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NATIONALLY APPROPRIATE MITIGATION ACTION: SUSTAINABLE TRANSPORT IN SRI LANKA THROUGH AN ELECTRIC BUS RAPID TRANSIT SYSTEM

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FOREWORD

The Sri Lankan transport sector plays an important role for the country's development and growth. At the same time, the transport sector is the country's biggest emitter of greenhouse gas emissions, accounting for almost 50 per cent of Sri Lanka's total emissions.

This document presents a NAMA on Sustainable Transport in Sri Lanka through Electric Bus Rapid Transit Systems to promote greenhouse gas emission reductions and at the same time sustainable development. The NAMA is designed to support Sri Lanka in achieving the country's policies on the promotion of alternative and cleaner modes of transportation. The NAMA is fully aligned with Sri Lanka's National Action Plan for the Haritha Lanka Programme with the main objectives to implement mass transit systems, promote alternate transport technologies, reduce GHG emissions and introduce efficient public transportation systems.

During recent years, NAMAs have become a focus of climate change mitigation negotiations in the UNFCCC process. The NAMA modality can provide the essential holistic framework to overhaul a complete sector when framed within the context of sustainable development and beyond pure mitigation aspects. The focus on the sustainability of the entire sector is essential for achieving lasting results.

Moreover, the understanding of the NAMA concept is still evolving, and there is relatively little on-the-ground experience with respect to turning the concept into concrete actions. COP 19 in 2013 saw the introduction of Intended Nationally Determined Contributions and while the exact relationship between INDCs and NAMAs is yet to be clearly defined, NAMAs can act as possible implementation tools for INDCs.

In this regard, UNDP MDG Carbon Programme has supported the development of the NAMA on Sustainable Transport in Sri Lanka through Electric Bus Rapid Transit Systems in order to help the country to bring about a paradigm shift in the transport sector.

The outcomes of this NAMA with regards to sustainable development and GHG emission reductions and are strongly interrelated building blocks as a pathway of a change framework that shall ensure that the NAMA is fully embedded in national development goals.

The NAMA design will provide the country with an accurate and credible information framework by applying robust MRV systems for sustainable development impacts and GHG emission reductions. The calculation of GHG emission reductions is based on an approved CDM methodology while the UNDP NAMA Sustainable Development Evaluation Tool will allow to quantify and monitor the sustainable development impacts.

NAMA on Sustainable Transport in Sri Lanka through Electric Bus Rapid Transit Systems is designed as a framework that will help Sri Lanka to move towards a low-carbon pathway while advancing long-term sustainable development benefits and strengthening the private sector.

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Executive Summary

The transport sector in Sri Lanka plays a crucial role in its economic and social development, contributing up to 14 per cent of its GDP. Sri Lanka depends heavily on its public transportation system with buses and trains forming the core of the system and of sea and air transport having only a limited presence in the domestic set-up. Roads are the backbone of the country's transport sector accounting for 93 per cent of total passenger traffic and 97 per cent of freight traffic in 2012. Therefore, it is evident that roads dominate Sri Lanka's transportation landscape, for both passenger and freight movements.

However, while the transport sector plays a crucial role in Sri Lanka's growth, this growth has come at an ecological, social and economic cost, with most of the steps taken to develop the sector 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 urban congestion and pollution.

The Sri Lankan transport sector is responsible for most of the country's greenhouse gas (GHG) emissions—almost half of the total emissions in the energy sector are from transportation, and roads are responsible for 88 per cent of this total.

While Sri Lanka's existing policy framework targets these issues through policies aimed at increasing the reach and utilization of public transport, such as buses and railways, as well as the adoption of alternative, cleaner modes of transportation, such as 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, offers a novel solution to the problem at hand by providing access to international finance which can help advance programmes and policies that promote the use of electric buses in a Bus Rapid Transit (BRT) system, in turn resulting in reduced GHG emissions and increased sustainable development benefits.

The transport NAMA for Sri Lanka focuses on the introduction and adoption of electric buses instead of conventionally fuelled buses in the planned Bus Rapid Transit (BRT) system on Galle Road in the Colombo Metropolitan Area (CMA), thus addressing the objectives of reducing GHG emissions and attaining SD goals, such as increased energy security, improved access to transportation, improved air quality and local job creation, among others. The NAMA is also in line with Sri Lanka's national and regional objectives for its transport sector: the promotion and adoption of electric vehicles are mentioned in numerous policy documents, including the country's Intended Nationally Determined Contribution (INDC) to the UNFCCC Secretariat as well as its National Transport Policy and Urban Transport Master Plan.

The Sri Lanka transport NAMA consists of a single intervention that involves the introduction and operation of 100 electric buses in the Galle BRT in place of what would have otherwise been 100 articulated, GHG emitting, diesel fuelled conventional buses.

The activities of the NAMA are divided into two distinct phases.

- **Pilot Phase (Phase 1):** Phase 1 of the NAMA intervention will introduce 10 electric buses, owned by the Government of Sri Lanka and operated by private operators, as directed by the Ministry of Transport, in to the Galle BRT. The aim of Phase 1 of the NAMA, a pilot phase, is to generate awareness about the NAMA and invite private sector participation, by highlighting the intervention's importance for the transport sector. Funding for the eBuses to be introduced in Phase 1 will be obtained in its entirety through international climate financing agencies in the form of direct grants.
- **Full Scale Operations (Phase 2):** Phase 2 will mark the start of the full scale operation of the NAMA in which the remaining 90 eBuses will be introduced and the operation of all 100 eBuses will commence on the Galle BRT. All the eBuses will be owned and operated privately. 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 and the total cost of the eBus. The funding for this phase will come from the private operators of eBuses and international climate finance.

The NAMA will also cover the costs of charging stations and capacity-building measures. Both phases will provide free charging for a period of 12 months from the first day of operation to all private operators running eBuses on Galle BRT.

The total cost of the NAMA is estimated to be around US$104 million, with approximately US$30 million being funded by international finance, the private sector financing around US$ 73 million (over a period of 10 years) and the remaining amount being sourced from the Government of Sri Lanka.

Capacity-building will be a key component in the implementation of the NAMA. Its focus will include the training of the government institutions involved, as well as of the private bus operators. It will also involve the development of outreach programmes to create interest in the NAMA within the private sector, along with promotional campaigns marketing the intervention to generate awareness and interest in the adoption and utilization of electric vehicles within the country.

The baseline scenario for this NAMA consists of two components, a GHG baseline and a sustainable development (SD) baseline. Setting the baseline scenario in this way allows all effects to be properly assessed and quantified through the monitoring activities described in the Measurement, Reporting and Verification (MRV) system. In the MRV, the UN Framework Convention on Climate Change's (UNFCCC) "AMS-III.C: Emission reductions by electric and hybrid vehicles" will be used to monitor GHG emission reductions.

Implementation of the NAMA will be led by the Ministry of Transport as the NAMA Coordinating Authority (NCA). The Ministry of Mahaweli Development and Environment has already been appointed as NAMA Approver/Focal Point to the UNFCCC and as the National Designated Authority (NDA) to the GCF. The Ministry of Transport, along with the Ministry of Finance and the Development Finance Corporation of Ceylon (DFCC Bank), will take up the role of the NAMA Implementing Entity (NIE), while the Sri Lanka Transport Board (SLTB) will act as the supervisory board for the National Executing Entities (NEEs), that is the private operators responsible for the operation of the eBuses on the BRT.

The implementation of the NAMA will be carried out in three steps over a period of five years. As the first step, the institutional structure for NAMA implementation proposed in NAMA will be established. In parallel, funding from both international and national sources will be secured. Once these two steps are complete, implementation of the NAMA intervention will proceed. The NAMA will operate for a period of at least 10 years from the start of its implementation.

Abbreviations

AC	Alternate Current
ADB	Asian Development Bank
AIDS	Acquired Immune Deficiency Syndrome
AirMAC	Air Resource Management Centre
BAU	Business As Usual
BE	Baseline Emissions
BRT	Bus Rapid Transit
BRTS	Bus Rapid Transit System
CAGR	Compound Annual Growth Rate
CCS	Climate Change Secretariat
CC&S	Climate Change and Sustainability
CDM	Clean Development Mechanism
CEA	Central Environmental Agency
CH_4	Methane
CMA	Colombo Metropolitan Area
CMC	Colombo Municipal Council
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COP	Conference of Parties
DC	Direct Current
DD	Distance Driven
DFCC	Development Finance Corporation of Ceylon
DFI	Development Finance Institution
DMT	Department of Motor Traffic
DOEs	Designated Operational Entities
EF	Emission Factor
EIB	European Investment Bank
ERP	Electric Road Pricing
EU	European Union
EV	Electric Vehicle
FDI	Foreign Direct Investment

GCF	Green Climate Fund
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GHG	Greenhouse Gas
GIS	Geographic Information System
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GNI	Gross National Income
Gt	Gigaton
HIV	Human Immunodeficiency Virus
ICE	Internal Combustion Engine
ICT	Information and Communications Technology
IEA	International Energy Agency
INDC	Intended Nationally Determined Contribution
IPCC	Intergovernmental Panel on Climate Change
IR	Improvement Rate
ISO	International Organization for Standardization
IT	Information Technology
JICA	Japan International Cooperation Agency
LDC	Least Developed Country
LE	Leakage Emissions
LiB	Lithium Ion Battery
$LiFePO_4$	Lithium Ferrous Phosphate
$LiMnO_2$	Lithium Manganese Oxide
LLDC	Landlocked Developing Country
LPF	Lithium Iron Phosphate
LRT	Light Rail Transit
MDG	Millennium Development Goal
MF&P	Ministry of Finance and Planning
MMC	Multi-Modal Center
MMD&E	Ministry of Mahaweli Development and Environment
MM&WD	Ministry of Megapolis and Western Development
MMTH	Multi-Modal Transport Hub
MoF	Ministry of Finance
MP&RE	Ministry of Power and Renewable Energy

