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ELECTRIFIED ISLANDS

The Road to E-Mobility in the Caribbean

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Executive Summary

Global electric vehicle[i] (EV) uptake is on the rise, propelled by declining battery costs, increased awareness, and favorable government policies. EVs are attracting interest worldwide for their role in reducing carbon emissions and local air pollution, but most progress to date has been concentrated in China, the United States, and Western Europe. Despite low EV numbers in the Caribbean, several factors make the region ideal for expansion. Caribbean islands are heavily dependent on oil imports, which makes fuel expensive and exposes them to oil price and foreign exchange risk. Transport sectors account for a large share of energy consumption. Renewable energy potential is abundant, meaning the environmental benefits of EVs can be maximized over time. And Caribbean islands are vulnerable to natural disasters and can benefit from the ancillary resilience services of EVs. Finally, Caribbean islands are small, naturally mitigating range anxiety and requiring less extensive charging networks.

This report examines the progress on and impediments to EV expansion in five case studies (Barbados, Bermuda,[ii] the Cayman Islands, Jamaica, and the Dominican Republic). It is based on the results of a high-level dialogue at the 2019 Caribbean Renewable Energy Forum (CREF), interviews with Caribbean stakeholders (including senior policymakers, regulators, utilities, and automakers), and supplemental research. The report evaluates the status of EV markets in each of the five jurisdictions, which are among those at the forefront of EV policy planning and adoption and those with the greatest untapped potential. It also identifies barriers and recommends actions that could be taken to realize the benefits that EVs can offer to the Caribbean.

The report finds that, despite contextual differences on each island, advances in electric mobility in the region are in many ways underpinned by common factors.

- **The reduction or elimination of import duties** for EVs is shortening the path to sticker price parity (in some cases and for some models, fully achieving it) and resolving the issue of high upfront cost, often the consumer's primary concern.
- **Long-term renewable energy and transportation goals** are communicating a strong commitment to EVs, thereby increasing certainty for utilities, automakers and dealers. These goals also capitalize on the region's abundant solar energy resources and potential to reduce oil import dependence.
- **High-use government and commercial fleets** are enhancing the visibility of EVs and proving their performance to the public. Electric buses represent an opportunity for public interaction with EV technology and in some cases are being granted serious consideration in public tenders.
- **Utilities and independent providers** are becoming involved in the deployment and operation of charging infrastructure, helping set the foundation for mass electrification of the transport sector. They are identifying EV charging as a potential source of demand growth and innovating by using smart metering and time-of-use tariffs to send economic signals to consumers, incentivize EVs, and sustainably integrate EVs into the grid.

The cases presented, and others in the Caribbean, also confront some shared challenges:

- **Public awareness** is a top barrier across the five jurisdictions. The unfamiliarity of EV technology has led to the propagation of misconceptions and a lack of knowledge about the benefits of EVs, including how long-term fuel and maintenance savings can compensate for the higher upfront cost.
- **Concerns that government revenues from the taxation of fuel** will dry up if EVs supplant internal combustion engine vehicles (ICEVs) on a large scale are widespread. To ensure the stability of government finances the impacts need to be clearly understood and appropriate fiscal strategies will have to be developed over the medium and long term as EV uptake increases.
- **The high use of oil for power generation** reduces the greenhouse gas reduction benefits of EVs unless electricity demand growth stemming from electric transport is met by concurrent increases in renewable energy capacity, as the islands included in the study have limited clean power generation.
- **Charging infrastructure** is insufficient to support large numbers of EVs despite the small size of many Caribbean islands. Consumers need to feel confident that they can access a public charger near them and charge rapidly at a low cost.
- **Lack of trained sales and maintenance personnel** is

i Electric vehicles in this report are defined as battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs).

ii Though Bermuda is located in the North Atlantic Ocean, it is an associate member of the Caribbean Community (CARICOM).

an impediment for consumers interested in driving an EV. For automakers, having sufficient EV-trained maintenance personnel is a prerequisite to export large numbers of these vehicles to Caribbean markets.

- **Most car dealers and auto manufacturers still need to be convinced that EVs will sell** in large enough numbers in the Caribbean market. Skepticism that the Caribbean market is primed for EVs exists for several reasons, limiting consumer choice and thus depressing demand.
- **The narrow roads** inherent to some small islands like Bermuda represent an additional bottleneck to consumer choice by limiting the number of EV models suitable for import. Narrow roads also mean most standard models of full-size public buses will not be able to run on some islands.

The paper concludes with several actions that could be taken by Caribbean governments and other stakeholders to stimulate EV adoption.

- **Governments should clearly communicate their goals to automakers, dealers, and utilities, and credibly establish their commitment to EVs.** Concrete long-term goals for EV penetration and the electrification of government fleets can demonstrate the seriousness of Caribbean governments about encouraging EV adoption, providing long-term certainty to automakers, dealers, utilities, and other players in the EV ecosystem. Neighboring islands may consider coordinating efforts to create larger collective markets to benefit from economies of scale in procuring electric vehicle supply equipment (EVSE) and EVs.
- **Levels of public awareness should be assessed and increased.** Governments should survey more consumers to understand their level of knowledge and preferences. Governments, auto dealers, and other stakeholders should collaborate to dispel myths about EVs and advertise their total cost of ownership savings.
- **Opportunities to electrify public transportation and government and commercial fleets should be seized.** They allow governments to capitalize on cost and emissions savings, demonstrate the viability of EV technology to the public, and add credibility to the EV goals and broader decarbonization targets established by many governments in the region.
- **Utilities should view the electrification of transport as an opportunity for growth, and governments should define the role of utilities in incentivizing electric mobility.** The grid applications of electric mobility present a host of new opportunities for utilities to diversify and expand their business. Innovative business models and partnerships will be necessary to realize this potential. Governments should define the role of public utilities in creating the enabling environment for EV charging infrastructure while striking a balance that allows innovative business models to evolve in the EV charging ecosystem.
- **Governments should analyze fiscal effects of large-scale EV use in the long term.** Governments should plan ahead for the depletion of significant revenues from fuel taxes. This loss should be weighed against the positive economic effects of EVs as governments set EV uptake targets, and ways to balance the budget without depending on fuel tax revenue should be identified before EVs reach significant scale.
- **The issue of electric mobility is multisectoral and all stakeholders should be engaged in a dialogue to coordinate efforts and align incentives.** Electric mobility has implications for transportation, urban planning, health, trade, power demand, fiscal sustainability, climate change mitigation and adaptation, local labor markets, and more. Thus, governments, utilities, regulators, automakers and dealers, and educational institutions must all be convened to create a shared vision and strategy for EVs, which can be used for planning on all sides. The absence of such a plan can create misalignments of incentives that impede the penetration of EVs in Caribbean markets.

The report evaluates the status of EV markets in each of the five jurisdictions, which are among those at the forefront of EV policy planning and adoption and those with the greatest untapped potential.

Introduction

Electric mobility is gaining traction worldwide, driven by falling technology costs, heightened awareness, and government policies that facilitate uptake. Battery costs are declining rapidly—in 2019, Volkswagen built the first battery that cost under $100/kWh,[1] 91% lower than the average cost in 2010.[2] $100/kWh has been hailed as the battery cost at which EVs undercut internal combustion engine vehicles (ICEV) prices. Some analytical outfits, such as the International Council on Clean Transportation (ICCT), predict general upfront price parity for shorter-range electric cars in certain markets as early as 2024.[3] Meanwhile, rising sales are increasing visibility, and thus demand, which in turn spurs an ever-wider selection of models and drives sales even higher. Moreover, government goals increasingly reflect the need for swift and decisive action to mitigate climate change and thus favor transport electrification. As a result, Bloomberg New Energy Finance projects that electric vehicles (EVs) will account for 57% of global passenger vehicle sales by 2040.[4]

The transport sector is a major source of greenhouse gas emissions—18% of global carbon emissions were generated by road transport in 2016.[5] EVs have generated tremendous interest in part because of their potential to reduce these emissions, especially when coupled with zero-carbon energy. For example, in Norway, where most electricity is zero-carbon, the lifecycle emissions of a Nissan LEAF are less than 30% of those of the average European car.[6] However, regardless of the fuel source, the energy efficiency of EVs is 77% or higher compared to about 17-21% for an ICEV.[7] With zero tailpipe emissions, EVs also reduce local air pollution.

Most EV deployment to date has taken place in China, the United States, and Western Europe, and their presence in the Caribbean remains minimal. Nonetheless, the conditions of Caribbean islands mean that EVs could offer unique benefits and enjoy some special advantages.

