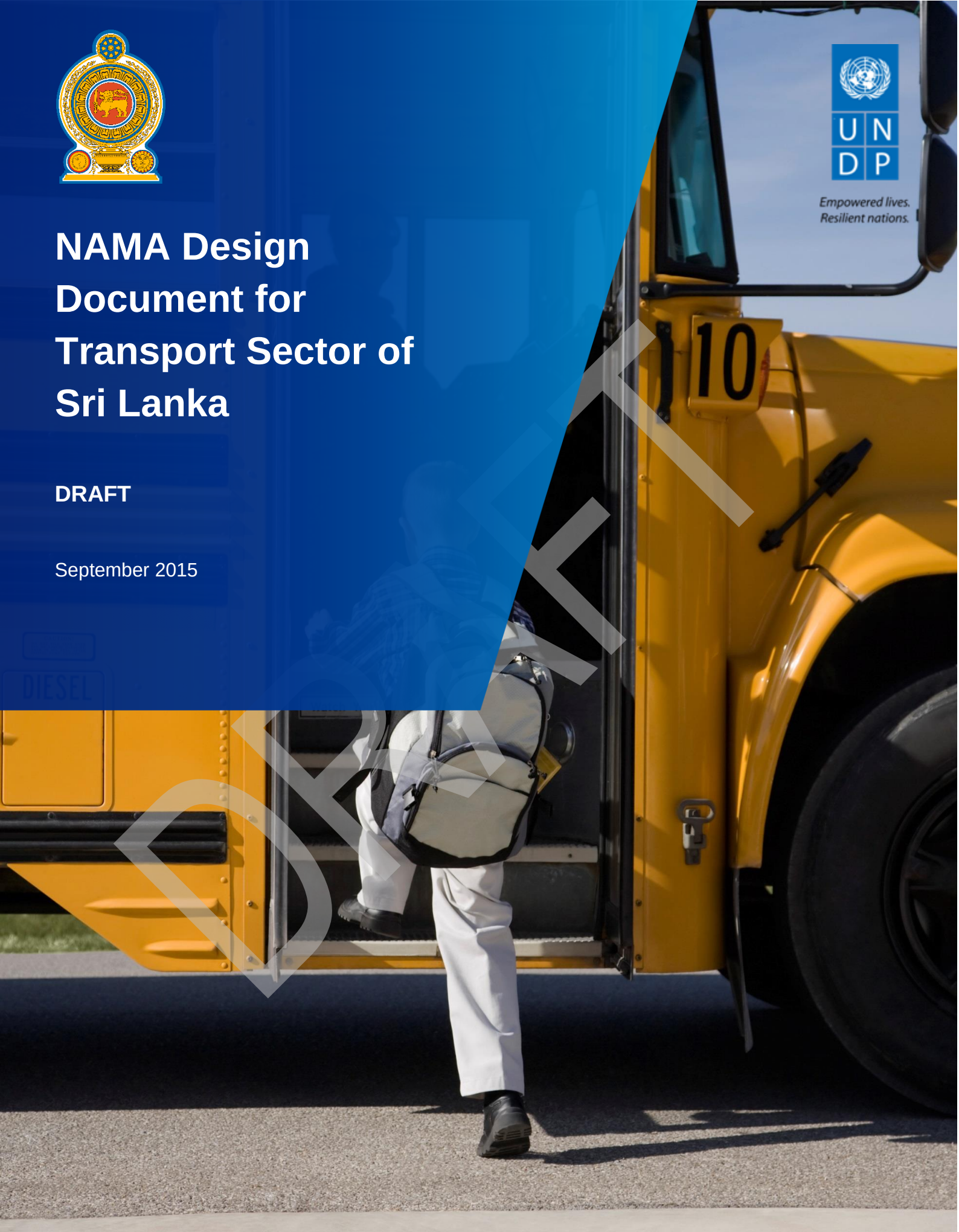
NAMA Design Document for Transport Sector of Sri Lanka

DRAFT

September 2015



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1. Introduction

1.1. Transport and Development

Mobility of goods and people from one place to another has been an integral part of human existence since the dawn of civilization and as a result, transport activity is considered to be one of the most essential components in economic development and human welfare. In today's world, this activity, motorized transportation in particular, is growing at a rapid pace and will continue to grow, fuelled by the growth of economies around the world, especially developing economies.

While the growth of the transport sector drives increased economic growth globally through the facilitation of specialization and trade, it is also fast becoming the highest emitter of greenhouse gases globally, resulting in a large contribution to climate change. As of 2010, the transport sector was responsible for producing 7.0 $GtCO_2eq$ of direct GHG emissions, including non-CO_2 gases. Out of the 7.0 $GtCO_2eq$ of GHG emissions, CO_2 emissions constitute 6.7 Gt which translates to 23% of the total energy-related CO_2 emissions globally (IPCC, 2014).

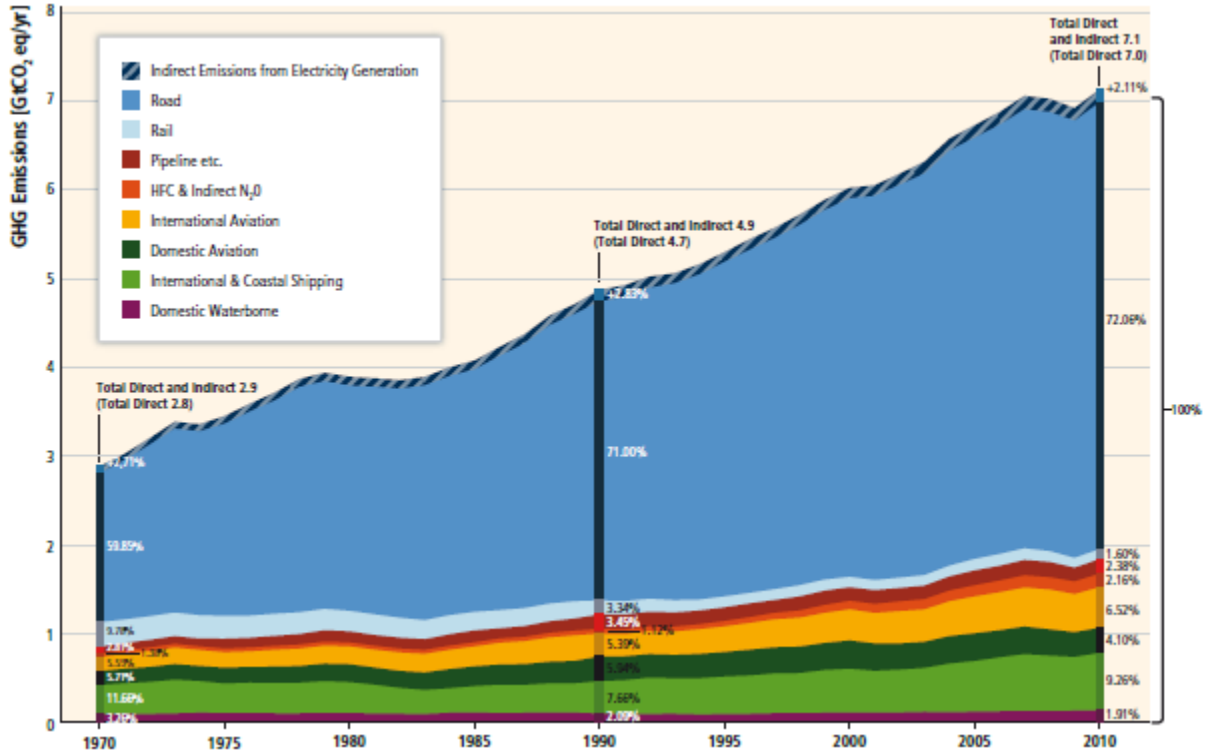

Figure 1: Direct emissions of the transport sector (250% increase from 1970 to 2010) (Source: IPCC, 2014)

94% of the total energy used by world transport is sourced from a single fossil fuel, petroleum. The global transport sector's excessive reliance on fossil fuels for energy, has resulted in a continued growth in GHG emissions in spite of more efficient vehicles (road, rail, water craft, and aircraft) and policies being adopted. Without robust mitigation policies being implemented, transport emissions could increase at a faster rate than emissions from the other energy end-use sectors and reach around 12 Gt CO_2eq/year by 2050 (IPCC, 2014).

Furthermore, while transport demand per capita in developing economies is currently far lower than that in OECD countries, given the rapid growth of developing economies, the demand per capita is likely to increase, subsequently resulting in a further increase in GHG emissions, thus aggravating the situation further. Hence, while the transport sector plays an integral role in the growth and development of the global economy, the world's dependence on fossil fuels to drive and grow the sector is untenable, from the perspectives of both resource management (petroleum is a finite resource) as well as global efforts to abate the effects of climate change.

In light of the current scenario of transportation in the world, it is imperative that countries especially developing economies develop sustainable, inclusive green growth strategies that will simultaneously help achieve GHG emissions reductions and reduce the sector's dependence on fossil fuels. These strategies could entail multiple measures including modal shifts to low-carbon transport systems such as BRT systems and the use of alternative technologies that reduce the carbon intensity of fuels (e.g. use of electric vehicles). Apart from providing direct GHG reduction benefits, sustainable transport strategies also provide multiple sustainable development benefits such as cleaner air and improved health benefits due to reduced pollution as well as employment creation through the development of ancillary industries.

However, while sustainable transport strategies involve low operational costs especially when compared to conventional fossil fuelled transport strategies, they require higher initial capital costs. Additionally, there are challenges of local-level maintenance, availability, and awareness of the technologies, which remain barriers to increased uptake. These challenges are compounded by the traditional issues faced by public modes of transport (e.g. buses, railways) such as low quality of service, low frequency, poor access, lack of integration with other modes of transport, etc. All of which contribute to a very poor image of public transport, leading consumers to veer towards conventional modes of private transport, thereby resulting in higher GHG emissions. Thus, in order to increase the adoption of alternative, cleaner technologies in the transport sector it is essential to establish robust support mechanisms for successful deployment of alternative forms of transportation. As sector-transforming instruments, Nationally Appropriate Mitigation Actions (NAMAs) have the potential to increase the adoption of sustainable and low emission modes of transport in developing countries.

1.2. Nationally Appropriate Mitigation Actions (NAMAs)

NAMAs are voluntary, non-binding policy instruments that provide a framework for pursuing a country's socio-economic and development goals, while contributing towards global greenhouse gas mitigation efforts. They were first introduced at the 13th Conference of the Parties (COP13) in Bali in 2007. Many developing countries are taking steps to develop and implement NAMAs; they can help countries achieve their growth objectives and participate in the global climate change mitigation agenda. NAMAs help governments leverage national and international support to achieve appropriate, effective and

transformational GHG mitigation and sustainable development targets for the country and within communities.

COP 19 in 2013 saw the introduction of Intended Nationally Determined Contributions (INDCs), which were to be submitted by all parties, developed and developing, to the United Nations Framework Convention on Climate Change (UNFCCC). The INDCs are for the period following 2020 and detail the actions the parties will take to address climate change. The types of actions (e.g. mitigation, adaptation) and the means of implementation to be included are yet to be determined. While the exact relationship between INDCs and NAMAs is yet to be clearly defined, both incorporate short/medium-term goals, with NAMAs also acting as a possible implementation tool to translate those short/medium-term goals into action by outlining the means and action plans to implement them (GIZ/UNEP, 2014).

1.3. A Transport NAMA – An Opportunity for Sustainable, and Inclusive Green Growth in Sri Lanka

NAMAs can be seen as one of the most promising voluntary instruments for reducing GHG emissions in developing countries while offering flexibility as to the interventions that can be employed. However, the objectives of a NAMA must go beyond its desired impact on GHG emission reductions to include the achievement of significant sustainable development goals that can benefit the country and its inhabitants as a whole.

Even though NAMAs are often praised as an innovative instrument of climate policy, the basic concepts are well known and established in developed countries in the form of national climate and environmental policies. The new elements are their transformation to address the special needs and circumstances of developing countries, and the availability of international financial and technical support for their implementation from developed partners.

Since the end of a three-decade long war, Sri Lanka has made good progress in restoring transport infrastructure and services throughout all provinces of the country. However, the growth of the sector has come at an ecological, social and economic cost, with most of the steps taken increasing Sri Lanka's dependence on the use of conventional fossil fuel driven modes of transportation. The lack of robust public transportation networks has also led to an increase in the adoption of private, low occupancy means of transportation giving rise to issues of urban congestion and pollution.

While Sri Lanka's existing policy framework targets these issues through various policies aimed at increasing the reach and utilization of public transport systems like buses and railways as well as the adoption of alternative, cleaner modes of transportation like hybrid vehicles, a marked lack of financing is hindering the successful implementation and deployment of these policies.

Thus, a NAMA framework that promotes the adoption of clean and sustainable transportation interventions, presents a novel solution to the problem at hand by providing access to international finance which can help forward programs and policies that promote the use of electric buses in a BRT system, in turn resulting in reduced GHG emissions and increased sustainable development benefits..

The proposed transport NAMA for Sri Lanka focuses on the promotion and adoption of electric buses in a BRT, thus addressing the objectives of reduction in GHG emissions and multiple SD objectives like

increased energy security, improved access to transportation, improved air quality and local job creation among others.

The NAMA differs from traditional funding mechanisms which promote sustainable transport because of three key components, summarized in Figure 2:

- **Alignment with country objectives:** The intervention under the NAMA framework are prioritized in line with the socio-economic development objectives of the host country. It takes into account the current social, economic and policy landscapes of the Sri Lankan transport sector and provides innovative technical and financial mechanisms to augment them and help Sri Lanka achieve its sectoral and country objectives like increased energy security, reduced environmental damage and employment creation, among others.
- **Focus on sustainable development:** The NAMA is designed with sustainable development benefits in mind. The design includes a focus on the development and implementation of an intervention that provides additional sustainable co-benefits like cleaner air, employment generation through the promotion of ancillary industries, an increased energy security due to a reduced dependence on fossil fuels, among others.
- **Facilitates transformative change:** The NAMA will spur the development of an environment which facilitates transformative change in the transport sector. An enticing regulatory and policy environment which incentivizes the participation of the private sector will be created, thus ensuring the intervention's longevity and sustainability. The business models associated with the NAMA intervention will be developed in a manner that can be easily replicated in other communities across the country.

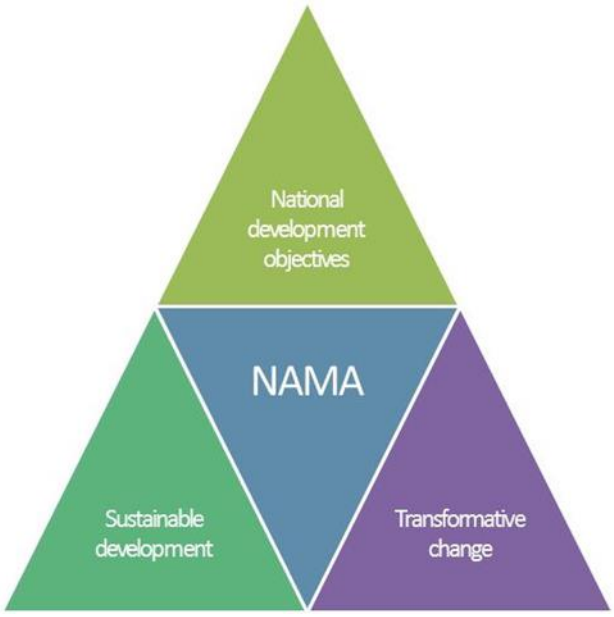

Figure 2: Components of a NAMA

The NAMA framework has been designed to be embedded into existing Sri Lankan sectoral development goals and objectives The NAMA will build on the feasibility studies carried out by JICA on behalf of the Sri Lankan Government ("Urban Transport System Development Project for Colombo Metropolitan Region

and Suburbs") and Sri Lankan Government's Department of Transport and Logistics Management, along with the faculty of engineering of the University of Moratuwa ("Study of Implementation of Bus Rapid Transit on Galle Road"), detailing the suitability and feasibility of a BRT (modal shift to low-carbon transport system) in the capital city of Colombo by introducing electric buses, replacing conventionally fossil fuelled buses in the BRT (alternative technologies that reduce the carbon intensity of fuels).

2. Transport Sector in Sri Lanka

2.1. Geography

Sri Lanka is situated in the south eastern part of Asia, with a total land area of about 62,710 sq.km. (World Bank, 2015a). It is a tropical island lying close to the southern tip of India and near the Equator. The country's population, according to the 2012 Population and Housing Census was 20,271,464. The annual growth rate of the population is 1.0 percent over the past 31 years. Majority of the population (28.7%) is concentrated in the Western province making its population density 1,621 persons per sq.km as against the national average of 323 persons per sq.km. The percentage of urban sector population is reported as 18.3 percent followed by 77.3 percent in rural sector and the balance of 4.4 percent in the estate sector (Government of Sri Lanka Department of Census and Statistics, 2012).

Figure 3: Map of Sri Lanka

2.2. The Economy

Economic growth in Sri Lanka has been among the fastest in South Asia in recent years. Growth averaged 6.3 percent between 2002 and 2013, with Gross Domestic Product (GDP) per capita rising from USD 859 in 2000 to USD 3,256 in 2013 (World Bank, 2015b). The annual growth rate in GDP of the country since 2005 is illustrated in the figure below.

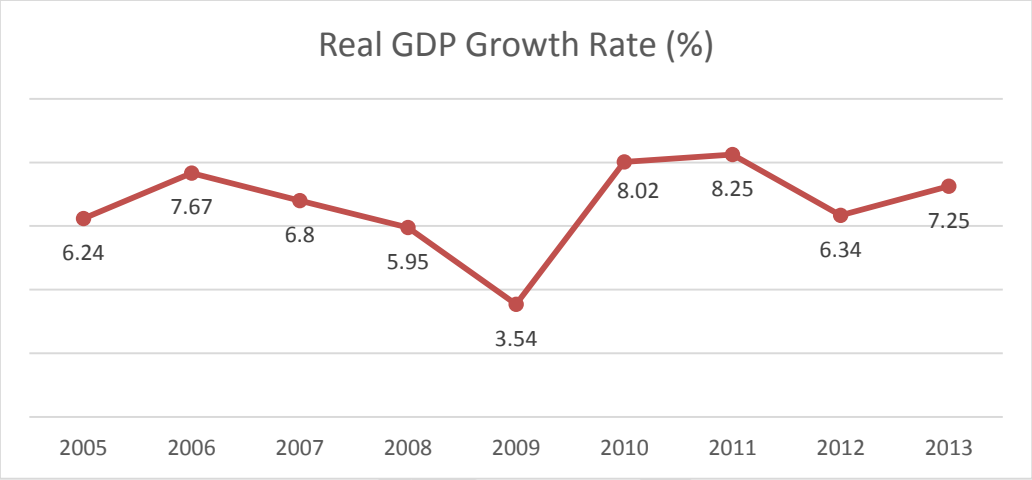

Figure 4: Sri Lanka's GDP Growth, 2005-2013 (Source: ADB, 2015)

The GDP grew by 7.4% during 2014, up slightly from 7.2% in 2013. The continued high growth was driven by faster expansion in industry, which offset substantially weaker growth in agriculture (ADB, 2015).

2.3. The Millennium Development Goals

In 2000, world leaders adopted the United Nations Millennium Declaration and, along with it, the Millennium Development Goals (MDGs) which aimed to reduce extreme poverty by 2015.

The Government of Sri Lanka also signed the Millennium Declaration along with other member countries of the United Nations (UN). It further included the MDGs into its ten year development plan "Mahinda Chintana: Vision for a new Sri Lanka" which extends from 2006 to 2016, thus according high priority to achieving them and showing the determination to meet set targets within stipulated time frame. Key initiatives introduced by the Government in this context include the establishment of Dairy villages, Irrigation rehabilitation, Medicinal herbal villages, Industrial villages, Community managed water supply schemes, Rural IT centers and Programmes to improve rural infrastructure (Government of Sri Lanka Department of Census and Statistics, 2008).

The latest MDG Country Report, jointly launched by the UN and the Government of Sri Lanka earlier in 2015 demonstrates Sri Lanka's progress in achieving seven out of the eight relevant development goals that were agreed by the world leaders in 2000 (United Nations, 2015). These have been summarized in the following table:

Millennium Development Goals	Sri Lanka's Performance
MDG 1: Eradication of Extreme Poverty and Hunger	Sri Lanka achieved the target of halving poverty at the national level seven years before 2015. • National poverty incidence declined from 26.1 percent in 1990-1991 to 6.7 percent in 2012-2013. • The urban sector reached the target in 2000; the rural sector in 2008.
MDG 2: Achieve Universal Primary Education	Sri Lanka has almost achieved universal primary education, and the proportion of pupils starting grade 1 who reach grade 5 is nearly 100 percent. • The literacy rate of 15 to 24 year olds increased from 92.7 percent in 1996 to 97.8 percent in 2012. • This increase is seen in all regions with the rate for females at 98.2 percent, exceeding the rate for males at 97.2 percent.
MDG 3: Promote Gender Equality and Empower Women	Sri Lanka has almost reached gender parity in primary education. • The ratio of girls to boys reached to 99.4 percent in 2012. • The share of women in wage employment in the non-agricultural sector, however, has not changed. • The proportion of seats held by women in the national Parliament remains very low.
MDG 4: Reduce Child Mortality	Sri Lanka is on track to achieve the target of reducing both the under-five and infant mortality rates by two-thirds of the level of the base year by 2015, if present trends continue. • The proportion of one-year-old children immunized against measles increased from 95.5 percent in 1993 to 99 percent in 2011.
MDG 5: Improve Maternal Health	Sri Lanka is expected to meet the target of reducing the ratio by three-fourths over the baseline year of 1990. • The maternal mortality ratio declined from 92 deaths per 100,000 live births in 1990 to 33.3 in 2010. • The proportion of births attended by skilled birth attendants, more than 70 percent of whom were doctors, had almost reached the target of 99.8 percent in 2010.
MDG 6: Combat HIV/AIDS, Malaria and Other Diseases	Although Sri Lanka remains a low prevalence country, the number of HIV/AIDS cases is gradually increasing. • Sri Lanka has managed to bring malaria cases down from 400,000 in the early 1990s to 23 by 2012. • No indigenous cases since November 2012 and no malaria-related deaths since 2007.
MDG 7: Ensure Environmental Sustainability	• Total forest cover has fallen. • Carbon dioxide emissions more than trebled between 1990 and 2004, but stabilized after 2004. • Sri Lanka has met the target for the proportion of people with access to safe drinking water and basic sanitation.
MDG 8: Develop a Global Partnership for Development	• ODA flows received as a percentage of Sri Lanka's gross national income (GNI) fell from 1.5 percent in 1997 to 1 percent in 2011. • Sri Lankan imports admitted duty free into developed countries significantly declined from almost 70 percent in 2010 to 37.5 percent by 2011. • Sri Lanka's debt-services-to-exports ratio remains relatively high compared to other developing countries in Asia-Pacific. • Telephone density has increased rapidly with the number of telephone connections exceeding the country's population.

