitation and clean drinking water, improved access to sustainable technology and job creation. The NAMA in the water sector aims to improve access to sanitation and clean drinking water by 5%, improve energy efficiency of water supply by 10%, increase total capacity of solar PV installed by 15 MW and create 50 permanent jobs through interventions. All these activities support the National Water Sector Policy and Implementation Plan, which aim to improve the energy efficiency of water supply and increase the share of renewable energy technologies.[71]

The NWC is implementing the NAMA in the water sector, in collaboration with the Water Policy Unit, Climate Change Department (CCD) and intervention specific implementation partners. Given the scale of the NAMA commitments, the implementation structure involves multiple stakeholders. The CCD is acting as the NAMA Approver or the national focal point for the commitment. The role of the NAMA Coordinating Authority, or responsible for coordinating the NAMA, is being taken by the Water Policy and Monitoring Branch in cooperation with Energy Division. Each NAMA intervention will be implemented by selected institutions. NAMA Implementation entities will be responsible for handling financial flows from funding entities to the beneficiaries as well as project approval. Finally, NAMA Executing Entities will execute projects under the NAMA and will be contracted for specific projects under Intervention 1 and 2.

The water sector NAMA is largely dependent on conditional financing, or finances from international sources. NAMA financing will come from a mix of national contributions from the GoJ and funding from international sources. For both interventions, a grant component of 30% is considered. Half of this (15%) is expected to be covered by external financiers and the other half (15%) by the Government of Jamaica. For the loan component, a revolving loan fund is being setup, which provides financing at preferential rates. International financing to-date includes a grant of approximately US$600,000 from UNDP under the Japan-Caribbean Climate Change Partnership Project (JCCCP). The total cost of Intervention 1 is US$34.97 million and the cost of Intervention 2 is US$25 million covering installation costs, travel, engineering and construction, project management and implementation expenses.[72]

In 2017, the NWC shortlisted four energy efficiency improvement projects. The company Ameresco shortlisted four projects for pump station efficiency improvements. The projects involve the replacement of pumps, installation of variable frequency drives and smaller changes on switches, sensors and controls. The measures are estimated to achieve total electricity savings of 5,059 MWh, which represents an electricity reduction of 2.4% compared to the baseline.

The rollout of 55 energy efficiency projects is planned in three stages. The initial rollout of the four pilot projects, shortlisted in the Amersco study, will be followed by four additional projects and a third stage, where the remaining 41 projects will be rolled out.

Electricity intensity has reduced to 2.69 MWh / million gallons as of 2021. This is equivalent to 0.0048% of the annual electricity savings target.

Pre-feasibility studies for the roll-out of the solar PV installations have been undertaken and financed through grants. These helped to understand the installed capacity on-site and annual electricity consumption, space available for the installation of solar panels and suggested capacity of solar PV unit. These pre-feasibility studies helped improve the financial viability of each installation by optimising the quantity of electricity consumed on-site and feeding as little electricity as possible back to the grid.

As per the NAMA Policy Draft, 2.6 MW of solar PVs were planned to be installed by 2021. The NWC planned to install 1.3 MW annually as per its NAMA Policy Draft, leading to the total of 13 MW by 2030. Due to delays, as of June 2021 the NWC is at 65 KW installed capacity and an additional 15 KW has been commissioned. It has also indicated that construction plans for an additional 350 KW will start soon.

[71] GoJ (2019)
[72] A detailed breakdown of operations and management costs by project is provided in the NAMA Policy draft.

As of 2021, solar PV has been installed in some water sector stakeholder sites. The NWC is beginning to install renewable energy in additional selected sites, including a 40 kW system at Portmore, a 15 kW system at the Hamilton Gardens Wastewater facility, a 350 kW system at Leader's Avenue Pumping Station, a 1016 kW system at the Constant Spring Filter Plant and a 213 kW system at Frazer's Content. These are to be used off-grid when electricity is required due to system faults. NWC has also tendered a 350 kW project in Forest Hill Relift Station, due to commence in the latter half of 2021. Procurement of future solar PV installations is ongoing in Montego Bay and other areas.[73]

Given the scale of the NAMA interventions, sustainable and long-term funding from donors and private actors is a key challenge. At present, 70% of the total costs required for this commitment are unfunded. Early-stage consultations with donors is essential to secure sufficient and ongoing donor funding. NWC is limited in its ability to borrow and therefore is seeking PPPs for all projects. A viable business case is required by private actors to invest in the NAMA projects. This can be challenging as the priority is often given to expansion of water coverage over replacing existing systems. Business case preparations entail additional costs of up to US$0.5 – 1 million per project. Prioritisation of available funds would have to be made between existing systems and future projects. Moreover, not all NWC projects may be suited to PPPs given the social responsibility underpinning them.

Limited engagement with implementation partners and delays in approvals are other key barriers. In addition to the large funding gap for this commitment, coordination between stakeholders has been made difficult by the scale of NAMA projects and number of implementing stakeholders. Improvements in communication and coordination between the NWC, Water Policy Unit, CCD and the Energy Division are crucial for timely deployment and effective monitoring of progress on this commitment. Moreover, planned upgrades at some stakeholder sites planned for 2021 have not been granted approval.

Continuous stakeholder engagement is required to increase participation in NAMA projects, secure funding and coordinate across multiple implementation partners. Securing ongoing funding is essential to meet associated capital and maintenance costs and address human resources and capacity constraints, which are expected to be the most significant costs in the long run. Moreover, institutional strengthening for the appropriate monitoring and evaluation of actions will be important for ongoing NAMA projects.

[73] Stakeholder engagements with NWC.

2 Financial summary

This section provides a summary of the financial costs and savings associated with the Implementation Plan. Understanding the costs associated with the Implementation Plan can help identify funding gaps and priorities for Jamaica's policymakers. In addition, analysing the savings associated with NDC commitments can help establish additional support and better communicate the co-benefits associated with policy commitments.

To analyse the financial impact of each commitment, the Implementation Plan covers investment needs and abatement cost:

- **Investment needs** refer to the upfront capital costs associated with each commitment, with potential sources for this investment identified as part of the analysis. This analysis has been primarily conducted using a literature review and stakeholder engagement.
- **Abatement cost** is the cost per tonnes of emissions abated (US$/t$CO_2$e) and includes all capital and operational costs & savings associated with the policy commitments compared to the relevant counterfactual. To analyse across each commitment consistently, abatement costs have been calculated using the marginal abatement cost curve analysis of the LEAP model, which was previously used to estimate the emissions savings associated with the NDC.

The analysis draws on data from sources including stakeholder engagement, local policy documents and official data and global initiatives. A preliminary cost analysis was included in developing the original NDC. These figures have been updated to capture the latest available data from both public sources and direct stakeholder engagement as appropriate. Local data has been prioritised to ensure the costings accurately represent cost estimates for Jamaica. Where local data is unavailable, global estimates and assumptions have been used to fill gaps and provide reasonable outputs.