For one, a high level of dependence on oil imports makes fuel expensive, and Caribbean islands are particularly vulnerable to oil price fluctuations and foreign exchange risk. Oil dependence also contributes to high debt levels, inflation, and weak currencies. For instance, Jamaica has the fourth highest share of fossil fuels as a percentage of the total value of imports in the world, and Caribbean small states as a region rank among the world's 10 most oil-dependent economies.[8] Transport is a major source of energy consumption in Caribbean islands, accounting for 28-37% in all of the case studies in this report for which data is available (see Figure 1).[9] The fuel cost savings produced by electric mobility (not counting the increased electricity cost) could total $2.2 billion over 20 years, according to consulting firm Castalia.[10]

FIGURE 1: SHARE OF ENERGY CONSUMPTION FROM TRANSPORT, CASE STUDIES

Sources: Barbados National Energy Policy 2019-2030; Cayman Islands National Energy Policy 2017-2037; International Energy Agency

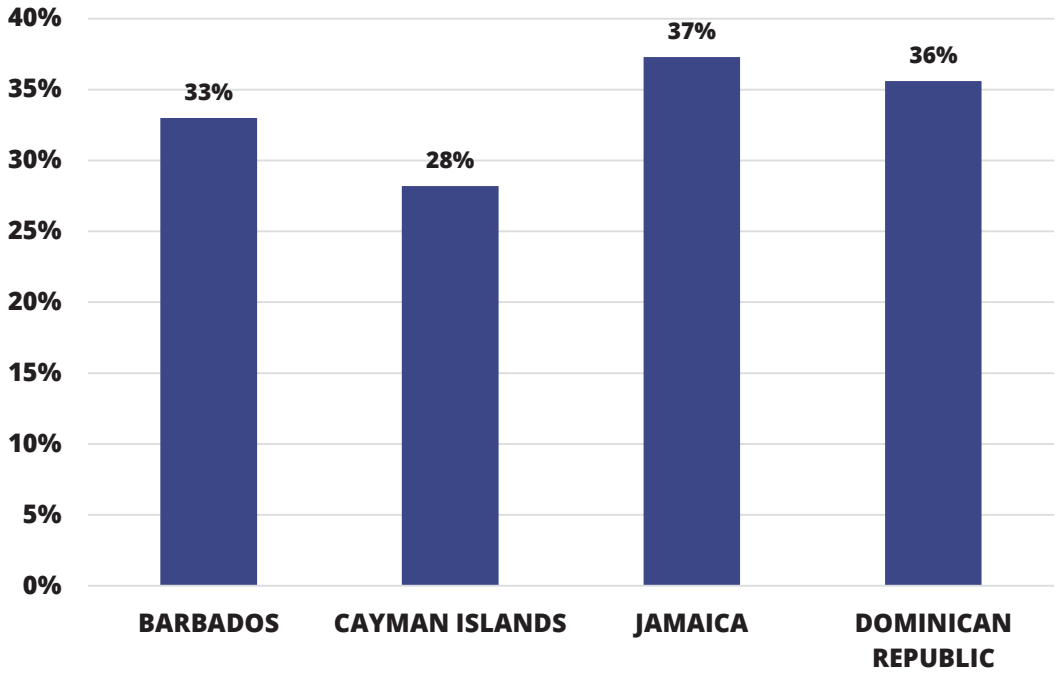
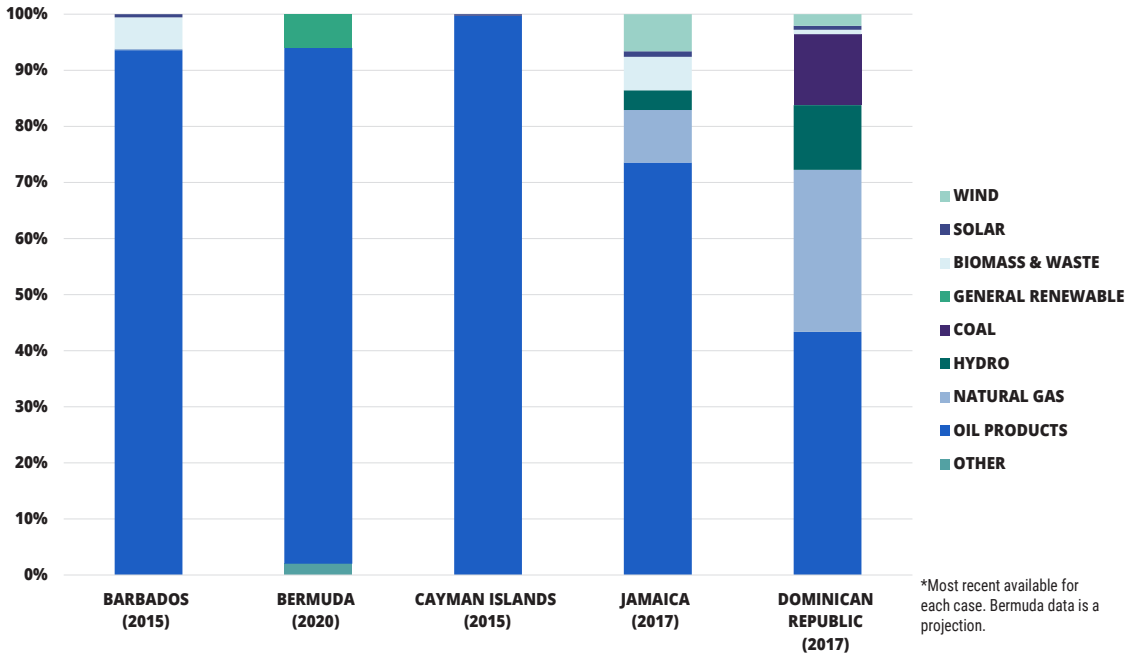


FIGURE 2: ELECTRICITY GENERATION BY SOURCE, CASE STUDIES*

Sources: Barbados National Energy Policy 2019-2030; Bermuda Integrated Resource Plan; Cayman Islands National Energy Policy 2017-2037; International Energy Agency



Caribbean islands are also abundant in renewable energy potential, which, if captured to produce power for EVs, could further reduce national fuel bills. Currently, many Caribbean countries rely on oil products for a high share of electricity consumption (see Figure 2). Pairing EV deployment with a parallel expansion of renewable energy could stem oil price vulnerability, reduce both transport and electricity costs, and drastically cut greenhouse gas emissions. Thus, policies and regulatory frameworks favorable to electric mobility can provide an additional impetus to renewable energy development and accelerate the transformation of both the transport and energy sectors.

Additionally, although small-island states like those in the Caribbean account for a tiny share of global carbon emissions, they are among the most vulnerable regions to the impacts of climate change, including rising sea levels and more intense storms. Small-island developing states (SIDS) and territories have long punched above their weight in climate negotiations and policy,[11] and EVs represent another opportunity to demonstrate leadership on climate action. Transport is a crucial emissions mitigation sector, and in the Caribbean, accounted for around 20% of emissions in 2015. Per unit of GDP, transport emissions are much higher than in other countries.[12]

In addition to mitigating greenhouse gas (GHG) emissions, EVs can bolster resilience to natural disasters exacerbated by climate change, a threat to Caribbean islands in particular. EV batteries can serve as energy storage and provide support to the grid, facilitating the integration of variable renewable energy such as wind and solar. When the grid is damaged by disaster, EVs can provide a mobile source of energy that can be reinjected through vehicle-to-grid (V2G), vehicle-to-microgrid (V2M), and vehicle-to-home (V2H) technology. EV batteries can also be recycled to provide off-grid and mini-grid solutions at the end of their vehicular utility, limiting dependence on the more vulnerable, centralized main grid.

Finally, Caribbean islands are generally small and, in many cases, relatively flat, meaning range anxiety (the concern

Although small-island states like those in the Caribbean account for a tiny share of global carbon emissions, they are among the most vulnerable to the impacts of climate change.

about becoming stranded by exhausting an EV's charge before reaching a charging station, a common hurdle for prospective buyers) is alleviated. The relatively small fleets of vehicles in these islands can also be fully electrified much more quickly than the massive fleets of larger jurisdictions, and the charging networks do not need to be as extensive as in larger countries.

Drawing on the results of a high-level dialogue at the 2019 Caribbean Renewable Energy Forum (CREF); interviews with Caribbean stakeholders, including senior policymakers, regulators, utilities, and automakers; and supplemental research, this report will consider five case studies: Barbados, Bermuda,[iii] the Cayman Islands, Jamaica, and the Dominican Republic. These island jurisdictions are among those at the vanguard of EV policy planning and adoption and those with the most potential to expand EV markets. The report will examine the status of EV markets in these jurisdictions, the strategies that have produced results, and factors hindering the development of the Caribbean EV market. Finally, it will suggest some measures to consider at a high level to capitalize on the opportunity that EVs represent in the region.

Case Studies

BARBADOS

Barbados is a regional leader in EV deployment, with around 430 EVs on the road.[13] In 2018, 1.28% of new car sales were electric, a share that is greater than in some higher-income countries, such as Canada.[14] With a population of around 287,000,[15] the island nation is also among the top users of EVs per capita.[16]

Higher levels of EV uptake could improve energy security in Barbados by slashing total energy consumption and reducing the country's dependence on imported oil, as well as its carbon footprint. Barbados is almost entirely reliant on oil imports for both power generation and transportation. The island produces a miniscule 700 barrels of oil per day, the equivalent of 6-7% of the total consumed.[17] In 2015 Barbados's electricity matrix was over 90% powered by imported fossil fuels, with 22 MW of solar capacity accounting for about 2.4% of electricity generation, and another 5.6% generated by bagasse.[18] Barbados's solar capacity has since increased to roughly 30 MW. In the transport sector, Barbados spends about $165,000 per day on oil, and during past oil price spikes, the island has spent as much as $800 million annually in foreign exchange to purchase oil.[19] Refined petroleum products cost the country 6.2% of GDP.[20] Barbados could further capitalize on the efficiency and economic gains associated with EVs by powering them with renewable energy. Expanding renewable energy generation and electrifying transport could amount to a transformational decarbonization of Barbados's energy mix and a considerable reduction in imports of oil products if pursued in tandem.