MRT	Mass Rapid Transit
MRV	Measurement, Reporting and Verification
MSD&W	Ministry of Sustainable Development and Wildlife
MSD&VT	Ministry of Skills Development & Vocational Training
MST&R	Ministry of Science, Technology & Research
MUE&H	Ministry of University Education and Highways
N_2O	Nitrous Oxide
NAMA	Nationally Appropriate Mitigation Action
NCA	NAMA Coordinating Authority
NCV	Net Calorific Value
NDA	National Designated Authority
NEE	National Executing Entity
NERDC	National Engineering Research and Development Centre
NGO	Non-Governmental Organization
NIE	NAMA Implementing Entity
NiMH	Nickel Metal Hydride
NMVOC	Non-Methane Volatile Organic Compounds
NOX	Nitrogen Oxides
NPV	Net Present Value
NREL	National Renewable Energy Laboratory
ODA	Official Development Assistance
OECD	Organisation for Economic Co-operation and Development
OLEV	Online Electric Vehicle
PE	Project Emissions
PPP	Public-Private Partnership
RDA	Road Development Authority
RMB	Renminbi
RS	Remote Sensing
SD	Sustainable Development
SDG	Sustainable Development Goal
SEA	Sustainable Energy Authority
SEC	Specific Electricity Consumption
SFC	Specific Fuel Consumption
SIDS	Small Island Developing States

SLR	Sri Lanka Railways
SLRs	Sri Lankan Rupees
SLTB	Sri Lanka Transport Board
SO_2	Sulphur Dioxide
SO_x	Sulphur Oxides
TDL	Transmission and Distribution Loss
TOD	Transit Oriented Development
UDA	Urban Development Authority
UN	United Nations
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
US	United States
US$	United States Dollar
Wh/kg	Watt hours per kilogram

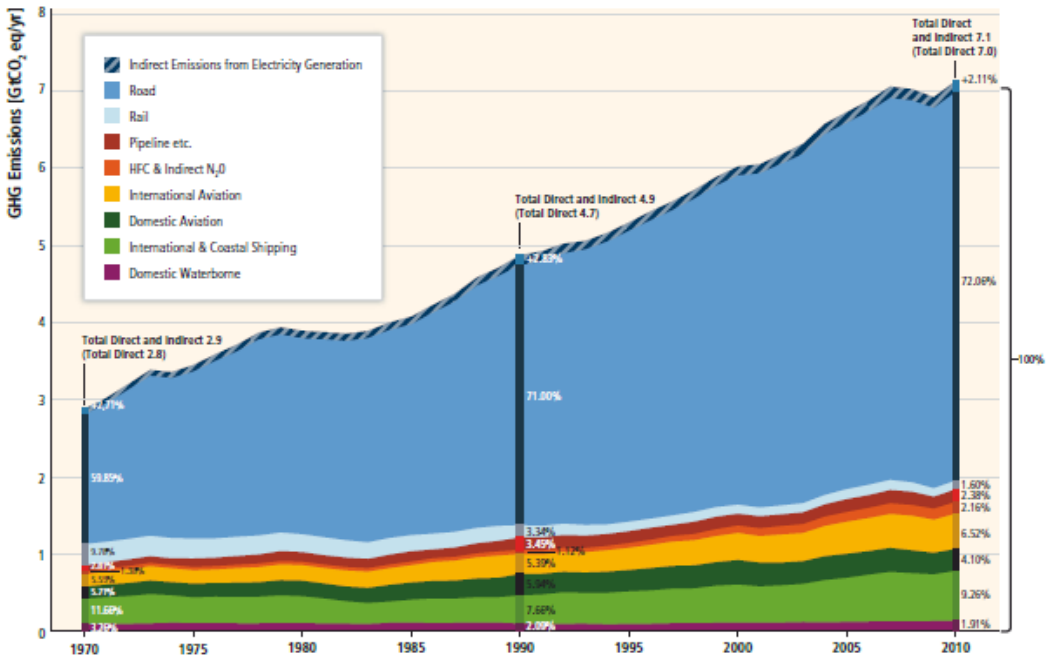
1. Introduction

1.1 Transport and Development

The 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, the sector is also fast becoming the highest emitter of greenhouse gases globally, and as a result makes a large contribution to climate change. As of 2010, the transport sector was responsible for producing 7.0 Gt of CO_2 equivalent of direct GHG emissions, including non-CO_2 gases. Out of the 7.0 Gt of CO_2 equivalent of GHG emissions, CO2 emissions constitute 6.7 Gt which translates to 23 per cent of the total energy-related CO_2 emissions globally (IPCC, 2014).

Figure 1. Direct Emissions of the Transport Sector, 1970-2010



Source: IPCC, 2014.

Ninety four per cent of total energy used for transport worldwide is source from a single fossil fuel, petroleum. The global transport sector's excessive reliance on fossil fuels for energy has resulted in the continued growth of GHG emissions in spite of the introduction of more efficient vehicles (road, rail, water craft, and aircraft) and of policies to encourage their use. Without the implementation of robust mitigation policies, transport emissions could increase

at a faster rate than emissions from the other energy end-use sectors and reach around 12 Gt of CO_2 equivalent per 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, resulting in a further increase in GHG emissions and 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 the growth of the sector is untenable, from the perspectives of both resource management (petroleum is a finite resource) and of global efforts to abate the effects of climate change.

In light of the current global transportation scenario, it is imperative that countries, especially developing economies, formulate 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 involve a range of 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. through the 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 with conventional fossil fuelled transport strategies, they require higher initial capital costs. Additionally, there are the challenges of local-level maintenance, availability of technical and financial resources, and a lack of awareness of technologies, which constitute barriers to increased uptake. These challenges are compounded by the traditional problems faced by public modes of transport (e.g. buses and railways), such as low quality of service, low frequency, limited geographical access, lack of integration with other modes of transport, etc. All of these factors contribute to public transport having a very poor image, leading consumers to prefer 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 countries 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 (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 as 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 conflict, 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 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, such as buses and railways, as well as the adoption of alternative, cleaner modes of transportation, such as 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 advance programmes and policies that promote the use of electric buses in a BRT system, and in turn result in reduced GHG emissions and increased sustainable development benefits.

The transport NAMA for Sri Lanka focuses on the promotion and adoption of electric buses in a BRT, thus addressing the objectives of reducing GHG emissions and achieving multiple SD objectives, such as increased energy security, improved access to transportation, improved air quality and local job creation, among others.

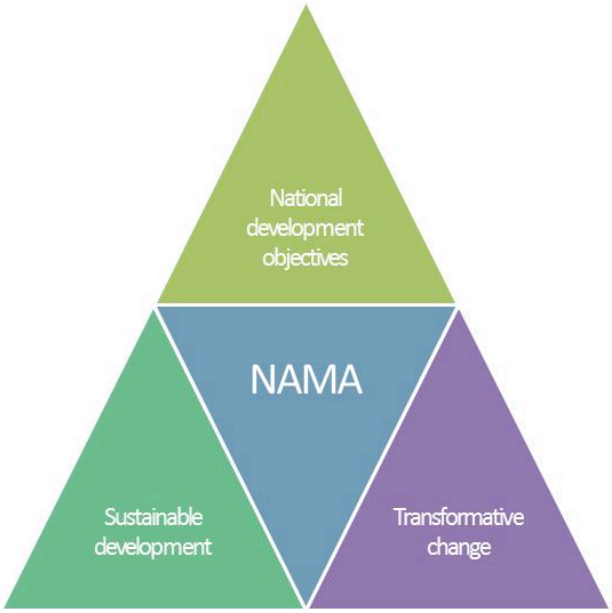
The NAMA differs from traditional funding mechanisms which promote sustainable transport because of the following three key components, which are summarized in Figure 2.

- **Alignment with country objectives:** The interventions under the NAMA framework are prioritized in line with the socio-economic development objectives of the host country. Thus, in the case of Sri Lanka, it takes into account the current social, economic and policy landscapes of the transport sector and provides

innovative technical and financial mechanisms to augment them and help Sri Lanka achieve such sectoral and country objectives as increased energy security, reduced environmental damage and employment creation.

- **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 such as cleaner air, employment generation through the promotion of ancillary industries, and increased energy security due to reduced dependence on fossil fuels.
- **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 the 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 system (modal shift to low-carbon transport system) in the capital city of Colombo, in which electric buses are introduced in place of conventionally fossil fuelled buses (alternative cleaner technologies that reduce the GHG emissions produced).

2. Background to 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 km^2 (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 population growth rate has been 1.0 percent over the past 31 years. The largest concentration of population (28.7 per cent of the total) is the Western Province, which has a population density of 1,621 persons per km2 as against the national average of 323 persons per km^2. The urban population is reported as 18.3 per cent of the total, against 77.3 per cent in the rural sector and the balance of 4.4 per cent in the estate sector (Government of Sri Lanka Department of Census and Statistics, 2012).

Figure 3. Map of Sri Lanka

Source: http://geology.com/world/sri-lanka-satellite-image.shtml

2.2 The Economy

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

Figure 4. GDP Growth, 2005-2013

Source: ADB, 2015.

GDP grew by 7.4 per cent during 2014, up slightly from 7.25 per cent 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 signed the Millennium Declaration along with other member countries of the United Nations (UN). It further included the MDGs into its 10- year development plan, thus according high priority to achieving them and showing a determination to meet set targets within a stipulated time frame. Key initiatives introduced by the Government in this context include the establishment of Dairy Villages, Medicinal Herbal Villages, Industrial Villages, community managed water supply schemes, rural IT centres, and programmes to improve rural infrastructure and rehabilitate irrigation (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 in 2015, shows that Sri Lanka has made progress towards achieving seven out of the eight development goals that were agreed by the world leaders in 2000 (United Nations, 2015). This progress is summarized in the following table.