Table 1: Sri Lanka Millennium Development Goals (MDG) Progress

While the Millennium Development Goals are on their way to being replaced by Sustainable Development Goals (SDGs), which will come into effect from the 1st of January 2016, the MDGs still form a strong base on which to adopt and further the SDGs.

2.4. Transport Sector Overview

The transport sector has played a crucial role in the economic and social upliftment of Sri Lanka. In 2003, the sector contributed to 10 percent of the country's GDP and generated about 4 percent of employment (World Bank, 2015c). By 2012, the contribution to GDP had increased to 14 percent (Government of Sri Lanka Department of Census and Statistics, 2013). However, the sector is also responsible for a majority of the country's greenhouse gas (GHG) emissions – almost half of the total emissions in the energy sector are from transportation.

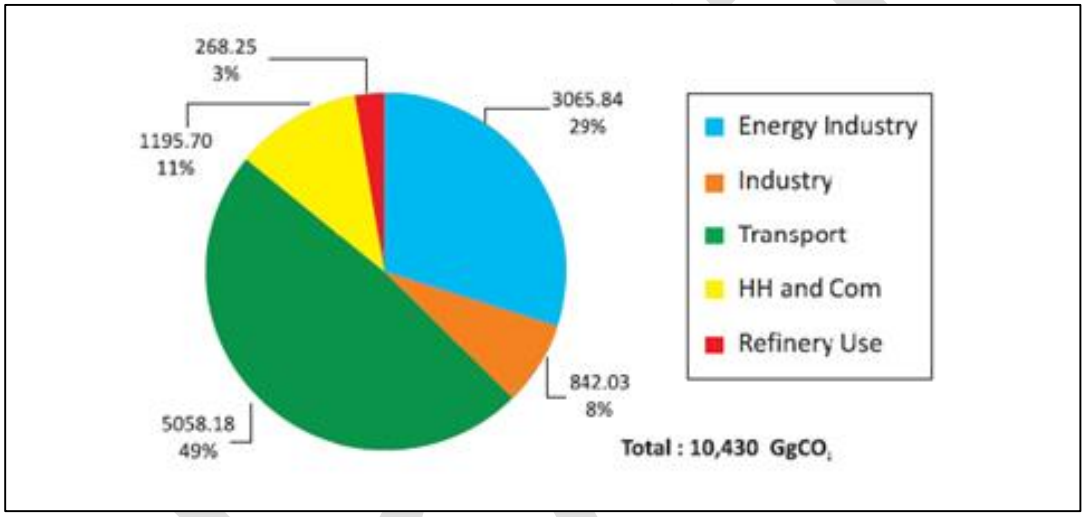

Figure 5: Breakup of CO_2 emissions in Sri Lanka
(Source: Government of Sri Lanka Ministry of Environment, 2011)

Sri Lanka depends heavily on its public transportation systems with buses and trains forming the backbone of the system with limited presence of sea and air transport in the domestic setup. The domestic passenger transport sector is primarily made up of cars, vans and motor cycles for private transport, while the public transport sector largely consists of buses and a small percentage of para-transit vehicles.

The various modes of transport prevalent in the country are discussed below:

Road Transport: Roads are the backbone of the transport sector in the country. They are vital for the movement of people and goods and play an important role in integrating the country, facilitating economic growth, and ultimately reducing poverty. National roads carry over 70 percent of the traffic in Sri Lanka (World Bank, 2015c). The country currently has around 11,700 km of major national highways, supplemented by 15,500 km of provincial roads, 65,000 km of local authority roads and about 24,000 km of roads owned or

controlled by irrigation, wildlife and other government authorities (Government of Sri Lanka Ministry of Environment, 2011).

Within the road sector, buses dominate the passenger transport section as seen in the modal share (2007) figures given below (University of Moratuwa, 2011).

As of 2012, the demand for passenger travel was around 80 billion passenger-kilometres (pkm) per year, of which road transport accounts for 93%. About 97% of freight traffic, measured in ton-km, is conveyed by road (ADB, 2012). Therefore, it is evident that roads dominate Sri Lanka's transportation landscape, both for passenger as well as freight movements.

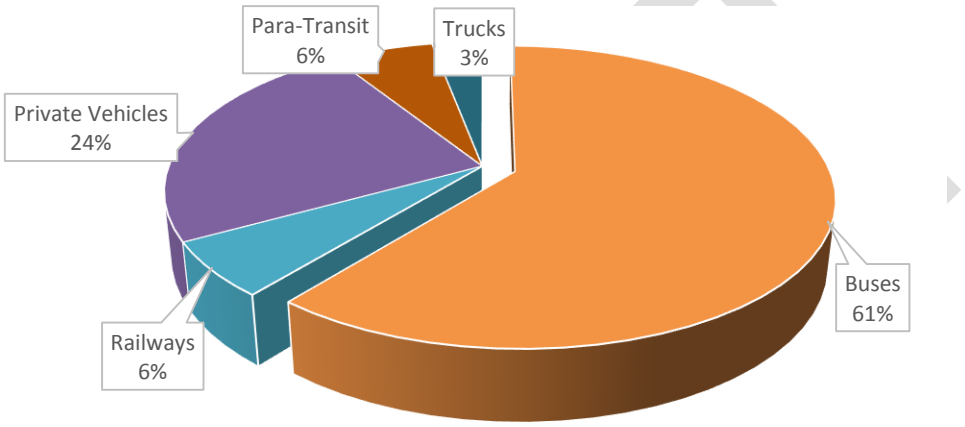

Figure 6: Modal share of road transport
(Source: University of Moratuwa, 2011)

Railways: Sri Lanka has around 1,450 km of railway track, an amount that has not changed since its independence, most of which is limited to single gauge track. The railway fleet is currently made up of about 200 diesel electric locomotives along with 46 diesel power sets and is responsible for carrying about 5% of Sri Lanka's total passenger traffic, amounting to around 4,567 million passenger-kilometres annually (2009). While Sri Lanka Railways (SLR) played a dominant role in the country's transport sector until 1928, its share in passenger and freight transportation has reduced drastically. The freight movements handled by the railways has come down drastically from 32% in 1979 to a paltry 1% today, emphasising the need of an overhaul in this sector. The railways continue to face serious competition from road transportation, and have been adversely affected by the country's two-decade war on terrorism.

Ports: Sea transport in Sri Lanka, with the three major ports of Colombo, Trincomalle and Galle, handles the bulk of Sri Lanka's freight imports and exports. There is little to no movement of passengers or freight within Sri Lanka by sea. Most of the internal movement is restricted to inland waterways with ferries and fishing boats plying both passengers and cargo. The Port of Colombo, the country's premier commercial port, is considered to be one of the premier ports in Asia. It handles both conventional cargo as well as containers, and has been acknowledged as one of the most economical ports in the region. After economic liberalization, a port expansion program, and the onset of containerization and trans-shipment cargo, port traffic grew at an average rate of 6.5% per year and reached the equivalent of 4 million containers of twenty-foot equivalent units in 2010 (ADB, 2012).

Air Transport: Sri Lanka has one international airport and 13 domestic airports with 2 national carriers operating international as well as domestic routes. The civil aviation sector has seen healthy growth in recent times, though most of this growth has come from international passenger and cargo movements.

The table below illustrates that while the transportation sector as a whole is important to look at in terms of NAMA opportunities, given the modal mix of GHG emissions within the sector where roads are responsible for 88% of the total emissions, followed by the air sector as a distant second (9%), it is prudent to focus on NAMA opportunities specifically in Sri Lanka's road transportation sector.

Sector	Emissions (Gg)						
	CO_2	CH_4	N_2O	CO	NO_X	NMVOC	SO_2
Road	4444.03	0.47	0.04	131.47	46.96	25.26	7.50
Rail	80.46	0.01	0.00	1.09	1.31	0.22	0.15
Air	496.99	0.00	0.01	0.70	2.10	0.35	0.16
Sea	36.70	0.00	0.00	0.50	0.75	0.10	0.17
Total	**5058.19**	**0.48**	**0.05**	**133.76**	**51.13**	**25.93**	**7.98**

Table 2: Modal mix of GHG Emissions (Transportation)

2.4.1. The Colombo Metropolitan Area (CMA)

The Colombo Metropolitan Area (CMA), which consists of the Colombo Municipal Council (CMC) and its adjacent areas is the largest metropolitan area in Sri Lanka with a population of 3.7 million as of 2012. This is estimated to grow to 5.1 million by 2035 bringing along with it increased economic growth and demand for transportation.

During this period, it is estimated that population growth will result in a 1.75 times increase in the total person trip demand. This increase is going to be accompanied by a significant increase in trip demand made by private modes of transportation, a result of the economic growth of individual households.

Figure 7: Colombo Metropolitan Area (CMA)

The increase in private traffic demand coupled with a number of issues such as reduced utilization of high occupancy vehicles, lack of capacity of public modes of transportation, inefficient road and traffic control infrastructure has led to a degradation in the speed of vehicles on the roads of Colombo resulting in higher operating costs for vehicles (economic damage) and greater congestion and pollution (environmental damage) throughout the city of Colombo. Given the status of Colombo as the economic driver of the country where it is responsible for almost half of Sri Lanka's economic activities, the negative effects of an ailing transportation system is felt throughout the country.

Furthermore, the capital intensive nature of transportation infrastructure makes it difficult for the Sri Lankan government to develop all the facilities required to alleviate the current situation of transportation in Colombo, all by itself.

Thus, given the importance of Colombo and the nature of investment required, it was deemed prudent to look at international donor support in the form of NAMAs to kick start transportation projects that will help Sri Lanka develop sustainable, economic and efficient modes of urban transportation, not just in Colombo but throughout the country.

2.5. Policy Environment

The Sri Lankan transport landscape is governed by a number of policies that include policy frameworks that were designed solely to cater to the transport sector as well as frameworks that view the transport sector through a broader lens of climate change and sustainable development. These policies have been detailed in the following sections:

2.5.1. National Transport Policy

The 'Draft National Policy on Transport in Sri Lanka', 2008 by National Transport Commission, Ministry of Transport is the key document addressing the national objectives and strategies for Sri Lanka's transport sector. The objective of this National Policy is to set out explicitly, the interventions of Government in 'ensuring that existing and potential mobility needs within the country for passengers and goods transport are satisfied safely and efficiently at least cost to the economy by using the minimum amount of resources and causing least impact on the environment'.

The main objectives which are, directly or indirectly, in support of the identified NAMA intervention are:

- To encourage the use of public transport, high occupancy vehicles and non-motorized transport, under the Section 'Modal preference and Choice'.
- To take steps to reduce the dependency on petroleum fuels for the country's mobility requirements.
- To reduce the number of vehicles circulating within urban area in order to make a greater proportion of limited road space available for high occupancy vehicles.
- To ensure that at least 1/3rd of existing road space on major highways within a dense urban area be reserved for high occupancy vehicles. Such areas to be utilized for high priority bus lanes, light transit systems (trams) or bus rapid transit (BRT) systems.
- Providing incentives (such as tax rebates) for new technologies such as hybrid vehicles and new source of fuel such as bio fuel is a proposed intervention

2.5.2. National Action Plan for the Haritha Lanka Programme

The National Action Plan for the *Haritha* Lanka Programme, 2009 is the product of the concerted effort of various ministries in Sri Lanka, which lays down the proposed strategies and actions that are set out to focus on fulfilling the ten mission statements of the programme. The main objectives of the Plan which are, directly or indirectly, in support of the identified NAMA intervention are:

- Implementation of mass transit systems such as 'MRT/LRT, BRT including Premium Bus- Service & one-way systems with centre-flow bus lanes in metropolitan regions', as a strategy for meeting Mission 1: Clean Air Everywhere
- Promoting the use of alternate transport fuel technologies that reduce GHG emissions, as part of Mission 3: Meeting the Challenges of Climate Change

- Introduction of efficient public transport systems including bus lanes where necessary, MRT systems, LRT systems, etc. integrated in the townscape in an aesthetic manner, as a strategy towards meeting Mission 8 : Green Cities for Health and Prosperity

2.5.3. Mahinda Chintana - Vision for the Future (Development Policy Framework)

The Mahinda Chintana vision is based on the economic philosophy that the growth in Gross Domestic Product (GDP) alone would not bring economic prosperity to the society. Followed by the 'Mahinda Chintana Vision for a new Sri Lanka' which was prepared in 2005, 'Mahinda Chintana – vision for the Future' was prepared by Department of National Planning, and Ministry of Finance & Planning in 2010.

The main objectives which are, directly or indirectly, linked with the identified NAMA intervention are:

- Complementary public transport systems like Bus Rapid Transit (BRT), Light Rail Transit (LRT) and Mass Rapid Transit (MRT) systems will be introduced to Colombo and suburbs providing more choices of different modes.
- Environmental sustainability will be achieved through the use of electric vehicles and hybrid vehicles in the transport sector to increase the efficiency and reduce pollution.

Other proposed activities include electrification of trail transportation, a high speed monorail transport system for Colombo, and, construction of Mass Rapid Transit Underground rail system in the city limits connecting other rail lines thereby linking all parts of the country Buses with a greater seating capacity, television, radio and internet facilities.

The policy also proposes enhancement of private sector participation by strengthening Public-Private Partnerships (PPPs) and opportunities for Foreign Direct Investments (FDIs).

2.5.4. Urban Transport Master Plan

The Urban Transport Master plan unites road network with economic development and provides for approaches to long-term maintenance of the road network in the country and to safeguard adverse social and environmental impacts of transport. The Plan is a highly comprehensive document that proposes various strategies for public transport and road networks, while also taking into consideration the institutional setup and financial arrangements for the proposed activities.

One key proposed intervention is to set up a BRT system in Colombo, and promotion of hybrid cars and electric vehicles is also proposed as a 'policy measure for air pollution and traffic noise reduction and promotion of health in transport'.

2.5.5. National Climate Change Policy

The National Climate Change Policy of Sri Lanka has been developed to provide guidance and directions for all the stakeholders to address the adverse impacts of climate change efficiently and effectively. It contains a vision, mission, goal and a set of guiding principles followed by broad policy statements under Vulnerability, Adaptation, Mitigation, Sustainable Consumption and Production, Knowledge Management and General Statements. The transport sector strategy is stated as "Taking action to promote integrated transportation systems, low emission fuels and improved fuel efficiency taking into consideration the long term sustainability of the existing resources."

2.5.6. Sri Lanka Strategy for Sustainable Development

The Sri Lanka Strategy for Sustainable Development developed by the Ministry in charge of Environment in 2007 outlined the sustainable development vision, goals, strategies and targets for a thirty-year period, viz., 2007-37.

The strategy document discusses Sri Lanka Transport Board Act No. 22 of 2005, which was enacted to establish Public Sector Bus System in order to upgrade and to meet the new challenges of competitive road passenger market. It also proposes 'fuel diversification in the transport sector' and 'moving towards greener urban transportation and clean air' as strategies for the transport sector in Sri Lanka.

The table below summarizes the Sri Lanka's sustainable priorities with respect to its transport sector, based on the policies detailed above:

Priority	Description
Public Modes of Transport	Large scale development and introduction of efficient public transport systems such as BRT, LRT and MRT systems leading to a modal shift from private to public modes of transportation.
Alternative Vehicles	Increased adoption of electric and hybrid vehicles running on alternative fuels such as electricity, biofuels, etc.
Urban Congestion & Pollution	Reduce traffic congestion and air, noise pollution in urban areas especially the CMA through increased adoption of public and alternative modes of transportation.
Energy Security	Achieve greater diversity of fuel sources and reduce dependence on imported sources of fuel especially petroleum.
GHG Emissions	Reduce GHG emissions from the transport sector through the adoption of alternative clean fuel vehicles and public modes of transport, decreasing its reliance on fossil fuels

Table 3: Summary of Sri Lanka Transport Sector Sustainable Priorities

The analysis of the policy environment in Sri Lanka shows that while the necessary policy framework for the NAMA is present, there is a distinct lack of encouragement and promotion of private sector participation in the transport sector. Additionally, another key barrier to the implementation of these policies is a severe lack of sovereign funding at the national and regional level.

The NAMA thus offers a robust mechanism to access international finance to bridge the gap in funding required for the implementation of these policies while developing a policy environment that encourages and invites increased private sector participation.

2.6. Stakeholders in the Transport Sector

Given the importance and scale of Sri Lanka's transport sector, there are multiple government organizations, academic institutions along with numerous private players that play important roles in the development of the sector. This section details the primary administrative as well as capacity building bodies that play a significant role in the development of climate change mitigation or sustainable development policies in the transport sector.

2.6.1. Major Administrative and Implementing Bodies

The following table details the organizations/ministries that are the major players in the Sri Lankan transport and sustainability/climate change sectors **(to be revised based on inputs from MoIT on structure)**

Main Organization	Sub Organization	Role in Sri Lanka
The Ministry in Charge of Environment	-	The M/E is responsible for the conservation of Sri Lanka's environment and natural resources. It is also responsible for developing Sri Lanka's national action plan on climate change and mitigation, i.e. the Haritha Lanka Programme.
Ministry of Internal Transport	-	The M/Transport is responsible for the development, implementation and maintenance of Sri Lanka's transportation sector (including policy formation and development) including road, rail, air and marine transportation.
	Sri Lankan Railways	The SLR is responsible for the development and maintenance of Sri Lanka's railway infrastructure.
	Department of Motor Traffic	The DMT is responsible for the enforcement of rules and regulation provided in the Motor Traffic Act including registration of motor vehicles, licensing of drivers, etc.
	National Transport Commission	This agency is responsible for advising the government on national policy relating to passenger transport services by omnibuses (para-transit).
	Sri Lanka Transport Board	This agency is responsible for advising the government on national policy relating to passenger transport services by buses.
	Road Development Authority	The RDA is the highway authority in Sri Lanka and is responsible for the maintenance and development of the National Highway Network, comprising the Trunk (A Class) and Main (B Class) roads including the planning, design and construction of new highways, bridges and expressways to augment the existing network.
	Port Development Authority	The PDA is responsible for the development and maintenance of Sri Lanka's ports and associated facilities and services.

Main Organization	Sub Organization	Role in Sri Lanka
Air Resource Management Center (AirMAC)	-	The AirMAC is the main organization responsible for ensuring effective air quality management in Sri Lanka.
Ministry of Highways, Ports and Shipping	-	This ministry is responsible for the governance, implementation, creation and development of Ports including Colombo, Galle and Trincomalee ports, highways including Southern expressway, Colombo Outer Circular expressway, Katunayake expressway and their transport services.
Ministry of Finance and Planning	-	The M/F&P responsible for developing and executing the Sri Lanka's public finance policy, economic policy and long term planning.
Ministry of Local Government and Provincial Councils	-	The ministry is responsible for the development of efficient and effective provincial and local administrative system to promote sustainable and economic development. It is also responsible for the promotion of decentralized governance models at the local and provincial level.
Ministry of Urban Development and Sacred Area Development	-	The M/UD&SAD is responsible for the development and maintenance of the infrastructure of Sri Lanka's urban centers including its major cities like Colombo.
Ministry of Power and Energy	-	The M/P&E is responsible for the development of the power and energy sector in Sri Lanka. In relation to the transportation sector, we will need to bring them in for the development of projects related to clean energy and alternative fuels like bio-diesel.
Urban Development Authority	-	The UDA is considered to be the principle planner and developer of sustainable urban centres in Sri Lanka.

Table 4: Major Administrative & Implementing Bodies

Most transportation projects in Sri Lanka involve multiple organizations/ministries working together, usually a combination of aforementioned organizations. Apart from these we have also listed a number of additional administrative and capacity building bodies that we will believe will play an important role in the implementation of a transportation NAMA in Sri Lanka.

2.6.2. Administrative Bodies (Climate Change Mitigation and Sustainability)

Apart from the ministries and organizations mentioned above, the following organizations play an important role in the development of Sri Lanka's climate change mitigation and sustainability policies,

Main Organization	Sub Organization	Role in Sri Lanka
Sustainable Energy Authority (SEA)	-	The SEA is responsible for the exploration, facilitation, research & development and knowledge management of indigenous energy resources while promoting conservation of existing resources.

The Ministry in Charge of Environment	Central Environmental Agency (CEA)	The CEA is responsible for the development and implementation of environmental rules and regulation including licensing, laboratory services, GIS/RS services, etc.