The long-term goals of reducing Barbados's carbon footprint and reliance on oil imports are high on the government's list of priorities, and electric mobility has been recognized as an integral component to meeting them. According to its 2019-2030 National Energy Policy, by 2023 the Barbadian government intends to achieve a 49% nationwide reduction in fossil fuel consumption, which will produce energy savings of $200-400 million.[21] The government also aims for the country to reach 100% reliance on renewable energy and carbon neutrality by 2030.[22] As part of this effort, it is aiming for 100% electric bus and government fleets by 2030.[23] The country's first electric buses are to be delivered by June 2020, with one tender having awarded a contract for 33 buses to Chinese manufacturer BYD, and the results of a second tender for about five buses were expected in January 2020. The government is also studying how to transition to biofuels for use in ICEVs, in order to phase out these vehicles rather than producing a massive amount of waste by abruptly disposing of them well before the end of their life cycle.[24] Finally, the government is also studying a transportation strategy and overarching EV policy with support from the Inter-American Development Bank.[25]

The government has already taken some immediate policy steps directed at expanding EVs. In terms of fiscal policy, import duties on EVs have been significantly lowered relative to those on ICEVs (see Figure 7 on p. 18). A transition away from dependence on fuel tax revenues is also being evaluated. Although the reduction of oil imports will improve the current account and foreign exchange reserves, taxation of fuel sales is an important source of government revenue that would be disrupted by mass electrification of transport.

The issue of public awareness is also being addressed. Pilot projects (discussed below) are helping to increase the visibility of electric vehicles in the island. The government is working with automakers to identify the measures necessary to make Barbados a more attractive market[26] and increase the number of brands and models available to consumers. One limiting factor is local human capital markets: EVs cannot be scaled up if there are not enough workers trained in their maintenance, and some

iii Though Bermuda is located in the North Atlantic Ocean, it is an associate member of the Caribbean Community (CARICOM).

automakers cannot even export to a market if there is not a certain threshold of professionals certified to work on EVs. Barbados currently has few trained EV technicians, but the government is working with the Samuel Jackman Prescod Institute of Technology to make EV maintenance part of its general auto maintenance course.[27]

In terms of charging infrastructure, much progress has already been made, and indeed this is part of the reason for Barbados's leadership in EV deployment. An impressive network of charging stations outnumbers gas stations on the island. With over 45 public EV chargers (including two superchargers)[28] on an island just 20 miles long and 15 miles wide (166 square miles),[29] drivers are never more than about three miles away from a charge point, eliminating range anxiety.

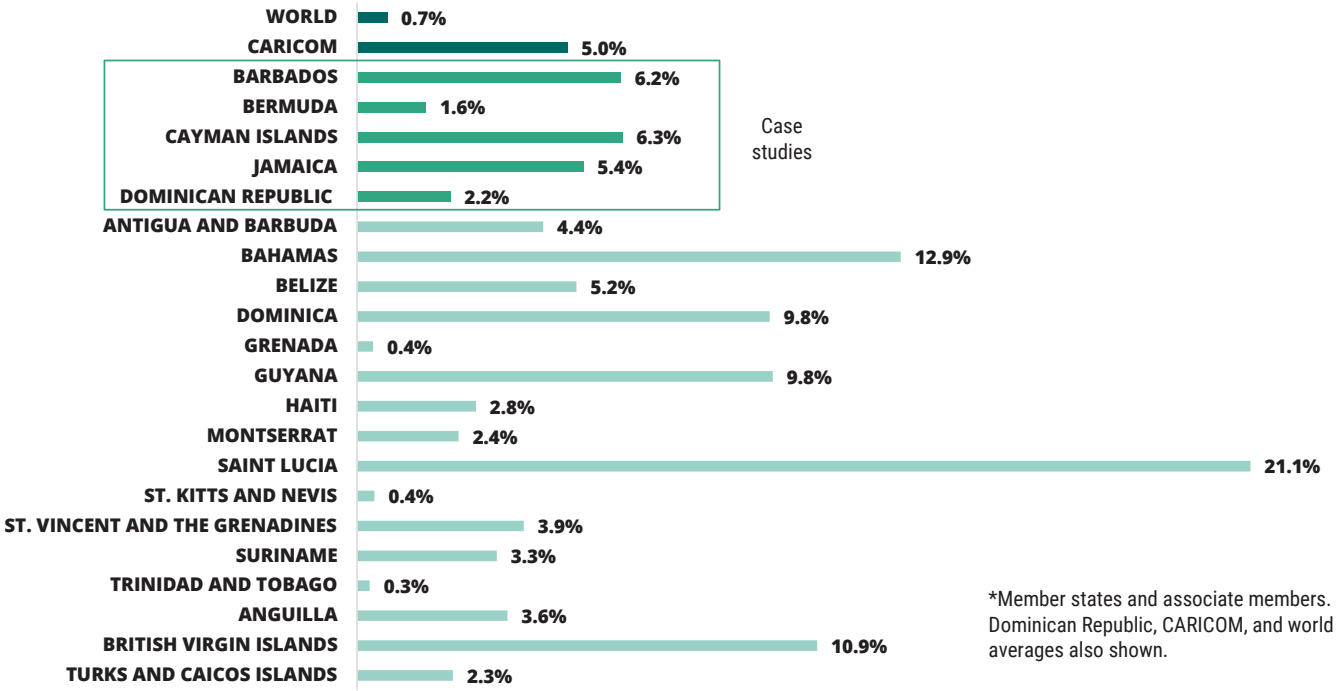
EV owners have also deployed more than 200 private EV chargers. Megapower, an EV importer founded in 2013 that is headquartered in Barbados and runs pilots and projects on several other islands, has made installing charging stations a key element of its business strategy, even though the charging stations don't directly generate profit at current usage levels.[30] Allowing independent operators of EV charging infrastructure (such as Megapower) is an innovative approach in the Caribbean, as the service provided is not considered electricity delivery, but an access service. This model is extensive in North America and Europe but is not picking up in some Caribbean islands, given tight interpretations of the legal authority of utilities to be the sole retailers of electricity. However, despite Barbados's progress on charging infrastructure, automakers cite the low number of charging stations as a barrier to the introduction of new EV models, meaning efforts to build out the network of charging stations must continue.[31]

Barbados Light & Power Company (BL&P), the island's sole utility, will be indispensable in achieving large-scale EV deployment. EVs have complex impacts on the electrical grid that must be analyzed well before mass electrification is reached (see Box 1 on p. 10). BL&P has already made investments in advanced/smart metering in order to more closely monitor customer-level power usage. It can thus project the effects of EVs on future demand and grid asset health and develop tools such as time-of-use rates to incentivize off-peak charging and avoid overloads.[32]

Some of the lessons derived from studying these grid factors have already been used in successful programs

FIGURE 3: REFINED PETROLEUM IMPORTS AS A SHARE OF GDP, CARICOM MEMBERS*

Sources: The Observatory of Economic Complexity, United Nations



*Member states and associate members. Dominican Republic, CARICOM, and world averages also shown.

in Barbados that can serve as pilots for the rest of the island. For instance, DHL's delivery fleet of eight vehicles was fully electrified by Megapower. Using smart metering and staggering the vans' charging during a low-demand period (overnight) facilitated their incorporation into DHL's electricity consumption without increasing the company building's demand charge. The conversion also produced major savings for DHL, decreasing their diesel and gasoline bill by 75% and avoiding 56 tons of emissions annually per van.[33] The government is planning to implement another pilot for a medium-sized bus that will seek to allay concerns, such as worries about the performance of EVs on hills, and create direct public exposure to EV technology. The lessons learned from these programs can both inform strategies for scaling up EV charging across the island and demonstrate the viability of EV technology to consumers.

Finally, the collaboration between Megapower, DHL, and BL&P demonstrates a principle that has been key to EV uptake in Barbados to date: that the formation of partnerships between stakeholders is critical. Electric vehicles are a multisectoral technology, and Megapower has cultivated partnerships with BL&P, with landlords to establish charging points, with companies including the National Petroleum Corporation (NPC) and the Barbados National Oil Company (BNOCL) to implement pilot projects, and with local educational and vocational institutions to train technicians to carry out EV maintenance.[34] Such efforts will be necessary in any region seeking to integrate EVs into its transportation system, and to make it an integral component of a sustainable energy transition.