Table 1. Sri Lanka's Progress on Achieving the Millennium Development Goals

Goals & Indicators	Summary of Progress	Target/Goal Achievable?
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 per cent in 1990-1991 to 6.7 per cent in 2012-2013. • The urban sector reached the target in 2000; the rural sector in 2008.	On track
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 per cent. • The literacy rate of 15- to 24-year-olds increased from 92.7 per cent in 1996 to 97.8 per cent in 2012. • This increase is seen in all regions with the rate for females, at 98.2 per cent, exceeding the rate for males, at 97.2 per cent.	On track
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 per cent 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.	On track
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 per cent in 1993 to 99 per cent in 2011.	On track
MDG 5: Improve Maternal Health	Sri Lanka is expected to meet the target of reducing the maternal mortality ratio by three-quarters 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 per cent of whom were doctors, had almost reached the target of 99.8 per cent in 2010.	On track
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.	Mixed Progress
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.	Off track

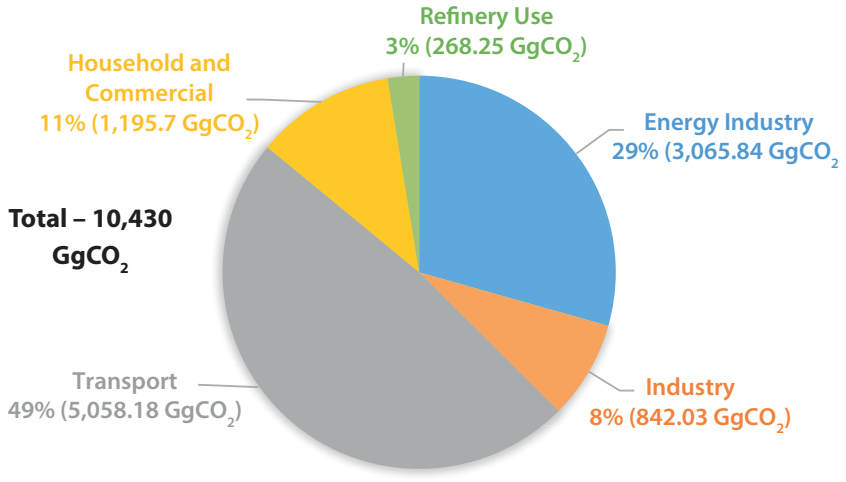
Goals & Indicators	Summary of Progress	Target/Goal Achievable?
MDG 8: Develop a Global Partnership for Development	• ODA flows received as a percentage of Sri Lanka's gross national income (GNI) fell from 1.5 per cent in 1997 to 1 per cent in 2011. • Sri Lankan imports admitted duty free into developed countries declined significantly from almost 70 per cent in 2010 to 37.5 per cent by 2011. • Sri Lanka's debt-services-to-exports ratio remains relatively high compared with other developing countries in the Asia-Pacific region. • Telephone density has increased rapidly and the number of telephone connections now exceeds the country's population.	Mixed Progress

While the Millennium Development Goals are about to be replaced by Sustainable Development Goals (SDGs), which will come into effect from 1 January 2016, the MDGs still form a strong base from which to adopt and achieve the SDGs.

2.4 Transport Sector Overview

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

Figure 5. Breakdown of CO_2 ($GgCO_2$) Emissions from the Energy Sector



Source: Government of Sri Lanka Ministry of Environment, 2011

Sri Lanka depends heavily on its public transportation system with buses and trains forming the backbone of the system and sea and air transport having only a limited presence in the domestic set-up. 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.

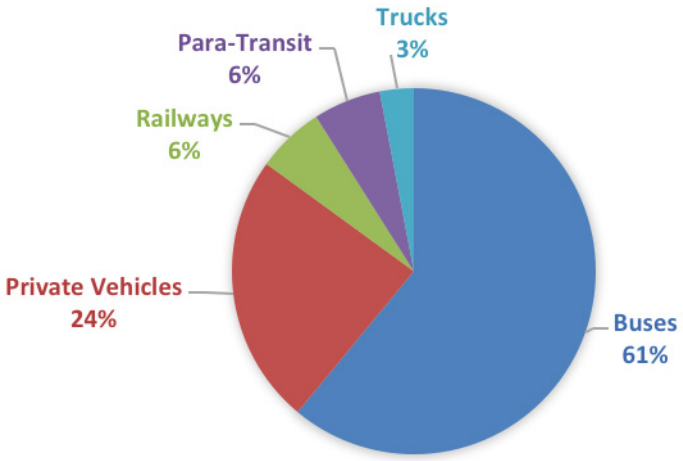
The various modes of transport prevalent in the country are discussed below.

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. Over 70 per cent of the traffic in Sri Lanka is carried by national roads (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 accounted for 93 per cent. About 97 per cent of freight traffic, measured in ton-km, is conveyed by road (ADB, 2012). It is evident therefore that roads dominate Sri Lanka's transportation landscape, for both passenger and freight movements.

Figure 6: Modal Shares of Road Transport, 2007



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 it 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 per cent 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 shrunk drastically. Freight movements handled by the railways have fallen sharply, from 32 per cent of total freight movements in 1979 to a paltry 1 per cent today, emphasising the need for an overhaul of 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, handles the bulk of Sri Lanka's freight imports and exports through the three major ports of Colombo, Trincomalle and Galle. 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 carrying both passengers and cargo. The port of Colombo, the country's main commercial port, is considered to be one of the premier ports in Asia. It handles both conventional cargo and containers, and has been acknowledged as one of the most economical ports in the region. After economic liberalization in the late 1970s, the introduction of a port expansion programme along with the onset of containerization and trans-shipment cargo, led to the growth of port traffic at an average rate of 6.5 per cent per year. As of 2010, port traffic in Sri Lanka had reached the equivalent of 4 million containers of twenty-foot equivalent units (ADB, 2012).

Air Transport: Sri Lanka has one international airport and thirteen domestic airports, two national carriers operate 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, which shows that roads are responsible for 88 per cent of total emissions, followed by the air sector as a distant second (9 per cent), it is prudent to focus on NAMA opportunities in Sri Lanka's road transportation sector.

Table 2. Modal Mix of GHG Emissions from Transportation

Sector	Emissions (Gg)						
	CO_2	CH_4	N_2O	CO	NO_x	NMVOC	SO_2
Road	4,444.03	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	**5,058.19**	**0.48**	**0.05**	**133.76**	**51.13**	**25.93**	**7.98**

Source: Government of Sri Lanka Ministry of Environment, 2011

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. Its population is expected to grow to 5.1 million by 2035, leading to 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, one 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, a lack of capacity in public modes of transportation, and inefficient road and traffic control infrastructure has led to a decline 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 responsible for almost half of Sri Lanka's economic activities, the negative effects of an ailing transportation system will be felt throughout the country.

Figure 7. Colombo Metropolitan Area (CMA)

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 transportation situation transportation in Colombo, all by itself.

Thus, given the importance of Colombo and the large scale 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.

3. Sri Lanka's Transport Policy and Stakeholder Environment

3.1 The 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 are detailed in the following sections.

3.1.1 The National Transport Policy

The Draft National Policy on Transport in Sri Lanka, 2008, prepared by the National Transport Commission in the Ministry of Transport (MoT, 2008), 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 directly or indirectly support the identified NAMA intervention are the following.

- To encourage the use of public transport, high occupancy vehicles and non-motorized transport (in the section entitled "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 areas in order to make a greater proportion of the limited road space available for high occupancy vehicles.
- To ensure that at least one-third 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 sources of fuel such as bio fuels.

3.1.2 Sri Lanka's Intended Nationally Determined Contributions (INDCs)

Sri Lanka's INDC, submitted in accordance with Decisions 1/CP.19 and 1/CP.20 of the Conferences of Parties of the UNFCCC, identifies four major areas of coverage, namely mitigation, adaptation, loss and damage and means of implementation. Sri Lanka's transport sector has been identified as an area of significance under the mitigation programme, under which Sri Lanka aims to reduce GHG emissions against the Business As Usual (BAU) scenario.

The main objectives for the transport sector as outlined in the INDCs document, which also align with the objectives of the transport NAMA, are as follows (MMD&E, 2015).

- Establish energy efficient and environmentally sustainable transport systems by 2030.
- Convert 25-40 per cent of public transport to green fuels.
- Shift passengers from private to public modes of transport.
- Enhance the efficiency and quality of public transport.
- Introduce economic instruments to help increase the adoption of sustainable transport measures.

3.1.3 National Action Plan for the Haritha Lanka Programme

The National Action Plan for the Haritha Lanka Programme, 2009, is the product of the combined efforts of several Sri Lankan ministries, which lays down the proposed strategies and actions that are set out to focus on fulfilling the ten mission statements of the programme (NCSD, 2009). The main objectives of the plan which directly or indirectly support the identified NAMA intervention are:

- implementation of mass transit systems such as "MRT/LRT [Mass Rapid Transit/Light Rail Transit], 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; and
- 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.

3.1.4 The Urban Transport Master Plan

The Urban Transport Master Plan unites the road network with economic development and provides for approaches to long-term maintenance of the road network and safeguarding adverse social and environmental impacts of transport. The plan is a comprehensive document that proposes various strategies for public transport and road networks, while also taking into consideration the institutional set-up and financial arrangements for the proposed activities (MoT, JICA & OCC, 2014)

One key proposed intervention is to set up a BRT system in Colombo. The 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".

