



## Promoting Low-carbon Electric Public Bus Transport in Mauritius

### Part I: Project Information

GEF ID

10372

Project Type

FSP

Type of Trust Fund

GET

CBIT/NGI

CBIT

NGI

Project Title

Promoting Low-carbon Electric Public Bus Transport in Mauritius

Countries

Mauritius

Agency(ies)

UNDP

Other Executing Partner(s)

Executing Partner Type

Ministry of Public Infrastructure and Land Transport (MPILT), Ministry of Energy and Public Utilities, National Transport Authority (NTA), National Transport Corporation Government (NTC), Traffic Management and Road Safety Unit (TMRSU), Private Bus Companies

**GEF Focal Area**

Climate Change

**Taxonomy**

Focal Areas, Influencing models, Stakeholders, Financing, Climate Change Mitigation, Climate Change, Sustainable Urban Systems and Transport, Renewable Energy, Technology Transfer, Demonstrate innovative approaches, Strengthen institutional capacity and decision-making, Transform policy and regulatory environments, Deploy innovative financial instruments, Local Communities, Civil Society, Private Sector, Gender Equality, Gender results areas, Gender Mainstreaming, Capacity, Knowledge and Research, Capacity Development, Learning, Enabling Activities, Knowledge Exchange

**Rio Markers****Climate Change Mitigation**

Climate Change Mitigation 2

**Climate Change Adaptation**

Climate Change Adaptation 0

**Duration**

60 In Months

**Agency Fee(\$)**

306,850

**Submission Date**

10/8/2019

## A. Indicative Focal/Non-Focal Area Elements

Programming Directions	Trust Fund	GEF Amount(\$)	Co-Fin Amount(\$)
CCM-1-2	GET	3,229,998	17,800,000
	<b>Total Project Cost (\$)</b>	<b>3,229,998</b>	<b>17,800,000</b>

## B. Indicative Project description summary

### Project Objective

Promote capital investments into developing sustainable transport infrastructure to reduce transport-related GHG emissions in Mauritius to mitigate climate change; engage and build technical capacities of transport-related policymakers, regulatory and other government agencies, financial institutions and the private sector.

Project Component	Financing Type	Project Outcomes	Project Outputs	Trust Fund	GEF Amount(\$)	Co-Fin Amount(\$)
1. Policy and regulatory framework for electric public (bus) transport in Mauritius	Technical Assistance	Favorable policy and regulatory framework and enabling environment is established for low-carbon, electric bus transport investments in Mauritius	<p>1. Designing and developing a long-term comprehensive 'Sustainable Low-carbon Transport Planning' document that provides with policy and regulatory framework for electric bus transport.</p> <p>2. Developing a comprehensive policy, regulatory and guidelines framework to enable e-bus deployment in Mauritius for public transport</p> <p>3. Feasibility studies and analysis that could potentially lead to the preparation of a GCF concept note to scale up low-carbon transport in Mauritius</p>	GET	106,189	350,000
2. Financial Incentive Package for electric buses and charging infrastructure	Investment	Financial subsidies, tax and other incentives for deployment of electric buses and associated solar charging infrastructure are established	1. Capital Subsidy scheme for electric buses (30 buses with upto 30-40% estimated capital subsidies – to be determined based on feasibility analysis) for both regular long routes and/or short loop feeder buses to provide last mile connectivity to and from MetroExpress stations and partial subsidy for Solar Charging stations.	GET	2,330,000	17,000,000

3. Technical Feasibility and Capacity Building	Technical Assistance	Establishment of technical and financial feasibility of deploying electric buses in Mauritius, and implementation of a comprehensive training and capacity building program on e-buses	<p>1. Economic and financial analysis and design of direct/indirect financial incentive scheme for e-buses and solar charging stations</p> <p>2. Identification of capacity gaps and training/capacity building activities that increase capacity of local institutions and stakeholders on electric mobility technology, business models and financing</p> <p>3. Improved knowledge among local stakeholders (MPILT, NTA, TMRSU, public and private bus operators) on suitable routes, risks, technical standards and operational issues of deployment of electric buses at scale</p>	GET	230,000	50,000
4. Awareness Raising to address barriers related to lack of awareness on benefits of low-carbon electric public transport	Technical Assistance	Increased awareness of benefits of clean, low-carbon public transport options in Mauritius, and benefits of using public transport, walking, cycling etc.	1. Increased awareness and sensitization among local population regarding the benefits of using public transport in general, and low-carbon electric mobility in particular	GET	160,000	150,000

5. 5. Knowledge Management, Monitoring and Evaluation	Technical Assistance	Knowledge acquired during the project, compiled and disseminated, M&E milestones implemented	1. Review of lessons learnt from other projects  2. Compilation of experience gathered in this project.  3. Strategic Communications plan  4. Mid-term and Terminal evaluations and annual project reports  5. Cooperation with UN Environment's GEF-funded Global E-Mobility program, including M&E for global program framework indicators, participation in global/regional e-mobility workshops/events, sharing of lessons learned and contribution to knowledge products	GET	250,000	50,000
<b>Sub Total (\$)</b>					<b>3,076,189</b>	<b>17,600,000</b>
<b>Project Management Cost (PMC)</b>						
					GET	200,000
					<b>Sub Total(\$)</b>	<b>200,000</b>
<b>Total Project Cost(\$)</b>					<b>3,229,998</b>	<b>17,800,000</b>

**C. Indicative sources of Co-financing for the Project by name and by type**

Sources of Co-financing	Name of Co-financier	Type of Co-financing	Investment Mobilized	Amount(\$)
Government	Metro Express Ltd	Public Investment	Investment mobilized	13,300,000
Government	NTC	Grant	Investment mobilized	3,000,000
Government	Ministry of Finance and Economic Development	Grant	Investment mobilized	1,000,000
Donor Agency	Green Climate Fund	Grant	Investment mobilized	300,000
Government	MPILT	In-kind	Recurrent expenditures	200,000
			<b>Total Project Cost(\$)</b>	<b>17,800,000</b>

**Describe how any "Investment Mobilized" was identified**

1) The total investment in the Mauritius island Metro Express project from Curepipe to Port Louis is estimated at USD 548 M in Mauritius. Of this sum, around USD 100 M will be spent during project implementation (2021 to 2025) and will concern the feeder bus routes. As a reasonable estimate, USD 13,300,000 M have been used as co-financing to the project. This co-financing will be ascribed to Component 2 entirely. 2) The National Transport Corporation has estimated its investment in new electric buses at around USD 3 M. This co-financing will be ascribed to Component 2 mainly and Component 3 and 4 as well. In the annual Budget for year 2019-2020, the Mauritian Government has included financial incentives estimated at USD 3 M per year available for new, including, electric buses as part of a partial grant per electric buses and this can be linked to discussions happening on the GEF project development. 3) The ministry of Finance and Economic development will also co-finance with Grants USD 1 M in the project. It is noteworthy that the item on electric buses is new in this year's Budget document. This co-financing is ascribed to Components 2, 3 and 5 as investment mobilized.

## D. Indicative Trust Fund Resources Requested by Agency(ies), Country(ies), Focal Area and the Programming of Funds

Agency	Trust Fund	Country	Focal Area	Programming of Funds	Amount(\$)	Fee(\$)	Total(\$)
UNDP	GET	Mauritius	Climate Change	CC STAR Allocation	3,229,998	306,850	3,536,848
<b>Total GEF Resources(\$)</b>					<b>3,229,998</b>	<b>306,850</b>	<b>3,536,848</b>

## E. Project Preparation Grant (PPG)

PPG Amount (\$)

100,000

PPG Agency Fee (\$)

9,500

Agency	Trust Fund	Country	Focal Area	Programming of Funds	Amount(\$)	Fee(\$)	Total(\$)
UNDP	GET	Mauritius	Climate Change	CC STAR Allocation	100,000	9,500	<b>109,500</b>
<b>Total Project Costs(\$)</b>					<b>100,000</b>	<b>9,500</b>	<b>109,500</b>

## Core Indicators

### Indicator 6 Greenhouse Gas Emissions Mitigated

Total Target Benefit	(At PIF)	(At CEO Endorsement)	(Achieved at MTR)	(Achieved at TE)
Expected metric tons of CO <sub>2</sub> e (direct)	10950	0	0	0
Expected metric tons of CO <sub>2</sub> e (indirect)	18250	0	0	0

### Indicator 6.1 Carbon Sequestered or Emissions Avoided in the AFOLU (Agriculture, Forestry and Other Land Use) sector

Total Target Benefit	(At PIF)	(At CEO Endorsement)	(Achieved at MTR)	(Achieved at TE)
Expected metric tons of CO <sub>2</sub> e (direct)				
Expected metric tons of CO <sub>2</sub> e (indirect)				
Anticipated start year of accounting				
Duration of accounting				

### Indicator 6.2 Emissions Avoided Outside AFOLU (Agriculture, Forestry and Other Land Use) Sector

Total Target Benefit	(At PIF)	(At CEO Endorsement)	(Achieved at MTR)	(Achieved at TE)
Expected metric tons of CO <sub>2</sub> e (direct)	10,950			
Expected metric tons of CO <sub>2</sub> e (indirect)	18,250			
Anticipated start year of accounting				
Duration of accounting				

Indicator 6.3 Energy Saved (Use this sub-indicator in addition to the sub-indicator 6.2 if applicable)

Total Target Benefit	Energy (MJ) (At PIF)	Energy (MJ) (At CEO Endorsement)	Energy (MJ) (Achieved at MTR)	Energy (MJ) (Achieved at TE)
Target Energy Saved (MJ)				

Indicator 6.4 Increase in Installed Renewable Energy Capacity per Technology (Use this sub-indicator in addition to the sub-indicator 6.2 if applicable)

Technology	Capacity (MW) (Expected at PIF)	Capacity (MW) (Expected at CEO Endorsement)	Capacity (MW) (Achieved at MTR)	Capacity (MW) (Achieved at TE)
Solar Photovoltaic	0.50			



## Indicator 11 Number of direct beneficiaries disaggregated by gender as co-benefit of GEF investment

	Number (Expected at PIF)	Number (Expected at CEO Endorsement)	Number (Achieved at MTR)	Number (Achieved at TE)
<b>Female</b>	5,000			
<b>Male</b>	5,000			
<b>Total</b>	10000	0	0	0

Provide additional explanation on targets, other methodologies used, and other focal area specifics (i.e., Aichi targets in BD) including justification where core indicator targets are not provided

This proposed GEF project proposes to facilitate the switch of 30 long route or feeder/last-mile diesel buses into electric semi-low floor models. An average diesel bus is estimated to emit about 1 kg of CO<sub>2</sub>e per km travelled (conservative estimate after accounting for a grid emission factor of 1.017 tCO<sub>2</sub>/MWh for Mauritius). It is important to note that UNEP estimates that each electric bus reduces ~1.7 kg of CO<sub>2</sub> emissions per km of operation, when compared to a diesel bus of similar specifications. However, CO<sub>2</sub> emission reductions of this proposed project have been estimated using a more conservative 1 kg CO<sub>2</sub> per km of e-bus operation due to: (i) grid emission factor of Mauritius currently being high (1.017 tCO<sub>2</sub>/MWh) and an assumption that the 30 buses to be deployed under this proposed project are likely to be charged by a combination of solar energy and grid electricity; (ii) some or all of the 30 buses to be deployed under this proposed project could be smaller mini e-buses (for last mile connectivity from Metro Express stations), which are likely to achieve lesser CO<sub>2</sub> emission reduction when compared to full-sized e-buses. Assuming a combination of solar powered and grid electricity powered charging is used for charging the 30 feeder e-buses to be used in Mauritius, which, when deployed, are estimated to operate for about 100 km per day, each e-bus is estimated to reduce atleast 36.5 tons of CO<sub>2</sub>e per annum. So 30 buses would achieve direct GHG benefits of ~10,950 tCO<sub>2</sub>e by 2030. More detailed analysis of CO<sub>2</sub> emission reduction from this proposed project's activities will be conducted during project preparatory phase, and analysis will be included in the detailed Project Document to be submitted for CEO ER. Indirect GHG benefits are calculated based on a conservative assumption that after the completion of this project's implementation, it would be scaled-up to 100 additional e-buses for public transport in Mauritius over 5 years between 2026 and 2030. At the same conservative assumptions of 1 kg of CO<sub>2</sub>e per km of e-bus operation and average of 100 km per day of e-bus operation for the additional 100 buses between 2026 and 2030, indirect GHG emission reductions from this project are estimated to be 18,250 tCO<sub>2</sub>e by 2030. In terms of number of passenger-trips impacted, based on conservative estimates of 30-35 passengers carried by each bus per last-mile trip from Metro Express stations to neighborhoods, and assuming each trip to cover 10 km distance; and based on an estimation of 100 km covered by each bus per day, each e-bus is estimated to offer ~350 passenger-trips every day. So 30 buses are conservatively estimated to offer ~10,000 passenger trips per day (which is 12.5% of the estimated 80,000 passenger trips per day likely to be offered by MetroExpress once its is fully operational). This works out to ~3.65 Million passenger-trips per annum to be provided by electric bus services that will be deployed with support from this GEF project, when all 30 buses are fully deployed and operational. Provide additional explanation on targets, other methodologies used, and other focal area specifics (i.e., Aichi targets in BD) including justification where core indicators targets are not provided

## Part II. Project Justification

### 1a. Project Description

#### 1) The Global Environmental and/or Adaptation Problems, Root Causes and Barriers that need to be Addressed (Systems Description)

##### *Climate Change in Small Island Developing States (SIDS)*

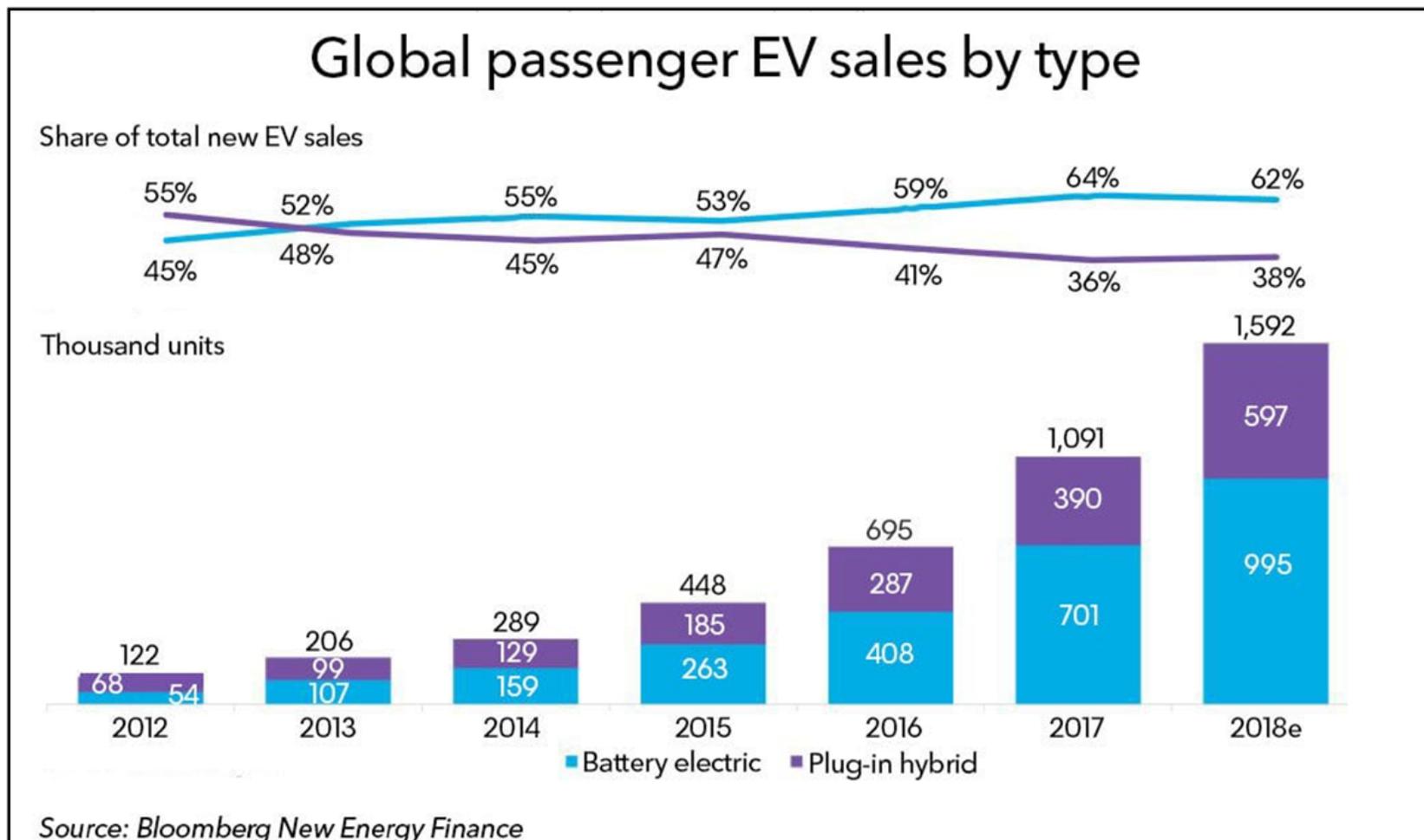
Small Island Developing States (SIDS), comprising 38 island UN member countries spread across Indian Ocean, Atlantic Ocean, Pacific Ocean, Caribbean and Mediterranean Sea, contributed less than 1% of global greenhouse gas (GHG) emissions as of 2015 but have been and continue to be among the earliest and most climate change affected countries in the world, according to a UN-OHRLS report on SIDS published in 2015. SIDS climate is affected by large ocean-atmospheric interactions such as El-Nino, trade winds and tropical cyclones. And since population, agricultural land and critical infrastructure in SIDS tend to be concentrated in coastal areas, any sea level rise due to climate change disproportionately affects socio-economic activities and GDP of SIDS. A substantial proportion of SIDS' GDP is derived from climate and weather-sensitive activities, such as agriculture, fishing, tourism, and climate change threatens their livelihoods and socio-economic wellbeing. This makes SIDS countries highly vulnerable to the impacts of climate change on the water and natural resource sectors. SIDS unique socio-economic vulnerabilities, such as their narrow resource/GDP base, remoteness from markets and limited ability to benefit from economies of scale, and adverse effects of climate change impose enormous additional economic burden on SIDS governments, which have struggled to raise funds for climate change mitigation and adaptation measures and for projects that promise to reduce GHG emissions in these countries.

