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ECLAC SUBREGIONAL HEADQUARTERS FOR THE CARIBBEAN

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Barbados, the British Virgin Islands and Jamaica

Willard Phillips
George Nicholson
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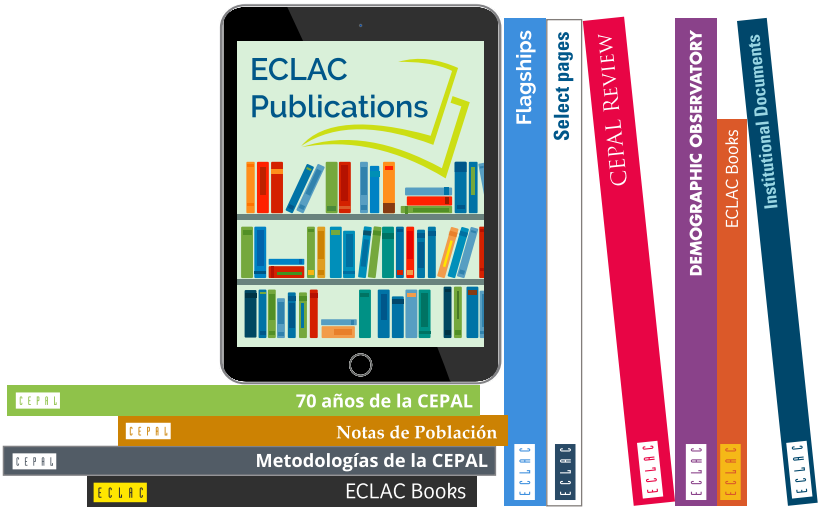

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This document was prepared by Willard Phillips, Economic Affairs Officer at the Sustainable Development and Disaster Unit, Economic Commission for Latin America and the Caribbean (ECLAC) subregional headquarters for the Caribbean, and by George Nicholson, Antonio Alleyne and Maurys Alfonso Risco. Contributions were made by the following expert reviewers: Rae Furlonge of LF Systems Limited and Trevor Townsend, Advisor on Transportation Engineering Projects of the Engineering Institute at the Faculty of Engineering, University of the West Indies.

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Contents

Figures

Diagram

Maps

Abstract

As the Caribbean subregion seeks to implement strategies for meeting its obligations under the Paris Agreement, the sustainable development of its land transportation subsector has emerged as a significant challenge. This relates to both the need to reduce green house gas emissions, for which the subsector is a major emitter, as well as the necessity for reducing its overall dependence on imported fossil energy. While several policy initiatives have sought to address these issues, the evidence of growing land transportation problems now motivates a closer examination of challenges in the subsector. Among the main issues are increasing motor vehicle concentrations in small island spaces and growing traffic congestion arising from increased private motor vehicle ownership. All of these factors operate to produce economic, social and environmental burdens such as growing imports of vehicles, fuel and spare parts; increased motor vehicle accidents and mortality; and socially deviant behaviors such as road rage. Given the pivotal role of transportation in the advancement of economies and society, this paper suggests policy options for improving land transportation efficiency and sustainability in the Caribbean. This study also seeks to add to the very limited literature related to the issue of land transportation in Small Island Developing States.

Introduction

The development of transportation systems has been pivotal to the evolution of society. The evidence of this relationship was observed even in ancient times, when civilizations such as Egypt, China, Greece and Rome were able to exploit the economic advantages associated with the establishment of river and maritime transportation routes (Nistor and Popa, 2014). Overtime, transportation has continued to drive economic and social change, and is today a major global industry both in physical and financial terms, a vast consumer of natural resources and an employer of a large number of persons (Button, 2014). The significance of the transportation sector is seen in the fact that it is today one of the largest emitters of greenhouse gases (GHGs), approximating 19.5% of all GHGs in 2014 (IPCC, Fifth Assessment Report, 2014). Moreover, given its high consumption of combustible fossil fuels, the transportation sector is one of the main contributors to air pollution worldwide (UNEP, 2022). It also imposes considerable negative environmental and social costs on society.

It is this central role in driving economic and social development, as well as its impact on environmental sustainability that has led to the identification of transportation as a specific target under several of the United Nations Sustainable Development Goals (SDGs)[1]. Notwithstanding that global transport systems have been hugely affected by the COVID-19 pandemic, the transport sector remains a pillar to the growth of any economy. And while several studies have examined the issue of transportation in the Latin American and Caribbean (LAC) region (Yanez-Pagans et al (2019); ACS (2017); M. Moscoso, T. van Laake, & L. Quiñones, (2019), there is a noticeable void in the research on the challenges of transportation evolution in Small Island Developing States (SIDS) such as those in the Caribbean subregion. This is a particular deficiency given the predominantly centralized pattern of physical planning within Caribbean SIDS. The challenge of scale in efficiently meeting transportation needs, capitalization costs with small populations, and the high unit costs of constructing and maintaining road infrastructure are among the leading concerns. Additionally, the Caribbean is energy dependent, and

[1] Among these targets are SDG 3 on health (increased road safety); SDG 7 on energy; SDG 8 on decent work and economic growth; SDG 9 on resilient infrastructure; SDG 11 on sustainable cities (access to transport and expanded public transport); SDG 12 on sustainable consumption and production (ending fossil fuel subsidies) and SDG 14 on oceans, seas, and marine resources (UN, 2022).

imports as much as 90% of its energy requirements which are used mostly for power production and transportation (IMF, 2016). This high dependence on imported fuel also exposes the subregion to global energy price shocks, and together with its obligations under the Paris Agreement, has motivated increasing efforts to transition its economy away from fossil energy. Land transportation is one such area which is now seen to require further examination.

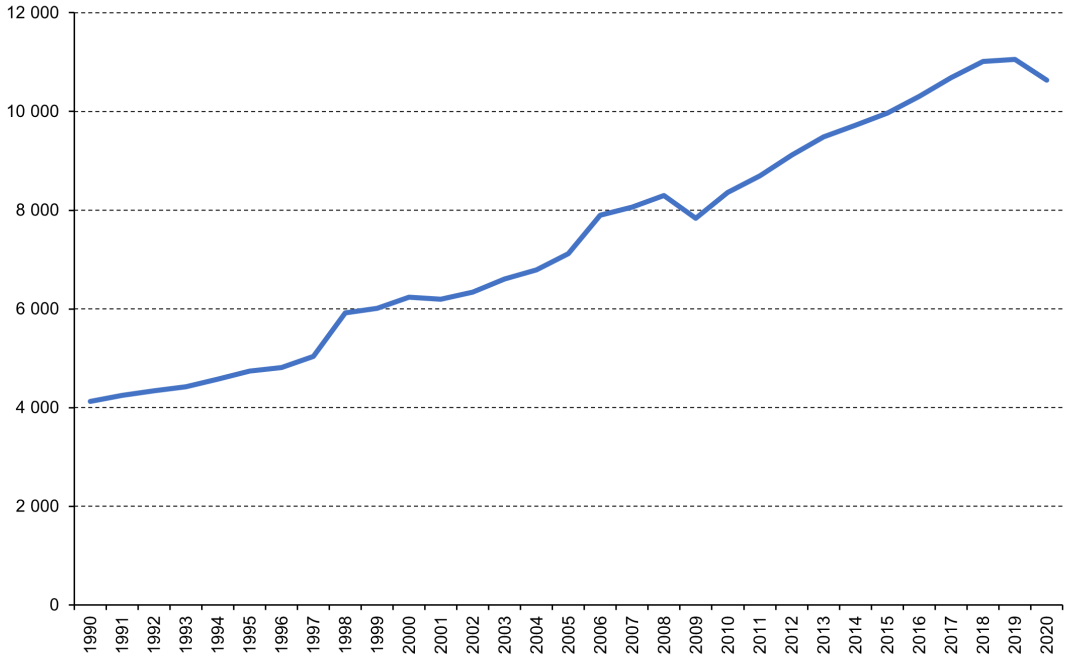
In light of these challenges, this study seeks to propose policy considerations for enhancing sustainable land transportation in Caribbean Small Island Developing States, and to explore options for improving land transportation efficiency. The paper is elaborated in eight sections. Section I discusses the role of, and peculiarities of transportation in a modern economy, while section II details elements of the land transportation system. Section III presents the methodological approach to the study, and land transportation efficiency and sustainability in the three case countries is discussed in section IV. The policy and institutional framework for land transportation is the focus of section V, while policy options for enhancing sustainable land transportation are proposed in section VI. Section VII outlines limitations of the study and suggestions for future research, and conclusions are summarized in section VIII.

I. Transportation and the economy

According to Button (2014), transportation in the modern economy is peculiar because it is provided as a derived demand. Transportation is necessary for the movement of people and goods, and facilitates the movement of labor and inputs for production. It also enables the access of consumers to, and delivery of outputs to markets. Additionally, the development of transportation systems affects the value and price of other economic inputs, especially with respect to the ease and cost of geographic access. Hence, reliable and cost-effective transportation options can offer significant advantages to economic growth in one location compared to another. This spatial dimension exceeds national and even regional boundaries, as was evident in the rapid expansion of global trade over recent decades. According to the World Trade Organization (2022), global merchandise trade increased from roughly 3.5 trillion USD in 1990 to a high of 19 trillion in 2018, just prior to the global pandemic. This global growth of trade was facilitated significantly by the expansion of international transportation to take advantage of emerging market opportunities. For example, the global volume of total goods discharged by commercial shipping increased from 4,126 million metric tons in 1990 to 10,631.1 million metric tons by 2020, representing an increase of 158% over the period (UNCTAD, 2022) (figure 1).

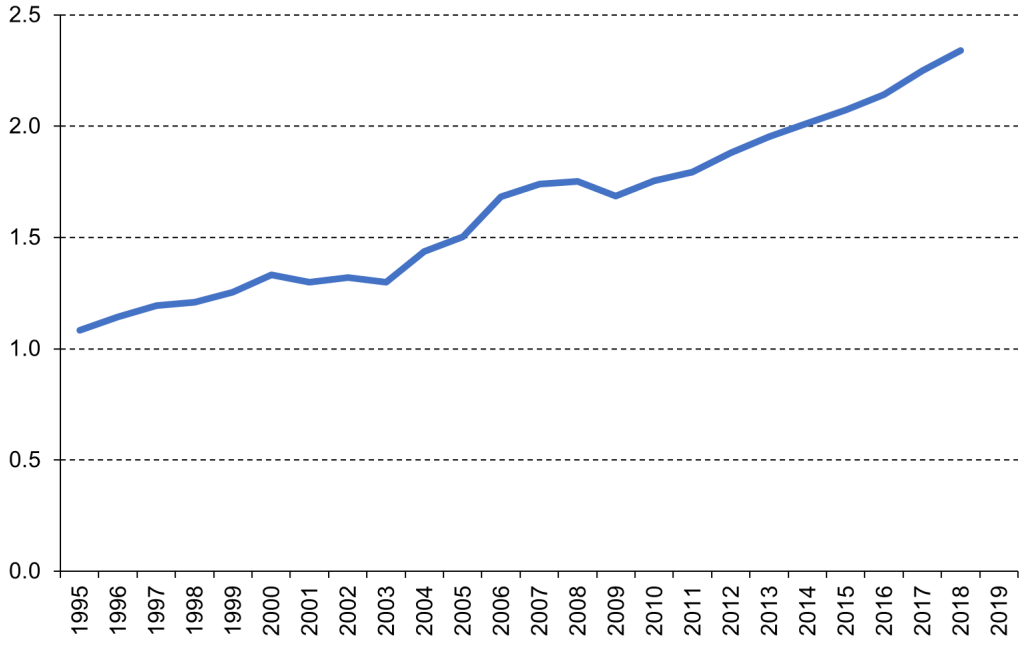
Similar global trends have been observed for the movement of passengers, as rising incomes have stimulated significant increases in tourism arrivals over the past two decades. According to the United Nations World Tourism Organization (2022), international tourism arrivals increased from 1.08 billion in 1995 to 2.4 billion in 2019 (figure 2). Much of this expansion has been facilitated by improved international passenger transportation services.