3.1.5 The 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, a mission, goals and a set of guiding principles followed by broad policy statements under the headings 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". (CCS, 2014)

3.1.6 Sri Lanka Strategy for Sustainable Development

The Sri Lanka Strategy for Sustainable Development developed by the Ministry of Environment in 2007 outlined the sustainable development vision, goals, strategies and targets for the 30-year period, 2007-37 (MMD&E, 2007)

The strategy document discusses the Sri Lanka Transport Board Act No. 22 of 2005, which was enacted to establish a public sector bus system, in order to upgrade and to meet the new challenges posed by a 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.

Table 3. Summary of the Sri Lanka Transport Sector's Sustainable Priorities

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 and biofuels.
Urban Congestion & Pollution	Reduced traffic congestion and air, noise pollution in urban areas, especially the CMA, through increased adoption of public and alternative modes of transportation.
Energy Security	Achieving greater diversity of fuel sources and reduced dependence on imported sources of fuel especially petroleum.
GHG Emissions	Reduced GHG emissions from the transport sector through the adoption of alternative clean fuel vehicles and public modes of transport, thereby decreasing the sector's reliance on fossil fuels

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. 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 helping develop a policy environment that encourages and invites increased private sector participation.

3.2 Stakeholders in the Transport Sector

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

3.2.1 Major Administrative and Implementing Bodies

The following table details the organizations/ministries that are the major players in Sri Lanka's road transport and sustainability/climate change sectors.

Table 4. Major Administrative and Implementing Bodies

Main Organization	Sub-Organization	Role in Sri Lanka
Ministry of Mahaweli Development & Environment	—	The MMD&E is responsible for the formulation of policies, programmes and projects, and monitoring and evaluation of matters related to Sri Lanka's environment. It is also responsible for the adoption of measures necessary for the development of national and international cooperation in relation to protection of environment for the present and future generations.
	Climate Change Secretariat	The Climate Change Secretariat is responsible for providing a platform to address climate change issues including emissions reductions in the transport sector. While its focus is on CDM projects in Sri Lanka, given the scope and scale of the NAMA we believe they will play an important part in its implementation.
Ministry of Sustainable Development & Wildlife	—	The MSD&W is responsible for the formulation of law and strategies to create sustainable development in an economy with minimum environmental changes and carbon dependency. It is also responsible for the formulation of sustainability standards and ecological footprint indicators.

Main Organization	Sub-Organization	Role in Sri Lanka
Ministry of Transport	—	The Ministry of Transport is responsible for the development, implementation and maintenance of Sri Lanka's transportation sector (including policy formation and development), covering road, rail, air and marine transportation.
	Department of Motor Traffic	The DMT is responsible for the enforcement of rules and regulations provided for 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 Central Transport Board	This agency is responsible for advising the Government on national policy relating to passenger transport services by buses.
Ministry of University Education & Highways	—	The MUE&H is responsible for adoption of measures necessary for the improvement of the national highway system to a high standard, and its maintenance at optimum level, so as to ensure balanced development.
	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.
Air Resource Management Centre (AirMAC)	—	AirMAC is the main organization responsible for ensuring effective air quality management in Sri Lanka.
Ministry of Finance	—	The MoF is responsible for developing and executing Sri Lanka's public finance policy, economic policy and long-term planning.
Ministry of Provincial Councils & Local Government	—	The ministry is responsible for the development of an efficient and effective provincial and local administrative system to promote sustainable economic development. It is also responsible for the promotion of decentralized governance models at the local and provincial level.
Ministry of Power and Renewable Energy	—	The MP&RE is responsible for the development of the power and energy sector in Sri Lanka. In relation to the NAMA, they will have a role as part of their responsibility for the development of projects related to clean energy and alternative fuels like bio-diesel.
Ministry of Megapolis & Western Development	—	The MM&WD is responsible for the integrated and systematic promotion and regulation of the economic, social and physical development of urban areas.
	Urban Development Authority	The UDA is the principal planner and developer of sustainable urban centres in Sri Lanka.

Most transportation projects in Sri Lanka involve multiple organizations/ministries working together, usually some combination of the organizations mentioned in Table 4. Apart from these we also list below 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.

3.2.2 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,

Table 5. Climate Change and Sustainability Administrative Bodies

Main Organization	Sub-Organization	Role in Sri Lanka
Ministry of Power & Renewable Energy	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.
Ministry of Mahaweli Development & Environment	Central Environmental Agency (CEA)	The CEA is responsible for the development and implementation of environmental rules and regulation including licensing, laboratory services, Geographic Information Systems and Remote Sensing (GIS/RS) services, etc.

3.2.3 Capacity-Building Organizations

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

Table 6. Capacity-Building Bodies

Main Organization	Sub-Organization	Role in Sri Lanka
Ministry of Science, Technology & Research	—-	The MST&R is responsible for the adoption of measures to expand scientific, technical, social and economic research and development activities.
	National Engineering Research and Development Centre	The NERDC is responsible for development, research and transfer of the latest technology in Sri Lanka in order to improve and develop indigenous industries.
Ministry of Skills Development & Vocational Training	—	The MSD&VT is responsible for modernizing technical and technological education to create a labour force suited to the job market in Sri Lanka.
	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.

3.2.4 Private Sector Entities, Educational Institutions, Non-Governmental Organizations & International Donor Agencies

Apart from the stakeholders already mentioned, the NAMA will also need to involve international donor agencies along with regional stakeholders, such as various private players such as bus or para-transit owners and operators, educational institutions, NGOs, etc.

Table 7. Other Organizations and Entities

Main Organization	Role in Sri Lanka
Private Sector Entities	The NAMA will need to involve regional stakeholders as well as various private players such as para-transit/bus owners and operators.
Academia & NGOs	The NAMA will require the involvement and inputs of various organizations in the civil discourse space, such as educational institutions (e.g. the University of Moratuwa) and non-governmental organizations (NGOs) active in the transport sector.
International Donor Agencies	There is also a need to approach international funding organizations such as the Asian Development Bank (ADB), the Japan International Cooperation Agency (JICA) and the World Bank, which 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 its financing.

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.

4. NAMA Objectives and Targets

4.1 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:

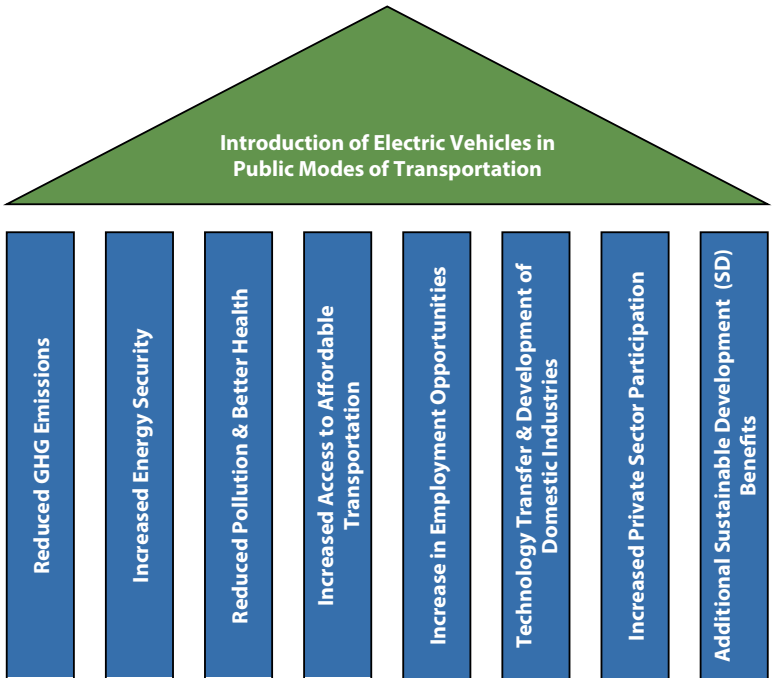
- encourage the use of public transport and high occupancy vehicles resulting in a modal shift from private to public modes of transportation; and
- encourage the promotion and adoption of new cleaner technologies such as electric or hybrid vehicles and reduce the environmental (GHG emissions and pollution), economic (expenditure on fossil fuels) and social (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 the following.

- reducing Sri Lanka's dependence on imported petroleum fuels for the country's mobility requirements, thereby increasing Sri Lanka's energy security.
- providing 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 groups and consequently within Sri Lanka as a whole.
- creating 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.
- providing Sri Lanka with multiple avenues for the transfer of advanced clean technologies from more developed economies such as China and Europe, thereby opening up opportunities for collaboration, knowledge transfer and the subsequent development of indigenous clean technology industries.
- increasing 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 partnerships 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 providing co-funding and taking risk, implementation of the interventions would be limited.
- Achieving additional sustainable development benefits, such as improved air quality, increased time savings and capacity-building.

The following figure summarizes the NAMA targets and objectives.

Figure 8. NAMA Targets and 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 objectives mentioned, 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.

4.2 Challenges Faced by CMA's Transport Sector

The CMA transport sector faces numerous issues, which have prevented it from being the sustainable, efficient system it should be. The primary issues facing the CMA as determined 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 Colombo Municipal Council (CMC) region which covers the Colombo and Thimbirigasyaya Divisional Secretariat Divisions. 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 in regions where congestion is prevalent.
- **Public Transport Issues**
  Each of the CMA's modes 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, insufficient integration with other modes of transport and lack of enforcement of on-road rules and regulations to name a few of the problems that have prevented the CMA from having a cohesive, efficient transportation network that can meet the growing demands of its people.

The two primary issues mentioned above are not mutually exclusive. An inefficient and under- connected network of public transportation consisting of slow, inefficient buses, low-capacity railways and an unregulated assortment of para-transit modes, such as three wheelers, contributes to passenger 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, which results in longer travel times for passengers.

Thus, an approach that tackles either one of the two primary 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 the 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.

