

Inter-American Development Bank (IDB)

Strategic Framework for Electric Mobility.

Technical Cooperation Number JA-T1172
– Sustainable Transport and Renewable
Energy-Powered Electric mobility

April 2020

Draft document subject to changes

This document has not been submitted to our standard revision procedures, due to this fact, we reserve the right to realize changes and modifications.

April, 2020

To: Inter-American Development Bank Headquarters
1300 New York Avenue, N.W.
Washington, D.C. 20577, USA

Dear Sir or Madam,

In reference to the project named of the "Development of a Strategic Framework for Electric Mobility in Jamaica and related activities", we present the first draft, subjected to changes, regarding the Strategic Framework for Electric Mobility, developed by Deloitte as a result of the contracted services by the Inter-American Development Bank, for your consideration and review.

The document includes an integrated diagnostic assessment of the current situation in Jamaica, as well as, a shared vision and collection of stakeholder perspectives on electric mobility. Within this document, specific and measureable objectives, with established targets have been detailed, based on the development of a scenario modelling assessment.

In addition, to support the path to achieve the electric mobility objectives, the document includes: (i) the development of a fiscal and tax strategy, mechanisms and considerations for electric mobility adoption in Jamaica, (ii) functional standards, efficiency and regulation considerations for electric mobility, (iii) energy sector guidelines for electric mobility accommodation, (iv) transport sector guidelines towards mobility transition, (v) guidelines for the development of an electric mobility ecosystem and (vi) mechanisms for the evaluation and monitoring of the strategy implementation.

Specific measures and suggested action lines are described throughout Sections 2 to 6 of this document.

The information included within the document relies on public available information, as well as, information provided by relevant stakeholders.

The present document represents a draft version of the Strategic Framework and will be further updated to incorporate the feedback and considerations from the Inter-American Development Bank and other relevant stakeholders. In addition, the content of the document could be modified amongst the availability of updated information.

For further questions related with the document, please do not hesitate to contact us.

Yours sincerely

Deloitte Advisory, S.L.

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Executive summary

Climate change, together with air quality, are emerging as major global concerns with serious social and environmental impacts on the World's population. Mitigating actions are being developed internationally with respect to policy development focused on decarbonisation targets and global emissions objectives.

Jamaica, as highlighted in its Nationally Determined Contribution to the United Nations Framework Convention on Climate Change, has set a **target to reduce emissions between 7.8% and 10% below a business as usual scenario mainly from the energy sector by 2030**.

In order to achieve a reduction of greenhouse gas emissions, Governments worldwide have set special focus on the development of electric mobility deployment strategies in order to reinforce the transition to the decarbonisation of the economy, while reducing emissions from the major contributing sectors. Additional benefits have been achieved from the deployment of electric mobility, such as, reducing fossil fuel dependency from the transportation sector and the energy sector. When combined with a decarbonized energy generation transition plan the results should be significant.

Therefore, electric mobility development represents an opportunity for Jamaica that can contribute to:

- **The reduction on fossil fuel dependence levels, especially from the transportation sector whilst shifting mobility preferences towards a zero direct emission transportation model.**

  Electric mobility adoption will result in a reduction of the current dependency on fossil fuel in Jamaica as the transportation sector represents the most dependent sector in terms of petroleum consumption. **Road and rail transportation in Jamaica represented approximately 31% of petroleum consumption in 2017.**

- **Increased reduction on fossil fuel dependence levels will be achieved when combined with an energy mix strategy moving towards an increasing use of renewable and low emission energy generation technologies**.

  Ambitious targets to increase the share of renewable energy by 2030 have been set by the Jamaican Government in order to exploit the existing renewable energy potential in Jamaica. In addition, **Natural Gas is also being deployed within the energy industry**, to replace high sulphur fuelled power plants.

  Electric mobility presents an opportunity to increase renewable energy resources and mitigate variability of supply via electric mobility distributed storage capacity.

- The combination of **electric mobility and digitalization of the network grid** not only provides the opportunity to increase renewable energy resources, but also **balance power network load and network congestion**. Addressing coordinated charging, electricity demand management and power production will support the increase of renewable energy, as well as, **contribute to increase security of supply of the network grid**.

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Currently, **Jamaica Public Service is investing in grid improvement projects across the network that will be beneficial to electric mobility deployment, such as voltage standardization initiatives in the transmission and distribution systems.**

- **Promoting electric mobility in highly-used transportation modes, combined with deployment in high density areas, can have an impact on traffic congestion, as well as, on reducing localized emissions and air quality improvement.**

  In addition to Greenhouse gases (GHG) emissions, the current land transport model results in a concentration of pollutants, such as particulates, in the major urban areas.

- **Lower 'localized emissions' and better air quality should have a significant impact, improving health and environmental conditions in Jamaica.**

- **The deployment of an electric mobility ecosystem, will result in new businesses and activities that will contribute to economic growth and job creation.**

- **Users' empowerment with respect to increasing options for interacting with the electricity system,** provides an opportunity for the user to better understand their bill and identify possible cost reduction solutions, as well as, an increased potential for **self-consumption integration**.

Nevertheless, in order to achieve the benefits arising from the adoption of electric mobility in Jamaica, the development of specific measures to address the key driving forces of mobility change is required. **From the analysis conducted, the areas of action to be addressed are based on the importance and sensitivity of the population with respect to the acquisition costs of the electric vehicle, as well as the development of the required charging infrastructure and electric mobility ecosystem**.

In order to maximize the benefits of electric mobility, Jamaica must ensure an enabling environment of incentives, policies, regulatory framework and business models without jeopardizing fiscal stability, while addressing the development of the key driving factors to increase electric mobility adoption.

The analysis conducted was based on four scenarios which took into consideration two key factors, namely: (i) total cost of ownership and, (ii) infrastructure and ecosystem deployment. The electric mobility penetration targets developed as a result of the aforementioned analysis are:

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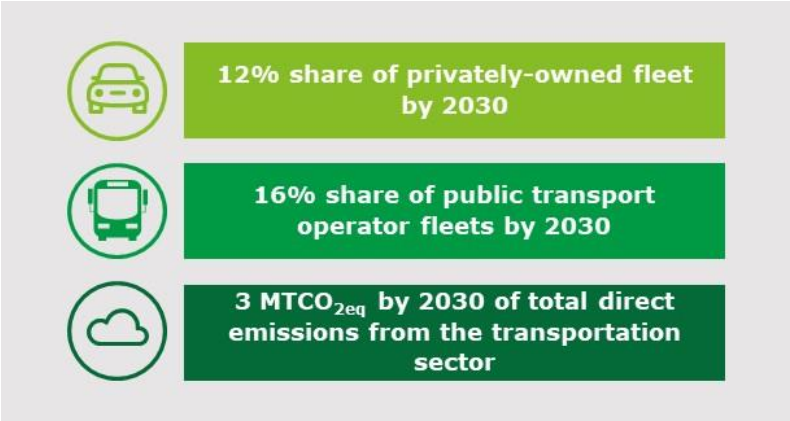


Figure 1: National targets of the Strategic Framework.

The achievement of these targets, whilst maintaining tax neutrality, could benefit the Jamaican economy by over 410,621 million Jamaican Dollars over a ten year timeframe (representing approximately 2% of annual Gross Domestic Product during the period). This is mainly due to an increase in investments and related assets, required for the deployment of electric mobility infrastructure, as well as, the improvement of Jamaica's trade balance through the reduction of fossil fuels.

In addition, to achieve the previous targets, specific measures must be developed. These measures have different timeframes and are structured in terms of the priority of development in the short, medium and long-term. The proposed measures are grouped below in sequential order of development:



Figure 2: Proposed measures in the current framework grouped by purpose of development.

Short-term measures are ranked high priority, in order to ensure the viability and sustainability of electric mobility deployment. In addition, specific measures in the short-term are intended to incentivize the adoption of electric mobility. The key measures proposed in this document to be developed in the short term are:

- **Development of a tax incentive program** to promote electric mobility adoption through: (i) a five-year temporary exemption of import duties on electric vehicles, (ii) a permanent reduction of import duties on electric vehicles imports, (iii) waivers on electric vehicle registration fees, and (iv) the development of an income tax credit programme.
- **The development of a policy to address short-term fiscal impacts.** Impacts of the proposed incentive measures to be analysed in order to develop appropriate policies to mitigate the impact of forgone tax revenue. An

analysis considering the impact of the proposed tax incentive measures has been developed.

- The **update of the energy regulatory framework** in order to define the **guidelines regarding tariff mechanisms** to support electric mobility charging, as well as to consider **commercial models** as a result of the deployment of charging infrastructure. The regulation focuses on the **definition of policies of new activities and new agents within the energy sector**.
- The **update of the National Transport Policy** and the development of operational codes to promote adoption of electric vehicles.
- **Definition of guidelines regarding the technical and communication standards for the deployment of charging infrastructure** and ancillary services. In addition, the creation of a "Standardization Committee" to oversee the development of the standards is recommended.
- The **development of policies to ensure an adequate deployment of charging infrastructure is required** in order to: (i) establish procedures to determine optimal and accessible locations of charging infrastructure, and (ii) planning mechanisms, guidelines and requirements to enable deployment of public charging infrastructure.
- **Policy guidelines adoption regarding the renewal of the public passenger transportation fleet**, considering both public and privately owned fleets. In addition, **measures promoting the development of pilot programs and feasibility assessments of the public fleet.** Development of pilot programmes deployment and renewal needs assessment taking into consideration electric buses and route taxis are to be developed to promote adoption on high use transportation modes.
- Definition of **financing mechanisms** in order to support the deployment of an electrified public fleet through **public-private partnerships and access to specific designed financing schemes**.
- **Measures focused on the development of an initial ecosystem to support early adoption of electric mobility**. The definition of measures must be developed in order to enhance Jamaica's readiness for increasing adoption of electric mobility: (i) **professionals and human capital training programs definition**, including first response professionals, (ii) **certified professionals policies** regarding electric mobility and related infrastructure operation and maintenance, (iii) **design and development of communication campaigns** to increase electric mobility benefit awareness, and (iv) the **development of policies and requirements with respect to research and development programs** on electric mobility applications.

Additional measures have been developed in the document considering medium and long-term priority of development. **Medium-term measures** are those to be developed in a 3 to 6 years and are focused on increasing development of electric mobility in Jamaica, including:

- The development of cost-benefit analysis on the adoption of **emission standards and vehicle efficiency, as well as the definition of guidelines and procedures towards the implementation of an emission standard**

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testing policy through (i) import emission testing and (ii) annual certified fitness evaluation procedures.

- Design and definition of a **tagging system in order to reduce congestion** in high traffic areas. The development of impact analysis on both private vehicle circulation, **freight vehicles transit needs, impact on industrial activities is required in order to support the viability of a tagging system.** In addition, measures regarding **constraints on conventional vehicles circulation will increase impact on the reduction of congested areas,** therefore **policies to control and monitor vehicle transit is to be developed.**

- **The development of guidelines and the definition of a regulatory framework regarding new activities arising from electric mobility adoption** are necessary, such as batteries reuse and disposal guidelines, regulatory framework towards applications of electric mobility to increase and support renewable energy, eco-tourism programmes regarding the deployment of charging infrastructure and guidelines to define public transportation service levels requirements.

- Additional measures regarding the **design of monitoring mechanisms over fleet renewal programmes, data collection on licensing of electric mobility fleets, monitoring development mechanisms regarding research and development programmes success and promoting pilot programmes regarding innovation of electric mobility secondary applications.**

Lastly, long-term measures are those measures developed in excess of six-years. These measures are to ensure both a high share of electric mobility, and the development and evolution of the services and technology related to deployed electric mobility. The key areas of development in the long term are:

- Measures to **enhance vehicle to grid solutions and scaling up renewables**, including the development of **communication campaigns** to promote awareness of the benefits of smart charging solutions and synergies obtained with self-consumption and the **development of a regulatory framework to ensure integration of vehicle to grid solutions in the network grid**.

- Development of **cybersecurity guidelines** and the definition of **new technology solutions regulatory framework** within its application in the charging infrastructure network.

- Regulatory framework development of new electric mobility shared services. **Regulatory sandboxes to ensure that the viability of shared mobility services deployment should be developed**. In addition, in order to address **micro mobility deployment**, the definition of guidelines towards the development of a safety and operational policy framework is required.

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Index

Section 1: Key aspects of the transportation and energy sectors in Jamaica 1

The urgency of decarbonisation 1

The energy and transport sectors in Jamaica 3

The opportunity of electric mobility in Jamaica – Scenarios of market demand and penetrations under different incentives and policies 6

National targets for electric mobility in Jamaica 13

Section 2: Tax regime and fiscal considerations to boost adoption 15

Action line 1: Development of an incentive program 17

Action line 2: Assessment of immediate or short-term fiscal impacts and strategies to inform policy development 19

Section 3: Technical, efficiency, and interoperability standards 29

Action line 3: Charging systems and EV charging station standards for private vehicles, buses and other transportation modes 30

Action line 4: Vehicle-charging stations communication standards 32

Action line 5: Vehicle to grid services and business model development structuring 33

Action line 6: Cybersecurity guidelines 34

Action line 7: Upgrading emissions and efficiency norms for internal combustion engine vehicles 35

Action line 8: Developing a tagging system for congested areas 36

Section 4: Enhancing energy sector readiness 38

Action line 9: Impacts of electric vehicles on grid operations and planning 39

Action line 10: Optimal location for public charging stations in the island 40

Action line 11: Electric sector regulatory framework for electric vehicles charging – tariffs and commercial models 41

Action line 12: Vehicle to grid integration and distributed energy aggregators, technical and commercial regulation, new business models 42

Action line 13: Regulatory and market mechanisms for scaling up renewables in the power sector 43

Section 5: Enhancing transport readiness 45

Action line 14: Update the general transport policy 46

Action line 15: Electric buses feasibility studies and immediate renewal needs assessment 47

Action line 16: Financial schemes for public transport operators to adopt new technologies 48

Action line 17: Immediate renewal program structuring 48

Action Line 18: Long-term and renewal phases guidelines for electric public transport fleets 49

Action line 19: Monitoring systems of the renewal programs 50

DRAFT

Action line 20: Post implementation renewal phases - feasibility studies 50
Action line 21: Legal and institutional arrangements for the performance and implementation of renewal programs in public transportation 51
Action line 22: Updated guidelines for the definition of service levels in public transportation 51
Action line 23: Circulation and transport incentives – use of restricted space, parking policy, amongst others 52
Action line 24: Electric bus deployment pilot 53
Action line 25: National taxi renewable program 53
Action line 26: Renewal program for urban freight delivery vehicles 54
Action line 27: Fleet renewal study and plan for public sector institutions 55
Section 6: Creating an e-mobility ecosystem in Jamaica 56
Action line 28: Training and development of local capabilities 56
Action line 29: E-mobility research and development programs with universities, private and public sector 57
Action line 30: Battery reuse and disposal guidelines 58
Action line 31: Program to support new ventures on second-life applications for batteries and entrepreneurship programs 59
Action line 32: E-mobility ecotourism program with key stakeholders 59
Action line 33: E-mobility infrastructure and human capital development through the private sector 60
Action line 34: Regulatory model for new shared mobility services 61
Action line 35: Regulatory model for electric car-sharing and urban rental services 61
Action line 36: Regulatory guideline for micromobility 62
Action line 37: Financial solutions for new acquisitions of electric vehicles (leasing), mechanisms to increase market penetration for e-vehicles, particularly for the medium and low-income segments of the markets 63
Indicators for the established strategy 64
Measure priority ranking 73
Short-term measures (2020 -2023) 73
Medium-term measures (2020-2026) 76
Long-term measures (2020-2030) 79
Appendix 1: Methodology 80
Appendix 2: References 81
Appendix 3: Model description 85
Assumption description 85
Mathematical structure behind the model 88
Appendix 4: Results from the model and target application 89
Appendix 5: Action lines mapping 95

DRAFT

Appendix 6: Tax credits for All-Electric Vehicles and Plug-In Hybrid Electric Vehicles..... 98

Europe 98
United States of America 100
Dominican Republic..... 100
Costa Rica 101
Argentina..... 101
Colombia 102
Mexico..... 102
Uruguay 102

DRAFT

Section 1: Key aspects of the transportation and energy sectors in Jamaica

The urgency of decarbonisation

Climate change and its environmental impacts are a concern internationally. International mitigation policy development is focused on decarbonisation targets and global emissions objectives. In this regard, special focus must be set on both the energy and transport sector, which are two of the main contributors worldwide (IEA, 2017).

As a result of global higher energy demand, in 2018 total CO_2 emissions related to energy rose 1.7%, representing a historic amount of 33.1 Gt CO_2, registering the highest growth rate since 2013. Considering historic emission growth by sector, the power sector is accountable for almost two-thirds of this increase. (IEA, 2019).

Along with the energy sector, the transportation sector is a major contributor to higher pollution levels. As stated by the World Health Organization, transportation sectors is positioned as a sector with an increasing emission growth.

Social trends including economic and population growth, along with accelerated urbanization patterns have led to a higher reliance on personal vehicles for transportation. This situation has been responsible for a growing contribution of particulate emissions. Road transport is estimated to be responsible for up to 50% of particulate emissions in Organization for Economic Co-operation and Development ("OECD") countries; -diesel vehicles are the main contributors- (World Health Organization, 2020). Furthermore, diesel transport represents one of the major sources of black carbon –a short-lived climate pollutant formed by the incomplete combustion of fossil fuels, biofuels and biomass, which is a major contributor of climate change. It does not only have a significant impact on warming, but it is closely associated with air-pollution related mortality (World Health Organization, 2020).

In addition, climate change poses another major challenge to overcome this is global warming. There is no doubt that weather patterns are changing along with sea levels rising and weather events becoming more and more extreme. As stated by the Sustainable development goals by the United Nations, if no actions are taken, world average temperature will surpass 3 degrees centigrade (United Nations, 2020) increase in this century and reach a "point of no return" that could cause sea levels to increase by 200 feet and a 4-5ºC increase in global average temperatures that would result in the apparition of severe storms, droughts and fires (Loria, 2018).

This is the reason why the Paris agreement, adopted by several countries at the COP21 in Paris, agreed to limit global temperature increase below 2 degrees centigrade from pre-industrial levels by reducing greenhouse gas emissions and promoting the use of green energy generation sources (United Nations, 2020).

This situation is calling for urgent solutions in which decarbonisation plays a major role. Decarbonisation in the energy sector, combined with the electrification of the transportation sector, represent critical drivers to reduce greenhouse gas emissions. Improving **energy efficiency, reducing the carbon content and replacing the direct use of fossil fuel with carbon-free energy are some of the main pillars** in this regard.

In addition, electrification of the transportation sector, not only contributes to a reduction of

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emissions, but it is also an opportunity to increase the support of the path to the energy transition.

Electric mobility adoption represents increasing benefits:

- Full electric vehicles do not have dust emissions. Hence they contribute to a reduction in urban pollution from mobile sources. Therefore, electric mobility contributes to an improvement of air quality in cities, along with a better quality of life.

  In addition, **emissions from internal combustion engine vehicles represent major contributors to a poor air quality** scenario, **and therefore to the impact on the populations health**.

  Under this context, electric mobility arises as an opportunity to develop a clean and sustainable transportation system within urban areas, becoming a key driver towards the reduction of ambient air pollution and greenhouse gas emissions.

  Electric mobility adoption, combined with a clean electricity generation mix, achieves an increased **positive effect on the improvement of localized air pollution**. In addition, this will support the Government's goals to reduce thes transportation sector contribution to Jamaica's emissions.

- Electric mobility facilitates a reduction of fossil fuel dependence and supports carbon neutrality goals**. An increase in the reduction of fossil fuel dependence levels is achieved when combined with an energy mix strategy moving towards an increasing participation of renewable and low emission energy generation technologies**.

- In addition, electric mobility offers the opportunity to **increase the integration of renewable energy sources within the generation mix.** The development of solutions and strategies to promote electric mobility as **distributed storage options within the electricity value chain, can mitigate variability of renewable sources and increase reliance on renewable technologies**.

- Electric vehicles are **more energy efficient** than conventional vehicles, as the thermal yield for the former is 90% while the thermal yield for the latter is close to 25%. As such, the average amount of energy saved from transportation in electric vehicles when compared to conventional vehicles approximates to 40% (SCAME, 2020).

- **Users' empowerment considering** increasing options to interact with the electricity system, provides an opportunity for the user to better understand their bill and identify possible cost reduction solutions.

- The need to address increasing demand of electricity supply represents an opportunity to increase the security of supply and quality of supply by considering **demand aggregation and charging patterns.**

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Hence, the electricity system can **integrate the use of local networks** with energy storage in electric vehicles, reducing the congestion of the grid and the generation mix.

- Electric vehicles have a huge potential for consumers to **integrate self-consumption solutions**.
- Electric mobility also contributes to the **national economy**, as it will stimulate the development of **new businesses and activities**.

  Along with the creation of products and services, there will be job creation, resulting in **greater employment rates**.
- **Maintenance of electric vehicles is cheaper** than conventional vehicles as they have less components, and thus a lesser probability of malfunctioning.

The energy and transport sectors in Jamaica

With regard to the current situation in Jamaica, the impact is extremely high. Jamaica will suffer from an increase in global temperatures and pollution, but will also be severely threatened by the impact of climate change, such as, the rise of sea level or an increase in extreme weather conditions (Chemonics International Inc., 2018).

According to the Third National Communication of Jamaica to the United Nations Framework Convention on Climate Change, greenhouse gas emissions in 2012 amounted for 7.38 $MTCO_{2eq}$ (excluding Land-Use Change and Forestry emissions). As a result, Jamaica is ranked 137 of 264 countries when considering a worldwide per capita emission ranking, with more than 2.5 metric tons per capita per year (World Bank, 2020).

The energy and transportation sectors are responsible for almost 40% and more than 20%, respectively, of greenhouse gas emissions in Jamaica, as shown in Figure 3:

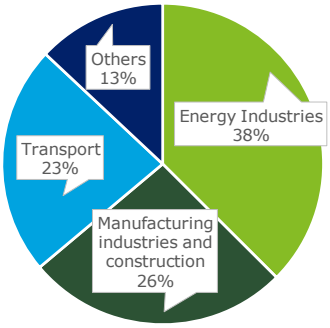


Figure 3: Greenhouse gas emissions per activity in Jamaica in 2012.

These emissions are highly related to the dependence on fossil fuels in both sectors, as almost a third of petroleum imports is consumed by the road transportation sector, and a quarter by the electricity generation sector (CARICOM, 2018).

Jamaica's energy generation sector is heavily dependent on imported fossil fuels, with 74% of primary energy coming from petroleum-based sources, as stated in figure 4 (JAMPRO, 2019). Moreover, this high dependence accounts for more than 80% of the total cost of electricity generation, according to the Jamaica Public Service Company Limited.

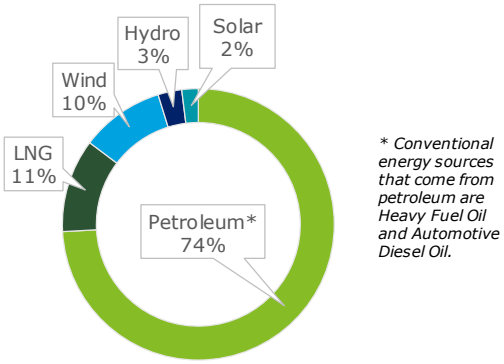


Figure 4: Energy generation by fuel source in Jamaica in 2017.

This dependence on imported fossil fuels, in turn, increases electricity

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costs for the Jamaican population, and uncertainty regarding fuel price levels.

This situation highlights the need for the Government of Jamaica to develop an action plan that includes public policies that will allow for a more efficient use of energy in order to reduce fossil fuel dependency and the associated vulnerability to fossil fuel price variation.

The Nationally Determined Contribution of Jamaica to the United Nations Framework Convention on Climate Change, sets a target to reduce emissions between 7.8% and 10% below the business as usual scenario mainly from the energy sector by 2030 (Jamaica First NDC, 2015).

In order to support the achievement of greenhouse gas emission targets within the energy sector, the increase of renewable energy resources in the national energy mix is critical. Jamaica's National Energy Policy, addresses the transition towards an increasing share of the renewable resources within the energy mix share.

In 2018, the share for Renewable Energy within the 2030 energy generation mix, was set at 30% by the Cabinet. This new target is dependent on an ambitious strategy to develop renewables technologies in Jamaica, and exploit the renewable potential in the country.

Figure 5: Renewable Energy potential in Jamaica in 2018 (CARICOM, 2018).

Renewable energy potential and national development offer an opportunity with respect to electric mobility specific measures specifically scaling up renewable energy resources.

Moreover, electric mobility is mainly based on electricity as fuel. When combined with renewable generation, it is one of the technological solutions with most potential to reduce fluctuations in fossil fuel prices.

In this regard, some policies have already been developed in the Jamaican electricity generation sector in order to reduce Greenhouse Gas emissions. These policies include a reconversion of power generation plants from high sulphur fossil fuels to cleaner liquefied natural gas (LNG), as well as, setting targets to increase renewable energy share within energy generation activities up to 30% of total energy production (Jamaica Information Service, 2018).

However, the electricity sector development must consider the adoption of electric mobility, in order to achieve increasing benefits.

As an island that is 240 km long and 80 km wide that is willing to reduce its greenhouse gas emissions, Jamaica has an outstanding opportunity **for the deployment of electric mobility as**

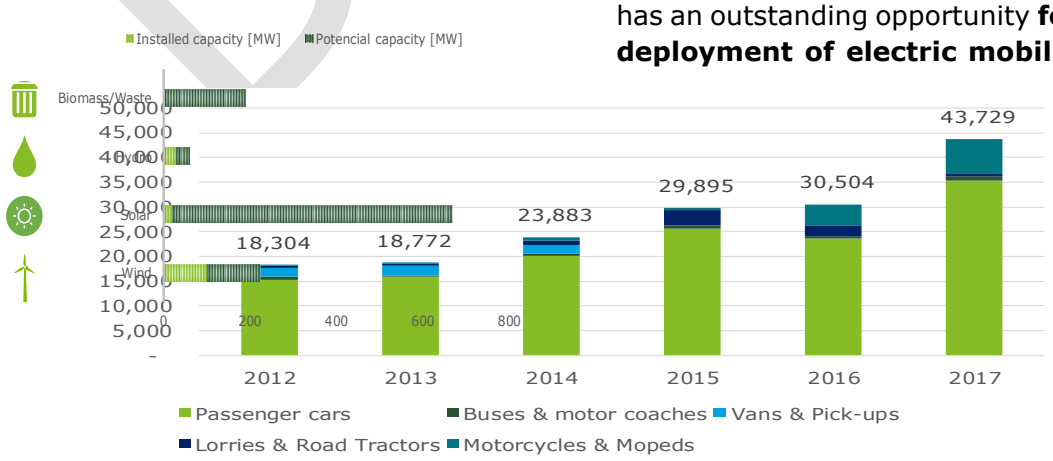


Figure 6: National imports of vehicles in Jamaica, by type and year.

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it represents a strategic opportunity towards transportation electrification and contributes to the adoption of measures and solutions to support an increase in clean energy generation capacity.

With respect to the transportation sector, Jamaica is dependent on **automobile imports as they represent a 7.72% of the 2018 National Trade Balance** (Trade Map, 2020)**.**

Jamaica's current vehicle market profile is dominated by used vehicles: approximately 75% of vehicles purchased in Jamaica are used vehicles.

Furthermore, electric vehicles[1] are currently almost non-existent, accounting for around 0.003 % of the total national fleet.

Low penetration of imports of electric vehicles is mainly influenced by two factors. Firstly, with a Gross Domestic Product per capita of 5.4 thousand US dollars in 2018 (World Bank, 2020), Jamaican consumers are particularly price sensitive, which drives mobility preferences towards second use vehicles. Secondly, the limited availability of publicly accessible charging infrastructure for electric vehicles appears to be a factor influencing mobility consumers in Jamaica as the charging infrastructure is in its early stages of development.

According to the World Road Statistics 2019 developed by the International Road Federation (IRF, 2019), the national fleet consists of almost 620,000 four-wheeler vehicles (data includes passenger cars, vans, pick-ups, lorries, road tractors, buses and motor coaches), and almost 20,000 two-wheeler vehicles. Moreover, the average growth of the fleet for the last three years was 5.77%. This increase is high if we consider a 0.19% average increase in population for the same timeframe -2014 to 2017- (Statistical Instiute of Jamaica, 2019). Vehicle imports have more than doubled in the past 5 years.

Patterns in vehicle imports show that the national fleet is aged. Considering imported vehicles and vehicles in use (IRF, 2019), the replacement rate for vehicles in Jamaica as of 2017 available information, stands at 14.55 years. As can be seen in figure 7, this replacement rate has been decreasing over the past years.

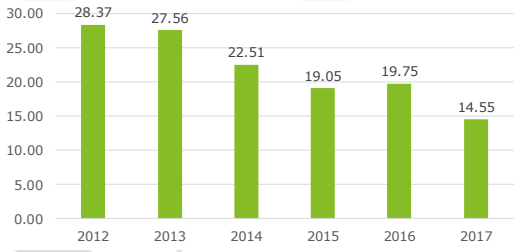


Figure 7: Replacement rate for vehicles in Jamaica from 2012 to 2017.

In order to develop the sector readiness, this Strategic Framework considers two differentiated groups within the national transportation fleet: the private fleet and the public fleet. Both fleets present several differences when it comes to the control that Government has: while it has a direct control over the public fleet, regarding the private fleet the Government has indirect control. It can influence in some way its composition by the implementation of specific measures, as will be shown in this document. In this document, public fleet is considered as both, state-owned and privately owned vehicles that provide public transportation services.

Regarding the use of transportation in Jamaica, and according to the Statistical Institute of Jamaica, more

[1] Electric vehicles considered refer to Pure Electric Vehicles Propulsion Engine.

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than a half of the population uses public transportation to fulfil mobility needs. Route taxis are the most popular mode of public transportation followed by bus service from JUTC (Jamaica Urban Transit Company Limited).

The adoption of electric vehicles in the transport sector will result in many benefits. Chief among them are that both fuel consumption and dependence on fossil fuels in the transportation sector would be drastically reduced. Therefore, electric mobility is an opportunity for the energy sector as it will allow electric system operators to provide consumers with a higher degree of reliability. Additional benefits include the possibility of integrating renewable energy: since electric vehicles can be used as distributed storage facilities, additional sources of energy, including solar and wind, are a perfect alternative source to be further developed in the island. Hence, **electric mobility is a critical component in local and regional decarbonisation and energy transition plans**.