Figure 1
Global total goods discharged by commercial shipping, 1990–2020
(Millions of metric tons)



Source: Authors' compilation based on UNCTAD Data, 2022.

Figure 2
International tourism arrivals, 2000–2019
(Billions)



Source: Authors' compilation, based on UNWTO data, 2021.

In terms of supply of transportation services, investment in the sector is two dimensional with public sector investment typically providing the fixed assets for supporting transportation, while the private sector typically provides the rolling assets for the delivery of the transportation service. Fixed assets in transportation are the public physical infrastructure such as roadways, railway lines, sea and airports and passenger hubs or terminals. Moveable assets on the other hand are the rolling stock (cars, buses, trains, ships, planes) that use public infrastructure to deliver transportation services. There are often combinations of these arrangments where the state may also own some moveable assests (for example nationally owned airlines) , while the private sector may own fixed transportation assests. In the latter case, revenues to the private owner are raised through the implementation of toll fees.

Since most transportation assets are dedicated to a single use, they are often capital intensive and lumpy[2], and not readily adaptable to other commercial applications. Their slowly declining long-run average costs make them very sensitive to scale and can quickly become economically inefficient in small or declining markets. Hence, transportation services are usually provided by a few agents who behave with a view to maximising their profit. This, as well as the fact that transportation is provided principally to support other economic activities, requires that its supply and demand be subject to myriad security and safety requirements, and are typically regulated in order to maximize social welfare.

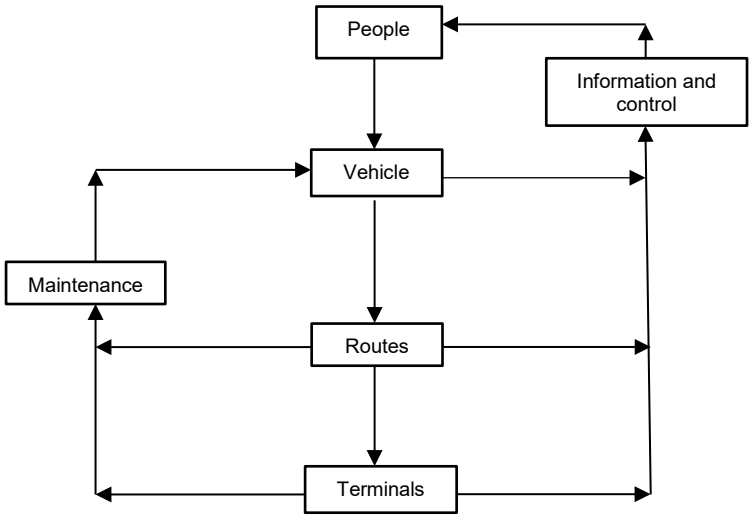
Finally, publicly owned transportation infrastructure allow for unrestricted access which can lead to congestion in use.This is especially evident in land transportation where limited road infrastructure often suffers major congestion in urban areas.

[2] Physical units are usually indivisible (or lumpy), in order to meet scale and cost efficiency. Hence while mathematically, a cost-effective solution for a shipping service may be 2.5 ships, this is not feasible in practice, and a service provider would be obliged to acquire 3 ships.

II. The land transportation system

In most discussions about transportation, focus is typically given to the fixed physical infrastruture and the rolling assets. However, given the centrality of transportation in the enhancement of economic and social welfare, a more prudent analysis requires a broader conceptualization of what is considered the transportation system. Furlonge (2022) offers an expanded perspective of the transportation sytem to include not only physical infrastructure (routes) and rolling assets (vehicles), but also people, terminals, and systems of maintenance and information and control (diagram 1).

Diagram 1
The land transportation system



Source: Furlonge R.(2022).

Since transportation systems are designed for the movement of both passengers and goods for specific purposes, the engagement of people with the system is important from the standpoint of user choice, suitability and efficiency. People include riders as well as pedestrians, and efficient transportation systems should take into account the particular needs of both groups, especially as in any transfer process, an individual might adopt either role as part of his or her journey. In a similar manner, terminals should not only facilitate the transfer of passengers through both intermediate and final stages of the journey, but should also provide parking facilities for vehicles[3]. Indeed, the location of intermediate transfer points as well as the cost and ease of parking are important variables which affect passenger choices within the transportation system. Maintenance is the process of ensuring and sustaining operability of routes, vehicles and terminals over time, and is built into the coordination of the transportation system. This function should take into account passenger needs, the requirements of maintenance service providers, scheduling and costs. Finally, the efficient operation of the transportation system depends on the availablity of accurate and timely data in order to facilitate information and control. Such data are necessary for service scheduling, assessing the quality of service delivery, projecting growth and planning for physical investments over the medium to long term. Importantly, Furlonge (2022) also notes the significance of the *interactions* between these systems and elements as a key dimension in the overall operation of the land transportation system.

This integrated approach to the transportation system is also evident in transportation planning and forecasting. As elaborated by Button (2014), these methods take into account myriad choices made by commuters; investment decisions by both the state and the private sector; and technical, operational and other social metrics. The maintenance aspects are reflected in the user and operational data employed in the planning analysis, while information and control functions support both data gathering, and policy decisions which affect land transportation.

Although these broad considerations are important, their complexity along with data limitations makes it necessary to carefully define the scope of analysis for any successful transportation research. In this regard, aspects related to the role of urban and physical planning, the maintenance of vehicles and transportation infrastructure; and social issues such as safety and security are not explored in this study.

[3] Vehicles here may also include bicycles, mopeds and other personal mobility devices.

III. Methodological approach to the study

This study seeks to assess measures of sustainability and efficiency for land tranportation systems in three case countries of the Caribbean, these being Barbados, the British Virgin Islands and Jamaica. Barbados was selected in order to evaluate land transportation dynamics in a small island with relatively high vehicle numbers per capita and a fairly entensive road network, while Jamaica allowed for the study of lower vehicle numbers in a relatively larger island space. The British Virgin Islands provided the opportunity to explore land transportation issues in a smaller multi-island state. Together, these islands represent the two broad geographic groups of the Greater and Lesser Antilles, as well as variations in size, economy and the range of land transportation systems in the subregion.

Several measures may be applied to assess the sustainability and efficiency of land transportation systems. As noted by the United States Environmental Protection Agency (2011), these include metrics such as 1) Transit Accessibility; 2) Bicycle and Pedestrian Mode Share; 3) Vehicle Kilometers Travelled per Capita; 4) Vehicles in Use per Capita; 5) Carbon Intensity; 6) Transportstion Affordability; 7) Average Vehicle Occupancy; and 8) Land Consumption.

Given data limitations, for the purpose of the analysis, Per Capita Vehicles in Use and Per Capita Vehicle Kilometers Travelled are used as proxies for land transportation sustainability and efficiency respectively. Changes in Vehicles in Use over time allow for an assessment of eventual land transportation capacity, since it implies changes in levels of vehicle congestion, as well as long run demand for physical infrastructure such as roads and parking spaces. Total Vehicle Kilometers Travelled (VKT) provides a proxy measure of the intensity of vehicle use as well as overall pressure on the environment from all forms of road transportation.

Data and information relating to the status of land transportation, as well as the prevailing policy and institutional regime for managing transportation for the period 2010 to 2020 were used in the analysis. The sources of data and other information were desk studies, field studies, and contributions from intergovernmental bodies and other departments in the respective countries. Meetings and interviews with Chief Transportation Engineers, Physical Planners, Chief Statisticians, and Transit Managers were held to complete the analyses required and to compile relevant data as well as to interrogate progress of legislation and related policies.

Based on the analysis, policy proposals for enhancing land transportation sustainability and efficiency were subsequently advanced.

IV. Land transportation sustainability and efficiency in three countries

As small, open, trade dependent economies, Caribbean SIDS are highly dependent on *international* transportation systems (air and sea) for their economic and social sustenance. Hence, greater attention is typically paid to examining arrangements for securing commercial aviation and shipping services. For instance, several countries have entered into bilateral agreements with international airlines in order to secure international airlift of visitors critical to the subregion's tourism sector. Moreover, joint efforts have been made under the CARICOM multilateral air services agreements, to facilitate regional standards of safety and reliability for air carriers operating in the Caribbean (CARICOM, 2020). Focus on internal land transportation systems, however, is primarily to facilitate internal movement of passengers and freight in order to meet the requirements of the local economy and society. Land transportation systems comprise principally a network of primary and secondary roads for conveying passenger vehicles, buses and commercial vehicles (trucks and vans). In some islands and territories, limited freight rail systems, used previously for supporting mining or agricultural activities, continue to operate albeit at significantly reduced levels, while water taxis and ferry services[4] supplement internal movement of mostly passengers in other countries. These last two forms of internal transportation represent the largest extent of inter-modal transportation connectivity within Caribbean countries.

From the standpoint of sustainability and efficiency, there are a number of characteristics of the three case countries which make these measures important for the development of sustainable land transportation policy. Firstly, while the countries may be considered to have relatively extensive road networks, they are highly variable in terms of density, quality and accessibility, reflecting both the cost of construction and maintenance, as well as physical geography. For example, two countries (Barbados and Jamaica) had roughly half of their road network classified as being in poor condition in 2021. In the

[4] These are utilized mostly in multi-island states such as Antigua and Barbuda, the British Virgin Islands, Saint Kitts and Nevis; Saint Vincent and the Grenadines; Grenada Carriacou and Petit Martinique; and Trinidad and Tobago. Water taxis also supplement the land transportation systems in Martinique and Saint Lucia.

case of the British Virgin Islands, although the internal road network on the main islands of this archipelagic state is fairly well developed, there remains connectivity challenges among the islands. Secondly, all three case countries have seen significant increases in motor vehicle imports over the past decade, largely due to the subregion's access to reconditioned vehicles from Asia. This growth in imports has resulted in increased congestion and other physical externalities such as vehicle emissions and the disposal of vehicle consumables into the natural environment. A third factor which impacts land transportation sustainability and efficiency is the related increased use of fossil energy to power a larger number of vehicles. To date, a relatively small number of vehicles utilize non-fossil energy sources, thus contributing to increased GHG emissions. Finally, inspite of the challenges associated with private vehicle ownership, public transportation in the case countries is not fully developed, with Jamaica having the most use, but with the highest reliability limited to metropolitan areas. Details of the land transportation systems in the three case countries are presented in the Annex.

A. Sustainability: motor vehicles in use

Land transportation sustainability has been approached from different perspectives by several researchers. For example, Townsend (2011) identifies a number of key considerations relevant to this issue including the integration of land use and transportation planning; cleanliness, safety, efficiency and affordability of transportation options; access to affordable rural transport services; mobility needs of special groups such as the elderly and disabled; facilitation of walking and non-motorized transport in urban centers; reduction of air pollution and improved logisitcs performance of freight services. Although this approach allows for a more comprehensive assessment of sustainability, other researchers such as Sullivan (2001) take a life-cycle approach by evaluating the possible impact of vehicle use over its total life cycle. This method places vehicle use, and its potential impacts on the environment at the centre of the sustainability discussion. Further, it allows for the application of specific data in assessing the impact of vehicle use on both the delivery of transportation services, as well as externality costs of such services. Given the limited environmental resources and the pivotal role of the natural resource base in the economy of small island States, this study employs an estimate of motor vehicle use as a measure of the sustainability of the transportation system in the case countries.