##### **Global Innovations in Low-carbon Transport**

Globally, innovations and efficiency improvements in transport technology and business models for bus transport have been driving deployment of low-carbon, smart transport solutions, such as electric bus transport, in both developed countries such as Europe, Japan, Korea and developing countries such as China, India, and the South Africa. Bringing such innovative, smart, low-carbon bus technologies and business models to a Small Island Developing State (SIDS) such as Mauritius is critical, considering the economy's reliance on imported fossil fuels, a need to achieve energy security and the country's vulnerability to climate change.

Many cities and urban agglomerations in both developed and developing countries have been rapidly adopting low-carbon bus transport options in recent years, with a large number of them adopting 100% electric bus transport instead of hybrid buses that were being considered earlier. Rapid fall in prices of Lithium-ion (Li-ion) batteries have made electric buses relatively more affordable than 5 years ago, and continued price reduction would drive large-scale adoption of electric vehicles and electric buses by 2025 and beyond. According to research by Bloomberg New Energy Finance (BNEF), in 2010, Li-ion battery packs were estimated to cost US\$1,000 per kWh, while in 2017 prices had fallen to just US\$209 per kWh. By 2030, BNEF predicts a US\$70 per kW price, while a few others predict battery prices will fall to US\$70/kWh by 2025 itself.

Large-scale improvements in battery technology efficiencies and economies of scale due to increased adoption of electric vehicles are driving this cost reduction and affordability of electric vehicles globally, with emerging markets such as China leading the way, apart from countries such as Norway and Sweden. Sales of electric vehicles globally were estimated to be nearly 1.6 Million units in 2018, up from 1.1 Million units in 2017. Battery electric vehicles accounting for 62% of all new EV sales and plug-in hybrid electric accounting for 38%, as shown in the BNEF chart below. According to BNEF, global EV sales are expected to reach 11 Million units per annum by 2025, and 30 Million units per annum by 2030.



According to BNEF research, electric buses (e-buses) are expected to be a significant portion of global EV sales, with adoption of electric buses expected to be faster than EV cars and other heavy vehicles in many developing countries, particularly in those countries that import most of their fossil fuel requirements, considering the large amounts of fossil fuels consumed by buses (mostly diesel, which is more polluting than gasoline that is typically used in passenger cars). According to BNEF research, there were an estimated 385,000 e-buses operational around the world in 2017, with Chinese cities accounting for over 99% of these buses.

The city of Shenzhen in China, an electronics manufacturing and technology hub, started replacing its diesel-powered public transport buses in 2011, and as of December 2017, all of the city's public transport buses – over 16,000 buses – are electric. For every 1,000 battery-powered e-buses on the road, about 500 barrels a day of diesel fuel will be displaced from the market, according to BNEF calculations. Many other Chinese cities including Beijing and Shanghai are

deploying e-buses in their public transport fleet rapidly. Significant reduction in air pollution, carbon emissions and improvement in air quality in Shenzhen has been observed since the large-scale deployment of e-buses. Cities such as Paris, London, Mexico City and Los Angeles have committed to deploying 100% zero emissions public transport by 2025, whereas cities in India such as New Delhi, Mumbai, Bangalore, Pune and Ahmedabad have started inducting e-buses into their fleets since 2017 under a government incentive program for e-bus leasing.

Falling battery prices and economies of scale are driving sales of e-buses. According to BNEF research, smaller e-buses (110 kWh battery with slow charging) that are required to run for about 90-100 km per day are already cost-competitive vis-à-vis diesel buses on a Total Cost of Ownership (TCO) basis. Larger e-buses such as 250 kWh and 350 kWh e-buses with slow charging are cost competitive vis-à-vis diesel buses at a daily operations of about 120 km and 220 km per day on a TCO basis.

Essentially, e-buses cost at least 50% more upfront than a comparable diesel bus in most countries, but their operational cost efficiencies make e-buses cheaper on a TCO basis over an 8-10 year period. However, considering the high upfront costs of e-buses, government incentives are necessary for e-buses to be cost competitive against diesel buses. For example, the following table shows cost and TCO comparison for a 40-seater diesel bus and a comparable electric bus in India, which is computed for an e-bus introduction program in the city of Navi Mumbai in 2018. The e-bus has a lower TCO than the diesel bus primarily due to the USD 119,000 government incentive (~49% of upfront cost) offered by the Government of India under its Faster Adoption and Manufacturing of Electric (FAME) Vehicles policy and program.

**Table 4. Total cost of ownership elements (USD)**

<b>Cost Element</b>	<b>Cost (USD)-AC VOLVO Diesel Bus</b>	<b>Cost (USD)-Goldstone Electric Bus</b>
Basic price (Inc. Taxes)	112000	245272
Government Incentive	0	119000
Net Price	112000	126272
MV Taxes	14560	0
Insurance	2255	4938
Interest	22596	49484
Schedule maintenance	115601	57801
Battery replacement cost	0	36883
Fuel oil (Diesel, Electricity)	374532	198601
Infrastructure cost	0	53623
Lube oil	1918	0
Staff cost	254078	254078
<b>Sub Total</b>	<b>897540</b>	<b>781681</b>
Miscellaneous and unaccounted costs (1%)	8975	7817
<b>Total Cost of Operation (TCO)</b>	<b>906516</b>	<b>789497</b>
<b>TCO per km (\$)</b>	<b>1.092</b>	<b>0.951</b>

Hence, government incentives and subsidies (upto 50% of upfront costs) are necessary for e-buses to be cost competitive against diesel buses in most countries including Mauritius, atleast for the next 3-4 years when battery costs would further come down due to economies of scale and make subsidies and incentives for e-buses not necessary.

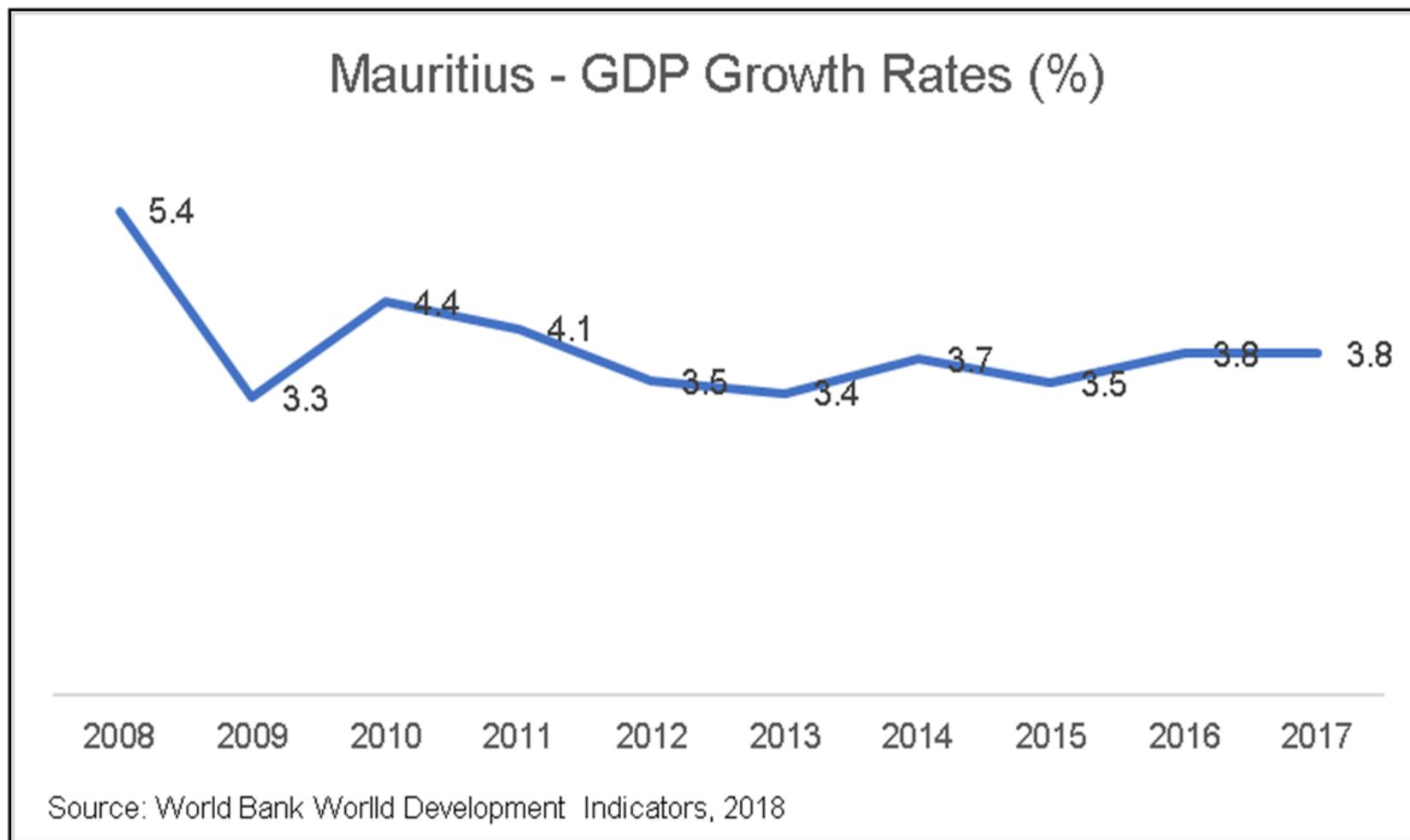
*Republic of Mauritius: Geography, Population, Economy*

The Republic of Mauritius is a SIDS country located in South West Indian Ocean, and comprises a group of islands namely the main Mauritius island and outer islands of Rodrigues, Agalega, Saint Brandon, Tromelin, and the Chagos Archipelago. The country's land area is mostly a volcanic formation and is almost entirely surrounded by coral reefs. The country's climate is characterised by tropical trade winds, and hot, rainy summer seasons. Mauritius is affected by anti-cyclones during the dry winter and cyclones during the rainy summer season.

The total land area of the Republic of Mauritius is estimated to be about 2040 square km, and the country has jurisdiction over an Exclusive Economic Area of approximately 2.3 million sq km, and its coastline runs for an estimated 175 km. According to the Government of Mauritius' data, the estimated resident population of the Republic of Mauritius was 1,265,309 as at 31 December 2017. The female population was 639,221 compared to a male population of 626,088. There were 97.9 males for every 100 females. Population growth rate in Mauritius during the period 2010 to 2016 was 0.2%, which is lower than worldwide population growth rate of 1.1%.

Mauritius had a population density of 620 persons per sq km as of end-2017, which is one of the highest in the world. Among its constituent islands, the main island of Mauritius had the highest population density (654), compared to 389 for the outer island of Rodrigues. Although Mauritius' population density is lower than other island countries such as Singapore (7916), Hong Kong (7040), and Maldives (1454), its density is higher than most other countries in Africa and Asia, such as Seychelles (208), India (450), Sri Lanka (342), UAE (112) and Madagascar (44).

Since independence in 1968, Mauritius has developed from a low-income country that was largely dependent on agriculture to an upper middle-income diversified economy with growing industrial, financial, tourism, and Information and Communication Technology (ICT) sectors. Between 1977 and 2008, GDP growth in Mauritius averaged 4.7%, as compared to a 2.9% average in Sub-Saharan Africa. Since 2008, GDP growth has continued to be good, averaging nearly 3.9%. Mauritius has a life expectancy of 73 years at birth and an HDI score of 0.777, which is considered high, and is higher than the 0.47 average in Sub-Saharan Africa.



#### *Republic of Mauritius: GHG Emissions in Energy and Transport Sectors*

Mauritius is heavily reliant on fossil fuels to power its economy. The grid emission factor of Mauritius is considered high at 1.01 tonnes CO<sub>2</sub> per MWh, since coal (43%) and fuel oil (37%) are the two main sources of electricity generation in the country. Moreover, both coal and fuel oil are imported fuel sources, thereby affecting the country's energy security. Hence, switching renewable sources of energy and low emission transport in a significant way could enhance the country's energy security, while also reducing its carbon emissions.

An estimated 43% of Mauritius' population lives in urban areas, and much of these urban areas are located in the North West of the main Mauritius island. The capital city of Port Louis, the tourism hotspot of Grand Baie, and other major urban centres such as Rose Hill, Quatre Bornes, Vacoas/Phoenix and Curepipe have higher population density than national average and are already quite congested in terms of vehicular traffic, accounting for a large portion of vehicular population and transport-related CO2 emissions in the country.

The Government of Mauritius has recognized the importance of incorporating low-carbon energy and transport sector development strategies in its national development planning, to enhance energy security, reduce carbon emissions and mitigate the impacts of climate change. The Second National Communication to the UNFCCC (2010) notes that Mauritius's overall greenhouse gas (GHG) emissions are growing at a rate of 3% per annum. But GHG emissions from the country's energy and transport sectors were growing at a higher rate, at 5.4% and 3.3% per annum respectively. Together, the energy and transport sectors account for 86% of Mauritius's total GHG emissions. As identified by the country's UNFCCC Technology Needs Assessment (2012), clean energy, specifically solar energy, and low-carbon transport systems offer significant GHG emission reduction potential in Mauritius. Given Mauritius' large sugarcane industry, bagasse-based co-generation of electricity, a renewable source of electricity generation, already accounts for 16% of Mauritian electricity generation mix. But bagasse-based co-generation capacity is difficult to scale due to land availability constraints and seasonal availability of bagasse.

In 2019, Mauritius adopted the new Renewable Energy Roadmap 2030 which sets out how the country will achieve its targets set out in the NDC and notes that Mauritius is still about 79% dependent on fossil fuels for electricity generation. In view of upcoming developmental changes, increasing energy demand and evolution in the energy market, the country is aiming to enhance its energy security and reduce its greenhouse gas (GHG) emissions. In 2025, solar PV energy is expected to contribute to about 10% of electricity production nationally. Other sources will include onshore wind, bagasse from the sugar industry, landfill gas, hydro and waste to energy. To support the increased reliance on renewable energy, the ongoing GCF funded project entitled "Accelerating the transformational shift to a low carbon economy" is helping Government in acquiring Battery Energy Storage Systems which will buffer the intermittency arising from the increased penetration of solar and wind power. It is important to consider that if the transport sector which is fossil fuel powered were simply to transition to electric modality without the grid also becoming greener, then the aim of decarbonisation would not be achieved. Hence, by coupling the introduction of e-buses with solar powered charging stations, the aim is to also trigger the decarbonisation of the transport sector.

## **2) The Baseline Scenario and any Associated Baseline Projects**

### ***Baseline Scenario: Road Transport in Mauritius***

Road transport is the most important mode of transport in Mauritius. Rail transport currently doesn't exist in the country, although a light rail project (Metro Express) is currently under construction. The country currently has an existing road transport network of over 2000 kilometres, of which nearly 50% are classified as main/primary roads, 29% are secondary roads, 3.6% as motorways. The motorway network consists of 3 main motorways/freeways:

1. M1 (Port Louis – Plaisance Dual Carriageway) which runs from Port-Louis to the International Airport, also connecting the urban centres of Beau Bassin-Rose Hill, Quatre Bornes, Vacoas-Phoenix and Curepipe. Its length is 47 kilometres, and it is the most important motorway in the island

2. M2 (Port Louis-Sottise Dual Carriageway), which runs from Port-Louis to the tourism hotspot of Grand Baie in the North; its length is 23 kilometres.
3. M3 (Terre Rouge-Verdun Link Road) which bypasses Port Louis

The main road network infrastructure upgradation work that is currently ongoing are (i) grade separated junctions at Pont Fer/Jumbo/Dowlut roundabouts, (ii) A1-A3 Link Road to connect Port Louis-St Jean Road (A1) to Black River Road (A3), and (iii) the A1-M1 Link Road to connect Port Louis-St Jean Road (A1) to M1 motorway. These three projects form part of the government's Road Decongestion Programme, which together with the upcoming Metro Express project, constitute the National Integrated Transport Network Project. The overall aim is to provide an effective and efficient road network to support the socio-economic development of Mauritius by improving the fluidity of traffic to reduce congestion time; decreasing accidents by improving road safety; and enhancing the level of service to road users through the provision of high quality infrastructure.