2.1 Investment needs

This section presents a summary of investment needs, the funding source and their current status. A summary of investment needs is presented in Figure 23.

The total upfront investment need for the sixteen commitments is estimated at US$921.1 million, with around 76% of this funding coming from private sources. The largest investment need relates to the implementation of the Integrated Resource Plan (IRP), with the investment cost of the renewable capacity estimated to be US$664.86 million. The financing of this commitment will be provided by private power companies. The next largest investment need is for the targeted reduction in system losses (US$64.7 million), which will be funded publicly by MSET. The remainder of commitments will be met by a combination of private, public and international partner funding. While the total figure is large, it represents only around 0.5% of Jamaica's cumulative GDP during the period from 2021-2030. In addition, much of the economic stimulus provided by these measures can be incorporated as part of Jamaica's recovery from the economic impacts of COVID, providing local jobs and supporting the growth of Jamaica's economy.

Figure 23 Summary of investment needs

Commitment	Upfront costs (USD)	Funding source	Status
Integrated Resource Plan (IRP)	**664.86 million** ~1.37 million *484 MW (IRP estimated cost is $1,500/kW)	Private	Partially Funded
Net billing	**114,474**	Public	Partially Funded
Targeted reduction in system losses	**64.7 million**	Public	Partially Funded
LED street lighting	**15 million** (supply of lamps) (281-374 per LED lamp)	Private	Funded (Budget: 30m)
Switch to T8 lighting in hospitals and schools	**102,851**	Public (decentralized)	Unclear
Introduction of 136 low-carbon public transport buses	**30.05 million** ***(of which additional: 11.5 million)*** 176,000/ bus (estimate from pilot at Portmore) *39,000/bus (additional cost relative to diesel buses)* 6.25 million (LNG infrastructure)	Private	Unclear
Biodiesel (B5) blending	**148.4 million** (annually)	Public	Unclear
Improved use of CHP in alumina refining	**1.96 million** (200MW CHP plant)	Private	Partially Funded
LNG in the Alpart refinery	Unclear	Private	Unclear
National Tree Planting Initiative (NTPI)	**2.16 million** (1 per tree)	Public and Private	Funded
No net loss (NNL) of forest cover	n/a	n/a	Unclear
Reduced water distribution losses (Kingston)	**45 million**	Public and Private	Partially Funded
Energy Efficiency and Conservation Programme (EECP)	**10.87 million** (43 projects)	Public	Funded (Budget: 20m) *Complete*
Energy Management and Efficiency Programme (EMEP) – Energy efficiency	**22.8 million**	Public	Partially Funded
EMEP Urban Transport Management System (UTMS)	**3.43 million**	Public	Partially Funded
Nationally Appropriate Mitigation Action (NAMA) in the Water Sector	**Intervention 1: 34.97m** **Intervention 2: 25m**	Public	Partially Funded

Note: Light blue: Unconditional financing – implemented without external support; Dark blue: Conditional financing – implemented with external support. A commitment is funded if the investment need is fully met, partially funded if at least some investment has been secured and unclear if no funding partner or no total investment need has been identified. All costs are expressed in 2020 USD constant prices.
Source: Vivid Economics

Funding requirements are most notable in the water sector commitments, with additional requirements across some other commitments. Policy in the water sector has typically focused on improving water access rather than energy efficiency improvements and renewable energy deployment, according to 2021 engagements with the National Water Commission. As a result, these commitments are currently unmet, and will require government support or innovative financing options such as private public partnerships (PPPs). Additional funding areas include transport sector activities such as B5 blending and introduction of low-carbon busses, which have had some financing from the private sector but will require additional support to scale up.

2.2 Abatement costs

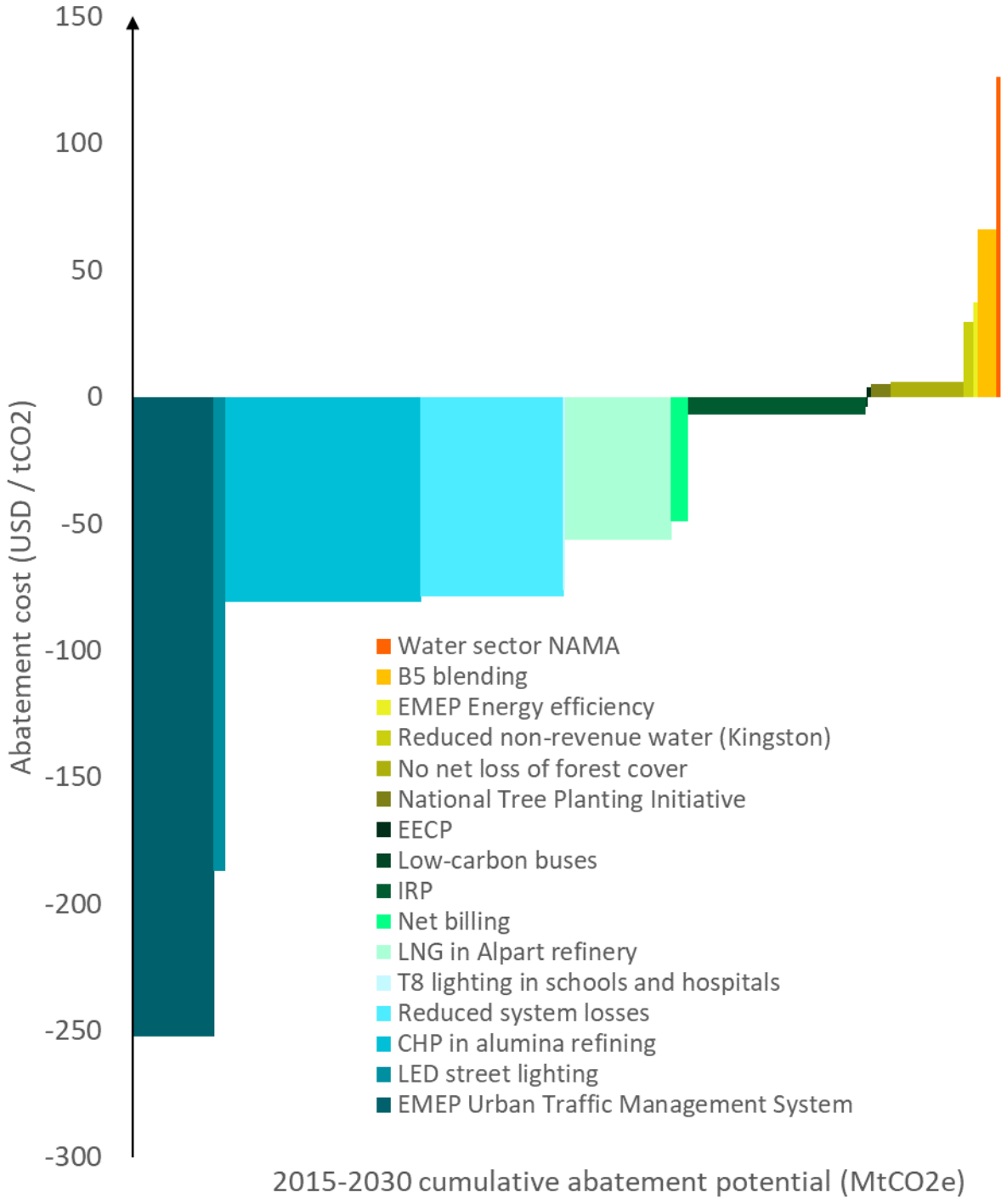
Abatement costs present a measure of total cost relative to emissions mitigated by each commitment. Total costs captured reflect both upfront and operational costs and savings over a period of time compared to the counterfactual. This is compared to the cumulative emissions abated over a period of time to create a measure of cost per unit of emissions reduction ($/t$CO_2$e).