The proliferation of vehicles over the past decade has resulted in the subregion now having high vehicle to population ratios ranging from 0.45 to 0.95 for many Caribbean countries. This compares to vehicle to popoulation ratios of 0.84 for North America; 0.52 for Europe; 0.22 for South America; and 0.14 for Asia/Pacific (European Automobile Manufacturers' Association, 2022). There is nevertheless great disparity in the numbers relating to motor vehicles across the three case countries.

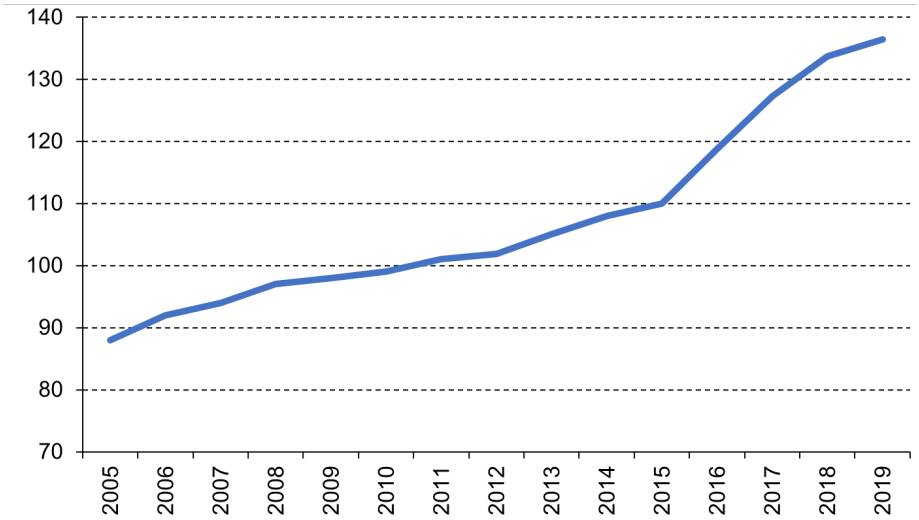
Of a total of 136,365 vehicles on register in Barbados in 2019, approximately 114,313 were registered as private, while diesel vehicles[5] at 19,348, accounted for most of the remaining vehicle types. Notably, in 2019 Barbados recorded 352 registered electric vehicles (figure 3).

For the British Virgin Islands, the fleet peaked at 19,100[6] vehicles in 2020, with gasoline powered vehicles representing 35% of fleet with 6,518 vehicles, and diesel comprising 11,769 or 64%. Electric vehicles numbering 181 represented the remaining 1% (figure 4).

[5] Note that this classification of diesel types conveys no notion of ownership. This is simply a classification category applied by the country's Motor Vehicle Department.

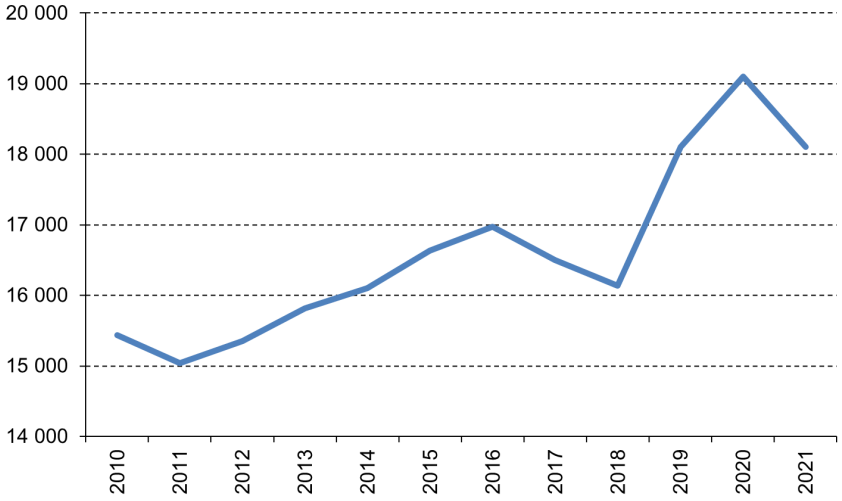
[6] Projected estimate.

Figure 3
Vehicles in use: Barbados
(Thousands)



Source: Author's estimates, based on data from Country's Motor Vehicles and Statistical Departments.
Note: Figures for 2016–2018 estimated.

Figure 4
Vehicles in use in the British Vrigin Islands
(Thousands)



Source: Author's estimates, based on data from Country's Motor Vehicles and Statistical Departments.

In the case of Jamaica, the data indicate that in 2011 there were 479,393 motor vehicles in use on the island's roadways. Over the last decade, this figure has steadily increased by roughly 32% to 708,254 registered vehicles in 2020 (figure 5). Gasoline vehicles accounted for some 82% with the remainder being diesel. Of note is the fact that in 2018, some 1,309 hybrid electric vehicles, along with 44 electric vehicles were imported. Sixty-five of the imported vehicles were also noted to be Liquified Natural Gas (LNG) powered.

Despite the high reliance and increasing congestion being seen on the road network, Jamaica's per capita motor vehicle ownership is low, with the latest available Jamaica Survey of Living conditions reporting that the percentage of households owning cars or other motor vehicles was 22.5% in 2018. This reflects increasing levels of urbanization where a disproportionate share of vehicle ownership is concentrated in urban and/or metropolitan areas. Coupled with approximately 2.6% of the population reporting owning a motor bike, ownership of a personal motor vehicles hovers at approximately 25% with a Vehicle to Population Ratio of 24.2%.

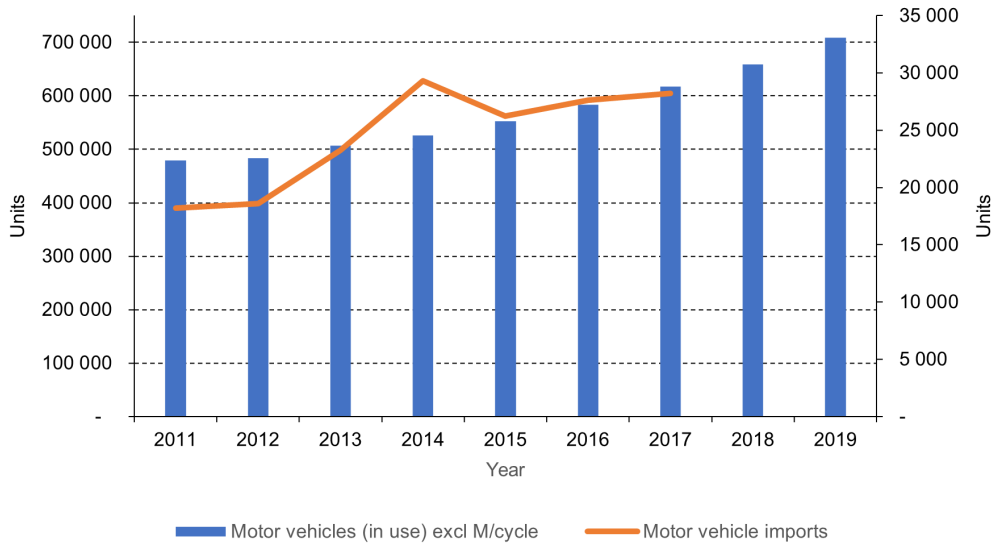
A deeper examination of the data indicates, as expected, that ownership is skewed to the highest earning quintiles in the population with the richest quintile owning 45.9% of all vehicles followed by Quintile 4, with 23.2%. The poorest quintiles, Quintiles 1 and 2, owned only 3.8% and 10.5% of the registered motor vehicles respectively.

Based on 2020[7] vehicle ownership and population measures, the estimates of Per capita Vehicles in Use for the three case countries were 0.50 (Barbados), 0.63 (British Virgin Islands), and 0.24 (Jamaica).

The higher estimates for Barbados and the British Virgin Islands can be largely attributed to the higher GDP earnings per capita for these countries compared to Jamaica. All three countries have also experienced growing vehicle congestion over the past two decades. While the data to confirm the percentage of the population that owns multiple vehicles were not available, anecdotally across all three territories it is noted that this is the case within the richest quintiles.

These figures also indicate that with the exception of Jamaica, the Caribbean case countries more closely approach vehicle ownership of North America and Europe, with the British Virgin Islands even exceeding the measures for Europe. Further, all case countries exceeded Vehicle in Use metrics for South America, Asia/Pacific, the Middle East and Africa (figure 6).

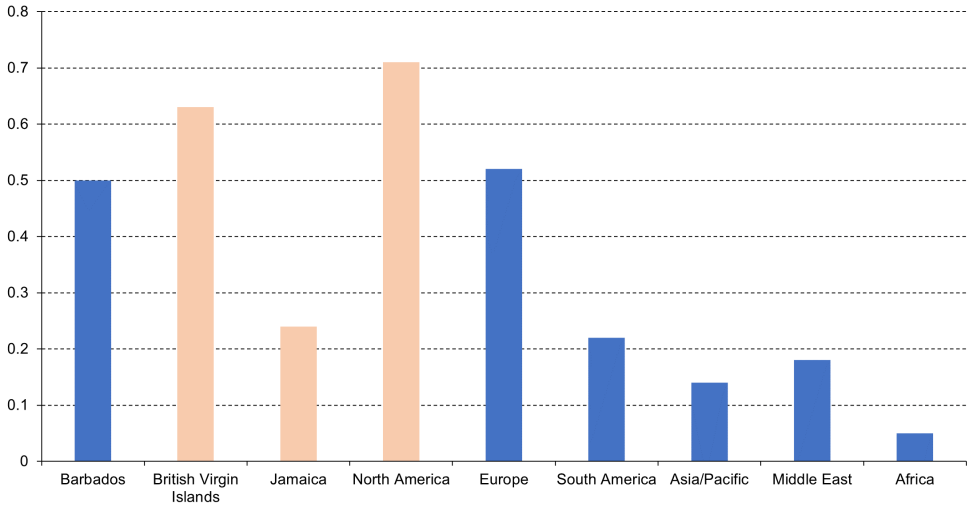
Figure 5
Vehicles in use in Jamaica
(Thousands)



Source: Author's estimates, based on data from Country's Motor Vehicles and Statistical Departments.
Note: M/cycle – Motor cycle.

[7] Estimates for 2019 in the case of Barbados.

Figure 6
Per capita vehicles in use compared, 2020



Source: Authors' estimates, based on data from Country's Motor Vehicles and Statistical Departments; and European Automobile Manufacturers Association (ACEA), 2022.

B. Efficiency: motor vehicle use intensity

Total Vehicle Kilometers Travelled (VKT) is defined as the number of kilometres travelled in a country by all vehicles during a one-year period. Estimates of VKT are used in transportation planning for estimating transportation efficiency, allocating resources, estimating vehicle emissions, computing energy consumption, and assessing traffic impact, all of which are important metrics for planning and environmental monitoring.