Table 5: CC&S Administrative Bodies

2.6.3. Capacity Building Organizations

The following organizations provide effective capacity (administrative and technical) building skills within Sri Lanka to ensure that the proposed projects can be carried forward indigenously.

Main Organization	Sub Organization	Role in Sri Lanka
National Engineering Research and Development Center	-	The NERDC is responsible for development, research and transfer of the latest technology in Sri Lanka inorder to improve and develop indigenous industries.
Ministry of Transportation	Ceylon German Technical Training Institute	The Ceylon German Technical Training Institute is responsible for the training of skilled technicians in the field of automobile engineering and allied trades.

Table 6: Capacity Building Bodies

The list of players provided above serves to highlight the major stakeholders in Sri Lanka's climate change and transportation sectors, whose participation is crucial for the successful implementation of any project involving these sectors.

Apart from the aforementioned stakeholders the NAMA will also need to involve regional stakeholders as well as various private players such as bus fleet or para-transit operators. There is also a need to approach international funding organizations like ADB, JICA and World Bank among others who have a significant presence in the development of Sri Lanka's transportation sector and will play a significant role when it comes to the implementation of the NAMA, especially in the aspect of financing.

3. NAMA Baseline and Targets

3.1. NAMA Objectives

The overarching target of the Sri Lanka NAMA is the promotion and adoption of clean, sustainable and efficient means of public transportation within the Colombo Metropolitan Area, resulting in a modal shift from private to public mode of transportation. The NAMA is intended to help Sri Lanka achieve the following objectives for the transport sector as identified in the National Transport Policy:

- Encourage the use of public transport and high occupancy vehicles resulting in a modal shift from private to public modes of transportation
- Encourage the promotion and adoption of new cleaner technologies such as electric or hybrid vehicles and reduce the environmental (reduce GHG emissions & pollution), economic (reduced expenditure on fossil fuels) and social (increase in health benefits) impacts of a conventionally fuelled transport sector

Apart from the objectives highlighted above, the NAMA will also contribute towards the achievement of numerous additional sustainable development objectives including:

- Reduce Sri Lanka's dependence on imported petroleum fuels for the country's mobility requirements, increasing Sri Lanka's energy security
- Provide access to safe, affordable, accessible and sustainable transport systems for all, especially the vulnerable sections of society, leading to greater development and mobility among these societies and consequently within Sri Lanka
- Creation of new job markets in Sri Lanka, increasing opportunities for skilled labour through the development of multiple ancillary industries around the development and implementation of the NAMA intervention
- Provide Sri Lanka multiple avenues for transfer of advanced clean technologies from more developed economies such as China, Europe, etc., opening up opportunities for collaboration, knowledge transfer and subsequent development of indigenous clean technology industries
- Increase private sector participation in the development of Sri Lanka's transport sector. The private sector is seen as an essential partner in the implementation of the NAMA – either through public-private partnership enterprises or in sub-contracting relationships with the public sector as technical consultants, technology suppliers, constructors, operators, etc. Without the private sector and its commitment to provide co-funding and take risk, implementation of the interventions would be limited
- Achieve additional sustainable development benefits such as improved air quality, increased time savings and capacity building among others

The following figure summarizes the NAMA targets and objectives:

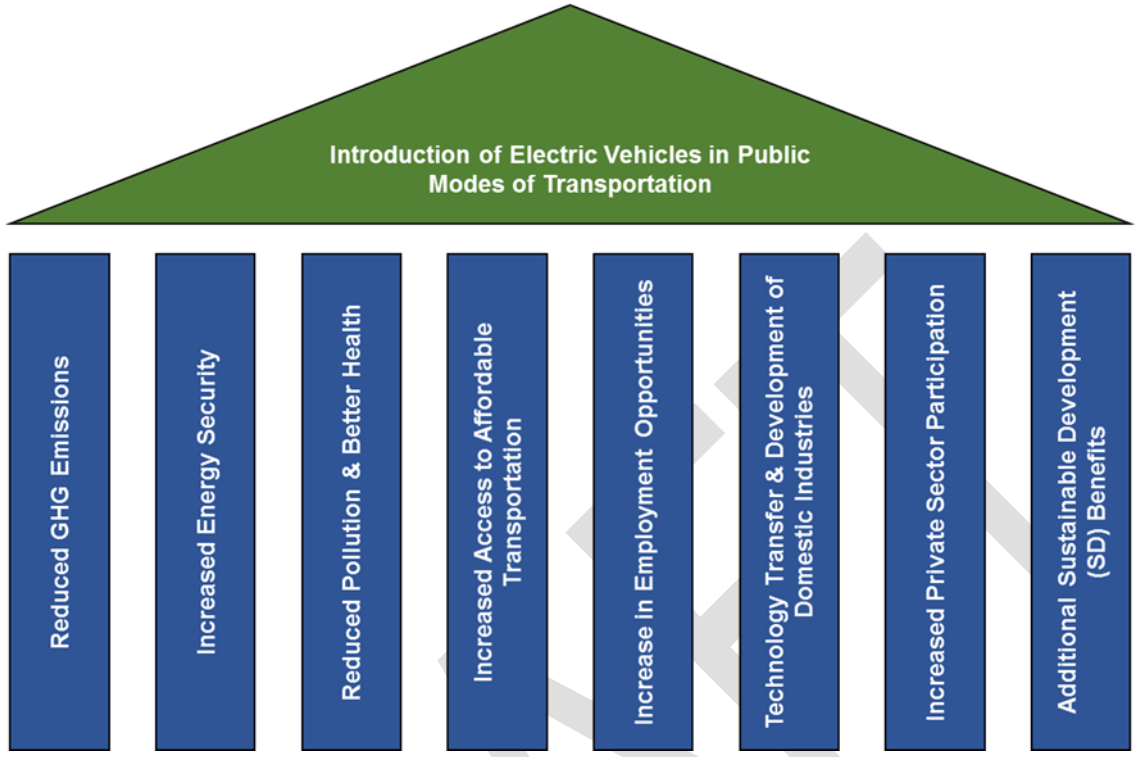

Figure 8: NAMA Targets & Objectives

All the objectives stated above are intrinsically tied to challenges faced by the CMA's transport sector, hampering its growth and development. Thus, in addition to achieving the aforementioned objectives, the NAMA was developed to help address these challenges. The challenges and the consequent genesis of the NAMA intervention have been detailed in the following sections.

3.2. Challenges faced by CMA's transport sector

The CMA transport sector faces numerous issues, which have prevented it from being the sustainable, efficient machine it should be. The primary issues of the CMA as defined by the Urban Transport System Development Project for Colombo Metropolitan Region and Suburbs can be divided into two broad categories:

- **Traffic Congestion**
  An unchecked increase in private traffic over the years has led to increased traffic congestion within the CMA, especially in the CMC region. This has had several negative effects on the economic and environmental health of the city due to increased vehicle operating costs, greater travel time costs and high pollution of regions where congestion is prevalent.

- **Issues of Public Transport**
  Each of CMA's mode of public transportation i.e. rail, bus and other road based transport systems is plagued by its own set of individual issues such as insufficient capacity, unregulated fares, insufficient integration with other modes of transport and lack of enforcement of on road rules and

regulations to name a few that have prevented the CMA from having a cohesive, efficient transportation network that can meet the growing demands of its people.

Neither of the issues mentioned above are mutually exclusive. An inefficient and under connected network of public transportation consisting of slow, inefficient buses, low capacity railways and unregulated assortment of para-transit modes such as three wheelers contributes to a passenger's dissatisfaction with public modes of transportation, thereby making private modes of transportation more attractive. This in turn contributes to the critical problem of traffic congestion in the city resulting in longer travel times for passengers.

Thus, an approach that tackles either one of the aforementioned issues will have a cascading remedial effect on both of them. While the development of large-scale infrastructure projects such as monorail and Bus Rapid Transit (BRT) can address issues of level of service, the introduction of electric vehicles into these public modes of transportation adds significant transformational potential by increasing the direct emissions reduction potential while promoting the adoption of cleaner, more efficient vehicles within the transport sector.

3.3. Introduction of electric buses on the planned Bus Rapid Transit (BRT)

The NAMA development process was initiated with the preparation of a concept note, detailing the various interventions that are suitable to the Sri Lankan context and could be taken up under the transport NAMA. Based on GHG reduction potential, sustainable development, transformation potential and financeability, the following interventions were identified:

- Energy Efficiency Measures in Transportation
- Development of an Integrated Transportation System
- Development of Transit Oriented Development (TOD) Cities

Following the development of a concept note which provided the frameworks for the aforementioned interventions, a stakeholder consultation workshop was conducted in Colombo with the purpose of selecting a final intervention. For the consultation, held with assistance from the Climate Change Secretariat, representatives from a number of government organizations working in the areas of environment, climate change and transport in Sri Lanka were invited.

The participants were able to narrow down the list of interventions to two possible interventions that could be taken up under the transport NAMA viz.:

- Development of an Integrated Transportation System (could possibly include Multi-modal transport hubs, Bus Rapid Transit (BRT), Monorail etc.)
- Promoting the adoption of electric vehicles

Based on the conclusions drawn from the stakeholder consultation workshop and subsequent research and literature review of the state of transportation in Sri Lanka, especially for the capital city of Colombo, the decision was taken to develop the following final NAMA intervention as the Sri Lankan Transport NAMA:

- **Introduce electric buses as replacement for conventionally fuelled buses on the planned Bus Rapid Transit (BRT) on Galle Road in the Colombo Metropolitan Area (CMA)**

While the NAMA will ultimately be scaled upwards and implemented throughout the country, the observations are based on the study of literature on the capital city of Colombo, which is not only an integral part of the development and economic fabric of the country but also has the most advanced plans for urban transport in the country. The NAMA design has therefore been developed based on the issues highlighted in the Urban Transport Master Plan for the Colombo Metropolitan Area (CMA) as well as the feasibility study on the implementation of a BRT on Galle Road in the Colombo Metropolitan Area (CMA).

3.4. Alignment of the NAMA Objectives and Targets with National Strategies and Transformative Change

The transformative change implicit in the NAMA can best be seen through the application of a theory of change approach. The theory of change approach "defines all building blocks required to bring about a given long-term goal. This set of connected building blocks - interchangeably referred to as outcomes, results, accomplishments, or preconditions - is depicted on a map known as a pathway of change/change framework, which is a graphic representation of the change process" (Center for Theory of Change, 2013). Using this approach will help to ensure that the NAMA focuses not just on emissions reductions but also on achieving sustainable development, national development goals and transformative change. This approach is also aligned with the Green Climate Fund (GCF) results framework. The overall targets

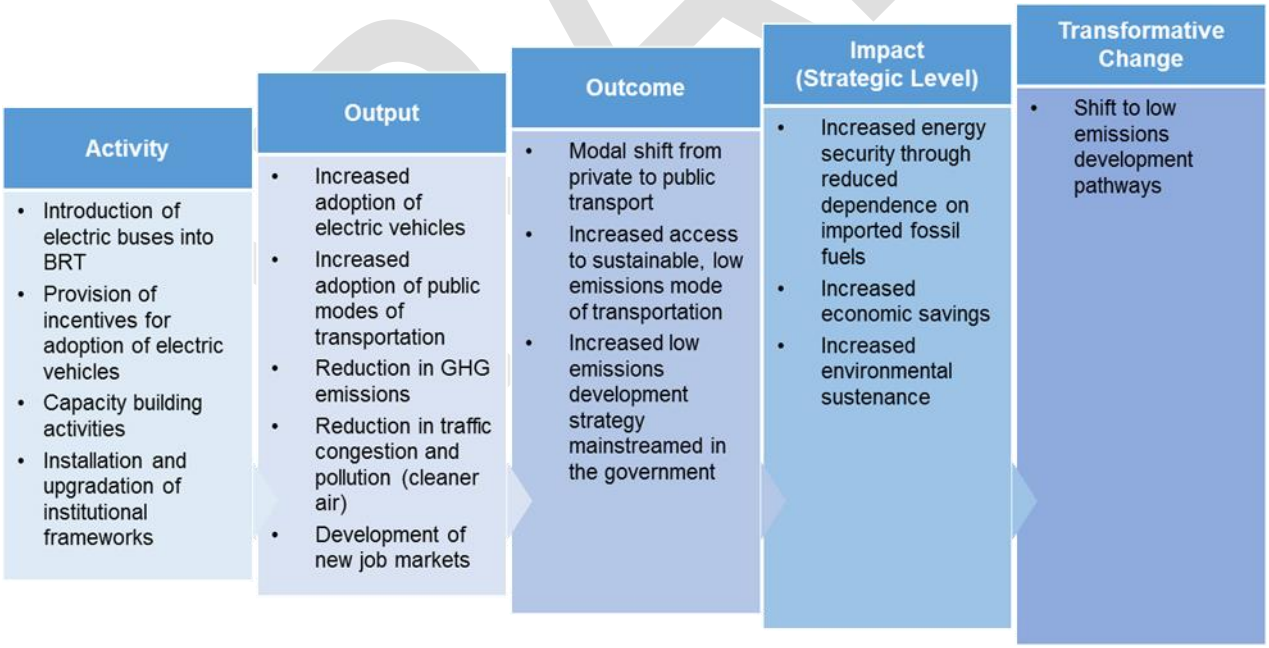

Figure 9: Theory of Change Approach to NAMA Targets

for the NAMA can be seen in the following figure:

The transformative change must also occur in a fashion which is aligned with Sri Lanka's development goals while benefiting the region where it is implemented. The regional and national alignment of the NAMA with respect to Sri Lanka's policies and needs for its transport sector has been discussed below.

3.4.1. Benefits for the CMA

This following table provides a brief overview of the specific benefits that the proposed NAMA intervention offers, thereby making it suitable and appropriate for the CMA region:

Benefit	Details
Cost savings & GHG emissions reduction	Given the distances and frequency of trips that buses on the BRT will be making, electric buses serve as the perfect medium of transportation providing the same level of service as conventionally fuelled buses with reduced fuel costs and subsequently reduced emissions.
Tax breaks for hybrid/electric vehicles	This intervention gives an opportunity to leverage tax breaks offered by the government for the adoption of hybrid and electric vehicles as an additional source of incentive from the side of the national government. This will also serve to incentivize greater amount of private participation.
Growth of ancillary industries and subsequent creation of new jobs	The introduction of newer, more efficient technology into the Sri Lankan transportation market through large scale adoption of electric vehicles (fleet adoption) provides demand side incentives for the development of a robust electric vehicle development and manufacturing industry in and around the CMA, giving rise to numerous ancillary industries such as manufacturing of batteries, charging stations, battery recovery and disposal units among others. This will further lead to the creation of numerous skilled labour opportunities giving rise to a new employment market.

Table 7: Benefits for the CMA

3.4.2. Suitability as a NAMA for the Sri Lankan transport sector

As discussed earlier, actions that result in reduction of greenhouse gas emissions from the baseline scenario and provide additional sustainable development benefits, if undertaken in a measurable, reportable and verifiable manner can be considered as NAMAs. They usually revolve around existing/upcoming regulations, policies, schemes, programmes or strategies in a country that have significant mitigation and sustainable development potential.

Even though there is an absence of a common standard definition for a NAMA, as per today's understanding every proposed intervention consists of a number of common elements based on which its appropriateness as a NAMA for the country is judged. The following elements have been used to judge the appropriateness of the proposed intervention as a NAMA:

- National and Regional Embeddedness
- GHG Mitigation Potential
- Transformational Potential
- Sustainable Development Benefits
- Financial Feasibility

The following table details the proposed intervention's effectiveness with regards to each of the aforementioned criteria:

<table>
<tr><th colspan="3">Proposed Intervention</th></tr>
<tr><td colspan="3">Introduce electric buses as replacement for conventionally fuelled buses on the planned Bus Rapid Transit (BRT) on Galle Road</td></tr>
<tr><th colspan="3">National & Regional Embeddedness</th></tr>
<tr><th colspan="2">Regional</th><th>National</th></tr>
<tr><td>MM-1~5: Multi-modal Transport Hub (MMTH), Multi-modal Center (MMC) and Park & Ride (P&R)</td><td rowspan="8">Urban Transport System Development Project for Colombo Metropolitan Region (CMA) and Suburbs</td><td rowspan="8">The introduction and utilization of electric vehicles as a national strategy also finds mention in the following policy documents:
National Transport Policy of Sri Lanka
Environmentally Sustainable Transport in Sri Lanka
Sri Lanka's Second National Communication on Climate Change
The National Climate Change Policy of Sri Lanka
National Action Plan for Haritha Lanka Programme</td></tr>
<tr><td>BT-01: Bus Rapid Transit (BRT)</td></tr>
<tr><td>RL-NT1~5: Monorail</td></tr>
<tr><td>RD-RN5: Enhancement of Traffic Distribution Function of Road Network</td></tr>
<tr><td>TM-ERP: ERP (Electric Road Pricing) System</td></tr>
<tr><td>RS-1: Education for Road Safety/Tight Control of Driver's License</td></tr>
<tr><td>EN-01: Air Emissions Standard for Vehicles</td></tr>
<tr><td>EN-02: Vehicles Inspection & Maintenance Program</td></tr>
<tr><td>EN-05: Promotion of Hybrid Cars and Electric Vehicles</td></tr>
</table>

GHG Mitigation Potential
The GHG mitigation potential of this intervention is twofold: • The use of electric buses on the BRT in lieu of traditional petrol/diesel vehicles leads to direct GHG emissions reductions. Electric buses are more fuel efficient than their ICE counterparts because of their battery powered electric drive systems which results in reduced fuel consumption. In case renewable energy is used to generate the power charging the batteries of the vehicles, it is possible to achieve additional, significant GHG emissions reductions. • The promotion and increased adoption of public transportation through the BRT decreases the use of low occupancy private vehicles i.e. it creates a modal shift where public transport moves a larger segment of the population in fewer trips compared to the scenario where the same amount of people utilize individual private vehicles. This modal shift generates significant saving in terms of GHG emissions. For example, the Janmarg BRTS in Ahmedabad, India has been able to reduce more than 90,000 tons of CO_2 annually (EMBARQ India, 2011).
Transformational Potential
The proposed intervention has the potential to transform the transportation sector for both the CMA and Sri Lanka as a whole in the following manner: • Developing and implementing a successful BRT in CMA would help increase the adoption of public transportation in the region, making it an attractive proposition for passengers. This increased adoption assists in decreasing the use of private vehicles for transportation within the city which results in a reduction in traffic congestion throughout the region resulting in numerous benefits such as reduced operating costs of vehicles, decrease in pollution, greater fuel savings, lower travel times, etc. • The introduction of newer, more efficient technology into the Sri Lankan transportation market in the form of large scale adoption of electric vehicles (fleet adoption) provides demand side incentives for the development of a robust electric vehicle development and manufacturing industry in and around the CMA. • A sector wide promotion of electric vehicle technology would have significant transformational potential beyond the transportation sector giving rise to numerous ancillary industries such as the manufacturing of batteries, charging stations, battery recovery and disposal units and others. • The success of this intervention in Sri Lanka's economic hub would showcase its viability for the rest of the country, leading to replication in other urban centres within the country increasing the likelihood of the development of a cohesive, sustainable transportation sector throughout the nation.

<table>
<tr><th colspan="2">Sustainable Development Benefits (for the Colombo Metropolitan Area)</th></tr>
<tr><th>Positive</th><th>Negative</th></tr>
<tr><td>Decreased traffic congestion – Increased adoption of public transportation by providing easy access and better quality of service decreases the use of private vehicles which in turn decreases the traffic congestion faced throughout the region</td><td rowspan="5">Stress on the electric grid of Sri Lanka – Large scale adoption of electric buses in BRTs across the country could stress Sri Lanka’s electric grid that is already dependent on generation of electricity through fossil fuels to meet the needs of the country.

Thus, the design of the NAMA has to ensure that while the adoption of electric buses in BRTs is encouraged, it is done so without stressing Sri Lanka’s grid any further wherein their dependence on fossil fuels for the generation of electricity increases.</td></tr>
<tr><td>Improved air quality – The combination of the use of electric vehicles, increased use of public transportation and decreased traffic congestion leads to a reduction in pollution and GHG emissions esp. NOx, SOx and other particulate emissions throughout the CMA</td></tr>
<tr><td>Quality of employment – Potential to create a lot of the skilled jobs not just directly through the BRT but through the rise of ancillary industries around the use of electric vehicles</td></tr>
<tr><td>Human & Institutional capacity - Training of executing agency staff to monitor, maintain & implement the project</td></tr>
<tr><td>Technology transfer & Technological self-reliance - Use of newer, more efficient technology that can then be used by Sri Lanka in other similar projects</td></tr>
<tr><th colspan="2">Financial Feasibility</th></tr>
<tr><td colspan="2">While the development of large-scale infrastructure projects such as a BRT can address issues of level of service and has significant potential to transform the sector by inducing a modal shift from private to public transport, their ambition especially in terms of GHG emissions reduction can be significantly increased with the introduction of electric buses as the main mode of transportation.

Further, the Sri Lankan government has shown great interest in pursuing the development of a BRT in the CMA region. However, there is a need for additional financing in order to successfully introduce electric buses to the BRT, replacing more polluting but cheaper conventionally fuelled buses. Thus, the NAMA is envisioned as an innovative project that demonstrates the benefits of using electric buses in place of conventionally fuelled buses as the primary mode of transportation in a Bus Rapid Transit network within the CMA region.</td></tr>
</table>

Table 8: Suitability as a NAMA for the Sri Lankan transport sector

3.5. NAMA Baseline Scenario

The baseline is a current or an expected business-as-usual (BAU) scenario. Baselines are defined for the areas where the NAMA will have high positive impact, such as:

- GHG emissions and
- Sustainable development

The **"AMS-III.C: Emission reductions by electric and hybrid vehicles"** methodology provided by the Clean Development Mechanism, was developed specifically for application to project activities that introduce new electric and/or hybrid vehicles that displace the use of fossil fuel vehicles in passenger and freight transportation. AMS-III.C was hence found to be most suitable and appropriate to determine the emissions in the baseline as well as mitigation scenarios of the NAMA.