At end of December 2017, 531,797 vehicles were registered with the government's National Transport Authority (NTA), compared to 507,676 at the end of December 2016, a net increase of 4.8%. The national vehicular fleet consisted mostly of cars, double cab pickup and dual-purpose vehicles (272,213 or 51%) and motorized two-wheelers (205,493 or 39%). The remaining 10% comprised vans, lorries, trucks, buses and other vehicles.

While population growth rate in Mauritius is low, rapid economic growth over the last decade has driven sales of private vehicles. Registration of private vehicles has grown at a high average growth rate of 5.1% between 2008 and 2017. Growth in road infrastructure in Mauritius is unable to keep up with this pace of increase in private transport, leading to severe traffic congestion on the streets of Port Louis and other urban centres such as Rose Hill, Quatre Bornes, Vacoas-Phoenix and Curepipe – with average speeds being as low at 12 to 18 kmph during peak hours. Currently transport accounts for 15% of annual household spending, but this is gradually increasing. Data from the government's health records show high occurrence of lifestyle diseases such as diabetes and cardiovascular problems, which are indicative of lack of physical activity, which typically happens when cycling, walking and public transport infrastructure is inadequate.

The number of road traffic accidents increased by 1.2% from 29,277 in 2016 to 29,627 in 2017. Among these accidents, 152 were fatal (caused death) against 132 in the preceding year, up by 15.2%. Accident rate, (number of accidents per 100,000 mid-year population) is estimated to be 2,425 in 2017, which is higher than the 2016 figure of 2,397. This rate is also considered to be relatively high when compared to other countries in Sub-Saharan Africa

### ***Bus Transport in Mauritius***

Buses are the principal form of public transport in Mauritius and both public transport and private transport buses account for about 7% of the country's entire vehicle fleet. Over 60% of the population uses buses at least once a week, with many passengers using them daily for commuting purposes. The public transport bus fleet carries an estimated 600,000-700,000 people every day and travels over 140 million km each year, making it a key lifeline for the Mauritian population and economy.

However, as highlighted by the Mauritius Transport Consensus Forums , the bus fleet (consisting of 2034 buses as of March 2018) is becoming increasingly antiquated and bus operators are struggling to pay for fleet renewal costs. One-third of the bus fleet is over 10 years old and over one-quarter is approaching (or exceeding) 16 years of age. The bus fleet is fuel-inefficient, polluting, uncomfortable and often unsanitary, and unsuitable for use by physically challenged and elderly commuters.

There are about 2034 public transport buses operating in Mauritius as of mid-2018, under Road Service License, which should typically be enough for the current population and for the tourist inflow in Mauritius. Buses are operated by private operators – 5 main organized bus companies (1 government-owned company National Transport Corporation (NTC), and 4 private bus operators), and a large number of individual bus operators – under a contract and fares fixed by the government. Number of buses operated by the various bus operators in Mauritius are as shown in the table below.



<b>Bus Operator</b>	<b>Number of Buses in its Fleet (as of mid-2018)</b>
National Transport Corporation (NTC)	557
United Bus Service (UBS)	336
Triolet Bus Service (TBS)	204
Rose Hill Transport (RHT)	100
Mauritian Bus Transport (MBT)	33
Individual Bus Operators	804
<b>Total</b>	<b>2034</b>

Public transport bus fares are set by the National Transport Authority (NTA) and fares were last revised in August 2013. Fares are relatively low, and exemptions and subsidies exist to various types of commuters including students, old age and disabled commuters. Prevailing public bus transport fares are as shown in the table below.

<b>Public Bus Commuter Category</b>	<b>Fare per Trip</b>
Adults	Ranges from MUR 12 to 37 (US\$ 0.33 to US\$ 1) Median fare of MUR 20 (US\$ 0.55) per trip for shorter/rural routes Median fare of MUR 34 (US\$ 0.93) per trip for longer/urban routes
Children	Ranges from MUR 7 to 19 (US\$ 0.2 to US\$ 0.52) Median fare of MUR 11 (US\$ 0.3) per trip for shorter/rural routes Median fare of MUR 18 (US\$ 0.5) per trip for longer/urban routes
Students	Ranges from MUR 12 to 33 (US\$0.33 to US\$ 0.92) Median fare of MUR 14 (US\$ 0.38) per trip for shorter/rural routes Median fare of MUR 20 (US\$ 0.55) per trip for longer/urban routes

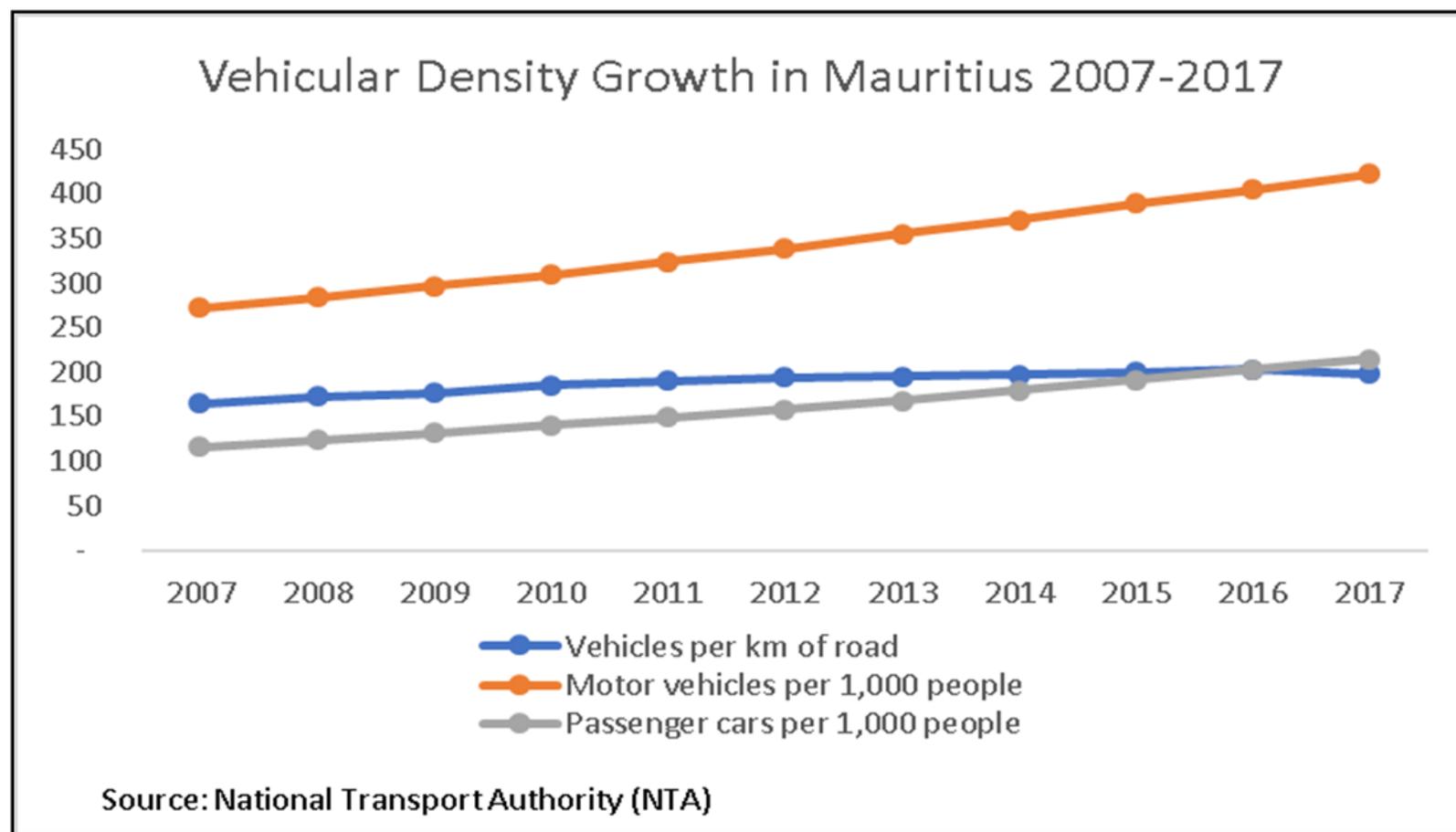
Additional subsidies from the government are offered to bus operators that operate on 'social routes' – routes that are frequented by school children and old age people (OAP). Government-owned operator, NTC, operates most of these social routes, and receives a fixed amount every month as subsidy payment, irrespective of number of student/school children/OAP commuters using these services. The fixed subsidy amount hasn't been revised for a few years, and hence most social routes are loss-making routes for NTC and other bus operators.

The key issues and challenges affecting the transformation of road transport infrastructure in Mauritius into a modern, efficient, low-carbon infrastructure accessible for all, are:

#### *Increased Use of Private Vehicles*

As explained earlier, while average annual population growth in Mauritius is low at about 0.2%, registration of vehicles has grown at a higher annual growth rate of 5.1% between December 2008 and December 2017.[1] Registration of private vehicles is growing at an even higher rate – registration of cars has grown by an average annual rate of 10% between December 2008 and December 2017, whereas registration of two-wheeler motorcycles has grown by an average annual rate of 11.7% in the same period. Growth in length of motorways and main roads has not kept pace with this vehicular growth, with length of motorways growing only by 3.3% per annum and length of main roads growing by just 2.4% in the same period.

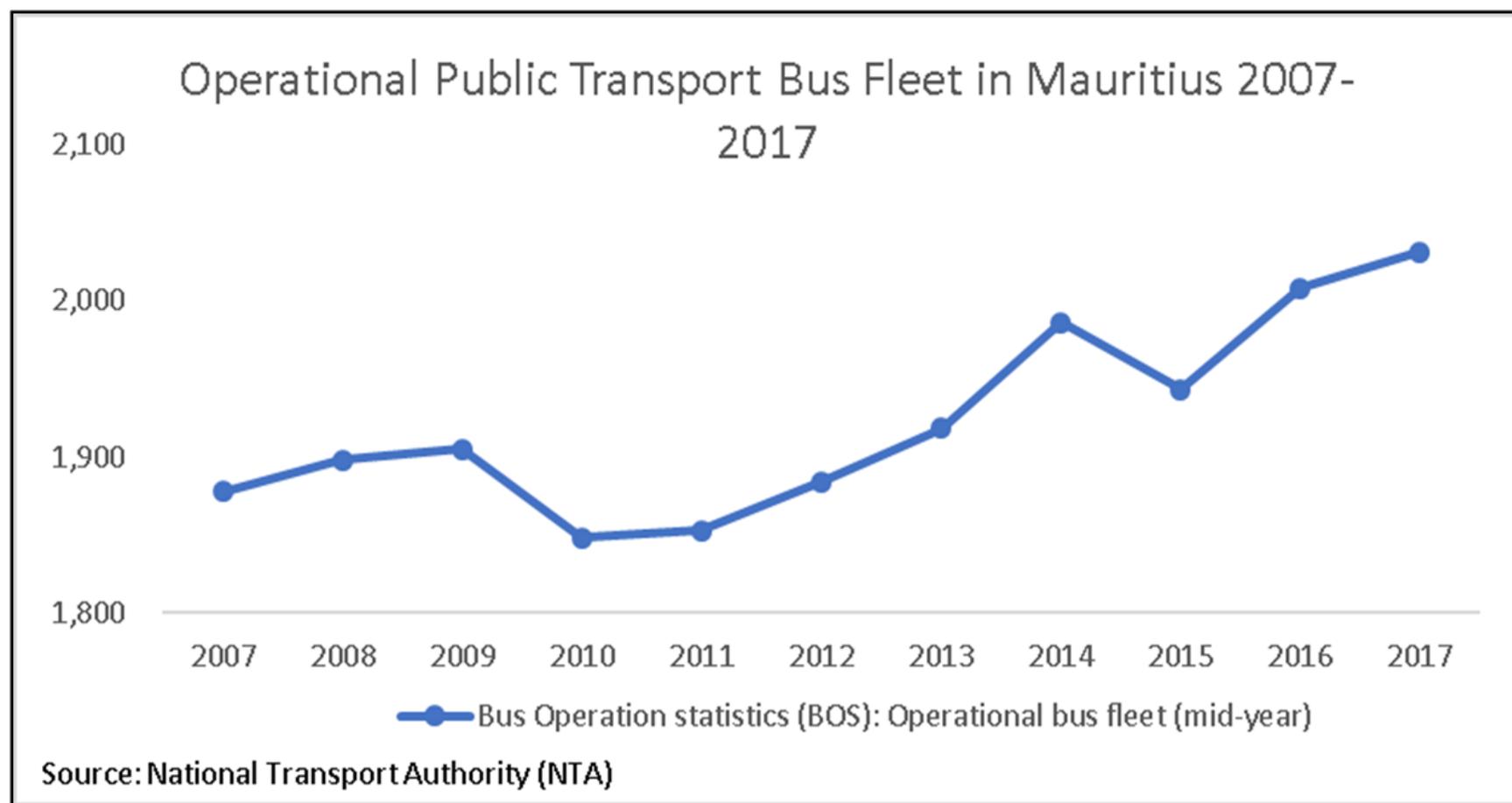
Vehicles per kilometer of road has increased from 173 in December 2008 to 198 in December 2017, while motor vehicles per 1000 population has increased from 284 in December 2008 to 423 in December 2017. Passenger cars per 1000 population has grown by over 73% in the same period, from 124 in December 2008 to 215 in December 2017, as shown in the figure below. This has led to severe traffic congestion on the streets of Port Louis – with average speeds being as low as 12 to 18 kmph during peak hours.



[1] Source: National Transport Authority (NTA), Government of Mauritius

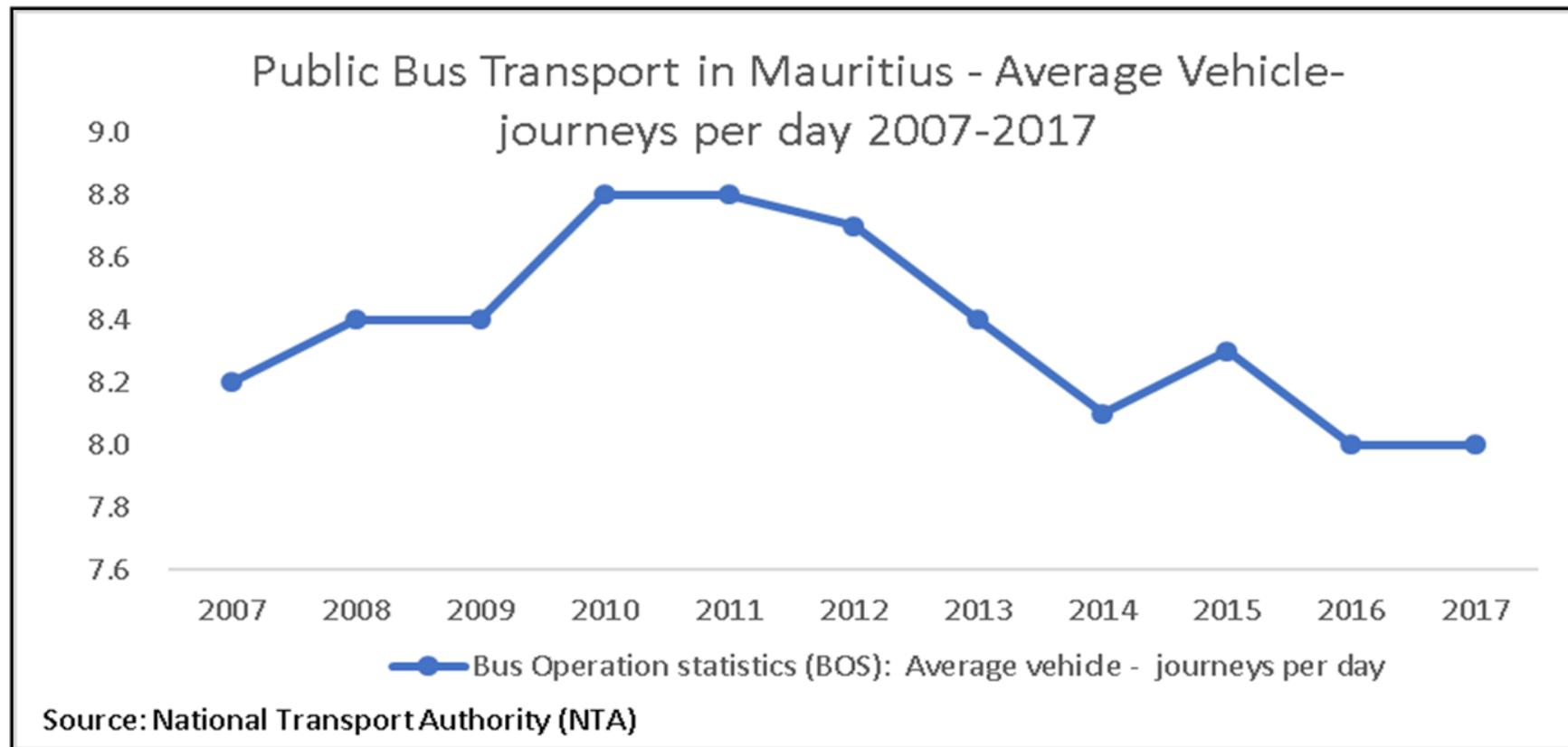
### *Lack of a Modern, Efficient, Low-carbon Public Transport System*

Growing use of private transport and increased accidents are indicative of an inadequate public transport system in Mauritius. There were 3101 buses registered in Mauritius as of December 2017, out of which 2034 buses were operating as public transport buses under the Road Service License on the island, which is only marginally increased from 1878 buses in 2007, registering an annual growth rate of 0.8%, as shown in the chart below.