Two broad traffic measurement methods exist to determine VKT (Fricker, J. and Kumapley, R. (2002). The first uses odometer readings (vehicle-based method) or traffic counts (road-based method), while the applies non–traffic measures such as household/driver surveys or the fuel sales. Vehicle kilometers travelled (VKT) is not tracked by any regulatory body in the subregion. Sales of fuel are available however, and accordingly an estimate using the fuel sales method was applied to estimate VKTs for the three case countries using the following equation:

$$AVKT = TNL * FKPL \quad (1)$$

Where, AVKT = Annual vehicle kilometres travelled

TNL = Total number of litres of fuel sold (gasoline and diesel)

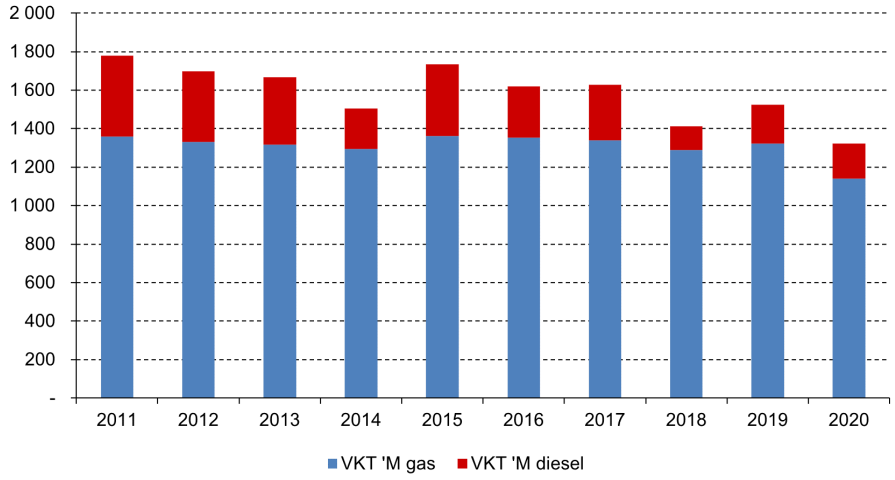
FKPL = Total fleet kilometres per litre.

While there will be some inaccuracies on account of generalizations on motor vehicle efficiency, geography, driving patterns, usage and other related factors, the fuel sales-based estimate allows for a simple total area wide estimate. To generate the VKT estimate, an average fuel economy for 9.5 litres /100km for light gasoline vehicles and 19 litres/100km for heavy vehicles using diesel was assumed. Reports of annual petroleum sales by product and activity were used to determine total fuel sales. Fuel sales of road-based diesel transport, which was not provided directly, were estimated by calculating the

difference between petroleum consumption by activity (Road and Rail) and petroleum use by product. Based on this assessment the annual average value of VKT was calculated using equation (1) above.

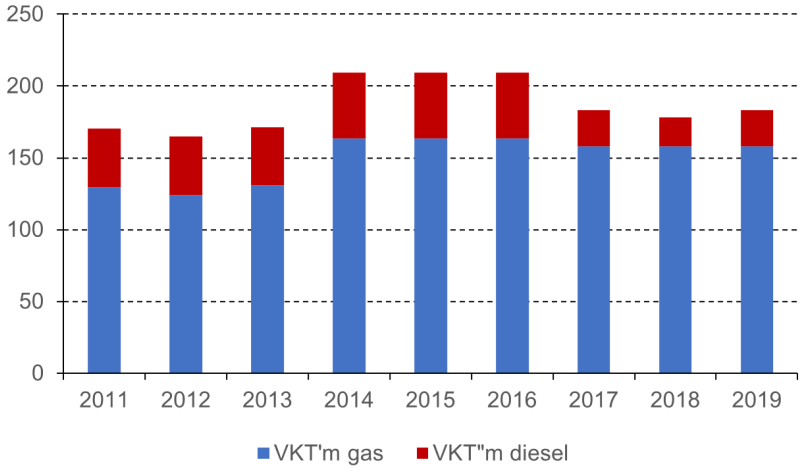
Using this method, the estimate for Barbados' annual VKT was 1,778.7 million in 2011 which declined over the years to 1,323.3 in 2020. The share of VKT by diesel vehicles declined significantly over the period from 24% in 2011 to 14% in 2020 (figure 7). It should be noted that there is no mechanism available to calculate the VKT from the electric vehicles in the Barbadian market, currently estimated to be approximately 0.3% of the fleet.

Figure 7
Vehicle kilometres travelled: Barbados, 2011–2020
(Millions)



Source: Author's estimates, based on data from Country's Motor Vehicles and Statistical Departments.

Figure 8
Vehicle kilometres travelled: the British Virgin Islands, 2011–2019
(Millions)

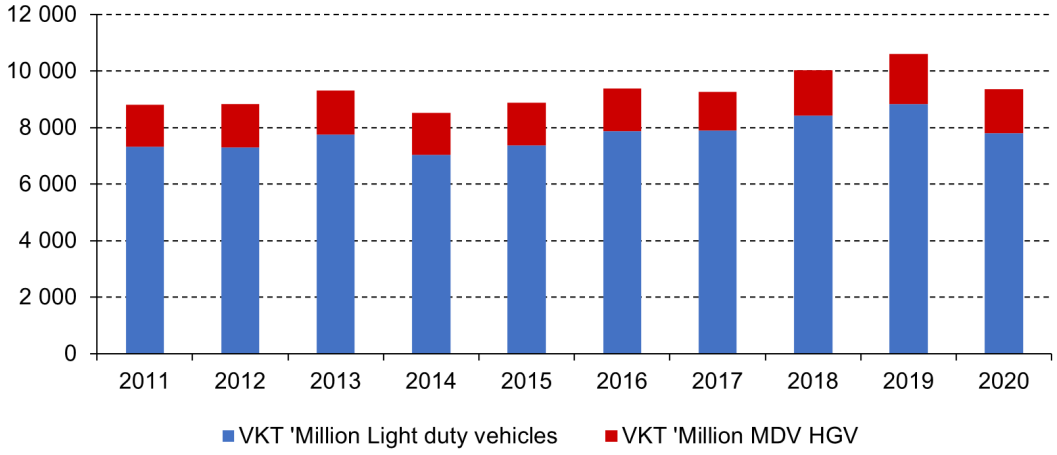


Source: Author's estimates, based on data from Country's Motor Vehicles and Statistical Departments.

For the British Virgin Islands, VKT in 2011 was 170.44 million which grew to a maximum of 209.38 million in 2016 before declining to 183.42 million in 2020. Diesel share of VKT declined from 24% to 14% over the period (figure 8).

Considering Jamaica, VKT increased marginally from 8,803 million in 2011 to 9,367 million in 2020 (figure 9). The share of VKT by heavy duty vehicles utilizing diesel remained constant over the period at approximately 17% of total.

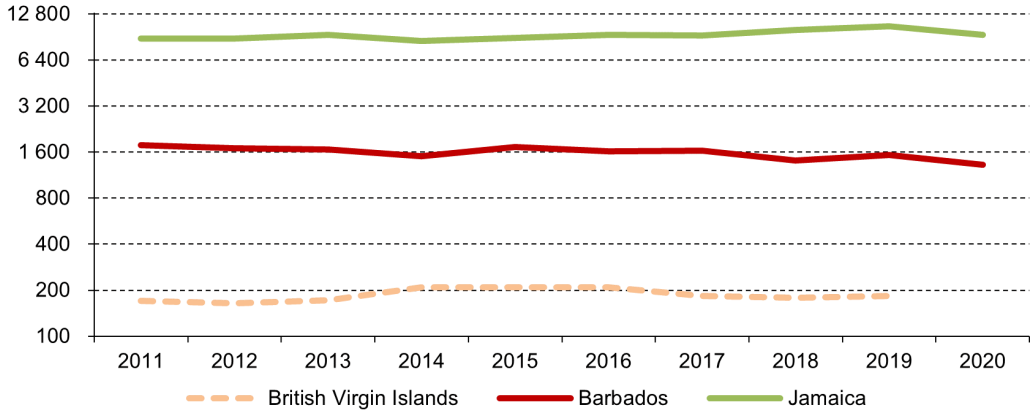
Figure 9
Vehicle kilometres travelled: Jamaica, 2011–2020
(Millions)



Source: Author's estimates, based on data from Country's Motor Vehicles and Statistical Departments.
Note : MDV HGV – Medium Duty Vehicles, Heavy Government Vehicles.

A comparison of VKT trends for the three case countries over the past decade is shown in figure 10.

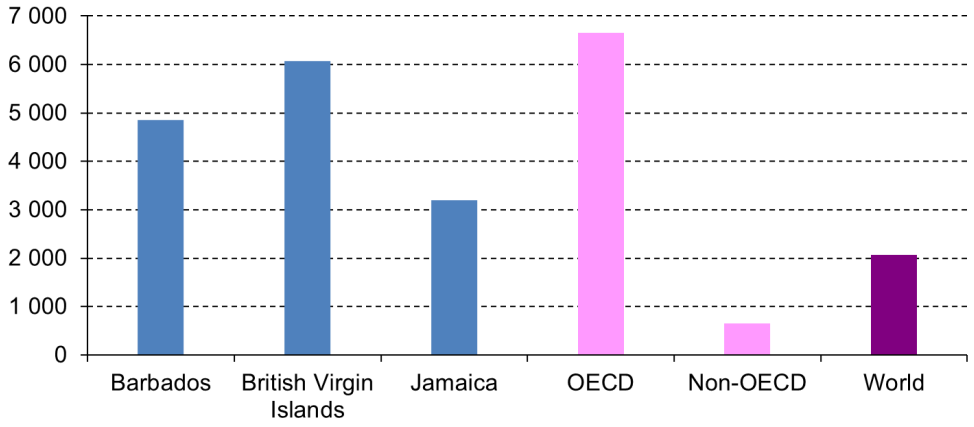
Figure 10
Vehicle kilometres travelled trends compared: Barbados, British Virgin Islands and Jamaica
(Log of totals)



Source: Author's estimates, based on data from Country's Motor Vehicles and Statistical Departments.

Based on the above estimates, the intensity of vehicle use *per capita*[8] was estimated to be 4,860 kilometers for Barbados, 6,066 kilometers for the British Virgin Islands, and 3,197 kilometers for Jamaica. These figures compare with 2020 per capita VKT projections by Fulton, Lah and Cuenot (2013) of 6,650 for OECD countries, 650 for non-OECD countries and 2,060 for the World. Figures for these three Caribbean countries suggest that vehicle use per capita is high relative to other developing countries, and with the exception of Jamaica, approximates the use intensity of developed economies. This efficiency measure also reflects the lower usage of public transportation in the case countries compared to private transportation (figure 11).

Figure 11
Per capita vehicle kilometers travelled compared, 2020



Source: Authors' estimates, based on data from Country's Motor Vehicles and Statistical Departments; and Projections by Fulton, Lah and Cuenot, 2013.

C. Evolving challenges to transportation efficiency and sustainability in three countries

With the growth of local vehicle ownership, several challenges have emerged which impact the efficiency and sustainability of public land transportation in Caribbean SIDS. As noted above, the exigencies of global climate change and the obligations to meet increasingly demanding targets under the Paris Agreement have added further urgency to the subregion's need to address its land transportation challenges. Among the most important aspects in this regard are increasing urbanization; the need to reduce dependence on imported fossil fuels; the growing environmental externalities of increased vehicle use; the balance of payments burden of supporting vehicle imports, fuels and spare parts; and the economic and social cost of constantly growing congestion on public roadways (see annex).

The Caribbean is part of the Latin America and the Caribbean region which has the distinction of having the highest share of urban population in the developing world, with up to 80% of its population living in cities (Jaitman,2015). While this same level of urbanization is not evident in the small islands of the Caribbean, a number of historical factors now serve as important drivers for urbanization in the

[8] Measured as VKT divided by total population.

subregion. Among these is the fact that historically, the subregion's physical planning has been centralized, with most public and other economic services provided in the cities. Cities are also where most jobs and other social services are available, thus motivating a strong incentive for persons to seek housing in cities. One particular aspect of the evolution of Caribbean economies is the development of touristic centres away from the main city, which results in demand for land transportation services to tourist areas, while at the same time meeting the commuting needs to the main cities. The subregion is further characterised by unplanned urban growth coupled with high rates of poverty, resulting in the expansion of informal settlements in some areas that are poorly served with respect to road infrastructure and public transit systems among others. All of these factors taken together explain the high rates of urbanization and attendant land transportation challenges in Caribbean SIDS.