BOX 1: GRID IMPLICATIONS OF LARGE-SCALE EV INTEGRATION

Large-scale electrification of transport represents both challenges and opportunities for grid management, issues which should be considered by utilities in Caribbean islands with long-term aspirations for EV deployment

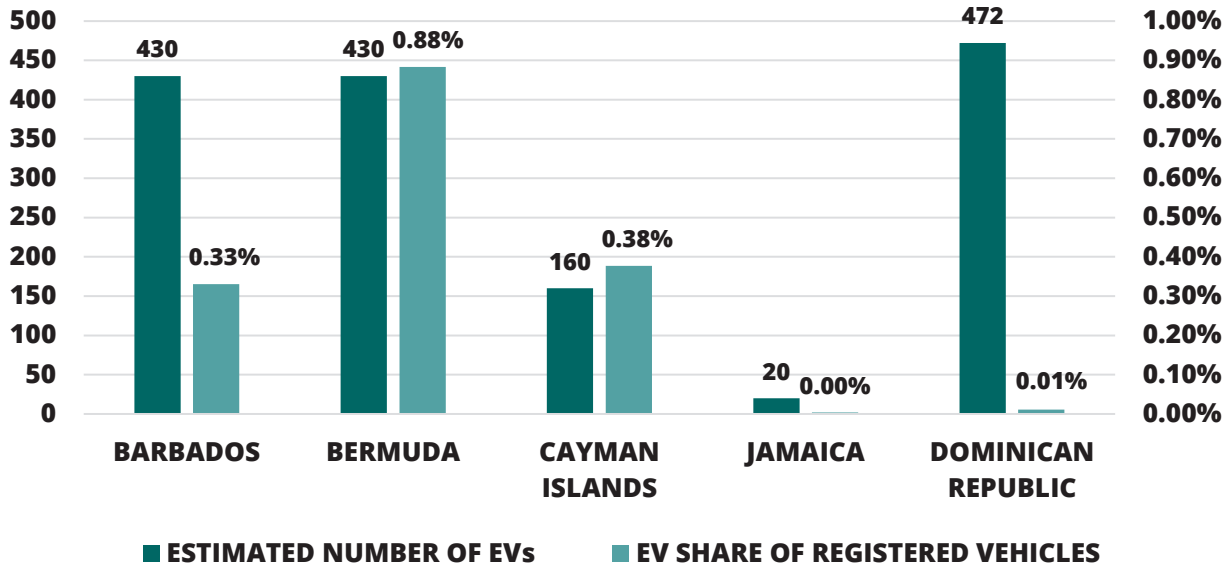
EVs represent an additional source of electricity demand and high penetration levels such as 10% can create the need for more investment and improved grid management tools, especially if they are not incentivized to charge during periods of low demand. Currently, most charges take place at homes or businesses during the evening and nighttime, and power infrastructure can become overloaded or degraded during peak consumption times by this large new source of demand, particularly if EV ownership is concentrated in limited geographical areas.[35] Various charge management strategies can be implemented, including demand charges (which are applied based on the maximum rate of power consumption during a period rather than the average, so as to prevent overload[36]), time-of-use rates (which are lower during periods of low grid demand and higher during periods of high demand), and coordinated charging (which can use timers to charge vehicles at pre-determined off-peak times[37]).

However, EVs can also enable utilities to balance loads through V2G technology. Bidirectional chargers enable EVs to be used as storage for later reinjection of energy into the grid, a particularly useful application for the integration of variable renewable energy (VRE) such as wind and solar.[38] When VRE sources provide excess supply, or when power demand is low (such as late at night), EVs can be charged. Then, when power supply is low and/or demand is high, they can reinject power into the grid. Called load balancing, this strategy uses EVs as a source of power capacity that supplements the grid and reduces the need for new capacity as peak demand increases over time.[39] Thus, EVs can make power systems more efficient and facilitate the introduction of more VRE into the grid.[40] However, though EV users can receive payment for these services, studies differ in their conclusions about whether it is profitable enough to be attractive. Studies also suggest that for certain applications V2G services can accelerate battery degradation.[41]

Of course, the potential challenges and commercial opportunities presented by the integration of EVs into the power system depend on the characteristics of a given system and merit further market-specific examination in any Caribbean jurisdiction hoping to expand EV use. EVs can also be deployed to bolster disaster resilience (see Box 2).

FIGURE 4: ESTIMATED NUMBER OF EVS AND SHARE OF REGISTERED VEHICLES, CASE STUDIES

Source: Prado 2019 (Barbados); Bermuda Transport Control Department, 2019 Transport Green Paper (Bermuda); Young 2019 (Cayman Islands); Oficina Nacional de Estadística & ASOMOEDO (DR)



BERMUDA

With around 430 electric vehicles on the road in early 2020[42] and just 64,000 residents,[43] Bermuda has even higher EV penetration per capita than Barbados. However, there is still significant untapped potential in this small, self-governing British overseas territory. With a land mass of just 21 square miles,[44] range anxiety should be virtually nonexistent in the main archipelago of seven interconnected islands. Additionally, Bermuda's remote location in the North Atlantic Ocean and near-total dependence on oil imports conspire to create some of the highest energy prices in the world and increase the incentives to decarbonize transport and power generation.

In 2017, Bermuda imported $102 million worth of refined petroleum products, representing about $1,600 per capita and costing the territory 1.6% of GDP.[45] Bermuda has great potential to reduce this fossil fuel dependence. Moreover, though fuel oil currently accounts for more than 98% of Bermuda's installed electricity capacity,[46] an Integrated Resource Plan (IRP) released in June 2019 lays out a timeline for a transition to 85% renewable generation by 2035, mostly through biomass and offshore wind plants, but also through solar PV installations.[47] If the entire vehicular fleet were electrified under these conditions, it would generate huge savings in fuel imports.

The Bermudian government has thus made EVs a priority. Although it has not established specific long-term targets for electric mobility, it has engaged in discussions with stakeholders on how to encourage their uptake and has directly implemented some incentives. EVs have been duty-free since 2012, and EV batteries since 2017. Duties were also eliminated for EV charging stations, parts, and other accessories in October 2018.[48]

The government has also made an effort to promote public awareness about the benefits of EVs. The Department of Energy hosted the first free, multi-vendor EV showcase in 2017.[49] It has also gathered information on public perception of EVs as part of government surveys. Myths about EVs persist, such as a misconception that they may have difficulty traveling over Bermuda's hilly terrain, due to a lack of public familiarity with the technology. Overall, though, it is promising that public perceptions are already strong—63% of respondents said in 2018 that they would be willing to replace their car with an electric or hybrid vehicle.[50] The survey also revealed that price is the most common determining factor—cited by 86% of respondents.[51]

Despite duty exemptions, an electric vehicle in Bermuda currently costs up to 1.5-2 times more than a similar-size ICEV,[52] and selection is also limited. Bermuda's roads, which are narrow and twisting, require private vehicles be regulated by size, and only a few EVs, including the Nissan LEAF, BMW i3, and Kia Soul, are suitable for import.[53] A dearth of trained maintenance personnel inhibits auto dealers from importing some models, as is the case in some other islands of the Caribbean.[54] The small size of Bermuda's EV market also makes it difficult

to interest dealers in importing EVs. Thus, increasing the number of EV models available in the market and making them affordable are considerable hurdles that must be surmounted for EV penetration to increase significantly in Bermuda. Consumer education about the total lifecycle cost of EVs versus ICEVs could help to address reservations about the high upfront cost of EVs. At around $8.25 per gallon in 2018, Bermuda has some of the highest gasoline prices in the region,[55] making the total cost of ownership savings relative to ICEVs even more compelling than in other markets of the Caribbean.

The ease of deploying sufficient charging infrastructure is one area in which Bermuda has a clear advantage due to its small size. There should be little concern about range, but as EVs become more popular, charging capacity will have to increase. There are some 17[56] public chargers in Bermuda, or roughly one per 14 EVs on the road, and the government has plans to mandate that any parking area for 10 or more vehicles include one EV charger per 10 spaces.[57]

Several early adopters boast EV fleets in Bermuda. As in Barbados, Bermuda's sole, vertically-integrated electric utility, Bermuda Electric Light Company (BELCO), has championed the benefits of EVs. It is one of the leading adopters in the territory, with 14 EVs in its fleet.[58] But BELCO's fleet is not the only one increasing the visibility of EVs in Bermuda. As of 2017, guests at the Hamilton Princess & Beach Club can also cruise the roads in one of more than two dozen Renault Twizy electric two-seaters, an exception to the prohibition otherwise barring tourists from renting cars in Bermuda.[59]

Electric buses are also being considered for the public transport fleet. With 60% of Bermuda's 100 buses at or beyond their nominal service life, the Department of Public Transportation is undertaking a tender for new vehicles, which it considers a potential opportunity to electrify one of Bermuda's largest and most visible fleets. By the end of 2019 it had performed total cost of ownership analyses for electric and ICE options from a bus manufacturer and scored the options on price, functionality, and environmental value. The government is likely to purchase 30 smaller electric buses suitable for more localized routes as a first phase. The larger buses will require further analysis because longer routes would make charging more logistically complicated and because they may need to be custom-made to fit the roads due to their larger chassis.[60] This process will be one to watch closely in Bermuda.

Increasing the number of EV models available in the market and making them affordable are considerable hurdles that must be overcome for EV penetration to increase in Bermuda.

Barriers like the often high sticker price, insufficient charging infrastructure, and limited selection persist. However, fleets like those operated by BELCO and the Hamilton Princess & Beach Club, as well as the e-buses planned by the Department of Public Transportation—along with increased public awareness of the total cost of ownership savings that EVs offer—serve to dispel the myths that hamper EV adoption. Increasingly, the government has recognized that electric mobility can support greater energy security and bring broader economic benefits to a territory with sky-high electricity and gasoline prices.

CAYMAN ISLANDS

An estimated 160 EVs were circulating in the Cayman Islands in 2019,[61] a considerable number for this British territory of around 64,000 residents.[62] EVs represent just 0.3% of the 42,459 registered vehicles[63] on the roads in the territory, however, and just 0.2% if the estimated 37,406 unlicensed ICE vehicles are included.[64] Several government strategies are being undertaken to stimulate EV adoption.