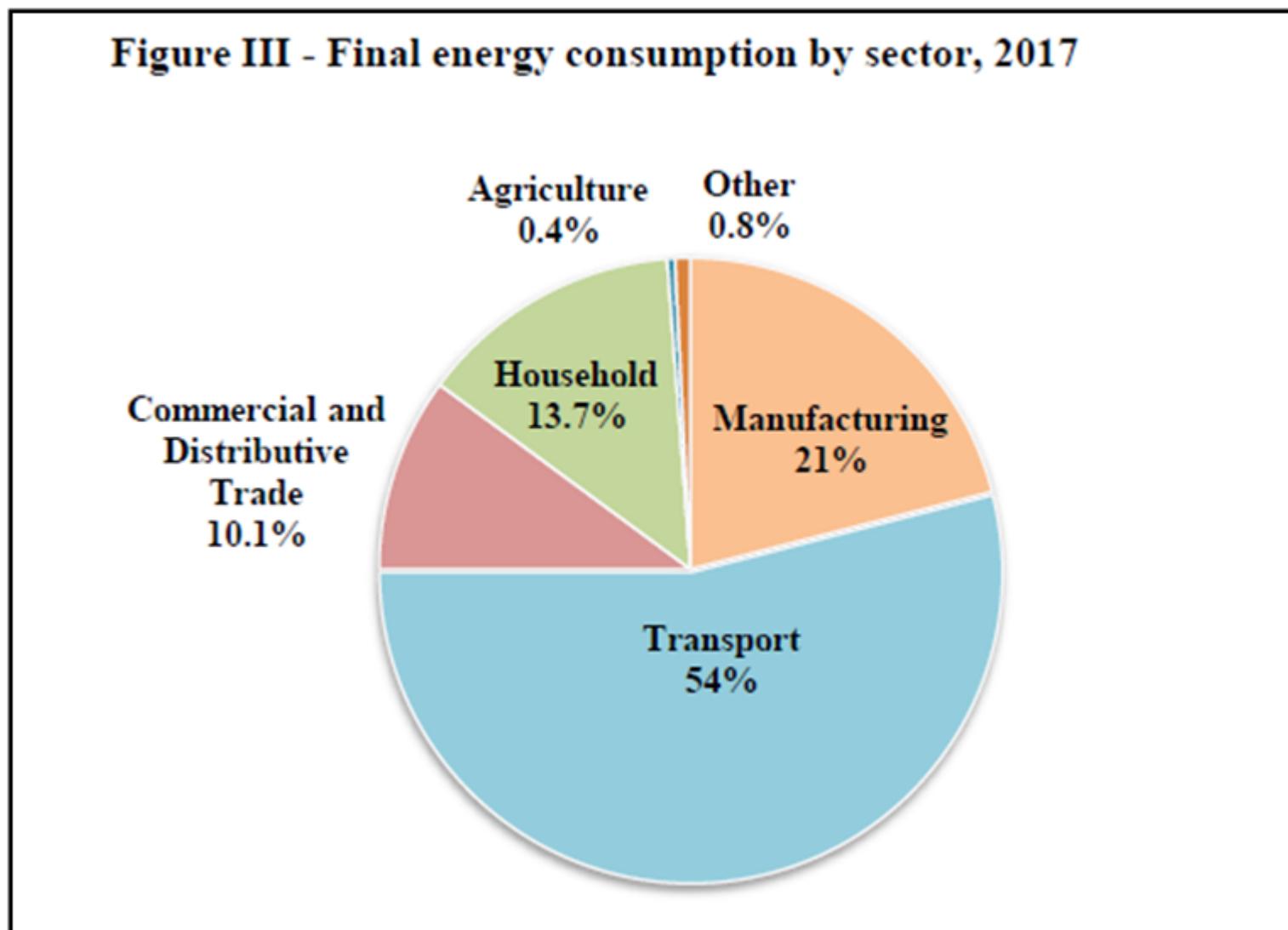
Buses are operated by private operators under a contract and fares fixed by the government. However, the quality of the bus services seems inadequate to prevent people from choosing private modes of transport. Improvement of public transport and non-motorised transport choices is the key to reversing the trend of increasing travel times and GHG emissions from the transport sector in Mauritius. With few exceptions, bus bodies are constructed locally on chassis imported by motor vehicle dealers. Conventional chassis are used for this purpose, without any consideration of engine capacity, fuel efficiency or emissions standards. The result is a bus fleet that is considerably less fuel-efficient than it ought to be, consuming 13.4% of national fuel consumption per annum (43 ktoe of 319 ktoe), despite accounting for only 7% of vehicles on the road.

This lack of modern and comfortable public bus transport system has resulted in usage of public bus transport services in Mauritius remaining nearly constant or marginally lower between 2007 and 2017, despite growing transport demand, as shown in the below charts. At the same time, sales and use of private vehicles has gone up (as described above), indicating a steady shift towards private vehicles based personal transport, which is unsustainable both in terms of managing traffic congestion and air pollution, and increased economic burden due to the need to import more fossil fuels such as gasoline and diesel.



*Rapidly Growing Energy Consumption by Transport Sector*

As per data from the Government of Mauritius[2], transport sector is, by far, the largest consumer of primary energy in Mauritius, accounting for 54% of all energy consumed in Mauritius in 2017.



[2] Source: Statistics Mauritius

Total final energy consumption by transport sector went up by 4.7% from 506 ktoe in 2016 to 530 ktoe in 2017, whereas consumption of fuel for land transport increased by 3.4% from 349 ktoe to 361 ktoe in the same period. This growth in energy consumption by transport sector has necessitated increased imports of fossil fuels such as gasoline and diesel.

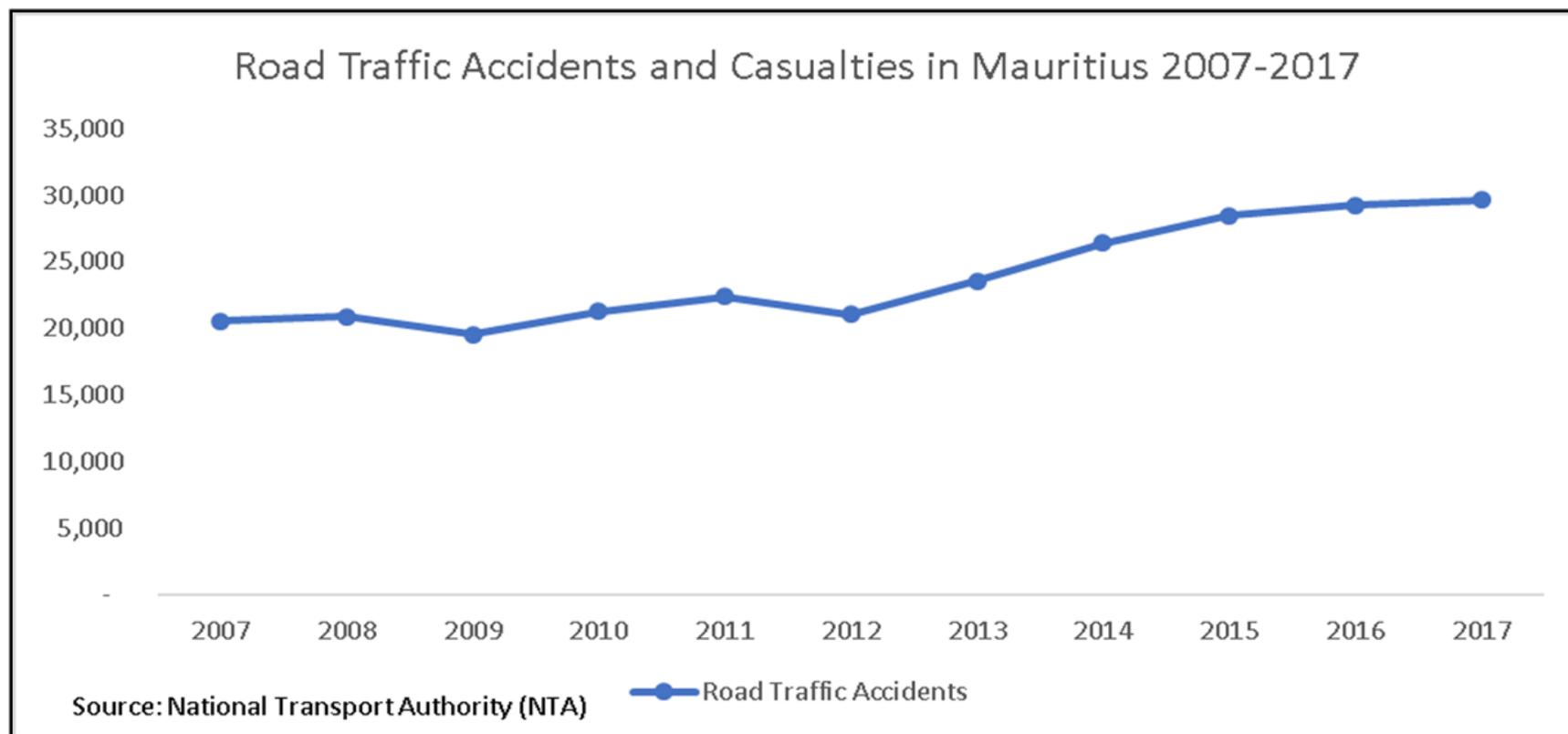
### ***Increased Traffic Congestion***

According to estimates by the Ministry of Environment and Sustainable Development,<sup>[3]</sup> Government of Mauritius, in 2013, an estimated 100,000 vehicles used to enter and leave the City of Port Louis (capital city and main commercial hub of the country) during peak hours, and fuel consumption and CO2 emissions increased significantly during these times. As of 2018, this vehicular movement has further increased, and congestion and higher levels of air pollution are observed in Port Louis throughout the day, with a major spike during morning and evening peak hours.

Other urban centers such as Rose Hill, Quatre Bornes, Vacoas/Phoenix and Curepipe have also seen a rapid increase in traffic congestion and vehicular emissions in recent years. Locations such as Ebene (near Quatre Bornes, about 15 km away from Port Louis) where large corporate offices such as Ebene Cybercity have been constructed, vehicular congestion is a serious problem, apart from lack of parking space for private cars of corporate employees, many of who end up parking their cars on the streets. It is estimated that Mauritius incurs a loss of MUR 4 billion (~US\$ 116 Million) per annum to its GDP due to traffic congestion.

### ***Increased Number of Road Accidents***

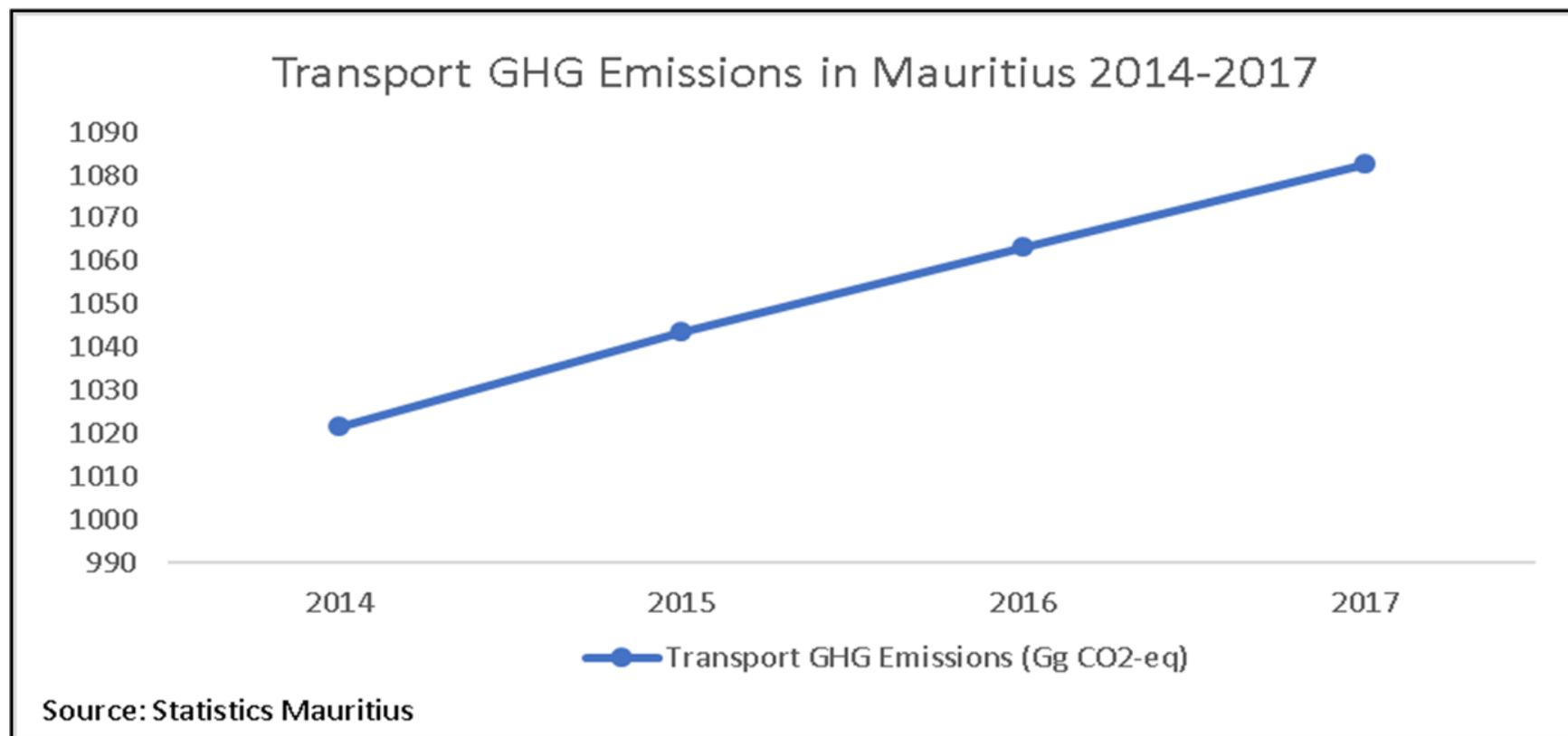
Accident rates in Mauritius are high, with nearly 12% of all vehicles involved in an accident each year. Fatality rate, at 11.8 per every 100,000 population, ranks badly in terms of road safety. The most vulnerable road users – pedestrians and cyclists – account for nearly 20% of all casualties in road accidents. Road traffic accidents in Mauritius registered an annual growth of 4.4% per annum between 2007 and 2017, whereas casualties in these road traffic accidents increased by 3.7% per annum during the same period as shown in the figure below.



[3] Ministry of Environment and Sustainable Development, GFEI, UNEP, EU, GEF, “Global Fuel Economy Initiative in Mauritius”, November 2014

### *Growing Transport CO2 Emissions*

According to data by the Ministry of Environment and Sustainable Development,[4] Government of Mauritius, in 2017, GHG emission from the transport sector was estimated at 1,083 Gg CO<sub>2</sub>-eq compared to 1,063 in 2016, up by 1.9% due to higher fuel consumption. It is to be noted that the number of registered motor vehicles went up by 4.8% from 507,676 in 2016 to 531,797 in 2017. Growth in CO<sub>2</sub> emissions from transport sector between 2014 and 2017 is as shown in the chart below.



[4] Ministry of Environment and Sustainable Development, GFEI, UNEP, EU, GEF, "Global Fuel Economy Initiative in Mauritius", November 2014

Outdoor/ambient air pollution has also started to become a matter of concern in Mauritius, particularly in the urbanised parts of the country such as the capital Port Louis, Beau Bassin/Rose Hill, Vacoas-Phoenix and Midlands areas. According to WHO data[5] (based on Government of Mauritius statistics), ambient air pollution in Beau Bassin/Rose Hill urban area was very high, with an annual mean PM<sub>10</sub> concentration of 137 micrograms per m<sup>3</sup> and annual mean PM<sub>2.5</sub> concentration of 67 micrograms per m<sup>3</sup> which is very high by most standards. PM<sub>10</sub> and PM<sub>2.5</sub> concentration in other urban areas of the country, including the capital city of Port Louis, is also growing rapidly.

According to UNEP research in 2015,[6] the main sources of air pollution in Mauritius are burning of fossil fuel for heat generation in industries, electricity generation and transportation. In Mauritius, air pollution control is regulated under the Environment Protection (Standards for Air) Regulations 1998 and with the support of UNEP and other donor agencies, Mauritius has implemented the Global Fuel Economy Initiative. Nevertheless, localized pollution, and

concentration of PM2.5 and PM10 in the air, along with concentration of SOx and NOx in the air has been growing. WHO estimates that outdoor air pollution causes 100 premature deaths annually in the country, co-benefits on health issues are expected with the transport electrification measures .