3.5.1. Baseline of GHG Emissions

The baseline scenario for the NAMA entails the operation of the conventionally fuelled vehicles, comparable to electric vehicles being operated in the mitigation scenario that would have been used to provide the same transportation service.

The baseline emissions are calculated based on the unit of service provided by the project vehicles (diesel fuelled articulated buses) i.e. travelled distance times the emission factor for the baseline vehicle to provide the same unit of service.

The emission factors included in the CDM methodology AMS-III.C were determined in a conservative manner through the application of emissions factors gathered from a variety of sources such as information from data published in public records, research and the Intergovernmental Panel on Climate Change (IPCC).

As per AMS-III.C, the emission factor of diesel, the fuel consumed by the baseline vehicle is 0.0000726 gCO_2/J (IPCC, 2006).

Using the emission factor mentioned above, the baseline GHG emissions for a diesel fuelled two articulated bus was calculated to be 153.20 tCO_2 annually.

3.5.2. Baseline of Sustainable Development Indicators

As discussed earlier, a NAMA consists of actions that not only provide GHG emission reductions but additional sustainable development benefits as well. Thus, the NAMA will contribute towards the improvement of several of the sustainable development indicators (Note that environment-related indicators, such as GHG emission reductions, are not included here).

Quantification of the sustainable development baseline is in most cases more appropriately done on the local level, in particular in locations where the NAMA intervention is to be implemented. However, if the overall situation of the focus area of the NAMA is taken into consideration, wherein a BRT does not exist at the proposed location of the intervention (CMA, Galle Road) or in any other region of Sri Lanka, it is assumed that the baseline for the NAMA is zero. Therefore the need for and impact of the NAMA intervention is considered to be high.

The following table provides a brief snapshot of the SD Indicators that are being considered for the NAMA baseline:

Domain	Indicator	Details
Environment	Decreased Pollution	Decrease in air and noise pollution due to reduced GHG emissions
Social	Health	Improvement of health due to a decrease in pollution and availability of cleaner air
	Access to Transportation Services	Increased access to public resources (transport) for the vulnerable/disadvantaged groups
	Quality of Labour	Job opportunities in the skilled labour segment leading to an increased standard of living
Growth and Development	Access to Clean and Sustainable Technology	Increased access to clean and sustainable technologies, subsequent decrease in costs and development of domestic industries
	Increased Energy Security	Reduced dependence on imported fossil fuels resulting in greater energy security as well as cost savings for Sri Lanka
	Capacity Building	Build extensive capacity on both the national and regional levels on development and implementation of clean and sustainable projects
Economic	Asset Accumulation and Investments	Increased private/public sector investments, increased cost savings/returns leading to increased accumulation of assets
	Job Creation	Creation of skilled job markets through the development of ancillary industries
Institutional	Private Sector Dialogue	Increased encouragement and promotion of private sector involvement creating a competitive, thriving market
	Enabling Policy Environment	Enhance policy coherence for sustainable development through the development of robust SD frameworks

Table 9: NAMA Sustainable Development Indicators

As explained earlier, given the absence of a BRT at the NAMA location or any other location within Sri Lanka, it is not possible to develop a baseline for the SD indicators with respect to the NAMA intervention for Sri Lankan conditions. Hence, the baseline for the SD indicators is assumed to be zero.

The SD indicators listed in the table above (among others) have been detailed further in Chapter 8 - NAMA Measurement, Reporting and Verification.

3.5.3. Expected and Targeted Impacts of NAMA Intervention

The values below are used in the following sections for estimation of NAMA impacts on annual GHG emission reduction over a period of 10 years and achievement of SD indicators listed earlier. The values are for the replacement of 100 diesel fuelled articulated buses with two door electric buses:

Emissions Reduction	
Target	**Indicator**
Emission reductions per year (tCO_2)	3,715.9
Total emissions reductions over a period of 10 years (tCO_2)	37,159
Sustainable Development	
Target	**Indicator**
Air pollution reduction (ppm)	
Number of cases of respiratory health problems	
Frequency of eBuses along the BRT	
Number of eBuses on the BRT	100
Capacity building (training/outreach programs held)	22
Cost savings from increased energy security per bus annually (USD)	30,159
Jobs created	
Number of private players involved	

Table 10: Expected and Targeted Impacts of NAMA Intervention

We will need inputs from the Sri Lankan Government to determine the targeted impacts (highlighted in yellow).

4. NAMA Technical Intervention

4.1. NAMA Intervention – Promotion and adoption of electric buses on the Galle Road Bus Rapid Transit (BRT)

Due to the large potential benefits of a well-designed Bus Rapid Transit system as well as the number of issues it helps to address, the Sri Lankan government has ardently worked towards the development of the Bus Rapid Transit (BRT) networks as one of their primary modes of climate change mitigation in the transport sector.

Furthermore, one of the biggest drawbacks of an increase in private vehicle traffic is large increase in emissions of greenhouse gases (GHG) exacerbating the Sri Lankan transport sector's already large and ever increasing GHG footprint. The intervention combats this issue by introducing electric vehicles; buses, as the vehicle of choice to carry passengers on the BRT.

The following table provides an overview of the Galle BRT and the aspects that the intervention will be addressing:

Performance Indicator	Value
Baseline Galle BRT (Completely Fossil Fuel Buses)	
Average Trip Length	10 km
Average km/bus/month	9704.7 km
Total km/bus/year	116,456 km
Average number of trips per bus/day	20
Composition of Buses	
Standard Two Door Buses	100
Articulated Buses	100
Sri Lanka Transport NAMA - Introduce & Operate Electric Buses in lieu of Articulated Buses	
Electric Two Door Buses	100

Table 11: Galle BRT details with intervention details

The overarching aim of the NAMA is to promote and promulgate the adoption of clean, sustainable modes of transport in Sri Lanka and while it aims to do so through the introduction of electric buses in the Galle BRT in place of what would have otherwise been articulated, GHG emitting, diesel fuelled conventional buses, it does not aim to replace all the conventional modes of transport. This is the reason why the Galle BRT, through the NAMA, will operate an equal mix of electric and conventionally fuelled buses.

Subsequent sections detail the activities envisaged under the intervention and the eligibility criteria that an eBus operator needs to meet inorder to qualify for funding under the NAMA.

4.2. An Introduction to Electric Buses

The following sections provides detailed insights into the status of the adoption of electric vehicles (including buses) around the globe and an overview of the technology that drives them.

4.2.1. A Global Outlook

In today's political and social climate, the global electric bus market is thriving due to growing environmental concerns of the public and various governments. While the high initial cost of electric buses is a key barrier for this industry, their operational cost is significantly low as compared to that of conventional buses as electricity is cheaper than diesel. The low fuel cost coupled with unstable crude oil prices and an increasing focus of transit agencies on minimizing operational costs, is expected to lower the impact of cost on the adoption of electric buses in the long term. Also, in recent times, investments of companies and transit agencies are being backed by funding from venture capitalists and governments, which are, in turn, favouring the growth of the electric bus market.

Studies have shown that electric vehicles result in lower greenhouse gas emissions when compared to most conventionally fuelled cars in the market (IEA, 2012).

Widespread adoption of electric fleets would also help transform the transportation sector with not just large scale GHG mitigation but also through the creation of ancillary industries such as the development and production of energy efficient technologies like batteries that would encourage further GHG emissions reductions as well as numerous other associated benefits like employment generation and higher standard of living, among others.

The US-based market research and consulting firm Pike Research forecast in August 2012 that the global market for all electric-drive buses including hybrid, battery electric and fuel cell buses will grow steadily over the next six years, with a CAGR (Compound Annual Growth Rate) of 26.4% from 2012 to 2018. According to Pike, the largest sales volumes will come in Asia Pacific, with more than 15,000 e-buses likely to be sold in that region in 2018, i.e. 75% of the world total. China will account for the majority of global e-bus sales, Pike predicts. It believes that growth in the e-bus market will accelerate strongly in Eastern Europe and Latin America, the latter driven largely by Brazil while sales in Western Europe will experience steady growth (around a 20% CAGR).

A December 2012 report by the research and consultancy firm IDTechEx forecast that the market for electric buses and taxis will grow from USD 6.24 billion in 2011 to USD 54 billion in 2021, of which the largest part will be buses. Thus, with this intervention Sri Lanka is poised to participate in a burgeoning market that is soon to play a major role in transportation services around the world.

Numerous cities around the world have implemented measures to encourage a shift to electric vehicles both in the private and public transportation sectors. A few notable examples have been listed below (IEA, 2012):

a. The city of Amsterdam, Netherlands provides subsidies to support companies intending to use electric cars, taxis and trucks as a key means of transportation around the city. The municipality aims to increase its population of EVs from 750 (2012) to 10,000 (2015).

b. Since 2012, Berlin, Germany started converting its state-run vehicle fleet to electric and plug-in hybrid vehicles. Various projects with e-fleets and e-car sharing are underway or are planned, for example: the Initiative 120 project, a concept for testing alternative drive systems in patrol cars at the Berlin police department.

c. The city of Kanagawa, Japan provides subsidies, tax breaks and other incentives to reduce initial user burden and to improve convenience. The national government provides a subsidy equal to 50 percent of the cost differential between an EV and a gasoline vehicle. In addition, K.P.G. tops up the other half of this subsidy and provides tax relief for automobile tax (for five years) and automobile acquisition tax by 100 percent.

d. The Chinese government provides national subsidies of 50,000 RMB for plug-in hybrid electric vehicles and 60,000 RMB for pure electric vehicles. In addition, the City of Shanghai offers 20,000 RMB and 40,000 RMB, respectively. Public service vehicles, such as light duty commercial trucks and buses, also receive subsidies. Shanghai also maintains a ratio of 1.2-1.5 charging stations for every electric vehicle. Twenty of these stations have been installed as part of “park and ride” trials.

4.2.2. A Technological Overview

Battery-electric buses are often referred to as “pure” electric buses because the propulsion system is powered only by the electric energy stored in the battery. The battery pack is either recharged daily or “swapped out” when the batteries are depleted. Due to the potential benefits of using zero emission buses in public fleets, there has been much R&D funding devoted to improving the battery technology over the last decade.

The most obvious and major benefit of electric drive buses is environmental improvement due to an absence of tail pipe emissions. In an electric vehicle, the impact on the region’s environment is dependent only on the power generation process for that region and not on the vehicle itself.

Hybrid electric and plug-in hybrid electric buses are also more fuel efficient than their ICE counterparts because of their battery powered electric drive systems which results in reduced fuel consumption, as well as reduced, or even zero, mobile emissions. Electric-drive bus fuel efficiency can be further improved through a regenerative braking system that captures energy that would otherwise be lost and stores it as electricity in the on board battery (NREL, 2008). Other advanced technologies such lightweight materials for body, chassis, and seat assemblies; stop-start systems for idle reduction; improved batteries, electric motors, converters, and power electronics are also being deployed to further improve the fuel efficiency of advanced electric buses and thereby further improve the level of service offered by these vehicles as well as the urban air quality.

Over the years, numerous studies have proved that electric drive buses have significant increases in fuel economy when compared to standard diesel buses. According to the National Renewable Energy Laboratory (NREL), hybrid buses offer an average 37% fuel economy improvement over conventional diesel buses (NREL, 2008).

Currently, active electric buses around the world are segmented into two broad categories:

1. **Autonomous Electric Buses**
    a. Autonomous electric buses are buses where an energy storage device (either a battery or a flywheel) is located onboard, within the bus itself
    b. They can be further categorized into:
        - Battery Electric Bus – Uses batteries as the storage device
        - Gyrobus – Uses a flywheel as the storage device

Figure 10: Gyrobus

Figure 11: Battery Powered Electric Bus

2. **Non-Autonomous Electric Buses**
    a. Non-autonomous electric buses are powered by electric wires or power lines located outside the bus, either overhead or located within the roads on which the bus travels
    b. They can be further categorized into:
        - The Trolleybus – The trolleybus utilizes two overhead electric wires, with electricity being drawn from one wire and returned via the other wire, using two roof-mounted trolley poles

Figure 12: Online Electric Bus (Gapbus)

Figure 13: Trolleybus

        - The Online Electric Vehicle (Bus) – The OLEV (also known as Gapbus) utilizes power that is supplied over a gap (12 cm to 17 cm) from a power line embedded in the ground

For the Sri Lanka transport NAMA, viable autonomous electric battery powered bus options are proposed.

The drive system for a battery-electric bus consists of an electric motor, a battery pack to provide energy storage, and a control system that governs the vehicle operation. The battery pack is either recharged daily or "swapped out" when the batteries are depleted. The following table provides an overview of the various components that make up an autonomous electric bus:

<table>
<tr><th colspan="4">Electric Motor</th></tr>
<tr><td colspan="4">Max. Rated Power: 150 kW (EBUSCO Buses) – 360 kW (BYD Buses)</td></tr>
<tr><th colspan="4">Battery Pack</th></tr>
<tr><td rowspan="2">Lithium Ion (LiB) Batteries</td><td>Lithium Ferrous Phosphate (LiFePO4)</td><td>Energy Density: 110 -150 Wh/kg</td><td rowspan="2">Preferred battery of choice in electric vehicles due to their high energy/power densities and stable chemistry, which prevents it from overheating at high temperatures.</td></tr>
<tr><td>Lithium Manganese Oxide (LiMnO2)</td><td>Energy Density: 280 Wh/kg</td></tr>
<tr><td colspan="2">Nickel Metal Hydride (NiMH)</td><td>Energy Density: 140 Wh/kg</td><td rowspan="2">Used in early hybrid/electric cars</td></tr>
<tr><td colspan="2">Lead Acid Batteries</td><td>Energy Density: 30 - 50 Wh/kg</td></tr>
<tr><th colspan="4">Mode of Charging</th></tr>
<tr><th colspan="4">Alternate Current (AC)</th></tr>
<tr><td colspan="4">• Majority of electric drivetrain buses available today are AC charge compatible and are able to charge from 120 or 208/240 Volt AC outlets using an appropriate connector.</td></tr>
<tr><th colspan="4">Direct Current (DC)</th></tr>
<tr><td colspan="4">• For higher speed charging, DC fast charging equipment is required. Although this technology requires a higher power utility supply, it is still preferred as it is able to supply DC power directly to the batteries allowing them to charge at a much faster rate.
• The fast charge system can charge a bus with a 40 mile range in roughly 10 minutes. If necessary, the system can reach at least a 92 percent charge in as little as six minutes.</td></tr>
</table>

Table 12: Components of a Battery Powered Electric Bus

Figure 14: Electric Bus Charging Stations

The table below lists out a few prominent manufacturers of the electric buses around the world:

Sr. No.	Manufacturer	Battery Technology	Battery Capacity (kWh)	Performance (kWh/km)	Range (km)	Charging Time (hr)	Cost per Km ($)	Cost ($)	Source
1	BYD	Lithium Iron Phosphate (LFP)	324 to 547.5	1.19	249 to 273	1.6 to 4	0.13	395,000 to 592,600	http://byd.com/na/auto/40feet.html
2	Siemens	Lithium Iron Phosphate (LFP) & Lithium Ferrite	85 to 96	NA	150	2 to 3 & 10 to 15 min (Lithium Ferrite)	NA	NA	http://www.siemens.com/about/sustainability/en/core-topics/innovation/references/hybrid-and-electric-buses.htm & http://www.siemens.com/about/sustainability/en/core-topics/innovation/references/hybrid-and-electric-buses.htm
3	New Flyer Industries	Lithium Ion	100 to 300	NA	128	10 to 15 min	NA	NA	http://www.chicagobus.org/buses/700-xe40
4	Proterra	Lithium Titanate	53 to 321	1.09	48	5 min	0.12	825,000	http://www.proterra.com/product-tech/product-portfolio/
5	Optare	Lithium Iron Magnesium Phosphate	80	NA	150	2 to 6	NA	NA	http://static1.squarespace.com/static/5318a7c0e4b03ba2018b69f4/t/551d6815e4b0e383d177f7a5/1427990549168/EV+Brochure.pdf
6	Ebusco	Lithium Iron Phosphate (LFP)	242 to 311	0.90	250 to 300	1.6	0.09	NA	http://www.ebusco.eu/en/electric-buses/ebusco-2-0
NA = Not Available									

Table 13: Electric Bus Manufacturers

The aforementioned manufacturers among others will be approached to determine the suitability of their buses for the implementation in the NAMA.

4.3. Activities under the NAMA

As highlighted earlier, the NAMA intervention comprises of the adoption and operation of 100 electric buses on the Galle BRT in place of conventional diesel fuelled, articulated buses. In this regard, the activities of the NAMA to achieve the same, are divided into two distinct phases, both of which have been detailed below:

4.3.1. Pilot (Demonstration) Phase (Phase 1)

Phase 1 of the NAMA intervention will introduce 10 electric buses, owned and operated by private operators in to the Galle BRT. The aim of Phase 1 of the NAMA, a pilot project, is to generate awareness about the NAMA, highlighting its importance for the transport sector. Phase 1 also displays the government's commitment to the development of a sustainable transport sector in Sri Lanka while encouraging increased private sector participation through the provision of grants. This should help make it appealing for other private bus operators in Sri Lanka to operate eBuses on the Galle BRT during full scale operations of the NAMA.

Apart from the introduction and operation of eBuses on the BRT, Phase 1 shall also include extensive capacity building measures and awareness programs, designed to fulfil the following purposes:

- Training the proponents and participants of the NAMA including training the trainee programs as well as training of government officials, bus operators and on-ground personnel, among others
- Raising awareness about the intervention including information on the technology adopted, benefits of the intervention, etc. among the Sri Lankan public

The funding for this phase of the NAMA will cover the complete cost of all the 10 eBuses to be introduced into the BRT, charging stations and capacity building measures. The funding will be sourced from a combination of sources which includes the private operators of eBuses, the Government of Sri Lanka and international climate finance.

4.3.2. Full Scale Operations (Phase 2)

Phase 2 will involve the start of full scale operations of the NAMA wherein the remaining 90 eBuses are introduced and operations of all 100 eBuses commences on the Galle BRT. As with Phase 1, all the eBuses will be owned and operated by private operators.

Funding for the second phase of the NAMA will cover the difference between the amount pledged by a private operator for the purchase of an eBus (minimum of 30 percent inorder to be eligible for participation in Phase 2) and the total cost of the eBus. The NAMA shall also cover the costs of additional charging stations and capacity building measures (if necessary). The funding for this final phase shall be sourced from the private operators of eBuses and international climate finance.

Both phases shall also provide free charging for a period of 12 months to all private players operating eBuses on Galle BRT, starting from the first day of operation.

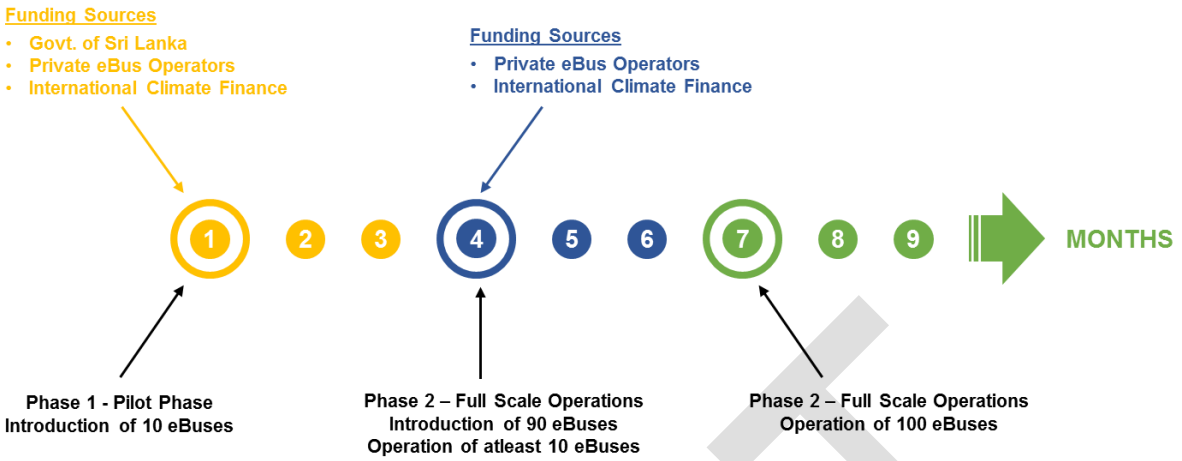

Figure 15: NAMA Activities

The details of the funding mechanisms for both the phases have been elaborated in Chapter 7 – NAMA Costs and Finance.

4.4. Eligibility Criteria for NAMA Funding

In order to be able to receive funding under the NAMA, every eBus operator needs to meet the eligibility criteria set out in the following table:

Eligibility Criterion	Description	
Location	Galle BRT, Colombo Metropolitan Area (CMA)	
Technology	Autonomous electric battery powered bus **(check with Sri Lankan Government if they wish to be specific about the particulars of the technology like type of battery, minimum battery capacity, mileage, etc.)**	
Minimum Bus Life	10 years	
Minimum Battery Life	5 years	
Minimum Level of Service	50,000 kms annually (40% of the expected average total distance to be travelled by a bus on the BRT every year) **(check with the Sri Lankan Government for any additional LoS requirements)**	
Implementation	The eBuses must be operational on the Galle BRT within 3 months of contract award **(check with the Sri Lankan Government if the time period is alright)**	
Funding	Phase 1	The maximum grant funding that can be applied for is a 100 percent of investment costs.