In its 2017-2037 National Energy Policy, the government of the Cayman Islands established long-term goals to signal its commitment to electric mobility and renewable energy. If the plan's goals are met, the transport sector in the Cayman Islands would be transformed. The plan aims to "increase the share of fuel efficient, electric, and hybrid vehicles in the fleet of the Cayman Islands," and full EVs are a central component.[65] The plan's transport sector strategy envisions a 68% reduction in energy consumption from gasoline and diesel for transport between 2015 and 2037.[66] This target excludes the small share of diesel that will be used to generate electricity for EVs, but most power for EVs is anticipated to come from solar energy.

The transport sector accounts for a large share of energy consumption—28.2% in 2015[67]—meaning the decrease

in energy consumption for transport projected under the plan is equivalent to 18% of economywide energy use in 2015. The reduction in fossil fuel consumption could also bring great relief from dependence on foreign oil products and the corresponding depletion of foreign exchange reserves. In 2017 the import of refined petroleum products amounted to about $253 million, almost $4,000 per capita, or 6.3% of GDP.[68]

The plan also establishes a target of 70% renewable electricity generation by 2037, which will aid the country to achieve its goal of a peak in economywide greenhouse gas emissions in 2020.[69] Most of this renewable energy is projected to come from utility-scale solar PV and would represent a vast improvement over an electricity matrix that relied on diesel for more than 99% of generation in 2015.[70] By 2019, some 17 MW of solar capacity had been commissioned, accounting for around 9% of installed capacity.[71]

In order to capitalize on the potential benefits of EVs, the government is already designing and implementing measures on several fronts. The 2019 elimination of duties on imported EVs for personal use valued under $30,000 was an important step.[72] For ICEVs in this price bracket, duties range from 29.5% to 37%.[73] Duties are also lower for more expensive EVs than for similar ICEVs. The 2017-2037 National Energy Policy envisions a mandated marketing strategy[74] for dealers and resellers to include fuel efficiency information, which could demonstrate to consumers the total cost of ownership benefits of EVs relative to ICEVs, boosted by high gasoline prices in the Cayman Islands. Local experts say other public awareness measures will also be necessary to disseminate basic

FIGURE 5: BENCHMARKING EV PROGRESS AND PLANS, CASE STUDIES

Sources: Prado 2019; Current Vehicles; PlugShare; Barbados National Energy Policy 2019-2030; Bermuda Integrated Resource Plan; Bermuda Transport Control Department; Cayman Islands National Energy Policy 2017-2037; Prime Minister of Jamaica; Plan Energético Nacional 2010-2025 (DR); 2019 Transport Green Paper (Bermuda); Young 2019 (Cayman Islands); ASOMOEDO; news reports; interviews

	ESTIMATED NUMBER OF EVS	ESTIMATED NUMBER OF PUBLIC CHARGERS	NOTABLE FLEETS/PILOTS	ELECTRIC MOBILITY TARGETS	RENEWABLE ENERGY TARGETS
BARBADOS	430	45	• DHL (eight vehicles) • National Petroleum Corporation • Government bus pilot (forthcoming)	100% electric bus and public fleets by 2030	100% by 2030
BERMUDA	430	17	• BELCO (14 vehicles) • Hamilton Princess & Beach Club (>24 Renault Twizy) • Electric buses under consideration for 60-vehicle renovation	No concrete target	85% by 2035
CAYMAN ISLANDS	160	22	• RFP issued for 85 government vehicles August 2019	10% of government fleet electric by 2022	70% by 2037
JAMAICA	~20	1	• Pilot with Global Environment Facility (TBD - possible electric buses in Kingston or government vehicles)	No concrete target	50% by 2030
DOMINICAN REPUBLIC	472	40	• CEPM corporate fleet (10 vehicles) • CEPM taxi pilot in Punta Cana	No concrete target	25% by 2025

knowledge about EVs, such as the fact that they can be charged at home simply by plugging in to a standard wall outlet.

In 2016, only one company, Cayman Automotive, sold EVs in the Cayman Islands. Today, consumers enjoy a number of EV models to choose from at several local dealers. Prospective buyers can now choose from Ford, Nissan, and Volvo models from local dealers like the Electric Car Company. Kia and Hyundai EVs are also popular, while the Nissan LEAF is the bestseller. There is even a Tesla owners club in the islands.[75]

However, in order to persuade more auto dealers and automakers to sell EVs in the Cayman Islands, the stock of trained maintenance professionals will have to continue to increase. EV service centers have been cropping up, and some dealers like Cayman Automotive service the EVs they sell.[76] For other dealers, a perverse incentive will have to be addressed: the fear that EVs could reduce parts and service revenues because they have fewer moving parts, no combustion and require less service and maintenance.

Charging infrastructure also remains inadequate in the Cayman Islands. The largest of the three islands, Grand Cayman, has an area of just 76 square miles,[77] meaning range anxiety should not be a problem. However, there are just around 20 public chargers available,[78] none of which is a supercharger,[79] meaning it can take up to six hours to fully charge an electric car. The government, which has installed six of the public charging stations, is considering issuing a request for proposals (RFP) for a network of public fast charging stations to eliminate the potential inconvenience posed by charging away from home.[80] A utility study that was conducted on potential points for renewable additions to the network could be used to recommend locations for charging stations. A consumer survey to project future EV demand could also help inform the proposed RFP.[81]

To persuade more auto dealers and automakers to sell EVs in the Cayman Islands, the stock of trained maintenance professionals must increase.

Caribbean Utilities Company (CUC), the vertically-integrated, sole public electricity utility in Grand Cayman (the largest of the three islands and home to most of the population), has also been involved in supporting EV adoption. CUC designed a rate structure with special tariffs that incentivize off-peak charging and a special rate for electric transport.[82] Residential customers who charge their EVs during off-peak hours (11pm – 8am) receive a 37% discount on that electricity. The preferential rates have increased uptake of home EV chargers.[83]

Finally, the government is also leading by example, having issued in August 2019 an RFP to convert 10% of its 850-vehicle fleet to EVs.[84] However, the government has no concrete plans to electrify mass public transport fleets. Unlike in Bermuda, the Cayman government does not operate public transportation, with private companies instead offering bus services.[85] Thus, to convert the Cayman Islands' bus fleet to electric buses, the government would have to do so indirectly through regulation or incentives in bus tenders.

The Cayman Islands face a number of challenges to further expanding EV use, including lack of public awareness, lack of regulations to stimulate the electrification of public transport and insufficient public chargers. Yet the government's ambitious plans for reductions in fossil fuel consumption and the expansion of renewable energy and electric mobility send a positive signal to EV manufacturers, dealers and the public that will likely drive further EV adoption in the coming years.

JAMAICA

Jamaica's EV market is incipient. Although the government does not report the number of EVs circulating in the country—nearly all of which have been imported by individuals as no new or used car dealers sell them—the figures are estimated to be very low at no more than a dozen full electric vehicles.[86] With 514,316 vehicles registered in 2016,[87] Jamaica is one of the region's largest markets and is growing rapidly, representing a considerable commercial opportunity for EVs.[88] The minister of Science, Energy & Technology has identified electric mobility as as an area of priority that converges many energy and transport policy goals.

The Jamaican government is beginning to signal a long-term commitment to electric mobility, despite limited uptake to date. It is nearing completion of a strategic framework for electric mobility with support from the Inter-American Development Bank,[89] which partnered with the Ministry of Science Energy and Technology (MSET), among

other key stakeholders, to establish a technical working group to advise on national EV adoption policies, targets, incentives, standards, and regulations. The framework will inform an EV policy to be crafted by the MSET in 2020. IDB Lab, the bank's arm that promotes innovation and entrepreneurship, is also supporting Jamaica with funding for building human capacity and the EV ecosystem.

The government's plans reflect a recognition that the electrification of transport would constitute a significant step in diminishing Jamaica's dependence on fuel imports, as well as its carbon emissions and air pollution more generally, a widespread concern. The transport sector accounted for 37.3% of total energy consumed in 2017, making the potential benefits of EVs significant.[90] In 2017, 81.3% of total primary energy supply was derived from oil[91] and refined petroleum imports cost the country $794 million, or 5.4% of GDP.[92] The Jamaican government has cited reducing dependence on imported fuel as an energy policy priority in its National Energy Policy (NEP) 2009-2030 and identified the resulting vulnerability to oil price volatility and supply disruption as threats to energy security.[93] This context provides an additional impetus for the development of renewable energy in the island, which would greatly amplify the benefits of electric mobility.

Jamaica's NEP established a target of 20% renewable generation in the energy mix by 2030,[94] which was later increased to 30% by the country's cabinet. In October 2018, Prime Minister Andrew Holness said that his administration would raise the 2030 renewable energy target to 50%.[95] A forthcoming integrated resource plan (IRP) is expected to chart a path to increased renewable energy. By the end of 2019, Jamaica had increased renewables to 17% of installed capacity following the commissioning of the 37-MW Paradise Park solar plant, the largest in the English-speaking Caribbean.[96] Awarded in a government tender at $0.085/kWh, the project set a new record low price for electricity for an independent power producer supplying the utility, a challenging benchmark for future renewable tenders expected to follow publication of the country's IRP. Jamaica is also home to the 62.7-MW Wigton Windfarm, the largest wind energy facility in the English-speaking Caribbean. The energy ministry's technical cooperation with the IDB explicitly prioritizes powering EVs with renewables.[97] In recent years, Jamaica has also increased its reliance in power generation on natural gas.