The design and implementation of policy measures to accelerate and support the deployment of electric mobility, in alignment with national objectives, require a comprehensive and multisector approach, involving several stakeholders from all affected industries. Thus, the electricity sector development must consider the inclusion of electric mobility as a main pillar and establish mechanisms and policies to ensure the sustainability of electric mobility adoption.

However, for electric mobility to take off in Jamaica further measures should be considered within the transportation sector along with effective communication and education campaigns to increase population awareness and knowledge of the opportunities and benefits.

In addition, to obtain an adequate understanding of the current situation, it is important to take into consideration that the main reason why a significant portion of vehicles imported into Jamaica are used is because of its lower costs. Hence, this strategic framework focuses on different measures for the development of the required charging infrastructure and inherent services, the ecosystem to support electric mobility adoption, along with the reduction in the price gap between electric and conventional vehicles, while the growth of the Jamaican economy is targeted.

Current global trends suggest a dramatic reduction in the cost of electric vehicle technology in the next 3 to 5 years. This is mainly due to technological progress, as well as, an international increase in second-use electric vehicle in the market, according to Groupe Renault (Laurent, 2019). **In order to maximize the benefits of electric mobility, Jamaica must ensure an enabling environment of incentives, policies, regulatory framework and business models without jeopardizing fiscal stability.**

The opportunity of electric mobility in Jamaica – Scenarios of market demand and penetrations under different incentives and policies

The introduction of new technologies along with policy and regulatory framework development will require an in depth-analysis of the situation in order to identify the main threats and success factors that need to be considered in order to develop an implementable strategic framework for electric mobility.

Technological development in the automotive industry and international trends affecting mobility patterns and consumer behaviour represent key drivers to stimulate the future of

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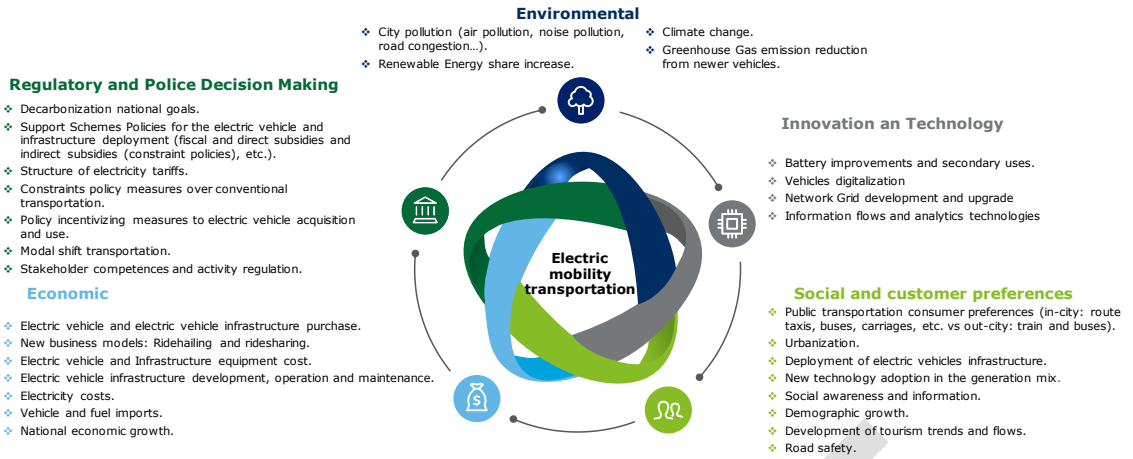


Figure 8: Driving forces for transportation patterns in Jamaica.

mobility. International trends, in addition to a number of key issues at the local level, will determine and establish the potential for adoption of electric mobility in Jamaica.

There are a number of key driving forces regarding the transportation sector transformation that must be considered in order to promote the adoption of new technologies, such as electric mobility. The main key forces driving change within the current situation and electric mobility adoption, are represented in Figure 8.

There is a strong relation between most of the key forces considered, which is strengthened by the impact of the future mobility trends and potential of development for its adoption in Jamaica. Key drivers can be grouped into two main categories that will determine the future scenario of mobility and transportation in Jamaica. They are detailed in the latter sections of this report.

The key driving forces were identified from a survey conducted amongst key national stakeholders.

The methodology used to define the scenarios was based on the evaluation of the different drivers and trends, which impact electric mobility development. The analysis conducted identified and prioritized key drivers based on the importance and the impact on the future of electric mobility adoption in Jamaica.

As a result, the shift of the Jamaican transportation sector towards electric mobility penetration will rely on two main factors: (i) the electric vehicle charging infrastructure and ecosystem deployment and (ii) electric vehicle total cost of ownership ("TCO"). Please note that TCO includes all costs and revenues during the lifetime of the vehicle, including purchase cost, operating and maintenance costs and, residual value.

The Government can play a leading role within the first key area through private partnerships whose involvement will be essential for the development of a fully integrated electric mobility ecosystem to increase penetration.

However, despite the fact that electric vehicle costs will be lower with new technological and efficiency developments from the automotive manufacturers, a number of actions from the Government can help to reduce the total cost of ownership of Electric Vehicle, compared to an Internal Combustion Engine vehicle.

Considering the development of these two key areas, the Jamaican transportation framework will be able to move towards different possibilities or scenarios.

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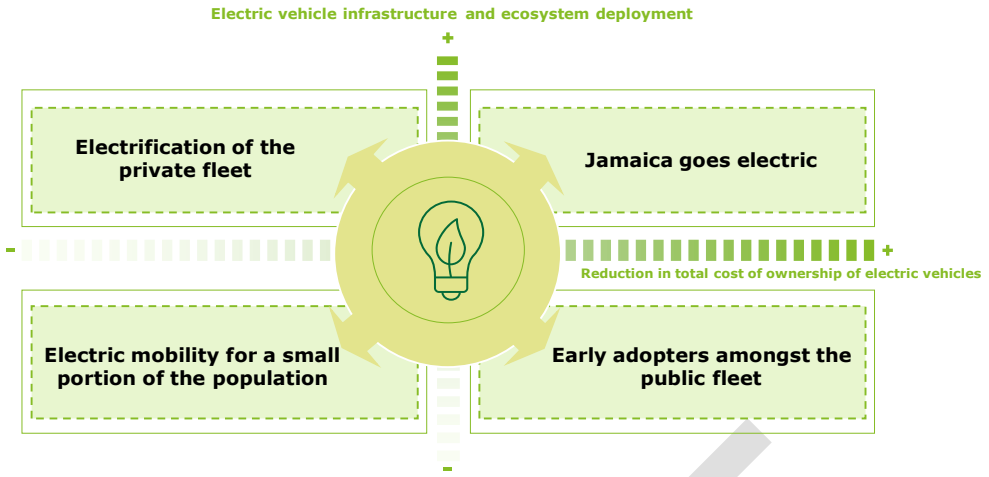


Figure 9: Possible scenarios for the future of mobility in Jamaica.

Possible scenarios are established in Figure 9. Public and private fleets will follow different paths towards electrification, as the needs and requirements for each fleet are different (for example public transportation, especially buses, will require a different charging infrastructure than private vehicles).

In order to analyse the impact and required measures towards adoption of electric mobility under the development of the key areas previously identified, a model has been developed that considered the following input data:

(i) Vehicle imports, gross domestic products and demand growth projections.
(ii) National fleet composition and fleet average rotation information.
(iii) Mobility patterns and trends to define mobility needs in Jamaica (Vehicle Kilometre Travelled – "VKT" - per capita by vehicle type).
(iv) Vehicle sales market in Jamaica, considering sales of new vehicles and second hand vehicles.

The key outcomes from the analysis conducted was dependent on the definition of penetration targets of electric mobility, under different scenarios, as well as, the evaluation of the impacts of target achievement on (i) greenhouse gas emissions, (ii) fuel savings and, (iii) tax and fiscal position.

Moreover, the evolution of the current fleet in Jamaica has been estimated for the period of the analysis, by an average growth increase rate in vehicle imports aligned with the projected gross domestic product growth in Jamaica.

As a result of an analysis that considered the past 10 years, an annual average of 1.59% increase was considered for the 2020-2030 period. From this point, the evolution of the future fleet for Jamaica is modelled and its composition is analysed and grouped into scenarios.

The model includes a base scenario that considered the same rate of vehicle increase in the national fleet and a steady full conventional fleet across scenarios in order to compare results.

The developed model considered mobility needs as Vehicle Kilometre Travelled, do not shift over time, even though it shifts according to the fuel type.

As a result, electric vehicle share within the different considered scenarios will rely on the behaviour of both the private and the public fleets and its sensitivity towards (i) the purchase

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cost of electric mobility, (ii) its financial benefits over the lifetime of the electric vehicle and (iii) the development of the ecosystem of electric mobility, including services and charging infrastructure access.

Further details of the model can be viewed in appendices 3 and 4.

A description of each scenario developed, considering key areas of development, is provided in figure 10:

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Scenario 1: Electric mobility for a small portion of the population.

The price of an electric vehicle is still considerably higher than the price of an internal combustion engine vehicle. As a consequence, the former is not yet perceived as a substitute for the latter by the Jamaican population. A number of issues can determine this price difference. For example, the secondary market of electric vehicles may not have developed enough, manufacturers may not have reached battery cost reduction, etc.

Therefore, its penetration amongst both the private and the public fleet is not high enough for the country to properly benefit from the technology and extend its benefits to the electric system. Approximately 1% of the fleet is electric in 2030.

In addition, charging infrastructure has not taken off in Jamaica and electric vehicle owners charge their cars with privately owned charging infrastructure.

Consequently, the transportation sector continues to be a main agent of greenhouse gas and other pollutants emissions (1% reduction by 2030 from base scenario) and dependence on fuel imports is still high. Last, the electricity supply sector is unable to benefit from the synergies with electric mobility.

Scenario 2: Early adopters amongst the public fleet.

Under this scenario, the total cost of ownership of the electric vehicle has been considerably reduced. Therefore, the publicly available transportation fleet has successfully implemented a number of the recommended actions within the present Strategic Framework that allow for a cheaper and more reliable public transportation service (improving quality service levels), such as a rollout of charging infrastructure that cover their needs.

However, the development of publicly available charging infrastructure has not developed appropriately and private users with electric vehicles experience range anxiety. Therefore, electric vehicle penetration within the private fleet is considerably low and total share of electric vehicles within the total national fleet represents 3% by 2030.

Even though greenhouse gas emissions and other pollutants and fuel dependence from the transportation sector have been considerably reduced (6% reduction in 2030 from the base scenario) further progress can be achieved, especially in terms of education and increasing awareness amongst private car owners in order to shift to electric mobility.

Scenario 3: Electrification of the private fleet.

This scenario considers that total cost of ownership of electric vehicles is considerably higher than the cost of conventional vehicles, due to both the lack of access to the secondary market of electric vehicles and a slower than expected decline in the price of electric vehicle prices. As a result, mainly high purchase capacity segments of population have access to electric vehicles.

Electric infrastructure has been developed across the island even though its usage is limited due to a low rollout of electric vehicles within the island.

Therefore, the electric share within the private fleet is low within the middle class and low within the public transportation fleet. Consequently, the national fleet reflects a 5% share of electric vehicles. Greenhouse gas emissions reduces although there is still a gap that needs to be covered in order to reach national targets. Greenhouse gas emissions reduce by 4% by 2030 from the base scenario.

Scenario 4: Jamaica goes electric.

Under this scenario, the public transportation fleet takes the lead in electric vehicle acquisition, increasing its electric vehicle share. As the population tends to follow technologies based on their success, benefits are extended through the private fleet and 12% of the national fleet is electric by 2030.

The ecosystem grows at a fast pace in order to provide adequate services to the growing demand of electric vehicles users. Furthermore, electric vehicle affordability is no longer an obstacle, as the acquisition costs are similar to that of a conventional vehicle. Benefits will accrue when considering full lifetime costs and expenses (Total Cost of Ownership).

Therefore, electric mobility becomes a component towards decarbonisation of the transportation sector and achieving national targets. Greenhouse gas emissions reduce by 14% from the base scenario.

Figure 10: Considered scenarios for the future of mobility in Jamaica.

Jamaica's ambition to reduce greenhouse gas emissions and fuel dependency along with the urgency of global decarbonisation strategies is a key consideration in this Strategic Framework. The present Framework focuses on five main pillars, grouping different action lines to set the path to achieve an increasing deployment of electric mobility in Jamaica.

Each scenario produced a different target result, based on the development of key driving forces, mobility fleet patterns and financing access (see figure 11).

In addition, **achievement of the penetration percentages under the different scenarios will result in different outcomes regarding greenhouse gas emissions reductions, as well, as in fuel savings**. Results of these impacts are shown in figures 12 and 13.

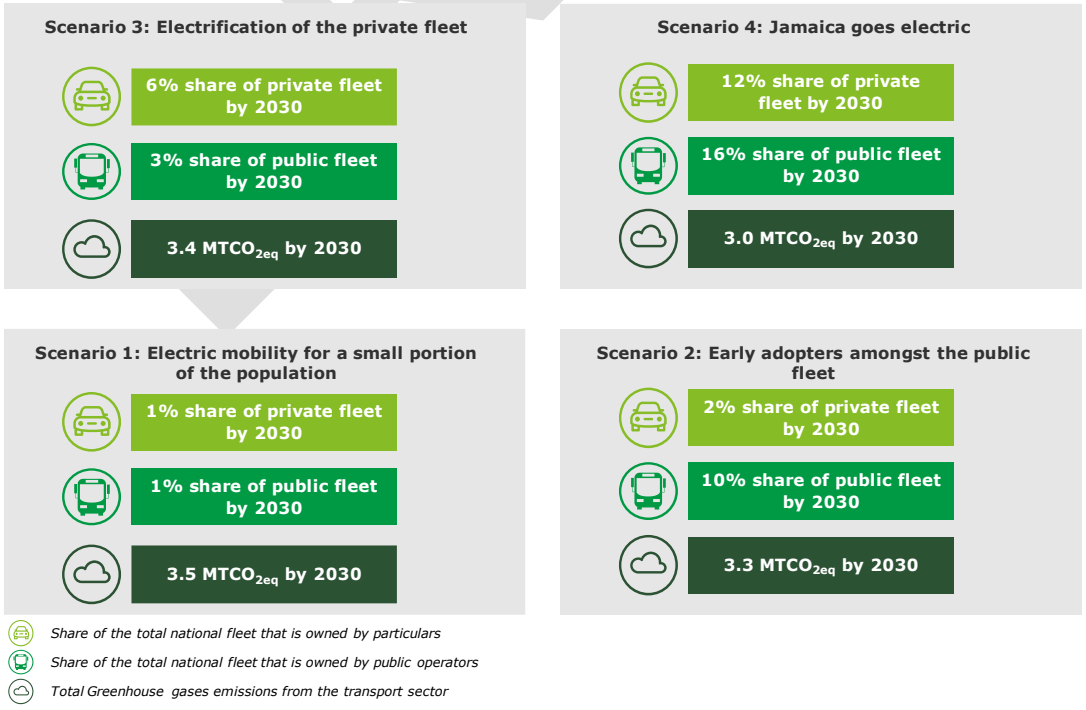
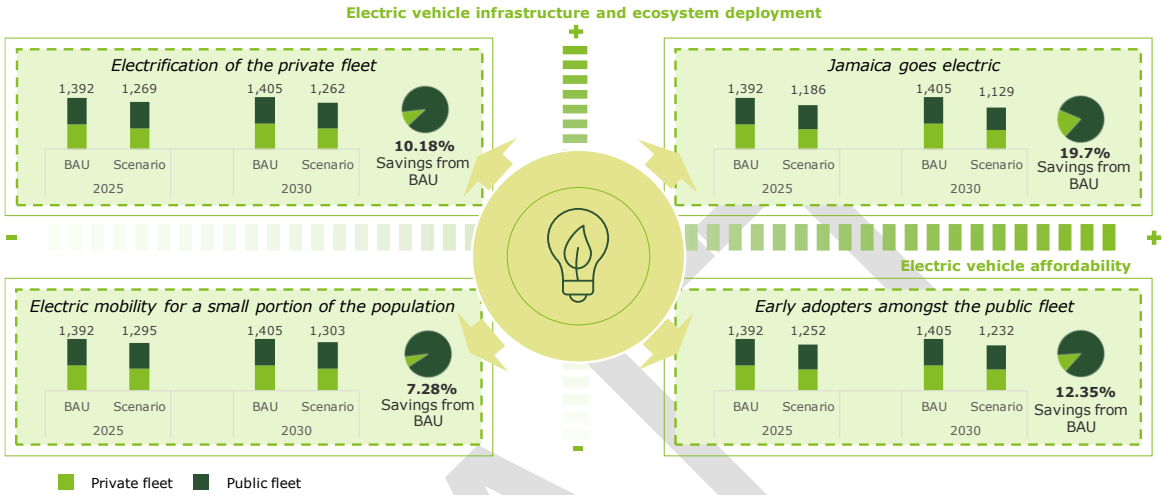


Figure 11: Targets for each scenario.

Fuel consumption savings arising from the deployment of electric mobility share under the different scenarios.

Fuel savings have been calculated as the difference between fuel consumption under a "business as usual" scenario considering national fleet composition, and the consumption avoided with the different electric vehicles share in Jamaica's vehicle fleet. Results are presented as a comparison between the established scenario and a reduction share for 2030. (See appendix 4)

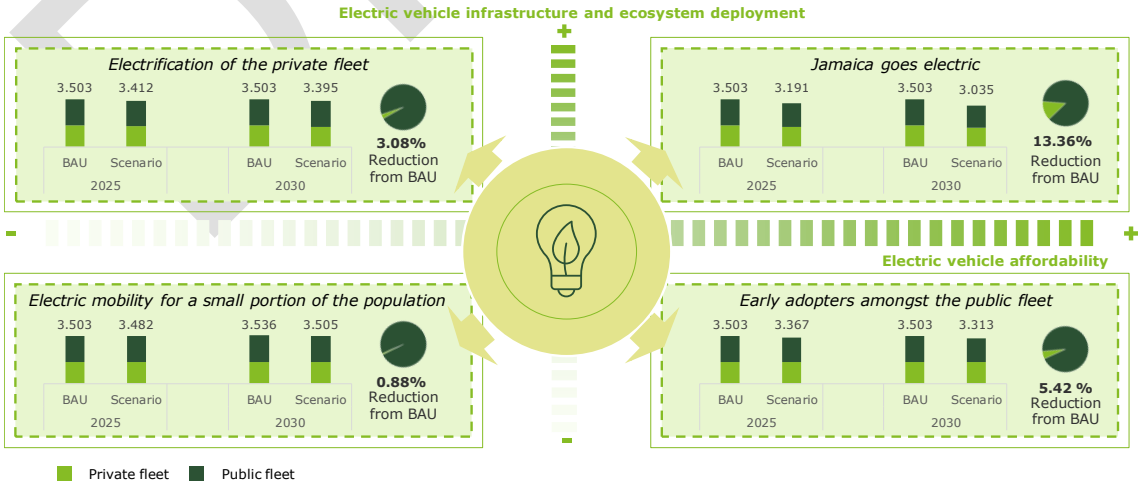


Figures expressed on million litres and the reduction percentage from "business as usual" scenario.

Figure 12: Projected fuel savings for the national fleet in Jamaica, depending on mobility scenarios.

GHG emission impact from electric mobility scenario penetration

Impacts on greenhouse gas emissions considering a "business as usual" scenario where there is no electric mobility penetration. In addition, greenhouse gas emissions impacts have considered Jamaica's indirect emissions. (See appendix 4)



Figures expressed on $MTCO_{2eq}$ and the reduction percentage from "business as usual" scenario.

Figure 13: Projected greenhouse gas emission reduction for Jamaica, depending on mobility scenarios.

National targets for electric mobility in Jamaica

When framing the national targets towards the promotion of electric mobility adoption in Jamaica, it is necessary to frame the development of the critical areas:

(i) Incentivizing the availability and development of an ecosystem that supports and enhances electric mobility, as well as ensuring that users do not feel range anxiety and have a wide range of services, and

(ii) Reducing the total cost of ownership of electric vehicles over internal combustion engine vehicles, considering both purchase costs and operation and maintenance expenses.

The following targets for electric mobility penetration up to 2030 for the different type of national fleets considers the "Jamaica goes electric" scenario (Figure 14). Different penetration targets have been proposed for each fleet, with a higher penetration for the public transportation fleet. Additionally, emissions will be reduced by 2030. According to estimations, greenhouse gas emissions from the transportation sector amount to 3.4 $MTCO_{2eq}$. Thus a reduction of around 0.4 $MTCO_{2Eq}$ (11.76% reduction) is proposed to be achieved by 2030.

In order to achieve these targets, several action lines and measures have been developed.

These action lines and driving forces for the development and adoption of electric mobility have been grouped into five sections.

In addition, these action lines are designed to achieve the development of one of the key drivers or both.

The following pages of this document set the structure for this Strategic Framework and develop the action lines, which are grouped into five sections.

Section 2 addresses the tax regime and fiscal considerations to enable measures to increase preference towards electric mobility regarding total cost of ownership, as well as, mitigation actions to enable tax revenue neutrality.

Section 3 addresses the technical and efficiency measures required to enable electric mobility interoperability.

Section 4 focuses on the design of energy system measures to enable and promote electric mobility adoption.

Section 5, addresses the transportation sector to enable measures that promote viability of electric mobility adoption.

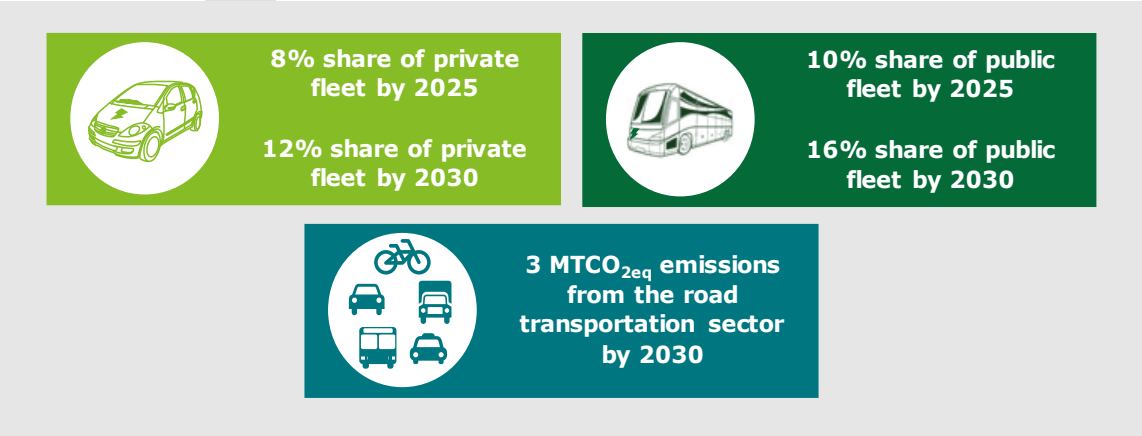


Figure 14: National targets for electric mobility penetration 2030.

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Lastly, Section 6 provides additional measures to ensure the development of an electric mobility ecosystem to support the established penetration percentages.

In addition, the success of the design and development of key action lines to facilitate electric mobility penetration will require the definition of mechanisms to monitor and evaluate the degree of achievement. For this purpose, indicators have been defined.

The following key outputs of the Strategic Framework will position Jamaica towards a sustainable transition to electric mobility:

- A re-design of the fiscal regime for vehicle imports, boosting the parity of acquisition costs for electric vehicles when compared to conventional vehicles.
- The development of standards that guarantee the integration of electric mobility in the Jamaican society and the achievement of full-advantages of this technology, guaranteeing the maximum contribution towards global targets.
- Technical standards guidelines to address interoperability of electric vehicles.
- The development of congestion solutions, especially in the Kingston Metropolitan Area, focused on the reduction of the emissions from the current fleet.
- Establishing key measures for the energy sector to adopt complimentary measures that allow for the development of a more eco-friendly value chain, as well as the development of business opportunities.
- Updating the general regulation for the energy and transportation sectors in order to allow for the full integration of electric mobility at the national level.
- Establish the base for the development of an electric fleet, separating the actions for each of the transportation modes, in order to allow for a financially sustainable development.
- Ensure that the population is aware and educated in order to appreciate the full benefits of electric mobility.
- Ensure that electric vehicles become completely sustainable, as waste is correctly managed and taken benefit of.

Allowing for the long-term future mobility trends to be included in the national panorama, is compelling in order to position Jamaica as a local reference in electric mobility integration.

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Section 2: Tax regime and fiscal considerations to boost adoption

According to the current tax regime in Jamaica for vehicle imports, different levies are applied depending on the importer –a dealer or an individual– the engine size or size of the vehicle, the type of fuel to be consumed and the purpose of use –commercial or private use.

For internal combustion engine vehicles, total taxes are, overall, higher when imported by individuals than by dealers. This is an implicit incentive for the Jamaican population to buy their vehicles from licensed car dealers.

The tax structure for Electric Vehicles is simpler than for other vehicles since it is a zero-consumption product that is exempt from the General Consumption Tax. As a result, taxes on electric vehicles are 30.5% of the cost of insurance and freight of vehicles, regardless of the type of importer and the battery size.

Although total taxes for electric vehicles are lower than for other vehicles, electric vehicles acquisition cost tend to be higher (around 33% higher) than for other vehicles (Joju Solar, 2020).

Moreover, electric vehicles need the deployment of charging infrastructure. This, in turn, increases even more the initial costs for adopting electric mobility.

Figures 15 and 16 show the current tax regime for different vehicles.

In order to achieve the "*Jamaica goes electric*" scenario previously described, Jamaica must work both on the reduction of the Total Cost of Ownership of an electric vehicle, when compared with a conventional vehicle,

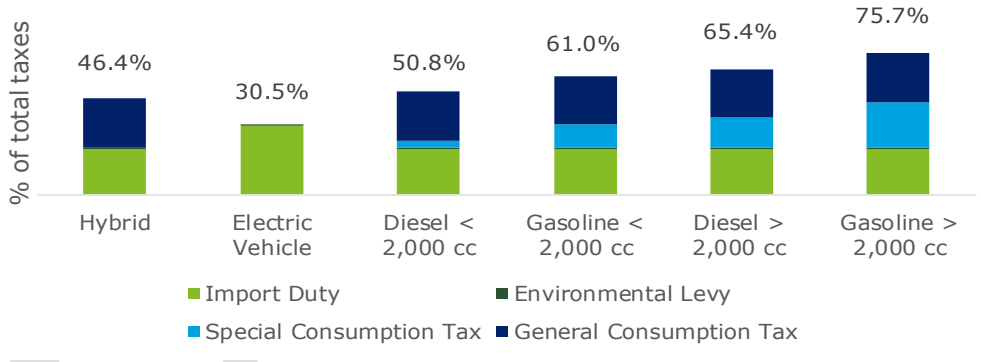


Figure 15: Current tax regime for vehicles imported by car dealers, by technology.

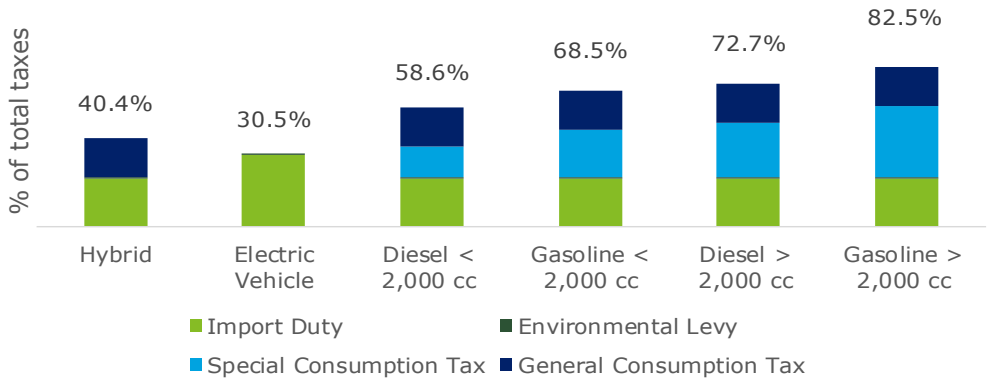


Figure 16: Current tax regime for vehicles imported by individuals, by technology.

and the development of the ecosystem.

As a result, the reform of the current tax regime must include a measure for reducing the price of acquisition of an electric vehicle, while reducing the total cost of ownership and boosting electric mobility in the island.

As such, a number of different measures have been considered and analysed:

a) Establish waivers on imports for (i) import duties on new technology vehicles and (ii) on tax licenses fees for new technology vehicle registrations,

b) Lower the Environmental Levy for electric vehicles, as their impact towards the environment is limited,

c) Establish waivers on circulation tax payments for electric vehicles in the access to road infrastructure, such as highways tolls.

d) Develop incentive mechanisms for private sector fleets such as income tax credit, benefits in kind from electric vehicle purchase and use, etc.

As the alternative for electric vehicles are traditional vehicles, an increase in their cost would make the total cost of ownership of an electric vehicle more attractive. As such, some complimentary measures were analysed:

a) Increasing levies on import duties applicable to conventional vehicles, aligned with long-term national goals regarding the environmental impact of the transportation sector.

b) Developing specific tariff and price taxation mechanisms that consider the use of energy resources required for new technology transportation that facilitates an increased control from the population over energy consumption and vehicle emissions control.

c) Establishing tax mechanisms that levy circulation of low efficient standards on conventional vehicles.

As a result of the analysis previously described, **different measures** were selected as they will have the biggest impact on the development of electric mobility in Jamaica in the short term and are fully developed later in the current section:

a) **Develop a temporary purchase sale tax exemption on import duty for five years,**

b) **Establish a purchase sale tax reduction on import duty after five years,**

c) **Establish a registration fee waiver incentive,**

d) **Develop an income tax credit programme,**

e) **Increase levies on imports for conventional vehicles.**

Nevertheless, since these measures will cause a decrease in the General State Budget of Jamaica, additional actions could be contemplated in order to neutralize these effects, and are described later on.

DRAFT

Action line 1: Development of an incentive program

Rationale

The previously considered list of incentive mechanisms can be narrowed down when looking at successful experiences internationally.

For example, in 2008 Japan introduced an exemption for imports of electric vehicles to be effective from 2009 to 2012 and was further extended until 2015. Note that electric vehicle stock in Japan by 2008 was null (IEA, 2019). As Figure 17 shows, electric vehicle stock increase during the timeframe was extremely high:

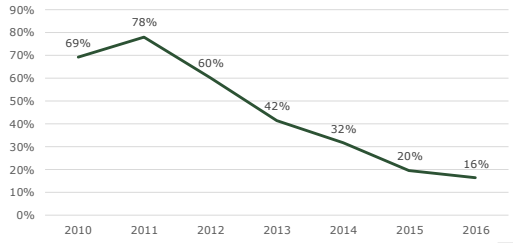


Figure 17: Electric vehicle stock yearly increases from 2010 to 2015.