Abatement costs are frequently presented using Marginal Abatement Cost Curves (MACCs). MACCs plot cumulative emissions reductions from successive mitigation options against the incremental cost per unit of emission reduction. Using a MACC, it is easy to compare both total emissions abated and relative cost across mitigation commitments.

MACCs for the Implementation Plan were constructed using the Low Emissions Analysis Platform (LEAP) energy-system model to analyse the costs and abatement of each commitment. The LEAP model was deployed in Jamaica's original and updated NDC submissions to estimate the emissions reduction potential of each commitment. The model captures interactions within the energy sector, making it suited to capturing the costs of policies which involve fuel switching and changes in electricity demand. By estimating economy-wide energy system costs and total emissions simultaneously and comparing this to baseline projections, LEAP calculates the estimated abatement cost of each commitment. The LEAP model can also incorporate the costs of forestry commitments.

The vast majority of abatement potential is available at negative costs, implying significant operational cost savings over time. Of the sixteen commitments analysed, nine have a negative abatement cost, which means the financial savings outweigh the initial upfront costs associated with these policies. In addition, these commitments are typically larger contributors to Jamaica's overall emission reductions during the 2015-2030 period. In total, the weighted average cost of all sixteen policy commitments is negative (-$63/t$CO_2$e), meaning that implementing the full NDC package would provide savings over the period to 2030. This is driven by energy savings, with many of the commitments included in Jamaica's NDC providing energy efficiency improvements or involving shifts to less expensive fuels such as LNG. In the case of these commitments, removing the non-financial barriers to deployment or securing financing should be targeted as a priority, as this provides financial benefits in addition to helping achieve environmental targets.

Figure 24 MACC analysis of all sixteen policy commitments



Source: Vivid Economics

Commitments with a positive abatement cost tend to involve international funding, and will provide other benefits for Jamaica's economy. The Water sector NAMA, EMEP energy efficiency, EECP have positive abatement costs, but have been, or it is expected will be, funded largely by international partners. In addition, these commitments often have other benefits. For example, the water sector NAMA and reductions in non-revenue water in the Kingston Metropolitan Area will support sustainable development goals, such as increasing water access, conserving scarce water resources, and reducing the exposure of Jamaica's economy to drought. Similarly, the forestry sector policies provide resilience and ecosystem

benefits to Jamaica, with tropical mangrove systems in particular offering protection from coastal hazards and providing a benefit to Jamaica's fishing community. The high cost of the B5 blending commitment reflects the relative expense of producing biofuels in Jamaica.

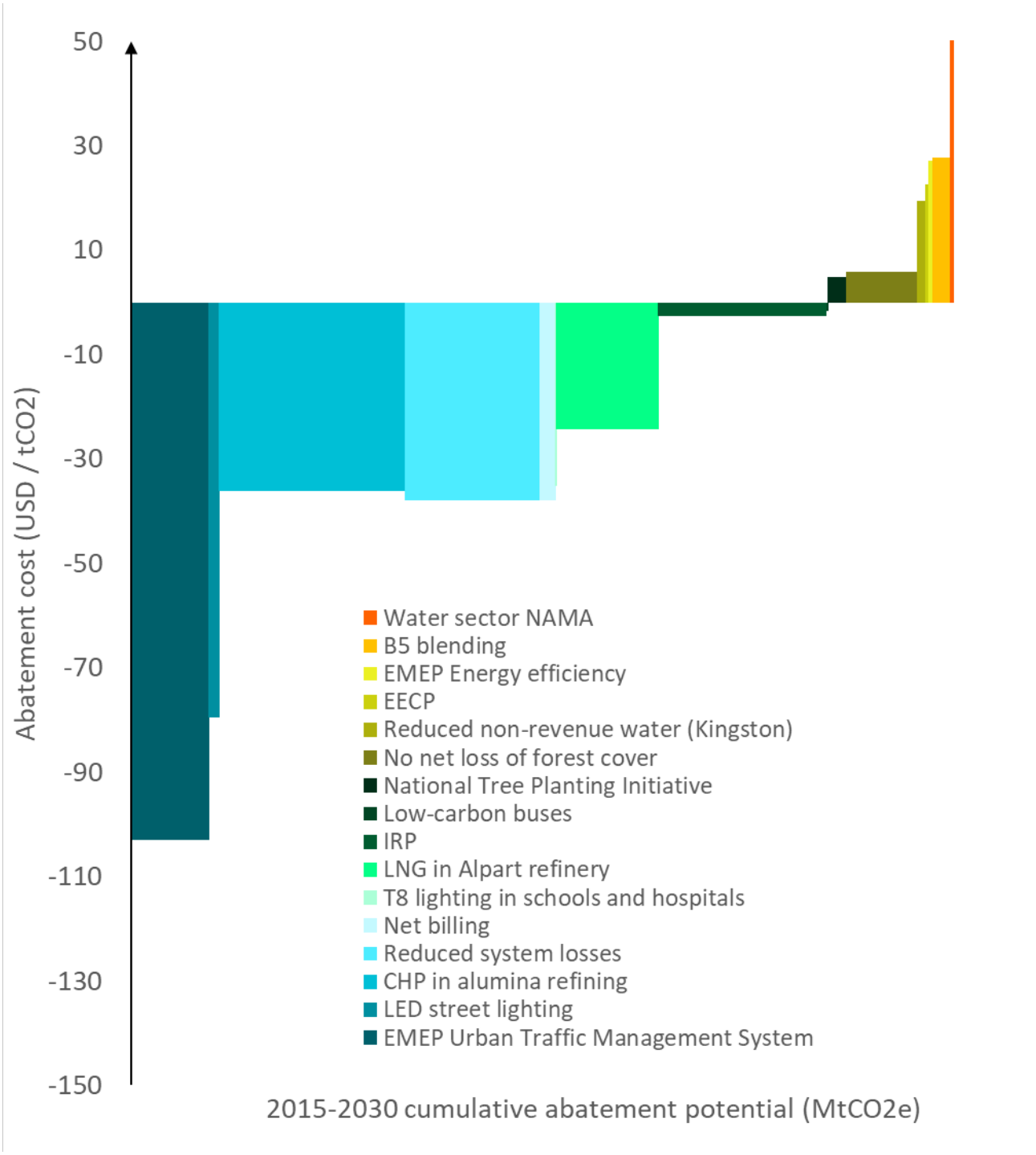
Key assumptions for the modelling work include:

- **Commitments are modelled for the period 2015-2030,** capturing all abatement, costs and savings within this period. The 2015 start year was selected to ensure all activity associated with commitments is captured, while 2030 aligns with the NDC target year. Extending the time horizon would, in most cases, capture ongoing operational costs savings and result in even lower cost estimates.
- **Costs are discounted at a rate of 5% per year**, to reflect interest rates, a weighting towards current costs and the uncertainty of future returns. A higher discount rate would weight future benefits less highly and would put higher weight on immediate costs or returns.