EVs in Jamaica currently face a challenging context with respect to their upfront price and competitiveness relative to ICEVs. In most markets with high EV penetration, including some discussed in this study, governments have implemented fiscal incentives to compensate for the high sticker price of EVs. In Jamaica these incentives exist but are not as comprehensive as in some other cases. Import duties on battery electric vehicles, at 30%, are actually higher than those on plug-in hybrid electric vehicles (PHEVs), conventional (non plug-in) hybrids, and ICEVs, which incur a 20% import duty. However, EVs are exempt from the special consumption tax (typically 10-20%) that is applied to ICEVs, and from the general consumption tax of 21.5% that is applied to hybrids, PHEVs, and ICEVs. Thus, aggregate duties on full EVs are 30.5%, compared to 46.4% for hybrids and PHEVs and 50.8-75.7% for ICEVs.[iv,98] In a recent setback for EV competitiveness, the age limit for imported vehicles was increased from five years to six years in November 2019,[99] resulting in an even greater influx of older, cheaper pre-owned ICEVs that are an easier sell in the mass market.

In most markets with high EV penetration, governments have implemented fiscal incentives to compensate for the high sticker price of EVs.

The lack of public awareness about EVs will also have to be overcome. Though concrete data on this subject is lacking, the near-total absence of EVs on the island's roads likely contributes to the lack of public knowledge of EVs. However, one effort already under way, the installation of public charging infrastructure, is expected to convince some drivers to start considering them as an option. The lack of demand for EV-trained mechanics means that significant efforts in this area may also be a prerequisite to large-scale EV introduction in Jamaica.

Limited charging infrastructure is also an impediment to EV expansion, although numerous efforts are underway to increase the number of charge points throughout the country. The only publicly accessible charge point in Jamaica is located at the AC by Marriott hotel in Kingston, installed in partnership with Jamaica's vertically integrated

iv Rates for dealers listed. Duty rates for individual importers differ.

utility, JPS. The hotel offers free charging to its guests. JPS has also been testing a Nissan LEAF and Mitsubishi Outlander PHEV for several years with a solar carport at its headquarters in Kingston. In early 2020, JPS plans to roll out 11 charging stations across the island, eventually installing at least one charging station in each of the country's 14 parishes, each no more than 19 miles apart.[100] This will be done through third-party arrangements, like the one announced as a partnership with the AC Hotel in Kingston, which is footing the bill. The first public charge point that will require drivers to pay for the electricity is planned for a Boot service station near Ocho Rios.

JPS is also eyeing EV incentives through electricity tariffs—in its 2019 tariff review submitted to the Office of Utilities Regulation, the utility also included a rate case for EVs, considering time-of-use charges and other aspects that will create a more favorable environment for EVs.[101] JPS is thus playing a leading role in EV deployment. This is a positive sign, but in Jamaica, it also reflects a key barrier to EV infrastructure development—the fact that no company besides JPS is licensed to sell electricity. Though JPS is making a concerted effort, this structural limitation will hamper the initiative of private investors that might otherwise accelerate the growth of the public charging network in the island. This highlights the need for electricity regulators to proactively regulate EV charging infrastructure and to define the role of utilities and other players in the value chain of charging infrastructure. Regulators need to define the extent of the utility's monopoly and avoid creating an overly restrictive legal environment that may block innovation to create new business models to deploy needed infrastructure.

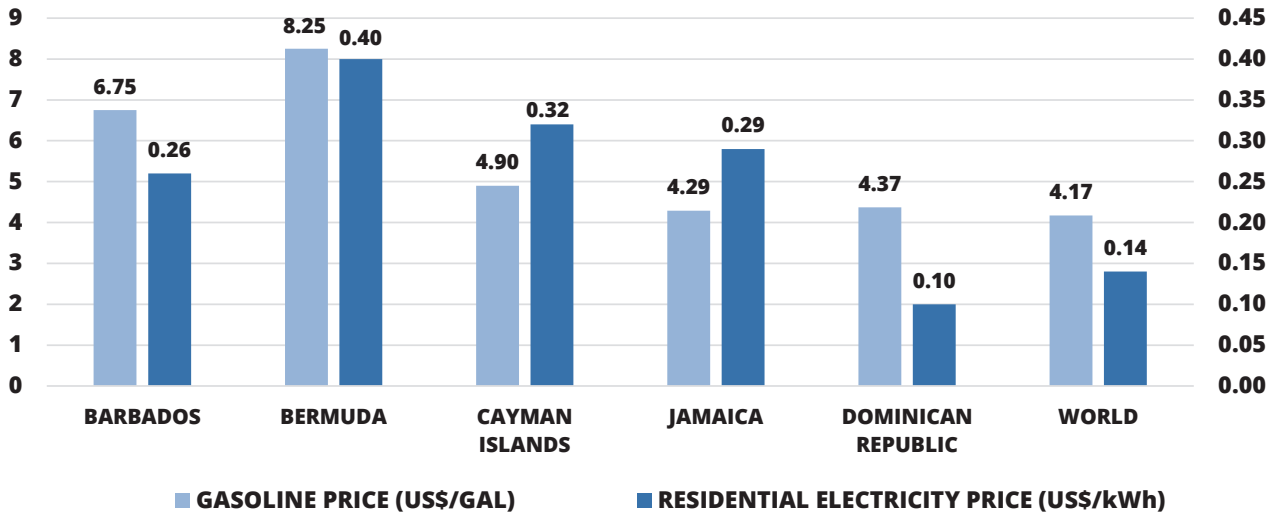
Together with the IDB, the government is also engaged in the early stages of a pilot program funded by the Global Environment Facility, which will accelerate the number and visibility of EVs in Jamaica. The program is in the preliminary phases, the type of fleet is yet to be determined, and within the next three years the pilot will be carried out, possibly with a group of electric buses in Kingston or a government fleet. The pilot's results could illustrate the benefits and cost savings of EVs and inform decisions about fiscal incentives. It will be an important development to watch as EVs begin to flow into the Jamaican market in large numbers.

DOMINICAN REPUBLIC

With 909,015 cars in circulation in 2018 (out of 4,350,034 total vehicles),[102] the Dominican Republic is the largest market in the Caribbean and has attracted much interest from dealers and automakers. It therefore enjoys greater EV options on the market than the other jurisdictions in this study. From 2018 to January 2020 the number of EVs

FIGURE 6: AVERAGE GASOLINE AND ELECTRICITY PRICES, CASE STUDIES AND WORLD AVERAGE

Source: GlobalPetrolPrices.com (gasoline prices for 12/2/2019 and electricity prices for March 2019); Bermuda gasoline price - 2018 estimate (AIRINC); Cayman Islands electricity price - September 2019 estimate (The Cayman Resident)



on the road increased almost ninefold, from 55[103] to around 472.[104]

The Dominican government has not yet set specific targets for electric mobility. However, its 2010-2025 National Energy Plan identifies high dependence on imported petroleum, and the accompanying high energy costs, as principal factors driving national energy policy.[105] In 2017, imports of refined petroleum products to the Dominican Republic totaled $1.67 billion, or 2.2% of GDP.[106] Moreover, the transport sector accounted for 35.6% of total energy consumption. The contribution of mass EV deployment to reducing oil imports would thus be large.[107] The executive director of the National Energy Commission (CNE) has stated that EVs will reduce greenhouse gas emissions and dependence on fossil fuels in the Dominican Republic,[108] and that the CNE is working with relevant stakeholders to develop a regulatory framework governing the location, installation, supervision, and quality of service of EV charging stations.[109]

Furthermore, the Dominican Republic's renewable energy market, which would buttress the benefits of EVs, is growing. The 2007 Law on Incentives for Renewable Energy and its Special Regime mandates a 25% share of generation from renewable energy by 2025, a number which stood at around 16.2% in 2019. With over 2 GW of wind and solar projects to be approved between 2020 and 2021 (compared to current total installed capacity of around 4.3 GW),[110] the share of renewables in the country's energy mix is set to increase by nearly 50% over the next few years. A significant share of the Dominican Republic's power generation also comes from natural gas, and oil products accounted for less than half of generation in 2017. A request for proposals prioritizing renewable and natural gas generation is anticipated in the first quarter of 2020 and should further bolster this perceived commitment.[111]

Some limited government incentives currently exist for electric mobility, including a 50% reduction of duties and registration fees for electric vehicles.[112] The executive director of the CNE has stated that the government will introduce incentives related to import costs, charging services, and electricity tariffs, and that it hopes the country will see large-scale EV deployment in the near future.[113] However, the government's involvement in EV deployment has been limited compared to the other markets covered in this report.