As a result, Japan rose to the position of the third country in the world with more electric vehicle stock by 2018 (IEA, 2019).

In the same way, the Dominican Republic developed a subsidy for the importation of energy-efficient vehicles, including electric vehicles.

As such, in 2013, the Dominican Republic published the law nº 103-13 in which they established a 50% tax reduction on import taxes and first registration fee on energy efficient vehicles (article 3) (Ley No. 103-13 de incentivo a la importación de vehículos de energía no convencional., 2012).

However, it is to be considered that the DR-CAFTA (Dominican Republic-Central America Free Trade Agreement) establishes a counter-effect on this subsidy. The DR-CAFTA establishes special tax reduction for commercial exchanges with Central American countries and the United States of America (Organization of American States, 2020). As many imported electric vehicles come from the U.S.A. this law reduces the financial benefits that the population from the Dominican Republic could have from the 103-13 Law.

Nevertheless, the Dominican Republic is actually the largest market in the Caribbean when it comes to electric vehicles size. Moreover, this market has almost nine-folded from 2018 to January 2020 (Inter-American Dialogue, Inter-American Development Bank and Organization of American States, 2020).

This policy goes along with the fact that even though the current import tax regime in Jamaica gives a reduced taxation to electric vehicles, the tax advantage is not enough to close the purchase price gap.

Dealer								
Vehicle type	**Electric Cars**				**Trucks**	**Bus**	**Electric motorcycles**	
Differentiator	**<60 kWh**	**60-75 kWh**	**75-90 kWh**	**>90 kWh**	**-**	**-**	**Transport of goods**	**Others**
Import Duty	20.0%	25.0%	30.0%	35.0%	25.0%	25%	2.5%	15.0%
Environmental Levy	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
Special Consumption Tax	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
General Consumption Tax	0.0%	0.0%	0.0%	0.0%	21.5%	21.5%	16.5%	16.5%
Total	**20.5%**	**25.5%**	**30.5%**	**35.5%**	**47.0%**	**47.0%**	**19.5%**	**32.0%**

Figure 18: New tax regime, considering stretch incentives for dealer imported electric vehicles.

Individual								
Vehicle type	**Electric Cars**				**Trucks**	**Bus**	**Motorcycles**	
Differentiator	**<60 kWh**	**60-75 kWh**	**75-90 kWh**	**>90 kWh**	**-**	**-**	**Transport of goods**	**Others**
Import Duty	25.0%	30.0%	35.0%	40.0%	25.0%	25.0%	2.5%	15.0%
Environmental Levy	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
Special Consumption Tax	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
General Consumption Tax	0.0%	0.0%	0.0%	0.0%	16.5%	16.5%	16.5%	16.5%
Total	**25.5%**	**30.5%**	**35.5%**	**40.5%**	**42.0%**	**42.0%**	**19.5%**	**32.0%**

Figure 19: New tax regime, considering stretch incentives for individual imported electric vehicles.

DRAFT

However, when comparing total cost of ownership of vehicles, we must consider that the majority of Jamaicans tend to buy their vehicle in the secondary market. As electric vehicles in Jamaica are rare, the secondary market for electric vehicles is reduced to imports of used vehicles.

As a consequence, the price gap will most likely be increased between the price of acquisition of a new electric car and that of a used fuel car.

Actions

When re-designing the tax regime in Jamaica for electric vehicles multiple options can be considered.

Firstly, taxes on electric vehicles are currently fixed, independently of the battery size or the price of the vehicle.

However, electric vehicles with bigger batteries cause a bigger impact in greenhouse gas emissions (considering the full-life cycle of a vehicle) and are usually more expensive. As a result, there is an additional reason for the Government to establish a higher taxation for vehicles with bigger batteries: thereby allowing for a bigger share of the population to acquire an electric vehicle and establishing price signals for global greenhouse gas emissions reduction.

The Government of Jamaica could consider four categories according to battery capacity for electric vehicles and different import duties should apply. This stretch incentive will allow for a gap reduction between acquisition costs for electric and conventional vehicles.

Figures 18 and 19 show an illustrative tax regime and the established differences for both cases amongst dealers and individuals, based on the current tax structure.

Likewise, for other vehicles, such as trucks, buses and motorcycles, the same distinction can be made. However, due to the low development of electric vehicles for non-car vehicles, a simple regime should be established.

In addition, temporary exemption tax mechanisms in the early stages of electric mobility adoption will help to provide price parity options to customers, and shift preferences towards electric mobility over internal combustion engine vehicles.

Within the present framework, exemption of import duties mechanisms, regarding the current tax regime, have been modelled during the first 5 years of the framework (See appendix 4).

In conclusion, recommendations for boosting electric mobility in Jamaica by means of re-designing the tax regime is set under two main actions:

a) **Temporary tax exemption for electric vehicles imports**. We recommend that the Government of Jamaica establish a five-year exemption.

b) **Tax re-design, establishing tiered taxes for electric vehicles**. We recommend the tiered incentives established in figures 18 and 19.

Moreover, in order to encourage consumers, the implementation of a **registration fee waiver incentive programme should be developed**. Therefore, electric vehicles will receive a full exemption from the registration fee.

The last recommendation regarding the incentives package includes the development of an **income tax credit programme**. Travelling allowances for employees driving their own electric vehicle will have a different taxation. Current genuine travelling officers with motor vehicle will have $43.00 per km of exemption and mileage with motor

DRAFT

vehicle amounts to $52.00 per km. As such, a 10% incentive could be provided, extending both numbers to $47.30 per km for the former and $57.20 per km for the latter. In order to quantify the impact of this measure, we considered that 10% of distances travelled by car are for business purposes (Department for Transport, 2017).

Main actors involved: Tax Administration Jamaica and National Environment and Planning Agency.

Action line 2: Assessment of immediate or short-term fiscal impacts and strategies to inform policy development

Rationale

Even though tax reduction is an effective measure towards boosting electric mobility deployment, it has a fiscal impact on Government revenues.

According to the International Monetary Fund, the total debt to GDP ratio in 2018 amounted to 93.47% (IMF, 2020). Although this ratio has reduced significantly in last few years, it is still considerably high. In order to continue this trend and protect the achievements gained, as well as reducing the price gap between the acquisition prices of an electric vehicle with that of a conventional vehicle, we recommend establishing a complementary measure to reduce the impact of the previous incentive.

In addition to the impact from the new tax regime exemption measures, a slight decrease in tax revenues coming from fuel consumption reduction is forecasted as the reduction in the percentage of traditional vehicles will impact tax revenue collection. The neutralization of this effect requires the development of complementary actions to maintain stability in tax revenue for the government.

Worldwide different options and measures have been developed:

a) Increase electricity taxes. This is not an optimal measure to implement due to (i) sensitivity to electricity prices by Jamaican population, (ii) it is not a popular option as it is a regressive tax and its application will impact highly on low-income consumers that most surely will not own electric vehicles.

b) Increase in fees for internal combustion engine vehicles. This option is easy to implement and signals shift to cleaner technology as it increases fees on less efficient or more greenhouse gas pollutant vehicles.

c) Monitor vehicles movement and the design of a new tax based on usage (mileage). In order to implement this option, monitoring systems must be established and considered.

Nevertheless, Jamaica has the option to increase taxes on internal combustion engine vehicles to compensate for lost revenue associated with established incentives for electric vehicles developed in action line 1.

In order to estimate the impacts of these measures, we considered the "*Jamaica goes electric*" scenario developed in Section 1 that includes an annual growth of 1.59% of the national Jamaican fleet and a share of 12.2% electric vehicles within the national fleet by 2030 (154,707 vehicles).

A Cost-Benefit Analysis was conducted to estimate the impacts. The different impacts were developed in the order they appear in figure 35, where the full analysis is included.

Overall the key effects considered can be categorized and classified within the following areas: (i) impacts on the tax and fiscal

DRAFT

revenue, (ii) impacts on GDP mainly from required investments and impacts on the trade balance due to the reduction of fuel needs and imports, and (iii) impacts regarding the economic efficiency and benefits for Jamaica's population. These impacts are listed hereafter:

- **Tax revenue impacts of proposed measures**:
  - Incentives provided to imports,
  - Income tax credit programme,
  - Registration fee waiver,
  - Tax import increase.
- **Tax revenue impacts from electric mobility adoption**:
  - Decrease in tax collection from fuel consumption reduction,
  - Taxes on batteries from used vehicles,
  - Taxes derived from an increase in electricity consumption.
- **Impacts on the Gross National Product:**
  - Investment in charging infrastructure,
  - Investment in Renewable Energy to cover electric mobility consumption,
  - Fuel import reduction.
- **Socio-Financial impacts from electric mobility adoption**:
  - Savings from the application of a new retail tariff,
  - Operational savings from users,
  - Maintenance savings from users,
  - Economic development in the island,
  - Savings on greenhouse gas emissions,
  - Health impact on the population.

The total aggregate tax revenue for the period 2020-2030 for Jamaica has been estimated considering an analysis of available data inclusive of adjusted inputs from the International Monetary Fund and the United States Department of Agriculture (USDA, 2020). The projected Accumulated Gross Domestic Product for Jamaica from 2020 to 2030 (time range covered in the analysis) amounts to 178.41 billion USD or 24,317.10 billion JMD considering 2019 average exchange rate. Moreover, tax revenue in Jamaica is approximately 25% (IMF, 2018). Considering a 25.38% average, tax revenue for the 2020-2030 would approximate to 6,172 billion JMD.

Tax revenue impacts from proposed measures:

Estimated impacts on tax revenue forgone as a result of the incentive measures to promote electric mobility adoption are detailed below:

i) Incentives provided to imports

As a result of the aforementioned impacts by 2030, the Government of Jamaica would reduce its tax collection by approximately 251,488 million Jamaican Dollars (4.07% of 2020-2030 tax revenue) from the tax regime change. This reduction is due to: (i) exemption on the import duty during the first five years, which represents approximately 219,631 million Jamaican Dollars (3.56% of 2020-2030 tax revenue), and (ii) the re-design of import duties on electric vehicles, which approximates to 31,857 million Jamaican Dollars (0.52% of 2020-2030 tax revenue). (Impacts are represented as aggregated values for the period 2020-2030).

After taking into consideration the fleet composition and taxes from the Integrated Tariff Jamaica table, we developed the following breakdown for electric vehicles in scenario 4 and electric vehicle taxes, considering the current import tax regime ("BAU") and the proposed incentive on import duties.

DRAFT

Year	EV	BAU	Scenario 4
2020	12,978	137,877	102,704
2021	13,185	140,075	104,341
2022	13,396	142,309	106,005
2023	13,609	144,578	107,695
2024	13,826	146,883	109,413
2025	14,047	149,225	111,157
2026	14,271	151,605	145,433
2027	14,498	154,022	147,752
2028	14,729	156,478	150,108
2029	14,964	158,973	152,502
2030	15,203	161,508	154,933

Figure 20: Forecasted impacts on Tax revenue from proposed tax regime on electric vehicles (million Jamaican Dollars).

ii) Income tax credit programme

In order to calculate the tax credit programme, we estimated total taxable kilometres travelled by business employees. According to different studies, 10% of travel are for business purposes. As such, we obtained the following results:

Year	Total km by EV	Business km by EV
2020	156,010,508	15,601,051
2021	298,664,816	29,866,482
2022	431,801,477	43,180,148
2023	555,527,288	55,552,729
2024	665,302,294	66,530,229
2025	769,997,985	76,999,798
2026	865,207,884	86,520,788
2027	949,363,474	94,936,347
2028	1,049,324,228	104,932,423
2029	1,147,350,410	114,735,041
2030	1,244,646,242	124,464,624

Figure 21: Forecasted total kilometres travelled in Electric Vehicles in Jamaica.

Lastly, as the income tax rate is 25% (TAJ, 2020), results of impacts for every year from 2020 to 2030 are detailed below:

Year	Impact (million JMD)
2020	8.58
2021	16.43
2022	23.75
2023	30.55
2024	36.59
2025	42.35
2026	47.59
2027	52.21
2028	57.71
2029	63.10
2030	68.46

Figure 22: Forecasted impacts on Tax revenue from tax credit programmes.

The income tax credit programme will result in an impact on the Jamaican tax balance of 447 million Jamaican Dollars (0.07‰ of 2020-2030 tax revenue).

iii) Registration fee waiver

Considering that current annual registration fee for electric vehicles amounts to 9,240.00 Jamaican Dollars (Tax Administration Jamaica, 2020) and given the number of electric vehicles from figure 20 the annual effect would amount up to:

Year	Impact (million JMD)
2020	119.92
2021	121.83
2022	123.78
2023	125.75
2024	127.75
2025	129.79
2026	131.86
2027	133.96
2028	136.10
2029	138.27
2030	140.47

Figure 23: Impacts on Tax revenue from registration fee waivers on electric vehicles.

As a result, the aggregated effect for the 2020-2030 period is estimated to be 1,429 million Jamaican Dollars (0.23‰ of 2020-2030 tax revenue).

Tax revenue impacts from electric mobility adoption:

Electric mobility will impact tax revenue. Tax revenue will be impacted mainly from:

i) Tax forgone due to the decrease in fuel consumption from the transportation sector.

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ii) Imports on supply equipment, specifically from battery imports.

iii) Increase in electricity consumption as fuel for electric vehicles.

Tax impact estimates have been developed considering the defined targets of electric mobility adoption

i) **Decrease in tax collection from fuel consumption reduction**

Additionally, there will be an approximate reduction of 108,271 million Jamaican Dollars in the Jamaican tax balance (1.75% of 2020-2030 tax revenue) as a result of the reduction in fuel consumption between 2020 and 2030. Figure 24 shows the results and compares business-as-usual scenario and scenario 4. Fuel consumption, in each scenario, multiplied by current fuel cost and aggregate taxes of 65.8% provide the following results:

Year	BAU	Scenario 4
2020	67,236	61,732
2021	67,423	60,857
2022	67,610	60,052
2023	67,797	59,316
2024	67,984	58,683
2025	68,171	58,087
2026	68,300	57,507
2027	68,430	57,009
2028	68,559	56,411
2029	68,688	55,832
2030	68,818	55,261

Figure 24: Forecasted impacts on Tax revenue from fuel consumption reduction (million Jamaican Dollars).

ii) Taxes on batteries from used vehicles

As new batteries would be imported in Jamaica for replacement purposes, these imports will generate approximately 90,829 million Jamaican Dollars (1.47% of 2020-2030 tax revenue) in tax receipts.

However, considering that close to 75% of imported vehicles are used cars, battery replacement will play a major role in their total cost of ownership. The price of an electric battery is approximately 176 USD/kWh (BloombergNEF, 2019). Considering that batteries are imported into Jamaica with 20% Import Duty, 16.5% Special Consumption Tax and 0.5% Environmental Levy, total importation taxes accrue to 40.4%. Annual tax revenue from batteries would amount under scenario 4 to:

Year	Impact (million JMD)
2020	7,619.69
2021	7,741.18
2022	7,864.62
2023	7,990.02
2024	8,117.42
2025	8,246.86
2026	8,378.35
2027	8,511.95
2028	8,647.67
2029	8,785.56
2030	8,925.64

Figure 25: Forecasted impacts on Tax revenue from battery import increase.

iii) Taxes derived from an increase in electricity consumption

Electricity consumption will increase as a result of the increased presence of electric vehicles. We considered a scenario in which electricity cost would remain stable at 40.27 JMD/kWh and the electricity aggregate tax at 16.5%.

Electricity consumption is calculated based on kilometres travelled by electric vehicles and per kilometre consumption of light-duty, medium-duty and heavy-duty vehicles.

As a result, electricity consumption and tax impacts are shown in figure 26:

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Year	Electricity consumption	Tax impact
2020	108.56	721.31
2021	207.82	1,380.87
2022	300.46	1,996.43
2023	386.55	2,568.48
2024	462.94	3,076.02
2025	535.79	3,560.08
2026	602.04	4,000.28
2027	660.60	4,389.37
2028	726.71	4,828.63
2029	790.78	5,254.36
2030	853.59	5,671.72

Figure 26: Forecasted electricity consumption from electric mobility (million kWh) impacts on Tax revenue from electricity usage increase (millions of Jamaica Dollars).

Electricity consumption increase from electric vehicle usage will generate an additional 37,448 million Jamaican Dollars (0.61% of 2020-2030 tax revenue), throughout the timeframe analysed (accumulated impact for 2020-2030).

Key Impacts on the Gross Domestic Product

Electric mobility deployment will impact the Gross Domestic Product ("GDP"). Electric mobility requires investment related to the deployment of infrastructure and renewable energy capacity, and the net exports mainly due to the reduction on fuel dependency. Other impacts regarding private consumption, other imports, and government expenditure have not been considered as significant impacts for this analysis.

Therefore, the following key impacts were considered in the cost-benefit analysis:

i) Investment in charging infrastructure,

ii) Investment in Renewable Energy to cover electric mobility consumption,

iii) Fuel imports reduction.

Impact estimates on GDP have been developed considering the defined targets of electric mobility adoption

i) Investment in charging infrastructure

In order to calculate the cost of investment required for the deployment of electric mobility by both private and public agencies, we have developed an analysis based on different sources.

The deployment cost of charging infrastructure and related assets, has been estimated based on an analysis of various studies and converted to Jamaican Dollars.

Various studies have established charging infrastructure benchmarks, they are:

- 90% of private users will install a charging port for their in-home use,
- 1 publicly available semi-fast charging connection per 100 private vehicles,
- 1 publicly available fast charging connection per 500 private vehicles,
- Public transport fleets should focus on having 2 connectors (Semi-Fast and Fast Charging) per electric urban bus route. In addition, 1 connection per 5 vehicles minimum within the public fleets.

JUTC has approximately 450 buses (Jamaican Urban Transit Company, 2020) and services approximately 120 routes (JUTC, 2019): They own close 3.75 buses per route.

The forecasted 2030 fleet is estimated to consist of 140,664 privately owned electric vehicles and 14,043 vehicles within the publicly operated fleets. The estimated charging infrastructure is as shown in figure 27:

DRAFT

Type of EVSE	Number of EVSE	Cost of EVSE
Normal	126,598	19,344
Semi-fast	2,822	3,772
Fast	1,744	17,020
Super-fast	2	106

Figure 27: Forecasted investment costs of charging infrastructure (millions of Jamaican Dollars).

Figures include estimations of private and public charging infrastructure.

As a result, the development of charging infrastructure and related assets, for electric mobility in Jamaica will require an estimated investment of 40,244 million of Jamaican Dollars.

ii) Investment in Renewable Energy to cover electric mobility consumption

Renewable power generation costs for solar and wind for 2018 amounted to 1,210 USD/kW and 1,500 USD/kW respectively (IRENA, 2019).

In 2017, the peak load in Jamaica was 667 MW and total sales amounted to 3,208,946 MWh (CARICOM, 2018). The peak load to sales ratio for 2017 was 0.02%.

Electricity consumption from electric mobility in 2030, according to figure 26 will be approximately 853.39 million kWh. To meet this increase in consumption (considering the peak-to-sales ratio) approximately 29,291 million Jamaican Dollars of investment in solar and 36,312 million Jamaican Dollars in wind will be required. Both solar and wind have high energy potential. We have based our estimates on the average of both technologies, which is approximately 32,801 million Jamaican Dollars.

iii) Fuel imports reduction

In estimating the reduction of fuel imports due to the deployment of electric mobility, estimations of fuel consumed by the total national fleet were considered:

Year	BAU	Scenario 4
2020	1.373	1.251
2021	1.377	1.223
2022	1.381	1.198
2023	1.385	1.175
2024	1.388	1.155
2025	1.392	1.136
2026	1.395	1.118
2027	1.307	1.103
2028	1.400	1.084
2029	1.403	1.066
2030	1.405	1.049

Figure 28: Forecasted consumption from the total national fleet in Jamaica (millions of litres).

Considering that fuel pre-tax price average was 74.42 JMD/L (Petrojam Ltd, 2020), the reduction in fuel imports would be approximately 203,635 million Jamaican Dollars.

Socio-Financial impacts as a result of electric mobility adoption

In addition, there are benefits for the population as a result of the adoption of electric mobility. The benefits and impacts have been estimated below:

i) Savings from the application of a new retail tariff

As consumers will feel more empowered through new billing and tariff mechanisms, financial benefits for society will arise.

We have considered that billed energy in 2017 to residential customers and small commercial customers amounted to 1,407,803 MWh (The Jamaica Public Service Company Limited, 2018) for 881,078 households (Statistical Institute of Jamaica, 2020). Potential savings from a Time of Use tariff based on a full ecosystem (including electric vehicles) is approximately 15% (International Renewable Energy Agency, 2019). We have assumed that households benefitting from this 15% savings will have electric vehicles (numbers on figure 20), forecasted savings would be approximately:

DRAFT

Year	Total electricity consumption for households with EV	Savings on bill (million JMD)
2020	9,962.25	781.00
2021	17,384.68	1,384.62
2022	24,078.87	1,948.37
2023	30,079.10	2,472.69
2024	35,184.60	2,938.52
2025	39,872.48	3,383.13
2026	43,943.72	3,788.03
2027	47,348.53	4,146.61
2028	51,149.99	4,550.95
2029	54,686.07	4,943.15
2030	58,017.62	5,327.91

Figure 29: Forecasted total electricity consumption from electric mobility players (kWh) and forecasted savings on electricity bill.

This would result in an accumulated benefit of 35,665 million Jamaican Dollars for Jamaican owners of electric vehicles, and thus to society as a whole.

However, after taking into account the 16.5% tax, the benefit will be reduced to 29,780 million JMD.

ii) Operation savings from users

In order to determine operation savings from the use of the electric vehicle, a number of assumptions have been considered.

Consumption for conventional vehicles is approximately 9.00 L/100 km (NREL, Jamaica Transportation Greenhouse Gas Reduction Plan, 2019) and the average price of gasoline in 2019, tax included, was 132.21 per litre in Jamaica (Petrojam Ltd, 2020).

Electric vehicles will consume on average 0.11 kWh/km (EV-Database, 2019). Based on a post-tax kWh for Rate 10 in Jamaica of 40.27 JMD (22.33 JMD from the Rate 10 price (JPS Co., 2020) and 17.78 JMD from the IPP charge (JPS Co., 2020)).

Operation savings on a per year basis, considering km travelled in electric vehicles, would be approximately:

Year	Total million km by EV	Savings (million JMD)
2020	158.03	1,180.35
2021	302.53	2,259.66
2022	437.39	3,266.95
2023	562.72	4,203.04
2024	673.91	5,033.59
2025	779.96	5,825.70
2026	876.40	6,546.04
2027	961.65	7,182.75
2028	1,040.01	7,768.05
2029	1,111.59	8,302.72
2030	1,177.16	8,792.46

Figure 30: Forecasted operation savings from electric vehicles in Jamaica.

Approximately 60,361 million Jamaican Dollars will be saved by Jamaicans who own an electric vehicle.

It is to be highlighted that under these assumptions, in Jamaica, a conventional vehicle fuel expense is 11.90 JMD/km and an electric vehicle electricity expense will be 4.43 JMD/km. Thus, an electric vehicle is 63% cheaper to operate than a conventional vehicle in Jamaica.

iii) Maintenance savings for users

Maintenance costs for conventional vehicles approximate 435 JMD/100 km while for electric vehicles it is 234 JMD/100 km (Logtenberg, 2018).

Maintenance savings on a per year basis approximate:

Year	Savings (million JMD)
2020	317.64
2021	608.09
2022	879.15
2023	1,131.06
2024	1,354.56
2025	1,567.73
2026	1,761.57
2027	1,932.92
2028	2,090.42
2029	2,234.30
2030	2,366.10

Figure 31: Forecasted maintenance savings from electric vehicles in Jamaica.

As a result, 16,244 million Jamaican Dollars will be saved.

DRAFT

iv) Economic development in the island

Electric vehicles stimulate economic development of a nation. It is estimate at approximately 965 USD per 120,000 miles in 10 years (Malmgren, 2016).

Considering that electric vehicles in Jamaica will have less mileage over the 2020-2030 period, this number has been adjusted to reflect Jamaica's situation.

The forecast has taken into account the number of EVs imported annually during the period 2020-2030 and the benefits adjusted based on year of import.

Yearly economic development is forecasted to be:

Year	Development (million JMD)
2020	199.08
2021	103.74
2022	71.90
2023	56.01
2024	46.58
2025	40.32
2026	35.89
2027	32.62
2028	30.11
2029	28.14
2030	26.55

Figure 32: Forecasted benefits of economic development in Jamaica.

As a result, total benefits of 671 million Jamaican Dollars will accrue.

v) Savings on greenhouse gas emissions

Based on the model, a forecast of greenhouse gas emissions from mobile sources was done. As evidenced in figure 33, from a comparison of annual GHG emissions from the business-as-usual scenario where electric mobility fleet in Jamaica remains almost non-existent and scenario 4, we obtain the following:

Year	BAU	Scenario 4	Differences
2020	3.454	3.391	0.063
2021	3.464	3.343	0.121
2022	3.473	3.299	0.175
2023	3.483	3.258	0.225
2024	3.493	3.224	0.269
2025	3.502	3.191	0.311
2026	3.509	3.159	0.350
2027	3.516	3.132	0.384
2028	3.522	3.099	0.423
2029	3.529	3.067	0.462
2030	3.535	3.036	0.500
Total	38.48	35.20	3.282

Figure 33: Forecasted greenhouse gas emissions ($MTCO_{2eq}$) in Jamaica for two different scenarios.

Carbon pricing is the subject of a wide number of studies. Usually it is priced at approximately 10 USD per ton or less. However this number is very low to drive for the needed transformational change in society. This is the reason why many recent studies price carbon between 40 USD and 80 USD (World Bank, 2020). We have considered, a 60 USD per ton in our estimates.

As a result of reducing carbon emissions by 3.282 $MTCO_{2eq}$, the economic benefits for Jamaica are approximately 26,869 million Jamaican Dollars (0.43% of 2020-2030 tax revenue).

From a greenhouse gas emissions perspective, and considering the established assumptions, an electric vehicle operating in Jamaica is 3.5 times more efficient than a conventional one.

vi) Health impact on the population

Health impact on the Jamaican population is linked to greenhouse gas emissions. We have assumed, 1,686 USD per 120,000 miles over 10 years of usage in our calculations (Malmgren, 2016). In addition we have considered the Jamaican mobility reality and considering purchasing power parity between Jamaica and the United States (1:74 ratio) (Knoema, 2020).

DRAFT

The forecast has taking into account the number of EVs imported annually during the period 2020-2030 and the benefits adjusted based on year of import.

Based on the forecasted from number of imported electric vehicles from figure 20 the estimated benefits are approximately 15.84 million Jamaican Dollars (0.003‰ of 2020-2030 tax revenue) with the following yearly distribution:

Year	Development (JMD)
2020	4,700,250
2021	2,449,291
2022	1,697,662
2023	1,322,480
2024	1,099,781
2025	952,041
2026	847,453
2027	770.142
2028	710,909
2029	664,309
2030	626,882

Figure 34: Forecasted economic impact on the Jamaican society on a per year basis.

Cost-benefit analysis

The previously stated benefits have been included into figure 35.

In order to achieve tax neutrality, the Government of Jamaica would need to increase taxes on imports by approximately 160,659 million Jamaican Dollars (2.60% of 2020-2030 tax revenue). These taxes would be collected from imports on conventional vehicles. In order to achieve the previous tax collection, import duties tariffs on conventional vehicles should increase by approximately 7% to 11% over the proposed timeframe.

Secondly, taxes based on operation should increase by 72,700 million Jamaican Dollars (1.18% of 2020-2030 tax revenue). In order to allocate this increment, measures to increase fees for internal combustion engine vehicles should target less efficient, higher GHG emitting vehicles. This measure would translate to an increase of around 7% on fuel taxation tariff for the proposed timeframe.

Lastly, other measures can be considered, such as monitoring of vehicle circulation and the implementation of a tax based on mileage.

After considering all the analyses the estimated benefits to the Jamaican economy would exceed 410,621 million Jamaican Dollars (representing approximately 2% annually of GDP during the ten year timeframe). Thus, the Jamaican population will experience a greater benefit from the adoption of electric mobility than the business-as-usual scenario.

Actions

In order to reduce the net impact on the revenue balance for the Government of Jamaica, an increase in tax revenue comprising both vehicle import duties and fuel taxes of approximately 15.41% and 4.06% annually respectively for non-electric vehicles is recommended for the proposed period. This increase would achieve tax revenue neutrality by 2030. This could be considered as a temporary action, similar to the new tax regime recommended in action line 1.

As such, the Government of Jamaica will need to develop all of the proposed actions in the current section in order to recover the tax losses and achieve the stated benefits to society.

Main actors involved: Tax Administration Jamaica and National Environment and Planning Agency.