When analysing the results with a higher discount rate (10%), the magnitude of costs falls but ordering and the direction of costs by commitment remains broadly unchanged (Figure 25). A discount rate of 10-12% is in line with the discount rates typically used by the World Bank.[74] Relative to results under a 5% discount rate, the magnitude of costs falls for most commitments, as all costs and savings in future periods are discounted more heavily. As a result, the average abatement cost across all commitments falls from -$63/tCO2 to -$27/tCO2. However, the relative ordering of each commitment is broadly unchanged. One notable change is that the EECP is now ranked as the fourth most costly commitment, with an abatement cost of $23/tCO2, up from $3/tCO2 previously. This is because under a 5% discount rate, the energy savings after implementation offset much of the upfront costs faced during the 2013-2018 period, which is no longer the case when the discount rate is increased.

[74] World Bank (2014)

Figure 25 MACC analysis of all sixteen policy commitments with a higher discount rate (10%)



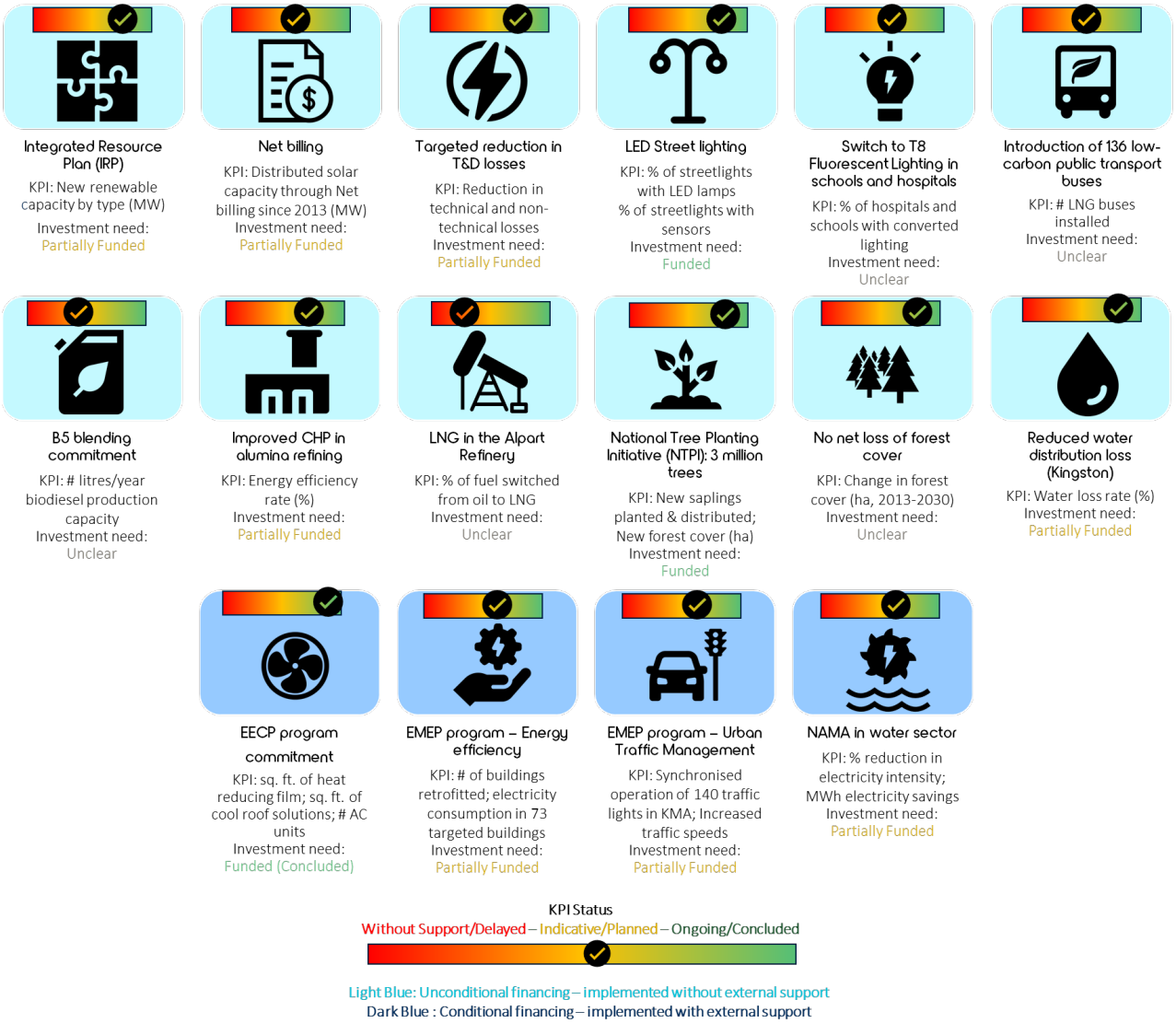
Source: Vivid Economics

3 Summary

3.1 Progress to date

As of 2021, most of the 16 commitments are on track to meet their targets. For the most part, commitments are on track to meet their targets based on their KPI status, seen in Figure 26**Error! Reference source not found.**. Of the 16 commitments, 13 are ongoing, one has concluded, one is indicative and one is without support. Commitments such as EECP (see section 2.14) are complete. However, the B5 blending commitment (see section 2.8) and LNG in the Alpart refinery (see section 2.10) are currently delayed or without support.

Figure 26 KPI status and investment needs of all 16 key commitments



Note: KPI status ranking follows the categorisation adopted in the NDC Partnership Plan Tool. Investment needs are defined as funded, partially funded, unmet or unclear.

Source: Vivid Economics

Key barriers include low stakeholder coordination, monitoring and compliance challenges and COVID-19 associated uncertainties. Coordination across partners has been challenging due to difficulties in assigning relevant implementation leads (e.g. B5 blending), resulting in delays. Liaising with multiple stakeholders has also been challenging for NTPI (see section 2.11) and EMEP (see section 2.15 and 2.16). In other cases, responsibilities have been assigned across stakeholders, but implementation challenges have been encountered, such as ensuring policy compliance (e.g. electricity theft affecting T&D losses, water leaks in NRW reduction) and low knowledge transfer (e.g. risks to the longevity of policies such as NAMA in the water sector). COVID-19 related closures and uncertainties have delayed reopening of Alpart refinery (see section 2.10) and switching to T8 fluorescent lighting in schools and hospitals (see section 2.6). Key barriers and overarching actions for example commitments are detailed in Figure 27 .