4.3 Introducing Electric Buses to the Planned Bus Rapid Transit (BRT)

The NAMA development process began with the preparation of a concept note, detailing the various interventions that are suitable to the Sri Lankan context and which could be taken up as a 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 each of these interventions, a stakeholder consultation workshop was conducted in Colombo with the purpose of selecting one of them. 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 that could be taken up as a transport NAMA, namely:

- development of an Integrated Transportation System (possibly including multi-modal transport hubs, Bus Rapid Transit (BRT), monorail etc.); and
- promoting the adoption of electric vehicles.

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

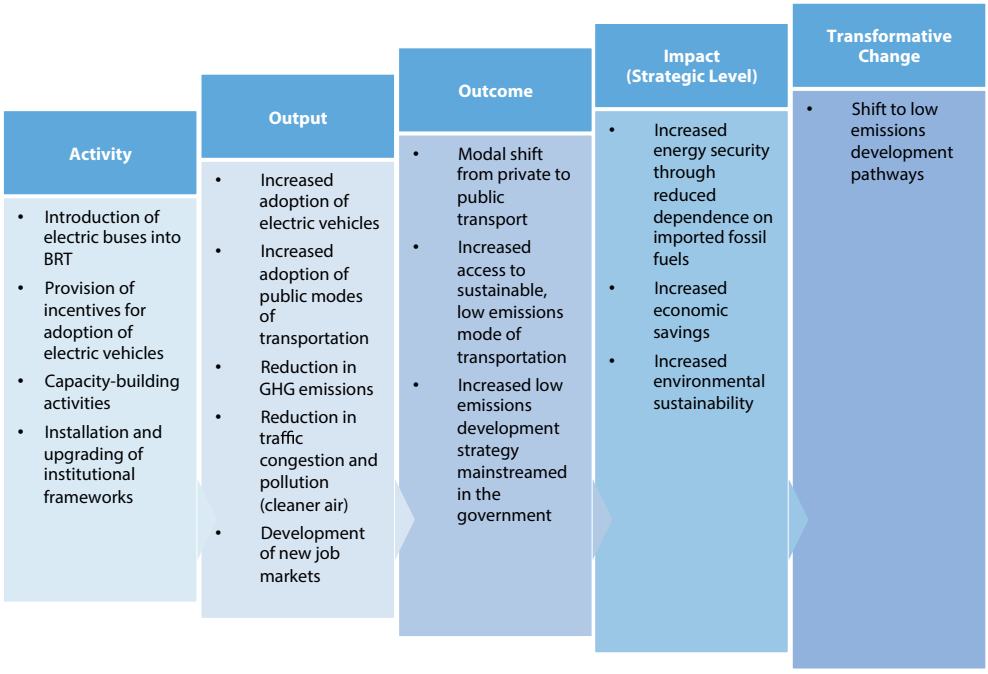
- the introduction and adoption of electric buses instead of conventionally fuelled buses on the planned Bus Rapid Transit (BRT) on Galle Road in the Colombo Metropolitan Area (CMA)

While the NAMA will ultimately be scaled upwards and implemented throughout the country, the observations presented in the NAMA are based on the study of the literature on the capital city of Colombo, which not only plays a strategic role in the development of the whole country's economic fabric 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).

4.4 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 blocks¾interchangeably referred to as outcomes, results, accomplishments, or preconditions¾is 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 for the NAMA can be seen in the following figure.

Figure 9. Theory of Change Approach to NAMA Targets



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

4.4.1 Benefits for the CMA

This following table provides a brief overview of the specific benefits that the proposed NAMA intervention offers, and therefore what makes it suitable and appropriate for the CMA region.

Table 8. Benefits for the CMA

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 consequently 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 incentive. This will also serve to encourage greater private participation.
Growth of ancillary industries and the 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 manufacturing industry in and around the CMA, giving rise to numerous ancillary industries such as battery and charging stations manufacturers, as well as battery recovery and disposal units. This will further lead to the creation of numerous job opportunities requiring skilled labour, thus giving rise to a new employment market

4.4.2 Suitability of 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 or upcoming regulations, policies, schemes, programmes or strategies in a country that has significant mitigation and sustainable development potential.

Even though there is an absence of a common standard definition for a NAMA, as currently understood, 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
- Sector-Transformational Potential
- Sustainable Development Benefits
- Financial Feasibility.

The following table details the proposed intervention's effectiveness with regard to each of these criteria.

Table 9. Suitability of the NAMA for the Sri Lankan Transport Sector

<table>
<tr><th colspan="3">Proposed Intervention</th></tr>
<tr><td colspan="3">Introduce electric buses in place of 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 Centre (MMC) and Park & Ride (P&R)</td><td rowspan="10">Urban Transport System Development Project for Colombo Metropolitan Region (CMA) and Suburbs</td><td rowspan="10">The introduction and utilization of electric vehicles as a national strategy is also mentioned in the following policy documents:
The 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
The National Action Plan for the 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 Drivers' Licences</td></tr>
<tr><td>EN-01: Air Emissions Standard for Vehicles</td></tr>
<tr><td>EN-02: Vehicles Inspection & Maintenance Programme</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 internal combustion engine (ICE) counterparts because of their battery powered electric drive systems which results in reduced fuel consumption. If renewable energy is used to generate the power to charge the vehicles' batteries, it is possible to achieve additional, significant GHG emissions reductions. • In addition to the GHG emissions reductions due to this intervention, the promotion and increased use of public transport 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 with the scenario where the same number of people use individual private vehicles. This modal shift generates significant savings in terms of GHG emissions. For example, the Janmarg BRTS in Ahmedabad, India has been able to reduce emissions by more than 90,000 tons of CO_2 annually (EMBARQ India, 2011).

Sector-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 the CMA would help increase the use of public transport in the region, making it an attractive proposition for passengers. Increased use assists in decreasing the use of private vehicles for transportation within the city, which results in a reduction in traffic congestion throughout the CMA region resulting in numerous benefits such as reduced operating costs of vehicles, decreased pollution, greater fuel savings, shorter travel times, etc. • The introduction of newer, more efficient technology into the Sri Lankan transportation market through the 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 manufacture of batteries, charging stations, and battery recovery and disposal units. • 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 and thus increasing the likelihood of the development of a cohesive, sustainable transportation sector throughout the nation.

Sustainable Development Benefits (for the Colombo Metropolitan Area)	
Positive	**Negative**
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 traffic congestion throughout the region.	**Stress on Sri Lanka's electric grid –** Large scale adoption of electric buses in BRTs across the country could put stress on Sri Lanka's electric grid, which is already dependent on fossil fuels to meet the electricity 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 putting further stress on Sri Lanka's grid and increasing dependence on fossil fuels for the generation of electricity. In conversation, Sri Lankan stakeholders have emphasized that energy demand from this intervention can be met by the grid, especially since the Sri Lankan transport sector also intends to pursue the electrification of its railways which has a far greater requirement. Risk of non-implementation of BRT – The current intervention has been designed to supplement the proposed Galle BRT, and is therefore intrinsically dependent to the development and implementation of the BRT. Thus, without the implementation of the BRT, the chances of the NAMA intervention being implemented decreases. However, the NAMA intervention has been designed to be flexible enough in its approach that even in the absence of the BRT, the intervention can be tweaked and adapted for implementation on conventional roads.
Improved air quality – The combination of the use of electric vehicles, increased use of public transport and decreased traffic congestion leads to a reduction in pollution and GHG emissions, in particular of NOx, SOx and other particulate emissions, throughout the CMA.	
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 related to the use of electric vehicles.	
Human & institutional capacity – Training of executing agency staff to monitor, maintain and implement the project.	
Technology transfer & technological self-reliance – Use of newer, more efficient technology that can then be used in other similar projects in Sri Lanka.	

Sustainable Development Benefits (for the Colombo Metropolitan Area)
Financial Feasibility
While the development of large-scale infrastructure projects such as a BRT can address issues of level of service and have 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. However, there is a need for additional financing if electric buses are to be introduced 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 BRT network within the CMA region.

4.5 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 the most suitable and appropriate methodology for determining the emissions in the baseline and mitigation scenarios of the NAMA.

4.5.1 Baseline of GHG Emissions

The baseline scenario for the NAMA entails the operation of conventionally fuelled vehicles comparable with the 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, from research and from 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 this emission factor, the baseline GHG emissions for a diesel fuelled two-door articulated bus was calculated to be 153.20 tCO_2 annually.

4.5.2 Baseline of Sustainable Development Indicators

As discussed earlier, a NAMA consists of actions that provide not only 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 at the local level, in particular in locations where the NAMA intervention is to be implemented. However, because of the overall situation of the focus area of this NAMA, that is, because 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.

Table 10. Sustainable Development Indicators 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 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, leading to a decrease in the cost of developing 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	Extensive capacity-building at both the national and regional levels through development and implementation of clean and sustainable projects
Economic	Asset Accumulation and Investments	Increased private/public sector investment, and increased cost savings/returns, leading to increased accumulation of assets
	Job Creation	Creation of markets for skilled labour 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

As explained earlier, given the absence of a BRT at the NAMA location or any other location in 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 are set out in greater detail in Chapter 9: NAMA Measurement, Reporting and Verification.

4.5.3 Expected and Targeted Impacts of the NAMA Intervention

The values below are used in the following sections for estimation of NAMA impacts on annual GHG emissions reductions over a period of 10 years and the achievement of the SD indicators listed earlier. The values provided are for the use of two-door electric buses in place of 100 diesel-fuelled articulated buses.

Table 11. Expected and Targeted Impacts of the NAMA Intervention

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 (SOx kt/year)	45
Frequency of eBuses along the BRT (buses/hour)	30
Number of eBuses on the BRT	100
Capacity-building (training/outreach programmes held)	22
Cost savings from increased energy security per bus annually (US$)	30,159
Jobs created	100
Number of private-sector operators involved	50

5 The NAMA Technical Intervention

5.1 The 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 worked hard to develop 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 a large increase in emissions of greenhouse gases (GHGs), exacerbating the Sri Lankan transport sector's already large and ever increasing GHG footprint. The intervention combats this trend by introducing electric 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.