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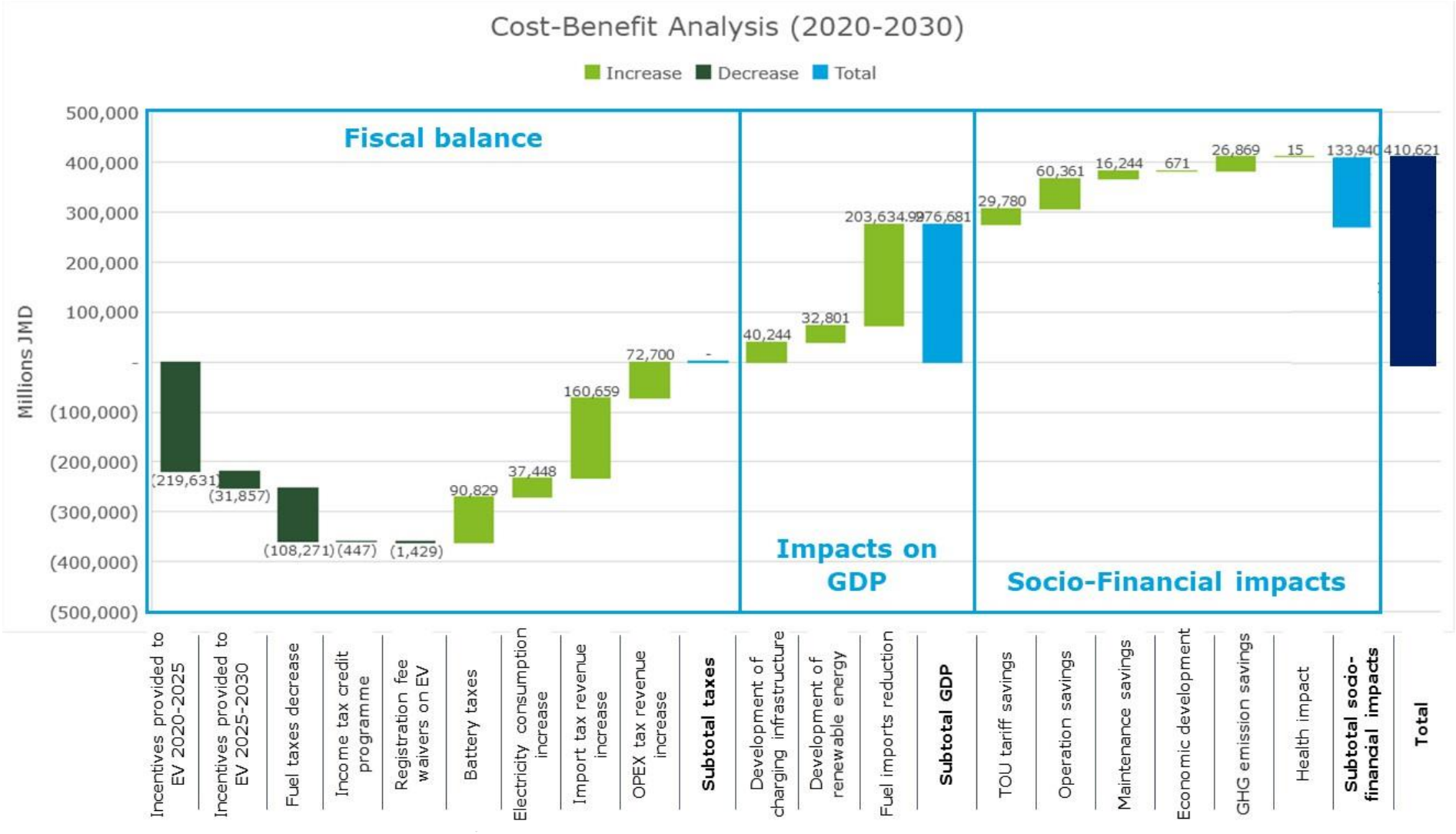


Figure 35: Cost-Benefit Analysis (millions of Jamaican Dollars).

Section 3: Technical, efficiency, and interoperability standards

The adoption of electric mobility in Jamaica will require the **development of new regulations and the upgrade of current policies to ensure the effective and efficient deployment** of this new mobility technology.

Jamaica should consider for development the following:

(i) Policies and regulations to support an adequate deployment of the required infrastructure for the viability of electric mobility adoption.

(ii) Policies and regulations to accommodate and support the development of new activities and business models to achieve an integrated electric mobility deployment.

(iii) The regulation of new transportation profiles to enhance preference towards electric mobility.

The following section presents the key areas to be addressed to achieve a nationally integrated and feasible electric mobility deployment.

The targets defined are based on the key areas of new policy adoption which will rely on the development of a regulatory framework that achieves:

(i) **Accessibility and interoperability** of electric mobility deployment.

(ii) **Security and reliability** of electric mobility integration.

(iii) **Guidance to monitor the development of opportunities** arising from electric mobility adoption.

(iv) **Policies to incentivise and support the transportation** profile of electric mobility.

The strategic framework developed within this section, **regarding the achievement of technical and efficient deployment of electric mobility, is focused on**:

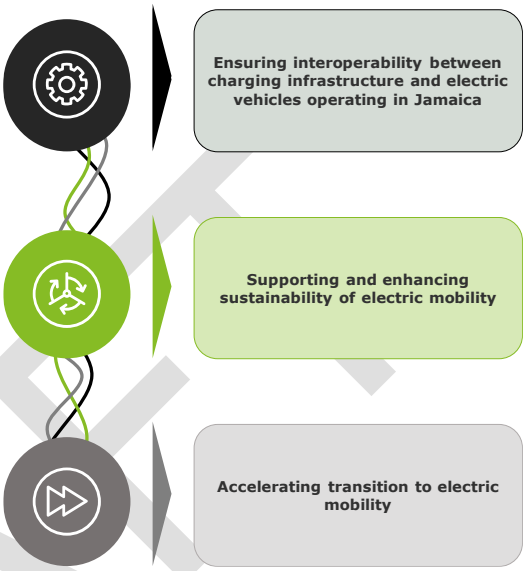


Figure 36: Actions to develop in Jamaica for achieving technical, efficiency, and interoperability standards.

In order to ensure electric mobility assets are deployed with interoperability as a priority, the following key areas have been identified, as well as, the main action lines that are required:

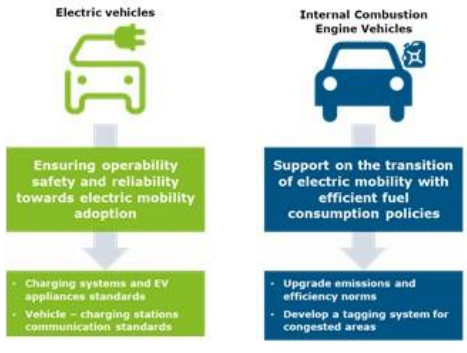


Figure 37: Focus of the development of technical, efficiency and interoperability standards.

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Action line 3: Charging systems and EV charging station standards for private vehicles, buses and other transportation modes

Rationale

Electric vehicle technology and efficiency have improved since the early stages of electric mobility adoption. Technical specifications and performance standards for new mobility technology are required to enhance the viability of electric mobility adoption. In order to enable adoption within the current mobility framework in Jamaica, the definition of standards to ensure a reliable and accessible electric mobility charging system is a key issue.

The definition of technical equipment supply standards to accommodate electric mobility adoption will require addressing the different mobility profiles to ensure adequate availability, as well as, the sustainability of the electric mobility national fleet within the network grid integration.

Globally, different technical standards have been defined and developed worldwide regarding the categorization of electric vehicles that allow for the classification of charging systems into different categories.

Different automakers have designed different connector designs, including connector types, supply power capacity and direct or alternate current as primary input.

Private deployment of charging infrastructure should include different technical charging standards than that of a publicly accessible charging system, as the needs and charging profiles are different.

Actions

In order to achieve an efficient and fully integrated charging system in Jamaica, different categories of electric vehicles charging stations should be defined.

The definition of technical charging standards will be necessary to ensure electric vehicle adoption viability and the meeting of users' needs, as well as addressing charging system grid integration sustainability.

The definition and implementation of policies that set technical standards for charging system infrastructure will inspire confidence and will result in the sustainable growth of electric mobility.

Policy considerations to establish technical standards include the following:

(i) Introducing standards for vehicle to grid interface components, batteries and other charging infrastructure.

(ii) Ensuring charging systems that are accessible to the national electric mobility fleet. A policy will have to be developed to ensure that electric vehicles operating within Jamaica have compatible charging infrastructure across the country.

(iii) Development of guidelines and policies to set standards to accommodate innovation within the charging system deployment.

(iv) Address safety risks – develop the technical specifications and operation of the charging system.

In order to achieve the aforementioned key targets, the following actions should be considered:

DRAFT

Classification in use	Level (SAE J1772)	Modes (IEC 61851-1)	Current	Power	Type per geographical area				Location within the city
					China	Europe	Japan	North America	
N/A	Level 1	Mode 1 and Mode 2	AC	≤3.7 kW	Devices installed in private household, the primary purpose of which is not recharging electric vehicles			SAE J1772-"Type 1"	Private homes and workplaces
Slow chargers	Level 2	Mode 3	AC	>3.7 kW and ≤22 kW	GB/T 20234 AC	IEC 62196-"Type 2"	SAE J1772-"Type 1"	SAE J1772-"Type 1"	Private homes, workplaces, public charging
			AC	≤22 kW	Tesla connector				
Fast chargers	Level 3	Mode 4	AC Triphase	>22 kW and ≤43.5 kW	N/A	IEC 62196-"Type 2"	N/A	SAE J3068	Public charging and highways corridors
			DC	Currently <200 kW	GB/T 20234 DC	CCS Combo 2 Connector	CHAdeMo	CCS Combo 1 Connector	
			DC	Currently <150 kW	Tesla and CHAdeMO connectors				

Figure 38: Summary of global charging infrastructure standards.

(i) Design and development of public policies regarding technical standards for the development and installation of electric mobility public charging infrastructure.

(ii) Design and development of the requirements and technical and safety standards for the deployment of private charging infrastructure.

An example of existing standards, is the SAE J1772 standard that covers the general physical, electrical, functional and performance requirements to facilitate conductive charging of EV/PHEV.

Nevertheless, the **brand of imported vehicles must be taken into consideration when developing the standards guidelines**.

As shown in figure 39, currently deployed charging infrastructure in Jamaica is mainly AC, either Type 1 or Type 3 (according to IEC 62196-2 & 3 classification). It is to be noted that Type 3 is a standard mainly developed in France and Italy that has been substituted by a Type 2 plug (as it is the AC charging plug used in Europe) ("Mennekes").

The definition of policies to define charging standards should consider both vehicles and their supply equipment, including operational,

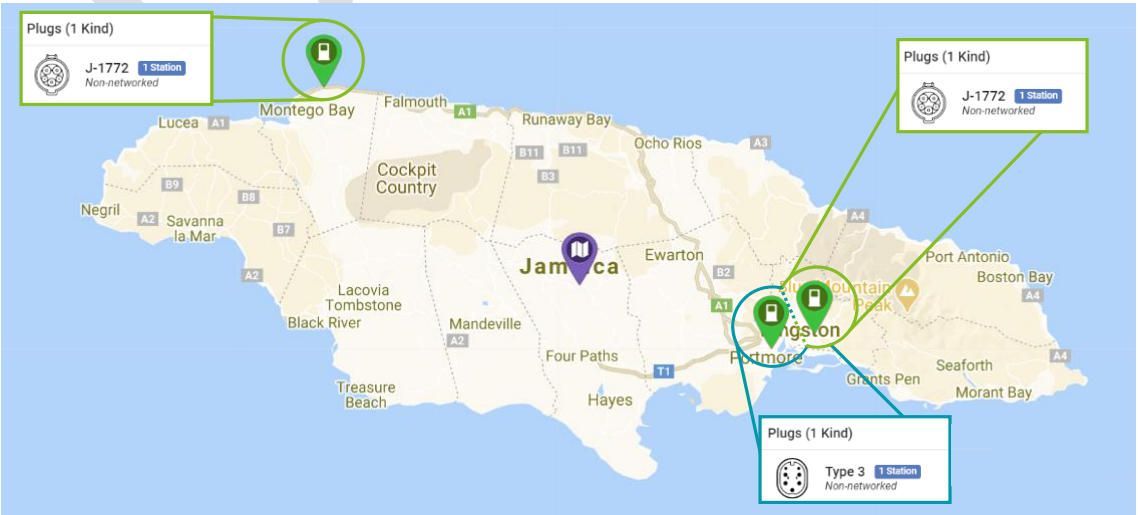


Figure 39: Existing charging infrastructure in Jamaica by mid-February 2020. Source: plugshare.com

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functional and dimensional requirements for the connection of the electric vehicle to the grid.

Additionally, electric vehicles supply equipment manufacturers along with Jamaican Public Service Company will need to play an essential role in the development of electric vehicles charging standards. We recommend, the creation of a "Standardization Committee" who will consider the definition of feasible deployment standards, upgrade, and monitoring and evaluation of standards processes. Compliance should be included as a function of the Committee.

Nevertheless, considering that vehicle imports in Jamaica mainly come from Japan and the United States, initial considerations point to the usage of Type 1 connectors for AC charging and CCS Combo 1 or CHAdeMO connectors for DC charging. However, the majority of right-hand drive countries in the world use Type 2 connectors, making this standard pretty attractive in terms of charging infrastructure deployment.

It is to be noted that AC converters exists (type 1 plug to type 2 and vice versa) but there are not for DC conversion.

In addition, please note that general guidelines regarding charging infrastructure standards is being undertaken.

Actors involved: Jamaican Public Service Company, Ministry of Science, Energy and Technology, the Ministry of Transport and Mining, Bureau of Standards Jamaica.

Action line 4: Vehicle-charging stations communication standards

Information exchange between the electric vehicle demand, charging infrastructure, and the power network grid represent key factors for the successful operation and management of the electric mobility deployment.

Communication and information requirements are critical in order to:

(i) Ensure safety and compatibility of the electric mobility charging infrastructure.
(ii) Meet increasing demand for energy arising from electric mobility adoption.
(iii) Ensure interoperability of the charging system, through data and information collection and treatment requirements.

Increasing development of the network grid, as well as, the development of new technologies and services, will require additional information management and therefore communication protocols are required to ensure an efficient operation of electric mobility deployment.

Hence, communication needs are higher with systems that are more complex and that provide more services to customers. Accordingly, less complex systems will communicate basic information such as battery levels, charging time, cost of the service and its payment. On the other hand, more complex systems can provide charging offset in order to develop load management or vehicle-to-grid solutions, amongst many other uses.

Overall, the definition of communication standards and guidelines are required to ensure that the early stages of electric mobility, as well as, future needs arising from the electric vehicle are taken into account. Ecosystem development is a key driver in order to remove barriers for electric

DRAFT

mobility development and ensuring its full potential within the Jamaican economy.

Actions

Interoperability between electric vehicles, charging infrastructure systems and the network grid represents a key factor with respect to the full integration of electric mobility. The following should be considered:

(i) Development of communication charging protocols for the operation and management of the charging system.

(ii) Development of communication standard protocols and policies to establish demand response mechanisms.

Additional communication standards and policies will need to be established under an environment of increasing penetration of technological innovation solutions within the charging system:

(i) Update of communication standards policies regarding smart metering technology deployment within the network grid.

(ii) Update of communication standards policies considering smart charging technology solutions integration (vehicle to grid services).

Policies and monitoring mechanisms should be developed in order to ensure the compliance of communication standards.

In addition, communication standard guidelines and policies implementation, will provide the opportunity to develop mechanisms to **monitor, and evaluate the efficiency of the use of the charging system**.

Existing communications standards have been developed and implemented globally. The ISO 15118 standard is considered a global reference.

The most developed markets include Europe (mainly United Kingdom, Denmark, Germany, Netherlands and France), Asia (Japan and Korea) and the United States. For the Jamaican scenario, the development of JUMPSmart MAUI in Hawaii and M-tech Labo in Japan are worth of study as they have been developed in an island.

Actors involved: Jamaica Public Service Company, Ministry of Science, Energy and Technology, the Ministry of Transport and Mining and the Bureau of Standards Jamaica.

Action line 5: Vehicle to grid services and business model development structuring

Rationale

The deployment of charging infrastructure for electric vehicles provides an opportunity to realize benefits that are not limited to environmental improvement through a reduction of greenhouse gas emissions and a reduction of fossil fuel demand. Electric mobility provides synergies with the electricity sector as it provides **options to deploy new technologies and business models focused on achieving benefits for the network grid operation and control management through the digitalization of the transportation framework**.

Similarly, other opportunities can emerge from the deployment of charging infrastructure, developing synergies between sectors and developing new business models thus increasing benefits within the electric mobility framework.

Smart charging solutions will develop as electric vehicle technology interaction with the electric system evolves. At first, users will be encouraged to charge their electric vehicles during low peak periods, by

DRAFT

means of an electricity tariff that encourages vehicle charging based on load demand. The second step to develop smarter charging solutions, will include the aggregation of electric vehicles as distributed storage, absorbing energy when it is cheaper and giving it back to the system once it is more expensive, resulting in an even further cost reduction for the system, and the user.

Other benefits arise in terms of giving consumers the power to manage their energy and reducing their reliance on utility companies.

As a result, this action line should contribute to a reduction of the total cost of ownership of an electric vehicle, compared to total cost of ownership of an internal engine combustion vehicle.

Actions

In order to allow the Jamaican electric mobility framework to benefit from these opportunities, as well as, from the development of future business models that may arise and protecting the established framework, the defined framework should be dynamic.

As such, the "Standardization Committee" will analyse new business models structured around charging infrastructure, including vehicle-to-grid solutions and will facilitate, if considered feasible, a pilot program. If the pilot program is successful, the "Standardization Committee" will authorise the full deployment of the business model or the integrated technology.

It is recognized that amendments to existing regulation or the development of new regulations may be required as a result.

Actors involved: Office of Utilities Regulation and the Ministry of Science, Energy and Technology and Jamaican Public Service Company.

Action line 6: Cybersecurity guidelines

Rationale

As previous action lines state, charging infrastructure for electric vehicles is a critical component for electric vehicle operation.

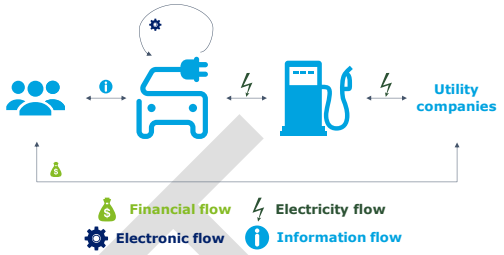


Figure 40: Information flows for electric vehicle charging.

Information flows defined in figure 40 identify four modal flows: (i) financial flows ensure the payment for the charging service, (ii) electricity flows ensure electric vehicles are charged, and thus available for the user, (iii) electronic flows within the electric vehicle ensure operability of all the different services provided by a vehicle and (iv) information flows that transfer data to users.

All the aforementioned information flows are subject to cyber-attacks. Financial information flows can be subject of fraudulent operations. Electricity information flows can be manipulated to show differences with consumption, introduce harmonic frequency distortions and impact disturbing system reliability, amongst others. Electronic information flows are very sensitive since electric vehicles have most of their functionalities controlled by an internal communication system.

In addition, the information flows include confidential data that can be threatened by unauthorised access to the information.

As a result of these threats, cybersecurity for electric vehicle information flows are an important

DRAFT

driver that needs cross-sector participation in order to improve the development and enhancement of the electric vehicle ecosystem in Jamaica.

Actions

In order to achieve a communication flow network free of risks for users and the system as a whole, different countermeasures must be established and defined.

Cryptography protocols are commonly used in order to secure flows and the process of encrypting information to ensure protection against unauthorized access.

The key targets to achieve a secured flow network include:

(i) Organising a **relevant group of stakeholders from the different industries in order to develop comprehensive and integrated actions**.
(ii) **Risk assessment analysis derived from potential risks impact assessment**.

Therefore, an **operating code for electric vehicles** should be defined, including the **requirements and related cybersecurity guidelines and procedures**. The operating code should consider:

(i) The design and implementation of how the different communication flows will be addressed.
(ii) The definition of the responsibilities of the different agents involved.
(iii) The creation of a cross-sector "Standardization Committee" for the supervision and development of the product.

Actors involved: Ministry of Science, Energy and Technology, Jamaica Public Service Company and any stakeholder financing or operating electric vehicle supply equipment.

Action line 7: Upgrading emissions and efficiency norms for internal combustion engine vehicles

Rationale

As a complimentary measure towards greenhouse gas reduction, many countries have developed strict emissions standards for internal combustion engine vehicles.

Emission standards are crucial to consider for two main reasons. Firstly, less efficient vehicles have more emissions and have a greater impact on climate change and its subsequent effects on the Jamaican population. Secondly, the imposition of emission standards on vehicles imported to Jamaica is a counter-measure that may help to disincentivize the population from purchasing aged conventional vehicles.

Currently in Jamaica, there is no greenhouse gas emission limit. Moreover, a recent Notice of Amendment (The Trade Board Ltd., 2020) establishes an extension in age limit for all vehicle imports, extending the year limit from five to six years for second-hand sedans and station wagons.

The data suggests that an increasing percentage of registered vehicles in Jamaica are second-hand vehicles. Hence, the Notice of Amendment will facilitate an increase in the age of the national fleet and result in reducing fuel efficiency of the internal combustion engine fleet. This will in turn produce more greenhouse gas emissions from the Jamaican transportation sector. Therefore, greenhouse gas emission standards should be established.

Thus, the age limit import restriction measures does not focus on targeting reduction on greenhouse gas emissions from the transportation sector, unless combined with

DRAFT

additional vehicle requirements such as pre-emission testing mechanisms.

Establishing greenhouse gas emission standards and upgrading efficiency norms for imported vehicles will in the long term result in a reduction of greenhouse gas emissions from the national fleet and in turn, will contribute to a higher air quality and better health conditions, amongst other benefits. As a result, the total cost of ownership of electric vehicles, compared to internal engine combustion ones, will experience an improvement.

Action lines

The Ministry of Transport and Mining in conjunction with the Jamaica Bureau of Standards and the National Environment and Planning Agency will be in charge of developing a cost-benefit analysis on adopting different greenhouse gas emission standards and efficiency norms in Jamaica, whilst taking into considering the environmental and health impacts on the Jamaican population.

A positive result from the cost-benefit analysis will inform the regulatory development by the Ministry of Transport and Mining and can be integrated into the Road Traffic Act 2019.

The development of the greenhouse gas emissions and efficiency standards will need to **include emission testing of vehicles in the national fleet at the Island's inspectorate locations.**

The definition of categorization of vehicle emissions should be addressed in order to establish greenhouse gas emission limit targets.

Furthermore, **annual vehicle fitness programs will need to include emission compliance tests**.

Hence, these measures should include:

(i) The development of an **updated and detailed greenhouse gas emission and vehicle efficiency standards**.
(ii) The **definition of vehicle greenhouse gas emission limits considering existing vehicles** within the national fleet, as well as, limits on greenhouse gas emissions **to newly imported vehicles**.
(iii) The definition of **measuring and monitoring mechanisms**: **vehicle annual fitness** monitoring mechanisms, as well as, **pre-fitness certification process on imported vehicles**.
(iv) Data collection mechanisms to evaluate efficiency.

Actors involved: Ministry of Transport and Mining, National Environment and Planning Agency and the Bureau of Standards Jamaica.

Action line 8: Developing a tagging system for congested areas

Rationale

Idling a vehicle for more than ten seconds will consume more fuel and emit more greenhouse gases than stopping and restarting it (Argonne National Laboratory, 2013).

Even though the impact of a single car towards both fuel consumption and greenhouse gas emission may be limited, the aggregated effect of the close to 640,000 vehicles that form the current Jamaican fleet has a significant effect on national imports and GHG emissions goal accomplishment.

In line with the previous idea, there are some urban areas that are truly congested during peak hours. This is why many countries develop Low-Emission Zones (LEZ) and Zero Emission Zones (ZEZ), usually within

DRAFT

cities and large towns. Low-Emission Zones and Zero Emission Zones represent an effort to tackle air pollution, greenhouse gas emissions and congestions by restricting the operation and circulation of specific vehicles. Common practices focus on restrictions on the most aged and polluting vehicles.

Moreover, reliance on public transportation, namely the JUTC service in Jamaica is impacted by congestion in the Kingston Metropolitan Area. A tagging system would also contribute to increase reliability and attractiveness of public transportation, by improving cycle times.

Many tagging systems are in operation internationally. Some common examples include, allowing access based on license plate numbers (odd or even) or monitoring devices on vehicles. Note that, tagging systems are short-term measures taken to reduce conventional vehicle emissions and fuel consumption.

Actions

The National Environment and Planning Agency, along with the Ministry of Transport and Mining and the Ministry of Health will be in charge of **developing a Cost-Benefit Analysis on establishing a tagging system for private cars in congested areas,** activities should include evaluating not only the benefits for the Jamaican society in terms of health improvement, greenhouse gas emission reduction, fuel dependence reduction and public transportation reliance, but also the **impact regarding freight vehicles transit needs and impact on industrial activities should be carried out**.

Results from the analysis undertaken will mandate the design of **guidelines**, from the Ministry of Transport and Mining, towards **the definition of the mechanism to implement a tagging system in order** to monitor vehicle circulation:

(i) **Updated definition and design of the technical standards** towards vehicle categorization and circulation conditions.
(ii) **Development of monitoring mechanisms** to identify non-compliance.

Actors involved: Ministry of Transport and Mining and the National Environment and Planning Agency.

DRAFT

Section 4: Enhancing energy sector readiness

Along with charging infrastructure development, the energy sector should be ready to support electric mobility deployment**.**

A massive rollout of electric vehicles will cause an increase in the total energy demand.

Electric mobility adoption provides the opportunity to exploit synergies within the energy sector, which will require the assessment of an integrated approach to encourage new business development.

In order to achieve an optimal situation, readiness of the sector is key. Along with this, since synergies are not always clear to consumers, communication objectives will need to be developed so users are able to consider the benefits of electric mobility adoption.

Due to these synergies, it is possible that electricity costs in Jamaica will most likely to decline due to the generation mix targets, as well as, the transition to less variable and cheaper fuels such as Natural Gas.

The main objectives of this section are listed below:

(i) Fair distribution of total costs between the users of the energy sector,
(ii) Security and reliability of electric mobility adoption,
(iii) Development of monitoring tools.

This section is **focused on the full enhancement of the energy sector**:

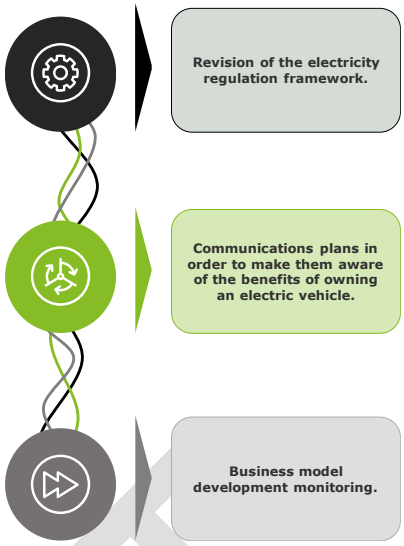


Figure 41: Actions to develop in Jamaica for achieving the energy sector readiness.

Hence, the actions to optimally support the energy sector to achieve electric mobility deployment can be grouped into the following action lines:

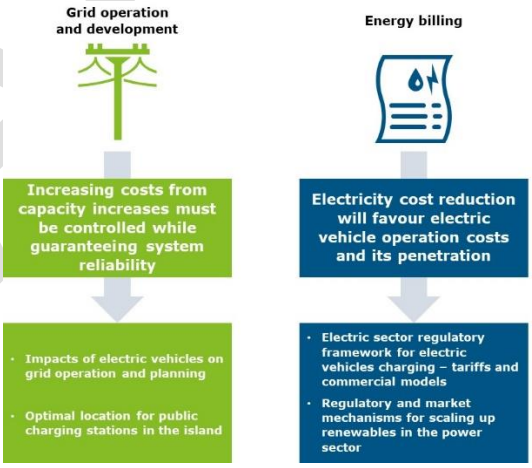


Figure 42: Focus on the enhancement of energy sector readiness towards electric mobility adoption.

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Action line 9: Impacts of electric vehicles on grid operations and planning

Rationale

The electrification of mobility and its evolution in the mid-to-long term represents a challenge for the power grid as the average load per domestic customer will increase. Along with the average load increase, the load generation curve will flatten as vehicle-to-grid solutions commence and bi-directional energy flows are developed.

In the short-term, the electric vehicle's impact on the Jamaican electric grid is likely to be small due to a gradual increase in the level of electric mobility adoption. However, as electric vehicle percentage of the national fleet increases, the demand for electricity will increase along with grid costs, if inappropriately planned. Energy system stakeholders will need to evaluate the impacts of electric vehicles on electricity grid from a planning and operation perspective.

Electric vehicle charging power demand may push local transformers beyond their current capacity and may require technical updates on the grid or on its operational procedures.

In addition, electric vehicle expansion may have an impact on the grid's operation and the system reliability, including increasing system costs. Given the need to accommodate electric vehicles charging loads into the system planning, the grid infrastructure may need to be improved. Thus, grid infrastructure and its operation should be properly prepared for this pattern change from electricity consumers and energy demand.

Actions

For an optimal grid operation and planning in the Jamaican electric system, the cost of development must be monitored and controlled. The Office of Utilities Regulation will need to supervise the Jamaica Public Service Company so the different divisions of the company include in their revenue requirement the following:

- General: a forecast of per capita demand increase island wide as a result of electric mobility increase, including peak forecast and consumer trends.
- Power supply: impact of introducing renewable energy.
- Grid and grid operation: grid planning, smart grid deployment, impact from local operation networks, impact from charging infrastructure deployment.
- Retail: Energy billing tariffs for electric vehicle consumers, including users with their own charging infrastructure and publicly available charging infrastructure.

Regarding cost recovery of charging infrastructure deployment, JPS will need to develop a new tariff with respect to their charging points in which they bill the user with 2 tariff charges: (i) the capacity charge will allow JPS to recover installation costs and (ii) the usage charge that will allow JPS to cover operational costs.

In order to properly assess the cost increase as a result of electric mobility development, Jamaica Public Service Company will need to develop a business model that will allow them to identify grid capacity increase. The Office of Utilities Regulation and the Ministry of Science, Energy and Technology will be in charge of the monitoring and control of this business model so that it does not include stranded costs, and to ensure that grid development is adequate after considering demand increases. In this business model, electricity costs must continue on a logic path and avoid

DRAFT

peak load increases for the Jamaican consumers.

This study will serve as a baseline for future grid development, both at transmission and distribution levels, and will allow the Jamaica Public Service Company to better plan, and the Office of Utilities Regulation to more effectively supervise planning, thereby reducing future unplanned costs and system failures.

In addition, the **development of policies to set the rules to monitor and supervise grid network planning and operation is required**. These policies should include:

(i) Information requirements to be provided by Jamaica Public Service Company.
(ii) Definition of the supervisory competences.
(iii) Guidelines to information validation.

Actors involved: Office of Utilities Regulation and the Ministry of Science, Energy and Technology and Jamaica Public Service Company.

Action line 10: Optimal location for public charging stations in the island

Rationale

The deployment of charging infrastructure represents a critical factor when framing electric mobility deployment as a common barrier for customers is "range anxiety". Moreover, this effect could be further enhanced in the urban areas of Jamaica as the traffic congestion is an issue.

A range-covering charging network decreases range anxiety for electric vehicle users and thus, lowers inconveniences related with the charging process.

However, the size of Jamaica plays a major advantage when developing a charging infrastructure network that negates range anxiety from consumers.

Thus, several factors should be taken into consideration when planning public charging stations deployment. Daily traffic, points of interest, idle time, idling areas and the distance between charging stations represent some of the most crucial ones. In addition, travel behaviour variables and energy network issues should also be considered: since there are different types of charging stations with different charging capacity, the power network should be capable of supplying the required energy at those points.

Furthermore, different types of charging infrastructure should be considered for the deployment, as some places will need specific types of chargers.