In response to all these issues faced by Mauritius in its land transport sector, the Ministry of Public Infrastructure and Land Transport (MPILT), Government of Mauritius, in 2014, embarked upon two key initiatives to improve public transport in Mauritius:(i) a bus modernisation programme providing subsidy of MUR 1 million (~US\$ 27,400) and exemption from VAT to private operators for modernising the bus fleet, (ii) development of a 28km long Light Rail Transport (LRT) line from Port Louis to Curepipe.

In the absence of a dedicated policy/regulatory framework, technical assistance for capacity building and a pilot incentive program for electric bus transport in the Mauritius, the following baseline projects/programs would be implemented/continue to be implemented.

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[5] Ambient Air Pollution Database, WHO, May 2016.

[6] UNEP "Mauritius Air Quality Overview", 2015

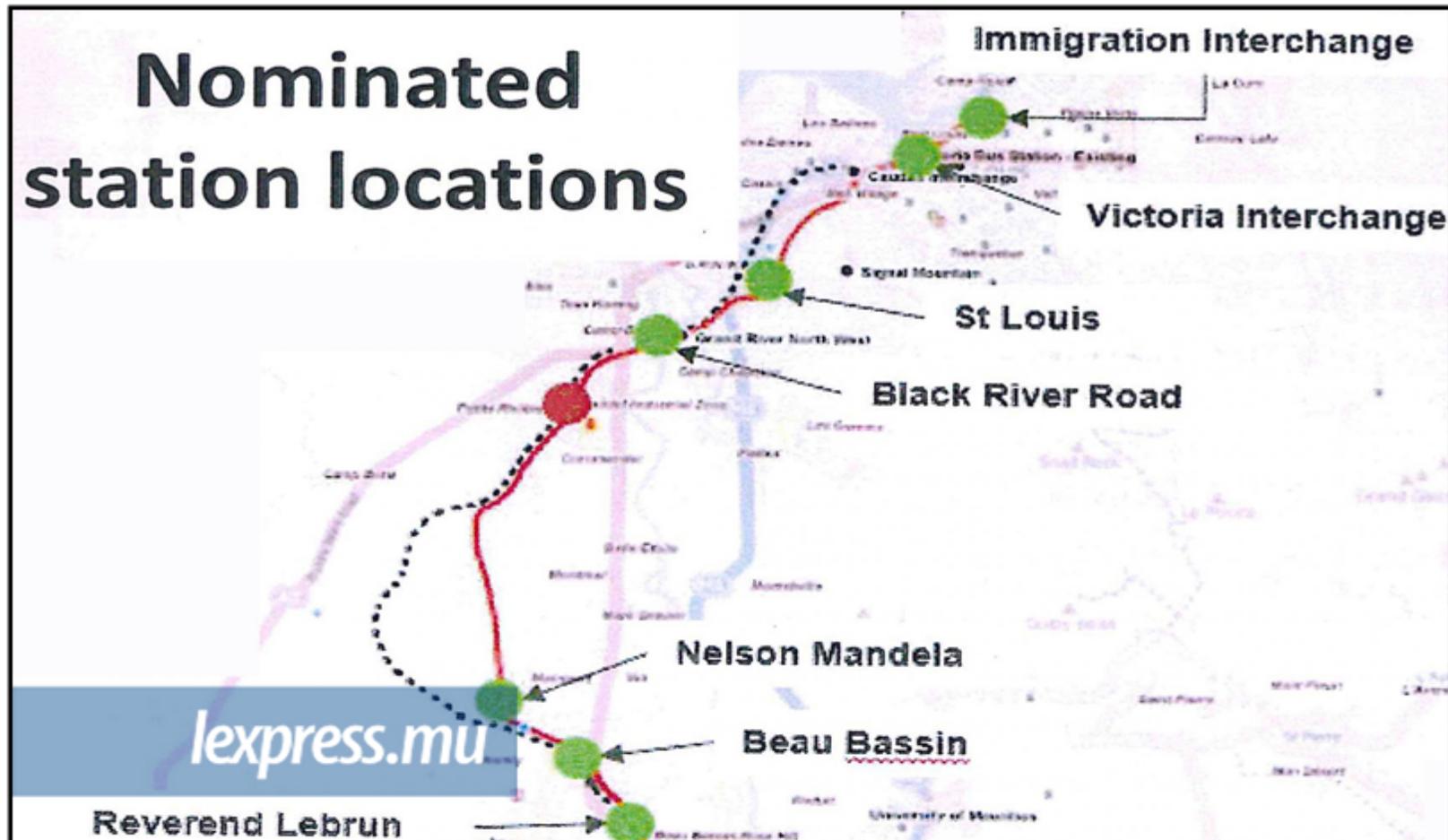
### ***Bus Modernisation Programme***

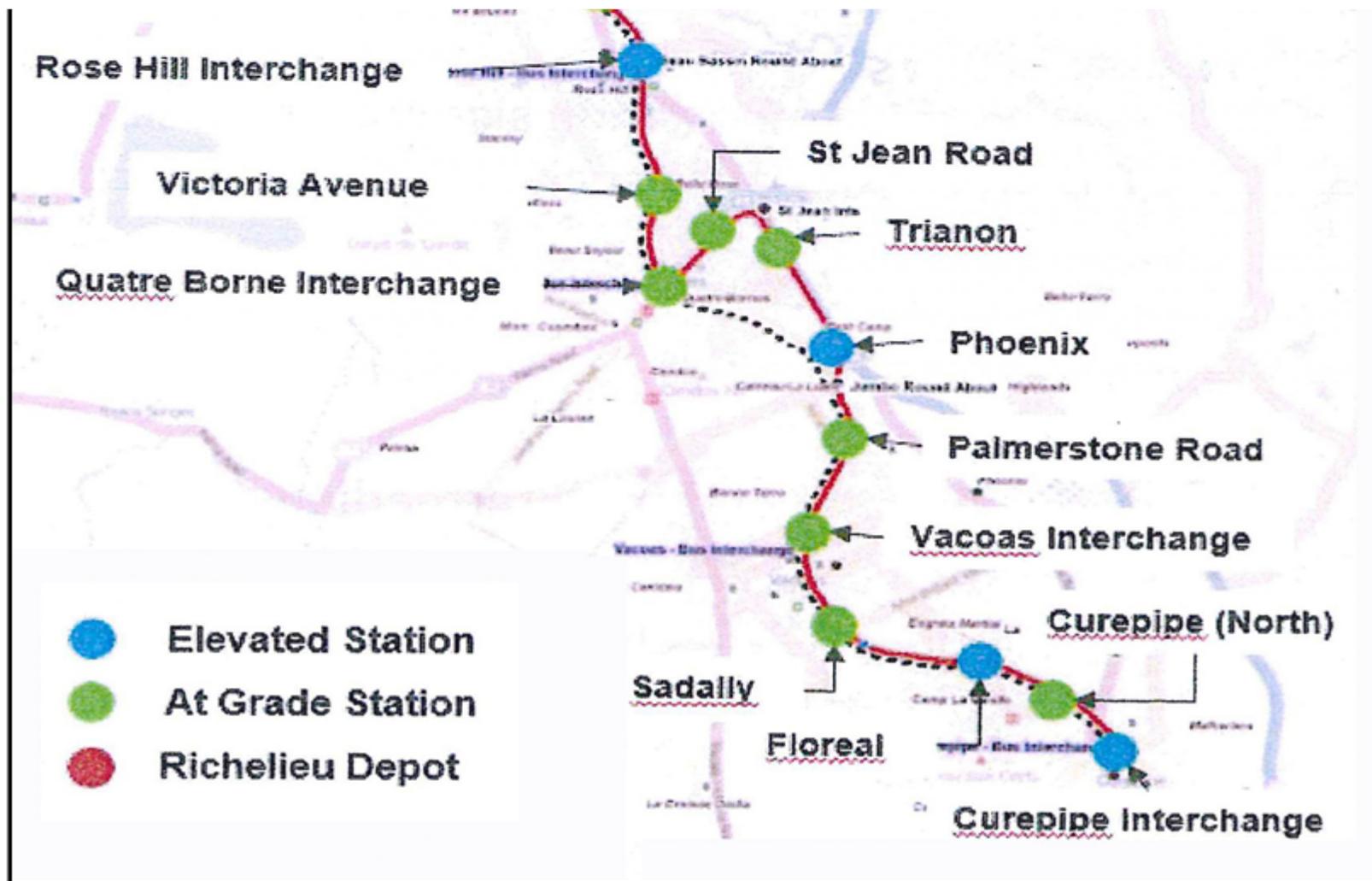
The National Transport Authority (NTA), under the Ministry of Public Infrastructure and Land Transport (MPILT), embarked on a Bus Modernisation Programme in 2014 with the aim of replacing the current buses with semi low-floor buses for increased comfort and better access to elderly and disabled passengers. The aim of the programme is to ensure that, by 2023, 75% of the country's bus fleet is less than 10 years old. The programme, funded by a Government budget, offers MUR 1 Million (~US\$ 27,400) in grants per bus and additional tax rebates (15% VAT exemption) to encourage bus operators to make the switch to semi-low-floor buses.

The programme has recorded limited success to date, for two reasons: (1) the funds on offer have proven sufficient but conservative for bus companies to invest in new semi-low-floor buses, and (2) several of the new semi low-floor buses that have been acquired have proven to have worse fuel efficiency than the old buses that were being replaced, with the result that the Bus Modernisation Programme is at risk of further undermining the country's energy security and increasing GHG emissions. Based on consultations conducted by UNDP with bus operators in Mauritius, fuel efficiency of the new low-floor buses is about 2.5 kmpl for the new semi-low floor buses (fuel efficiency is lower if airconditioning in buses is switched on), whereas the older higher floor buses offered better fuel efficiency of 3 kmpl. While these semi-low floor buses do offer better commuting experience to commuters, their higher upfront costs and lower fuel efficiency than earlier buses have made them unpopular among bus operators, including the government-owned NTC. Hence, the government's bus modernization program has seen low adoption so far.

## Light Rail Transport (LRT) Metro Express Project

After years of debates and discussions among the government, transport operators and stakeholders, the Metro Express project was finally approved in 2016 and construction began in March 2017 on the occasion of 25th Republic Day in Mauritius. The 28km long LRT 'MetroExpress' line from Port Louis to Curepipe in Upper Plaines Wilhems, is a welcome development in public transport sector in Mauritius, and it is also the only railway line in the country, since the Mauritius Government Railways unit was closed down in 1960s. The project is estimated to cost MUR 17 billion (~US\$ 466 Million) and it is being financed by a MUR 10 billion (~US\$ \$ 274 Million) grant from the Government of India and the remaining amount being financed by the Government of Mauritius and local banks. Government of Singapore is providing technical and project management support to the Metro Express project. The project is intended to be complete within 4 years' time , i.e. by 2021, with Phase 1 between Port Louis and Rose Hill expected to be completed by February 2020 and Phase 2 between Rose Hill and Curepipe to be completed by September 2021. Proposed route of Metro Express project is as shown below





When fully operational, the Metro Express is estimated to operate 32 trains operating on the rail track (15 trains per hour, each with 304 passenger capacity) carrying up to 80,000 passengers per day. Services are planned between 7 AM and 9 PM, and it is estimated to take 42-45 minutes to travel from one end to the other on the Metro Express, as opposed to nearly 1.5 hours currently. Immediately after introduction of the Metro Express, 20% of bus commuters and 10% of personal vehicle users are expected to switch to using the LRT Metro Express system. Footpaths and roads leading upto MetroExpress stations are being improved, with walking and bicycling tracks being implemented.

A number of long-distance trunk bus routes that are currently operated by bus operators are likely to be converted into last mile connectivity routes to complement the Metro Express. However, lack of affordable, clean, smart, electric last-mile public transport connectivity options to MetroExpress stations would result in deployment of fossil fuel based short-loop buses and/or use of personal transport options between MetroExpress stations and commuters' homes/offices/destinations. This would undermine some of the goals of MetroExpress project, which are to encourage fast, affordable, clean public transport in the country.

### ***Major Highway/Road Construction Projects***

Large road transport network construction/upgradation projects are being undertaken by MPILT and some of the major ones are

- Grade separated junctions at Pont Fer/Jumbo/Dowlut roundabouts
- Highway construction project A1-A3 Link Road to connect Port Louis-St Jean Road (A1) to Black River Road (A3), and
- Highway construction project A1-M1 Link Road to connect Port Louis-St Jean Road (A1) to M1 motorway

While these projects are necessary to de-congest road transport in urban areas of Mauritius, they end up encouraging more individual transport options rather than public transport options.

Introduction of electric buses in Mauritius is consistent with the following goals in the government's transport energy sector strategy, as described in the Government of Mauritius' 'Long-term Energy Strategy 2009-2025':

- Promote the use of more efficient and lower emission vehicles and fuels
- Promote the use of hybrid and electric vehicles through fiscal incentives and concessions and introduce fiscal policies to encourage transport fuel efficiency technologies

Introducing small e-buses for providing last mile connectivity to the upcoming Light Rail Transport (LRT) MetroExpress system in Mauritius would be a good way to begin the introduction of e-buses in the country, since last mile connectivity can be provided with smaller e-buses and this offers a relatively lower-cost and lower-risk opportunity to introduce e-buses to bus operators in Mauritius. Nevertheless, given the right selection of e-bus design and manufacturer and the right vehicle charging technology, e-buses could be competitively and effectively deployed on longer bus routes in Mauritius as well. Nevertheless, it is important to establish the feasibility of deploying buses on both short loop last-mile routes to MetroExpress and regular, longer bus routes.

However, introduction of electric buses in Mauritius has several barriers and challenges, as outlined below.

### **Key Barriers and Challenges for E-mobility**

#### ***Lack of Policy and Regulatory Framework***

Lack of policy and regulatory framework for introduction of electric mobility solutions in Mauritius is the key reason, although introduction of e-buses is already in the government's transport energy strategy for 2025. Nevertheless, Mauritius doesn't have any deployment targets for electric mobility, and there are no incentives or subsidy schemes in place, apart from permitting and technical certification processes which are currently unclear.

There are also no standardised processes such as standard import/customs norms or leasing/hire-purchase agreement framework that is applicable to the transport sector. Besides, bus transport tariffs are maintained at affordable levels, given the relatively lower income levels of bus transport users, and the government's intent to make public transport more attractive than personal transport options. Hence, for the electric bus transport market, investors/bus operators/leasing companies who undertake market analysis conclude that there are large numbers of commuters who will have great difficulty to pay the full tariffs necessary to ensure economic viability of electric bus deployment.

A clearly defined and outlined policy and regulatory framework from the government that outlines subsidies/tax incentives, together with a publicly declared electric vehicle and e-bus deployment targets would eliminate a major hurdle for introduction of e-buses in Mauritius. An investment prospectus is necessary to be developed, that could provide broad roadmaps on how to initiate and scale-up electric mobility, particularly electric buses for public transport in Mauritius in terms of the number of buses that need to be deployed to achieve transport emission reduction targets and their costs, while providing accessible and affordable bus transport to commuters.

There are also no guidelines from the government on technical standards/specifications/product quality framework for e-buses in Mauritius. The current public transport framework in Mauritius does not specifically address electric mobility or its affordability or technical standards. This results in a status quo of sorts in the public transport sector, with traditional approaches for bus transport (such as the bus modernization program) that do not specifically address issues of smart, low-carbon, future-ready public transport that is affordable to everyone in the country. There is also no streamlined licensing, safety or permitting processes for e-buses or an import/customs/VAT regime specific to this sector. Similarly there is a lack of standard guidelines on bus leasing/hire-purchase agreements or their associated financial incentives/liabilities which creates pricing uncertainties. Thus, for bus operators, lack of policy and regulatory clarity and uncertainty deters them from making electric mobility investments.

***Lack of local capacity, as well as techno-commercial and market knowledge***

Mauritius, as with many developing countries, lacks capacity in various aspects of electric mobility policy formulation, implementation, and actual deployment, while also lacking the necessary knowledge and skills to perform these tasks. Electric mobility as a technology, and innovative ownership/leasing business models are relatively less understood in most developing countries, where traditional fossil fuel buses were/are purchased outright and operated for public transport purposes. In consultations with Ministry of Public Infrastructure and Land Transport (MPILT), NTA, and bus operators, they indicated that there is very little understanding of electric mobility for public transport in the country and these skills and knowledge need to be quickly developed, in order to develop a modern, smart, low-carbon transport network for Mauritius, while also reducing their fossil fuel consumption. The Ministry also indicated that their staff lack capacity to effectively develop, implement and monitor electric mobility policies and programs in the country.