Figure 27 Suggested actions to address key barriers identified in the Implementation Plan

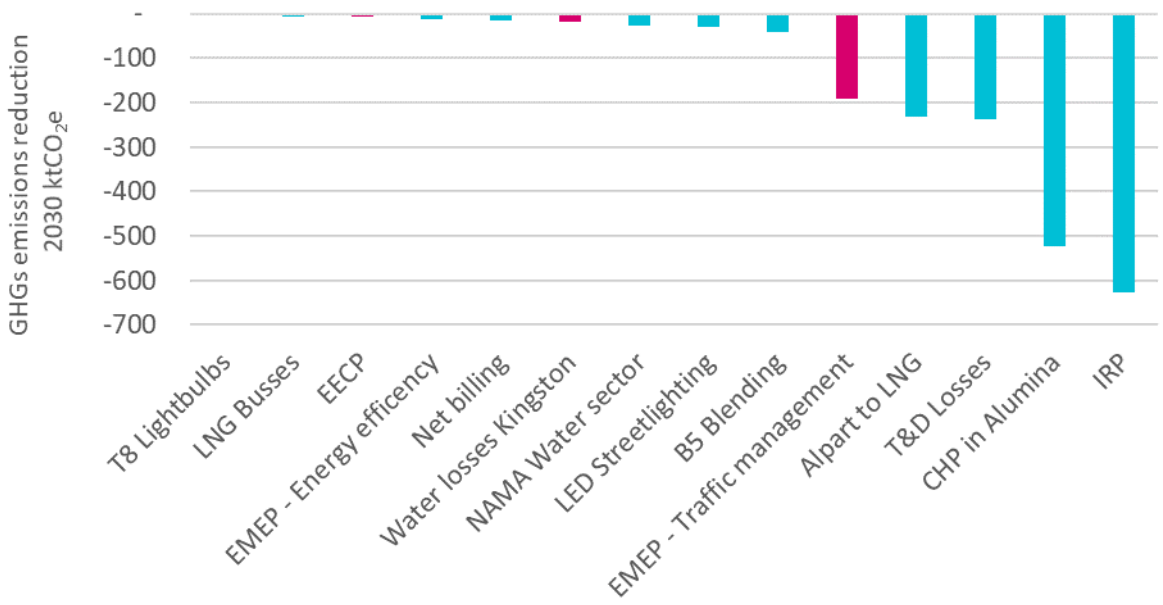
Key barrier	Suggested actions	Example commitments
Unmet funding needs	Pursuing Public-Private Partnerships (PPPs) or private sector investments to secure funding sources.	136 low-carbon buses, Reduced non-revenue water distribution loss (Kingston)
Lack of stakeholder ownership	Coordination across agencies to nominate appropriate commitment leads and clarify respective stakeholder responsibilities.	B5 mandate, Alpart refinery, EMEP, NAMA in water sector, T8 Fluorescent Lighting in schools and hospitals
Ensuring longevity of projects	Upskilling of staff, appropriate personnel training and learning lessons from completed commitments.	CHP in refining, Net billing
Monitoring and compliance challenges	Improving regulatory enforcement and deployment of tracking technology to conduct M&E.	T&D losses, LED streetlights, Net billing, No net loss of forest cover
Timely deployment and uptake	Stakeholder buy-in, active engagement with consumers and private financers.	136 low-carbon buses, B5 mandate, Alpart refinery, NTPI

Note: A full list of barriers and specific suggested actions can be found in individual commitment sections.
Source: Vivid Economics

There are some funding gaps in publicly funded commitments. In terms of investment needs, eleven commitments are fully funded or partially funded and five are unclear. In particular, funding gaps exist in the water sector (e.g. reduction in NRW losses and NAMA in the water sector). The upfront costs highlighted in section 3.1, should however, be contrasted with the longer-term abatement potential, with many commitments having negative costs per tonne of CO_2 abated (see section 3.2).

There is significant abatement potential within the 16 commitments, with the highest Greenhouse Gas (GHG) emissions reductions coming from the IRP, CHP in alumina and reduction in T&D losses in 2030 (Figure 28). The largest reduction in emissions is expected to come from a substantial change in electricity generation technology, outlined in the IRP (see section 2.2). As a result, the largest emission reductions will come from the electricity sector, which accounts for 73% of total abatement in 2030 in the unconditional NDC, followed by the industry and transport sectors.

Figure 28 Energy emission reductions are led by five key commitments



Note: Conditional commitments are highlighted in red. Because the commitments interact with each other, adding the abatement of each commitment individually does not equal to the combined abatement in the overall NDC scenarios.
Source: Vivid Economics

Further GHG emissions reductions can be achieved through the expansion of some commitments. Commitments such as the reduction in NRW losses and improved CHP in alumina refining, present opportunities for expansion. For example, the reduction in NRW losses, originally focused in KSA, is expanding to other jurisdictions such as St Ann parish (see section 2.13). Similarly, with the gas-fired CHP plant owned by New Fortress Energy as a prototype, implementation partners are seeking funding for future CHP plants (see section 2.9).

The IP will also deliver adaptation and sustainable development benefits across commitments. Key climate change mitigation co-benefits can be categorised into four broad groups, with most commitments delivering multiple benefits (e.g., NAMA in the water sector).[75] These benefits include:

- **Climate-related benefits**: enhanced resilience to climate change or enhanced adaptation to climate change (e.g. NTPI and NNL)
- **Economic benefits**: strengthened energy security; increased private investment; improved economic performance; positive employment impacts; technological change (e.g. net billing, reduced T&D losses, improved CHP in alumina, B5 mandate, NAMA in water sector)
- **Environmental benefits**: reduced pressure on finite resources and on wider ecosystems; improved water, air and soil quality; carbon sequestration (e.g. EMEP, EECP, reduction in NRW losses)
- **Social benefits**: reduced air pollution impacts; enhanced energy access; improved water security; better human health; reduced traffic congestion; improved road safety; cost savings for lower income households; improved transport access for female-headed households; deterred violent crimes in public (e.g. LED street lighting, T8 lighting in schools and hospitals)

[75] These categories of benefits are adapted based on Mayrhofer & Gupta (2016)

3.2 Using the Implementation Plan

Immediate next steps include securing funding sources, nominating implementation leads, introducing enforcement and Monitoring & Evaluation (M&E) processes and pursuing stakeholder buy-in. Commitments require a range of funding sources and models, including private sector investments and Public Private Partnerships (PPPs) (e.g. low-carbon buses). Delayed (e.g., B5 mandate, Alpart refinery) and collaborative commitments (e.g., EMEP, NAMA in water sector) require coordination across agencies to nominate appropriate leads. Ongoing commitments necessitates upskilling of staff (e.g., CHP in refining, Net Billing), regulatory enforcement (e.g., T&D, LED) and deployment of tracking technology to conduct M&E (e.g., NNL, Net Billing). External buy-in is required to ensure commitment deployment and uptake. This includes engaging consumers (e.g., low-carbon buses, B5) and the private sector (e.g., Alpart refinery, NTPI). Completed commitments such as EECP can provide lessons for large-scale conditional financed commitments such as the EMEP and NAMA in the water sector.