In addition to this, it is essential to consider that the two defined fleets have totally different needs and purposes. The public fleet needs simpler charging infrastructure, as existing hubs for the public fleet can be more easily addressed. However, the publicly-available charging infrastructure for private fleet will need a better-designed charging infrastructure distribution in order to avoid excessive waiting time for vehicle charging and ensure that consumers always have charging stations close by.

Actions

When developing the business plan around charging infrastructure deployment, the planners must develop location proposals that take into consideration, amongst others, the transportation trends of the Jamaican population and available data from the Ministry of Transport and Mining and the National Works Agency.

DRAFT

In the business plan, different types of charging infrastructure must be considered.

Moreover, the development of a regulatory and policy framework related to accessible location, aligned with charging system standard requirements is required. For instance, a **policy with respect to the strategic location of charging infrastructure** should be addressed.

In addition, prior to the deployment of charging infrastructure comprehensive planning and **feasibility assessments** are necessary to support the final investment. **Mechanisms and guidelines** with respect to the planning of charging infrastructure should include the following:

(i) **Definition and analysis of the development of location deployment motivation guidelines**.

(ii) **Integration and accessibility to network grid connection**.

Measures and mechanisms to evaluate and monitor the deployment of charging infrastructure are required to ensure deployment efficiency.

Actors involved: Ministry of Transport and Mining, Jamaica Public Service Company, Ministry of Science, Energy and Technology, National Works Agency, points of interest and construction companies.

Action line 11: Electric sector regulatory framework for electric vehicles charging – tariffs and commercial models

Rationale

In Jamaica, the legislative and regulatory frameworks governing the electricity sector are, mainly, the Electricity Act (2015), Amendments in 2015 to the OUR Act and the Electricity Licence in 2016.

Along with the necessary infrastructure development previously described, total cost of ownership is another key issue for Jamaican electric mobility deployment. In addition, operational expenditures for an electric vehicle are mainly the cost of electricity when charging the vehicle. Thus, as part of the total cost of ownership, this represent a key element for the Jamaican population. Hence, the **cost of electricity and the structure of electricity tariffs represent an essential issue to examine**.

Moreover, increasing integration of electric vehicles within the electricity sector is dependent on load management from electricity customers.

The current tariff design in Jamaica allows time of use tariffs for rates ranging from Rate 10, allowing for load management except for domestic users. Given the fact that privately-owned charging points will be installed by domestic users, time-of-use tariffs will have to be adapted so that residential consumers can also benefit from these tariffs, allowing them to reduce their costs when charging their vehicles.

Along with tariff re-design, users must be able to charge their electric vehicles in public locations. As a consequence, **commercial tariff definition must be considered within the use of public accessible infrastructure**.

DRAFT

Moreover, when considering electric mobility development in a Caribbean country, Barbados comes as a reference. Even though electric mobility deployment in Barbados has been carried out by a company, the Government has developed policies for its allowance. As a matter of example, Barbados allowed independent operators to deploy and operate charging infrastructure as they considered the business model as an access service rather than an electricity delivery. As such, there are more than 200 private chargers in Barbados, mostly owned by the private company Megapower (Inter-American Dialogue, Inter-American Development Bank and Organization of American States, 2020).

In order to encourage private participation in the deployment of charging infrastructure (in addition to the Jamaica Public Service Company's deployment) it will be necessary to design a regulatory framework to establish interaction amongst Jamaica Public Service Company and charging supply providers.

Actions

The Office of Utilities Regulation, along with the Ministry of Science, Energy and Technology, will need to **incorporate updates on the definition of the role of the new activities** arising from the electric mobility deployment within the electricity sector, **as well as the development of new agents and interaction with the Jamaica Public Service Company**. Moreover, studies on the integration of companies that can sell electricity services within the charging infrastructure sector for electric vehicles should be established as it would represent a huge development opportunity for Jamaica.

On the other hand, in order to allow domestic customers to actively manage their electric loads, the regulatory update must include a time-of-use tariff option for all consumers. The Office of Utilities Regulation and the Ministry of Science, Energy and Technology, together with Jamaica Public Service Company, will need to work on **a regulatory policy in order to include time-of-use tariffs in low-consumption segments for electricity consumers**.

Actors involved: Ministry of Science, Energy and Technology, Office of Utilities Regulation, Jamaica Public Service Company and private stakeholders.

Action line 12: Vehicle to grid integration and distributed energy aggregators, technical and commercial regulation, new business models

Rationale

Vehicle-to-grid technology implies an integration between the electric vehicle and the grid. Despite the difficulty of this integration within system operation and the grid's bilateral flow, vehicle-to-grid integration can result in a cost reduction, as well as improved operating efficiencies from distributed storage. These benefits will be extremely profitable to Jamaica, as consumers with electric vehicles will be able to reduce their electricity bills and the reliability of the system will be highly increased.

In order to maximize the potential and opportunities of electric vehicles in vehicle-to-grid systems, Aggregators play an essential role. The Aggregator will develop a storage model that takes into consideration the electric vehicle and their battery characteristics as well as owners preferences to provide sufficient storage to impact the grid. The aggregator is an essential link in the storage supply chain and makes it possible to exploit the economic possibilities that the vehicle-to-grid market offers.

DRAFT

Another potential obstacle to successful vehicle-to-grid operation is profit allocation. As many stakeholders are included in the process, a profit sharing mechanism is required in the regulation.

Actions

The Office of Utilities Regulation, along with the Ministry of Science, Energy and Technology, will need to develop a policy to guide vehicle-to-grid integration. **Policy and guidelines regarding (i) technical operation of the bidirectional flow, (ii) aggregator operation, (iii) profit-sharing mechanisms with stakeholders participating in vehicle-to-grid solutions and (iv) allow new business models around vehicle-to-grid operation.**

Vehicle-to-grid requires a critical mass of electric vehicles to be economically viable. Hence, the successful implementation of previous phases are critical precursors to the implementation of vehicle-to-grid systems.

This regulatory framework will need to include an **alignment programme with the development of a smart grid that allows the system operator to integrate the distributed electric fleet.**

Actors involved: Ministry of Science, Energy and Technology, Office of Utilities Regulation, Jamaica Public Service Company and private stakeholders.

Action line 13: Regulatory and market mechanisms for scaling up renewables in the power sector

Rationale

Renewable energy is a clean and competitive energy source. In contrast to fossil fuel, it represents a great alternative for further greenhouse gas emissions reduction as well as a favourable opportunity for a further reduction in fuel dependence for Jamaica.

Even though renewable energy (hydro, wind and solar) in Jamaica accounts for only 14.80% of the installed capacity in 2018 (Ministry of Science, Energy & Technology, 2013), fossil fuel energy accounts for over 80% of generation costs (The Jamaica Public Service Company Limited, 2018).

Moreover, Jamaica signed the Paris Agreement in 2016 and ratified it in 2017, committing to the 20/20/20 target (20% of carbon dioxide (CO_2) reduction, 20% renewable energy share and 20% increase in energy efficiency).

As the electric vehicle technology has synergies with self-consumption, there is the potential for renewable energy to scale up in Jamaica. The synergy can be quickly explained as distributed storage combines with distributed generation and vehicles can act as vehicle-to-home solutions in order to allow for individuals to benefit. However, at a system level, these benefits quickly increase as consumers are incentivized to develop self-consumption to reduce their bills. This, in turn will increase even more electricity network reliance and reduce fuel dependence and greenhouse gas emissions.

The Jamaican electricity system includes net billing compensation for consumers who own renewable energy systems and allows them to sell excess energy to the Jamaica Public Service Company.

In addition, the development of smart grid solutions within the network grid will position the Utility to facilitate renewables development. Current projects to increase network grid digitalization by Jamaica Public Service Company, creates an opportunity to address combined decisions on scaling up renewables and incentivising electric mobility integration.

DRAFT

Actions

Given all the aforementioned benefits, regulatory and market mechanisms should be developed in order to foster renewable energy integration within the national electric vehicle deployment and penetration plan.

The energy framework needs to **establish net billing mechanism together with the integration of electric mobility and vehicle to home solutions**, in order to provide further reductions in operational costs to electric vehicle owners in their electricity bill.

A key point for consideration is the **definition of compensation procedures** for consumers.

Moreover, in order to make the population aware of these benefits, **communication programs will need to be developed** by the Jamaican Public Service Company, highlighting the synergies between electric vehicles and self-consumption.

Actors involved: Ministry of Science, Energy and Technology, Office of Utilities Regulation and Jamaica Public Service Company.

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Section 5: Enhancing transport readiness

Along with the energy sector, the transport sector represents a critical stakeholder group in boosting electric mobility deployment.

Different policies and measures should be developed for the national fleet. Separate policies need to be developed for the public fleet and private fleet in order to make implementation of electric vehicles viable at the national level through an effective process.

This strategic framework has been developed on the premise that electric vehicles will gradually replace internal combustion engine vehicles and not necessarily increasing the number of vehicles. Hence, there will be in the sector both electric and conventional vehicles. A program of incentives and disincentives will have to be evaluated on their effectiveness of encouraging the transition of the national fleet to electric vehicles.

Hence, **special focus should be on the encouraging high use transportation modes, such as public passenger transportation vehicles to move to electric vehicles, as their potential impact on greenhouse gas emission reduction is significant.**

Moreover, consideration of complementary measures to address improvement in the quality of services provided by this type of transportation modes is necessary in order to shift preference to public electric transport services.

The main objectives of this section are enhancing the development of measures towards:

(i) Reliability and efficiency of electric mobility penetration.

(ii) Development of monitoring tools.

(iii) Development of communication campaigns to increase awareness regarding electric mobility among the Jamaican population.

This section will address transport sector readiness regarding:

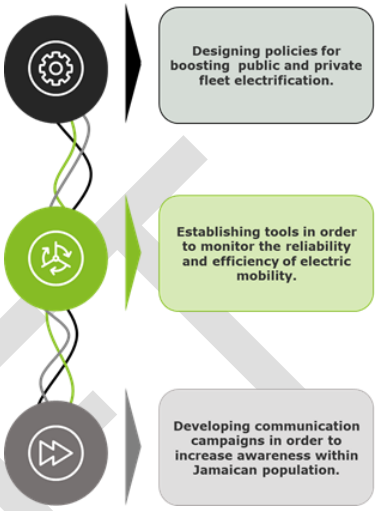


Figure 43: Actions for developing transport sector readiness.

Actions to support the transportation sector to achieve electric mobility deployment can be grouped into the following action lines:

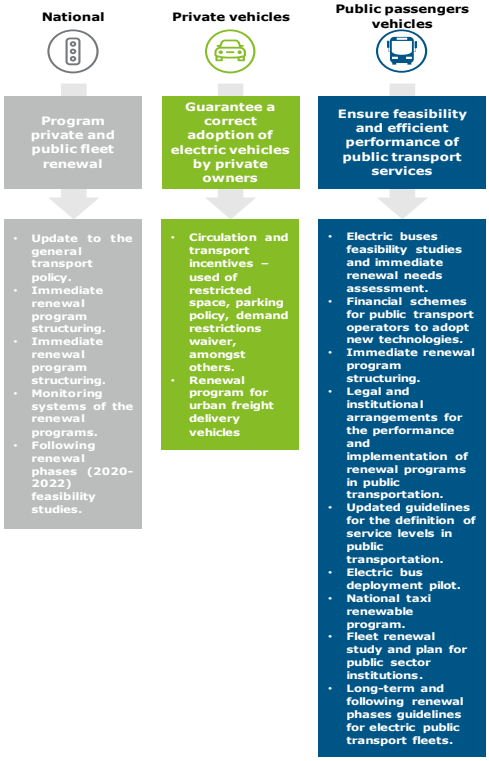


Figure 44: Areas of focus to enhance transportation sector readiness.

DRAFT

Last, Chile defined in its electric mobility strategic framework that electric vehicles have a natural development in public transportation (Ministerio de Energía - Gobierno de Chile, 2017). This natural development is explained by two factors:

1. Due to its intensive use, operation costs easily overcome acquisition costs.
2. Public policies will have a more controlled impact.

Following this case study, actions for a leading example on electric mobility adoption in Jamaica arise.

Action line 14: Update the general transport policy

Rationale

The Jamaican National Transport Policy identifies the issues that the Government faces in the development of the transportation sector.

However, the National Transport Policy in Jamaica is dated 2007 and updates a document from 1993.

This document covers a number of key priorities that are examined within this Strategic National Framework, such as reducing fuel imports, integrating the transportation sector with other key sectors and enabling private participation.

However, the development needs of the transportation sector, including electric mobility have changed. In order to enhance the transport readiness for electric mobility adoption by the Jamaican population new infrastructure needs to be deployed and new business models may arise from technology adoption.

Moreover, the transportation sector has changed at the international level. Globally, mobility trends include car-sharing and car-hailing which are developing at a fast-pace. Mobility as a Service business models are emerging. Even though these services have not yet been developed in Jamaica, electric mobility can foster its adoption and transport regulators should be prepared for this innovation.

Actions

For the transportation sector to be fully prepared for a massive adoption of electric vehicles from consumers, the Jamaican transportation sector needs to evolve.

For instance, even though the deployment of charging infrastructure is partially going to be deployed by the Jamaica Public Service Company, its integration within the transportation sector, needs to be defined within the National Transport Policy.

Therefore, the National Transport Policy needs to be updated in order to ensure it is flexible enough to allow for technology to change while it still includes the key issues in this document: emission reduction, congestion reduction, multi-modal transportation, etc.

In addition, further updates of the National Transport Policy should be considered in order to include the different areas of development of electric mobility adoption as detailed in this document, such as, congestion tagging system mechanisms, efficiency norms, vehicle circulation guidelines, etc.

Furthermore, this policy update needs to be in alignment with the energy regulation recommendations in section 4.

Main actors involved: The Ministry of Transport and Mining, National Environment and Planning Agency and the Ministry of Science, Energy and Technology.

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Action line 15: Electric buses feasibility studies and immediate renewal needs assessment

Rationale

Bus fleets are critical components of the transportation sector when considering fuel consumption and the consequent greenhouse gas emissions as internal combustion engine buses are often a high source of greenhouse gas emissions due to the fact that buses cycle through their routes a number of times per day.

For instance, buses from Jamaica Urban Transit Company travelled, on average 31,273,332 km per year from 2014 to 2016 (Bailey, 2018), amounting for more than two thousand tonnes of CO_2 equivalent in greenhouse gas emissions per year.

Introducing electric buses within bus fleets in Jamaica would allow the government to drastically reduce greenhouse gas emissions from the transportation sector.

However, the total cost of ownership of electric buses and its economic profitability is still questionable. According to the IEA Global electric vehicle Outlook 2019, electric buses that travel around 40,000 to 50,000 kilometres per year are competitive for battery prices of 260 USD/kWh in regions where diesel attracts high taxes (IEA, 2019).

Research indicates that one bus in Jamaica travels, on average, more than 75,000 km per year and battery prices reached 176 USD/kWh in 2018 (BNEF, 2019). The aforementioned average annual distance travelled and the battery price suggest that electric buses are feasible in Jamaica, even though taxes on fuels are lower in Jamaica than in other Caribbean countries.

Moreover, a number of studies have determined that electric buses have a lower total cost of ownership when taking into account other factors. These factors include air and noise quality and greenhouse gases' external costs. However, the total cost of ownership of electric buses would exceed the total cost of ownership of conventional buses if costs related to "other factors" are not considered.

Finally, electric buses will provide an opportunity for public operators to offer a cheaper, more reliable and more independent service for Jamaican customers, as operational costs will decline in line with battery cost reduction.

In conclusion, electric buses provide an option with great advantages and will position the transportation sector in Jamaica towards sustainability.

Actions

In order to properly transition to an electric bus fleet in Jamaica, **licensed companies for bus transportation will have to consider the option of replacing their fleets with electric buses. This assessment should include the total cost of ownership and costs related to "other factors"** in Jamaica.

Publicly owned companies such as the Jamaica Urban Transit Company and Montego Bay Metro, will report their analysis to the Planning Institute of Jamaica and the Ministry of Transport and Mining.

Considering that the economic analysis for the total cost of ownership of any electric vehicle must factor electricity tariffs into their operating costs, the tariff recommendations of the previous section must be implemented. In fact, section 4 established a redefinition of the tariff to include vehicle-to-grid solutions in the national policy in order to reduce the costs of electric vehicles. This reinforces the need for the energy sector to adopt these measures, as it will lead to a reduction in the total cost

DRAFT

of ownership for any electric vehicle, including buses.

Main actors involved: Jamaica Urban Transit Company, other bus operators, Ministry of Transport and Mining, Planning Institute of Jamaica, Ministry of Science, Energy and Technology, Office of Utilities Regulation and Jamaica Public Service Company.

Action line 16: Financial schemes for public transport operators to adopt new technologies

Rationale

Any public transport operator company, privately or publicly owned, that owns electric vehicles will need to develop an ecosystem when adopting electric vehicles.

Considering this, a company acquiring a large fleet of electric vehicles will need, at least, to develop a charging infrastructure network for their vehicles to charge, establish a charging schedule and train operation and maintenance workers to acquire technical knowledge.

Therefore, companies operating public fleets will need to make significant investments in order to develop the needed ecosystem.

Some public transport operator companies may not have the financial means to fund this development. Financing schemes will have to be considered.

In addition, the public transport operator fleets have partially relied on public subsidies in order to balance their cost structure. Developing financial schemes can help in the achievement of subsidy reduction, while fostering a reliable and independent public transport operator fleet in the future.

Actions

In addition to the national budget financing public transportation services, other strategies should be studied as electric mobility deployment requires high investments, not only with respect to vehicle purchases but also the deployment of the charging infrastructure.

Globally, public companies can **access different finance schemes that allow them to finance big rollouts or new technology adoption**. For example, taxes and charges can be used to finance deployment, as well as **public-private partnerships and access to specially designed loans or public loan access**.

In order to provide flexibility for stakeholders, a number of these finance schemes should be included within regulatory developments. As a result, the **National Transport Policy update should include different finance schemes for public fleets, in order to increase the share of electric vehicles**.

Main actors involved: Private stakeholders (companies and banks), the Ministry of Transport and Mining and the Jamaica Urban Transit Company.

Action line 17: Immediate renewal program structuring

Rationale

Given the fact that the current national public fleet in Jamaica is aged, its greenhouse gas and particle emissions and fuel consumption are higher than in other countries.

The implementation of electric mobility will require a demonstration of its feasibility, which will act as a catalyst for its adoption by the population.

As policy and regulatory updates will not have an immediate impact on the public fleet renewal, the Government of Jamaica will have to launch **programs and guidelines to address short-term actions**.

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Planning and structuring represent a crucial part of the electric vehicle deployment strategy in the public fleet. In order to develop an efficient renewable program, several actions should be followed.

(i) Pre-deployment fleet evaluation in order to help both, private bus fleets and public bus fleets, to identify the companies owning buses that are suitable for immediate electric vehicle replacement and determining cost-effective ways to deploy the electric vehicle fleet.
(ii) Design of the deployment plan in order to set penetration targets.
(iii) The design of incentives and other measures to increase the electric vehicle fleet.
(iv) Education, training plans and additional policy development to monitor the progress of the electric public transportation fleets' deployment.

However, as a key strategic driver towards transportation enhancement in Jamaica, and in order to set an immediate integration of electric public fleets, measures need to be considered.

Actions

In order to ensure a quick deployment of electric bus integration in Jamaica, the Government will need to develop a communication campaign that will inform public fleet transportation companies of the benefits, inclusive of financial and environmental benefits.

Main actors involved: Government of Jamaica, Jamaica Urban Transit Company Limited, Montego Bay Metro and other bus operators.

Action Line 18: Long-term and renewal phases guidelines for electric public transport fleets

Rationale

Demonstration of the feasibility of new technology is a good catalyst for its adoption. Therefore, the electrification of vehicles within public transport fleets would be a leading example for a shift in mobility patterns.

In addition, public transport fleets, especially buses, due to their larger size, are great greenhouse gas emitters. Thus, the electrification of these fleets represents an area of focus to achieve higher impact on greenhouse gas emission reduction.

Public transportation fleets that should be considered for renewal are: route taxis, hackney carriages, stage carriages, express carriages and contract carriages.

Actions

In order to establish an organized transition towards a full electrification of the public fleets, the Transport Authority, along with the Ministry of Transport and Mining will develop a strategic plan for the gradual acquisition of electric vehicles for the five fleets identifies above.

As licenses for public transportation are issued by the Transport Authority, additional requirements could be incorporated in order to progressively include electric vehicles within the public transportation fleet.

For instance, **the licence issuance model could consider a maximum number of licenses and will reflect a priority issuance ranking. This ranking will consider if an applicant submits an electric vehicle or an internal combustion engine vehicle**. In case it is the latter, vehicles will be ranked from a lower fuel efficiency and emission factors from top to bottom.

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Main actors involved: Ministry of Transport and Mining and Transport Authority.

Action line 19: Monitoring systems of the renewal programs

Rationale

Previous action lines represent the starting point towards the definition of public policies for the electrification of the private and the public transportation fleets.

However, in order to verify that the impact of the established policies work as intended, supervision methods should be taken into consideration.

In addition, information collection and analysis is critical in order to monitor progress of the renewal of public transportation fleets.

Actions

Specific control and monitoring over the public transportation fleets, will require the design and development of information collection mechanisms.

Specific records and databases of issued licenses of public transportation fleets should be considered.

The database and the proposed licence issuance model where, licenses are ranked based on vehicle technology, as well as, the average greenhouse gas emissions of the vehicles are captured, must include procedures to process and analyse the data if the Transport Ministry is to successfully monitor the renewal of the public fleet. These actions will allow the Government to directly supervise the evolution of the public transportation fleets.

Main actors involved: Ministry of Transport and Mining, Jamaica Urban Transit Company and Transport Authority.

Action line 20: Post implementation renewal phases - feasibility studies

Rationale

In the short term, post fleet renewal evaluation will be required to achieve the feasible deployment of electric vehicles.

Total cost of ownership should be evaluated by Jamaican citizens: although in the short-term, the investment needed for the acquisition of an electric vehicle is substantially higher than that for a conventional vehicle, in the medium and long term expenditure costs will be compensated by the lower operational costs. This will benefit public transport vehicles which log larger distances during the day: for them, initial investments will be quickly recovered in the following years.

During the short-term, the ecosystem for the electric vehicles will not be completely developed: some advancements regarding charging infrastructure network will be implemented. In addition to this, the main electric mobility regulation and incentive policies will have to be formulated as they will encourage the further deployment of electric mobility in Jamaica.

Actions

Within this two-year period, market research should be conducted via pilots, which will introduce a specific number of electric vehicles in each type of fleet, both public and private. Ministry of Transport and Mining should be in charge of designing and administering these pilots, to ensure that the deployment is done properly and aligned with the installation of charging stations throughout the island. During these first stages, it is essential to coordinate actions between the different elements of the ecosystem.

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Main actors involved: Ministry of Transport and Mining.

Action line 21: Legal and institutional arrangements for the performance and implementation of renewal programs in public transportation

Rationale

Along with the design and implementation of renewal phases, as described in the previous action lines, legal and institutional arrangements to guarantee its success should be studied. The management of the public fleet mainly resides in the Ministry of Transport and Mining. Public vehicle fleets might present some obstacles in their electrification, due to the Public Passenger's Vehicles licenses requirements, as there is no available specification regarding vehicle's powertrain.

As declared by the National Transport Policy, the main objective of public transport is the promotion of efficient and safe public transport. For this reason, it is recommended that a regulation that considers electric vehicles within the public transportation fleet is established.

Actions

Within the updated general transport policy, procedures for investing in electric vehicles and their economic operating feasibility will be developed.

The Transport Authority, the Jamaica Urban Transit Company and the Ministry of Transport of Mining will be in charge of analysing the established transport policy and ensuring that the regulations will set no legal or institutional obstacles towards the deployment of the electric vehicle.

Main actors involved: Ministry of Transport and Mining, Transport Authority.

Action line 22: Updated guidelines for the definition of service levels in public transportation

Rationale

As previously described the electrification of the public fleet will bring several benefits in terms of cost and greenhouse gas emissions reduction. However, further advantages include reliability in its services. In Jamaica, public transport is not entirely able to provide quality services. In order to offer acceptable alternatives to private transport, the public sector should improve its quality of service and improve the service offered to consumers.

The ability of public transport to provide fast and efficient transportation services depends on the ability to evaluate the existing services and determine where progress could be made. Additionally, recognizing the need to perform evaluations in order to address quality concerns and improve urban transport performance in cities is crucial.

Defining the service levels in Jamaica is necessary for setting performance baselines for the public transport sector. These service levels will be used to determine if the transportation facility is operating from a traveller's perspective to standard. They should be based on reliability and punctuality of the service provided.

Actions

Annual objectives should be established within public fleets. These targets could be designed by the public operators, under the supervision and approval of the Ministry of Transport and Mining. Additionally, surveys of public transport users will be conducted on a three-month basis: the results obtained should be evaluated by the Ministry in order to verify if the specific targets proposed by public services have been accomplished.

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These results can be used to identify current or potential gaps and inform possible improvements.

Additionally, economic incentives could be offered to those public services that have successfully fulfilled the objectives. These types of initiatives can motivate public operators to optimize their services and offer users valuable experiences.

Main actors involved: Ministry of Transport and Mining and Transport Authority.

Action line 23: Circulation and transport incentives – use of restricted space, parking policy, amongst others

Rationale

Apart from the renewal of public and private fleets, further measures should be contemplated in order to guarantee the shift from internal combustion engine vehicles to electric vehicles. Throughout the globe, governments use different policies for incentivizing the adoption of electric vehicles.

A common policy in incentive development is economic subsidies that contribute to electric vehicle price reduction.

However, another common approach is the use of constraint policies. Instead of helping consumers in electric vehicle acquisition, constraint policies take a different approach as they allow consumers owning an electric vehicle to have easier movements within the city or the country.

Constraint policies work better when electric mobility adoption is beginning. Examples of different constraint policies are: high-occupancy vehicle lanes in urban areas, parking reduction or free-parking for electric vehicles, road toll exemptions, access to restricted areas (generally city centres), etc.

Considering that public transportation has considerable issues with cycling and circulation due to congestion, developing constraint policy measures would serve as a double-edge policy as some measures could help in increasing efficiency and reliability for the public transportation sector. As a consequence of the increased efficiency and reliability, public transportation could increase its utility to customers and some of them may even shift towards its use as their main transportation mode.

Moreover, the fact that the Jamaican population will reduce the amount of kilometres they travel in their private vehicles, greenhouse gas emissions will be further reduced.

One major drawback of constraint policies is that they would only allow for electric vehicle development within urban centres as these policies help congestion management by impacting the private fleet. Once the rollout of electric vehicles has reached the saturation point, these measures will not be perceived as an advantage. Another major drawback is that these policies need monitoring tools in order to guarantee its effectiveness, increasing its expenses.

Lastly, some of the detailed measures will improve the awareness of the benefits of electric vehicles to drivers who own internal combustion engine vehicles and encourage them to purchase an electric vehicle when they consider replacing their current vehicle.

Action lines

When **updating the National Transport Policy, the Ministry of Transport and Mining, National Environment and Planning Agency and the Ministry of Science, Energy and Technology will set the baseline to develop constraint policies to be deployed in the Kingston Metropolitan Transport**

DRAFT

Region and other areas if considered.

Main actors involved: Ministry of Transport and Mining.

Action line 24: Electric bus deployment pilot

Rationale

As previously discussed, the electrification of the bus fleets represent an opportunity for improving air pollution and reducing greenhouse gas emissions in concentrated urban environments in Jamaica. However, one of the main issues is how to start deploying this fleet around the country. While some countries have opted for establishing ambitious and aggressive penetration targets by acquiring large-scale fleets, other countries have gone for more steady strategies as they develop pilot programs to ensure the feasibility of electric buses initially.

As electric mobility is not yet fully developed in Jamaica, starting with pilot programs could be an appropriate strategy. Since the process of transition to electric transportation includes several challenges, it must be addressed through careful planning and coordination. The pilot programme will allow companies to obtain key operating information, which in turn will assist them to plan for a successful transition of their fleet.

Actions

In order for the Jamaican bus operators to develop expertise in electric bus performance, the Jamaica Urban Transit Company will include and operate at least 25 electric buses and their charging infrastructure. **Within this context, the Government of Jamaica is working with the Jamaica Urban Transit Company for the procurement of 25 to 50 electric buses as pilot for its fleet**.

As a first step for this action line and according to a number of press articles, 45 electric buses are to be added by JUTC in the 2020-2021 legislative year.

The pilot program will last two years and findings will be reported to the Ministry of Transport and Mining.

The pilot program should allow the energy sector to analyse the integration and cross-sector benefits from electric mobility.

In addition, the pilot program should allow for the evaluation and monitoring of the environmental benefits achieved with the deployment of an electric bus fleet.

Main actors involved: the Jamaica Urban Transit Company, the Ministry of Transport, Mining and Island Traffic Authority and the National Environment and Planning Agency (NEPA).

Action line 25: National taxi renewable program

Rationale

According to the Statistical Institute of Jamaica, route taxis are the most common mode of transportation within the public transportation fleet. 26.7% of the population uses route taxis, this implies that 45% of the public transportation is provided by route taxis. As a result, an electrification of this fleet would be a huge step towards greenhouse gas emission reduction.

The transition of this fleet to electric vehicles offers a great potential for air quality improvement and noise reduction in congested urban areas. Nevertheless, some challenges need to be addressed when designing its renewal programs.

Even though the route taxi fleet is privately owned, it is a regulated service and concise actions can be considered.

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For example, the issuance of public licenses could be ranked by a number of factors, giving priority to electric vehicles, higher occupancy in vehicles or emission factors.

Along with this measure, other considerations can be studied. For example, emission standards could be applied to taxis. Therefore, GHG emissions testing could be further considered for taxis operating in the most congested areas of the cities.

Actions

The Transport Authority, along with the Ministry of Transport and Mining will be in charge of the design and execution of a support plan to target electrification of the route taxi fleet.

Special considerations include the following:

(i) Specific guidelines regarding GHG emissions for public passenger fleets
(ii) Concrete circulation guidelines through congested areas to target this fleet.
(iii) Licence issuance prioritization and fees exemptions for electric vehicle renewal of the fleets.

Main actors involved: Transport Authority, Ministry of Transport and Mining and taxi associations.

Action line 26: Renewal program for urban freight delivery vehicles

Rationale

Freight transport in Jamaica will probably go through important changes over the next few years. Logistics and supply, especially in urban areas, will change in the near future as a result of sustainability and environmental protection mechanisms developed for the transport sector.