Eligibility Criterion	Description	
	Phase 2	The maximum funding that can be applied for is equal to 70 percent of the total cost of an eBus. As part of the eligibility criteria, a private operator needs to pledge atleast 30 percent of the cost of eBuses inorder to qualify for participation in the bidding process in Phase 2.

Table 14: Eligibility Criteria for the NAMA

4.5. Approval Structure of the NAMA

The selection of private eBus operators to be financed under the NAMA will carried as per the steps delineated in the table below:

Sr. No.	Step	Description
1	Confirmation of interest from private bus operators	The NAMA Implementing Entity (NIE) will contact private players who operate buses in the CMA region, where the Galle BRT will be implemented, through the issuance of an expression of interest confirming the level of interest in taking part in the introduction and operation of electric buses on the BRT
2	Promotion of electric buses	The planned implementation of the BRT along with eBuses will be promoted by the NIE in and around the CMA. Information will be given to households and institutions about the level of service they can receive and associated costs. Existing companies (for example, battery manufacturers) and potential operators of ancillary industries will be informed about the planned intervention and associated costs such as operational and maintenance costs for an eBus.
3	Invitation of financial bids from private operators	Financial bids for permits to operate eBuses on the BRT and access funding for procurement of eBuses, from private operators will be invited. For Phase 1, financial bids for a total of 10 eBuses will be invited while for phase 2, bids for 90 eBuses will be invited.
4	Announcement of results of bids	Results of financial bids are announced and the name of private bus operator selected to operate eBuses on the Galle BRT is sent to NAMA Coordinating Authority (NCA) for approval.
5	Contract signing	The private bus operator wining the bid shall sign a contract with **Govt. of Sri Lanka (need inputs from the government as to which ministry/organization should be involved here)**, committing to a minimum level of service as by the eligibility criteria to receive funding. The private player shall now be considered to be an individual NAMA Executing Entity (NEE).

Sr. No.	Step	Description
6	Release of payment	Payment is released by the NAMA donor to the NCA (also part of the NIE), who forwards it to the NIE, where from it is released to the NEEs.
7	Purchase and Operation of eBus	Purchase of eBuses, followed by their operation on the BRT is carried out by the NEE.

Table 15: Approval Structure for the NAMA

The diagram shown below details the workflow of the approval process along with the entities involved.

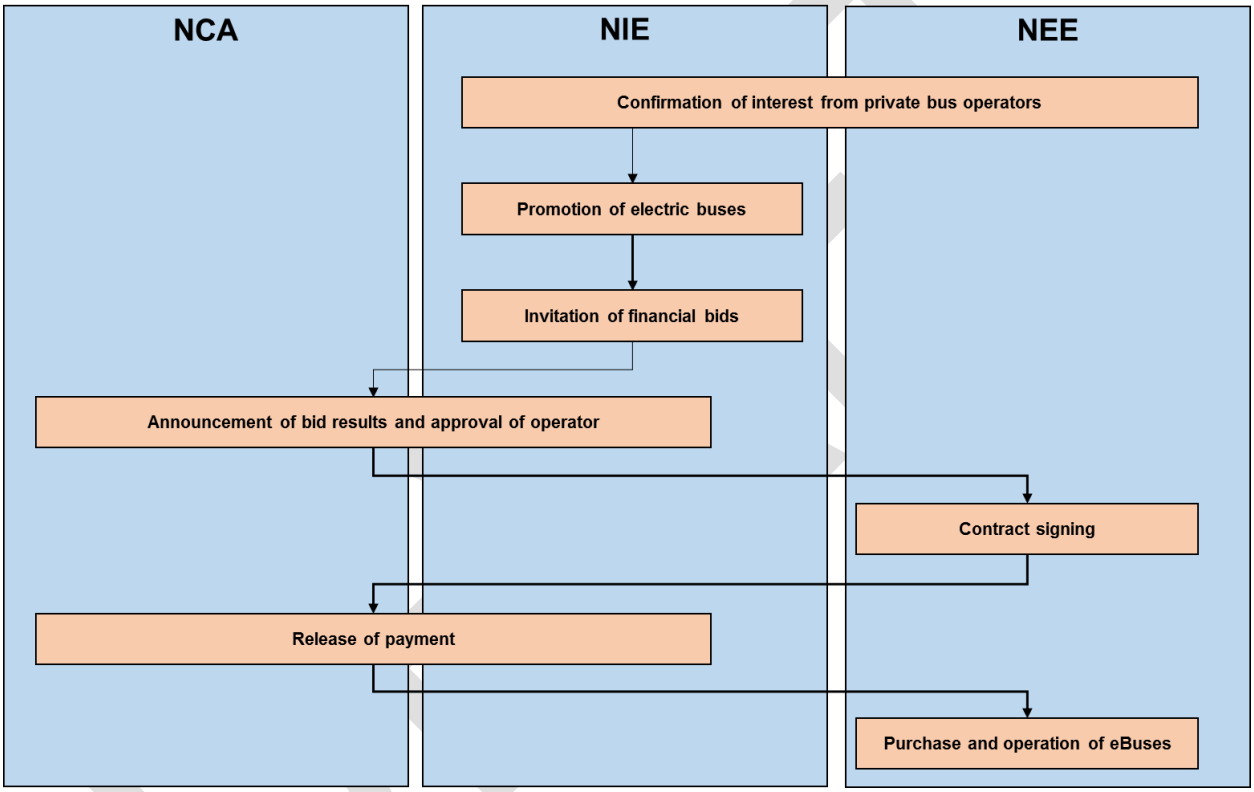

Figure 16: Workflow of the NAMA Approval Process

5. NAMA Implementation Structure

5.1. Actions to Institutionalize the NAMA

The coordination and management of the NAMA requires an institutional structure, which shall meet the following requirements:

- It must be embedded in national and sectoral policies and strategies.
- It must be capable of effective communication and reporting as required by international agencies, such as the UNFCCC.
- It must provide an interface to international bilateral and multilateral NAMA funding entities, such as the Green Climate Fund and NAMA Facility among others.
- It must be able to ensure proper management of financial flows between the NAMA funding entities and the recipients.
- It must be able to ensure the achievement of NAMA targets in terms of use of electric vehicles, GHG mitigation and sustainable co-benefits.
- It must be able to allow transparent monitoring of GHG emission reductions and Sustainable Development indicators.

The recommended institutional structure of the NAMA is based on the following principles:

- Ensuring the strong involvement of national stakeholders to create country ownership and political commitment.
- Using existing and experienced entities organizational systems which are already in place and allow for prompt and smooth implementation of the NAMA.
- Ensuring that the institutional structure is appropriate for the receipt of international private and/or public donor funding.

5.2. Institutional Framework for NAMA Implementation and Management

The institutional structure for the NAMA shall include the following institutional bodies at the country level:

- a NAMA National Focal Point or National NAMA Approver (NA)
- a NAMA Coordinating Authority (NCA)
- a NAMA Implementing Entity (NIE)
- NAMA Executing Entities (NEEs)

The following sections provide an in-depth understanding of the roles and responsibilities of the institutional bodies listed above.

5.2.1. National NAMA Approver/Focal Point

The national NAMA Approver or Focal Point shall inter alia:

- Approve NAMAs which shall be registered at the UNFCCC

- Provide guidance to sectoral NAMA coordinating entities (access to climate finance, financial flows, MRV etc.)
- Issue procedures for accounting of emission reductions to avoid double counting of emission reductions from various implemented NAMAs
- Support the preparation of the National Communication, Biennial Update Reports, and Summary of GHG Reductions etc.

The **Ministry of Mahaweli Development and Environment (check with the Ministry of Env. if this is the new name for the Ministry of Environment and Natural Resources)** has already been appointed as NAMA Approver/Focal Point to the UNFCCC and as the National Designated Authority (NDA) to the GCF.

5.2.2. The NAMA Coordinating Authority (NCA)

The NAMA Coordinating Authority (NCA) is the entity which coordinates the proposed NAMA on replacement of conventional buses with e-buses. Its main tasks are:

- Acting as primary contact for international donor(s)
- Managing and directing the NAMA
- Approving NAMA targets
- The implementation process with regard to the submission of project applications and the disbursement of funds (in close collaboration with the NCCC, the NAMA Focal Point, the NIE)
- Approving and updating eligible interventions
- Approving annual monitoring reports prepared by the NIE (covering inter alia the number of projects implemented, the calculation of emission reductions etc.) and
- Supervising the financial flows between donors and beneficiaries.

The **Ministry of Internal Transport** will act as the NAMA Coordinating Authority (NCA) for the Sri Lanka Transport NAMA.

5.2.3. NAMA Implementing Entity (NIE)

The NIE will be responsible for handling financial flows from funding entities to the beneficiaries as well as for project approval. The NAMA Implementing Entity (NIE) is the main operative body of the Transport NAMA in Sri Lanka.

The main tasks of the NIE are to:

- Ensure the proper transfer and disbursement of funds from the donors to the recipients based on an agreed set of criteria (e.g. money will be held in a trust account with limited access, money will be disbursed only after the project has been implemented, etc.)

- Prepare reports to the NCA/donor(s) on various elements of the NAMA, for example:
  - the use of funds,
  - the number of projects implemented,
  - targets achieved

  Among other elements
- Capacity-building for institutions and companies involved in the implementation of the NAMA (e.g. micro-grid operators and equipment suppliers)
- Development of technical standards for equipment/installations used under the NAMA
- Co-ordination of promotion and awareness raising campaigns and of support for the implementation of the NAMA
- Integration of the private sector into NAMA implementation
- Co-ordination of monitoring activities and preparation of monitoring reports for all interventions
- Facilitation and coordination of verification through the external entity designated for this task
- Reporting to the NCA in fulfilment of reporting requirements to the donor and
- Co-operation with internal and external financial auditors

The NIE needs to have a strong background and good track record in financing. Therefore, it makes sense to recruit external experts to provide support to the NIE on technical financial issues. The distribution of work between the NIE and the technical experts will be agreed before the start of NAMA implementation.

The Ministry of Internal Transport along with the Ministry of Finance and Planning and the Development Finance Corporation of Ceylon (DFCC Bank) (check with Sri Lankan Government) shall take up the role of the NIE.

The Ministry of Internal Transportation is responsible for the development, implementation and maintenance of Sri Lanka's transportation sector (including policy formation and development) and hence has an in-depth understanding of the requirements for and barriers to the implementation of the Transport NAMA.

The Ministry of Internal Transport will be supported by The Ministry of Finance and Planning on matters related to finance. The Ministry of Finance and Planning is responsible for developing and executing Sri Lanka's public finance policy, economic policy and long term planning and will be essential in providing the technical assistance required in the area of finance such as developing norms and regulations around the disbursement of the funds.

The Development Finance Corporation of Ceylon (DFCC Bank) will be responsible for disbursing the funds received from the NAMA donor to the NAMA Executing Entities (NEEs). The DFCC Bank is the oldest development finance institution (DFI) in Sri Lanka and also the nodal entity for providing loans related to renewable energy and energy efficiency projects on behalf of the European Investment Bank (EIB). They thus have extensive experience in the management and disbursement of funds allocated for the purpose of development in Sri Lanka.

5.2.4. NAMA Executing Entities (NEEs)

The NAMA Executing Entities (NEEs) are the private operators who will operate electric buses under the auspice of the NAMA. Each NEE will:

- Operate electric buses on the proposed Galle BRT in compliance with the rules of the intervention
- Inform the NIE about the performance of their buses and
- Collect data for monitoring purposes (requirements will be communicated by the NIE based on the MRV).

The existing Sri Lanka Transport Board (SLTB) will act as the supervisory board for the NEEs (As with every other institution, check with the Sri Lankan Government for approval). The SLTB is responsible for advising the government on national policy relating to passenger transport services by buses, providing efficient passenger service by bus throughout the country, maintaining designated bus terminals and improving services at such terminals for passenger benefit. Thus, they are the most appropriate organization to supervise the NEEs in the execution of the NAMA.

The following organizational diagram illustrates the recommended institutional structure of the NAMA described above. **The Ministry of Internal Transport** will be the core stakeholder in the NAMA due to its various functions. Bilateral funding entities or donors will be in direct contact with the **Ministry of Internal Transport**.

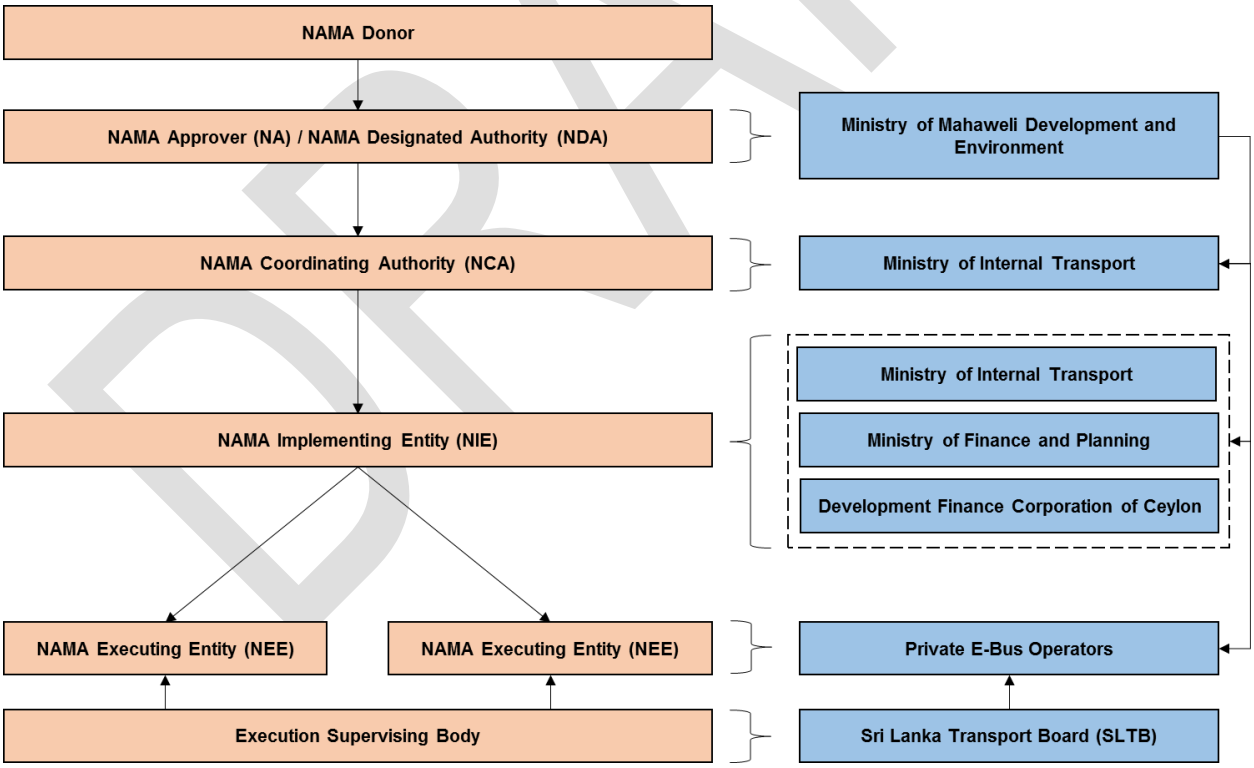

Figure 17: NAMA Institutional Structure

6. NAMA Capacity Development Needs

6.1. NAMA Capacity Development Program

The NAMA capacity development program is designed to ensure a smooth launch of the NAMA and contribute to the successful implementation of its activities. The development and implementation of the Sri Lanka Transport NAMA will require capacity building and training of the institutions involved, government ministries and institutions as well as private bus operators. It will also need the development of outreach programs inorder to incite interest within the private sector for the NAMA along with promotional campaigns marketing the intervention (utilization of electric buses in the BRT) to generate awareness and interest in the adoption and utilization of electric vehicles within the country.

The proposed NAMA capacity development program will consist of two components:

- Component 1 will target support for the launch of the NAMA and will provide capacity-building for the governmental entities involved (such as the NCA and the NIE).
- Component 2 will focus on awareness-raising about the NAMA once implementation has begun and will provide:
  - General capacity development to create a common awareness of the NAMA
  - Specific stakeholder oriented capacity building

The capacity development program will be led by international consultant(s) with the support of national experts. The first component will be carried out by international/national consultants only. In the second component NCA and NIE staff who have been trained in the first component will start to provide seminars/trainings and workshops.

6.2. Component 1: Capacity Development for NAMA Launch and Implementation

Component 1 of the capacity development program will support the capacity development of institutions involved for the launch and implementation of the NAMA and will assist in the development of the following activities:

- Establishing a NAMA work flow detailing its processes including implementation cycles, staff training, etc.
- Designing NAMA related contractual conditions (for example, contract for the hiring of an operator as a NEE)
- Preparing NAMA project documentation (application forms, call and bid documents, procurement rules, monitoring, evaluation and reporting forms, etc.)

This component is concerned solely with activities which have to be performed by the NAMA Coordinating Authority (NCA) and the NAMA Implementing Entity (NIE).

Capacity development for implementation will be carried out by international/national consultants only. In this regard international experts (technical and financial) will be hired for a period of 3 years, as international advisors.

The following sections elaborate the various activities of Component 1 of the capacity development program.

6.2.1. Implementing NAMA network and communication framework

This part of the capacity development program will facilitate establishment of the NAMA entities and explain the roles that stakeholders will play within the NAMA structures through multilateral and bilateral meetings and workshops.

During this phase, the NIE will receive assistance through the following types of technical training:

- Train the trainer programs about the objectives, benefits and procedures of the NAMA (the NIE will then be able to offer training to the NEEs)
  - Case study training for project approval and verification
  - Training on MRV for GHG emission reductions and SD benefits
  - Designing designation of authority and time frames for process steps within the NIE
  - Training on reporting to the NCA
- Prepare communication structure and informing procedures detailing the flow of information from the NA right down to the NEEs and NAMA ground personnel

6.2.2. Regulations and Contractual Conditions

This part of the capacity development program will perform the following roles:

- Draft, in close cooperation with the Government, amendments to the existing regulations as required
- Assist in the drafting of contractual conditions and documents setting out the relationships between the NAMA stakeholders, as required (e.g. to distribute responsibilities between the entities constituting the NIE)
- The contract to be signed by the NIE and the NEEs will be designed by the NIE (with the support of the capacity building program) and will contain at least:
  - Name and address of the legal entity asking for support
  - A description of the eBuses to be purchased by the NEEs (private operators)
  - Amount of grant/loan/subsidy to be given
  - Reference to the legal framework for this NAMA and the relevant approval procedures
  - The period for finalizing the purchase and operation of eBuses and issuing invoices to the NIE
  - Reporting requirements by the NEEs
  - Payment conditions

6.2.3. Preparing NAMA project documentation

This activity of the capacity development program involves the following:

- Prepare the documents (application forms, call and bid templates, evaluation and reporting forms, etc.)
- Prepare the procedures for practical implementation (procurement rules, monitoring manual, evaluation, cross-check, approval and reporting structures, etc.)
- Ensure that the relevant forms and procedures are subject to consultation with potential end users and are sufficiently robust to secure practicability, avoid bureaucracy and eliminate corruption

6.3. Component 2: Awareness Raising and Marketing

Component 2 of the capacity development program will focus on generating interest for the NAMA among the various stakeholders of the NAMA including private players being invited to participate for the purchase and operation of eBuses on the BRT (potential NEEs) as well as the Sri Lankan public who will be utilizing the services provided by the NAMA. This will done through the development of a combination of awareness raising programs and marketing campaigns, disseminating information on the NAMA among its various stakeholders.

This component will consist of the following activities:

6.3.1. General activities

A countrywide generic marketing/awareness-raising strategy for the NAMA will create a common understanding of the benefits of electric buses, their use in the BRT and explain the NAMA's objectives and procedures.

- Organizing NAMA Launch Event

  The launch event will be the countrywide kick off for the NAMA and will inform people about its objectives, stakeholders and timelines. The launch event will include a press briefing and will provide some informal networking opportunities.

- Designing/Maintaining the NAMA Website

  The web page is one of the main communication tools of the NAMA providing information about:

  - The qualification criteria for private bus operators
  - Case studies
  - Best practices
  - Success stories
  - Templates
  - News and achievements of the NAMA
  - Donors

- Coordinating General NAMA Information Events

  In addition to the launch event, two general information events (outreach programs) will be organized per year (for the first three years of the NAMA) which will present the idea of electric vehicles and this specific NAMA, its objectives and opportunities, and explain the NAMA procedures.

- Support in Business Development

  Focus will be given to supporting new entrepreneurs in developing ancillary industries around the requirements of the eBus operators and the NAMA. This will include support on technical issues, such as production techniques, as well as general business development issues, such financing of production, product selection, client selection and market access.

- Preparing/Disseminating NAMA Marketing Material

  Typical materials will include leaflets, pens, notepads, a best practice guide, folders, banners, etc.

- Cooperation with public and private media

  There will be continuous information to the media about the implementation and outcomes of the NAMA.

6.3.2. Stakeholder-Targeted Activities

These marketing/awareness-raising strategies will help ensure widespread participation in the NAMA. This section refers to the capacity-building activities, tailored to the needs of the stakeholders, especially the private bus operators (potential NEEs) and will be provided by international experts.

- **National NAMA Implementing Entity (NIE)**

  One of the most important tasks of the NIE with regard to the NAMA is to avoid double counting of emission reductions and ensure proper monitoring and reporting of the NAMA intervention. Therefore the NIE's specific capacity-building will focus on:

  - The exchange of know-how with other countries which are implementing or have implemented transport NAMAs using electric vehicles
  - The MRV system of the NAMA

  In case of the Sri Lanka Transport NAMA, while the NIE constitutes three separate organizations, the aforementioned training shall be provided to **The Ministry of Internal Transport.**

- **Private Bus Operators**

  Private bus operators are the companies which will invest in the NAMA (future NEEs) by buying and operating the eBuses on the BRT as well as providing related services. Workshops and presentations on NAMA objectives, eligibility, procedures, etc. will be provided to these companies.