Table 12. Baseline and Bus Fleet Data for the Galle BRT

Performance Indicator	Value
Baseline Galle BRT[a]	
Average length of trip	10 km
Average km/bus/month	9,704.7 km
Total km/bus/year	116,456 km
Average number of trips per bus/day	20
Composition of Bus Fleet	
Standard two-door buses	100
Articulated buses	100
Buses introduced to Galle BRT under Sri Lanka Transport NAMA	
Electric two-door buses[b]	100

[a] Baseline data for buses using fossil fuels only. [b] Electric buses will be used instead of diesel fuelled articulated buses.

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 in order to qualify for funding under the NAMA.

5.2 An Introduction to Electric Buses

The following sections provide an account of the adoption of electric vehicles (including buses) around the globe and an overview of the technology that drives them.

5.2.1 A Global Outlook

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

Studies have shown that electric vehicles produce less greenhouse gas emissions than most conventionally fuelled cars now on the market (IEA, 2012). The widespread adoption of electric fleets would also help transform the transportation sector not just through 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 having numerous other associated benefits like employment generation and a higher standard of living.

The US-based market research and consulting firm Pike Research forecast in August 2012 that the global market for all electricity-driven buses, including hybrid, battery electric and fuel cell buses, would grow steadily between 2012 and 2018 at a compound annual growth rate (CAGR) of 26.4 per cent. According to Pike, the largest sales volumes would come in the Asia-Pacific region, with more than 15,000 eBuses likely to be sold in that region in 2018, 75 per cent of the world total. China was expected to account for the majority of global eBus sales, Pike predicted. It believed that growth in the e-bus market would also accelerate strongly in Eastern Europe and Latin America, the latter driven largely by Brazil while sales in Western Europe would experience steady growth (at a CAGR of around 20 per cent) (Pike Research, 2012).

A December 2012 report by the research and consultancy firm IDTechEx forecast that the market for electric buses and taxis would grow from US$6.24 billion in 2011 to US$54 billion in 2021, of which the largest part would 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 (IDTechEx, 2012).

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 are listed below (IEA, 2012).

- The city of Amsterdam provides subsidies to support companies intending to use electric cars, taxis and trucks, hoping to turn them into a leading means of transportation around the city. The municipality aims to increase its population of electric vehicles from 750 in 2012 to 10,000 in 2015.
- Since 2012, Berlin has been converting its state-run vehicle fleet to electric and plug-in hybrid vehicles. Various projects to promote e-fleets and e-car sharing are underway or are planned. One is the Initiative 120 Project, under which alternative drive systems in Berlin police department patrol cars are tested.

- The city of Kanagawa in Japan provides subsidies, tax breaks and other incentives to reduce the initial user burden and to improve the convenience of electric vehicles. The national Government provides a subsidy equal to 50 per cent of the cost differential between an electric and a gasoline vehicle. Kanagawa Prefecture (K.P.G.) tops up the other half of this subsidy and provides 100 per cent relief for automobile tax (for five years) and automobile acquisition tax.
- The Chinese government provides national subsidies of RMB50,000 for plug-in hybrid electric vehicles and RMB60,000 for pure electric vehicles. In addition, the City of Shanghai offers RMB20,000 and RMB 40,000, respectively for these types of vehicle. Public service vehicles, such as light duty commercial trucks and buses, also receive subsidies. Shanghai also maintains 1.2-1.5 charging stations for every electric vehicle. Twenty of these stations have been installed as part of "park and ride" trials.

5.2.2 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, due to an absence of tail pipe emissions. In an electric vehicle, the impact on the local 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 produce 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 include lightweight materials for body, chassis, and seat assemblies; stop-start systems for idle reduction; improved batteries, electric motors, converters, and power electronics. These are 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 increased uel economy compared with standard diesel buses. According to the National Renewable Energy Laboratory (NREL), hybrid buses offer an average 37 per cent 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 Buses, which use batteries as the storage device; and
        - Gyrobuses, which use 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 on the roads on which the bus travels
   b. They can be further categorized into:
      - The Trolleybus, which utilizes two overhead electric wires, with electricity being drawn from one wire and returned via the other wire, using two roof-mounted trolley poles; and

Figure 12. Online Electric Bus (Gapbus)

Figure 13. Trolleybus

- The Online Electric Vehicle (Bus) (OLEV), also known as Gapbus, which utilizes power that is supplied over a gap (of 12-17 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's 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 13. Components of a Battery Powered Electric Bus

Electric Motor			
Max. Rated Power: 150 kW (EBUSCO Buses)360 kW (BYD Buses)			
Battery Pack			
Lithium Ion (LiB) Batteries	Lithium Ferrous Phosphate ($LiFePO_4$)	Energy Density: 110 -150 Wh/kg	Preferred battery of choice in electric vehicles due to their high energy/power densities and stable chemistry, which prevents them from overheating at high temperatures.
	Lithium Manganese Oxide ($LiMnO_2$)	Energy Density: 280 Wh/kg	
Nickel Metal Hydride (NiMH)		Energy Density: 140 Wh/kg	Used in early hybrid/electric cars.
Lead Acid Batteries		Energy Density: 30 -50 Wh/kg	
Mode of Charging			
Alternate Current (AC)			
• 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.			
Direct Current (DC)			
• 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 per cent charge in as little as six minutes.			

Figure 14. Electric Bus Charging Stations

The table below lists some of the prominent manufacturers of the electric buses around the world.

Table 14. Electric Bus Manufacturers

Manufacturer	Battery Technology	Battery Capacity (kWh)	Performance (kWh/km)	Range (km)	Charging Time	Cost per Km (US$)	Cost (US$)	Source
BYD	Lithium Iron Phosphate (LFP)	324-547.5	1.19	249 to 273	1.6-4 hours	0.13	395,000 to 592,600	http://byd.com/na/auto/40feet.html
Siemens	Lithium Iron Phosphate (LFP) & Lithium Ferrite	85-96	..	150	2-3 hours (LFP) & 10-15 minutes (Lithium Ferrite)	..	..	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
New Flyer Industries	Lithium Ion	100-300	..	128	10-15 minutes	..	..	http://www.chicagobus.org/buses/700-xe40
Proterra	Lithium Titanate	53-321	1.09	48	5 minutes	0.12	825,000	http://www.proterra.com/product-tech/product-portfolio/
Optare	Lithium Iron Magnesium Phosphate	80	..	150	2-6 hours	..	..	http://static1.squarespace.com/static/5318a7c0e4b03ba2018b69f4/t/551d6815e4b0e383d177f7a5/1427990549168/EV+Brochure.pdf
Ebusco	Lithium Iron Phosphate (LFP)	242-311	0.90	250 to 300	1.6 hours	0.09	..	http://www.ebusco.eu/en/electric-buses/ebusco-2-0

.. = Not Available

These manufacturers (among others) will be approached to determine the suitability of their buses for the implementation of the NAMA.

5.3 Activities under the NAMA

As highlighted earlier, the NAMA intervention comprises 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:

5.3.1 Pilot (Demonstration) Phase (Phase 1)

Phase 1 of the NAMA intervention will introduce 10 electric buses, owned by the Government of Sri Lanka and operated by private operators, as directed by the MoT, in to the Galle BRT. The aim of Phase 1 of the NAMA, a pilot project, is to generate awareness about the NAMA and invite private sector participation, highlighting its importance for the transport sector. The funding for eBuses in Phase 1 will be completely sourced through international climate financing agencies in the form of direct grants. This should help make it appealing for other private bus operators in Sri Lanka to operate eBuses on the Galle BRT once the full scale operations of the NAMA is under way.

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

- training the proponents and participants in the NAMA including training the trainee programmes as well as training government officials, bus operators and on-ground personnel, among others;
- raising awareness about the intervention including information on the technology adopted and benefits of the intervention, 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 come from a combination of sources which includes the private operators of eBuses, the Government of Sri Lanka and international climate finance bodies.

5.3.2 Full Scale Operations (Phase 2)

Phase 2 will involve the start of full scale operations of the NAMA: the remaining 90 eBuses will be introduced and operation of all 100 eBuses will begin on the Galle BRT. 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 amounts pledged by a private operator for the purchase of an eBus (a minimum of 30 per cent of the total cost will be required for operators to be eligible for participation in Phase 2) and the total cost of the eBus. The NAMA shall will also cover the costs of additional charging stations and capacity-building measures (if necessary). The funding for this final phase will be sourced from the private operators of eBuses and international climate finance.

Both phases will 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.

The details of the funding mechanisms for both the phases are elaborated in Chapter 8 – NAMA Costs and Finance.

5.4 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.

Table 15. Eligibility Criteria for the NAMA

Eligibility Criterion	Description	
Location	Galle BRT, Colombo Metropolitan Area (CMA)	
Technology	Autonomous electric battery powered bus	
Minimum Bus Life	10 years	
Minimum Battery Life	5 years	
Minimum Level of Service	50,000 km annually (40 per cent of the expected average total distance to be travelled by a bus on the BRT every year)	
Implementation	The eBuses must be operational on the Galle BRT within three months of contract award	
Funding	Phase 1	The maximum grant funding that can be applied for is 100 per cent of the investment costs.
	Phase 2	The maximum funding that can be applied for is 70 per cent of the total cost of an eBus. As part of the eligibility criteria, a private operator needs to pledge at least 30 percent of the cost of eBuses to qualify for participation in the bidding process in Phase 2.