Nevertheless, the Dominican EV market has begun to take off, driven largely by imports of more affordable used vehicles. Consumers in the Dominican Republic can purchase a used Nissan LEAF, Hyundai Ioniq, or Chevy Volt, as well as luxury models by Tesla, BMW, Fiat, Porsche, and Volvo. The prices of used EVs are competitive with those of ICEVs—especially taking into account the total cost of ownership of the vehicles and the fact that gasoline in the Dominican Republic is expensive and subject to taxes that can double the price. Purchasing EVs used from the United States, a popular option, also allows buyers to indirectly benefit from tax credits that lower their initial price in the United States.[114] But since such a large share of vehicles imported from the Dominican Republic are manufactured in the United States, the effects of the 50% duty reduction on EVs are diminished—under the Dominican Republic-Central America-United States Free Trade Agreement (CAFTA-DR), US-made vehicles are already exempt from duties.[115]

Concerted public awareness efforts are underway by several private sector organizations and companies, including Vehículos Eléctricos RD and the Dominican Electric Mobility Association (ASOMOEDO). These efforts include exhibitions like the 1era Feria de Vehículos Eléctricos in late 2019 and a major conference on electric vehicles in the Dominican Republic that has been held three years in a row.[116]

Private initiative has also been integral to the installation of a charging network that anticipates much higher levels of EV use in the coming years. By one estimate there are just 40 public charging stations in the country of 10.6 million people today.[117] Yet by the end of 2021, the Consorcio Eléctrico Punta Cana Macao (CEPM), a subsidiary of InterEnergy, plans to install 500 chargers (mostly level 2) across the country[118] in a joint venture with Blink Charging, a US provider of EV charging station services such as smart phone applications.[119] In late 2019 it completed a pilot program to inform this process.[120] CEPM claims that, according to surveys, the lack of charging infrastructure

From 2018 to January 2020 the number of EVs on the road in the Dominican Republic increased almost ninefold, from 55 to around 472.

FIGURE 7: DUTIES, TAXES, AND ESTIMATED FULL PRICE FOR NISSAN LEAF AND SIMILAR ICEV (TOYOTA YARIS)

Sources: Megapower, Nassco Limited, Auto Solutions, Bermuda Motors, Government of Bermuda, Cayman Islands OfReg, Cayman Islands Customs, Premier Automotive Export, Vampt Motors, Jamaica Customs, Toyota Jamaica, Ley 103-13 de la República Dominicana, ASOMOEDO, De Moya Auto Sale

	NISSAN LEAF DUTIES AND TAXES	NISSAN LEAF FULL PRICE	TOYOTA YARIS DUTIES AND TAXES	TOYOTA YARIS FULL PRICE	LEAF PRICE % GREATER THAN YARIS
BARBADOS	• 10% import duty • 20% excise tax • 17.5% VAT	$52,500	• 45% import duty • 46.95% excise tax • 17.5% VAT	$34,998	50%
BERMUDA^	• 0% import duty	$46,995	• 75% duty on first $10,000, 150% on value in excess of $10,000	$34,000	38%
CAYMAN ISLANDS	• 5% import duty	$50,235	• 29.5% import duty	$28,671	75%
JAMAICA	• 30% import duty • 0% special consumption tax • 0% general consumption tax • 0.5% env. levy	~$43,917†	• 20% import duty • 10% special consumption tax • 21.5% general consumption tax • 0.5% env. levy	$27,121	62%
DOMINICAN REPUBLIC*	• 0% import duty • 8% circulation tax • 9% VAT • Resale price lowered becuase of tax credits when first sold in US	$15,000	• 0% import duty • 16% circulation tax • 18% VAT	$13,524	11%

^ Prices are pre-tax but include duty † Estimate based on starting MSRP in US, freight and insurance costs from US to Jamaica

* For 2015 used model imported from the United States

is consumers' principal reservation about EVs, after cost. Current demand may not justify so many chargers, but they are a bet on the future that is necessary for EV deployment, since a lack of charging infrastructure is a principal barrier to EV adoption in most markets. Electric Car RD, another company, also intends to install between 90 and 120 charging stations connecting Santo Domingo to the north and south.[121] Other companies are encouraging real estate companies to install EV chargers in new residential and commercial buildings.[122] Thus, due to the efforts of CEPM and other companies, charging infrastructure should be sufficient to support a much higher level of EV penetration in the Dominican Republic in the next few years.

Creating nationwide incentives for EVs on the side of electric utilities is more complicated in the Dominican Republic than in the cases of Barbados, Bermuda, and Jamaica (in which only one state-owned, vertically-integrated utility operates), and Grand Cayman (where only one company distributes most electricity). In the Dominican Republic three main state-owned distributors (Edesur, Edenorte, and Edeeste) operate in different parts of the country, in addition to smaller distributors like CEPM, which serves the tourist area of Punta Cana-Bávaro and Bayahíbe. On the other hand, this lack of centralization allows private companies like CEPM to innovate, as opposed to the situation in Jamaica where JPS enjoys

a monopoly over marketing electricity. In 2020, CEPM is planning to offer residential home charging with a lower rate for off-peak hours and integration with its smart grid.[123]

Finally, pilot programs will play an important role in demonstrating the viability and cost savings offered by EVs and familiarizing consumers and companies with the technology. To that end, CEPM has identified three EV models suitable for use by taxi organizations that shuttle tourists to and from the airport in the Punta Cana area—for seven, 18, and 43 passengers.[124] High fuel taxes, superior efficiency, and the high rate of usage that accelerates the payback period for these vehicles should illustrate their profitability when CEPM offers the test vehicles to taxi companies in early 2020. If the results of the pilot are noticed, they could catalyze electrification of other fleets, such as the country's public buses. A 2019 tender for buses in Santo Domingo was not open to electric options. However, electrification of such a fleet, with which many Dominican citizens (not just tourists) interact daily, could further accelerate the country's EV uptake.

BOX 2: POTENTIAL FOR EVS TO BOLSTER DISASTER RESILIENCE IN THE CARIBBEAN

The urgency of fortifying disaster resilience in the Caribbean has been underscored by the unprecedented devastation of recent hurricanes, such as Maria in 2017 and Dorian in 2019, including to the electricity grid. Climate scientists project even more destructive storms as climate change advances. EVs have been retooled as an instrument of grid resilience in other disaster-prone regions, notably Japan, for several reasons. Assuming they are charged beforehand or have access to a generation source, EVs can provide a portable source of large quantities of stored electricity and offer emergency backup power when the grid is compromised by a disaster. They can also diversify transportation options, which is useful since electricity supply is often restored before transport fuel supply.[125]

When Japan was struck by a catastrophic earthquake and tsunami in 2011, companies including Nissan and Mitsubishi demonstrated the possibilities for EVs to support the relief effort.[126] Nissan sent 66 LEAFs to the impacted area. According to the company, when paired with a portable power station or vehicle-to-home system, a LEAF can supply an average Japanese home with power for two to four days depending on the model.[127] EVs were also used to transport doctors and emergency supplies amid severe fuel shortages.[128] Nissan has since formed partnerships with local governments to add EVs to their fleets and with convenience stores to provide electricity from EVs during outages.[129] In 2019, Nissan again sent 50 LEAFs to power community centers following a typhoon.[130]

The Californian utility PG&E has also capitalized on EVs as a mobile power source, commissioning PHEV trucks capable of exporting 125 kW of electricity for several hours. This has helped the company during both planned outages and emergency situations such as wildfires.[131]

These are promising cases, but the resilience potential of EVs is not yet widely recognized. In the Caribbean, home to some of the world's most vulnerable islands, this is an exciting possibility that warrants serious examination.

Key Trends in Electric Mobility in the Caribbean

Each Caribbean island has its own unique features, and the five cases examined here are not uniform. However, they do permit the observation of some of the general trends emerging in the Caribbean electric mobility sphere, in terms of both the progress being made and the obstacles encountered.

CHARGING AHEAD

The progress in electric mobility in the five cases is in many ways underpinned by common factors.

Long-term renewable energy and transportation goals are sending a strong signal to auto manufacturers, dealers, and utilities about future demand for EVs in the Caribbean, which may help broaden the selection of EVs offered in Caribbean islands. These goals, such as Barbados's 2030 goal of 100% electric bus and public fleets and Bermuda's goal of 85% renewable energy by 2035, also capitalize on the region's abundant solar energy resources and on the vast potential to reduce the nearly universal dependence on oil imports across the region.

The reduction or elimination of import duties for EVs is also a promising development that is shortening the path to price parity and addressing the issue of high upfront cost, often the consumer's foremost concern. In Bermuda, for example, a Nissan LEAF is not subject to an import duty, compared to a duty of 75% on the first $10,000 and 150% on the value in excess of $10,000 for a similar ICEV (see Figure 7).

High-use government, commercial and public transport EV fleets are in operation or planned, which will increase the visibility of EVs and prove their viability to the public. The high utilization of such vehicles throughout the day increases the total cost of ownership savings as well as the environmental benefits. Since the public interacts directly with buses and witnesses how they function, public transportation is a particularly potent proving ground for EV technology. Corporate EV fleets have already cropped up in Barbados, Bermuda, and the Dominican Republic. In Barbados and Bermuda, electric buses will likely be introduced, and Jamaica is beginning to examine their potential.

Long-term renewable energy and transportation goals are sending a strong signal about future demand for EVs in the Caribbean.

Utilities are becoming involved in the planning process for EV deployment in all five cases. They are engaged in implementing charging infrastructure (whether through the government or private initiative), even where EV markets are not yet strong, to lay the groundwork for mass transport electrification. They are using or developing smart metering and time-of-use tariffs to send economic signals to consumers, incentivize EVs, and sustainably integrate EVs into the grid. They are recognizing EV charging as a new source of demand and potentially large revenue stream while also examining the potential grid management challenges. The potential of EVs to increase disaster resilience and grid reliability is also widely recognized, if not yet capitalized upon.

SPEED BUMPS

The cases presented, and others in the Caribbean, also confront some shared challenges.