The above also gives impetus to the significant expansion of the vehicle population in the countries, made possible by economic factors such as growth in income, response to poor public transportation along with other factors which drive demand for greater independence and private mobility. Additionally, the availability of second-hand vehicles from south-east Asia has made personal transportation more affordable. Growing vehicle usage intensity along with poor urban planning has also resulted in increased traffic congestion and other social impacts, and the manifestation of environmental impacts related to the use of petroleum-based fuels, disposal of vehicles at end of life, waste oil, tyres and other products.

The challenge the Caribbean faces is made even more stark as the subregion now seeks to adjust its land transportation infrastructure in response to the carbon reduction requirements under the 2030 Agenda, and its Sustainable Development Goals (SDGS), the SAMOA Pathway, the Paris Agreement, the New Urban Agenda and other multilateral agreements.

The subregion's large number of vehicles within small geographic confines has produced other social impacts such as increased traffic congestion, growing rates of motor-vehicle fatalities and high-risk driving behaviors such as road rage (Yañez-Pagans et al, 2019).

From the stand point of public transportaton, the subregion is also not generally well served by public transit services which are often inadequate and/or unreliable. This has created a demand gap that is supplemented by paratransit transportation systems[9] (Wright, Tangwell and Dick, 2021). While such systems are regarded as critical in many underserved areas, they have been described as unsafe and dangerous, and associated with a negative sub-culture. Given however that they play an essential role in the land transportation sector, they are difficult to replace and/or regulate.

The transportation sector is also a significant user of imported vehicles, fossil energy, spares, tires and other related consumables. In terms of balance of payment the subregion spends a significant share of its incomes on these types of imports which limit the capacity for more dynamic economic growth over the medium term.

These existing issues nothwithstanding, the Caribbean also faces several challenges with respect to the *future evolution* of its land transportation systems. Consistent with global trends, many countries have identified the electrification of its vehicle fleets as a key strategy for improving land transportation sustainability. This objective however would be feasible only if it is supported by sustained efforts to make the national electricity grid greener, through the increased use of renewable energy technologies. And while the subregion has made significant progress in this area over recent decades, there is still a

[9] Paratransit modes are informal, private and semi-public transit systems typically found in developing economies. They include shared taxis, minibuses, and other flexible services offered to patrons on demand. In the Caribbean, these services include the Maxi Taxi operations in Trinidad and Tobago, as well as the Z-Vans in Barbados. A recent evolution of the paratransit system in developed countries is the ride-share services of Uber and Lyft (Wright et al, 2021).

long way to go in order to supplement the current share of fossil energy used for land transportation, with greener energy sources.

The high concentration of vehicles in the limited land space of many Caribbean countries also poses a signficant environmental challenge from the disposal of automotive consumables (used oil, tyres, batteries, and replaced parts), as well as end of life vehicles. These negative externality effects will continue to increase overtime, especially with greater vehicle ownership and use.

Future sustainable land transportation for the Caribbean also contemplates the adoption of non-motorized mobility technologies such as cycling, in order to mitigate vehicle use. But this approach is likley to see limited adoption given the environmental factors such as high ambient temperatures and humidity, limited infrastructure such as bicycle lanes and parking stations, and the high affinity of Caribbean peoples to vehicle use.

Finally, with a global move to reduce the production of vehicles with internal combustion engines, there arises the question of what policy and strategic options may be available to the subregion in order to develop a sustainable land transportation system which could adequately serve the economic, social, and environmental needs of the Caribbean for the foreseeable future.

V. Policy and institutional framework for land transportation in three Caribbean small island developing States

In order to address the challenges of sustainability and efficiency in land transportation in any Caribbean country, an enabling policy and institutional framework is critical. Two overarching aspects are apparent in considering any such framework. The first is that the institutional environment for the management of land transportation continues to be based on arrangements from the colonial period when there was limited road infrastructure, and low numbers of vehicles and road users. Land transportation management in the subregion is typically vested with a Division/Department of Works whose principal objective is to enforce rules related to road use, motor vehicle conditions, and the licensing of vehicles and operators. The second is that the evolved policy framework over recent decades seems to favor the expansion of personal mobility over the development of public transportation. This is reflected in a fiscal regime which allows for mass vehicle ownership, particularly through the importation of reconditioned vehicles (UNEP, 2020). Together, these policy and institutional elements have proven to be inadequate in meeting the new challenges of a sustainable and efficient land transportation system. With an emphasis on "road works", many Caribbean countries have embarked on ambitious road expansion programmes in response to growing congestion on roadways (Yañez-Pagans et al, 2019).

And although several countries have articulated policy positions related to the reduction of GHGs (Barbados National Energy Policy – 2019 – 2030; National Environmental Policy for Trinidad and Tobago, 2018; Medium Term Development Strategy 2020 – 2023 of Saint Lucia), *comprehensive* strategies for addressing the economic efficiency, reliability, and environmental sustainability of land transportation systems remain largely absent in the subregion. Indeed, a review of the policy and legislative framework across all three countries shows similar issues: 1) weak implementation/enforcement of legislation and policy which constrains the effectiveness of policy where it exists; 2) no agreed strategic framework or clear targets and indicators against which progress could be measured; and 3) no clear policy coherence resulting in a fragmentation of policy, legislation

and the proliferation of initiatives that have been loosely coordinated, and in many cases non-specific. No specific policies on sustainable transportation exist across the territories that were assessed, although some alignment with the 2030 Agenda and its SDGs was observed. Overall, broad policy intentions seem to relate to fleet electrification, reduction in fossil energy use, and enhancement of public transportation.

Land transportation policy for Barbados is embedded in its national energy policy - Barbados National Energy Policy (BNEP) 2019-2030. These strategies are articulated within the context of the Government's intended Nationally Determined Contributions (NDC) emerging from the Paris Agreement, and in recognition of the fact the transportation sector accounts for approximately one-third of the energy consumed in the country. Specifically, the island's national policy emphasizes that the transport sector will be a crucial contributor towards attaining the country's goal of being a 100% renewable energy and carbon-neutral island by 2030. It also reports that the expanded use of electric vehicles and alternative fuels is critical to improved overall efficiency. Notably, the BNEP provides measures to address efficiency, transportation management, clean fuel use, and emissions control within the sector. The policy also outlines specific measure relating to land transportation such as:

(i) establishment of a transportation information system to provide data for transportation and energy policies;

(ii) development of a road network that promotes energy efficiency;

(iii) implementation of more stringent regulations on vehicles' exhausts and emissions;

(iv) removal of duties and VAT from electric vehicles and encourage a scheduled approach to increasing their use in the national transportation fleet;

(v) incorporation of management-related technology in the operation of the public transport system.

With respect to the country's fiscal regime, vehicles powered by hybrid, electric motor, compressed natural gas, and liquid petroleum gas currently attract an excise tax at a flat rate of 20% compared to as high as 120% on traditional internal combustion engine powered vehicles. In addition, a fuel tax of USD 0.20 per litre replaces the annual road taxes previously charged. This provides an advantage to motorists that make the switch to electric-powered vehicles depending on engine size. Barbados is already reaping the benefits of this exercise with a battery electric vehicle penetration of approximately 0.3%, which compares favorably with the penetration in larger markets. Barbados also launched its electric bus project in August 2020, deploying 33 electric buses and installing all the necessary infrastructure such as charging stations. The objective of the exercise is to prepare a large-scale deployment of an electric bus fleet given that the existing buses are past service life with the oldest dating back to 1997. This exercise also forms part of the national plan towards carbon neutrality by 2030. Finally, a sustainable urban mobility plan for the Greater Bridgetown Area has also been prepared to accompany the move towards decarbonization of the transport sector and includes upgrading the public transport system, introducing bicycle lanes, connected sidewalks and accessibility measures, as well as parking management policies.

With respect to the British Virgin Islands, while no direct policies on sustainable transportation exist, in 2021, the government with the support of ECLAC, completed its National Sustainable Development Plan. This plan seeks to align national objectives with the United Nations Sustainable Development Goals. Additionally, the government has prepared a package of incentives which specifies zero tax on the import of clean energy systems such as solar and wind power generation equipment and hybrid vehicles. This further elimination or reduction of import duties, as signaled by the British Virgin Islands and other territories for electric/hybrid vehicles, should make newer vehicles more affordable thereby removing the barrier of high initial cost which is likely the primary concern of the purchaser.

Additionally, given that there is no restriction on the make or model of vehicles that can be used for public transport, a significant number of vehicles imported annually serve this purpose.

The government of the British Virgin Islands has also signaled the direction in which it intends to go with its Go Green Initiative that is being developed in partnership with local entrepreneurs and business persons. This initiative seeks to encourage the ownership of electric vehicles. Aligned with this, the British Virgin Islands Climate Change Trust Fund was established in March 2015 as an independent entity dedicated to raising, managing, and disbursing funds to qualified applicants to build resilience to climate change impacts and to reduce carbon emissions through on-the-ground projects. Such projects include capacity building, education, research/studies, the introduction of innovative technologies, changes in legislation, policy/strategy development and the establishment of incentive programs.

In the case of Jamaica, although previous efforts have been made to institutionalize an overarching national policy for the transportation sector , the sector has still evolved without a single guiding policy framework. Actions taken in the sector have arisen from several different government agencies with the expectation that there will be eventual harmonization under a "whole of government" approach currently being espoused. Jamaica's National Development Plan – Vision 2030 – recognizes that a well-organized and accessible transportation sector capable of moving people and goods efficiently, safely, and affordably, is indispensable to economic progress, especially for the most vulnerable and excluded populations. Moreover, with the development of its new transportation policy, Jamaica has the opportunity to build sustainable land transportation into the policy mix, and to support the specific policy goals of increased mobility, public transportation and electric motor vehicle ownership.

VI. Policy options for sustainable land transportation

The results of the analysis of land transportation systems in the case countries reflects the reality of the wider Caribbean subregion, particularly given the commonality of economy, geography, institutional structure and society. On that basis, while the proposed policy recommendations are specific to the three countries assessed, they should be also applicable to the development of sustainable land transportation policy in many Caribbean SIDS. Ultimately, the future evolution of the land transportation subsector in the case countries should result in cost effective, reliable and flexible land transportation systems which minimize impacts on the natural environment, while at the same time enhancing the economic and social well-being of Caribbean peoples. The following policy options are proposed:

- Create National Transportation Authorities:

A key deficiency for the evolution of future land transportation systems is the existing national transportation management framework which is currently oriented towards licensing and enforcement of related rules. However, the scope of economic, social and environmental challenges which now confront the subregion's land transportation systems requires institutional capacity for researching, planning and implementing policies towards meeting the broad range of competing interests in the land transportation sector. Consideration should be given to the establishment of firstly, specialized National Transportation Agencies and/or Authorities, and ultimately, a Regional Land Transportation Management entity for coordinating policies on regional land transportation in the subregion.