5.5 Approval Structure of the NAMA

The selection of the private eBus operators to be financed under the NAMA will carried out in the steps delineated in the table below.

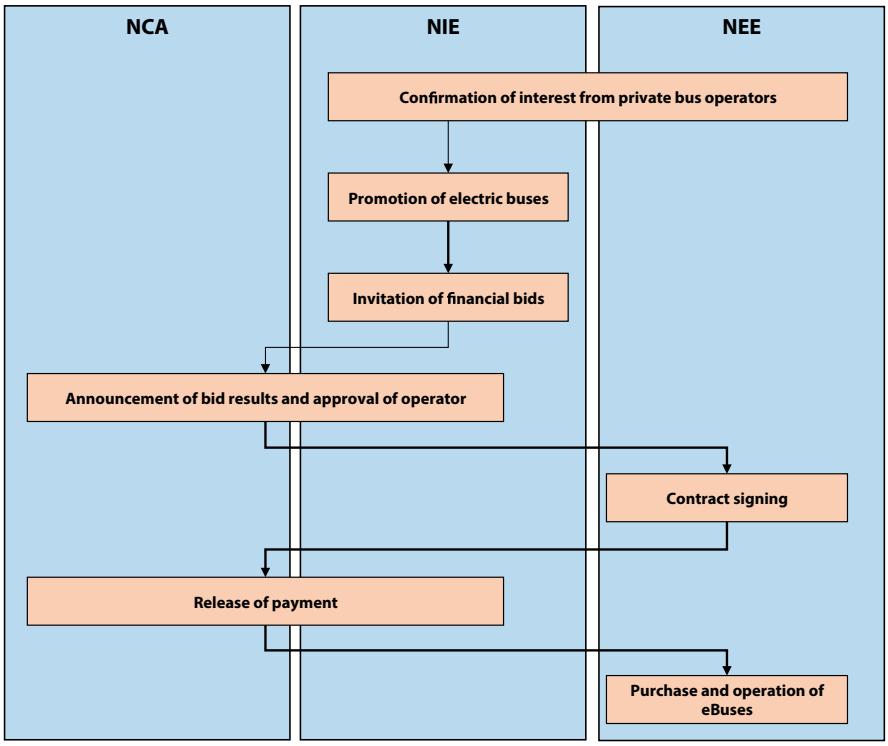
Table 16. Approval Structure for the NAMA

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 invitation of expressions of interest in taking part in the introduction and operation of electric buses on the BRT.
2	Promotion of electric buses	The plans for implementation of the BRT using 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 expect to receive and the 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.

No.	Step	Description
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 will be invited from private operators. 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	The results of financial bids will be announced and the name of private bus operators selected to operate eBuses on the Galle BRT will be sent to the NAMA Coordinating Authority (NCA) for approval.
5	Contract signing	The private bus operators wining the bid will sign a contract with the NIE committing to a minimum level of service as set out in the eligibility criteria for receiving funding. A private operator with a winning bid will now be considered to be an individual NAMA Executing Entity (NEE).
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, which releases it to the NEEs.
7	Purchase and Operation of eBuses	The purchase of eBuses, followed by their operation on the BRT, is carried out by the NEEs.

The diagram shown below shows the stages of the approval process along with the entities involved.

Figure 15. The NAMA Approval Process



6 NAMA Implementation Structure

6.1 Actions to Institutionalize the NAMA

The coordination and management of the NAMA requires an institutional structure meeting the following requirements.

- It must be embedded in national and sectoral policies and strategies.
- It must be capable of being subject to 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 the NAMA Facility.
- 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 ensure transparent monitoring of GHG emission reductions and the 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 with organizational systems that are already in place and allow for the 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.

6.2 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.

6.2.1 National NAMA Approver/Focal Point

The national NAMA Approver or Focal Point shall inter alia:

- approve NAMAs and register them at the UNFCCC;
- provide guidance to sectoral NAMA coordinating entities (on access to climate finance, financial flows, MRV etc.);
- issue procedures for the accounting of emission reductions that will avoid double counting of emission reductions from various implemented NAMAs;
- coordination of monitoring activities and preparation of monitoring reports for the intervention;
- collect data for monitoring purposes (requirements will be determined based on the MRV);
- reporting to the donor in fulfilment of all reporting requirements;
- facilitation and coordination of verification through the external entity designated for this task;
- development of annual monitoring reports for the intervention (covering, inter alia, the number of projects implemented and the calculation of emission reductions); and
- support the preparation of the National Communication, Biennial Update Reports, and Summary of GHG Reductions and other documentation to be submitted to the UNFCCC.

The Ministry of Mahaweli Development and Environment has already been appointed as NAMA Approver/Focal Point to the UNFCCC and as the National Designated Authority (NDA) to the GCF.

6.2.2 The NAMA Coordinating Authority (NCA)

The NAMA Coordinating Authority (NCA) is the entity which coordinates the proposed NAMA utilizing eBuses in place of conventionally fueled, diesel 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 Climate Change Secretariat (CCS), the NAMA Focal Point and the NIE);
- approving and updating eligible interventions; and
- supervising the financial flows between donors and beneficiaries.

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

6.2.3 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) will be the main operative body of the Transport NAMA in Sri Lanka.

The main tasks of the NIE are as follows.

- Ensuring 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.).
- Preparing 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.
- Capacity-building for institutions and companies involved in the implementation of the NAMA (e.g. eBus operators and equipment suppliers).
- Development of technical standards for equipment/installations used under the NAMA.
- Coordination of promotion and awareness-raising campaigns and of support for the implementation of the NAMA.
- Integration of the private sector into NAMA implementation.
- Cooperation 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 Transport along with the Ministry of Finance and the Development Finance Corporation of Ceylon (DFCC Bank) will take up the role of the NIE.

The Ministry of Transport 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 Transport will be supported by The Ministry of Finance on matters related to finance. The Ministry of Finance 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 covering 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.

6.2.4 NAMA Executing Entities (NEEs)

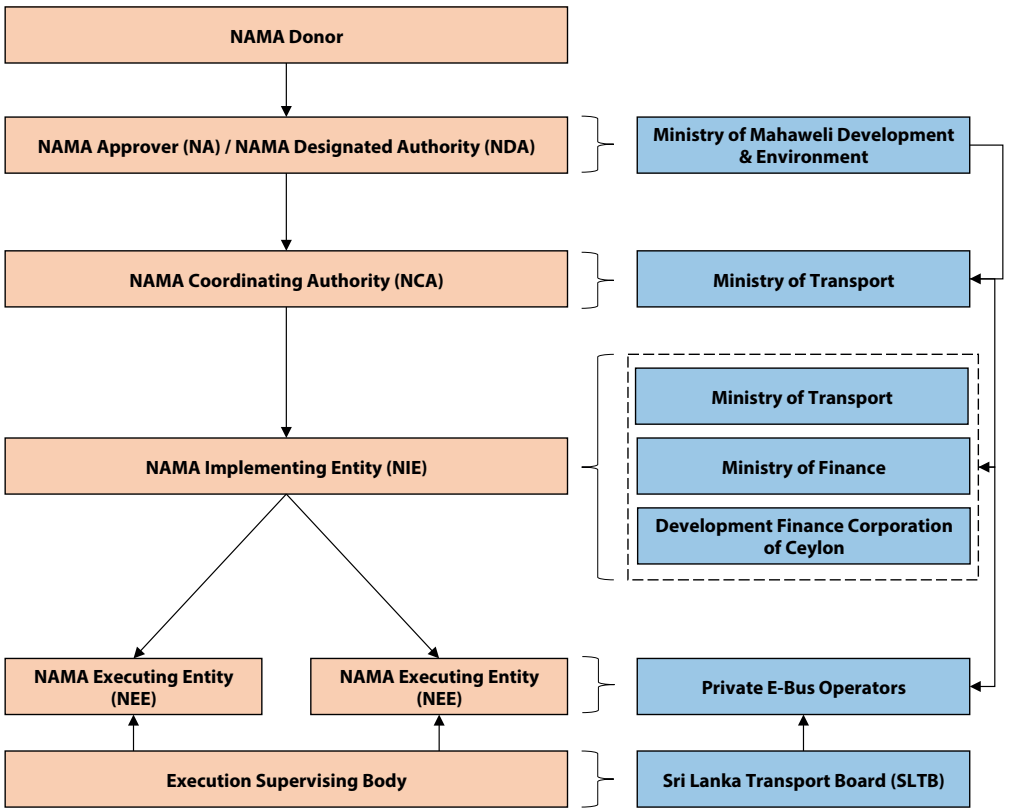
The NAMA Executing Entities (NEEs) are the private operators who will operate electric buses under the auspices of the NAMA. Each NEE will:

- 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.

The Sri Lanka Transport Board (SLTB) will act as the supervisory body for the NEEs. 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, it is 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 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 Transport.

Figure 16. The NAMA Institutional Structure



7. NAMA Capacity Development Needs

7.1 NAMA Capacity Development Programme

The NAMA capacity development programme 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 Government institutions involved as well as of private bus operators. The development of outreach programmes will also be required to stimulate interest in the NAMA within the private sector, as well as promotional campaigns generating awareness and interest in the adoption and utilization of electric vehicles within the country at large.

The proposed NAMA capacity development programme 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 programme 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.

7.2 Component 1: Capacity Development for NAMA Launch and Implementation

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

- establishing the NAMA's workflow, detailing its processes including implementation cycles, staff training, etc.
- designing NAMA related contractual conditions (for example, the contract for the hiring of an operator as an 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. For this purpose, international experts (technical and financial) will be hired for a period of three years, as international advisors.