- **Suppliers of EV Equipment (Ancillary Industries)**

  General information on the NAMA's business potential will be provided to interested companies.

It is estimated that the total cost of the capacity development for the Sri Lanka Transport NAMA will be approximately around USD 1.2 Million (details provided in Chapter 7 – NAMA Costs and Finance).

7. NAMA Costs and Finance

7.1. Proposed Investment in the Galle Bus Rapid Transit

The "Study of BRT on Galle Road", by the University of Moratuwa has recommended a public-private partnership for the financing of the proposed Galle BRT, with the government of Sri Lanka contributing upto USD 140 million for the construction and implementation of the BRT, with a majority of the financing being directed towards the development of the BRT's infrastructure components such as bus stations, the run way and traffic components among others. The private sector would be involved through the purchase of new buses that would operate on the BRT.

The following table indicates proposed investments from the Sri Lankan Government (public investment) for the various components of the proposed Galle BRT:

Proposed Public Investment	
Component	**Financing (Million USD)**
Planning Stage Cost	2.9
Running Way	16.5
Stations	10
Traffic Improvements	68.8
Marine Drive	1.3
Operator Development/Compensation	33.8
Urban, Social and Environment Costs	6.9
Total Public Contribution	**140.2**

Table 16: Proposed BRT Investments from Sri Lanka Government

It is evident from the information provided in the table above that while the government does not pledge any finance for the purchase of buses that will run on the BRT, it contributes significantly to the development of the infrastructure of the Galle BRT. The purchase and operation of buses on the Galle BRT is expected to be completely under the purview of the private sector.

However, in order to bolster the effectiveness and financial viability of eBuses to private sector bus operators, it is proposed that the Sri Lankan government contribute financially through the provision of subsidies to the operators of eBuses on the BRT. The subsidies provided shall be in the form of an import tax exemption and a fuel subsidy, designed to make the purchase and operation of eBuses on the BRT attractive for private operators. A financial contribution directly from the local government signifies political stake and support in the implementation of the NAMA intervention for the BRT, thus strengthening the commitment to the project.

7.2. Financial Analysis of the NAMA intervention

The proposed NAMA intervention vies to provide an avenue for GHG mitigation and accrue sustainable development benefits within the CMA through the adoption of eBuses in the Galle BRT, in place of conventionally fuelled (diesel) buses.

The following table provides an overview of the Sri Lanka Transport NAMA intervention and the costs associated with its various components:

Performance Indicator	Value
Galle BRT - Baseline Scenario (Conventional Fossil Fuelled Buses)	
Articulated Buses	100
Cost of Individual Bus	195,000 USD
Life of Bus	5 years
Sri Lanka Transport NAMA - Replace Conventional Buses with Electric Buses	
Electric Buses	100
Cost of Individual Bus	395,000 USD
Life of Bus	10 years
Cost of Replacement Battery	64,800 USD
Life of Battery	5 years
Charging Stations required	50
Cost of Charging Station	50,000 USD

Table 17: NAMA Costs Overview

Apart from the capital investment required for the purchase of 100 eBuses, the NAMA also includes other components such as placement of charging stations and capacity building measures.

Utilizing the information presented above, a detailed financial analysis of the intervention was performed, covering a period of 10 years from the start of the NAMA. The results of this analysis have been highlighted below:

Indicator	Conventionally Fuelled Buses	Electric Buses
Total Number of Buses	100	100
Total Capital Cost	39,000,000 USD	48,480,000 USD
Total Operational Cost	85,944,823 USD	55,785,527 USD
Total Cost	124,944,823 USD	104,265,527 USD
Financial Comparison		
Net Present Value (NPV) of Benefits in eBuses	-8,893,213 USD	
Payback Period	< 5 years	

Table 18: Financial Analysis of NAMA

The analysis showcases that the use of eBuses in place of conventionally fuelled buses in the Galle BRT is a financially viable and lucrative option when compared to the operation of conventional buses, while also leading to mitigation of GHG emissions and providing various sustainable development benefits for the CMA. Thus, the development and implementation of the Sri Lanka Transport NAMA provides not just environmental and social benefits for the country but also yields its operators economic benefits in the form of early payback and profitability.

Additionally, the financial analysis also details the major cost components of the NAMA that need financial support (table below) with estimates of the amount of finance required:

Capital Investment				
Cost Component	**Unit**	**Unit Rate (USD)**	**Quantity**	**Cost (USD)**
Electric Buses				
Cost of eBuses in Phase 1	Nos.	395,000	10	3,950,000
Cost of eBuses in Phase 2	Nos.	276,500	90	24,885,000
Infrastructure				
Charging Stations	Nos.	50,000	50	2,500,000
Subsidy				
Fuel Subsidy	Nos.	13,600	100	1,360,000
Import duty exemption for BRT eBuses	Nos.	0*	100	0
Capacity Development				
Cost Component	**Unit**	**Unit Rate (USD)**	**Quantity**	**Cost (USD)**
International Experts				
Technical Expert	Month	12,000	36	432,000
Financial Expert	Month	12,000	36	432,000
Travel				
International Flights	Flight	2,000	18	36,000
National Travel	Per Diem	150	180	27,000
Food & Lodging	Per Diem	200	180	36,000
Awareness Programs				
Training programs for BRT staff	Event	1,500	12	18,000
Outreach program for private sector	Event	1,500	6	9,000
NAMA public awareness raising events	Event	1,500	4	6,000
Contingency (5%)				49,800
Project Administration (7%)				69,720
TOTAL				**33,810,520**

Table 19: NAMA Costs Details

*** Currently 0 as the value for import tax exemption per bus is yet to be decided**

The assumptions as well as detailed calculations, along with their respective sources have been elaborated in the annexures.

7.3. Financing Mechanism for the Sri Lanka Transport NAMA

The financing mechanism for the NAMA has been designed taking into account the various modes of funding that are available from international financing agencies. The following sections propose a customized financing mechanism (based on a combination of approaches) that can be utilized based on the route or scenario through which financing is accessed, i.e. a combination of grants and soft loans.

The table below describes the various approaches on which the mechanism is based:

Approach	Description
Soft Loan	A soft loan is a loan, typically given to a developing country, on terms that are very favourable to the borrower. It usually involves provision of the loan at below-market or zero rate of interest.
	International financing agencies usually prefer providing soft loans when it comes to infrastructure projects or projects that require a large amount of financing. Since the transport NAMA could be considered to be an infrastructure project it is likely that financing agencies would offer soft loans for its implementation.
Reverse Auction	In reverse auctioning, proposals are collected on the basis of tendering or an eligibility criteria. Proposals are subsequently accepted based on the amount of funding requested, with preference given to the lowest technically competent offer.
	In case of the transport NAMA, proposals from private operators, in order to access NAMA financing to purchase eBuses shall be accepted on the basis of the least amount of funding (gap funding) requested.
Import duty exemption	An import duty is a tax collected on imports and some exports by the customs authorities of a country. This tax is used to raise state revenue and is based on the value of goods called ad valorem duty or the weight, dimensions, or other criteria of the item such as its size. It is also referred to as customs duty, tariff, import tax and tariff.
	In case of the transport NAMA, it is proposed that the Sri Lankan government relax taxation of electric buses meant for the BRT in the form of exemption from import duties on the same (indirect subsidy).
Fuel Subsidy	A fuel subsidy is a discount on the selling price of fuel as compared to its market value.
	In case of the transport NAMA, it is proposed that the Sri Lankan government provide operators of eBuses fuel subsidy for the first twelve months (one year) of operation in the form of free charging (direct subsidy).

Table 20: Financial Approaches Utilized

7.4. NAMA financing through a combination of grants and soft loans

The financing mechanism proposed in this section is based on the recommendation that all of the international climate financing required for the NAMA be availed in the form of grants and soft loans with support from the Sri Lanka government in the form of a grant and indirect subsidies (import duty exemption).

The following table highlights the various components of NAMA finance, their corresponding financing requirements along with their respective proposed fulfilment mechanisms:

Investment Category	Cost Component		Unit	No. of Units	Cost	Total Cost	Financing Source	Financing Mechanism
Phase 1: Pilot Phase - Introduction of 10 eBuses								
Capital Investment	Finance for eBuses		Bus	10	395,000	3,950,000	International Climate Finance	Grant + Reverse Auctioning
	Charging Stations		Charging Station	5	50,000	250,000		Grant
Operations & Maintenance	Free Charging (12 Months)		Bus	10	13,600	136,000	Sri Lanka Government	Direct Subsidy
	Import duty exemption for BRT eBuses			10	0*	0		Indirect Subsidy
Capacity Development	International Experts		Months	48	12,000	576,000	International Climate Finance	Grant
	Travel	International Flights	Flight	12	2,000	24,000		
		National Travel	Per Diem	120	150	18,000		
		Food & Lodging	Per Diem	120	200	24,000		
	Awareness Programs		Events	13	1,500	19,500		
	Contingency					33,075		
	Project Administration					46,305		
Total Cost for Phase 1						**5,076,880[#]**		
Phase 2: Full Scale Operations - Operations of 100 eBuses								
Capital Investment	Finance for eBuses		Bus	90	276,500	24,885,000	International Climate Finance	Soft Loan + Reverse Auctioning
	Charging Stations		Charging Station	45	50,000	2,250,000		
Operations & Maintenance	Free Charging (12 Months)		Bus	90	13,600	1,224,000	Sri Lanka Government	Direct Subsidy
	Import duty exemption for BRT eBuses			90	0*	0		Indirect Subsidy

Capacity Development	International Experts		Months	24	12,000	288,000	International Climate Finance	Grant
	Travel	International Flights	Flight	6	2,000	12,000		
		National Travel	Per Diem	60	150	9,000		
		Food & Lodging	Per Diem	60	200	12,000		
	Awareness Programs		Events	9	1,500	13,500		
	Contingency					16,725		
	Project Administration					23,415		
Total Cost for Phase 2						**28,733,640#**		
Total NAMA Cost						**33,810,520#**		

Table 21: NAMA Intervention Financing

*** Currently 0 as the value for import tax exemption per bus is yet to be decided based on discussions with the Government of Sri Lanka**

 # The total values are liable to change depending on the value of import tax exemption that is finally decided upon by the Government of Sri Lanka

The following figure highlights the financial flows for the different financing components within the two phases of the NAMA:

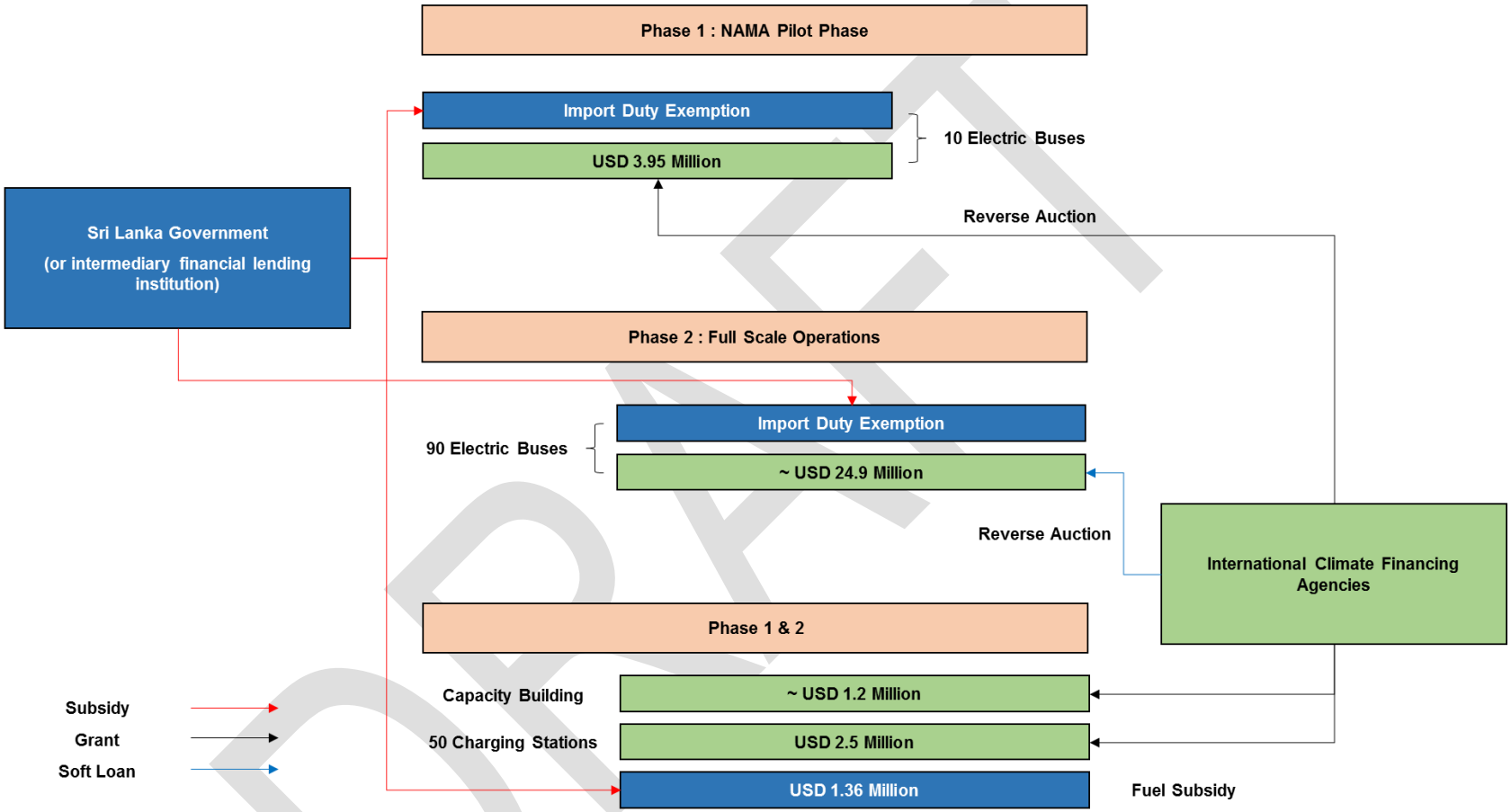

Figure 18: NAMA Financial Flows

7.4.1. Phase 1 - NAMA Pilot (Demonstration)

Phase 1 introduces 10 electric buses through private operators in to the Galle BRT, a pilot project whose aim is to generate awareness about the NAMA, highlighting its importance for the transport sector. Funding for eBuses being introduced in Phase 1 will cover the complete cost of the 10 eBuses that the government wishes to introduce into the BRT, i.e. USD 395,000 per bus (USD 3.95 million for 10 buses), and shall be covered by international climate financing agencies in the form of grants. This should help make it appealing for other private bus operators in Sri Lanka to operate eBuses on the Galle BRT during full scale operations of the NAMA (while also raising awareness about the technology among the Sri Lankan public).

Furthermore, the design parameters for the disbursement of aforementioned funds are as follows:

- **Funding for the lowest bidder (Reverse Auctioning)**

  Financial bids for the 10 eBus permits from private operators will be invited. The funds allotted to the permit will be provided to the operator with the lowest bid, i.e. the lowest amount of funding requested (reverse auctioning).

- **Disbursement of funds**

  The funding allotted to every eBus permit will be sourced in the following manner:

  i. The complete amount requested (winning bid) shall be provided from funds availed through the international climate financing agency.
  ii. The remaining unused amount (if any) shall be utilized for the next phase of the NAMA intervention.
  iii. For example, in case a winning bid requests for USD 295,000 for an eBus, USD 295,000 shall be fulfilled by the grant from the international climate financing agency while the remaining USD 100,000 shall be channelled into Phase 2 of the NAMA intervention i.e. the NAMA's full scale operations.

7.4.2. Phase 2 - Full Scale Operations of the NAMA

Phase 2 of the NAMA involves the initiation of the NAMA's full scale operations wherein the remaining 90 eBuses are introduced and operated on the Galle BRT. The financing for phase 2 shall cover the entire differential cost of the 90 buses open to the private sector, i.e. a value of USD 24.9 Million.

This differential amount shall be availed through international climate finance in the form of a soft loan, at a low, preferential rate of interest. The NIE will then disburse this amount in the form of soft loans to the private operators at a very favourable rate of interest, lower than the prevalent market rate.

Thus, while the operators are indebted to return the financing received back to the government, they do so at a rate which is far lower than the prevalent market rate of return, making the government soft loan an attractive vehicle to finance the purchase of eBuses.

The disbursement of the loans shall be done on the basis of the lowest bids (reverse auctioning) and it is likely that not all the amount will be disbursed. The remainder could be channelled into other similar projects across Sri Lanka or can even be used in the operation and maintenance of the Galle BRT, with

lending being carried out at possibly higher rates than which it was received, thereby acting as an additional revenue generating source for the government.

The design parameters for the financing of Phase 2 have been elaborated below:

- **Invitation to bid**

  Financial bids from an operator will be invited, if and only if, the aforementioned operator has committed to investing atleast 30% of the capital cost required for the purchase of an eBus in the form of equity. The remaining amount of the capital cost can be covered by the operator through the soft loan (received at a rate of interest far lower than prevailing market rates, thus making it a very attractive option) from the NIE.

- **Funding for the lowest bidder**

  The electric bus permits and the subsequent funds allotted to the permit will be provided to the operator (making it a NEE) with the lowest bid, i.e. the lowest amount of funds requested (reverse auctioning).

- **Disbursement of funds**

  i. Prior to disbursement, the NIE and NEE will enter into a Fund Securitization Agreement (as agreed upon by the Government of Sri Lanka) providing the NIE claim over the asset, i.e. the eBus (or eBuses) owned by the NEE, in case of an event of loan default or failure to meet the required level of service during operation of the eBus on the BRT.

  ii. The funding allotted to the NEE will be released in full at the time of purchase of the eBuses by the NEE.

- **Seizure of assets**

  In the event that a NEE:

  i. Defaults on the loan

  ii. Fails to operate an eBus for a minimum of atleast 50,000 kms (approximately 40% of the expected average total distance to be travelled by a bus on the BRT every year) in a year

  iii. Performs a sale of an eBus before the end of its expected life time i.e. 10 years

  The NIE holds the right to seize the asset (eBus). The NIE can then resell the eBus to a new buyer at a lower cost than market cost, on the condition that the eBus continues its operation on the Galle BRT till the end of its remaining lifespan.

7.4.3. Phase 1 & 2 - Provision of import tax exemption (indirect subsidy), fuel subsidy (direct subsidy), financing of charging infrastructure and capacity building

Financing for the following cost components shall also be provided through a combination of government intervention and international climate finance grants:

- **Exemption of import duty on eBuses**

  Apart from the grant funding proposed, it is proposed that the government relax taxation of eBuses meant for the BRT in the form of exemption from import duties on the same. This will act

as further proof of the government's commitment to the development of a BRT with electric buses and sustainable transport in Sri Lanka, while making adoption of eBuses in the BRT attractive for the private sector.

- **Fuel subsidy through free charging facility**

  In addition to the exemption of import duty on eBuses, it is proposed that the government provide operators of eBuses fuel subsidy for the first twelve months (one year) of operation in the form of free charging. It has been estimated that the fuel subsidy for 100 eBuses for a period of one year would cost the government a total of USD 1.36 million.

- **Charging station infrastructure & capacity building**

  The costs of:

  i. Purchasing and setting up 50 charging stations for the electric bus fleet, each costing approximately USD 50,000 (infrastructure development),
  ii. Capacity development and training for the NAMA, to a tune of approximately USD 1.2 million (details provided above).

  Shall be availed through grants from international climate financing agencies

The operations and maintenance costs (including cost of replacement batteries) for the eBuses are expected to be covered by the revenue generated by the respective players through the operation of the eBuses on the Galle BRT.

8. NAMA Measurement, Reporting and Verification

8.1. NAMA Measurement, Reporting and Verification Framework

As a NAMA is an instrument of output based aid, the results of implemented NAMAs need to be amenable to Measurement, Reporting and Verification (MRV) in order to attract donors and to guarantee the sustainable success of the interventions.

The methodology for monitoring the effects of NAMAs needs to follow the general principles of transparency, consistency, comparability, completeness and accuracy. This applies to all the components to be monitored. The objective of the MRV framework is to provide a credible and transparent approach for quantifying and reporting GHG emission reductions.

An MRV framework includes the following elements:

- **System boundary definition**

  The system boundary encompasses significant anthropogenic GHG emissions by sources under the control of the project participant that are reasonably attributable to the NAMA intervention as a project activity.

- **Baseline scenario**

  The baseline scenario is the scenario for a project activity that reasonably represents the anthropogenic emissions by GHG sources as well as sustainable development that would occur in the absence of the proposed project activity, i.e. the NAMA intervention. In case of the Sri Lanka Transport NAMA, the baseline scenario constitutes the use of conventionally fuelled (diesel) articulated buses on the Galle BRT.

- **Project activity scenario**

  The project activity scenario is a NAMA intervention, in this instance the utilization of electric buses on the Galle BRT, and the related anthropogenic emissions by GHG sources and the associated sustainable development that occurs due to the project activity.

- **Emissions reduction calculation**

  The GHG emissions reduction achieved by the project activity will be determined as the difference between the baseline emissions and the project emissions.

- **Monitoring**

  Defines the parameters to be monitored.

- **Reporting and verification**

  Defines the reporting requirements and verification procedures.