The lack of capacity and skills and a lack of experience in deploying electric buses creates a major barrier to their deployment in the country. While electric cars for personal transport are slowly making inroads into the Mauritian market, particularly among high income households, lack of affordable electric mobility options and associated charging infrastructure result in low consumer and policy-makers' confidence, thus delaying and limiting market introduction and growth. During consultations, some policy makers and bus operators expressed concerns about electric bus' driving range, charging speeds and affordability/durability of batteries. These concerns are based on limited understanding and experience with electric bus technology, which can be reduced over time with appropriate technical know-how and good technology management skills. Similarly, due to lack of experience with newer ownership models such as bus leasing models, some bus operators were reluctant to support such a model for electric bus deployment. Nevertheless, both self-ownership and leasing models need to be studied and explored, and bus operators and other stakeholders need to have all necessary information, data and analysis before they can make an informed decision on the right ownership model.

Furthermore, understanding of techno-commercial and market mechanisms of introducing e-buses is very limited among MPILT, NTA, bus operators, banks and other stakeholders in Mauritius. Limited financial viability of e-buses without government incentives at current bus transport tariffs, coupled with the fact that electric bus technology is a completely unknown technology as far as Mauritius is concerned, is a key barrier for deployment of e-buses in the country. There are concerns among bus operators regarding range anxiety of e-buses, high upfront cost of batteries, their durability, charging infrastructure, driver training/capacity and commuter experience. Nevertheless, many bus operators - both public and private - are interested in making investments or procure e-buses on a pilot basis. They are interested in exploring procurement and deployment of e-buses for routes such as short-loop, last-mile connectivity routes to the upcoming LRT MetroExpress line and regular, longer routes as well, to understand the viability of e-bus technology in terms of travel range per charge, battery charging times, efficiency and infrastructure and financial viability, in addition to understanding commuter comfort/experience and driver experience of driving e-buses.

Thus, all stakeholders, including MPILT, NTA, bus operators, drivers, commuters, banks and other stakeholders need to understand these implication and viability issues in detail, before pilot investments in e-buses are made.

### ***Relatively high capital costs of electric buses and lack of affordable finance***

Another key barrier to electric bus investments in Mauritius (as in most developing countries) is the relatively high capital costs of purchasing electric buses vis-à-vis diesel buses, and a lack of affordable finance which is rooted in the lack of market maturity of electric bus transport markets and the domestic financial institutions' lack of understanding and experience with financing e-buses. Both electric mobility and bus leasing models are relatively new in Mauritius, and investments in electric mobility for public transport is currently non-existent due to high risk perception, low awareness of returns and other benefits of electric buses, and lack of risk-mitigation instruments and investment incentives. There are no dedicated financial incentives or financial instruments for electric buses in Mauritius at present, and many bus operators do not have the necessary capital and/or incentives to be able to successfully obtain asset financing for electric buses. On the financial market side, the banking sector is interested in financing electric buses and bus leasing models, but they lack understanding/experience and are reluctant without a clear policy/regulatory framework in this direction.

### ***Undemonstrated technical and financial viability of electric bus transport***

None of the bus operators in Mauritius currently have experience in deploying electric buses for public transport and hence, are unclear about its operations and economic viability. This creates barriers for deployment of electric buses, and hence, technical and financial viability of electric bus transport remains undemonstrated in the country.

### ***Lack of Awareness on Long-term Benefits of Electric Mobility***

There is a general lack of awareness among government stakeholders, bus operators, commuters and banks/investors on the long-term benefits of electric mobility in Mauritius. A general perception that electric mobility is expensive and unaffordable creates barriers for its commercial introduction into the transport sector in the country, without consideration of their long-term financial and environmental benefits. These benefits can be summarised as follows:

- **Health:** The World Health Organization labels outdoor air pollution – and especially particulate matter – a carcinogen. Air pollution causes cancer, as well as heart disease, dementia, asthma, and other health problems. A leading cause of air pollution is emissions from vehicles. One of the fastest and most effective ways to reduce air pollution is to reduce the number of emissions-producing vehicles on the road. EVs have no tailpipes and produce zero local emissions.
- **Business, Tourism and Quality of Life:** With e-mobility, cities can offer a cleaner, greener and quieter environment, a higher quality of life, where families want to walk around and play outside, tourists want to visit, and businesses want to have offices because the community is attractive to their future employees. Zero emission electric mobility is an essential part of this cleaner future.

- **Economic Development:** In addition to a high quality of life being attractive to workers and employers, the cleantech economy is one of the fastest growing portions of the broader global economy. E-mobility is one of the core sub-sectors of the cleantech economy.
- **Energy Independence:** In many places, petrol and diesel need to be imported. Electricity, on the other hand, can usually be generated from local energy sources, thus boosting the local or national economy, not sending that money abroad, and without relying on other countries.
- **Smart Cities:** Smart cities are places where objects and infrastructure are networked and able to communicate with each other, thus increasing the ability to monitor, control, and connect them. EVs have onboard GPS, software, and batteries that can easily network with other devices, creating many more opportunities for cities to become smarter.
- **Climate Change:** If society continues with a “business as usual” approach, the livability of the planet will be threatened. The transport sector is globally one of the biggest emitters of greenhouse gases. Moving to zero emissions electric transport is one of the key things a country can do to move towards decarbonisation

### ***The Mauritius Approach to Coordination of Sources of Climate Finance for Low to Zero Carbon Transportation”.***

In view of the urgency to move towards e-mobility, Government of Mauritius is exploring various strategies to obtain multilateral and bilateral help in this sector. These include GEF and the GCF as well as other bilateral sources. However, in this process, Mauritius has to reckon with the administrative processing times and the different techno-feasibility requirements. The overall discussions to obtain aid for the transport sector are spearheaded by the Ministry of Finance and Economic Development in close collaboration with the sector Ministry i.e. Ministry of Public Infrastructure and Land Transport. Furthermore, the Ministry of Finance and Economic Development being the GCF National Designated Authority as well as the GEF Operational Focal Point, has engaged discussions with the Secretariats of GEF and GCF to design this operation in a coordinated engagement fashion over the past year.

### **3) Proposed Alternative Scenario with a Brief Description of Expected Outcomes and Components of the Project;**

#### **Proposed UNDP-GEF Project**

This proposed GEF project will address investment barriers including risk aversion and lack of capacity by clarifying policies, regulations and procedures, demonstrating the financial viability of electric bus investments, supporting access to finance, reducing risk aversion by financial institutions, and overall, creating an environment for mobilizing resources from bus operators, government, and banks/financial institutions. The GEF project will contribute to meeting the objectives of the government's transport sector goals and National Transport Consensus wherein electric bus transport can play an important role in the development of smart, future-ready, low-carbon bus transport options in the country, thereby making them more attractive and affordable to commuters, who would otherwise use fossil fuel based personal transport or public transport options.

The project will also create synergies to the work being undertaken by the Ministry of Public Infrastructure and Land Transport (MPILT), NTA, bus operators, TMRSU and other agencies involved in transport and energy sector in the country, in addition to development partners, NGOs, private sector and others to ensure cost-effectiveness and efficiency.

### **Proposed UNDP-GEF Project Activities**

This proposed GEF-funded, UNDP-implemented project proposes to develop necessary policy/regulatory framework and deploy a small electric bus fleet for regular long routes and/or last mile/feeder connectivity to MetroExpress stations – based on establishment of technical and financial feasibility - from nearby high population density urban and rural locations in Mauritius. Both self-ownership and bus leasing models will be explored and deployed based on feasibility and interest among stakeholders in either or both of these models. This model would still require government subsidies, which could be financed from incremental resources from the Global Environment Facility (GEF) with support from UNDP. Solar energy based electric bus fast-charging infrastructure and their maintenance would be the responsibility of bus leasing companies, although bus operators could collaborate with charging infrastructure providers and/or bus manufacturers in this aspect. The program implementation and investment timeline would be 2021-25.

Based on results achieved, a similar, larger follow-on program could be initiated, with Green Climate Fund (GCF) being one of the potential sources of funding. Discussions are ongoing between the Government of Mauritius, the GCF and the GEF regarding the potential avenues for the scale-up project, initially through the execution of a GCF Readiness activity in parallel with, and as co-financing to the GEF project, to explore the potential for further GCF financing to scale up the GEF project activities. The GEF project will deliver its outcomes and outputs through the following four components:

#### ***Component 1: Policy and regulatory framework for electric public (bus) transport in Mauritius***

The GEF project activities will focus on developing a comprehensive policy and regulatory framework for electric public (bus) transport in Mauritius, with the following key outputs and activities:

The key outputs of this component would be:

- (i) Designing and developing a long-term comprehensive 'Sustainable Low-carbon Transport Planning' document that provides with policy and regulatory framework for electric bus transport.
- (ii) Developing a comprehensive policy, regulatory and guidelines framework to enable e-bus deployment in Mauritius for public transport
- (iii) Feasibility studies and analysis that could potentially lead to access GCF funds for scaling up low-carbon transport in Mauritius

Key activities under this component to achieve the described outputs are:

- (i) The long-term comprehensive 'Sustainable Low-carbon Transport Planning' document would inform the design of policy, regulatory and fiscal/financial incentive schemes/programs for Mauritius to support the implementation of electric public transport .
- (ii) Procedures and tools for the accelerated licensing, safety certifications and other necessary frameworks
- (iii) Design and delivery of training modules to each stakeholders on planning, developing and implementing policy/regulatory framework, management, operations, maintenance, partnerships, and financing/leasing of electric bus transport infrastructure
- (iv) Guidelines and procedures on taxation, incentives and permits for bus operators with reference to import/customs tariffs regulations,
- (v) Following review of import/customs tariff regulations, designing appropriate incentives for bus operators, financial institutions and other stakeholders such as tax waivers, subsidy schemes and other benefits to support public and private sector participation in electric public transport.
- (vi) Development of a technical standards and quality framework including quality and testing protocols, benchmarks and certification guidelines for electric buses and their components such as batteries
- (vii) Development of a technical standards and quality framework including quality and testing protocols, benchmarks and certification guidelines for electric vehicle charging infrastructure; globally, multiple technical standards exist for electric vehicle charging, such as SAE Combined Charging System (CCS), CHAdeMO, Type 2 charging, Tesla Superchargers etc. Hence, it is important to understand and assess each of these charging technology standards and adopt a standard that is suitable for Mauritius – both from public and private e-vehicle charging standpoint.
- (viii) Reduce the risk of hazardous waste from used batteries entering local ecosystems by supporting the government to setup policy and regulatory framework for safe recycling and disposal of battery components in the country
- (ix) Incorporate both self-ownership and bus leasing models, if found feasible, for route allocation/auction mechanism in which specific bus routes are allocated or auctioned to bus operators.
- (x) Preparation of a GCF concept note to scale up low-carbon transport in Mauritius based on experience gained, new regulatory and policy environment established, feasibility studies conducted and data collected under this proposed GEF-funded project

### ***Component 2: Financial Incentive Package electric buses***

The key outputs of this component would be:

- (i) Capital Subsidy scheme for electric buses for both regular long routes and/or short loop feeder buses to provide last mile connectivity to and from MetroExpress stations

(ii) Capital subsidy scheme for solar charging stations for electric buses

Key activities under this component to achieve the described outputs are:

This component would focus on procurement of 30 electric buses for various bus operators with route operation licenses on longer routes and/or last-mile/feeder routes, with a viability gap funding based subsidy (could be 30-40% of the upfront cost of an electric bus, to be determined based on feasibility analysis) paid to bus operators (or bus leasing companies if leasing option is chosen) to deploy electric bus fleet for regular long routes and/or last mile/feeder connectivity to MetroExpress stations – based on establishment of technical and financial feasibility - from nearby high population density urban and rural locations in Mauritius. Both self-ownership of e-buses bus operators and bus leasing models will be explored, with electric buses being leased from either domestic leasing companies (2 of Mauritius' largest commercial banks have their asset leasing subsidiaries) or directly from international electric bus manufacturers/leasing companies. Furthermore, the potential role of the National Transport Authority will be explored, as potential owner who would lease the buses to operators. There are encouraging results in this area from a recent study which explores the innovative concept of Pay As You Save (PAYS)[7] for electric buses. In addition, potential role of and Central Electricity Board (CEB – national utility) will also be explored, as the potential owner and operator of bus charging stations.

This model would still require government subsidies, which could be financed from Global Environment Facility (GEF) with support from UNDP. About 30 buses are proposed to be procured by bus operators in this program with a viability gap funding based subsidy financed by GEF funding provided to bus operators. However, if the bus leasing model is chosen, the subsidy amount would be paid to the leasing companies and not the bus operators. A 30-seater electric bus is estimated to be priced at about US\$ 200,000 (although prices are rapidly falling), and hence procurement of 30 buses would cost US\$ 6 Million. A certain portion of bus procurement budget will be financed from government in the form of viability gap funding based subsidies, and the rest to be financed by bus operators (or bus leasing companies).

A partial capital subsidy would also be provided for the procurement of solar energy based electric bus fast-charging infrastructure and their maintenance would be the responsibility of bus operators or their charging infrastructure providers/partners. A public bus charging station is typically of 50-70 kW load capacity and if it is to be powered by a combination of solar panels and grid electricity, then the typically cost of setting up one such charging station is estimated to be US\$70,000. For 30 e-buses, it maybe necessary to deploy atleast 10 such charging stations. The proposed viability gap funding based subsidies for the procurement of these e-buses and charging stations will be critical to enabling the Bus companies to move into e-mobility. .

It should be noted that bus operators that have the concessions to operate buses on regular longer routes and last-mile feeder routes to Metro Express stations, with support from NTA, would have to conduct a transparent auction-based tendering system with participation from e-bus manufacturing companies, who would make offers to bus companies, and the bus operators, with support from NTA, would select the best offers. This project will support

the NTA and bus operators in this procurement process, by providing technical, financial and bid implementation support for documentation, managing procedures and its implementation. If bus leasing option is selected, similar auctions need to be conducted for leasing companies and bus operators would sign long-term contracts with these leasing companies. The technical assistance from the project would be tailored accordingly.

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[7] [https://www.climatefinancelab.org/wp-content/uploads/2018/02/PAYS-for-Clean-Transport\\_Instrument-Analysis.pdf](https://www.climatefinancelab.org/wp-content/uploads/2018/02/PAYS-for-Clean-Transport_Instrument-Analysis.pdf)

### ***Component 3: Technical Feasibility and Capacity Building***

This component is intended to address the technical and knowledge barriers and barriers related to lack of capacity and skills to plan, manage, operate, finance electric mobility based public transport system in Mauritius.

The key outputs of this component would be:

- (i) Economic and financial analysis and design of financial incentive schemes for electric buses for both regular long routes and/or short loop feeder buses to provide last mile connectivity to and from MetroExpress stations; economic and financial analysis and design of direct/indirect financial incentive scheme for solar charging stations
- (ii) Identification of capacity gaps and training/capacity building activities that increase capacity of local institutions and stakeholders on electric mobility technology, business models and financing
- (iii) Improved knowledge among local stakeholders (MPILT, NTA, TMRSU, public and private bus operators) on suitable routes, risks, technical standards and operational issues of deployment of electric buses at scale

Key feasibility studies under this component to achieve the described outputs are:

- (i) Economic and financial feasibility study for electric mobility to assess adequate level of incremental subsidy for e-buses and design and set up renewable energy based electric bus charging stations for govt and private sector operators, including various charging standards, costs,
- (ii) Risk assessment for renewable energy charging infrastructure will be carried out
- (iii) Feasible bus routes (topography and other factors) – both regular long routes and feeder routes for last mile connectivity to MetroExpress stations will be studied for technical and financial feasibility
- (iv) Maintenance implications for Mauritius for both e-buses and charging infrastructure

The following capacity building activities under output 3 of component 3 are proposed under GEF project for an array of stakeholders relevant to this project:

- (v) Conducting detailed capacity gap analyses to inform development and implementation of a targeted, multi-level electric mobility training and capacity building programme to improve capacities of various stakeholder including MPILT, NTA, TMRSU, bus operators, transport planners, leasing companies, services providers, commuters and financial institutions, and others.
- (vi) Design and delivery of training modules on electric bus technologies with a focus on bus operators and their technicians to electric buses, and also develop strong knowledge, skill and capacity base in Mauritius on electric bus technology
- (vii) Training/capacity building of financial institutions/leasing companies on electric bus technology, business and operational models

#### ***Component 4: Awareness Raising***

This component is intended to address the barriers related to lack awareness about benefits of electric mobility, public transport and walking/cycling options in Mauritius. Proposed outputs and activities include:

The key outputs of this component would be:

- (i) Increased awareness and sensitization among local population regarding the benefits of using public transport in general, and low-carbon electric mobility in particular

Key activities under this component to achieve the described outputs are:

- (i) Develop and implement sensitization program that amplifies the outreach efforts to encourage electric mobility and additionally encourages use of public transport, walking and cycling
- (ii) Town-level, city-level or community-level roadshows, fairs and general market-day promotions of electric mobility and low-carbon transport

- (iii) Community focus group meetings and other social gathering based awareness raising activities
- (iv) Mass media based marketing and awareness raising campaign, including campaigns on radio and TV, leaflets, brochures, newspaper articles, and presentations;
- (v) Promotional activities at metro stations and bus stations, schools, office complexes and apartment communities
- (vi) Promotional activities through thought-leaders and community influencers where citizens will be encouraged to use public transport, electric mobility options, walking and bicycling

#### ***Component 5: Knowledge Management, Monitoring and Evaluation***

This component will focus on knowledge management and monitoring and evaluation of the proposed GEF-funded project.