- Redesign of public transportation offerings:

Optimizing how the population physically goes about its daily business will be a key aspect of improving the sustainability in the transportation sector. For the Caribbean, a key factor would be the rationalization of the roles of the both the state and the private sector in the provision of public transportation services. As noted by Furlonge (2022), there are several short-comings with respect to the provision of public transportation services. From the standpoint of the state, improved

transportation would require better investments, not only in the aquisition of buses, but also in the establishment of improved passenger facilities; optimal location of bus stops and transit points; enhanced quality and standards of service in terms of cleanliness, scheduling and reliability; automated and flexible ticketing and payment options; mechanisms for intra- and intermodal transfers; and modern services such as WiFi, and other informatics. Townsend (2022) also point to the issue of first and last mile passenger connectivity[10] as critical, and this factor should also be taken into account in the deployment of public transportation services. Additionally, the state should play a more integral role in regulatory functions such as public health, safety and security, as well as effective oversight of paratransit services, particularly where such services are the dominant form of public transportation. These efforts should be in consonance with public policy to disincentivize private vehicle ownership and use, with a focus on efficient transportation rather than efficient vehicles. While the cost of improving the service is likely to be significant, it should be recognized that there is a relatively large public transport market in each country. Further, coupling improvements in public transportation with changes in the design of the urban spaces will only improve the performance and attractiveness of the mode. As observed by Townsend (2022), the evolution of suburban spaces outside of city centres (suburbanisation) can result in increased vehicle use which is a greater contributor to traffic congestion relative to vehicle *ownership*. And although the spatial planning aspects related to land transportation are beyond the scope of this study, these considerations are also important in the design of land transportation systems particularly in the limited land spaces of Caribbean small island states. Ultimately, the improvement of the layout and management of public transportation in a sustainable manner should be the overarching policy objective.

- Electrify public transportation systems:

Where possible, and in particular with regard to the public bus services, governments should begin the process of electrification of its fleets. This process should include rationalization of vehicle use so that ultimately more effective use is made of electric vehicles through enhanced passenger loadings, improved service offerings, and reduced traffic congestion[11]. Along with creating a more attractive, cost-effective mode of public transport, this process would also reduce green house gas emissions. These changes are likely to yield significant annual benefits to the treasury and reduce the impact of negative externalities associated with transportation such as air quality and noise pollution, among others. Governments should lead from the front in this regard given the benefits to be enjoyed by the population and seek public support of electrification/decarbonization policies by ensuring that government fleets, as much as is feasible, be converted to hybrid or electric.

- Incentivize electric/hybrid vehicle ownership:

The use of tax policies, such as purchase or import taxes to encourage persons to choose electric vehicles (EVs) as opposed to traditional fossil-fuel-based vehicles, would incentivize the population given the difference in prices between the two motor vehicle categories. This is especially important for paratransit transportation systems, as only a small percent of the fleet lies in government ownership. This measure should also reduce the total cost of operation for private operators over time.

- Support Systems for Electric Vehicle Transitions:

A key element that hampers the decision-making process for adoption of electric vehicles is the lack of required capacity to service or repair these technologies . Further, given that during the transition to EV, there will likely be job losses in the traditional combustion based-automotive section,

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[10] These are the mobility options such as walking, cycling and other forms of *short distance* transportation undertaken by passengers in order to access, and return from public transportation services.

[11] The key point here not to simply replace fossil energy vehicles with electric ones, but to simultaneously seek to reduce the overall number of vehicles through more efficient fleet use.

governments should facilitate the training or retraining of auto-mechanics and electricians to repair and maintain EVs and to install charging infrastructure. This would help buttress the traditional automobile, and related sub-sectors that would incur revenue and job losses with the increased adoption of EVs, and provide some comfort into the market to support adoption of the platform.

- Encourage and support use of non-motorized modes:

As noted by Furlonge (2022) citing Litman (2016), Caribbean countries typically have semi-constrained cities with limited options for expansion given that many of them have a seaport boundary. He therefore recommends reduced private automobile ownership and roadway designs that favour walking, cycling and public transportation, and that road operations should "limit vehicle travel to what their road systems can accommodate". Hence, integrating cycling and improved pedestrian facilities into the urban space would significantly increase the share of personal mobility relative to vehicle traffic. Cycling is a more sustainable travel method than single-passenger cars with a significantly lighter carbon footprint as well as health benefits. While it is understood that the subregion's climate and geography may limit the wide scale adoption of these measures relative to the more temperate countries, construction of green corridors along crowded city streets or bike-friendly routes in neighborhoods should be seen to be integral to advancing the sustainable transportation agenda.

- Integrate sustainable transportation in national development policy:

Regionally, policy development takes place relatively slowly, in part due to lack of specialist knowledge and credible data to interrogate. Of the three countries examined in this study, only Jamaica has a National Transport Policy which was first articulated in 2007. Notwithstanding this, there are key elements within the sustainable transportation landscape that can be incorporated into the national development policy framework. Among these are fiscal policies to discourage private investment in, and use of motor vehicles; strategies to reduce motor vehicle congestion; and efforts to enhance connectivity, accessibility, reliability, affordability and security of land transportation systems, especially for vulnerable and special needs users. Clarity on such elements would provide guidance to technocrats, developers, the private sector, the public and other stakeholders with respect to standards to be adopted as well as the path the government wishes to pursue.

- Improve data collection and availability:

The ability of the public to make decisions regarding purchase of vehicles, and well as the ability to craft cogent policy requires more than anecdotal evidence. Further, strong policy requires strategic planning as well as tools to measure the effectiveness of the policy post its implementation, and these are all undergirded by data. National Statistical Agencies should therefore enhance efforts to gather and make relevant data widely available in order to facilitate more efficient decision making with respect to the sustainable evolution of the land transportation sector. Such data would include basic sector data such as energy consumption, vehicle congestion and costs of public transportation services.

- Renewable Energy adoption:

All three countries have made commitments towards the greater utilization of renewable energy and the displacement of fossil fuels for power generation. These commitments have in some cases been supported by national policies that promote and encourage the use of renewable energy technologies. As the global wave of electric vehicle adoption arrives to the Caribbean shore it is imperative that policy makers move aggressively towards ensuring that a greater share of the power supply comes from renewable sources, if the benefits of electrification are to be obtained. However, as pointed out by Dolcy and Townsend (2021), such efforts should nevertheless take into account the broad range of challenges to adapting alternative fuels in land transportation. Apart from fiscal measures, these would include robust systems to *provide* alternative fuels; public education programmes to overcome consumer resistance; and policy and technological updates that are supported by continuous evaluation.

- Integrate digital technologies into national land transportation systems:

As part of the rationalization of land transportation services, consideration should also be given to enhanced mainstreaming of digital technologies into national land transportation systems in the case countries. Such technologies will enhance service delivery by providing more accurate and timely information for scheduling, passenger safety and security, real time management of passenger loadings, monitoring of levels of congestion, vehicle maintenance analytics, and overall system performance. Moreover, digital services such as WiFi connectivity, both in terminals and onboard public transportation vehicles, could enhance ridership experience, expand tariff payment options, and improve passenger decision making with respect to intermodal connectivity, and other passenger travel logistics. The latter options are likely to be important incentives for attracting a wider cohort of travellers who would otherwise choose the use of private vehicles over public transportation.

- Implement measures of land transportation externality accounting:

Given the rapid growth of vehicle imports and intensity of use, several negative health and environmental effects of land transportation are already apparent in the case countries. As described by Furlonge (2022), such externalities arise from the discard of vehicle consumables such as used oil, batteries, and tires as well as the scrapping of larger numbers of end-of-life vehicles due to increasing rates of vehicle depreciation. Further, growing abandonment of old vehicles on roadways contributes to congestion and creates a poor visual impact in communities. In the absence of vehicle recycling services in Caribbean SIDS, proper externality accounting is necessary not only to take such indirect costs into account, but also to inform economic prospects for such services in planning the future development of the land transortation subsector.

- Undertake public education:

Finally, any successful approach towards sustainable transportation would require a comprehensive public education effort in order to promote more positive attitudes towards the use of public transportation. These efforts should include changes in behaviours relating to private motor vehicle use; building awareness of land transportation externalities; and the promotion of wider acceptance and use of public transportation services.

VII. Limitations and areas for future research

Notwithstanding efforts to articulate policy options for land transportation in the Caribbean, this research effort is limited in at least five areas. Firstly, there was difficulty in collecting data. This is a typical challenge with respect to land transportation studies, given the wide range of factors and stakeholders who operate in the sector. Data access was made more difficult due to the public health restrictions occasioned by the Covid 19 pandemic, which required potential data providers to work away from public offices.

A second important limitation is that the study does not consider freight transportation systems in Caribbean SIDS. This omission is in part due to the unavailability of data which gave specific focus on *land* freight transportation. Further, given that for SIDS, freight transportation issues arise under conditions of last-mile logistics[12], this area of inquiry could not be addressed in the general policy context of the research.

Thirdly, with respect to GHG emissions, the study addressed emissions from the transportation sector that are generated primarily from fossil fuel combustion. Assessment of other sources of GHGs were not considered in the study.

Fourthly, while the research fully recognized the pivotal role of urban and physical planning in informing the development of national land transportation services, this aspect was not examined in the study.

Finally, the study did not explore some economic and spatial issues related to the evolution of a modern, sustainable land transportation system in Caribbean SIDS. Such issues include marginal land value intersections for competing land used for expansion of roadways, and the construction of passenger termnals and public car parks. All these issues remain important areas for future research.

[12] Last mile logistics are the physical and institutional arrangements for the movement of goods at the extreme end (near destination) of the supply chain. Typically, this is the only area of logistics management where SIDS have an opportunity to intervene, given that most of its supply chain is delivered by air or sea transportation.

VIII. Conclusion

The analysis of land transportion in the three case countries points to an increase in vehicle acquisition and use in the three case countries, over the past decade. At the same time, public transportation services have not kept pace with the connectivity and mobility needs of the countries, nor has there been significant transitioning to date, of land transportation services to the use of more renewable energy sources. Assuming that these trends are representative of the wider Caribbean subregion, the development of sustainable land transportation in the future would require a shift in policy perspective which better incentivizes the use of public transportation services that are driven by cleaner energy sources. Moreover, policy planning should seek to expand connectivity (accessibility) and mobility options of passengers, while at the same time discouraging the unnecessary use of private motor vehicles. This latter strategy would require a close re-examination of physical and urban planning approaches and objectives, if the subregion is to significantly improve the efficiency and ultimate sustainability of its land transportation services over the medium to long term.

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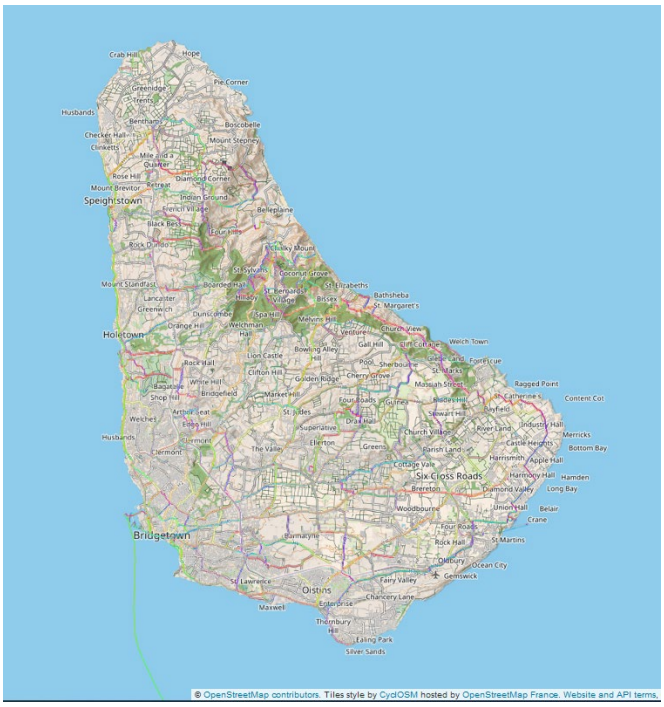
Annex

Annex
Profile of land transportation in the case Countries

A. Land transportation network in Barbados, the British Virgin Islands and Jamaica

Barbados is a small island (430 km²) with an estimated population of 272,300 persons in 2020 (Barbados Statistical Service, 2021). The island's road network system consists of 4,405.6 km of roadways which are identified under seven categories and four classes (map A1). Seven major highways (highways 1 to 7) radiate from the capital Bridgetown and serve as the primary corridors for traffic between the rural areas and the capital. These primary highways, representing 7% of the road stock, connect the island's touristic, industrial, and business areas with the Bridgetown Port and the Grantley Adams International Airport, via the ABC highway. This road network supports transportation for the productive sectors which are mainly tourism, light manufacturing, quarrying, and agriculture. Approximately 45.9% Barbados' road network is categorized as being in poor condition (unpaved or tracks) and a significant portion, 76.5% of them, are labeled as tracks. The country's road density[13] is estimated at 3.720km/km². Over the last two decades, Barbados has seen a major increase in motor vehicles imported for personal use resulting in a significant increase in congestion on many of its roadways.