As freight demand usually concentrates around big cities and metropolis, it can be a source of congestion and pollution. Many cities have applied first and last mile delivery policies, including only allowing urban freight providers to deliver their goods at defined times in the morning (first mile) or late in the night (last mile). These policies will result in congestion reduction, encouraging the efficiency of road networks, improving public transportation reliance and reducing greenhouse gas emissions. Moreover, there are many advantages for urban freight companies as well, since congestion reductions allow for more efficient logistics, reducing the cost of the service and improving its efficiency.

These advantages could be further increased with the adoption of an electric fleet by urban freight carriers. Even though the current cost of acquisition of an electric vehicle is still higher than the cost of an internal combustion engine vehicle, operational costs tend to be much lower. Therefore, the total cost of ownership decreases over time, even more for vehicles with high movement patterns such as urban freight fleets.

The conversion of an existing fleet to electric commercial vehicles represents a major challenge in the construction of charging infrastructure and operational planning. However, designing commercial vehicles renewal programs may help in the transition to a clean future and may lead the electrification of the rest of vehicles.

Actions

Main barriers for the development of a service that rely on an electric fleet are the total cost of ownership and the development of an ecosystem.

The cost of acquisition is considered in this National Strategic Framework along with the tax reduction for electric vehicle imports, as stated in section 2.

DRAFT

Moreover, operating expenses are reduced within many action lines and will allow for tariff management and electricity cost reduction.

Regarding the ecosystem development, urban freight delivery companies need to develop their own charging stations in their distribution centres.

Charging infrastructure development will be included within the update of the general transport policy.

Main actors involved: the Tax Administration Jamaica, the Ministry of Finance and the Public Service, the Ministry of Science, Energy and Technology, the Ministry of Transport and Mining, the Office of Utilities Regulation, the Jamaica Public Service and urban freight companies.

Action line 27: Fleet renewal study and plan for public sector institutions

Rationale

Vehicle fleets owned by the Government are considered part of the institutional fleet. The institutional fleet include all the vehicles used by the Government of Jamaica, including its Ministries and first response fleets.

Continuing with the premise that the Government of Jamaica should lead by example. It should develop and implement strategies that result in the electrification of the institutional fleet.

A critical component of the fleets' development, is the need for charging infrastructure hubs to be established for each of the fleets, as many vehicles will have particular needs.

Actions

Initially, a specific number of divisions and ministries will be selected in order to develop pilot programs within the institutional fleet in order to analyse and establish the feasibility of electric vehicles within each fleet. These pilot programs will be developed within a two-year period.

If the pilot program is a success, the entity will renew its fleet with electric vehicles, ensuring a full-electric fleet for 2050.

Main actors involved: all the Ministries that depend upon the Government of Jamaica, the Jamaica Fire Brigade and the Jamaica Constabulary Force.

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Section 6: Creating an e-mobility ecosystem in Jamaica

Action line 28: Training and development of local capabilities

Rationale

Electric mobility adoption and increasing penetration and transition of the mobility patterns will require the updating skill levels of all stakeholders in relation to electric mobility.

Training programs should be developed based on the type of services to be provided by stakeholders.

The development of local capabilities for key stakeholders is critical to ensure the readiness and viability of electric mobility deployment. The following agents are considered critical to the present framework:

(i) First response fleet professionals (including, police officers, firefighters, etc.).

(ii) Vehicle maintenance and repair professionals.

An adequate education and preparation program to ensure readiness for the electric mobility is needed. Re-training programs will be required in order to prepare the Jamaican labour force (that is currently specialized in internal combustion engines vehicles) to become certified in servicing electric vehicles.

The development of requirements and initiatives that prepare Jamaican vehicle service providers to service electric vehicles and the charging infrastructure will result in increasing confidence of Jamaica's readiness to support new eMobility.

Actions

Increasing the knowledge, skills and capabilities represents a requirement towards supporting and ensuring readiness to accommodate electric mobility penetration. In order to achieve this, knowledge transfer sessions with local mechanics may be necessary for them to acquire the specific and required electric mobility know-how. The government needs to be proactive in the implementation of these programs.

In addition to the development of training capacities regarding electric mobility deployment in the island, additional training programs need to be developed. Within this environment, electric vehicles' fitness certification will be required. Thus, Island Traffic Authority officers will have to develop further capabilities to perform these functions.

Measures and actions to incentivize training programs availability, as well as, to ensure training certification requirements, should be considered to enhance the achievement of a sustainable electric mobility ecosystem.

Policies and measures to support the development of local capabilities should be considered:

- Development of Certification programs for first response fleet professionals in relation to risks in the use and attendance of emergencies involving electric vehicles.
- Certification programs and professional registration policies to acknowledge readiness to operate and maintain electric mobility vehicles and related supply equipment.

Therefore, policies and public initiatives will need to be

DRAFT

promoted in order to ensure national labour force readiness to support electric mobility deployment.

Main actors involved: Ministry of Education, Youth and Information, HEART Trust/NTA, Ministry of Science, Energy and Technology and Ministry of Economic Growth and Job Creation.

Action line 29: E-mobility research and development programs with universities, private and public sector

Rationale

Electric mobility is a technology that is still in its early stages of development and, thus, needs improvement in the research and development field. As it poses a challenge for many disciplines, it needs the cooperation of the public authorities along with other private players.

Electric mobility should be deployed in a systematic and comprehensive approach. Universities play an important role in this context, offering multiple options when collaborating with electric mobility studies and tests. Research and Development projects, represent an excellent opportunity to increase awareness and involvement of the Jamaican population in the development of the electric mobility ecosystem.

Actions

Specific organisations including the Ministry of Science, Energy and Technology and Ministry of Education, Youth and Information should promote electric mobility through Research and Development efforts with industries, public and private sector and educational organizations. These programs should focus on core areas of electric mobility, namely: power generation and energy, energy storage technology, technical integration and reliability.

Additionally, partnerships between universities and Electric Vehicle dealers or experts can involve research and education in different fields. Public sector institutions should contribute to these programs by providing funding.

Moreover, researchers will be able to access the results of the aforementioned pilot programs in order to base their studies on real data.

Public authorities can incentivize and support the development of R&D&I innovation projects in electric mobility penetration, by the implementation of procedures that will enable the following:

(i) Definition of the requirements for the development of specific programs.

(ii) Financing procedures to grant funding of selected program development.

(iii) Deployment of pilot programmes in new technology standards for electric mobility support.

(iv) Development of measures to further evaluate and monitor success of the programs developed.

Main actors involved: Ministry of Science, Energy and Technology, Ministry of Education, Youth and Information and universities.

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Action line 30: Battery reuse and disposal guidelines

Rationale

The successful implementation of this National Framework is likely to result in the growth of electric vehicles in the Jamaican market in the short and medium term. However, one of the major concerns regarding electric vehicle are the batteries with respect to the secondary use and/or disposal of lithium-ion batteries once they have reached the end of their useful life.

When lithium-ion batteries reach their end-of-life cycle, different measures can be considered: (i) the reuse to exploit potential for additional activities or (ii) the disposal, recycling and waste management.

The absence of guidelines and policies with respect to electric mobility battery after-use, can result in arbitrary disposal in land waste sites and the resultant environmental impact.

The potential demand of batteries for energy storage services amongst technology solutions development is an opportunity for electric mobility equipment reuse solutions. Moreover, it presents economic advantages for electric vehicle owners since they would be able to recover part of their initial investment. A major concern is likely to be the high acquisition cost of new batteries. Thus, battery reuse alternatives is an opportunity to lower battery costs, and thus the total cost of ownership of electric vehicles.

Additionally, battery lifecycle management is a great emerging opportunity to address the concern of toxic materials waste.

Actions

When selling the substitution battery, companies will be responsible for collecting the used ones.

Used batteries can be used for a large number of initiatives as they are energy storage devices and can be used in solar systems. This is one of the most promising reuse applications. Energy storage could be deployed, both on the grid and at businesses or individual consumer´s houses. Jamaica Public Service Company could consider acquiring these used batteries for developing energy storage systems.

Other options include re-manufacturing used batteries for reuse in the same car model. The Automobile Dealer Association of Jamaica will develop certain procedures for collecting used batteries and reselling refurbished ones for use in electric vehicles.

In this context, **not only battery reuse programs should be contemplated, but also additional training will be required for the Local Government. In particular, sessions about battery use after reaching their End-Of-Life should be developed**.

Along with these lines, the National Environment and Planning Agency will need to develop stricter standards regarding safety, performance and quality.

The definition of guidelines and policies to monitor and supervise these new activities is required. In addition, the requirements to enable the re-use and disposal of batteries will have to be developed.

Main actors involved: the Jamaica Public Service, the Automobile Dealer Association of Jamaica and the National Environment and Planning

DRAFT

Agency, Ministry of Local Government and Island Traffic Authority.

Action line 31: Program to support new ventures on second-life applications for batteries and entrepreneurship programs

Rationale

As previously discussed, used batteries, after reaching their end-of-use within electric vehicles, can be employed for other purposes. This certainly represents an appealing opportunity for cost reduction at the same time as reducing the negative environmental impact of EV batteries.

Actions

Training programs involving battery recycling will be developed by the Ministry of Transport and Mining and the National Environment and Planning Agency. In addition, Ministry of Local Government may play a leading role in the disposal of batteries. Along these lines, **promoting entrepreneurship programs** can be advantageous by the launching of special research programs designed to incentivize entrepreneurs to find innovative solutions in order to deal with the challenges of batteries second-use.

Additionally, Jamaican **public institutions have an interesting role in encouraging the Jamaican population in the development of new ideas, by the definition of funding and financing mechanisms for start-up companies**.

Main actors involved: Jamaica Public Service Company, Ministry of Local Government, Ministry of Transport and Mining and National Environment and Planning Agency.

Action line 32: E-mobility ecotourism program with key stakeholders

Rationale

Emerging tourism market trends are encouraging destinations to consider mobility as a crucial component for their tourism programs. This must be considered by the Jamaican tourism sector in order to maintain its competitiveness, add value to visitors and ensure a quality experience for tourists while enhancing Jamaican citizens' wellbeing. The offer of sustainable mobility services can help the country to differentiate itself and attract new segments of tourists. Implementing electric mobility services in the island can add value to the visitor experience, both from a sustainable perspective and an opportunity for an innovative tourism destination. International experiences including green tourism programs have been deployed worldwide.

The environmental impact caused by tourist is generally very high. According to Jamaica Information Services, the island received 4.3 million tourists in 2017, a record (Jamaica Information Service, 2020).

By mixing tourism and mobility, sustainable a clean tourism industry would be achieved through a coalition between public sectors institutions, including Ministry of Tourism and private agents, hotels and tour operators in order to offer viable solutions in this development. By enabling visitors the use of Electric Vehicles, the tourism industry opens the door for a new greener tourism at the same time as it builds consumer and brand awareness.

Actions

By creating an integrated ecosystem in which electric mobility becomes the preferred service and is easily

DRAFT

accessible for visitors, further development will be achieved.

Active collaboration between hotels should be encouraged for the deployment of charging stations. The possibility of offering charging points inside hotels affords guests the accessibility to charging ports as well as transitioning hotel fleets towards electric mobility. Hotel chains and Jamaica Public Service cooperation could enhance charging infrastructure deployment.

In addition, tourism tour operators should be included in the development of an electric mobility ecotourism framework, in order to achieve electrification of tourism fleets within the country.

The **development of mechanisms to incentivize the deployment of electric mobility amongst tourism fleets is required** to achieve private sector engagement:

(i) Development of public-private partnerships for the deployment of charging infrastructure within key areas of tourism areas.
(ii) Development and deployment of charging infrastructure programs and procedures along established tourism operator routes.
(iii) Design and development of certification and standards for the adoption of electric mobility within the companies' fleets.

In addition, **complementary actions in terms of car rentals companies** should considered. By providing a fuel-efficient fleet, car rental companies will reduce emissions at the same time they could reduce travel costs for visitors. With the proper programs, Ministry of Transport and Mining could encourage car rental companies to provide an electric vehicle offering.

Main actors involved: Jamaica Public Service Company; Ministry of Transport and Mining; Ministry of Tourism; Ministry of Economic Growth and Job Creation.

Action line 33: E-mobility infrastructure and human capital development through the private sector

Rationale

Working along with private sector companies is an efficient way to develop electric mobility capability. Since private sector is usually driven by commercial interests in the roll out of electric mobility charging infrastructure, working with it seems to be a suitable alternative for the development of the electric vehicle infrastructure and promoting human capital development.

Considering the scope of the electric mobility deployment and the costs required for its deployment, further investments will be required along with the need to share risks. In this scenario, collaboration with the private sector is necessary to ensure a successful engagement.

Actions

Collaboration with the private sector can accelerate deployment and support funding of infrastructure. Thus, in the deployment of charging infrastructure throughout the island, Jamaica Public Service Company could set strategic alliances with agents from the private sector.

Additionally, private sector engagement will be key in terms of providing funds for the development of workshops and training programs and activities in order to promote human capital development. Along with the Ministry of Economic Growth and Job Creation, joint programs should be fostered.

In this context, other associations, such as the Jamaican German Automotive School (JAGAS) and the

DRAFT

Cornwall Automotive Training Institute are ideal candidates. Both institutions can represent alternatives towards the training of automotive technicians in the servicing and diagnostics of electronic vehicles.

Main actors involved: Jamaica Public Service Company; Ministry of Economic Growth and Job Creation; Ministry of Science, Energy and Technology.

Action line 34: Regulatory model for new shared mobility services

Rationale

The American and European markets have adopted a new mobility concept: shared mobility. This new concept consists of privately owned business models that allow users to share the costs of a vehicle.

Shared transportation services have expanded impressively over recent years, and reduced environmental, economic and energy issues. Additionally, important advances in electronics and technology have enabled increasing share of mobility efficiency.

These new services are an innovative response to consumers that allow for traffic congestion reduction, lower transportation costs and offer alternative choices for population mobility transit.

Shared mobility services may open a new window for users' mobility as it provides the opportunity to move within the city in different vehicles depending on the required mobility range.

Despite the benefits that shared mobility services offer, the Jamaican transport framework is far from being ready for its adoption.

Actions

Local authorities have a crucial role in the development of policies and guidelines to achieve the deployment of new mobility services, in order to ensure the safety and reliability.

Policy and regulation to achieve the integration of new mobility services and fleet deployment will require:

(i) Definition of stakeholders' obligations.
(ii) Operational standard guidelines and requirements.
(iii) Safety standards for the shared services.

In order to guarantee the readiness of the transportation system to incorporate new mobility services, additional transport policy amendments will be required to include these concepts within its update.

Main actors involved: Ministry of Transport and Mining and Island Traffic Authority.

Action line 35: Regulatory model for electric car-sharing and urban rental services

Rationale

Car sharing represents a suitable and attractive solution for those users who cannot afford or are not willing to pay for the acquisition, operation and maintenance of an electric car. Car sharing is as an alternative that separates car use from ownership, providing the user the possibility of accessing a car whenever he/she has the necessity.

Car sharing provides the opportunity of combining its services with the use of public transportation for commuters. This certainly represents an opportunity for the Jamaican population who is highly reliant on public transport but may need a car in specific situations or to drive to certain locations that are less accessible by public transport services.

DRAFT

In addition, the introduction of electric mobility car sharing models when not well assessed can impact the public transportation system.

However, in order to ensure its adoption, initial deployment will require the development of a regulatory framework.

In order to ensure the correct development of car-sharing services, regulatory changes will have to be considered by the Jamaican authorities.

Actions

In order to accommodate the deployment of new mobility car-sharing services, within a transportation system vision, regulation framework and approaches to evaluate the interaction with existing transportation use trends and infrastructure is required. Therefore, **regulatory sandboxes represent an optimal approach to ensure the ultimate full deployment of car-sharing**.

The following measures should be taken into account:

(i) Definition of targeted urban areas for the **deployment of car-sharing services pilot programmes**
(ii) Development of policies and guidelines to set operation service requirements.
(iii) Establishment of **key outcome based monitoring and evaluation mechanisms**.

Main actors involved: Ministry of Transport and Mining.

Action line 36: Regulatory guideline for micromobility

Rationale

Micromobility revolution has already started in some countries. The use of micromobility not only brings benefits by reducing the traffic congestion, but has several environmental advantages when compared to the rest of vehicles, besides cost reduction. Micromobility refers to electric scooters, electric skateboards, shared bicycles and electric pedal assisted, or any other vehicle that weighs less than 500kg.

In addition, within the vehicle import share, micromobility modes of transport have increased significantly over the past years, representing an opportunity electrify this category (in particular motor bikes).

Nevertheless, this new tool brings unique challenges for Jamaican adaptation as concerns remain regarding the feasibility of micromobility, including congestion and traffic safety. Thus, proper regulation should be designed in order to guarantee the efficiency and safety of these transport modes as they can pose several risks, for the population.

Actions

State-level and local authorities have a critical role to play when facilitating the growth and proper implementation of micromobility transport modes. Ministry of Transport and Mining should **design regulation and guidelines in order to ensure the safety and correct operation of these transport modes**, including specifications for users. These specifications should include type of areas where micromobility transport modes can be used and parked.

Further regulation should be considered for the operators of these services, ensuring that vehicles will be equipped to ensure the safety of the users.

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Main actors involved: Ministry of Transport and Mining.

Action line 37: Financial solutions for new acquisitions of electric vehicles (leasing), mechanisms to increase market penetration for e-vehicles, particularly for the medium and low-income segments of the markets

Rationale

Electric vehicle acquisition cost is one of the major barriers for consumers when considering buying a new car: along with the acquisition price, charging infrastructure installation cost poses another major obstacle. This price barrier is especially elevated for individuals, who generally have little or no discretionary income. They, therefore, base their purchase decision on the cost of the vehicle without considering operating and maintenance costs included within total cost of ownership. For electric mobility development in Jamaica to be equitable, electric vehicles should be accessible to every segment of the population, especially for low-income families, who generally live near busy roads, so the risks of getting health problems are higher.

Financial solutions should be established along with the deployment of a tax and fiscal incentive plan, previously described in order to shift consumer preferences towards electric vehicles.

Actions

Financial solutions can be implemented by Jamaican credit unions and financial institutions in order to provide loans to citizens with **lower interest rates along with longer payback periods**. **Ministry of Finance and the Public Service will be required to develop policies to provide financial support to incentivize electric mobility preferences**.

Other financial mechanisms include leasing contracts. Leasing has become a trendy alternative for the acquisition of vehicles. Leasing an electric vehicle will not only provide advantages for Jamaicans by making monthly expenditures more affordable, but it also affords customers to acquire the benefits of the most recent technology without the necessity of buying a car.

The main objective is to offer incentives and channels that encourage consumers to choose electric vehicles over conventional vehicles.

Main actors involved: Ministry of Finance and Public Service, Ministry of Transport and Mining.

DRAFT

Indicators for the established strategy

In order to measure the level of success of the implementation of the aforementioned detailed action lines, the following indicators must be tracked. These indicators will assist in identifying deviations from the established plan so that corrective steps can be taken to ensure the full implementation of electric mobility in Jamaica.

Section	Action line	Goals	Indicator(s)	Proposed measures
Section 2: Tax regime and fiscal considerations to boost adoption	Development of an incentive program	Establish a new tax regime to incentivize the deployment of electric vehicles.	% of electric vehicles share in total fleet	Re-design of the tax regime in Jamaica, developing tiered incentives for electric vehicles and reducing import taxation.
	Assessment of immediate or short-term fiscal impacts and coping strategies to inform policy development	Mitigate the impact of the new tax regime on the Government tax revenues.	Publication of an incentive policy	Incentive package mechanism Increased taxation for internal combustion engine vehicles imports
Section 3: Technical, efficiency and interoperability standards for EVs and ICE	Charging systems and EV charging standards (level 1, level 2 and fast charging stations) for private vehicles, buses and other modes of transportation	Define and implement policies to set technical standards for charging system infrastructure.	Publication of a standards guideline framework regarding charging infrastructure deployment specifications.	Design and development of public policies with respect to technical standards for the development and installation of electric mobility public charging infrastructure, including technical safety standards.
				Creation of a "Standardization Committee" for the definition of feasible deployment standards, upgrade, and monitoring and evaluation of standards compliance.

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Section	Action line	Goals	Indicator(s)	Proposed measures
Section 3: Technical, efficiency and interoperability standards for EVs and ICE	Vehicle charging stations communications standards.	Develop policies and monitoring mechanisms to ensure compliance of communication standards.	Publication of a standards guideline framework regarding charging infrastructure deployment specifications.	Development of communication protocols for the operation and management of the charging system.
				Development of communication protocols and policies to establish Demand Response mechanisms.
	Vehicle to grid services and business model development structuring	Improving electric mobility ecosystem by introducing additional services (e.g. vehicle to grid).	Number of vehicle to grid services developed in the island	Analysis of new business models by the Standardization Committee along with the deployment of a pilot program
	Cybersecurity guidelines	Achieving secure communication between electric vehicles, their charging infrastructure and the electric system.	Standards and policies cybersecurity risks guidelines publication	Establishment of an operating code for electric vehicles
	Upgrading emissions and efficiency norms for ICEs.	Improve the efficiency of the Jamaican fleet.	Policy development and publication of emissions and efficiency standards. Development of a monitoring system to measure average emissions and fuel consumption of conventional vehicles.	Cost-Benefit Analysis for adopting different emission standards and efficiency norms in Jamaica and, establish the norm.

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Section	Action line	Goals	Indicator(s)	Proposed measures
	Developing a tagging system for congested areas	Reduce congestion in urban areas.	Development and publication of the policy to implement a tagging system.	Development of a Cost-Benefit Analysis that includes tagging system for congested areas, and if positive, develop the tagging system.
Section 4: Enhancing energy sector readiness	Impacts of electric vehicles on grid operations and planning	Reduce economic impact from grid development on consumers.	Update and publishing the policies to monitor planning and operation of the network grid to accommodate electric mobility	Cost control and avoid the inclusion of stranded costs.
	Optimal location for public charging stations in the island	Reduce range anxiety from electric vehicle users.	Definition of procedures and processes to develop public available infrastructure	Develop locations as proposals, considering the transportation trends from the Jamaican population.
				Development of a regulatory and policy framework related to accessible location.
				Development of mechanisms and guidelines regarding planning of charging infrastructure.
	Electric sector regulatory framework for electric vehicles charging - tariffs and commercial models	Allow for load management from electric consumers.	Publication of an updated framework	Update of the energy regulatory framework.

DRAFT

Section	Action line	Goals	Indicator(s)	Proposed measures
Section 4: Enhancing energy sector readiness			Definition of a specific rate structure based on Time-Of-Use tariffs.	Update of the energy regulatory framework.
	Vehicle to grid integration and distributed energy aggregators, technical and commercial regulation, new business models	Allow for load management from the electric system	Possibility to manage vehicle to grid	Develop policy and guidelines for vehicle-to-grid use. This regulatory framework will include an alignment programme with the development of a smart grid.
	Regulatory and market mechanisms for scaling up renewables in the power sector	Enable combined opportunities to increase renewable energy resources amongst electric mobility adoption	Policy update to incorporate guidelines for electric mobility interaction. Number of communication programs.	Compensation procedures for consumers from electricity sales.
				Communication programs from the Jamaican Public Services Company that highlight synergies of self-consumption and the electric vehicle.
	Update to the general transport policy	Include electric mobility in the transportation framework.	Update of National Transport Policy	Define electric mobility concepts in the National Transport Policy and develop codes of operation.

DRAFT

Section	Action line	Goals	Indicator(s)	Proposed measures
Section 5: Enhancing transport readiness	Electric buses feasibility studies and immediate renewal needs assessment	Electrification of the public fleet.	% of electric bus in operation by 2030	Analysis of electric buses deployment feasibility in Jamaica from bus operators.
				Ban on internal combustion engine buses from 2030 onwards.
	Financial schemes for public transport operators to adopt new technologies	Electrification of the public fleet.	% of electric vehicles in 2030 from the public fleet	Increase access to financial schemes for fleet renewal by public transport operators in Jamaica.
	Immediate renewal program structuring	Electrification of the national fleet.	% of electric vehicles in operation by 2025	Development of communications campaigns.
	Long-term and following renewal phases guidelines for electric public transport fleets	Electrification of the public fleet.	% of electric vehicles in 2050 from the public fleet	Policy adoption for the gradual renewal of the public transportation fleet.
	Monitoring systems of the renewal programs	Electrification of the public fleet.	% of electric vehicles from the public fleet	Control and monitoring programs through importations.
				Record and a database over issued licenses of public fleets.
	Following renewal phases (2020-2022) feasibility studies	Electrification of the national fleet.	% of electric public and private fleet in 2022	Electric vehicle deployment in established fleets.

DRAFT

Section	Action line	Goals	Indicator(s)	Proposed measures
Section 5: Enhancing transport readiness	Legal and institutional arrangements for the performance and implementation of renewal programs in public transportation	Electrification of the public fleet.	Publication of regulatory guidelines to the definition	Regulatory procedures development in the National Framework.
	Updated guidelines for the definition of service levels in public transportation	Increase reliance of the public service.	Level of service guidelines publication	Elaboration of service level targets for public fleet services.
				Development and analysis of surveys to public transportation users.
	Circulation and transport incentives – used of restricted space, parking policy, demand restrictions waiver, amongst others	Reduce internal combustion engine share in the national fleet.	Guideline publication on congested areas circulation	Develop constraint policies for internal combustion engine vehicles in congested areas.
	Electric bus deployment pilot	Ensure the feasibility of electric buses in Jamaica.	% of electric buses increase by 2025 and 2030.	Jamaica Urban Transit Company will operate 25-50 electric buses and their charging infrastructure before 2021.
	National taxi renewable program	Increase electrification of the taxi fleet.	% of electric taxis in the public fleet.	Plan development for the electrification of the route taxi fleet.

DRAFT

Section	Action line	Goals	Indicator(s)	Proposed measures
Section 5: Enhancing transport readiness	Renewal program for urban freight delivery vehicles	Increase electrification on urban freight fleets.	% of electric vehicles in urban freight fleets.	Policy development for electric vehicle adoption and charging infrastructure deployment for urban freight fleets.
	Fleet renewal study and plan for public sector institutions	Institutional fleet will be full-electric in 2050	% of electric vehicles in institutional fleet.	Pilot programs development to ensure feasibility for full institutional fleet.
Section 6: Creating an e-mobility system in Jamaica	Training and development of local capabilities	Prepare future professionals by increasing the degree of technical knowledge.	Number of certified professionals by 2030.	Develop certification programs for first response professionals.
				Professional registration policies to acknowledge readiness to operate and maintain electric mobility vehicles and related supply equipment.
	E-mobility research and development programs with universities, private and public sector	Electric mobility deployment in a systematic and comprehensive approach.	Number of funded programs with universities, the private and the public sectors	Define specific programs requirements.
				Develop financing procedures for selected program developments.
				Deployment of pilot programmes in new technology standards for electric mobility support.

DRAFT

Section	Action line	Goals	Indicator(s)	Proposed measures
Section 6: Creating an e-mobility system in Jamaica				Development of measures to further evaluate and monitor success of the developed programs.
	Battery reuse and disposal guidelines	Reduce the environmental impact of electric vehicles	% of batteries, which are reused or recycled.	Procedures development for used batteries collection and reselling refurbished ones for its use in electric vehicles.
	Program to support new ventures of second-life applications for batteries and entrepreneurship programs	The creation of new business models around battery second-life applications.	Number of business models developed.	Training programs development.
				Public economic resources deposits towards start-up companies funding related to second-life applications for batteries.
	E-mobility ecotourism program with key stakeholders	Increase tourism value proposition in Jamaica.	Definition of programs and policies to develop electric mobility tourism oriented initiative programs.	Public-private partnerships for charging infrastructure development.
				Development and deployment of charging infrastructure programs and procedures along established tourism operator routes.
				Design and development of certification and standards for the adoption of electric mobility within the companies' fleets.

DRAFT

Section	Action line	Goals	Indicator(s)	Proposed measures
Section 6: Creating an e-mobility system in Jamaica	E-mobility infrastructure and human capital development through the private sector	Increase the implementation of electric vehicle technology along with the private sector.	Number of initiatives with private sector	Set of strategic alliances with agents from the private sector.
				Creation of training programs for promoting human capital development.
	Regulatory model for new shared mobility services	Develop the penetration of shared-mobility services in Jamaica	Number of shared-mobility services deployed in Jamaica by 2035	Update of the transport policy to include these new concepts
	Regulatory model for electric car-sharing and urban rental services	Increase car-sharing services in Jamaica	Number of electric car-sharing services in Jamaica by 2035	Regulatory sandboxes to be developed in order to ensure a full deployment of car-sharing
	Regulatory guidelines for micromobility	Develop micromobility services in Jamaica	Number of micromobility services deployed in Jamaica by 2035	Design of regulation and guidelines to ensure the safety of these transport modes
	Financial solutions for new acquisitions of electric vehicles (leasing), mechanisms to increase market penetration for e-vehicles, particularly for the medium and low-income segments of the markets	Allow for more flexible options for consumers to own an electric vehicle.	Number of financial solutions available in the market by 2025.	Low interest rates design for EV purchase finance.
				Developing attractive leasing contracts.

DRAFT

Measure priority ranking

The measures proposed have been detailed below based on the timeframe required to be developed. As such, we have considered that short-term actions must be developed in 2 to 3 years, medium-term actions within 3 to 6 years and long-term actions to be developed over 6 years.