8.2. Measurement and Monitoring of GHG Emissions Reductions

The GHG emission reductions which will be achieved by the NAMA intervention, adoption of electric buses in the BRT, are calculated by comparing project emissions with the emissions under a baseline scenario. The MRV, including GHG emission calculation and details on the methodology used, for the NAMA intervention are given in detail in the next section.

8.2.1. Baseline and Project GHG Emissions – An Overview

The Clean Development Mechanism provides the methodology, **"AMS-III.C: Emission reductions by electric and hybrid vehicles"**, to apply to project activities that introduce new electric and/or hybrid vehicles that displace the use of fossil fuel vehicles in passenger and freight transportation. This methodology was found to be most suitable and appropriate to determine the emissions in baseline as well as NAMA scenario.

System Boundary

The project activity is defined by the use of electric buses on the Galle BRT, thus the project boundary encompasses the electric buses, the BRT and the source of electricity generation (fuel for eBuses).

8.2.2. Baseline Emissions (Diesel Fuelled Articulated Buses)

The baseline emissions are calculated based on the unit of service provided by the project vehicles (travelled distance, kms) times the emission factor for the baseline vehicle to provide the same unit of service as per the equation below:

$$BE_y = EF_{BL,km} \times DD_y \times N_y \times 10^{-6}$$

Parameter	Unit	Description
BE_y	tCO_2	Total baseline emissions in the year y
$EF_{BL,km}$	gCO_2/km	Emission factor for baseline vehicle
DD_y	km	Annual average distance travelled by project vehicle in the year y
N_y	-	Number of operational project vehicles in the year y. In case of the Sri Lanka Transport NAMA this number is a 100.

Table 22: Baseline Emissions

Using the formulae presented above, the total GHG emissions from 100 diesel fuelled articulated buses operating on the Galle BRT was calculated to be **15,320 tCO_2** annually.

The emission factor for baseline vehicles ($EF_{BL,km}$) is determined as follows:

$$EF_{BL,km} = SFC \times NCV_{BL} \times EF_{BL} \times IR^t$$

Parameter	Unit	Description
SFC	g/km	Specific fuel consumption of baseline vehicle

NCV_{BL}	J/g	Net calorific value of fossil fuel consumed by baseline vehicle
EF_{BL}	gCO_2/J	Emission factor of fossil fuel consumed by baseline vehicle
IR	-	Technology improvement factor for baseline vehicle in year t. The improvement rate is applied to each calendar year. The default value of the technology improvement factor for the baseline vehicle was assumed to be 0.
t	-	Year counter for the annual improvement (dependent on age of data per vehicle category)

Table 23: Baseline Emission Factor

The assumptions as well as detailed calculations, along with their respective sources have been elaborated in the annexures.

8.2.3. Project Emissions (Electric Buses)

Project emissions include emissions from the electricity (fossil fuel consumed for generation of electricity) associated with the operation of project vehicles and shall be calculated as follows:

$$PE_y = EF_{PJ,km,y} \times DD_y \times N_y$$

Parameter	Unit	Description
PE_y	tCO_2	Total project emissions in the year y
$EF_{PJ,km,y}$	tCO_2/km	Emission factor per kilometre travelled by project vehicle
DD_y	km	Annual average distance travelled by project vehicle in the year y
N_y	-	Number of operational project vehicles in the year y. In case of the Sri Lanka Transport NAMA this number is a 100.

Table 24: Project Emissions

Using the formulae presented above, the total GHG emissions from 100 electric buses operating on the Galle BRT was calculated to be **11,604 tCO_2** annually.

The emission factor for project vehicles ($EF_{PJ,km,y}$) is determined as follows:

$$EF_{PJ,km,y} = SEC_{PJ,km,y} \times EF_{elec,y}/(1 - TDL_y) \times 10^{-3}$$

Parameter	Unit	Description
$SEC_{PJ,km,y}$	kWh/km	Specific electricity consumption by the project vehicle per km in year y in urban conditions
$EF_{elec,y}$	$kgCO_2/KWh$	CO_2 emission factor of electricity consumed by project vehicle in year y
TDL_y	%	Average technical transmission and distribution losses for providing electricity in the year y

Table 25: Project Emission Factor

The assumptions as well as detailed calculations, along with their respective sources have been elaborated in the annexures.

8.2.4. Emissions Reduction

Emissions reduction is the difference between the baseline emissions and project emissions after implementing the NAMA intervention of adopting and operating eBuses on the Galle BRT. Therefore, the emissions reduction is calculated as follows:

$$ER_y = BE_y - PE_y - LE_y$$

Parameter	Unit	Description
ER_y	tCO_2	Emission reductions in year y
BE_y	tCO_2	Baseline emission in year y
PE_y	tCO_2	Project emission in year y
LE_y	tCO_2	Leakage emission in year y

Table 26: Emissions Reduction

Since the project activity does not involve any fossil fuel switching measures, leakage calculation is not required and hence "Leakage emission" is taken to be 0.

Thus, the emissions reduction due to the NAMA intervention (100 buses) is calculated to be a total of **3,715.9 tCO_2** annually or **37,159 tCO_2** over a period of 10 years.

This represents a total of approximately **24%** decrease in emissions with respect to the baseline over a period of 10 years. With an increase in scope and scale of the project, one can expect the emission reductions to increase further.

8.2.5. Measurement and Monitoring

The following parameters will be monitored for the Sri Lanka transport NAMA:

Parameter	Description	Data Unit
DD	Annual average distance driven by project vehicle	km
SEC	Specific electricity consumed per km per project vehicle	kWh/km
EF	CO_2 emission factor of electricity used by project vehicle	$kgCO_2/kWh$
N	Number of project vehicles in operation	-

Table 27: Monitored Emission Parameters

The aforementioned parameters are detailed below:

DD (Annual average distance driven by project vehicle)

Parameter	DD
Data Unit	Km
Description	Annual average distance driven by project vehicle
Source of Data	Measurement
Frequency	Monthly
Measurement Procedure	Monitor the distance travelled by all project vehicles

SEC (Specific electricity consumed per km per project vehicle)

Parameter	SEC
Data Unit	kWh/km
Description	Specific electricity consumed per km per project vehicle
Source of Data	Measurement
Frequency	Annual
Measurement Procedure	Monitor electricity consumption of all project vehicles

EF (CO_2 emission factor of electricity used by project vehicle)

Parameter	EF
Data Unit	$kgCO_2/kWh$
Description	CO_2 emission factor of electricity used by project vehicle
Source of Data	Desk Research
Frequency	Annual
Measurement Procedure	Through international publications such as IPCC Guidelines for National Greenhouse Gas Inventories as well as national energy data sources like Ceylon Petroleum Corporation

N (Number of project vehicles in operation)

Parameter	N
Data Unit	Number
Description	Number of project vehicles in operation
Source of Data	Measurement
Frequency	Monthly

Measurement Procedure	Operational contract between the private bus operator (NEE) and the NAMA implementer (NIE)

Table 28: Monitored Emission Parameters Details

8.3. Measurement and Reporting of Sustainable Development Benefits

In addition to GHG emissions, the MRV system for this NAMA will monitor the impact of the NAMA interventions on selected Sustainable Development (SD) indicators.

The selection of the SD indicators was done using the Sustainable Development Evaluation Tool (SD Tool) developed by UNDP. The tool divides the SD indicators into five different domains: environment; social; growth and development; economic and institutional.

The tool requires that for each intervention that an indicator (such as air pollution, biodiversity, health, etc.) is selected. The impact of the intervention on the chosen indicator can then be identified and explained, and the effects (positive, negative or both) pinpointed.

8.3.1. Sustainable Development Benefits of the Sri Lanka Transport NAMA

The indicators selected for the NAMA, in each of the five SD domains, are as follows:

Domain	Parameter	Data Unit
Environment	Air pollution	Ppm
Social	Number of cases of respiratory health problems	Person
	Frequency of eBuses along the BRT	Bus/Hour
Growth and Development	Number of eBuses on the BRT	Bus
	Capacity building (training/outreach programs held)	Event
Growth and Development / Economic	Cost savings from increased energy security annually	USD/Bus
	Jobs created	Job
Institutional	Number of private operators involved	Operator

Table 29: Monitored SD Parameters

Given the absence of a BRT prior to the development of the NAMA, the baseline values for most of the parameters listed above can be safely assumed to be zero. However, parameters such as air pollution and cases of respiratory health problems have existed even before the development of the BRT and have accordingly been taken into account.

Sr. No.	Parameter	Data Unit	Baseline Value	Project Value
1	Air pollution	Ppm		
2	Cases of respiratory health diseases	Person		
3	Frequency of eBuses along the BRT	Bus/Hour	0	
4	Number of eBuses on the BRT	Bus	0	100
5	Capacity building	Event	0	22
6	Cost savings from increased energy security	USD/Bus	0	30,159
7	Jobs created	Job	0	
8	Private operators involved	Operator	0	

Table 30: SD Parameters Baseline and Project Values

We will require inputs from the Sri Lankan government for the parameters highlighted in yellow.

8.3.2. Measurement and Monitoring

The SD benefits achieved due to the NAMA needs to be measured continuously, and reported by the responsible entity/intervention implementer regularly. Hard or soft copies of the reports should be kept at a safe centralized point, and be archived.

The SD parameters have been detailed below:

Air Pollution

Parameter	Concentration of air pollutants in the atmosphere
Data Unit	ppm
Description	The amount of pollutants in the atmosphere including SO_x, NO_x and particulates, measured in parts per million (ppm)
Source of Data	Measurement
Frequency	Monthly
Measurement Procedure	Monitor the concentration of pollutants in the atmosphere in and around the BRT

Respiratory Health Diseases

Parameter	Number of cases of respiratory health diseases
Data Unit	Person

Description	Number of cases of respiratory health disease reported in the vicinity of the BRT since the implementation of the NAMA
Source of Data	Hospital Records
Frequency	Annually
Measurement Procedure	Monitor records of hospitals located in and around the vicinity of the BRT for cases of respiratory health diseases and survey undertaken in cooperation with the local community

Frequency of eBuses along the BRT

Parameter	Frequency of eBuses
Data Unit	Bus/Hour
Description	Number of eBuses available at every stop of the BRT every hour
Source of Data	NAMA implementer's records
Frequency	Weekly
Measurement Procedure	Monitor the number of eBuses stopping at bus stops every hour

Number of eBuses on the BRT

Parameter	Number of eBuses on the BRT
Data Unit	Bus
Description	Number of eBuses operational on the BRT
Source of Data	NAMA implementer's records
Frequency	Monthly
Measurement Procedure	NAMA implementer's records on the operational contracts signed between the private bus operator (NEE) and the NAMA implementer (NIE)

Capacity building

Parameter	Number of events/programs held to train relevant NAMA stakeholders
Data Unit	Events
Description	Number of training/outreach/awareness programs/events held to train/raise awareness of relevant NAMA stakeholders including NIE, NEEs and the general public
Source of Data	NAMA implementer's records
Frequency	Monthly
Measurement Procedure	Counting

Cost savings

Parameter	Cost savings from increased energy security
Data Unit	USD/Bus
Description	Amount of financial savings accrued due to a decrease in the use of imported conventional fuels for the operation of eBuses on the BRT
Source of Data	NAMA executing entities' and NAMA implementer's records
Frequency	Monthly
Measurement Procedure	Comparison between operational costs of eBuses and conventional buses operating on the BRT

Jobs created

Parameter	Number of new jobs created
Data Unit	Job
Description	Number of new jobs created due to the implementation of the NAMA
Source of Data	NAMA implementer's records
Frequency	Annually
Measurement Procedure	NAMA implementer´s records on number of new employees generated internally within institution and reports on numbers of new employees from intervention implementers and other relevant stakeholders

Private operators involved

Parameter	Number of private operators operating on eBuses on the BRT
Data Unit	Private Operators
Description	Number of private operators operating on eBuses on the BRT indicating a policy environment encouraging private sector involvement
Source of Data	NAMA implementer's records
Frequency	Half Yearly
Measurement Procedure	NAMA implementer's records on the operational contracts signed between the private bus operator (NEE) and the NAMA implementer (NIE)

Table 31: Monitored Emission Parameters Details

Details of the SD indicators chosen for the Sri Lanka Transport NAMA have been provided in the annexures.

8.4. Measurement and Reporting of NAMA Support

The support provided as part of the NAMA will also need to be measured. While support can be provided in many forms: capacity-building, technology transfer and financial, since the bulk of support will come in the form of financing, it is the financial support which will be measured.

International Finance

Parameter	International Financial Support
Data Unit	USD
Description	The amount of international financial support spent per activity
Source of Data	NAMA implementer's (NIE) records
Frequency	Monthly
Measurement Procedure	All finances disbursed need to be tracked as per the standard governmental tracking procedures.

National Finance

Parameter	National (Government) Financial Support
Data Unit	USD
Description	The amount of national financial support (i.e. subsidies) spent per activity
Source of Data	NAMA implementer's (NIE) records
Frequency	Monthly
Measurement Procedure	All finances disbursed need to be tracked as per the standard governmental tracking procedures.

Table 32: Monitored NAMA Support Parameters

8.5. Monitoring, Reporting and Verification (MRV) Management Framework

The main responsibility of the MRV system lies with the NAMA implementing agency i.e. the NIE. The database and the compliance system will be set up by the NIE. The NIE may however delegate some of the tasks to the organizations operating the intervention, i.e. the NEEs.

The process flow for the MRV management framework is as follows:

- The monitoring agency, which in case of the Sri Lanka Transport NAMA are the NEEs, will collect the data according to the monitoring plan (as part of their approved application), ensuring they fulfil all related requirements such as record keeping and quality control.
- The NEEs report the monitoring results to the NIE in an annual report.
- The NIE collects all monitoring reports, combines them in a central monitoring database and summarizes the results in a NAMA monitoring report. This report contains information on GHG

emission reductions, progress in the SD indicators, and the financial performance of the NAMA activities.

- The report is then forwarded to the NCA, who then checks and approves the annual monitoring report.
- The NIE also arranges for an external verification entity to verify the annual monitoring report.
- The final monitoring report together with the verification report of the external verifier is submitted to the NAMA donor(s).

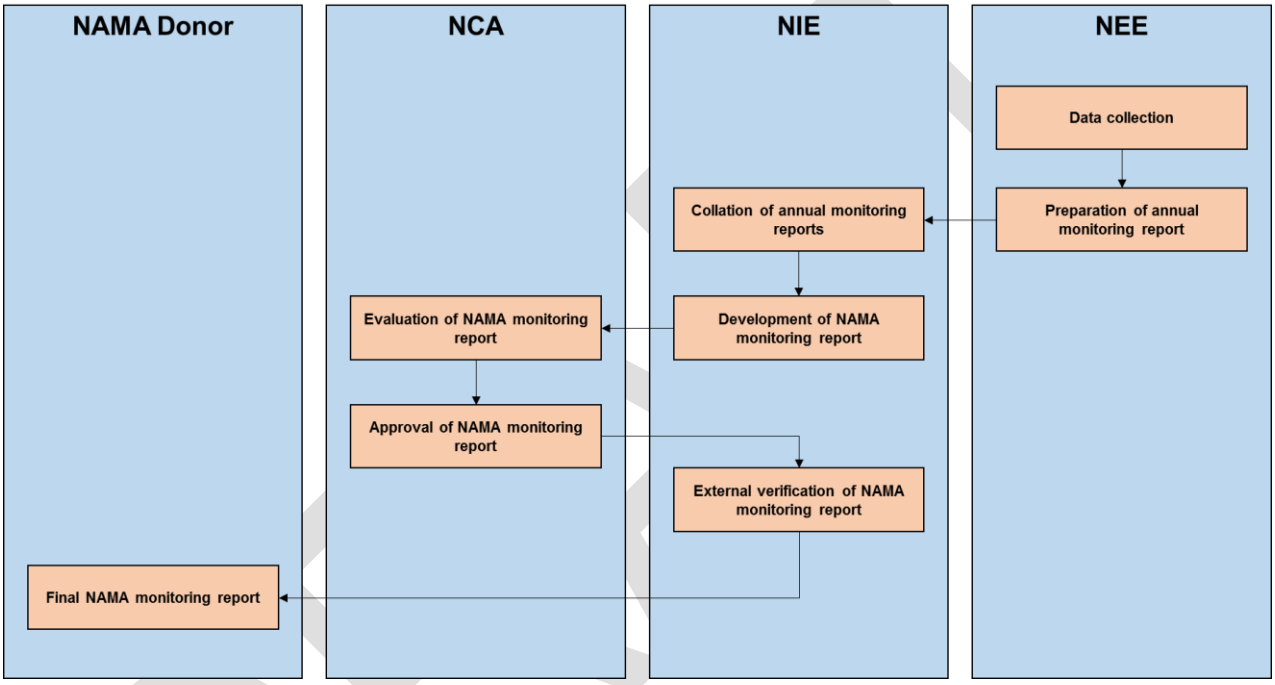

Figure 19: NAMA MRV Management Process Flow

The following figure illustrates the management flow as described above:

8.6. Reporting Forms

The NAMA Coordinating Authority (NCA) is responsible for the development of reporting form templates. These forms will include at a minimum the following information:

- Details of the technology used
- Details of the NEE, including contact details
- Description of the measuring system
- Data parameters measured
- Default values applied
- Sampling plan details

- Calculation of emissions reductions

The reporting form template will be provided by the NCA to the NEEs. The completed forms will be submitted annually to the NIE by the NEEs.

8.7. Verification Mechanisms

Verification rules for NAMAs are usually based on the requirements of the NAMA funding agencies, as well as host country requirements. Before developing domestic capacity for verification, it is recommended to use some of the existing CDM Designated Operational Entities (DOEs) or ISO 14064 certification bodies with experience in the transport sector and a good understanding of local conditions in the Sri Lanka, but NAMA-specific verification rules should be developed in the future.

The goal of verification is to have an independent third party auditor ensure that the NAMA is operating as planned and that the measuring and reporting system is being implemented as planned. The verification also ensures that emissions reductions and SD benefits are real and measurable.

9. NAMA Implementation Plan

9.1. NAMA Implementation Flow

The implementation of the NAMA will be carried out in three main steps. As a first step, the institutional structure for NAMA implementation proposed in this document needs to be established. In parallel, funding from both international and national sources needs to be secured. Once these two steps are finalized, implementation of the NAMA intervention can proceed.

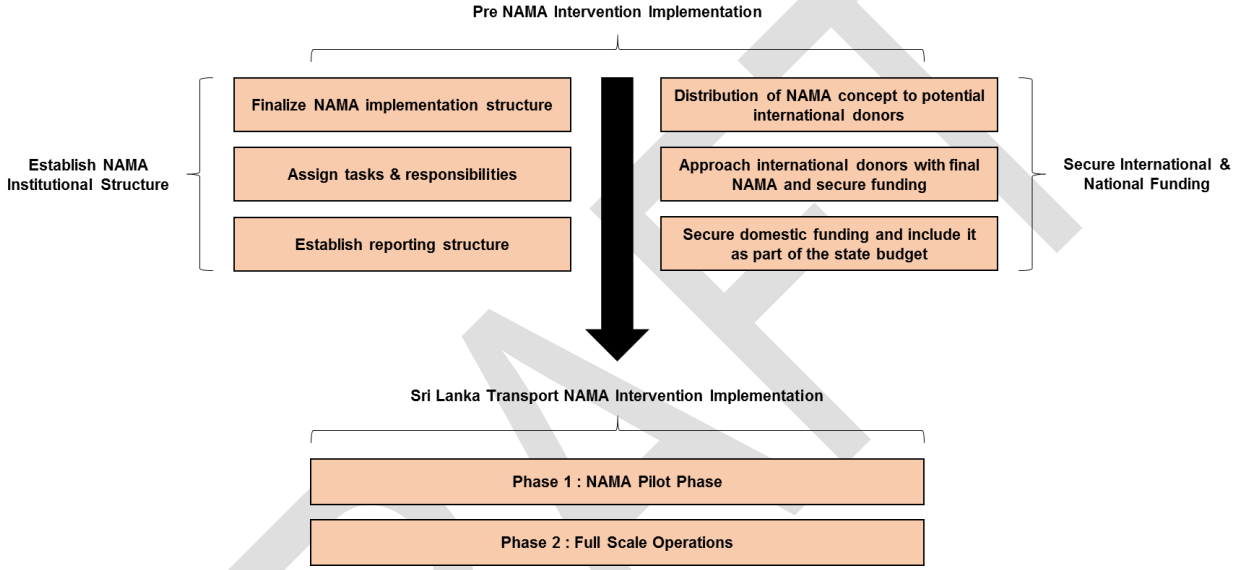

Figure 20: NAMA Implementation Flow

9.2. Establishing NAMA Institutional Structure

As mentioned earlier, the first step of the NAMA implementation involves the establishment of the institutional structure proposed in this document. This would involve the following steps:

- **Finalizing NAMA implementation structure**

  This involves the final assignment of roles within the NAMA implementation structure, such as NAMA Coordinating Authority (NCA) and NAMA Implementing Entity (NIE) to the various organizations/ministries as proposed in Chapter 5 – NAMA Implementation Structure.

- **Assignment of tasks and responsibilities**

  Once the roles have been assigned, jurisdictions along with associated tasks and responsibilities of each of the NAMA implementation entities need to be defined and convened to the concerned entity. These tasks and responsibilities have been detailed in Chapter 5 – NAMA Implementation Structure.

- **Establish reporting structure**

  Apart from defining roles and responsibilities, there is also a need to clearly define the reporting structure of the NAMA implementation structure, along with its associated process flows. These too have been detailed in Chapter 5 – NAMA Implementation Structure.

The benefit of the proposed structure is that all players (government ministries and financial institutions) already exist and no new body needs to be created.