Map A1
Map of Barbados showing road network

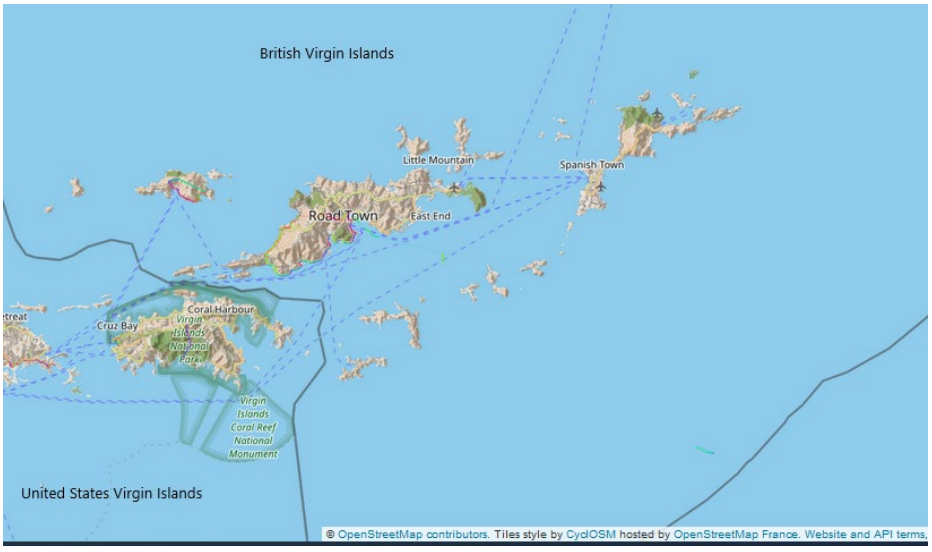


Source: Openstreet Maps, 2022.
Note: The boundaries and names shown on this map do not imply official endorsement or acceptance by the United Nations.

[13] Road density is the ratio of the total number of kilometres of roadway to total land area (Km/Km²).

The British Virgin Islands is a British Overseas Territory which forms a small archipelago with a population of 30,237 (Government of the British Virgin Islands, 2019). The archipelago consists of the four main islands of Tortola, Virgin Gorda, Anegada and Jost Van Dyke, along with more than 50 other smaller islands and cays; about 16 of the islands are inhabited (map A2). The evolution of modern transportation was directly related to the establishment of the 1950 Constitution which allowed the territory to start developing its infrastructure and economy independently. Up until 1958, the Territory had only 20 kilometres of drivable roads. Over the next 12 years however, the road system was vastly improved, linking Tortola's West and East Ends, and joining Tortola to Beef Island by a new bridge. Each of the main islands in the British Virgin Islands has its internal road network with Tortola having two major roads running across the island from east to west and another connecting Tortola to Beef Island. Virgin Gorda also has an extensive road network with connections to local areas in the south around the island's main town, The Valley and the centre of the island, near the Gorda Peak National Park. In total, the road network comprises some 200km of paved roadway.

Map A2
Map of the British Virgin Islands



Source: Openstreet Maps, 2022.
Note: The boundaries and names shown on this map do not imply official endorsement or acceptance by the United Nations.

Land transportation in Jamaica encompasses two components these being road and railway transportation. The railway service has the distinction of being one of the oldest in the western hemisphere and previously played a role in the provision of passenger services, but now provides only freight services to the agricultural and mining sectors. With an estimated population of approximately 2.93 million persons in 2020 (Statistical Institute of Jamaica (2021), and a land mass of 11,400 km^2, Jamaica is considered to have one of the densest road networks in the world, with a total road network of 15,394 km of road (map A3). This comprises the main road network of 5,286km, under the administration of the National Works Agency (NWA), and a secondary road network of 9,962 km administered by the various Municipal Corporations. Community roads and farm roads represent the remainder of the network. A significant portion (over 48%) of the main road network under the administration of the NWA is classified as being in "bad" condition, with potholes, poor drainage and other issues that compromise their functional integrity (National Transport Policy, Government of Jamaica, 2019).

Map A3
Map of Jamaica showing major roads network

Source: Openstreet Maps, 2022.
Note: The boundaries and names shown on this map do not imply official endorsement or acceptance by the United Nations.

Thirty-three percent is categorized as poor while information on the approximately 10,000km of secondary corridors is not available. Road density, while increasing marginally with the development of new highspeed corridors, is approximately 2.05 km/km^2.

The economy relies heavily on road transport for passenger and freight movement and while a significant portion of the road network has been improved over time, it is to be that recognized that they were never originally constructed to modern engineering standards, but have evolved in many cases, from bridle tracks.[14] Further in the absence of proper enforcement and adequate urban and transport planning, the condition of much of the network, particularly the tertiary roads, can be regarded as ranging from poor to very poor. Land transportation is also the most affected by natural disasters such as hurricanes, floods and tropical storms, which have caused extensive damage to infrastructure in recent years, and in effect result in a significant reduction in activities of Jamaica's transportation system. As is the case with Barbados and the British Virgin Islands, an increase in the importation of motor vehicles particularly in the last decade, coupled with a network that did not contemplate the surge in economic development and urban migration, has resulted in increased traffic volumes. This in turn has led to significant traffic congestion problems in the major towns across the island.

Jamaica's large road network is complemented by railways covering 331 kilometers of government owned tracks as well as six private mining lines. Rail transport was originally introduced to facilitate the transport of fruit from estates to the ports and most of the railways were constructed prior to the 1950s. Currently very little economic activity takes place across the railway network. Government run passenger services on the railway ceased in 1992 given that the services were unable then to generate adequate revenues to fund operational costs, capital replacements, and equipment maintenance. The condition of existing stations is primarily categorized by the Jamaica Railway Corporation (JRC) as very poor or deplorable with significant investments being required to revitalize or replace them. Freight services continue however with the bauxite mining companies leasing access to a single line to facilitate transport of fuel and products between the refineries and the ports. Since then, the Government of Jamaica through the Jamaica Railway Corporation (JRC) has explored several privatization options and joint venture arrangements to re-establish passenger and tourist services. To

[14] Tracks used by animals (horses or donkeys), typically for hauling carts or sacks. These were typically used for transporting agricultural produce in rural Caribbean in the past.

date however, none of these have borne fruit. As a result, coupled with the impact of hurricanes and other storms, the rail infrastructure, that is lines, station facilities, and equipment, except that which is used under lease, has fallen into disrepair.

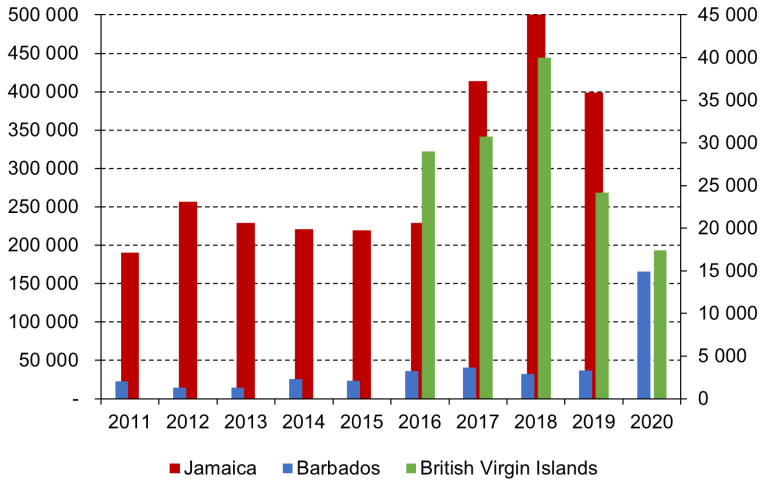
B. Motor vehicle imports

The Caribbean subregion has seen major growth in vehicle imports in recent decades. This is largely on account of significant increases in cheap reconditioned vehicles primarily from Asia. In 2020, the value of imported vehicles in Barbados was recorded at USD 14.9 million rising from 2 million in 2011.

For the British Virgin Islands motor vehicles imports totalled some 1,013 vehicles in 2010 rising to a total of 1363 in 2020. There was a significant spike in imports in 2018 with vehicles imported totalling 2,806 units twice the amount imported the previous years. This was likely a response to the damage done to vehicles by the 2017 hurricane. It is estimated that most vehicles in the country are less than 20 years old as a result. The value of import before 2016 was unavailable however imports in 2016 totalled some USD 29 million tapering off to 17 million in 2020.

The number of motor vehicle imports into Jamaica totalled 18,197 in 2012 rising to 28,239 in 2018. The corresponding value of imports over the period was approximately USD 190 million in 2011 rising to 397 million in 2019. Vehicle imports for the three case countries over the past decade are shown in figure A1.

Figure A1
Value of motor vehicle imports Barbados, British Virgin Islands and Jamaica, 2011–2022
(Dollars)



Source: Author's estimates, based on data from Country's Motor Vehicles and Statistical Departments.
Note: Figures for Barbados and British Virgin Islands (BVI) are on the right axis.

While data are unavailable for the other case countries, current estimates done to determine carbon emission of the Jamaica fleet suggest that the average age of a reconditioned vehicle imported into Jamaica is 3.6 years old. Vehicles are also kept for approximately 11.2 years giving an estimate of average vehicle life as 14.8 years. Coupled with a change in the import regulations that have reduced the age for vehicles to be imported for sale, Jamaica's current trade policy favours the importation of energy efficient vehicles with hybrids now attracting 39% duty and battery electric vehicles attracting a rate of 30%. This compares to internal combustion engine powered passenger cars for which aggregate duties range from 52-80% depending on engine size. This change in duties in Jamaica, implemented in April 2020, is expected to begin to nudge the local market towards vehicle electrification. With respect

to the overall transportation sector, the prevailing strategy seeks to discourage the importation of inefficient motor vehicles by linking the tax regime to mileage per gallon of vehicles and to promote energy conservation through implementation of carpooling, development of efficient public/urban mass transit transportation systems and encouraging nonmotorized transportation.

C. Vehicle energy consumption

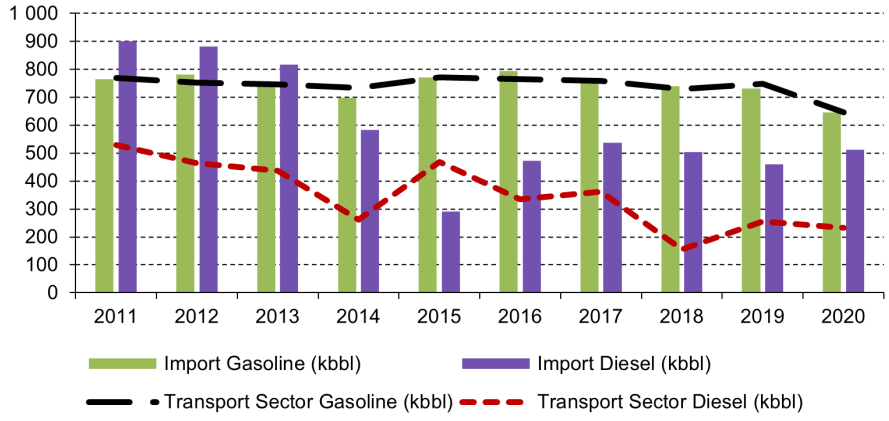
As noted above, the transportation sector in the Caribbean is powered almost exclusively by fossil energy either in the form of gasoline or diesel. With the exception of Trinidad and Tobago[15], most of this fuel is imported.