Short-term measures (2020 -2023)

Rank	Measure	Action line	Section
1	Re-design of the tax regime in Jamaica, developing stretch incentives for electric vehicles and reducing import taxation.	Development of an incentive program	2
2	Increased taxation for internal combustion engine vehicles imports.	Assessment of immediate or short-term fiscal impacts and coping strategies to inform policy development	2
3	Update of the energy regulatory framework.	Electric sector regulatory framework for electric vehicles charging - tariffs and commercial models	4
4	Define electric mobility concepts in the National Transport Policy and develop codes of operation.	Update to the general transport policy	5
5	Regulatory procedures development in the National Framework.	Legal and institutional arrangements for the performance and implementation of renewal programs in public transportation	5
6	Creation of a "Standardization Committee" for the definition of feasible deployment standards, upgrade, and monitoring and evaluation of standards compliance.	Charging systems and EV charging standards (level 1, level 2 and fast charging stations) for private vehicles, buses and other modes of transportation	3
7	Development of communication charging protocols for the operation and management of the charging system.	Vehicle charging stations communications standards.	3
8	Development of communication standard protocols and policies to	Vehicle charging stations communications standards.	3

DRAFT

	establish Demand Response mechanisms.		
9	Design and development of public policies regarding technical standards for the development and installation of electric mobility public charging infrastructure, including technical safety standards.	Charging systems and EV charging standards (level 1, level 2 and fast charging stations) for private vehicles, buses and other modes of transportation	3
10	Develop locations as proposals, considering the transportation trends from the Jamaican population.	Optimal location for public charging stations in the islands	4
11	Development of mechanisms and guidelines regarding planning of charging infrastructure.	Optimal location for public charging stations in the islands	4
12	Development of a regulatory and policy framework related to accessible location.	Optimal location for public charging stations in the islands	4
13	Cost control and avoid the inclusion of stranded costs.	Impacts of electric vehicles on grid operations and planning	4
14	Policy adoption for the gradual renewal of the public transportation fleet.	Long-term and following renewal phases guidelines for electric public transport fleets	5
15	Analysis of electric buses deployment feasibility in Jamaica from bus operators.	Electric buses feasibility studies and immediate renewal needs assessment	5
16	Increase access to financial schemes for fleet renewal by public transport operators in Jamaica.	Financial schemes for public transport operators to adopt new technologies	5
17	Pilot programs development to ensure feasibility for full institutional fleet.	Fleet renewal study and plan for public sector institutions	5
18	Plan development for the electrification of the route taxi fleet.	National taxi renewable program	5
19	Electric vehicle deployment in established fleets.	Following renewal phases (2020-2022) feasibility studies	5

DRAFT

20	Jamaica Urban Transit Company will operate 5 electric buses and their charging infrastructure before 2021.	Electric bus deployment pilot	5
21	Development of communications campaigns.	Immediate renewal program structuring	5
22	Low interest rates design for EV purchase finance.	Financial solutions for new acquisitions of electric vehicles (leasing), mechanisms to increase market penetration for e-vehicles, particularly for the medium and low-income segments of the markets	6
23	Professional registration policies to acknowledge readiness to operate and maintain electric mobility vehicles and related supply equipment.	Training and development of local capabilities	6
24	Define specific programs requirements.	E-mobility research and development programs with universities, private and public sector	6
25	Develop certification programs for first response professionals	Training and development of local capabilities	6
26	Training programs development.	Program to support new ventures in second-life applications for batteries and entrepreneurship programs	6
27	Creation of training programs for promoting human capital development.	E-mobility infrastructure and human capital development through the private sector	6

DRAFT

Medium-term measures (2020-2026)

Rank	Measure	Action line	Section
1	Control and monitoring programs through importations.	Monitoring systems of the renewal programs	5
2	Cost-Benefit Analysis for adopting different emission standards and efficiency norms in Jamaica and, establish the norm.	Upgrading emissions and efficiency norms for ICEs.	3
3	Development of a Cost-Benefit Analysis that include tagging system for congested areas, and if positive, develop the tagging system.	Developing a tagging system for congested areas	3
4	Develop constraint policies for internal combustion engine vehicles in congested areas.	Circulation and transport incentives – used of restricted space, parking policy, demand restrictions waiver, amongst others	5
5	Policy development for electric vehicle adoption and charging infrastructure deployment for urban freight fleets.	Renewal program for urban freight delivery vehicles	5
6	Procedures development for used batteries collection and reselling refurbished ones for its use in electric vehicles.	Battery reuse and disposal guidelines	6
7	Record and a database over issued licenses of public fleets.	Monitoring systems of the renewal programs	5
8	Public-private partnerships for charging infrastructure development.	E-mobility ecotourism program with key stakeholders	6

DRAFT

9	Compensation procedures for consumers that sell electricity to the Grid.	Regulatory and market mechanisms for scaling up renewables in the power sector	4
10	Development of measures to further evaluate and monitor success of the developed programs.	E-mobility research and development programs with universities, private and public sector	6
11	Set of strategic alliances with agents from the private sector.	E-mobility infrastructure and human capital development through the private sector	6
12	Develop financing procedures for selected program developments.	E-mobility research and development programs with universities, private and public sector	6
13	Development and deployment of charging infrastructure programs and procedures along established tourism operator routes.	E-mobility ecotourism program with key stakeholders	6
14	Elaboration of service level targets for public fleet services.	Updated guidelines for the definition of service levels in public transportation	5
15	Development and analysis of surveys to public transportation users.	Updated guidelines for the definition of service levels in public transportation	5
16	Deployment of pilot programmes in new technology standards for electric mobility support.	E-mobility research and development programs with universities, private and public sector	6

DRAFT

17	Developing attractive leasing contracts.	Financial solutions for new acquisitions of electric vehicles (leasing), mechanisms to increase market penetration for e-vehicles, particularly for the medium and low-income segments of the markets	6
18	Design and development of certification and standards for the adoption of electric mobility within the companies' fleets.	E-mobility ecotourism program with key stakeholders	6

DRAFT

Long-term measures (2020-2030)

Rank	Measure	Action line	Section
1	Ban on internal combustion engine buses from 2030 onwards.	Electric buses feasibility studies and immediate renewal needs assessment	5
2	Communication programs from the Jamaican Public Services Company that highlight synergies of self-consumption and the electric vehicle	Regulatory and market mechanisms for scaling up renewables in the power sector	4
3	Public economic resources deposits towards start-up companies funding related to second-life applications for batteries.	Program to support new ventures on second-life applications for batteries and entrepreneurship programs	6
4	Establishment of an operating code for electric vehicles	Cybersecurity guidelines	3
5	Analysis of new business models by the Standardization Committee along with a deployment of a pilot program	Vehicle to grid services and business model development	3
6	Develop policy and guidelines for vehicle-to-grid use. This regulatory framework will include an alignment programme with the development of a smart grid.	Vehicle to grid integration and distributed energy aggregators, technical and commercial regulation, new business models	4
7	Update of the transport policy to include these new concepts	Regulatory model for new shared mobility services	6
8	Regulatory sandboxes to be developed in order to ensure a full deployment of car-sharing	Regulatory model for electric car- sharing and urban rental services	6
9	Design of regulation and guidelines to ensure the safety of these services	Regulatory guideline for micromobility	6

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Appendix 1: Methodology

The present document has been developed through a deductive methodology, divided into three main steps.



Starting with the assumption definition, this step has helped when considering the most compelling driving forces that will affect the implementation of electric mobility, ranking them and establishing logical scenarios that will enable the quantification of assumptions. For this to be possible, the correct understanding of the key question by all stakeholders will be crucial in order to give an adequate perspective of the relevance of the framework.

The main stakeholders that have participated in this process are listed below:

- Public stakeholders:
  - Ministry of Transport and Mining,
  - Jamaica Urban Transit Company Limited,
  - Ministry of Science, Energy and Technology,
  - Ministry of Economic Growth and Job Creation,
  - Ministry of Finance and the Public Service,
  - Tax Administration Jamaica,
  - Island Traffic Authority,
  - Planning Institute of Jamaica,
  - National Environment and Planning Agency, and
  - Office of Utilities Regulation.
- Private stakeholders:
  - Jamaica Public Service Company, Ltd.,
  - Guardsman Group,
  - Civilectric Solutions Ltd.,
  - Knutsford Express,
  - Williams Caribbean Capital,
  - Carland Investments Ltd., and
  - Motor Repairers Association of Jamaica (MRAJ)

Additionally, in order to identify key forces, a cross-sectorial analysis has been developed thanks to the information provided by stakeholder interviews. Once the key forces have been identified and its level of importance determined, the different scenarios were created. The development of these scenarios, enabled specific values for the assumptions have been established.

Secondly, once key drivers were established, national targets were identified and determined. Defining these targets along with the establishment of a relation with assumptions have helped in the identification of missing data for target calculations. The definition of these targets will help when monitoring its implementation.

Finally, the specific goals were defined. Based on the collected data, a model was developed in order to provide specific goals for the defined targets. This model has enabled us to provide specific figures for each goal according to the four scenarios.

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Appendix 3: Model description

The developed model estimates, for each of the developed scenarios in this National Strategic Framework included, the total vehicle fleet and its composition, considered electric vehicles and internal combustion engine vehicles, as well as a breakdown of both the private and public fleet regarding vehicle differentiation. Moreover, it establishes different outputs based on the calculated fleet, including an estimation of greenhouse gas emissions for the road sector and an estimation of taxes on imported vehicles (based on the increase of the total national fleet)

Assumption description

In the model, several assumptions have been taken regarding (i) fleet composition and growth, (ii) vehicles prices, and (iii) electric vehicle cost evolution.

For the **fleet composition and growth**, key considerations for the development of targets are detailed below:

i. Mobility trends for Jamaican consumers do not change over time: the model assumes that preferences of Jamaicans in terms of mobility are static overtime and thus, will move the same direction for each mobility option overtime. Mobility estimations by mode of transportation were established for 2016 and set constant, based on total population.

ii. Fleet renovation is based on private and public fleet rotations: the Jamaican private and public fleets are renovated on a constant basis and the total future fleet is based in its renewal. Correspondingly, a 1.59% increase is considered for the national fleet. Furthermore, the model considers that electric vehicle penetration is established through a share in imports.

iii. Fleet composition: the model considers that the composition of imports remains stable over time. As such, imports maintain a fixed correlation between the different vehicle fleets.

iv. The model optimizes the tax structure: within a specific subsidy in electric vehicles imports, other taxes are increased so that the incentive is sustainable over time.

v. Fuel efficiency improvement is not considered: the model assumed that Internal Combustion Engine vehicles and electric vehicles will have a similar improvement pace for their fuel efficiencies. In order to simplify this assumption, fuel efficiency for all vehicles is considered as a constant. The outcome of this assumption is a worst case scenario for greenhouse gas emissions and fuel consumption.

In determining the fleet composition and its growth, private and public fleets are separated. First, the initial private fleet, based on 2017 data from the International Road Federation World Road Statistics 2019, provided by the Ministry of Transport and Mining. The public fleet data was obtained from the Transport Authority Regulation of Public Passenger Vehicles and from the Child Road Safety Assessment (UNICEF).

Vehicle Kilometres Travelled per capita for each category of the private fleet, an average from the annual vehicles miles travelled by major vehicles category was estimated based on data from the US Department of Energy. For public fleet categories, data from the Statistical Institute of Jamaica was used as a main source.

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The global average for the private and public fleet data comes from the National Renewable Energy Laboratory (NREL). The start point for data collection was fuel consumption: NREL and the US Department of Transportation were the main sources providing the data for the private and public average retirement age.

	Initial fleet (2017)	Vehicle Kilometres Travelled per capita	Average retirement age
Motor cars	428,297	147.49	15 years
Motorcycles	18,596	30.56	
Motor trucks	111,410	990.86	
Others		304.81	
Private fleet	**558,303**	**1,474**	
Route taxis	12,762	896.32	12 years
Stage carriage	897	530.41	
Contract carriage	4,710	289.42	
Hackney carriage	2,078	10.07	
Express carriage	43	2.64	
Robot	23,578	114.14	
Public fleet	**44,068**	**1,843**	

Figure 45: Jamaican initial fleet composition, VKT and retirement age.

Vehicle prices considerations were based on an analysis of current market prices of the models hereafter presented. Vehicles were divided into main categories (motor cars, motor trucks, motorcycles and motor bus) and by the type of fuel used (petrol, diesel or electric). For estimating the Cost, Insurance and Freight prices, a study was performed along multiple seller pages.

	Used fuel	Car model	Average Cost, Insurance and Freight price (Jamaican Dollars)
Motor cars	Petrol	Toyota Prius	2,428,164
	Diesel	Hyundai Tucson	2,260,241
	Electric	Nissan Leaf	2,647,812
Motor truck	Petrol	Toyota Duna	5,629,757
	Diesel	Hino Ranger	6,114,530
	Hybrid	Hino	15,884,038
Motorcycles	Petrol	Honda Forza	1,014,193
	Diesel	N/A	N/A
	Electric	BMW C evolution	2,490,943
Motor bus	Petrol	Nissan Civilian	15,187,815
	Diesel	Toyota Coaster	14,050,630
	Electric	BYD K9	73,450,401

Figure 46: Vehicle prices.

Cost evolution of electric vehicles and cost reduction for the car battery were based on a Bloomberg analysis (BloombergNEF, 2019). In this regard, the following graph shows how battery prices have been falling since 2015 and future estimations demonstrate how this tendency seems will continue into the future.

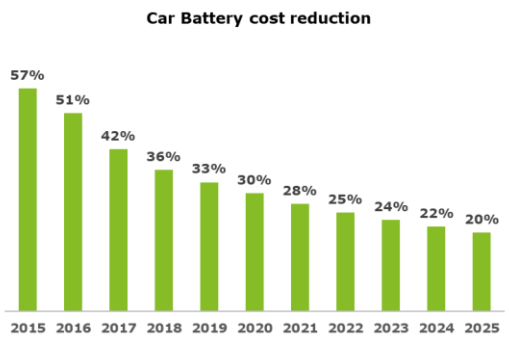


Figure 47: Car battery cost reduction.

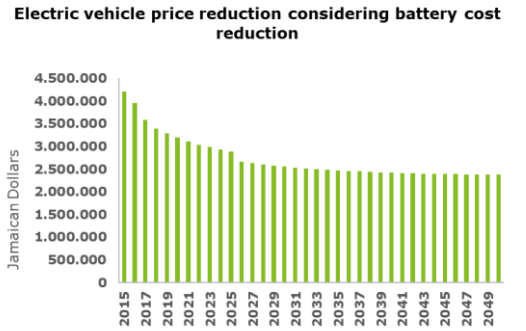


Figure 48: Electric vehicle price.

Additionally, fuel and energy consumption and greenhouse gases emissions from each type of vehicle have been contemplated in the model.

Regarding Internal Combustion Engine vehicles, for calculating its greenhouse gas emissions a multiplication has been done between the fuel consumption, data provided by National Renewable Energy Laboratory (based on on-road consumption fuel) (NREL, Jamaica Transportation Greenhouse Gas Reduction Plan, 2019), and the conventional vehicles emission factor, data provided by the Environmental Protection Agency from the United States (EPA, 2018).

For electric vehicles greenhouse gas emissions, energy consumption, obtained from NREL (NREL, Jamaica Urban Transit Company Drive-Cycle Analysis, 2019) and EV Data Base (EV-Database, 2019), has been multiplied by the energy mix. This energy mix has been calculated by considering the Jamaican energy sector greenhouse gas emissions in 2014 -data obtained from the CAIT Climate Data Explorer website- and total kilowatts sold in 2017 -data obtained from the Ministry of Science, Energy and Technology (MSET, 2017)-.

	Fuel consumption (L/100 Km)	Greenhouse Gas emission ICE vehicle (kgCO2eq)
Motor cars	9	24.21
Motor truck	19	51.648
Motorcycles	9	24.21
Motor bus	19	51.648

	Energy consumption (kWh/km)	Greenhouse Gas emission Electric (kgCO2eq)
Motor cars	0.11	0.069
Motor truck	1.1	0.682
Motorcycles	0.11	0.069
Motor bus	1.1	0.682

Figure 49: Fuel consumption and greenhouse gas emissions for each type of vehicle (ICE and EV).

For the purpose of greenhouse gas emissions, the energy mix has been considered to be constant, representing the most pessimistic scenario. Thus, Jamaica should achieve not only the proposed objectives but exceed them.

Lastly, according to an analysis of the UN Comtrade Database based on tariff codes and its product label, we determined that 94.56% of imported vehicles are through a dealer, while 5.44% of vehicles are imported by individuals.

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Mathematical structure behind the model

Considering previous assumptions on essential drivers for modelling the composition and the volume of the Jamaican fleet, the structure of the model is hereafter detailed in figure 50:

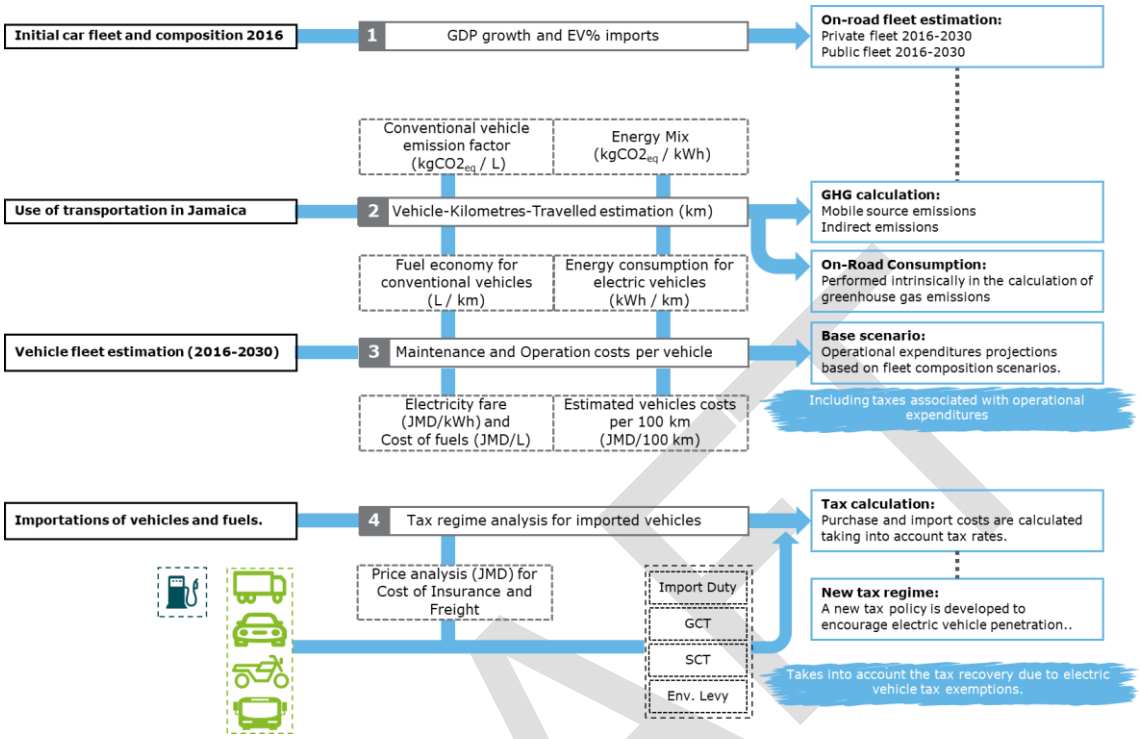


Figure 50: Dynamics and calculation developed in the model and their relationship with considered assumptions.

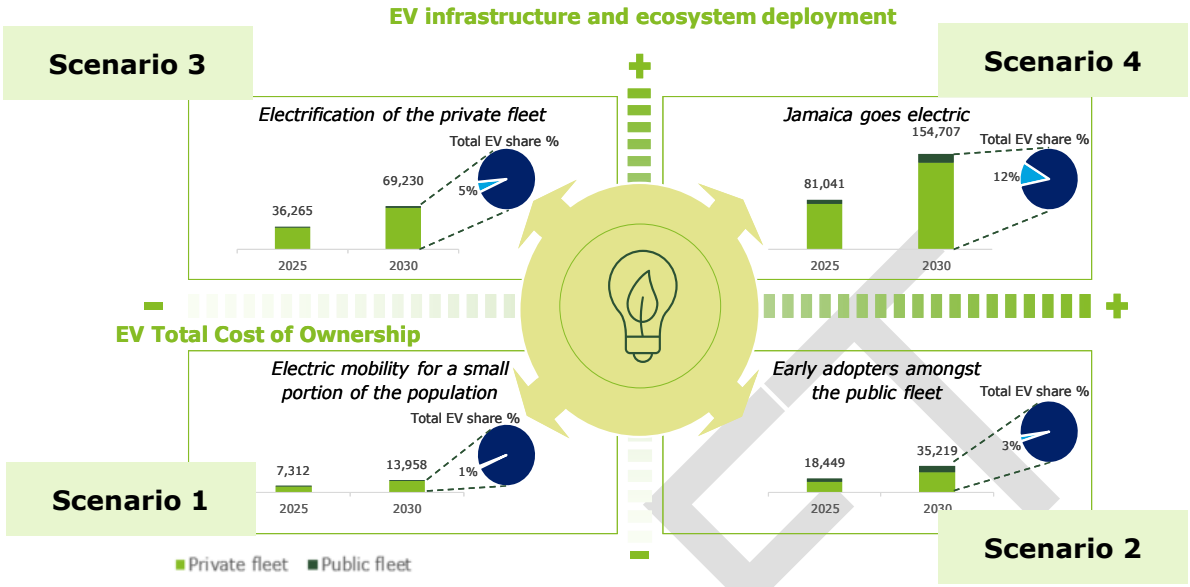
This mathematical structure is based on a number of assumptions:

1. Firstly, vehicle imports and fleet composition are on data obtained from the Ministry of Transport and Mining.
2. As only few vehicles are produced in Jamaica, it is assumed that the vehicle fleet grows based on imports and its increase is related to GDP. Based on the different actions considered in each scenario, the degree of penetration of the electric vehicle imports was established.
3. Mobility pattern analysis from other countries were taken into account when defining the mobility needs in Jamaica and developing VKT travelled per capita for each type of vehicle. These mobility needs enabled the development of estimations for greenhouse gas emissions related to the transportation sector, both from mobile sources and non-mobile sources, fuel consumption, operational expenditures for the Jamaican vehicle fleet and taxation from fuel consumption.
4. Taxes were calculated based on an analysis of the cost of insurance and freight for the vehicles included in the study and the current tax regime. Based on the reduction of the total cost of ownership of electric vehicles in relation to conventional ones, tiered incentives were established, along with counter measures for tax neutrality.

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Appendix 4: Results from the model and target application

The key figures and results are presented below based on the different electric mobility penetration scenarios developed on this document:



Figures represent number of vehicles

Figure 51: Projected electric vehicle fleet within the future of mobility in Jamaica.

The results presented in this appendix comprise the evolution of different variables based on the achievement of the different targets of electric mobility penetration share:

i. Trends of GHG emissions from the total national fleet emission calculation from transportation sector, considering the different shares of electric mobility.

ii. Simulations on fuel savings arising from the penetration of electric mobility. Fuel savings have been calculated based on the scenarios' total vehicle fleet over a total equivalent internal combustion engine fleet.

iii. Simulation of the impacts on tax revenue collection with respect to both import duties, as well as, operational expenditure taxes due to reduction of vehicle fuel consumption from electric mobility penetration shares. Impacts have been calculated considering a "business as usual" scenario:

   a. Regarding import tax revenue, impacts have been calculated considering the application of current import duties regime.

   b. Tax revenue impacts arising from operational expenditure have been calculated considering the scenarios' of electric mobility share and the equivalent scenario regarding total fleet of internal combustion engine vehicles.

As previously acknowledged, the ultimate objective is Scenario 4: "Jamaica goes electric". With this scenario, the highest electric vehicle penetration is reached in both fleets. If correctly accomplished, it will result in greenhouse gas emission reduction as well as fuel dependency decrease. Thus, in order to achieve this target, the comprehensive adoption and achievement of the action lines and proposed measures within the current Strategic Framework is required.

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The graphs below show the greenhouse gas emissions and fuel consumption savings for transportation sector for each scenario.

Greenhouse Gas Emissions calculation from the transportation sector under different electric mobility penetration scenario analysis

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Scenario 1	3.45	3.46	3.47	3.48	3.49	3.50	3.51	3.51	3.52	3.52	3.53
Scenario 2	3.45	3.46	3.46	3.47	3.47	3.48	3.48	3.48	3.48	3.47	3.47
Scenario 3	3.46	3.46	3.47	3.48	3.49	3.50	3.50	3.50	3.51	3.51	3.51
Scenario 4	3.45	3.46	3.46	3.46	3.46	3.46	3.46	3.45	3.44	3.43	3.40

Figure 52: Greenhouse Gas Emissions calculation from the transportation sector under different electric mobility penetration scenario analysis

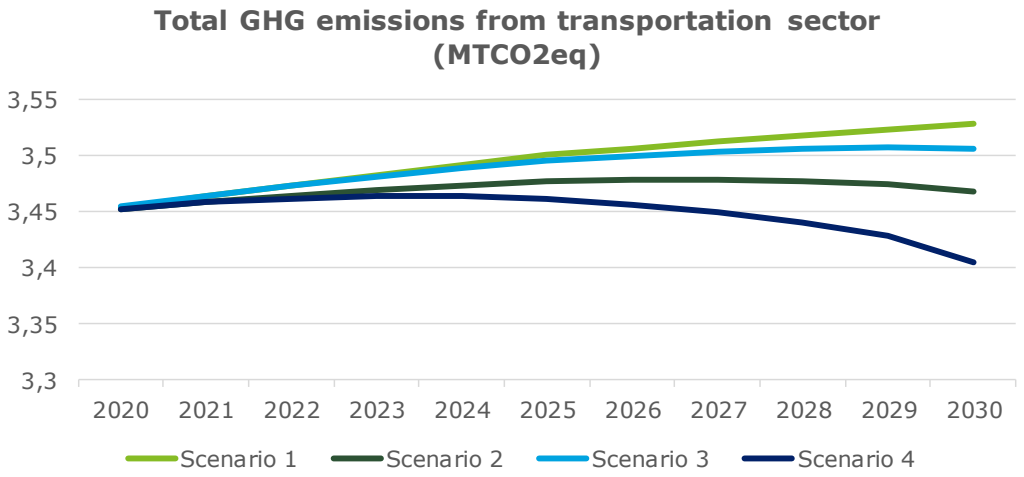


Figure 53: Total GHG emission from transportation sector.

Fuel consumption savings on transportation sector under different electric mobility penetration scenarios

(Millions of litres)	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
BAU	**1,284.11**	**1,287.68**	**1,291.25**	**1,294.81**	**1,298.38**	**1,301.95**	**1,304.42**	**1,306.90**	**1,309.37**	**1,311.84**	**1,314.31**
Scenario 1	1,282.64	1,284.87	1,287.19	1,289.59	1,292.13	1,294.72	1,296.29	1,297.97	1,299.60	1,301.27	1,302.97
Scenario 2	1,273.95	1,268.24	1,263.15	1,258.67	1,255.09	1,251.85	1,248.12	1,245.12	1,240.66	1,236.24	1,231.77
Scenario 3	1,277.33	1,274.70	1,272.49	1,270.68	1,269.48	1,268.50	1,266.84	1,265.65	1,264.33	1,263.21	1,262.23
Scenario 4	1,260.66	1,242.78	1,226.34	1,211.31	1,198.38	1,186.21	1,174.37	1,164.19	1,151.99	1,140.16	1,128.51

Figure 54: Fuel consumption savings on transportation sector under different electric mobility penetration scenarios.

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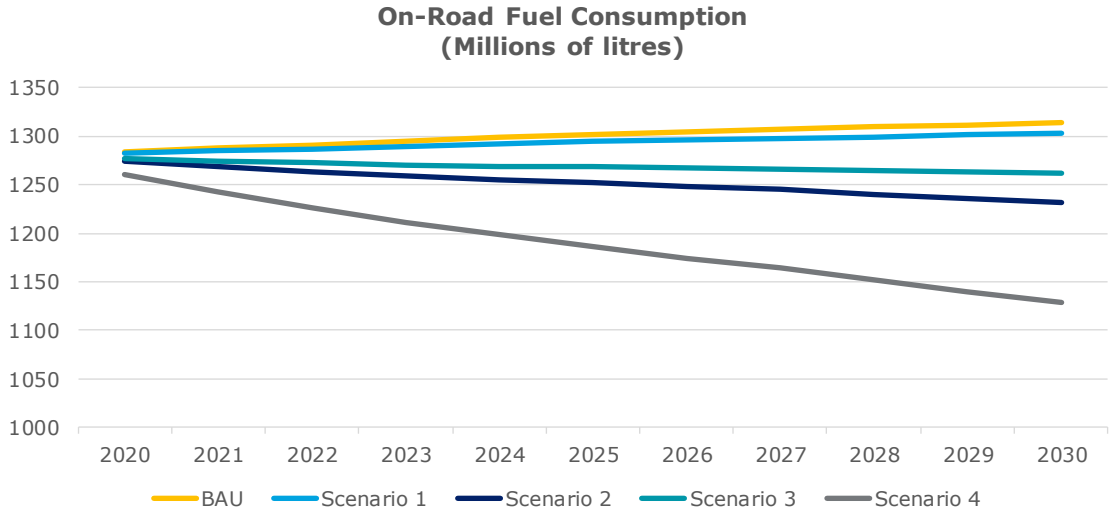


Figure 55: On-road fuel consumption.

Import tax revenue impacts considering different scenarios of electric mobility penetration share

As section 2 described, a new fiscal regime was proposed in order to boost electric mobility in Jamaica.

The following graphs and tables depict the main effects of the tax regime for each scenario and its associated business as usual scenarios for the considered timeframe.

The impacts on tax revenue have been calculated considering:

a) Import duties exemptions during the first 5 years of the timeframe (2020 to 2025).
b) Reduction on the import duties of the current tax regime from 30% to 25%. For the following five years (2025-2030), tiered incentives will be applied. As stated in Section 2, according to the battery capacity, four categories were established for electric cars -for non-car electric vehicles, as they still have a lower development, a simpler regime should be established-.
c) Consideration of 94.5% of imports realized by dealers, in last 5 years trends on imports between dealers and individuals.

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Figure 56: Import tax revenue impacts considering different scenarios of electric mobility penetration share.

Scenario 1

Thousands of JMD	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	TOTAL
Conventional Vehicles taxes	109,136,618.13	110,876,812.78	112,644,755.01	114,440,887.26	116,265,659.03	118,119,526.97	120,002,955.03	121,916,414.55	123,860,384.37	125,835,350.99	127,841,808.66	1,300,941,172.78
Electric Vehicles taxes	4,365,442.33	4,435,049.76	4,505,767.09	4,577,612.01	4,650,602.50	4,724,756.84	4,800,093.58	4,876,631.57	4,954,389.96	5,033,388.22	5,113,646.11	52,037,379.97
SCENARIO 1 (BAU)	**113,502,060.46**	**115,311,862.54**	**117,150,522.10**	**119,018,499.27**	**120,916,261.54**	**122,844,283.82**	**124,803,048.61**	**126,793,046.11**	**128,814,774.33**	**130,868,739.21**	**132,955,454.77**	**1,352,978,552.75**
Conventional Vehicles taxes	109,136,618.13	110,876,812.78	112,644,755.01	114,440,887.26	116,265,659.03	118,119,526.97	120,002,955.03	121,916,414.55	123,860,384.37	125,835,350.99	127,841,808.66	1,300,941,172.78
Electric Vehicles taxes	1,307,641.68	1,328,492.16	1,349,675.11	1,371,195.82	1,393,059.68	1,415,272.16	4,265,846.33	4,333,865.69	4,402,969.62	4,473,175.43	4,544,500.67	30,185,694.35
SCENARIO 1	**110,444,259.81**	**112,205,304.94**	**113,994,430.12**	**115,812,083.08**	**117,658,718.71**	**119,534,799.13**	**124,268,801.36**	**126,250,280.23**	**128,263,353.99**	**130,308,526.42**	**132,386,309.33**	**1,331,126,867.13**
Tax impact	(3,057,800.65)	(3,106,557.60)	(3,156,091.98)	(3,206,416.19)	(3,257,542.83)	(3,309,484.68)	(534,247.25)	(542,765.88)	(551,420.34)	(560,212.79)	(569,145.44)	(21,851,685.62)
% Tax impact over BAU	-2.7%	-2.7%	-2.7%	-2.7%	-2.7%	-2.7%	-0.4%	-0.4%	-0.4%	-0.4%	-0.4%	-1.6%

Figure 57: Conventional and Electric vehicle taxes Scenario 1.