Public awareness has been identified as a top concern across markets. A lack of familiarity with EV technology has led to the propagation of misconceptions regarding their range, performance on hilly terrain, and other issues. Consumers are also often unaware of useful information about EVs, such as the fact that they can be charged at home with a simple wall outlet. They may also be unaware of how long-term fuel and maintenance savings can more than compensate for what is oftentimes a higher upfront cost.

Fuel taxes represent a significant source of government revenue that will be foregone as EVs displace ICEVs and will make an impact when consumers adopt EVs in large quantities. To ensure the stability of government finances, impacts need to be understood and, when appropriate, other sources of revenue will have to be identified or other fiscal strategies devised, which may prove to be a major

challenge as the share of EVs on the road increases. As price parity between EVs and ICEVs is achieved by market forces over the next five-to-ten years, EV uptake can be expected to accelerate, and fuel taxes will dry up, making a major dent in government budgets if alternative measures are not implemented ahead of time.

Dependence on petroleum products for power generation is high across the board—as great as 99% in the Cayman Islands, at least for the time being. This diminishes the carbon reduction potential of EVs relative to the use of renewable energy or even natural gas, though the greater efficiency of EVs relative to ICEVs in converting energy to motive power still results in lower fuel consumption and lower emissions.

In many of these case studies, charging infrastructure is insufficient to support a large number of EVs. Despite the small size of Caribbean islands, consumers on the road still need to feel confident that they can find a public charger near them, charge at a low cost, and do so rapidly. Slower chargers are thus unattractive in the public charging context, and a combination of government direction, utility involvement, and private sector initiative will be necessary for the mass installation of public fast chargers. Though it may lose money in the short term, a robust charging ecosystem must precede large-scale EV usage—most consumers will not buy an EV merely trusting that charging infrastructure will materialize.

An ample supply of trained maintenance personnel is a precondition for the export of large numbers of EVs to Caribbean markets by automakers. Local human capital must be developed for this purpose. While maintenance requirements for EVs are much lower than for ICEVs, they represent a new technology that requires a different set of skills from specialized maintenance personnel.

A robust charging ecosystem must precede large-scale EV usage—consumers will not buy an EV trusting that charging infrastructure will materialize.

Most car dealers and auto manufacturers still need to be convinced that EVs will sell in large enough numbers in the Caribbean market. Consumer choice is limited because of skepticism that EVs are marketable. This doubt is rooted in several factors, including a lack of public charging infrastructure, limited public awareness, high upfront costs, and insufficient maintenance personnel. Additionally, auto dealers in the region generate a large share of their earnings from after-sales parts and service and are concerned about the impact selling vehicles requiring less maintenance and repairs will have on revenue.

The narrow roads in some smaller Caribbean islands creates an additional barrier to consumer choice by limiting the number of EV models permissible for import. This problem has been cited especially in Bermuda, and means that tenders for electric public transportation, a promising area, may become a cumbersome process with finite options. The fact that most electric bus orders are tailor made for specific markets may help address this challenge that is unique to smaller territories.

EV UPTAKE IS EXPECTED TO ACCELERATE, AND FUEL TAXES WILL DRY UP, MAKING A MAJOR DENT IN GOVERNMENT BUDGETS IF ALTERNATIVE MEASURES ARE NOT IMPLEMENTED.

CONCLUSIONS

1 GOVERNMENTS SHOULD CLEARLY COMMUNICATE THEIR GOALS TO UTILITIES, AUTOMAKERS, AND DEALERS, AND CREDIBLY ESTABLISH THEIR COMMITMENT TO EVS.

Concrete long-term goals for EV penetration and the electrification of government fleets can demonstrate the seriousness of Caribbean governments about transitioning to electric mobility. This will provide long-term certainty to automakers, car dealers, utilities, and other players in the EV ecosystem, thus facilitating investment, broadening consumer choice and elevating public awareness, and in turn, boosting demand. Governments also need to develop plans to transition their power matrices to cleaner fuels, such as renewables and natural gas. Since the small size of many individual Caribbean markets can never be overcome, neighboring islands could consider coordinating these efforts to create larger collective markets. Policymakers should also solicit input from the private sector in an ongoing dialogue as part of the process for establishing the government's long-term strategy. Governments must be aware of what measures are necessary for automakers and dealers to export/import EVs to Caribbean islands. These include a greater supply of trained maintenance professionals and adequate charging infrastructure.

2 LEVELS OF PUBLIC AWARENESS SHOULD BE ASSESSED AND INCREASED, AND TOP CONSUMER CONCERNS SHOULD BE IDENTIFIED AND ADDRESSED.

Surveys should be conducted to gauge the public's level of awareness and knowledge about EV technology and identify misconceptions, knowledge gaps, and the top concerns that preclude purchasing an EV. Governments and auto dealers should partner to dispel myths about EVs through marketing campaigns, public events, and other channels. The total cost of ownership savings of EVs compared to ICEVs should be advertised, along with the environmental and health benefits. Efforts should be made to demonstrate and quantify the benefits of cleaner air in terms of healthcare savings and increased productivity in public awareness campaigns and to raise awareness about energy efficiency and environmental stewardship.

3 FISCAL INCENTIVES, SUCH AS A REDUCTION OR ELIMINATION OF DUTIES, SHOULD BE CONSIDERED.

Caribbean islands should consider reducing or eliminating duties on EV imports for a temporary period, given their economic, environmental, and energy security benefits over ICEVs. Technology improvements are expected to eventually lead to price parity between EVs and ICEVs, but in the meantime governments may need to level the playing field to foster greater EV uptake. Commercial banks could also provide new financing products for EV purchases with longer repayment periods in order to promote their uptake by mitigating the high upfront costs.

4 OPPORTUNITIES TO ELECTRIFY PUBLIC TRANSPORTATION AND GOVERNMENT FLEETS SHOULD BE SEIZED.

Governments can capitalize on cost and emissions savings, demonstrate the viability of EV technology to the public, and add credibility to their EV goals and broader decarbonization targets. Electric options for public bus fleets are especially interesting because they facilitate direct public interaction with EV technology.

5 UTILITIES SHOULD VIEW THE ELECTRIFICATION OF TRANSPORT AS AN OPPORTUNITY FOR GROWTH, AND GOVERNMENTS SHOULD DEFINE UTILITIES' ROLE IN INCENTIVIZING ELECTRIC MOBILITY.

Governments should define the role of public utilities in creating the enabling environment for electric mobility. The grid applications of electric mobility present a host of new opportunities for utilities to diversify and expand their business. Utilities can play a leading role in the deployment of public charging infrastructure, but energy regulators should also take action to ensure that the EV charging ecosystem grows in accordance with EV penetration. Utilities could serve as enablers of basic initial infrastructure (especially fast charging), but the regulatory environment must also be flexible enough to spur private sector-led initiatives and innovative business models. Utilities can also incentivize EVs through rate-setting while simultaneously serving their business, such as by providing discounted rates during off-peak hours. Governments and regulators can define the framework for such involvement by utilities and create a balanced environment that is also apt for private sector initiative. The sale of electricity to power EVs and the use of EVs for load management and resilience services through V2G technology also present opportunities for utilities. Another area for exploration is that of EV battery reuse, such as for off-grid and microgrid applications, which can boost system resilience and small-scale renewable generation while also reducing waste.

6 GOVERNMENTS SHOULD PLAN FOR THE LONG-TERM FISCAL IMPACT OF LARGE-SCALE EV ADOPTION.

While the mass displacement of ICEVs by EVs is a seemingly distant reality, governments should plan ahead of time for the depletion of significant revenues from fuel taxes. These foregone revenues, which will increase gradually, should be weighed against the positive economic effects of EVs in reducing oil imports, improving trade balances, lowering transportation costs, and preserving foreign exchange. This calculation should be considered as governments set EV targets, and alternatives to balance the budget without fuel tax revenue should be identified before EVs reach significant scale to avoid future pitfalls. Several countries around the world are considering measures to mitigate this effect. Such measures include a gradual increase of taxes on carbon-intensive oil-based fuels in concert with distance-based charges that apply to all vehicles and reflect pollution and congestion costs, as well as infrastructure use. Several states in the United States, including California, Oregon and Colorado have completed pilot programs introducing taxes based on vehicle miles traveled. California has increased its vehicle registration fee to compensate for lost revenue, while London, Milan, Singapore and Stockholm have implemented road charging schemes.[132] Reforms to the tax structure to accommodate a large-scale transition to EVs will thus undoubtedly demand innovation by governments and could be accelerated by information-sharing by those that find success.

7 THE ISSUE OF ELECTRIC MOBILITY IS MULTISECTORAL AND STAKEHOLDERS SHOULD BE ENGAGED IN AN ONGOING DIALOGUE TO COORDINATE EFFORTS AND ALIGN INCENTIVES.

As demonstrated by the case studies, electric mobility has implications for transportation, trade, the power sector, fiscal health, climate change mitigation and adaptation, local labor markets, health and more. Thus, governments, utilities, regulators, automakers and car dealers, and educational institutions must all be convened to create a shared vision for electric mobility. Such a coordinated plan can be used for energy, transport, grid, and resilience planning, human capital development, EV marketing, and other key initiatives. The absence of such a plan can lead to misalignments, for instance, between government aspirations and incentives for automakers and utilities. These inefficiencies can considerably impede the adoption of EVs in Caribbean markets.

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