For Barbados, gasoline imports and usage levels in 2020 within the transport sector remained relatively consistent as the sector imported 646,522 barrels and consumed 644,991 barrels, with slight declines attributed to the global COVID pandemic (figure A2). On the other hand, diesel for vehicles approximated 231,492 barrels for the year. Between 2011 and 2021, the fuel import bill for the Barbados economy has shown significant decline, most of which reflects the movement in global fuel prices and, to a lesser extent, the downward trajectory of diesel quantities used. In 2020, Barbados' spending on fuel was approximately USD174.4 million.

With respect to the British Virgin Islands, petroleum importation in 2011 totaled 126,616 barrels (73,485 barrels of gasoline and 51,120 barrels of diesel). While petrol importation has remained fairly constant between 2014 and 2020, diesel importation has fallen significantly between 2016 and 2019 resulting in importation of only 31,950 barrels down from 57,510 in 2016 (figure A3).

In the case of Jamaica, the land transport sub-sector (road and rail) is the second largest consumer of petroleum, accounting for 28.24% of total consumption in 2011 and rising to 30.55% in 2020. This increase reflects the growing population of motor vehicles on the island over the same period. The data on consumption of automotive fuels show a decline in the consumption of diesel from 3.7 million barrels in 2011 to 1.3million barrels in 2020 (figure A4). Ultra-Low-Sulfur (ULSD) fuel, that is diesel with sulfur content is 15 parts per million or less, was introduced into the market in 2013 in an attempt to reduce particle emissions and improve motor vehicle efficiency.

Figure A2
Fuel imports and usage in the transportation sector: Barbados, 2011–2020

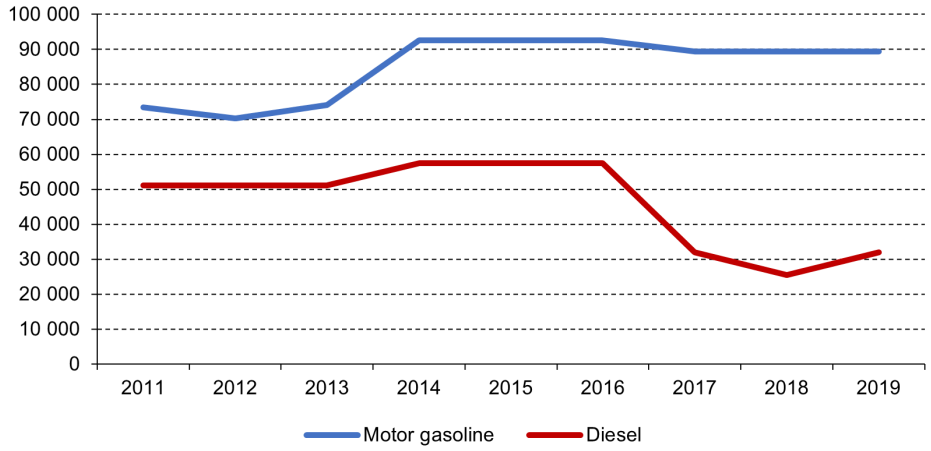


Source: Author's estimates, based on data from Country's Energy and Statistical Departments.

[15] Although Guyana has recently become a net energy exporter, it still lacks petroleum refining capability, and therefore continues to import motor vehicle fuels.

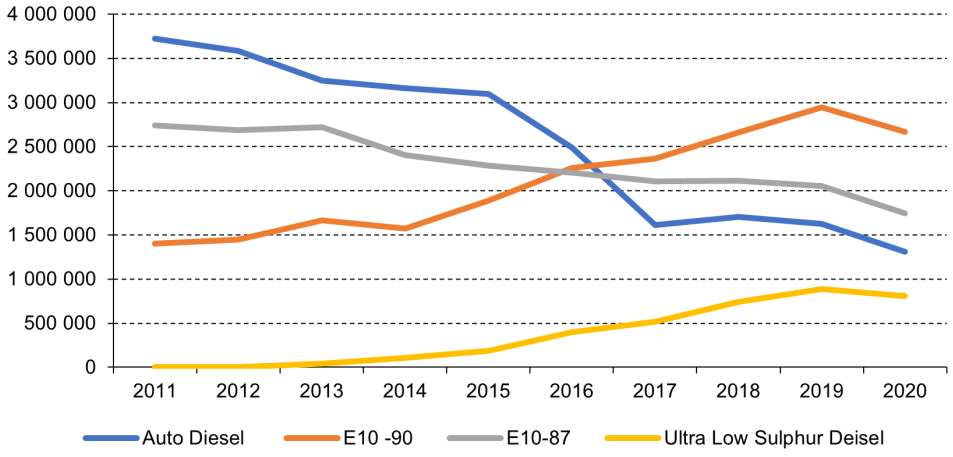
Based on the annual average retail price of fuel, total expenditure on fuel has fallen from USD1.6 billion in 2011 to USD799 million in 2017. Between 2017 and 2020, total expenditure rose to a maximum of USD1.427 billion before falling once more to approximately USD1.0 billion. Use of automotive diesel commanded the largest share of expenditure representing approximately 48% between 2011 and 2015 eventually declining to 21% in 2020. The use of higher octane fuel specifications such as E10-90 and E10-87 were also introduced into the fuel mix in 2011, and expenditure on such fuels also increased from 17% to 40% between 2011 and 2020. Figure A5 compares annual fuel import expenditures for Barbados and Jamaica[16] over the period 2011 – 2020.

Figure A3
Petroleum consumption: British Virgin Islands, 2011–2019
(Barrels)



Source: Author's estimates, based on data from Country's Energy and Statistical Departments.

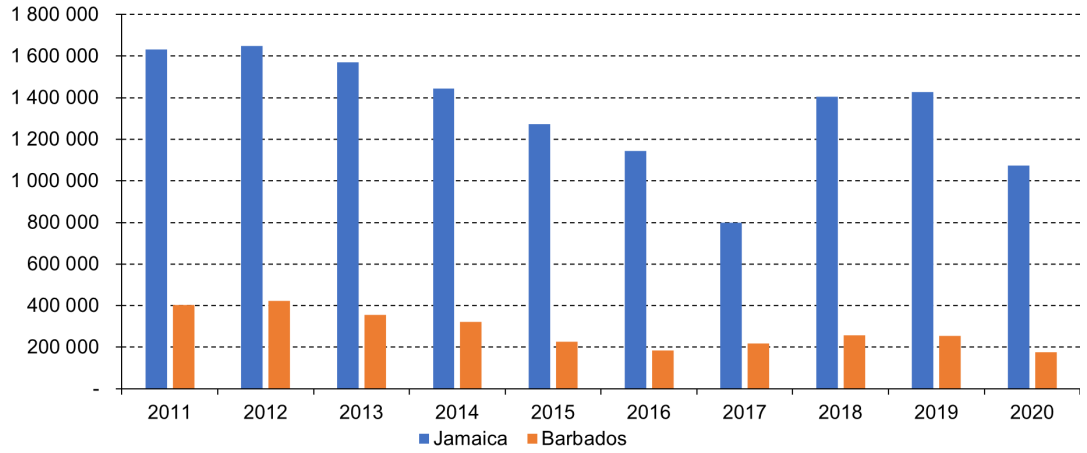
Figure A4
Petroleum consumption: Jamaica, 2011–2020
(Barrels)



Source: Author's estimates, based on data from Country's Energy and Statistical Departments.

[16] Figures unavailable for the BVI.

Figure A5
Annual fuel import bill: Barbados and Jamaica, 2011–2020
(US Dollars)



Source: Author's estimates, based on data from Country's Energy and Statistical Departments.

D. Public transportation

Public transportation is important to sustainable land transportation since it benefits from cost efficiency through higher passenger loads, while at the same time reducing congestion. These benefits are however only maximized under conditions of a concentrated commuting area with high reliability, safety, comfort and affordability. Within the Caribbean, public land transportation comprises a mix of fully publicly owned and operated bus services, which are complimented by privately operated taxis and mini-bus or paratransit services. Privately provided services typically function under regulatory authorities such as the national licensing and/or transportation authority which controls operator and vehicle licensing, management of passenger terminals as well as safety and fare setting structures for these services. In this sense, privately provided services form part of the public transportation infrastructure to the extent that vehicles, while privately owned, operate under the regulatory purview of the national transportation entity. In many Caribbean countries, the total public land transportation service is provided by privately owned buses and/or taxis. Additionally, the subregion's transportation system is often further supplemented by 'private for hire' taxi services which operate outside of the regulated framework. Such services typically provide public transportation to under-served communities which do not benefit from other forms of public land transportation. In some countries, the public transportation system also extends to the provision of school bus/taxi services, either through direct public services or under contracts with private service providers.

In Barbados, the Barbados Transport Board is a government-owned and funded public transportation system. In 2021, the Board owned and operated 165 buses, 35 of which are electric. These buses run on 88 specific bus routes and travel within specified times during the week. These arrangements notwithstanding, privately owned and operated mini-buses and route-taxis, otherwise known as ZRs comprise the majority of the services available to the travelling public. They however do not benefit from the subsidy that the Transport Board buses receive.

While there is no organized public transportation system in the British Virgin Islands, a private taxi service serves some locations, mainly along the flatter areas and connects the capital, Road Town with the Airport on Beef Island. Most of these taxis focus their operations on the tourism sector especially during the cruise ship season, when the island receives an average of two international cruise

ship arrivals per day. These same taxis support approximately sixty different schools in the country, providing student transportation during the school entry and exit hours. These arrangements ultimately result in a temporary gross reduction in the public transportation capacity during part of the day, and even during a part of the year.

Of the three territories, Jamaica has the most elaborate public transportation service since 75% of Jamaican households do not own a motor vehicle. In the Greater Kingston Metropolitan area which contains nearly a third of the country's population, public transportation is facilitated by a combination of government and private owned buses as well as taxis, (hackney carriages and route taxis). In the Kingston Metropolitan Transport Region (KMTR) which comprises Kingston and St Andrew, including Port Royal, St Catherine (Portmore and Spanish Town), the state-owned Jamaica Urban Transit Company (JUTC) has the exclusive right to provide transport services. Outstation services are also provided to destinations outside the KMTR such as Longville in Clarendon and Old Harbour in St. Catherine. This company, established in 1998, is an agency of the Ministry of Transport and Mining and services 122 routes with three different services levels. It provides public transportation to over 250,000 people daily across a network that stretches for 2,747 km. The company also provides tours and charter services to private citizens or companies for events. The bus route network includes 43 passenger terminals, 80 percent of which protect passengers from the elements with shelters in varying conditions. Bus stops are not established or managed by the Transport Authority nor the service provider. Approximately 855 bus shelters established by advertising companies dot the network. The level of design and quality of these shelters vary with some having posted signs indicating route information and schedules. Overall therefore, the taxi and bus industry forms a critical part of the transportation sector in Jamaica, with there being some 26,349 licensed Public Passenger Vehicles (PPV), excluding buses operated by the Government of Jamaica-owned company. The majority of these vehicles (21,097) were taxis and stage carriage vehicles, which are major modes of public transportation both in the urban and rural areas.

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