Private sector funding will be critical to ensure the enactment and longevity of commitments. The private sector has been involved at the implementation (e.g., Miya Jamaica in NRW losses) and funding stages (e.g., New Fortress Energy in the deployment of LNG buses) of numerous commitments. Leveraging similar models will be important to meet the financing costs of commitments and future project timelines. For example, innovative private funding models are likely to be required to meet investment needs in the water sector (see section 2.13 and 2.17).

Indicative and delayed commitments require nominating implementation leads and reassessing timelines. In terms of KPI progress, delayed commitments such as the B5 blending commitment (see section 2.8) and commitments without support such as LNG in the Alpart refinery (see section 2.10), require coordination across agencies such as MSET and Petrojam to ensure activities are resumed as per revised timelines. Similarly, progress will have to be monitored for commitments that have been delayed due to COVID-19 such as the switch to T8 fluorescent lighting in schools and hospitals (see section 2.6).

The IP can be used by stakeholders to recognise synergies across commitments and identify opportunities for collaboration. Some organisations are responsible for implementing multiple commitments. For example, MSET is currently involved in 11 out of the 16 commitments underpinning Jamaica's NDC. Therefore, it is essential it gains a holistic view and considers policy interdependencies whilst implementing commitments simultaneously. The IP will also help agencies such as JBI understand its role in implementing (e.g. LNG in the Alpart refinery, improved CHP in alumina refining) and facilitating policies (e.g. rehabilitating land as part of the NTPI and NNL) across the energy and forestry sectors. Stakeholder collaboration is needed to address barriers identified in the IP, such as JPS and OUR's role in addressing power theft (see section 2.4) and reducing non-technical NRW losses (see section 2.13).

The IP will be most effective if used by stakeholders on an ongoing basis. Inclusive stakeholder engagement can be fostered through a wide range of channels including stakeholder workshops, one-to-one meetings and a steering committee to review the IP periodically. As per the Global Green Growth Institute (GGGI), regular engagement with implementation partners is particularly essential in Small Island Developing States, such as Jamaica, where there may be higher turnover of public officials.[76]

The NDC Partnership Plan Tool complements the IP, enabling stakeholders to monitor progress continually. The NDC Partnership recommends adopting a Measurement, Reporting and Verification (MRV) process for the IP in line with MRV processes stipulated in Jamaica's NDC or other national MRV processes (e.g., national GHG inventories, national communications, NAMAs, etc.).[77][78] Typically, a review of the IP is conducted on an

[76] GGGI (2018)
[77] NDC Partnership (2021)
[78] UNDP (n.a)

annual or biennial (every two year) basis. Additional frameworks can complement IP updates. For instance, the GGGI recommends conducting a comprehensive data assessment and survey to update progress across commitments given smaller scale of potential actions and limited number of stakeholders involved.[79]

[79] GGGI (2018)

4 References

Aluminium International Today (2016) Rusal sells Alpart alumina refinery in Jamaica. 19 July. Accessed at https://aluminiumtoday.com/news/rusal-sells-alpart-alumina-refinery-in-jamaica.

Biofuel Digest (2018) University of Technology, Jamaica teams with US company on biodiesel. 8 October. Accessed at https://www.biofuelsdigest.com/bdigest/2018/10/08/university-of-technology-jamaica-teams-with-us-company-on-biodiesel/.

Bnamericas (2020) Smart LED Streetlights Now Cover Two-thirds of Jamaica. 24 July. Accessed at https://www.bnamericas.com/en/news/smart-led-streetlights-now-cover-two-thirds-of-jamaica.

Bnamericas (2021) JPS Hits Streetlight Success – Over 80% f Island's Streetlights Now Smart LEDs. Accessed at https://www.bnamericas.com/en/news/jps-hits-streetlight-success--over-80-of-islands-streetlights-now-smart-leds.

Climate Central (2019) Climate Change is Threatening Air Quality across the Country. 30 July. Accessed at https://www.climatecentral.org/news/climate-change-is-threatening-air-quality-across-the-country-2019.

Doris, E., Stout, S. and Peterson, K. (2015) Jamaica National Net-Billing Pilot Program Evaluation. Accessed at https://www.nrel.gov/docs/fy16osti/65544.pdf.

EIA (2021) Diesel fuel explained. US Energy Information Administration, Independent Statistics & Analysis. Accessed at https://www.eia.gov/energyexplained/diesel-fuel/prices-and-outlook.php.

Forestry Department (2017) Jamaica National Forest Management and Conservation Plan. Accessed at https://megjc.gov.jm/docs/policies/nfmcp_draft_jan_2017.pdf.

FTA (2018) Zero-Emission Bus Evaluation Results: King Country Metro Battery Electric Buses. FTA Report No. 0118. Accessed at https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/research-innovation/115086/zero-emission-bus-evaluation-results-king-county-metro-battery-electric-buses-fta-report-no-0118.pdf.

GGGI (2018) NDC Implementation Roadmap Development: Guidelines for Small Island Developing States. GGGI Technical Guideline No. 5. Accessed at https://gggi.org/report/ndc-implementation-roadmap-development-guidelines-for-small-island-developing-states/.

Gleaner (2017) ALPART to use LNG not coal. 2 November. Accessed at https://jamaica-gleaner.com/article/news/20171102/alpart-use-lng-not-coal.

Gleaner (2019a) Delay in net billing approvals burning solar dealers. 25 September. Accessed at https://jamaica-gleaner.com/article/lead-stories/20190925/delay-net-billing-approvals-burning-solar-dealers.

Gleaner (2019b) JPS promises bright Christmas - Company commissions 25MW energy storage system. 12 December. Accessed at https://jamaica-gleaner.com/article/news/20191212/jps-promises-bright-christmas-company-commissions-25mw-energy-storage-system.

Gleaner (2019c) Reduction in non-revenue water losses in Kingston, St Andrew. 7 September. Accessed at https://jamaica-gleaner.com/article/news/20190907/reduction-non-revenue-water-losses-kingston-st-andrew.

Gleaner (2019d) PCJ completes energy efficiency projects at Ministry of Education. 31 July. Accessed at https://jamaica-gleaner.com/article/news/20190731/pcj-completes-energy-efficiency-projects-ministry-education.

Gleaner (2020a) Massive savings for NWC as utility plugs leak. 3 June. Accessed at https://jamaica-gleaner.com/article/lead-stories/20200603/massive-savings-nwc-utility-plugs-leaks.

Gleaner (2020b) Noble floats 2021 as date for Jamalco listing. 16 September. Accessed at https://jamaica-gleaner.com/article/business/20200916/noble-floats-2021-date-jamalco-listing.

Gleaner (2020c) $26-Billion Power Grab - Electricity thieves plunder JPS. 8 December. Accessed at https://jamaica-gleaner.com/article/lead-stories/20201208/26-billion-power-grab-electricity-thieves-plunder-jps.