Scenario 2

Thousands of JMD	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	TOTAL
Conventional Vehicles taxes	105,692,640.76	107,377,920.83	109,090,072.87	110,829,525.35	112,596,713.58	114,392,079.81	116,216,073.34	118,069,150.63	119,951,775.43	121,864,418.88	123,807,559.63	1,259,887,931.11
Electric Vehicles taxes	12,810,434.78	13,014,698.49	13,222,219.20	13,433,048.85	13,647,240.20	13,864,846.86	14,085,923.27	14,310,524.77	14,538,707.57	14,770,528.76	15,006,046.37	152,704,219.12
SCENARIO 2 (BAU)	**118,503,075.54**	**120,392,619.32**	**122,312,292.07**	**124,262,574.20**	**126,243,953.78**	**128,256,926.66**	**130,301,996.61**	**132,379,675.40**	**134,490,483.00**	**136,634,947.64**	**138,813,606.00**	**1,412,592,150.23**
Conventional Vehicles taxes	105,692,640.76	107,377,920.83	109,090,072.87	110,829,525.35	112,596,713.58	114,392,079.81	116,216,073.34	118,069,150.63	119,951,775.43	121,864,418.88	123,807,559.63	1,259,887,931.11
Electric Vehicles taxes	3,945,991.28	4,008,910.52	4,072,833.01	4,137,774.76	4,203,752.00	4,270,781.26	12,513,673.03	12,713,204.84	12,915,918.20	13,121,863.85	13,331,093.33	89,235,796.07
SCENARIO 2	**109,638,632.04**	**111,386,831.35**	**113,162,905.88**	**114,967,300.11**	**116,800,465.58**	**118,662,861.07**	**128,729,746.36**	**130,782,355.47**	**132,867,693.63**	**134,986,282.73**	**137,138,652.95**	**1,349,123,727.18**
Tax impact	(8,864,443.50)	(9,005,787.97)	(9,149,386.19)	(9,295,274.09)	(9,443,488.20)	(9,594,065.59)	(1,572,250.24)	(1,597,319.94)	(1,622,789.37)	(1,648,664.91)	(1,674,953.04)	(63,468,423.05)
% Tax impact over BAU	-7.5%	-7.5%	-7.5%	-7.5%	-7.5%	-7.5%	-1.2%	-1.2%	-1.2%	-1.2%	-1.2%	-4.5%

Figure 58: Conventional and Electric vehicle taxes Scenario 2.

Scenario 3

Thousands of JMD	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	TOTAL
Conventional Vehicles taxes	100,743,619.16	102,349,986.57	103,981,967.68	105,639,970.89	107,324,411.14	109,035,709.96	110,774,295.62	112,540,603.21	114,335,074.75	116,158,159.32	118,010,313.17	1,200,894,111.48
Electric Vehicles taxes	21,513,400.11	21,856,433.49	22,204,936.58	22,558,996.59	22,918,702.12	23,284,143.20	23,655,411.26	24,032,599.24	24,415,801.52	24,805,113.99	25,200,634.10	256,446,172.21
SCENARIO 3 (BAU)	**122,257,019.27**	**124,206,420.07**	**126,186,904.26**	**128,198,967.49**	**130,243,113.26**	**132,319,853.16**	**134,429,706.88**	**136,573,202.45**	**138,750,876.27**	**140,963,273.32**	**143,210,947.27**	**1,457,340,283.69**
Conventional Vehicles taxes	100,743,619.16	102,349,986.57	103,981,967.68	105,639,970.89	107,324,411.14	109,035,709.96	110,774,295.62	112,540,603.21	114,335,074.75	116,158,159.32	118,010,313.17	1,200,894,111.48
Electric Vehicles taxes	6,435,846.27	6,538,466.50	6,642,723.02	6,748,641.93	6,856,249.72	6,965,573.33	21,022,925.45	21,358,138.17	21,698,695.88	22,044,683.83	22,396,188.59	148,708,132.70
SCENARIO 3	**107,179,465.43**	**108,888,453.07**	**110,624,690.70**	**112,388,612.82**	**114,180,660.86**	**116,001,283.30**	**131,797,221.07**	**133,898,741.37**	**136,033,770.63**	**138,202,843.16**	**140,406,501.77**	**1,349,602,244.18**
Tax impact	(15,077,553.84)	(15,317,966.99)	(15,562,213.56)	(15,810,354.66)	(16,062,452.40)	(16,318,569.86)	(2,632,485.82)	(2,674,461.07)	(2,717,105.63)	(2,760,430.16)	(2,804,445.51)	(107,738,039.51)
% Tax impact over BAU	-12.3%	-12.3%	-12.3%	-12.3%	-12.3%	-12.3%	-2.0%	-2.0%	-2.0%	-2.0%	-2.0%	-7.4%

Figure 59: Conventional and Electric vehicle taxes Scenario 3.

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Scenario 4

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	TOTAL
Conventional Vehicles taxes	87,489,347.18	88,884,373.86	90,301,644.38	91,741,513.43	93,204,341.33	94,690,494.18	96,200,343.89	97,734,268.31	99,292,651.32	100,875,882.90	102,484,359.27	1,042,899,220.06
Electric Vehicles taxes	50,387,411.92	51,190,844.41	52,007,087.71	52,836,346.09	53,678,827.09	54,534,741.53	55,404,303.62	56,287,730.96	57,185,244.64	58,097,069.28	59,023,433.05	600,633,040.29
SCENARIO 4 (BAU)	137,876,759.10	140,075,218.26	142,308,732.09	144,577,859.52	146,883,168.42	149,225,235.71	151,604,647.51	154,021,999.28	156,477,895.96	158,972,952.18	161,507,792.32	1,643,532,260.35
Conventional Vehicles taxes	87,489,347.18	88,884,373.86	90,301,644.38	91,741,513.43	93,204,341.33	94,690,494.18	96,200,343.89	97,734,268.31	99,292,651.32	100,875,882.90	102,484,359.27	1,042,899,220.06
Electric Vehicles taxes	15,214,488.81	15,457,085.40	15,703,550.23	15,953,944.96	16,208,332.26	16,466,775.79	49,232,826.07	50,017,848.57	50,815,388.33	51,625,644.95	52,448,821.19	349,144,706.55
SCENARIO4	102,703,835.99	104,341,459.26	106,005,194.61	107,695,458.38	109,412,673.59	111,157,269.97	145,433,169.97	147,752,116.88	150,108,039.65	152,501,527.85	154,933,180.46	1,392,043,926.61
Tax impact	(35,172,923.11)	(35,733,759.00)	(36,303,537.48)	(36,882,401.14)	(37,470,494.83)	(38,067,965.74)	(6,171,477.54)	(6,269,882.39)	(6,369,856.31)	(6,471,424.33)	(6,574,611.86)	(251,488,333.73)
% Tax impact over BAU	-25.5%	-25.5%	-25.5%	-25.5%	-25.5%	-25.5%	-4.1%	-4.1%	-4.1%	-4.1%	-4.1%	-15.3%

Figure 60: Conventional and Electric vehicle taxes Scenario 4.

Below, we present the main tax revenue impacts that will accrue from operational expenditures based on the scenarios. The main aspects that will be considered are total tax revenues coming from operational expenditures of (i) internal combustion engine vehicles and (ii) electric vehicles, along with the (iii) the battery taxes. Taking into account the possibility that some of the electric vehicles imported by Jamaica will come from a secondary market, these vehicles will need replacement batteries. Thus, new imported batteries will provide additional tax revenues for the Government of Jamaica.

Tax revenue impacts arising from operational expenditure amongst the different scenarios of electric mobility penetration share

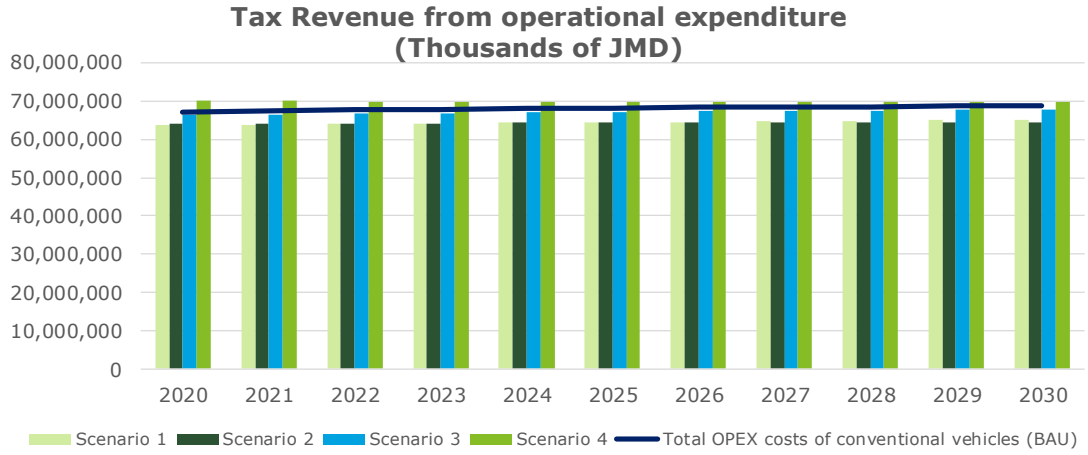


Figure 61: Tax revenue from operational expenditure.

Scenario 1

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Total tax revenue from operational expenditures on ICE vehicles	62,808,759.10	62,917,882.57	63,031,387.37	63,149,224.36	63,273,483.44	63,400,080.73	63,477,262.30	63,559,532.60	63,639,458.21	63,721,263.50	63,804,477.35
Total tax revenue from operational expenditures on EV share	47,747.56	91,407.40	132,154.34	170,021.05	203,618.07	235,660.55	264,799.87	290,555.98	317,141.77	342,331.60	366,426.39
Batteries	725,684.57	737,255.68	749,011.30	760,954.36	773,087.86	785,414.82	797,938.34	810,661.55	823,587.64	836,719.83	850,061.41
TOTAL TAX REVENUE	**63,582,191.23**	**63,746,545.65**	**63,912,553.01**	**64,080,199.77**	**64,250,189.37**	**64,421,156.10**	**64,540,000.51**	**64,660,750.13**	**64,780,187.61**	**64,900,314.93**	**65,020,965.15**

Figure 62: Tax revenue from operational expenditure Scenario 1.

Scenario 2

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Total tax revenue from operational expenditures on ICE vehicles	62,383,459.81	62,103,694.24	61,854,256.01	61,634,804.82	61,459,806.93	61,300,993.94	61,118,624.39	60,971,478.65	60,753,022.70	60,536,529.15	60,317,807.23
Total tax revenue from operational expenditures on EV share	292,704.02	560,349.39	810,137.92	1,042,270.00	1,248,227.83	1,444,655.94	1,623,286.99	1,781,178.14	1,977,896.71	2,172,825.90	2,368,379.89
Batteries	1,451,369.13	1,474,511.36	1,498,022.60	1,521,908.73	1,546,175.72	1,570,829.65	1,595,876.69	1,621,323.11	1,647,175.27	1,673,439.65	1,700,122.82
TOTAL TAX REVENUE	**64,127,532.97**	**64,138,555.00**	**64,162,416.54**	**64,198,983.54**	**64,254,210.47**	**64,316,479.52**	**64,337,788.06**	**64,373,979.90**	**64,378,094.68**	**64,382,794.70**	**64,386,309.94**

Figure 63: Tax revenue from operational expenditure Scenario 2.

Scenario 3

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Total tax revenue from operational expenditures on ICE vehicles	62,548,679.29	62,419,988.61	62,311,545.82	62,223,123.71	62,164,380.61	62,116,443.27	62,034,903.66	61,976,881.04	61,912,259.67	61,857,174.90	61,809,521.06
Total tax revenue from operational expenditures on EV share	223,567.86	427,995.88	618,784.82	796,087.72	953,398.68	1,103,430.83	1,239,869.55	1,360,467.10	1,482,353.97	1,597,183.95	1,706,322.16
Batteries	3,628,422.83	3,686,278.41	3,745,056.50	3,804,771.81	3,865,439.29	3,927,074.12	3,989,691.72	4,053,307.77	4,117,938.18	4,183,599.13	4,250,307.05
TOTAL TAX REVENUE	**66,400,669.99**	**66,534,262.90**	**66,675,387.14**	**66,823,983.24**	**66,983,218.59**	**67,146,948.23**	**67,264,464.93**	**67,390,655.91**	**67,512,551.82**	**67,637,957.98**	**67,766,150.27**

Figure 64: Tax revenue from operational expenditure Scenario 3.

Scenario 4

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Total tax revenue from operational expenditures on ICE vehicles	61,732,223.22	60,856,974.01	60,051,781.78	59,315,860.41	58,682,627.36	58,086,781.85	57,506,976.44	57,008,538.99	56,411,174.47	55,831,542.26	55,261,072.27
Total tax revenue from operational expenditures on EV share	721,313.12	1,380,873.98	1,996,430.08	2,568,475.21	3,076,018.92	3,560,078.46	4,000,280.54	4,389,373.12	4,828,634.02	5,254,355.58	5,671,718.86
Batteries	7,619,687.95	7,741,184.66	7,864,618.65	7,990,020.81	8,117,422.51	8,246,855.65	8,378,352.62	8,511,946.32	8,647,670.18	8,785,558.18	8,925,644.81
TOTAL TAX REVENUE	**70,073,224.30**	**69,979,032.65**	**69,912,830.51**	**69,874,356.43**	**69,876,068.79**	**69,893,715.97**	**69,885,609.60**	**69,909,858.43**	**69,887,478.67**	**69,871,456.01**	**69,858,435.93**

Figure 65: Tax revenue from operational expenditure Scenario 4.

Total OPEX costs of conventional vehicles (BAU)

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Total OPEX costs of conventional vehicles (BAU)	**67,236,365.10**	**67,423,265.90**	**67,610,166.71**	**67,797,067.51**	**67,983,968.31**	**68,170,869.11**	**68,300,261.97**	**68,429,654.83**	**68,559,047.70**	**68,688,440.56**	**68,817,833.42**

Figure 66: Total OPEX of conventional vehicles Business as Usual.

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Appendix 5: Action lines mapping

As previously specified, action lines represent strategic objectives towards the electric mobility deployment boost in Jamaica. However, in order to determine the most crucial actions to perform, it was necessary to group action lines into four different clusters according to the key areas developed in section 1: (i) the electric vehicle infrastructure and ecosystem deployment and (ii) electric vehicle total cost of ownership.

Figure 67, shows the four main clusters that have been established.

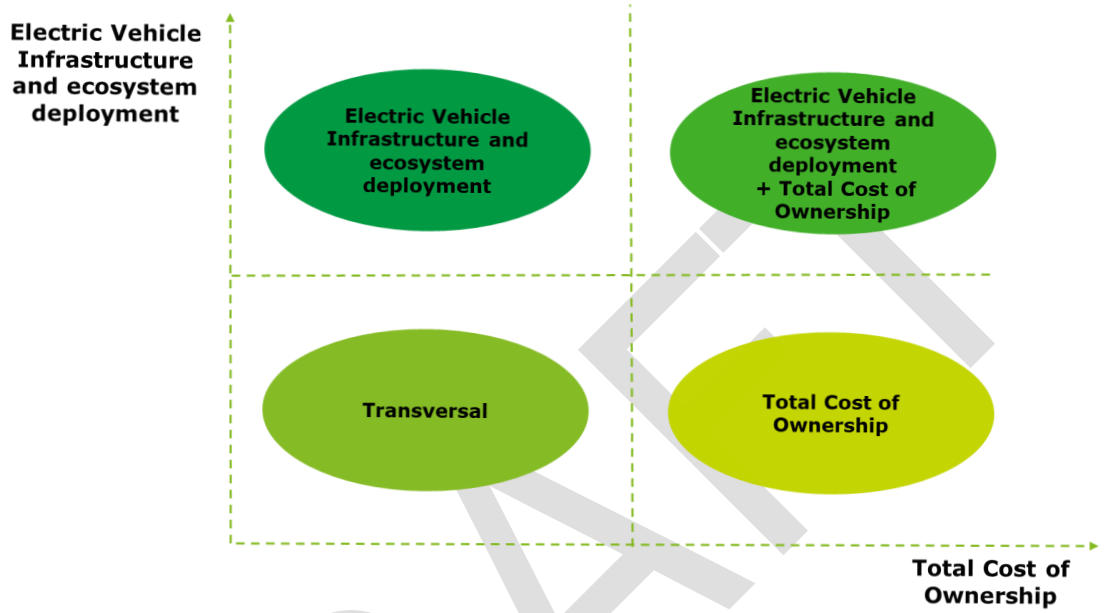


Figure 67: Action Lines clustering groups.

The first cluster includes the most relevant action lines in order to reduce the Total Cost of Ownership of an electric vehicle for the Jamaican population along with the proper development of the electric mobility ecosystem and its infrastructure. This cluster includes the following action lines:

> Action line 11: Electric sector regulatory framework for electric vehicles charging - tariffs and commercial models
>
> Action line 30: Battery reuse and disposal guidelines
>
> Action line 31: Program to support new ventures on second-life applications for batteries and entrepreneurship programs

Total Cost of ownership cluster will include those action lines purely designed to reduce electric vehicles total cost, both in its acquisition price and during the useful life of the vehicle, including operational and maintenance costs. These actions will follow the first cluster in terms of priority. The main action lines included are:

Action line 1: Development of an incentive program

Action line 7: Upgrading emissions and efficiency norms for internal combustion engine vehicles

Action line 9: Impacts of electric vehicles on grid operations and planning

Action line 16: Financial schemes for public transport operators to adopt new technologies

Action line 37: Financial solutions for new acquisitions of electric vehicles (leasing), mechanisms to increase market penetration for e-vehicles, particularly for the medium and low-income segments of the markets

In third place, Electric Vehicle Supply Equipment cluster concentrates those action lines dedicated to the development of the electric mobility ecosystem, not only from the perspective of electric vehicle infrastructure but also further measures designed to create an integrated ecosystem between all the major players in Jamaica. In this regard, the action lines to be included are the following ones:

Action line 2: Assessment of immediate or short-term fiscal impacts and strategies to inform policy development

Action line 3: Charging systems and EV charging standards for private vehicles, buses and other modes of transportation

Action line 4: Vehicle-charging stations communication standards

Action line 10: Optimal location for public charging stations in the island

Action line 28: Training and development of local capabilities

Action line 29: E-mobility research and development programs with universities, private and public sector

Action line 32: E-mobility ecotourism program with key stakeholders

Action line 33: E-mobility infrastructure and human capital development through the private sector

To conclude, the final cluster will include transversal action lines. Although they are substantial to apply in order to achieve a proper electric mobility deployment, they are not considered as priority. These are:

Action line 5: Vehicle to grid services and business model development structuring

Action line 6: Cybersecurity guidelines

Action line 8: Developing a tagging system for congested areas

Action line 12: Vehicle to grid integration and distributed energy aggregators, technical and commercial regulation, new business models

Action line 13: Regulatory and market mechanisms for scaling up renewables in the power sector

Action line 14: Update to the general transport policy

Action line 15: Electric buses feasibility studies and immediate renewal needs assessment

Action line 17: Immediate renewal program structuring

Action line 18: Long-term and following renewal phases guidelines for electric public transport fleets

Action line 19: Monitoring systems of the renewal programs

Action line 20: Following renewal phases feasibility studies

Action line 21: Legal and institutional arrangements for the performance and implementation of renewal programs in public transportation

Action line 22: Updated guidelines for the definition of service levels in public transportation

Action line 23: Circulation and transport incentives – used of restricted space, parking policy, demand restrictions waiver, amongst othersAction line 24: Electric bus deployment pilot

Action line 25: National taxi renewable program

Action line 26: Renewal program for urban freight delivery vehicles

Action line 27: Fleet renewal study and plan for public sector institutions

Action line 34: Regulatory model for new shared mobility services

Action line 35: Regulatory model for electric car-sharing and urban rental services

Action line 36: Regulatory guidelines for micromobility

Appendix 6: Tax credits for All-Electric Vehicles and Plug-In Hybrid Electric Vehicles

Europe

Across Europe, different incentives and subsidies have been established. The most common incentives and subsidies are listed hereafter:

- VAT deduction and exemptions on electric vehicle purchases. These deductions and exemptions are usually based on the vehicle type and emissions (grams of CO2 equivalent per kilometre travelled).
- Tax reliefs on vehicle acquisition of a certain amount by vehicle type.
- Direct support on electric vehicle acquisition, both to private users and companies.
- Exemptions and deductions for company cars.

Incentives and subsidies at a country-level are detailed in figure 68. For the matter of this table a number of acronyms were used:

- BEV: Battery Electric Vehicles,
- EREV: Extended-Range Electric Vehicles
- FCEV: Fuel-Cell Electric Vehicle,
- HEV: Hybrid Electric Vehicle,
- PHEV: Plug-In Hybrid Electric Vehicle.

Countries	Incentives
 *Austria*	VAT exemptions for BEV and FCEV. VAT deductions for other electric vehicles. There is an incentive scheme until late 2020 (www.umweltfoerderung.at).
 *Belgium*	The tax scheme in Belgium depends on the State: - Brussels and Wallonia: minimum rate for BEV. - Flanders: exemption apply for vehicles that emit 50g CO_{2eq}/km at most.
 *Cyprus*	Vehicles emitting less than 120 g of CO_{2eq}/km are tax exempted.
 *Czech Republic*	Vehicles emitting less than 50 g of CO_{2eq}/km are tax exempted and have a special plate.
 *Denmark*	Fuel-cell electric vehicles are exempt before 2022. BEV and PHEV pay 40% of the tax in 2020 (65% in 2021, 90% in 2022 and 100% in 2023). Furthermore there is a reduction of close to 10,000 EUR for BEV and PHEV.
 *Finland*	The tax rate is minimal for zero-emissions vehicles. Moreover there is a purchase incentive of 2,000 EUR for BEV that cost less than 50,000 EUR.

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Countries	Incentives
 *Greece*	VAT exemptions for zero-emission vehicles.
 *Hungary*	VAT exemptions for BEV and PHEV.
 *Ireland*	Tax reduction and purchase incentive for BEV up to 5,000 EUR before 2022.
 *Italy*	There is a bonus-malus scheme ending in 2022. Vehicles emitting 20g CO_{2eq}/km or less have a maximum 6,000 EUR deduction and vehicles emitting more than 250 g CO_{2eq}/km have to pay up to 2,500 EUR.
 *Luxembourg*	There is a tax relief of 5,000 EUR for BEV and FCEV and a tax relief of 2,500 EUR for PHEV.
 *Malta*	Minimum rate for vehicles that have emission of less than 100g CO_{2eq}/km.
 *Netherlands*	VAT exemption for zero-emission cars.
 *Portugal*	BEV and PHEV have VAT deductions (vehicle value maximum of 62,000 EUR for BEV and 50,000 EUR for PHEV).
 *Slovakia*	Minimum rate for BEV (33 EUR).
 *Slovenia*	Minimum rate for electric vehicles that have emissions less than 110 g $CO2_{eq}$/km (0.50%). Moreover there is an incentive scheme of 7,500 EUR for BEV cars, 4,500 EUR for vans, PHEV and EREV and 3,000 EUR for light-duty vehicles.
 *Spain*	There is a tax exemption for vehicles that emit less than 120 of CO_{2eq}/km. There is also an incentive scheme for BEVs, FCEVs, PHEVs and EREVs, depending on the vehicle: up to 5,500 EUR for cars, 6,000 EUR for vans, 8,000 EUR for medium duty vehicles and 15,000 EUR for heavy-duty vehicles.
 *United Kingdom*	There is an exemption for vehicles emitting less than 50 g of CO_{2eq}/km until March 2021. Also, the government establishes a grant through car dealers for BEV cars and vans: 35% of purchase cost (up to 4,000 EUR) for cars and 20% of purchase cost (up to 9,200 EUR) for vans.

Figure 68: Subsidies and incentives in Europe to foster electric mobility.

United States of America

In the United States of America, at a federal level and through the U.S. Department of Energy Alternative Fuels Data Center, there are federal tax credits for electric vehicles, both full electric vehicles (also known as Battery Electric Vehicles) and Plug-In Hybrid Electric Vehicles.

State incentives apply only for new vehicles and vary depending on the model of electric vehicle. As such, the federal tax credit allows for a credit up to 7,500 USD per acquired vehicle:

- Full electric vehicles are eligible for the full credit.
- Plug-In Hybrid Electric Vehicles are eligible for a maximum tax credit of 7,500 USD and a minimum tax credit of 2,500 USD, depending on both the model of the vehicle and the year in which it was acquired.

Furthermore, electric vehicle buyers are also eligible for regional credits.

As an example, in the state of California, the Clean Vehicle Rebate Program offers maximum rebates of 4,500 USD for fuel-cell electric vehicles, 2,000 USD for battery electric vehicles, 1,000 USD for plug-in hybrid electric vehicles and 750 USD for zero emissions motorcycles for eligible vehicles. Additionally, more incentives and subsidies can apply depending on the area of residence or the specific model of the acquired vehicle.

Last, the U.S. Department of Energy Alternative Fuels Data Center has developed an online platform that allows any electric vehicle buyer to verify different incentives: https://afdc.energy.gov/laws/state. This communication campaign results very effective in order to establish transparency with consumers, helping them when buying a new vehicle.

Dominican Republic

In 2013, the Dominican Republic published the law nº 103-13 in which they established a 50% tax reduction on import taxes and first registration fee on energy efficient vehicles (article 3) (Ley No. 103-13 de incentivo a la importación de vehículos de energía no convencional., 2012).

However, it is to be considered that the DR-CAFTA (Dominican Republic-Central America Free Trade Agreement) establishes a counter-effect on this subsidy. The DR-CAFTA establishes special tax reduction for commercial exchanges with Central American countries and the United States of America (Organization of American States, 2020). As many imported electric vehicles come from the U.S.A. this law reduces the financial benefits that the population from the Dominican Republic could have from the 103-13 Law.

Nevertheless, the Dominican Republic is actually the largest market in the Caribbean when it comes to electric vehicles size. Moreover, this market has almost nine-folded from 2018 to January 2020 (Inter-American Dialogue, Inter-American Development Bank and Organization of American States, 2020).

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Costa Rica

In 2018, Law 9518 came into effect, granting financial and non-financial incentives to electric vehicles. This Law aims to create a regulatory framework to promote electric mobility in Costa Rica, as well as, to incentivize the adoption of electric vehicles.

However, it must be highlighted that previous to this Law, the Government had already considered incentivizing electric vehicle by reducing taxes. The Executive Decree 33096/2006 and the Executive Decree 37822/2013, included the definition of taxes exemptions or reductions on electric vehicles.

The Law 9518 establishes not only financial incentives to promote electric mobility adoption, but also incentives towards the ease of use in vehicle circulation. Regarding, tax incentives, this Law sets exemptions on consumption taxes dependent on the vehicles value. The application of taxes exemptions or reductions are established based on different value ranges. The previous tax structure is defined for a period of 5 years from the publication of the Law regarding General Consumption Tax tariffs, Special Consumption Tax tariffs and Customs Tax tariffs, for the new vehicles imported to the country, and is limited to a total applicable exemption amount.

In addition, this Law stablishes an incentive through the vehicle property taxes for electric vehicles during a period of 5 years. During this period of time there is a total or partial exemption on the application of the vehicle property tax. The application of this incentive dilutes through the period of time applied: the first year there is a 100% exemption of the tax, this exemption reduces each year, representing the last year of application an exemption of 20% of the tax.

Argentina

Within Argentina's national electric mobility strategy to promote adoption on electric vehicles and the development of an electric mobility industry, different policies where developed focused on the financial and fiscal incentives.

The development of the Executive Decree 331/17, included within its scope, the decrease of import tariffs for electric vehicles, as well as, hybrid vehicles and fuel cells. This temporary decrease on the import tariffs were limited to a specific number of units and period of time: maximum of 6,000 units over a period of 3 years.

It must be highlighted that the design of the tariff reduction differentiates amongst the type of imports amongst complete armed vehicles and unarmed vehicles higher reductions on imports on unarmed or semi-armed vehicles are established in order to promote the development on the national industry.

In addition, the Executive Decree 51/18, focuses on the tax reduction on the electric buses import tariffs. This decrease on the import tariffs applied to a maximum of 350 units.

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Colombia

Colombia's tax incentive framework to promote new technology mobility adoption includes not only incentives over import tariffs, but also differentiated Value Added Taxes for electric vehicles.

On this end, the Law 1819 defines the differentiation on Value Added Tax regarding vehicle parts, as well as, charging infrastructure for electric and hybrid vehicles.

In addition, the Executive Decree 1116, stablished incentives to electric and hybrid vehicles through the import tariffs. This policy also includes import tariff incentives to electric vehicles chargers, granting a 0% import tax.

Last, the electric mobility law approved by the Colombian Government included the applicable tariff taxes, as well as, limiting the tax imposition to 1% of the vehicles commercial value.

Mexico

Within the fiscal Federal Law regarding taxes on new vehicles, there is an exemption on the sale or import of electric battery motor vehicles ("Ley Federal del Impuesto sobre Automóviles Nuevos").

In addition, amongst the incentives designed to promote electric mobility in Mexico, Mexican States can establish additional incentives: the incentives rely on the exemption on the annual vehicle property tax, adopted by most states, and the exemption on emission verification procedures.

Uruguay

Uruguay has stablished amongst other, financial measures to incentivize the adoption of electric mobility in the country, including consumption tax reductions, as well as, customs and import duties exemptions.

Through the definition of the Decree 246/012, electric and hybrid vehicles are granted a reduction on the Internal Specific Tax, based on the different vehicle categorization. The Internal Specific Tax applicable to a passenger electric vehicle is established between at 5.75%, whilst a conventional vehicle tax (motor diesel) is set at 115%.

In addition, exemption on import tariffs are established for electric motor vehicles within the modification of the applicable tax regime during a temporary period of time (five years sin the Decree's publication).

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