9.3. Securing International and National Funding

Early stage consultations with international climate financing agencies are essential for securing sufficient international donor funding. Informal distribution of information on the NAMA concept should start immediately, in a bid to generate interest in the country, the NAMA and the sector in which the NAMA is being developed for. Formal approaches to potential funding agencies should start as soon as the NAMA document is finalized.

Potential donors that already actively fund NAMAs are the German and British governments through the NAMA support facility, Global Environmental Facility (GEF) through its executing agencies, the Green Climate Fund (GCF), other EU Governments, and Japan through the Japan International Cooperation Agency (JICA).

A secured budget for the domestically funded component will provide a strong signal to potential international financing agencies of a commitment to NAMA implementation by the Sri Lankan government. Therefore, it is essential that the domestic contributions to the interventions (subsidies in the form of import tax exemption and free charging) are secured within the state budget.

9.4. Implementation of NAMA Intervention

Once the institutional structure is in place and funding (both national and international) is secured, implementation of the intervention can start. The process of implementation will be as described in detail in Chapter 4 – NAMA Technical Intervention (Sections 4.3, 4.4 and 4.5) and Chapter 7 – NAMA Costs and Finance (Section 7.4). The following table gives a summary of the implementation timeline:

Nº	Activity	Years																			
		Year 1				Year 2				Year 3				Year 4				Year 5			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Pre NAMA Intervention Implementation																					
1	Establishing NAMA institutional structure																				
2	Securing international and national funding																				
NAMA Intervention Implementation																					
3	Confirmation of interest from private bus operators																				
4	Raising awareness of NAMA and promotion of electric buses																				
Phase 1: NAMA Pilot Phase (10 eBuses)																					
5	Invitation of financial bids from private operators																				
6	Announcement of results of bids																				
7	Contract Signing																				
8	Release of payment																				
9	Purchase and operation of 10 eBuses																				
Phase 2: Full Scale Operations (100 eBuses)																					
10	Invitation of financial bids from private operators																				

Nº	Activity	Years																			
11	Announcement of results of bids																				
12	Contract Signing																				
13	Release of payment																				
14	Purchase and operation of 90 new eBuses (total of 100 eBuses operational)																				

Table 33: Sri Lanka Transport NAMA Implementation Timeline

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Annexures

Annexure A: Financial Assessment

Parameter	Value	Units	Source
Conventional Articulated Bus			
Investment Cost	195,000	USD	Study of BRT on Galle Road by University of Moratuwa
Life of articulated bus	5	years	
Fuel cost	50	LKR/km	
Electric Bus			
Investment Cost per bus	395,000	USD	Estimate for BYD Electric Bus
Additional cost of battery	64,800	USD	Battery technology charges ahead, McKinsey
Life of electric bus	10	years	Estimate for BYD Electric Bus
Life of electric bus battery	5	years	Estimate for BYD Electric Bus
Performance of Bus	1.19	kWh/km	Technical specifications of BYD Electric Bus
Cost of electricity	13	LKR/kWh	Estimates from Ceylon Electricity Board
Fuel cost	15.47	LKR/km	Calculated
Other operating costs			
Driver cost	16.86	LKR/km	Study of BRT on Galle Road by University of Moratuwa
Maintenance expenses	11.16	LKR/km	
Road user charges	3.3	LKR/km	
Yards & Terminals	3.3	LKR/km	
IT service charge	9.03	LKR/km	
Fare collection	2.11	LKR/km	
BRT Agency fee	2.11	LKR/km	
Regulator fee	0.53	LKR/km	
Total Operational Cost (Excluding fuel cost)	**48.40**	**LKR/km**	
Other Assumptions			
Average distance travelled per bus per annum	116,456	km	Study of BRT on Galle Road by University of Moratuwa
Discount Rate	6%	%	Study of BRT on Galle Road by University of Moratuwa
1 Sri Lankan Rupee	0.0075	USD	Estimated

A.1: NAMA Baseline Scenario: Utilization of diesel fuelled internal combustion engine (ICE) buses

The following table details the financial costs, capital and operating, of utilizing conventionally fuelled buses in the Galle BRT:

Conventional Bus Scenario											
Parameter	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**
Number of buses procured	100	0	0	0	0	100	0	0	0	0	0
Total number of buses operational	0	100	100	100	100	100	100	100	100	100	100
Capital cost	19,500,000	0	0	0	0	19,500,000	0	0	0	0	0
Operational cost	0	8,594,482	8,594,482	8,594,482	8,594,482	8,594,482	8,594,482	8,594,482	8,594,482	8,594,482	8,594,482
Total outflow	**19,500,000**	**8,594,482**	**8,594,482**	**8,594,482**	**8,594,482**	**28,094,482**	**8,594,482**	**8,594,482**	**8,594,482**	**8,594,482**	**8,594,482**

A.2: NAMA Mitigation Scenario: Adoption and utilization of electric buses

The following table details the financial costs, capital and operating, of replacing conventionally fuelled buses with electric buses in the Galle BRT:

Electric Bus Scenario											
Parameter	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**
Number of buses procured	100	0	0	0	0	0	0	0	0	0	0
Total number of buses operational	0	100	100	100	100	100	100	100	100	100	100
Capital cost – Buses	4,20,00,000	0	0	0	0	64,80,000	0	0	0	0	0
Operational cost	0	5,578,553	5,578,553	5,578,553	5,578,553	5,578,553	5,578,553	5,578,553	5,578,553	5,578,553	5,578,553
Total outflow	**4,20,00,000**	**55,78,553**	**55,78,553**	**55,78,553**	**55,78,553**	**1,20,58,553**	**55,78,553**	**55,78,553**	**55,78,553**	**55,78,553**	**55,78,553**

A.3: Difference in Cash Flows of NAMA baseline and mitigation scenarios

The following table details the differences between the cash flows of the NAMA baseline and mitigation scenarios:

Difference in cash flow (USD)	2,25,00,000	-30,15,930	-30,15,930	-30,15,930	-30,15,930	-1,60,35,930	-30,15,930	-30,15,930	-30,15,930	-30,15,930	-30,15,930

Net Present Value (NPV)	-88,93,213	USD
Payback Period	< 5	Years
Total GHG emission reductions	37,159	tCO_2
Marginal cost of abatement	-239	USD/tCO_2

Appendix B: Emissions Calculations

B.1: NAMA emissions baseline (Diesel fuel for internal combustion engine (ICE) buses)

Emission factor for Diesel ICE bus ($EF_{BL,km,i}$) (gCO_2/km):

$$EF_{BL,km,i} = SFC_i \times NCV_{BL,i} \times EF_{BL,i}$$

Parameter	Unit	Value
Fossil fuel used in ICE bus	-	Diesel
Specific fuel consumption of baseline vehicle (SFC_i)	gm/km	410
Net calorific value of fossil fuel consumed by baseline vehicle ($NCV_{BL,i}$)	J/gm	44195.86[1]
Emission factor of fossil fuel consumed by baseline vehicle ($EF_{BL,i}$)	gCO_2/J	0.0000726[2]

Emission factor for diesel ICE bus:

Parameter	Value (gCO_2/km)
Emission factor for ICE bus	1315.5

Total emissions for diesel ICE bus (BE_y) (tCO_2):

$$BE_y = EF_{BL,km,i} \times DD_{i,y} \times N_{i,y} \times 10^{-6}$$

Parameters	Unit	Value
Emission factor for diesel ICE bus (EF_{BL})	gCO_2/km	1315.5
Annual average distance travelled (DD)	km	116456
Number of operational diesel ICE buses (N)	-	100 Error! Bookmark not efined.

Emissions for diesel ICE bus:

Parameter	Value (tCO_2)
Emissions for a diesel ICE bus	15,320

[1] Calorific values of fuels were obtained from the specifications published by the Ceylon Petroleum Corporation – http://www.info.energy.gov.lk/, Petroleum Data → Product Specifications

[2] 2006 IPCC Guidelines for National Greenhouse Gas Inventories – http://www.ipcc-nggip.iges.or.jp/ public/2006gl/pdf/2_Volume2/V2_1_Ch1_Introduction.pdf

B.2: NAMA project emissions (e-Buses)

Emission factor for electric bus ($EF_{PJ,km,i,y}$) ($kgCO_2/km$):

$$EF_{PJ,km,i,y} = SEC_{PJ,km,i,y} \times EF_{elec,y}/(1 - TDL_y)$$

Parameters	Unit	Value
Specific electricity consumption by the electric bus ($SEC_{PJ,km,i,y}$)	kWh/km	1.193035[3]
CO_2 emission factor of electricity consumed by electric bus ($EF_{elec,y}$)	kgCO2/KWh	0.735[3]
Average technical transmission and distribution losses for providing electricity (TDL_y)	-	12%[4]

Emission factor for electric buses:

Parameters	Value (kgCO2/km)
Emission factor for electric bus	0.9964554

Total emissions for electric bus (PE_y) (tCO_2):

$$PE_y = EF_{PJ,km,I,y} \times DD_{i,y} \times N_{i,y}$$

Parameters	Unit	Value
Emission factor for electric bus ($EF_{PJ,km,I,y}$)	$kgCO_2/km$	0.9964554
Annual average distance travelled by electric bus ($DD_{i,y}$)	km	116,456
Number of operational electric buses ($N_{i,y}$)	-	100

Emissions for electric bus:

Parameters	Value (tCO_2)
Emission for an electric bus	11,604

[3] BYD Electric Bus Specifications - http://www.byd.com/na/auto/ElectricBus.html

[4] World Bank Electric power transmission and distribution losses (% of output) - http://data.worldbank.org/indicator/EG.ELC.LOSS.ZS

Appendix C: Sustainable Indicators

C.1: Environment Indicators

Domain	Indicator	Relevance to SDG including targets	Effect on indicator	Identified Impacts	Explanation of chosen indicator
Environment	Air Pollution	**Build inclusive, safe and sustainable cities and human settlements**			
		11.6 by 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality, municipal and other waste management	Positive	Better air quality	The adoption of electric buses in the BRT would lead to a decrease in the pollution caused from the burning of fossil fuels due to the use of conventional buses. This leads to an increase in the air quality in the region.
	Other (Noise / Visibility)	**Build inclusive, safe and sustainable cities and human settlements**			
		11.6 by 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality, municipal and other waste management	Positive	Reduced noise pollution, congestion	The development of a BRT will lead to a streamlining of traffic in the city, subsequently reducing the traffic congestion, making life much easier for commuters. Also, the use of electric buses will lead to a decrease in the noise pollution caused by the vehicles owing to the fact that electric vehicles by nature are very quiet.

C.2: Social Indicators

Domain	Indicator	Relevance to SDG including targets	Effect on indicator	Identified Impacts	Explanation of chosen indicator
Social	**Health**	**Attain healthy life for all at all ages**			
		3.6 by 2020 halve global deaths and injuries from road traffic accidents	Positive	Better health	The adoption of electric buses in the BRT would lead to a decrease in the pollution caused from the burning of fossil fuels due to the use of conventional buses. This should lead to a decrease in the no. of air pollution related health issues such as asthma and other respiratory diseases. The development of the BRT should also lead to a streamlining of traffic in the city leading to a decrease in the no. of traffic accidents that occur.
		3.9 by 2030 substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water, and soil pollution and contamination			
	Provides vulnerable groups access to local resources and services	**Build inclusive, safe and sustainable cities and human settlements**			
		11.2 by 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons	Positive	Increased access to public resources for the vulnerable/disadvantaged groups	The development of a BRT with cheap fares, especially when compared to private means of transportation increases the level of access offered to vulnerable sections of society, thereby allowing greater development and mobility among these societies.

Domain	Indicator	Relevance to SDG including targets	Effect on indicator	Identified Impacts	Explanation of chosen indicator
		Promote strong, inclusive and sustainable economic growth and decent work for all			
	Quality of employment	**8.3** promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation, and encourage formalization and growth of micro-, small- and medium-sized enterprises including through access to financial services	Positive	Job opportunities in the skilled labour segment - Increased standard of living	The development of a BRT with electric buses will lead to the development of ancillary industries around the development and maintenance of electric vehicles, which in turn will lead to an increase in the no. of skilled jobs available in the market (this will be additional to the jobs that the BRT itself creates).

C.3: Growth & Development Indicators

Domain	Indicator	Relevance to SDG including targets	Effect on indicator	Identified Impacts	Explanation of chosen indicator
Growth & Development	**Access to clean and sustainable technology**	**Ensure access to affordable, sustainable and reliable modern energy services for all**			
		7.a by 2030 enhance international cooperation to facilitate access to clean energy research and technologies, including renewable energy, energy efficiency, and advanced and cleaner fossil fuel technologies, and promote investment in energy infrastructure and clean energy technologies	Positive	Increased access to clean and sustainable technologies - Subsequent decrease in costs, leading to greater adoption	Development of a BRT with electric buses will call for the transfer of advanced clean technologies from more developed economies such as China, Europe, etc. and this opens up opportunities for collaboration, knowledge transfer and subsequent development of indigenous clean technologies.
		7.b by 2030 expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, particularly LDCs and SIDS			
		Promote sustainable industrialization			
		9.a facilitate sustainable and resilient infrastructure development in developing countries through enhanced financial, technological and technical support to African countries, LDCs, LLDCs and SIDS	Positive	Increased access to clean and sustainable technologies - Subsequent decrease in costs, leading to greater adoption	The development of a successful BRT will need the adoption of ICT in a significant manner. This along with the adoption of electric buses as the NAMA intervention should provide impetus for the development of sustainable industries around these technologies.
		9.b support domestic technology development, research and innovation in developing countries including by ensuring a conducive policy environment for inter alia industrial diversification and value addition to commodities			
		9.c significantly increase access to ICT and strive to provide universal and affordable access to internet in LDCs by 2020			

Domain	Indicator	Relevance to SDG including targets	Effect on indicator	Identified Impacts	Explanation of chosen indicator
Growth & Development	**Energy Security**	**Promote sustainable consumption and production patterns**			
		12.a support developing countries to strengthen their scientific and technological capacities to move towards more sustainable patterns of consumption and production	Positive	Reduced dependence on imported fossil fuels - Greater energy security as well as cost savings for the nation	The use of electric vehicles and the increased cost and fuel savings from the BRT will lead to a reduced dependence on imported fossil fuels which in turn provides greater cost savings. These savings can then be funneled into the sections of economy such as education and health. The BRT if accompanied with removal of inefficient fuel subsidies and other policies that encourage the development of clean modes of energy, would lead to the development of a more clean and sustainable economy.
		12.c rationalize inefficient fossil fuel subsidies that encourage wasteful consumption by removing market distortions, in accordance with national circumstances, including by restructuring taxation and phasing out those harmful subsidies, where they exist, to reflect their environmental impacts, taking fully into account the specific needs and conditions of developing countries and minimizing the possible adverse impacts on their development in a manner that protects the poor and the affected communities			
	Capacity Building	**Promote actions at all levels to address climate change/build climate change goal based on COP 21 of the UNFCCC**			
		13.3 improve education, awareness raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction, and early warning	Positive	Build extensive capacity on both the national and regional levels on development and implementation of clean and sustainable projects	The NAMA gives Sri Lanka an opportunity to extensively build capacity of its regional and national institutions in the areas of development and implementation of climate change mitigation projects. This will especially prove beneficial for subsequent climate change mitigation projects that Sri Lanka decide to take up, wherein with a strong institutional structure already present, the benefits that they can reap from subsequent projects will be higher, especially when it comes to directly increased funding to the implementation of the project.
		13.b Promote mechanisms for raising capacities for effective climate change related planning and management, in LDCs, including focusing on women, youth, local and marginalized communities			

Domain	Indicator	Relevance to SDG including targets	Effect on indicator	Identified Impacts	Explanation of chosen indicator
		Strengthen and enhance the means of implementation and global partnerships for sustainable development			
Growth & Development	**Capacity Building**	**17.9** enhance international support for implementing effective and targeted capacity building in developing countries to support national plans to implement all sustainable development goals, including through North-South, South-South, and triangular cooperation **17.18** by 2020, enhance capacity building support to developing countries, including for LDCs and SIDS, to increase significantly the availability of high-quality, timely and reliable data disaggregated by income, gender, age, race, ethnicity, migratory status, disability, geographic location and other characteristics relevant in national contexts	Positive	Build extensive capacity on both the national and regional levels on development and implementation of clean and sustainable projects	The NAMA provides Sri Lanka numerous opportunities to extensively collaborate with international agencies. Sri Lanka can use these opportunities to build capacity in line with the best practices utilized around the world.

C.4: Economic Indicators

Domain	Indicator	Relevance to SDG including targets	Effect on indicator	Identified Impacts	Explanation of chosen indicator
Economic	**Income generation / Expenditure reduction / Balance of payments**	**Promote strong, inclusive and sustainable economic growth and decent work for all**			
		8.2 achieve higher levels of productivity of economies through diversification, technological upgrading and innovation, including through a focus on high value added and labor-intensive sectors	Positive	Lower dependence on imported fossil fuels, increased adoption of new, latest sustainable technologies leading to greater cost savings and returns over longer periods of time and subsequent increased economic growth	The introduction of electric buses in the BRT should lead to the development of ancillary industries around electric vehicles, which in turn will lead to the creation of a new market of growth along with new opportunities for labour, especially skilled labour.
		Promote sustainable industrialization			
		9.1 develop quality, reliable, sustainable and resilient infrastructure, including regional and trans-border infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all	Positive	Lower dependence on imported fossil fuels, increased adoption of new, latest sustainable technologies leading to greater cost savings and returns over longer periods of time and subsequent increased economic growth	The BRT will be one of the first key steps towards developing sustainable, clean transportation infrastructure in Sri Lanka.
		Strengthen and enhance the means of implementation and global partnerships for sustainable development			
		17.1 strengthen domestic resource mobilization, including through international support to developing countries to improve domestic capacity for tax and other revenue collection	Positive	Lower dependence on imported fossil fuels, increased adoption of new, latest sustainable technologies leading to greater cost savings	The NAMA will give Sri Lanka tremendous opportunities to extensively collaborate with and acquire funding from international agencies. Sri Lanka can use these opportunities to understand and utilize best practices around the world to develop and implement a strong climate change mitigation

Domain	Indicator	Relevance to SDG including targets	Effect on indicator	Identified Impacts	Explanation of chosen indicator
		17.4 assist developing countries in attaining long-term debt sustainability through coordinated policies aimed at fostering debt financing, debt relief and debt restructuring, as appropriate, and address the external debt of highly indebted poor countries (HIPC) to reduce debt distress		and returns over longer periods of time and subsequent increased economic growth	program in the form of the transportation NAMA.
		17.5 adopt and implement investment promotion regimes for LDCs			
	Asset accumulation & investments	**Promote sustainable industrialization**			
		9.5 enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries, particularly developing countries, including by 2030 encouraging innovation and increasing the number of R&D workers per one million people by x% and public and private R&D spending	Positive	Increased private/public sector investments, increased cost savings/returns leading to increased accumulation of assets	The development of a BRT with electric buses will lead to the development of ancillary industries around the development and maintenance of electric vehicles, which will also lead to increase in indigenous research and development and help create conditions which when leveraged efficiently will invite increased public/private investments.
		Strengthen and enhance the means of implementation and global partnerships for sustainable development			
		17.3 mobilize additional financial resources for developing countries from multiple sources	Positive	Increased private/public sector investments, increased cost savings/returns leading to increased accumulation of assets	The NAMA will give Sri Lanka tremendous opportunities to extensively collaborate with international leaders in sustainable development, allowing Sri Lanka to develop a network of global partnerships that she can leverage for further climate change mitigation projects, for both technical and financial assistance.
		17.5 adopt and implement investment promotion regimes for LDCs			
		17.17 encourage and promote effective public, public-private, and civil society partnerships, building on the experience and resourcing strategies of partnerships			

Domain	Indicator	Relevance to SDG including targets	Effect on indicator	Identified Impacts	Explanation of chosen indicator
		Promote strong, inclusive and sustainable economic growth and decent work for all			
Economic	**Job creation**	**8.3** promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation, and encourage formalization and growth of micro-, small- and medium-sized enterprises including through access to financial services	Positive	Creation of skilled job market	The introduction of electric buses in the BRT should lead to the development of ancillary industries around electric vehicles, which in turn will lead to the creation of a new market of growth along with new opportunities for labour, especially skilled labour.

C.5: Institutional Indicators

Domain	Indicator	Relevance to SDG including targets	Effect on indicator	Identified Impacts	Explanation of chosen indicator
Institutional	**Private Sector Dialogue**	**Revitalize the global partnership for sustainable development**			
		17.17 encourage and promote effective public, public-private, and civil society partnerships, building on the experience and resourcing strategies of partnerships	Positive	Increased involvement of the private sector	The NAMA has been designed to promote and encourage increased participation of private players in the Sri Lankan transport sector, through the provision of financial support in the form of grants, subsidies and soft loans. This also leads to increased partnerships between the public and private sectors in the sustainable transport sector leading to increased sources of finance (private sector) thus providing alternatives to address the issue of paucity of financing for sustainable transport initiatives. This model can then also be replicated across the country.
	Enabling Policy Environment	17.14 enhance policy coherence for sustainable development	Positive	Strengthened policy framework which involves extensive public-private partnerships thus providing alternative sources of finance to develop a sustainable transport sector in Sri Lanka	

Contact us

Alexandra Soezer, Ph.D.
Project Manager MDG Carbon
United Nations Development Programme
Bureau for Policy and Programme Support
304 E 45th Street, FF-910
New York, NY 10017, USA
E alexandra.soezer@undp.org

www.undp.org

Manpreet Singh
Associate Director, Climate Change
KPMG in India
Building No. 10, 8th Floor, Tower B
DLF Cyber City, Phase - II
Gurgaon - 122002, India
E manpreetsingh@kpmg.com

www.kpmg.com/in