Gleaner (2020d) JPS's smart LED streetlights leading to new St Catherine community stolen. 1 December. Accessed at https://jamaica-gleaner.com/article/news/20201201/jps-smart-led-streetlights-leading-new-st-catherine-community-stolen.

Gleaner (2020e) JUTC says LNG pilot positive – Next up: testing electric vehicle buses. 29 November. Accessed at https://jamaica-gleaner.com/article/business/20201129/jutc-says-lng-pilot-positive-next-testing-electric-vehicle-buses.

Gleaner (2021) Electricity thieves in Corporate Area siphon US$61m from JPS. Accessed at https://jamaica-gleaner.com/article/lead-stories/20210222/electricity-thieves-corporate-area-siphon-us61m-jps.

GoJ, (2018). Third National Communication of Jamaica to the United Nations Framework Convention on Climate Change, Ministry of Economic Growth and Job Creation, Climate Change Division.

GoJ (2019) National Water Sector Policy and Implementation Plan, Ministry of Economic Growth and Job Creation.

Green Climate Fund (2020) Jamaica Country Programme. Prepared under the guidance of Jamaica's National Designated Authority and The Climate Change Division, Ministry of Economic Growth and Job Creation.

IADB (2016) Environmental Analysis for Jamaica Energy Management and Efficiency Program (Project Number JA-L1056). Accessed at https://ewsdata.rightsindevelopment.org/files/documents/56/IADB-JA-L1056_lSEY5Dd.pdf.

International District Energy Association (2020) New Fortress Energy starts LNG operations at Jamalco power plant. 3 November. Accessed at https://www.districtenergy.org/blogs/district-energy/2020/03/11/new-fortress-energy-starts-lng-operations-at-jamal.

Jamaica Observer (2018a) Alpart expands: Mined bauxite lands to be returned to communities. 1 January. Accessed at https://www.jamaicaobserver.com/observer-central-front-page/alpart-expands-mined-bauxite-lands-to-be-returned-to-communities_121280?profile=1373.

Jamaica Observer (2018b) NWC reports significant progress in water loss reduction. 22 December. Accessed at https://www.jamaicaobserver.com/news/nwc-reports-significant-progress-in-water-loss-reduction_152561.

Jamaica Observer (2019a) Opposition questions push for LNG, CNG in JUTC buses. 21 November. Accessed at https://www.jamaicaobserver.com/news/opposition-questions-push-for-lng-cng-in-jutc-buses_180169.

Jamaica Observer (2019b) NWC, Miya partner to reduce water loss in Kingston and St Andrew. 21 September. Accessed at https://www.jamaicaobserver.com/latestnews/_nwc,_miya_partner_to_reduce_water_loss_in_kingston.

Jamaica Observer (2020a) JPS to convert 25,000 street lights to LEDs in 2050. 1 January. Accessed at https://www.jamaicaobserver.com/news/jps-to-convert-25-000-street-lights-to-leds-in-2020_183411.

Jamaica Observer (2020b) PCJ to be wound up by March 31. 30 January. Accessed at https://www.jamaicaobserver.com/news/pcj-to-be-wound-up-by-march-31_185908?profile=1606.

Jamaica Observer (2020c) Coronavirus halts plans at JISCO/Alpart plant. 14 February. Accessed at https://www.jamaicaobserver.com/news/coronavirus-halts-plans-at-jisco-alpart-plant_187159.

Jamaica Observer (2020d) Focus on traffic management systems. 7 August. Accessed at https://www.jamaicaobserver.com/auto/focus-on-traffic-management-systems_200303?profile=1052.

Jamaica Observer (2021a) JPS rejects St Ann councillors' claim of poor service. 14 April. Accessed at https://www.jamaicaobserver.com/latestnews/JPS_rejects_St_Ann_councillors_claim_of_poor_service.

Jamaica Observer (2021b) FosRich puts in bid for final phase of National Street Lighting Replacement Project. 3 March. Accessed at https://www.jamaicaobserver.com/business-observer/fosrich-puts-in-bid-for-final-phase-of-national-street-lighting-replacement-project-announcement-of-successful-bidder-to-be-made-this-month_216099?profile=1442.

JCDT (2021) Jamaica Conservation and Development Trust. About. Accessed at https://www.jcdt.org.jm/about/overview.

JICA (2018) Japanese ODA Loan: Ex-Ante Evaluation. Accessed at https://www.jica.go.jp/english/our_work/evaluation/oda_loan/economic_cooperation/c8h0vm000001rdjt-att/jamaica_171123_01.pdf.

JIS (2011) PCJ Launches Lighting Efficiency Project. 17 February. Accessed at https://jis.gov.jm/pcj-launches-lighting-efficiency-project-2/.

JIS (2019a) Decision to Subsume PCJ Into Energy Ministry Will Improve Efficiency and Oversight. 18 September. Accessed at https://jis.gov.jm/decision-to-subsume-pcj-into-energy-ministry-will-improve-efficiency-and-oversight/.

JIS (2019b) Three Million Trees in Three Years. 4 November. Accessed at https://jis.gov.jm/features/three-million-trees-in-three-years/.

JIS (2019c) Energy Efficiency & Conservation Programme (EECP). 2 April. Accessed at https://jis.gov.jm/radio_programs/energy-efficiency-conservation-programme-eecp/.

JIS (2019d) Jamaica's Climate Resilience Strengthened Under $78-Million Project. 5 September. Accessed at https://jis.gov.jm/jamaicas-climate-resilience-strengthened-under-78-million-project/.

JIS (2020a) Stage One Upgrading of JISCO/Alpart to be Completed by 2020. 19 July. Accessed at https://jis.gov.jm/stage-one-upgrading-of-jisco-alpart-to-be-completed-by-2020/.

JIS (2020b) Food For The Poor Supports Three Million Trees Planting Initiative. 26 November. Accessed at https://jis.gov.jm/food-for-the-poor-supports-three-million-trees-planting-initiative/.

JIS (2020c) Gov't to Spend US$13 Million To Tackle Non-Revenue Water Loss in Portmore. 21 December. Accessed at https://jis.gov.jm/govt-to-spend-us13-million-to-tackle-non-revenue-water-loss-in-portmore/.

JIS (2020d) JPS LED Street Light Programme To Be Completed Next Year. 11 March. Accessed at https://jis.gov.jm/jps-led-street-light-programme-to-be-completed-next-year/.

Mayrhofer, J. and Gupta, J. (2016) The science and politics of co-benefits in climate policy. *Environmental Science and Policy*, 57(1) 22-30.

MSET (2018) Energy Efficiency & Conservation: Standards Guide for the Public Sector. First Edition.

MSET (2019) Jamaica Energy Statistics 2019. Accessed at https://www.mset.gov.jm/wp-content/uploads/2020/06/Jamaica-Energy-Statistics-2019.pdf.

MSET (2020) Jamaica Integrated Resource Report. Accessed at https://www.mset.gov.jm/documents/jamaica-integrated-resource-report/.