The key outputs of this component would be:

- (i) Review of lessons learnt from other projects
- (ii) Compilation of experience gathered in this project.
- (iii) Strategic Communications around the project
- (iv) Evaluations and project reports
- (v) Cooperation with UN Environment's GEF-funded Global E-Mobility program

Knowledge Management:

Knowledge management part of this component will focus on capturing lessons learned, developing and publishing knowledge products such as market intelligence reports and replication guides that can be used by government institutions, other donor and development agencies, NGOs, and private sector in Mauritius and other countries. Key activities will include:

- (i) Conducting research on best practices that can inform the project development including existing ongoing Donor funded green transport projects, their lessons learnt, evaluations and approaches to promoting green transport.
- (ii) Compiling knowledge acquired through the project, as regards all aspects, i.e. appropriateness of technology, ownership models, incentives etc. .

- (iii) Developing strategic communications around project results including reports, clips, case studies, and other knowledge material; and
- (i) Organising knowledge management, communication and learnings/information dissemination workshops to promote further dialogue on clean tech in the transport sector among stakeholders.
- (ii) Cooperation with UN Environment's GEF-funded Global E-Mobility program, including participation in global/regional e-mobility workshops/events, sharing of lessons learned and contribution to knowledge products

#### Monitoring and Evaluation:

Monitoring and evaluation (M&E) part of this component will implement the relevant activities expected under the UNDP and the GEF Monitoring and Evaluation Policy. Key activities will include:

- (i) Establishment of project baseline of all proposed project interventions as the basis to monitor and evaluation the project's impact and achievement of project outputs;
- (ii) Monitoring of Project progress through Mid-term and terminal evaluations and yearly progress reporting, and annual Project Implementation Reports
- (iii) Monitoring through project progress meetings at monthly intervals, project visits, Project Board meetings
- (iv) Evaluation at Mid Term and end of project to assess the various aspects of project as per UNDP and GEF Evaluation guidelines and policy.
- (v) Cooperation with UN Environment's GEF-funded Global E-Mobility program, including M&E for global program framework indicators

#### **4) Alignment with GEF Focal Area and/or Impact Program Strategies;**

This proposed project is aligned with Objective 1 of the Climate Change Focal Area to "Promote innovation and technology transfer for sustainable energy break-throughs", through CCM1-2 - Promote innovation and technology transfer for sustainable energy breakthroughs for electric drive technologies and electric mobility.

#### **5) Incremental/Additional Cost Reasoning and Expected Contributions from the Baseline, the GEFTF, LDCF, SCCF, and Co-financing;**

The incremental reasoning of the project is summarized below:

Overall, the proposed project aims to cover the incremental costs of eliminating barriers to introduction and commercialization of electric mobility technology in Mauritius. While total cost of ownership of electric vehicles in fleets in some countries might already be competitive today, without the intervention of proposed GEF project, barriers would not be adequately addressed in Mauritius, where electric vehicle based public transport fleets are still not competitive vis-à-vis fossil fuel based transport fleets. Specifically, apart from the policy derisking and capacity building activities the project will provide funding for the difference between the cost of a normal diesel powered bus and an electric bus along with a portion of the investment required in the charging infrastructure, which in itself is fully incremental to the normal operations of a Bus company.

De-risking of electric mobility technology is a part of incremental costs of barrier removal that is being targeted by this proposed project: to attract finance for upscaling (e.g. from GCF and other development banks) the technology needs to be proven locally, and expertise to handle specific requirements need to be gained, which can only be done through grants and local demonstrations.

This model would require government subsidies, which could be financed from Global Environment Facility (GEF) with support from UNDP. About 30 buses are proposed to be procured by bus operators in this program with only an incremental cost as viability gap funding (partial capital subsidies) based subsidy financed by GEF funding provided to bus operators. However, if the bus leasing model is chosen, the subsidy amount would be paid to the leasing companies and not the bus operators. A 30-seater electric bus is estimated to be priced at about US\$ 200,000 (although prices are rapidly falling), and hence procurement of 30 buses would cost US\$ 6 Million. A certain portion of bus procurement budget will be financed from government in the form of viability gap funding based subsidies, and the rest to be financed by bus operators (or bus leasing companies).

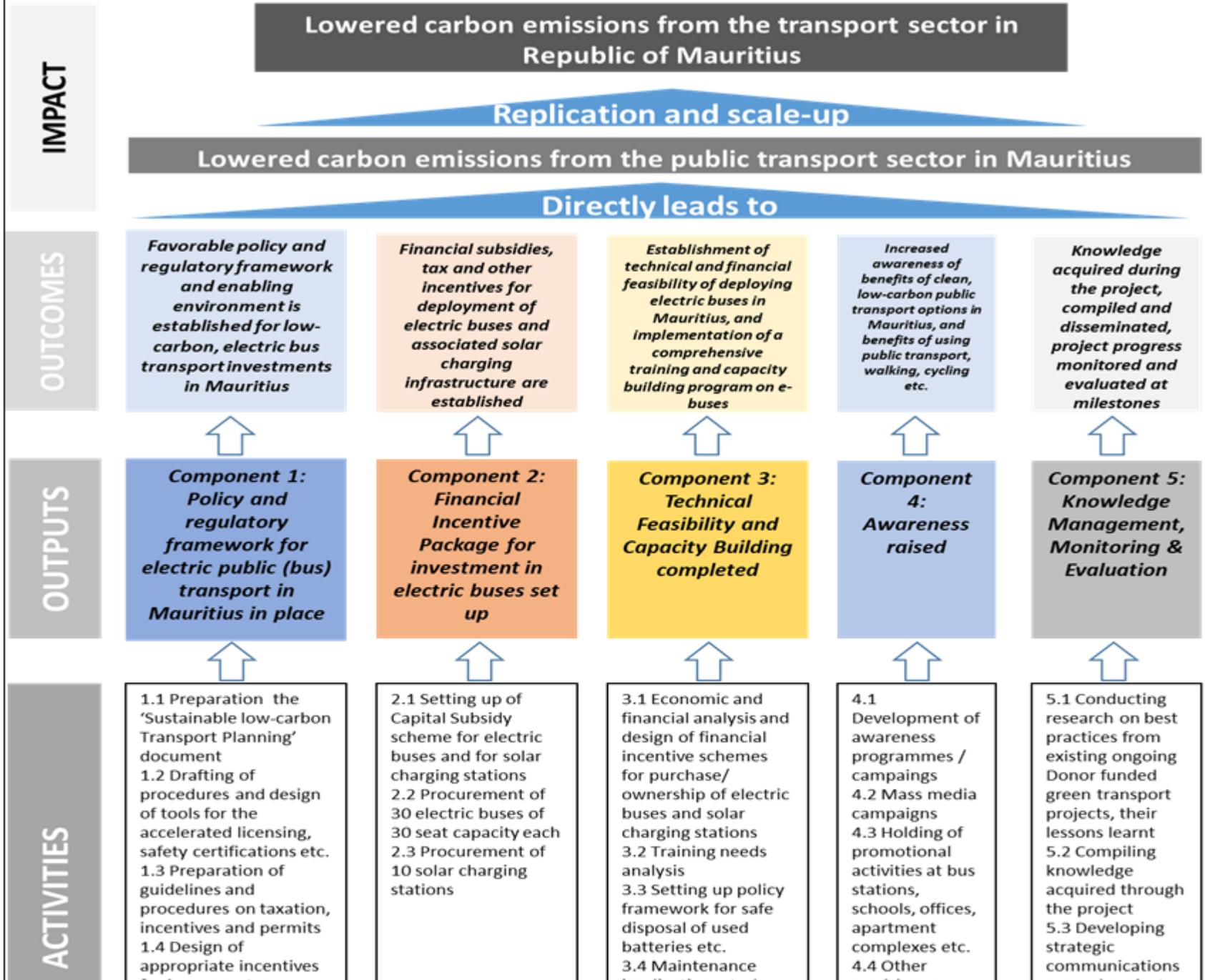
A partial capital subsidy would also be provided for the procurement of solar energy based electric bus fast-charging infrastructure and their maintenance would be the responsibility of bus operators or their charging infrastructure providers/partners. A public bus charging station is typically of 50-70 kW load capacity and if it is to be powered by a combination of solar panels and grid electricity, then the typical cost of setting up one such charging station is estimated to be US\$70,000. For 30 e-buses, it maybe necessary to deploy atleast 10 such charging stations. The proposed viability gap funding based subsidies for the procurement of these e-buses and charging stations will be critical to enabling the Bus companies to move into e-mobility.

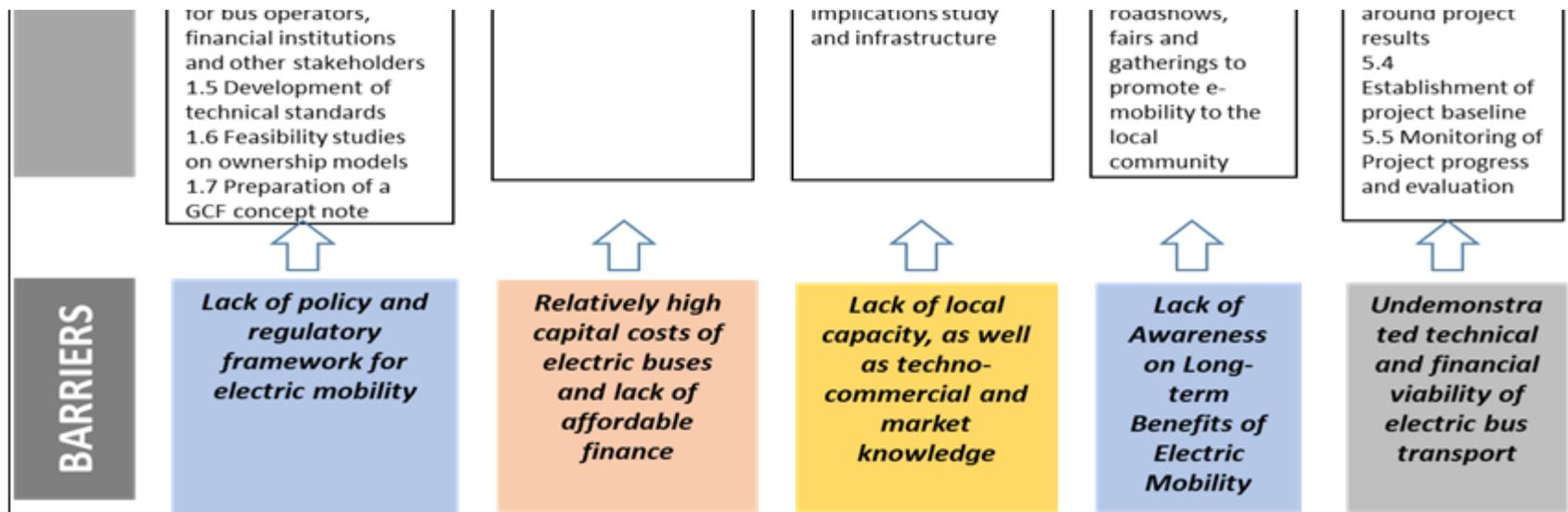
In addition, the proposed project is supported by the UN Environment's global electric mobility project and this programmatic approach seeks to bundle demand in the region and thus reduce the incremental costs. Knowledge Management component addresses, with set aside resources, the needed activities to join global/regional e-mobility workshops/events, sharing of lessons learned and contribution to knowledge products with UNEP Global E-Mobility program.

The key Theory of Change (TOC) proposed to be achieved through this GEF-funded program is described in the diagram below.

# Promoting Low-carbon Electric Public Bus Transport in Mauritius

## Theory of Change Diagram





A. Lack of tools for policy implementation, procedures and planning for electric bus transport in Mauritius, and lack of policy and regulatory framework.

- This will be addressed by Component 1 activities that will focus on developing a comprehensive policy and regulatory framework for electric public (bus) transport in Mauritius.
- Due to the support from global project to this proposed project, generic tools that are produced at the global level will be disseminated through regional support and investment platforms and adapted to the needs in Mauritius – thus return on investment for development of tools and methodologies is maximized

B. Limited knowledge, capacity, awareness and skills of all project stakeholders on electric mobility-based public transport in Mauritius

- This will be addressed by Component 2 and Component 4 activities that will focus on developing knowledge, skills and capacity building for electric public (bus) transport in Mauritius and also awareness raising

C. No investments in electric public bus transport and associated charging infrastructure in Mauritius, and lack of finance and leasing models

- This will be addressed by Component 3 activities that will deploy 30 electric buses for either regular long routes or short-loop, last mile connectivity from MetroExpress stations to neighboring, densely populated urban areas. Investment risk for demand side will be addressed through bundling demand for e-vehicles for demonstration in the region due to the proposed cooperation of this project with the global project, which could lead to lower vehicle costs
- Technology risk for supply side will be addressed through adequate training of vehicle operators and exchange between this proposed project numerous country-specific projects facilitated by the global e-mobility project

### Estimation of Global Environmental Benefits

This proposed GEF project proposes to facilitate the switch of 30 long route or feeder/last-mile diesel buses into electric semi-low floor models. An average diesel bus is estimated to emit about 1 kg of CO<sub>2</sub>e per km traveled (conservative estimate after accounting for a grid emission factor of 1.017 tCO<sub>2</sub>/MWh for Mauritius). Assuming a combination of solar powered and grid electricity powered charging is used for charging the 30 feeder e-buses to be used in Mauritius, which, when deployed, are estimated to operate for about 100 km per day, each e-bus is estimated to reduce atleast 36.5 tons of CO<sub>2</sub>e per annum. So 30 buses would achieve GHG benefits of ~10,950 tCO<sub>2</sub> by 2030. It is important to note that UNEP estimates that each electric bus reduces ~1.7 kg of CO<sub>2</sub> emissions per km of operation, when compared to a diesel bus of similar specifications. However, we have estimated CO<sub>2</sub> emission reductions of this proposed project using a more conservative 1 kg CO<sub>2</sub> per km of e-bus operation due to: (i) grid emission factor of Mauritius currently being high (1.017 tCO<sub>2</sub>/MWh) and an assumption that the 30 buses to be deployed under this proposed project are likely to be charged by a combination of solar energy and grid electricity; (ii) some or all of the 30 buses to be deployed under this proposed project could be smaller mini e-buses (for last mile connectivity from Metro Express stations), who are likely to achieve lesser CO<sub>2</sub> emission reduction when compared to full-sized e-buses.

Indirect GHG benefits are calculated based on a conservative assumption that after the completion of this project's implementation, it would be scaled-up to 100 additional e-buses for public transport in Mauritius over 5 years between 2026 and 2030. At the same conservative assumptions of 1 kg of CO<sub>2</sub>e per km of e-bus operation and average of 100 km per day of e-bus operation for the additional 100 buses between 2026 and 2030, indirect GHG emission reductions from this project are estimated to be 18,250 tCO<sub>2</sub>e by 2030.

More detailed analysis of CO<sub>2</sub> emission reduction from this proposed project's activities will be conducted during project preparatory phase, and analysis will be included in the detailed Project Document to be submitted for CEO ER.

In terms of number of passenger-trips impacted, based on conservative estimates of 30-35 passengers carried by each bus per last-mile trip from Metro Express stations to neighborhoods, and assuming each trip to cover 10 km distance; and based on an estimation of 100 km covered by each bus per day, each e-bus is estimated to offer ~350 passenger-trips every day. So 30 buses are conservatively estimated to offer ~10,000 passenger trips per day (which is 12.5% of the estimated 80,000 passenger trips per day likely to be offered by MetroExpress once its is fully operational). This works out to ~3.65 Million passenger-trips per annum to be provided by electric bus services that will be deployed with support from this project, when all 30 buses are fully deployed and operational.

It is important to recognize that when powered with grid electricity, e-buses will produce GHG emissions related to the electricity generation process. However, in most countries, emissions savings are expected when introducing e-buses even in case of carbon intense electricity grids that are used to recharge them. This is because of higher efficiency of electric drive technologies, versus ICEs..

The introduction of e-buses makes the transport system "future-ready" as it enables emission reductions to be generated automatically in the transport sector as the national electricity grid gets cleaner overtime. This is to say that even in case of carbon intense grids, timely and early introduction e-buses still make sense.

In this connection, as previously outlined, it is important to refer to the effort of Government of Mauritius to increase the penetration of renewable energy connected to the grid with the support of the ongoing GCF funded project to the level of 35% by year 2025, thus reducing the current grid emission factor. Therefore, as the grid will become less carbon intensive, the benefits of e-buses are increased.