NDC Partnership (2021) Developing the NDC implementation plan. Accessed at https://ndc-guide.cdkn.org/book/planning-for-ndc-implementation-a-quick-start-guide/developing-the-ndc-implementation-plan/.

New Energy (2019) Jamaica's net billing program sees continued growth. 3 October. Accessed at https://newenergyevents.com/jamaicas-net-billing-program-sees-continued-growth/.

New Energy (2020) Jamaica fires up first CHP plant, fuelled by LNG. 13 March. Accessed at https://newenergyevents.com/jamaica-fires-up-first-chp-plant-fuelled-by-lng/.

NREL (2019) Jamaica Transportation Greenhouse Gas Reduction Plan. National Renewable Energy Laboratory Technical Report TP-5400-73380. Accessed at https://www.nrel.gov/docs/fy19osti/73380.pdf.

OAS (2011) Assistance for Biofuels Development and Policy Support in Jamaica. Final Report. 24 May. Accessed at http://www.oas.org/en/sedi/dsd/GeneralDocs/Publications/Jamaica_Biofuels_Report_Final.pdf.

OUR (2020) Jamaica Public Service Company Limited Rate Review 2019-2024 Determination Notice. 24 December. Accessed at https://our.org.jm/document/jamaica-public-service-company-limited-rate-review-2019-2024-determination-notice/.

Painter, K. (1996) The influence of street lighting improvements on crime, fear and pedestrian street use, after dark. *Landscape and Urban Planning,* 35(2-3) 193-201.

PCJ (2019) PCJ to Train 330 Public Sector Professionals in Energy Efficiency Under EMEP. 14 March. Accessed at http://go-jamaica.com/pressrelease/item.php?id=7754.

Power Engineering (2017) $265m gas-fired CHP for Jamaica. 4 August. Accessed at https://www.powerengineeringint.com/gas-oil-fired/265m-gas-fired-chp-for-jamaica/.

Renewable Energy World (2017) The Global Transition to Renewable Energy — Can the Caribbean Lead the Way? Part 1: The Potential. 20 June. Accessed at https://www.renewableenergyworld.com/baseload/the-global-transition-to-renewable-energy-can-the-caribbean-lead-the-way-part-1-the-potential/.

SEC (2020) Form 18-K Jamaica Government Of: Annual report for foreign governments and political subdivisions. Accessed at https://sec.report/Document/0001193125-20-305278/.

SEI (2018) Climate Change Mitigation Consultancy. Final Report. Accessed at https://cdn.sei.org/wp-content/uploads/2018/03/jamaica-mitigation-consultancy-final-report.pdf.

Smart Energy (2020) Jamaica Public Service reports benefits from smart grid technology. 29 January. Accessed at https://www.smart-energy.com/industry-sectors/smart-grid/jamaica-public-service-reports-benefits-from-smart-grid-technology/.

UNDP (n.a.) NDC Implementation Readiness Checklist (draft). Accessed at https://www.uncclearn.org/wp-content/uploads/library/ndc_implementation_handout.pdf.

UNDP, UNEP, UNEP DTU & WRI (2020) Implementing Nationally Determined Contributions (NDCs). UNEP DTU Partnership Copenhagen, Denmark.

USAID (2019) Jamaica: A Private Utility's Journey with Loss Reduction in its Urban, Low-income Communities. 13 November. Accessed at https://www.usaid.gov/energy/smartutilities/sruc-portfolio/jamaica-main.

Williams (2019) Science, Energy and Technology at Your Service. Sectoral Presentation 2019-2020. Accessed at https://jis.gov.jm/media/2019/05/MSET-Sectoral-Presentation-2019.pdf.

World Bank (2014). Making Informed Investment Decisions in an Uncertain World: A Short Demonstration. Policy Research Working Paper 6765.

World Bank (2020a) Electric power transmission and distribution losses (% of output). Accessed at https://data.worldbank.org/indicator/EG.ELC.LOSS.ZS.

World Bank (2020b) Assessment of Jamaica's Climate Change Mitigation Potential and Implications for its Updated NDC – Sectoral Modelling and Analysis. Accessed at https://openknowledge.worldbank.org/bitstream/handle/10986/35228/Assessment-of-Jamaica-s-Climate-Change-Mitigation-Potential-and-Implications-for-its-Updated-NDC-Sectoral-Modelling-and-Analysis.pdf?sequence=1&isAllowed=y.

World Bank (2021) Gender Statistics DataBank Metadata Glossary. Accessed at https://databank.worldbank.org/metadataglossary/gender-statistics/series/SP.HOU.FEMA.ZS#:~:text=In%20the%20developed%20countries%20most,FHH%20social%20and%20economic%20levels.

Appendix – consultation

Stakeholder consultation is a critical step in developing the Implementation Plan. It is a two-way communication process that allows:

- Information to be disseminated to stakeholders, including project details, potential impacts, and proposed implementation measures
- Information to be collected from stakeholders, including baseline data, and opinions, perspectives, concerns, and expectations that could lead to identification of potential interventions.

Consultation also builds relationships with key stakeholders to allow continued communication during commitment implementation. The IP team focused engagement activities during the initial stage of review to relevant government agencies, public and private companies involved in the commitments, and international NDCP climate advisors. Engagement activities included: remote interviews and written correspondence. A summary of stakeholder engagement conducted is shown in Table 2.

Table 2 List of stakeholder engagements conducted

Stakeholder	Engagement type	Commitments discussed
Forestry Department	Remote interview	No net loss of forest cover; National Tree Planting Initiative (NTPI)
Ministry of Science, Energy and Technology (MSET)	Remote interview	Net Billing; Targeted reduction in T&D losses; Integrated Resource Plan (IRP); EECP program (engagements); B5 blending commitment (written response)
National Water Commission (NWC), Water Policy Unit	Remote interview	NAMA in water sector; Reduced water distribution loss (Kingston)
Petrojam	Remote interview	B5 blending commitment
Jamaica Bauxite Institute (JBI); Ministry of Transport & Mining (MTM)	Remote interview	LNG in the Alpart Refinery, Improved CHP in alumina refining
Office of Utilities Regulation (OUR)	Remote interview	Targeted reduction in T&D losses; Reduced water distribution loss (Kingston)
Jamaica Public Service Company (JPS)	Remote interview	Net Billing; Targeted reduction in T&D losses; LED Street lighting
Investment Unit & Economic Advisor	Remote interview	n/a: policy framework and NDC alignment with broader policy action
Ministry of Health (MoH)	Remote interview	Switch to T8 Fluorescent Lighting in schools and hospitals
Jamaica Urban Transit Company (JUTC)	Remote interview	EMEP program Introduction of low-carbon public transport buses by 2025

Stakeholder	Engagement type	Commitments discussed
National Works Agency (NWA)	Remote interview	EMEP program

Note: Stakeholder engagements were conducted virtually between May and July 2021 due to constraints resulting from the pandemic.
Source: Vivid Economics

Company profile

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