This shows that the introduction of e-buses will result in GEBs even though Mauritius has a currently high grid emission factor. This is first because in most cases this will already produce net emission savings because of the higher efficiency, and second because grid emission factors are always expected to decrease as consequence of government policies and falling prices of clean technologies. Finally, to further accelerate the emission savings that can be achievable and avoid as much as possible emissions linked to electricity production, the project will look to develop direct integration of renewable energy into recharging stations for the e-buses with clean minigrids for battery recharge, making the buses truly net zero-emission

### **Innovativeness, Sustainability and potential for Scale-up**

**Innovativeness:** The project focuses on electric public bus transport for last-mile connectivity from MetroExpress stations using leasing models, which is essentially a deployment of a modern, smart, low-carbon technology innovation with an innovative business model for Mauritius. Moreover, the project is innovative in that it adopts a blended approach towards further supporting the deployment of electric mobility technology, through both support for technical assistance and access to viability gap financing. The financial incentive package component (component 2) will provide viability gap funding for deployment of 30 electric mobility technology-based buses for bus operators (both public and private sector bus operators). The project is further innovative in its use of public-private partnership model introduction and commercialization of electric mobility technology in Mauritius, wherein public investments in policy and financial de-risking for electric mobility would enable public and private sector bus operators to switch to electric mobility in their fleets. Innovative nature of this proposed project's deliverables are summarized below:

- e-mobility solutions (vehicles and charging)
- business models and financing schemes (bus leasing models, viability gap funding)

- renewable integration (solar charging stations)
- battery re-use, recycling and safe disposal
- financial mechanisms (subsidy as viability gap funding, potential for lease finance for commercialization and scale-up)

**Sustainability:** The project blends market-based principles such as bus leasing with subsidies and incentives to create a sustainable business and operational model for the project's activities to sustain over a medium-to-long-term on their own without the need for further policy/regulatory/financial interventions. The project not only provides demonstration of electric vehicle technology but a range of policy de-risking measures to create a sustainable market for e-mobility in Mauritius. Policy/regulatory interventions instruments, building up of adequate local knowledge and capacity, viability gap finance and business models such as bus leasing will stimulate increased participation of bus operators/investors in electric mobility in Mauritius. Demand for electric mobility will be created through an improved sense of ownership among commuters through provision of comfortable, affordable, safe and zero emission e-mobility transport solutions, and through awareness raising campaigns. The market oriented approach of this proposed project, which aims to blend technical assistance with viability-based financial support would ensure an increase in private sector participation in electric mobility in Mauritius. Efforts to mobilize funds from the GEF are incorporated upfront in this project's design through coordinated engagement and ongoing dialogue between Government of Mauritius, GEF and GCF Secretariats. Additional DFIs are also being targeted to ensure the results of the GEF project will be sustained and scaled up overtime

In terms of environmental sustainability, one of the proposed project's core objectives is to ensure environmental sustainability through the introduction and commercialization of low-carbon electric mobility in Mauritius, which would contribute towards climate change mitigation. The project also aims to ensure environmental sustainability of charging stations for electric buses, through incentives to solar charging stations.

Apart from the reduction in the emission of greenhouse gases, a leading cause of air pollution globally is emissions from vehicles. One of the fastest and most effective ways to reduce air pollution and thereby improve the health of the population, reduce their healthcare costs, and improve their lives is to reduce the number of emissions-producing vehicles. As the introduction of such electric buses will have significant benefits in terms of local air quality and reduction of particulate matter pollutants

The project also aims to reduce the risk of hazardous waste from used batteries by supporting the government setup policy and regulatory framework for safe recycling and disposal of battery components in the country.

**Replicability:** At the end of the project, the proposed activities of this project would have eliminated some of the key barriers to introduction and commercialization of electric mobility in Mauritius, through policy and financial de-risking activities, which in turn would have triggered a market-based approach and hence, strong interest from private sector bus operators and investors, which would support scaling up of electric mobility deployment on its own, potentially with further investments from GCF, other development banks and private investors.

If proven successful, the project's model will be replicated across the larger public and private bus transport industry in Mauritius, and the same principles, frameworks and models could be used to incentivize other forms of bus transport sectors including corporate employee transport, tourism industry's transport needs and so on. Besides, the success of this model will demonstrate the viability of electric bus transport in other SIDS countries such as Maldives, Pacific Island countries, Caribbean islands as well as in large, congested cities of Africa and Asia.

**1b. Project Map and Coordinates**

**Please provide geo-referenced information and map where the project interventions will take place.**

## 2. Stakeholders

Select the stakeholders that have participated in consultations during the project identification phase:

**Indigenous Peoples and Local Communities**

**Civil Society Organizations** Yes

**Private Sector Entities** Yes

If none of the above, please explain why:

**In addition, provide indicative information on how stakeholders, including civil society and indigenous peoples, will be engaged in the project preparation, and their respective roles and means of engagement.**

To date, the Government stakeholders including the Ministry of Public Infrastructure and Land Transport, The Ministry of Finance and Economic Development as well as the Road Development Authority, the National Transport Authority and representatives from Business Mauritius as well as main Bus Companies have participated in consultations. NGOs involved in road safety also participated in the preparatory consultative meetings held at the Ministry of Public Infrastructure and Land Transport. At project preparation stage, further consultations will be held with the Bus companies, NGOs and Academia i.e University of Mauritius, through the PPG phase Inception Workshop, and focus group meetings. The role of the Bus companies and private sector associations will be to provide feedback on the feasibility of the proposed approach and their capacity building requirements. NGOs would be consulted to provide input on their expectations of such systems and any recommendations for making the project a success. Finally, from academia it is expected that the project will benefit from their technical knowledge and views.

### 3. Gender Equality and Women's Empowerment

**Briefly include below any gender dimensions relevant to the project, and any plans to address gender in project design (e.g. gender analysis).**

As per normal project design for UNDP GEF projects, a gender analysis will be carried out at project development stage and a gender action plan will be designed, in compliance with UNDP and GEF Gender mainstreaming policies. These will enable the project to establish gender-based targets for training and capacity building activities, and also help identify employment opportunities in the operation of the new bus fleet.

As much as possible, capacity building activities will ensure inclusion of both women and men, as well as persons from disadvantaged backgrounds and minority groups. In addition, the project will incorporate women-friendly, senior citizen-friendly and disabled-friendly transport strategies and safety measures for public transport. The project will employ UNDP's Gender Assessment Tool. The project will also aim to address any harassment and safety issues for female commuters on public transport in Mauritius, via awareness raising campaigns and using modern technologies such as CCTVs that would be included in the e-buses that are proposed to be deployed under this proposed project.

**Does the project expect to include any gender-responsive measures to address gender gaps or promote gender equality and women empowerment? Yes**

**closing gender gaps in access to and control over natural resources;**

**improving women's participation and decision-making; and/or Yes**

**generating socio-economic benefits or services for women.**

**Will the project's results framework or logical framework include gender-sensitive indicators?**

Yes

#### 4. Private sector engagement

##### Will there be private sector engagement in the project?

Yes

##### Please briefly explain the rationale behind your answer.

Private sector engagement is a key feature of this proposed project and it is built into every component and activity proposed. As explained earlier, public buses in Mauritius are operated by 1 government-owned bus operator (NTC), 4 organized private bus operators and hundreds of private, individual bus operators. This project proposes to work with both govt-owned and private bus operators for providing financial incentives (component 2) for procurement and deployment of e-buses and solar charging stations, and also provide technical capacity and awareness raising activities (components 3 and 4) for all bus operators including private bus operators. Besides, the focus and strategy of this proposed project is for the government agencies (MPILT, NTA, others) to formulate suitable, consultation-based policy and regulatory mechanism, technical standards and specifications and other necessary frameworks/guidelines and then allow the market – mainly private sector bus operators -take over and scale up deployment of e-mobility based public transport in Mauritius. Essentially, the program is structured to create an enabling environment for the private sector to deploy and scale-up e-mobility in the country.

The modalities of the private sector consultations and engagement that will be planned for the further development of the project are as described below.

At project preparation stage, bus companies, and private sector associations will be convened to the Inception Workshop and invited to form part of a consultative committee to provide recommendations to the project design team on a fast track basis. The same members will also be invited to the Project Validation Workshop as well to the appraisal committee to ensure that their views are taken on board.

At project implementation stage, those bus companies and private sector associations will be invited to form part of the project steering committee. The list of bus companies and private sector associations concerned is as follows:

- 1) National Transport Corporation
- 2) Rose Hill Transport
- 3) United Bus Service
- 4) Triolet Bus Service
- 5) Business Mauritius
- 6) Mauritius Chamber of Commerce and Industry

## 7) Association of Bus companies

Collectively their role will be to provide inputs to inform the project on the barriers encountered in the sector, on the mechanisms being designed, the quantum of subsidies being proposed and as well as inform of the results being obtained and experiences acquired.

## 5. Risks

Indicate risks, including climate change, potential social and environmental risks that might prevent the Project objectives from being achieved, and, if possible, propose measures that address these risks to be further developed during the Project design (table format acceptable)

Risks	Assessment	Mitigation/Remediation Plan	Assessment
	without Mitigation		with Mitigation
<b>Macroeconomic Risks</b>			
High fiscal deficit and current account deficit widen, resulting in risks to import of electric buses due to balance of payment issues	Moderate	Continue policy dialogue with government to maintain prudent macroeconomic policies	Low
<b>Policy and Regulatory Risks</b>			
Inability or delay in introduction of policy and regulatory mechanism for electric mobility and/or fiscal/tax measures	Moderate	Continue dialogue with the Government to implement enabling conditions	Low
Weak coordination between various government and private sector stakeholders	Moderate	UNDP will work to ensure sufficient coordination is achieved among all stakeholders	Low
<b>Market and Business Risks</b>			
Affordability problem due to high upfront costs and e-buses and high interest rates on bank loans to bus operators for procuring e-buses	High	Partial capital subsidies offered as part of the project, and the project will work with banks for offering affordable financing	Moderate
Lack of knowledge and awareness	High	Awareness raising and capacity building are part of the project's design and ac	

s on e-buses

High

activities

Moderate

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**Technology Risks**

More efficient electric or plug-in hybrid bus technology becomes available after procurement of e-buses under this program

High

Continuously monitor technology and market developments in e-bus industry, and ensure latest technology is procured

Moderate

Other low-carbon mobility technologies such as hydrogen fuel cell-based technology become technically and financially viable

High

Continuously monitor technology and industry developments, and also ensure e-bus procurement is done in phases so that large-scale upfront commitment to e-bus technology is not made

Moderate

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**Climate/Environmental Risks**

As a SIDS country, Mauritius is vulnerable to the impact of climate change, such as tropical cyclones, floods and coastal erosion

High

Climate resilient designs, such as electric buses that can withstand flooding, would be included in the project design specifications; work with the government to reduce the impact of flooding through climate change adaptation of public transport and coastal areas

Moderate

Risk of unscientific disposal of used batteries leading to hazardous materials/chemicals entering Mauritius' ecosystems

High

Providing support to the government to setup policy and regulatory framework for safe recycling and disposal of battery components in the country

Moderate

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**Overall**

High

**Overall, several risks exist to the program's overall successful implementation but, if mitigation measures are effectively implemented, the project's benefits are expected to outweigh the potential risks**

Moderate

## 6. Coordination

**Outline the institutional structure of the project including monitoring and evaluation coordination at the project level. Describe possible coordination with other relevant GEF-financed projects and other initiatives.**

UNDP will be the implementing agency, with responsibilities related to technical support in activity design, project quality assurance, progress reporting, ensuring that Social and Environmental standards are complied with, quality of outputs is as per expectation. MPILT will be the Executing Entity, with responsibilities related to the execution of all activities in Components 1 to 5. UNDP will not have any direct implementation role.

Although UNDP won't have any direct implementation role, support services maybe requested during project implementation. The Government of Mauritius may request support services for specific projects, according to its policies and convenience. Based on a preliminary analysis this may include, but not be limited to, costs related to financial transaction management, recruitment of project staff, and procurement of goods. These supports will be provided only upon Government request. At PPG stage, further analyses will be performed, for example including HACT assessments, to determine which entity is the best actor to provide these support services and what are the exact associated cost.

The focal point of this project will be the Ministry of Public Infrastructure and Land Transport (MPILT), and it will be responsible for the coordination of the project with other related, ongoing electric mobility initiatives in the country, both public and private. The project will be implemented in close coordination with the MetroExpress LRT project that is currently under construction, to maximize effectiveness and impact. UNDP will facilitate the cooperation of this proposed GEF project with other relevant projects such as the UNDP-UNE global e-mobility programme. The project will help facilitate the introduction and commercialization of electric mobility technology for public transport in Mauritius, complementing other efforts to reduce transport-related GHG emissions in the country. A coordination mechanism with other donors and development agencies that are interested in electric mobility investments in Mauritius, such as GCF and AFD will also be established.

For project implementation, a Project Management Unit (PMU) will be established within MPILT and a Project Board will be established within the MPILT comprising representatives of MPILT, UNDP, MEPU, MoFED, NTA, TMRSU, NTC and private bus operators. Representatives of Metro Express Limited (MEL) would also be invited for selected coordination meetings. MPILT will take a lead in implementation and coordination of the project, and technical assistance will be supported by the proposed GEF project as necessary. This proposed implementation and coordination arrangement is explained in the table below.

<b>Role</b>	<b>Organization(s)</b>
Lead Implementation Agency and Project Management Unit (PMU)	Ministry of Public Infrastructure and Land Transport (MPILT)
Project Coordination Committee – Core Members	<ul style="list-style-type: none"> <li>○ MPILT</li> <li>○ UNDP</li> <li>○ Ministry of Energy and Public Utilities (MEPU)</li> <li>○ Ministry of Finance and Economic Development (MoFED)</li> <li>○ National Transport Authority (NTA)</li> <li>○ Traffic Management and Road Safety Unit (TMRSU)</li> <li>○ National Transport Corporation (NTC)</li> <li>○ Private Bus Operators</li> </ul>
Project Coordination Committee – Additional Members (invited only to selected coordination committee meetings as relevant)	<ul style="list-style-type: none"> <li>○ Ministry of Environment and Sustainable Development</li> <li>○ Road Transport Authority (RTA)</li> <li>○ MetroExpress Limited (MEL)</li> <li>○ NGO and Civil Society</li> </ul>

## 7. Consistency with National Priorities

**Is the Project consistent with the National Strategies and plans or reports and assessments under relevant conventions**

Yes

**If yes, which ones and how: NAPAs, NAPs, ASGM NAPs, MIAs, NBSAPs, NCs, TNAs, NCSAs, NIPs, PRSPs, NPFE, BURs, INDCs, etc**

- Technology Needs Assessment (TNA) under UNFCCC (2012)
- National Communications (NC) under UNFCCC (Second National Communication to UNFCCC 2010)
- Others - Mauritius Transport Consensus Forums
- Others – Long-term Energy and Transport Strategy 2009-2025, Government of Mauritius

The project is in accordance with the Nationally Determined Contributions document which makes specific provision for the development of sustainable transport in Mauritius and the need for more energy efficient mass transportation systems based on cleaner energy sources. Furthermore, The Third National Communication also mentions the transport sector as being one of the main emitters of greenhouse gases and uses electric mobility as one of the potential alternative scenarios

## 8. Knowledge Management

**Outline the Knowledge management approach for the Project, including, if any, plans for the Project to learn from other relevant Projects and initiatives, to assess and document in a user-friendly form, and share these experiences and expertise with relevant stakeholders.**

The proposed project aims to collaborate with UNEP's global e-mobility program on knowledge sharing, management and info dissemination activities.

Component 2 of this project includes a focus on capacity building and knowledge management activities in order to address skills, knowledge and information gaps. As part of the knowledge management sub-component, the project will facilitate the creation of a network to support knowledge sharing on electric bus transport among policymakers, bus operators, service providers, and financial institutions who are key market enablers. Other than the formal knowledge network, the project will facilitate participation in local, national, regional and global knowledge sharing events such as workshops and conferences by key stakeholders in order to disseminate its lessons and best practices and to learn from other projects.

Beside the capacity building and awareness raising activities of components 2 and 4, the following knowledge management practices will also be implemented such as: 1) gathering an overview of existing lessons and best practice that inform project concept at project design stage; 2) in the same vein, at project design stage learn from relevant projects, programs, initiatives & evaluations; 3) during project implementation, the project team will capture, assess and document information, lessons, best practice & expertise generated; 4) furthermore, tools and methods for knowledge exchange, learning & collaboration will be explored such as the possibility of south south exchanges; 5) As the project progresses, technical and lessons learnt reports will be produced and shared with stakeholders; 6) At key milestones, i.e. mid term review and terminal evaluation, discussion will be held on how knowledge and learning will contribute to overall project/program impact and sustainability and 7) finally, the project will develop plans for strategic communications and contribute to such communications as well. The development of the PIF was largely based on reviews of global developments in the transport sector. At CEO ER stage, the knowledge management plan will be further enhanced.

**Part III: Approval/Endorsement By GEF Operational Focal Point(S) And Gef Agency(ies)**

A. RECORD OF ENDORSEMENT OF GEF OPERATIONAL FOCAL POINT (S) ON BEHALF OF THE GOVERNMENT(S): (Please attach the Operational Focal Point endorsement letter with this template).

<b>Name</b>	<b>Position</b>	<b>Ministry</b>	<b>Date</b>
Mr. D.D. Manraj Gosk	Financial Secretary and GEF Operational Focal Point	Ministry of Finance and Economic Development	10/4/2019

## ANNEX A: Project Map and Geographic Coordinates

Please provide geo-referenced information and map where the project intervention takes place

The generally used coordinate of Mauritius island is: 20.3484° S, 57.5522° E