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

7.2.1 Implementing the NAMA network and communication framework

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

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

- Train the trainer programmes on the objectives, benefits and procedures of the NAMA (the NIE will then be able to offer training to the NEEs), covering:
  - case study training for project approval and verification;
  - training on MRV for GHG emission reductions and SD benefits;
  - designing lines of authority and time frames for process steps within the NIE;
  - reporting to the NCA.
- Prepare communication structures and reporting procedures detailing the flow of information from the NA right down to the NEEs and NAMA ground personnel

7.2.2 Regulations and Contractual Conditions

This part of the capacity development programme 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).
- Design by the NIE of the contract to be signed by the NIE and the NEEs (with support through the capacity-building programme), which will contain at least:
- the name and address of the legal entity asking for support;
  - a description of the eBuses to be purchased by the NEEs (private operators);
  - the 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 the start of operation of eBuses and the issuing invoices to the NIE;
  - reporting requirements by the NEEs;
  - payment conditions.

7.2.3 Preparing NAMA project documentation

This element of the capacity development programme involves the following.

- Preparing the documents (application forms, call and bid templates, evaluation and reporting forms, etc.).
- Preparing the procedures for practical implementation (procurement rules, monitoring manual, evaluation, cross-check, approval and reporting structures, etc.).
- Ensuring 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.

7.3 Component 2: Awareness-Raising and Marketing

Component 2 of the capacity development programme will focus on generating interest in the NAMA among the various stakeholders in the NAMA including private players being invited to participate through 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 as a result of the NAMA. This will done through the development of a combination of awareness-raising programmes and marketing campaigns and disseminating information on the NAMA among various stakeholders.

This component will consist of the activities described below.

7.3.1 General activities

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

- Organizing the 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 programmes) will be organized per year for the first three years of the NAMA, which will present the concept of electric vehicles and this specific NAMA, its objectives and opportunities, and explain the NAMA procedures.

- Support for Business Development
  Focus will be given to supporting new entrepreneurs in developing ancillary industries to meet 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 as financing 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 and banners.
- Cooperation with public and private media
  There will be a continuous flow of information to the media about the implementation and outcomes of the NAMA.

7.3.2 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 capacity-building specifically for the NIE will focus on:
  - the exchange of know-how with other countries which are implementing or have implemented transport NAMAs using electric vehicles; and
  - The MRV system for 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 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 capacity development for the Sri Lanka Transport NAMA will be approximately US$365,000 (details are provided in Chapter 8 – NAMA Costs and Finance).

8 NAMA Costs and Finance

8.1 Proposed Investment in the Galle Bus Rapid Transit

The "Study of BRT on Galle Road" by the University of Moratuwa recommended a public-private partnership for the financing of the proposed Galle BRT, with the Government of Sri Lanka contributing up to US$140 million for the construction and implementation of the BRT, most of it being directed towards the development of the BRT's infrastructure components such as bus stations, the runway and traffic components. The private sector's financial involvement would be through the purchase of new buses that would operate on the BRT.

The following table indicates proposed investment by the Sri Lankan Government (public investment) in the various components of the proposed Galle BRT.:

Table 17. Proposed Government Investment in the BRT

Component	Financing (US$ million)
Planning Stage Cost	2.9
Runway	16.5
Stations	10
Traffic Improvements	68.8
Marine Drive	1.3
Operator Development/Compensation	33.8
Urban, Social and Environmental Costs	6.9
Total Public Contribution	**140.2**

It is evident from the information provided in the table above that while the Government will not be pledging any finance for the purchase of buses that will run on the BRT, it will contribute significantly to the development of the BRT's infrastructure. The purchase and operation of buses on the Galle BRT is expected to be completely entrusted to 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 will be in the form of an import tax exemption and a fuel subsidy, designed to make the purchase and operation of eBuses attractive for private operators. A financial contribution directly from the national Government will be a sign of its willingness to take a political stake in and give its support to the implementation of the NAMA intervention, and thus of its strong commitment to the project.

8.2 Financial Analysis of the NAMA Intervention

The proposed NAMA intervention aims 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.

Table 18. Overview of NAMA Costs

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

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

Using 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 are highlighted in the table below.

Table 19. Financial Analysis of NAMA

Indicator	Conventionally Fuelled Buses	Electric Buses
Total Number of Buses	100	100
Total Capital Cost	US$39,000,000	40,000,000 USD
Total Operational Cost	US$85,944,823	54,434,342 USD
Total Cost	US$124,944,823	100,914,342 USD
Financial Comparison		
Net Present Value (NPV) of Benefits in eBuses	-12,454,254 USD	
Payback Period	< 5 years	

The analysis shows that the use of eBuses in place of conventionally fuelled buses in the Galle BRT is a financially viable and lucrative option when compared with 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 an early payback and profitability.

The financial analysis also details the major cost components of the NAMA that need financial support (see Table 20 below) with estimates of the amount of finance required.

Table 20. Breakdown of NAMA Costs

Capital Investment				
Cost Component	**Unit**	**Unit Rate (US$)**	**Quantity**	**Cost (US$)**
Electric Buses				
Cost of eBuses in Phase 1	No.	395,000	10	3,950,000
Cost of eBuses in Phase 2	No.	395,500	90	35,550,000
Infrastructure				
Charging Stations	No.	10,000	50	500,000
Subsidy				
Fuel Subsidy	No.	13,600	100	1,360,000
Import duty exemption for BRT eBuses	No.	0*	100	0
Operations & Maintenance				
O&M of eBuses (10 Years)	No.	622,655	100	62,265,500
O&M of charging stations (10 Years)	No.	10,000	50	500,000
			Total Capital Investment Cost	**104,125,500**
Capacity Development				
Cost Component	**Unit**	**Unit Rate (US$)**	**Quantity**	**Cost (US$)**
International Experts				
Technical Expert	Month	1,700	36	61,200
Financial Expert	Month	1,700	36	61,200
Local Consultant	Month	900	84	75,600
Travel				
International Flights	Flight	2,000	18	36,000
National Travel	Per diem	150	390	58,500
Awareness Programmes				
Training programmes for BRT staff	Event	1,500	12	18,000
Outreach programme for private sector	Event	1,500	6	9,000
Capacity Development				

Capital Investment				
Cost Component	**Unit**	**Unit Rate (US$)**	**Quantity**	**Cost (US$)**
NAMA public awareness-raising events	Event	1,500	4	6,000
Contingency (5 per cent)				16,275
Project Administration (7 per cent)				22,785
			Total Capacity Development Cost	**364,560**
TOTAL				**104,490,060**

**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 Annex A.

8.3 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.

Table 21. Financing Options under the NAMA

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 a 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.
Auction	In an auction, financial bids, starting from a minimum value, are invited for operation permits/ leases wherein the permit/lease is ultimately sold to the highest bidder.
	In case of the transport NAMA, financial bids for operating permits/leases to operate the 10 eBuses during Phase 1, will be invited from private operators. The permit/lease will be given to the operator with the highest bid.
Reverse Auction	In reverse auctioning, proposals are collected on the basis of tendering or 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.

Approach	Description
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 an ad valorem duty) or the weight, dimensions, or other criteria of the item such as its size. It is also referred to as a customs duty, a tariff or an import tax.
	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 relative to its market value.
	In case of the transport NAMA, it is proposed that the Sri Lankan government provide operators of eBuses a fuel subsidy for the first 12 months (one year) of operation in the form of free charging (direct subsidy).

8.4 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 drawn down in the form of grants and soft loans supplemented by funding from the Sri Lankan 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 and their proposed fulfilment mechanisms.

Table 22. NAMA Intervention - Phase 1 Financing

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	10,000	50,000		Grant
	Import duty exemption for BRT eBuses	Bus	10	0*	0#	Sri Lanka Government	Indirect Subsidy
Operations & Maintenance	Free Charging (12 Months)		10	13,600	136,000		Direct Subsidy
	O&M of eBuses (10 Years)		10	622,655	6,226,550	Private Bus Operators	Direct Investment
	O&M of charging stations (10 Years)	Charging Station	5	10,000	50,000	International Climate Finance	Grant

Investment Category	Cost Component		Unit	No. of Units	Cost	Total Cost	Financing Source	Financing Mechanism
Capacity Development	International Experts		Months	48	1,700	81,600	International Climate Finance	Grant
	National Experts		Months	36	900	32,400		
	Travel	International Flights	Flight	12	2,000	24,000		
		National Travel	Per diem	210	150	31,500		
	Awareness & Capacity Building Programmes		Events	13	1,500	19,500		
	Contingency					9,450		
	Project Administration					13,230		
Total Cost for Phase 1						**10,624,230**		

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

Table 23. NAMA Intervention - Phase 2 and Total Financing

Investment Category	Cost Component	Unit	No. of Units	Cost	Total Cost	Financing Source	Financing Mechanism
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	10,000	450,000		
	Finance for eBuses	Bus	90	118,500	10,665,000	Private Bus Operators	Direct Investment
	Import duty exemption for BRT eBuses		90	0*	0#	Sri Lanka Government	Indirect Subsidy
Operations & Maintenance	Free Charging (12 Months)		90	13,600	1,224,000		Direct Subsidy
	O&M of eBuses (10 Years)		90	622,655	56,038,950	Private Bus Operators	Direct Investment
	O&M of charging stations (10 Years)	Charging Station	45	10,000	450,000	International Climate Finance	Grant

Investment Category	Cost Component		Unit	No. of Units	Cost	Total Cost	Financing Source	Financing Mechanism
Capacity Development	International Experts		Months	24	1,700	40,800	International Climate Finance	Grant
	National Experts		Months	48	900	43,200		
	Travel	International Flights	Flight	6	2,000	12,000		
		National Travel	Per diem	180	150	27,000		
	Awareness & Capacity Building Programmes		Events	9	1,500	13,500		
	Contingency					6,825		
	Project Administration					9,555		
Total Cost for Phase 2						**93,865,830**		
Total NAMA Cost						**104,490,060**		

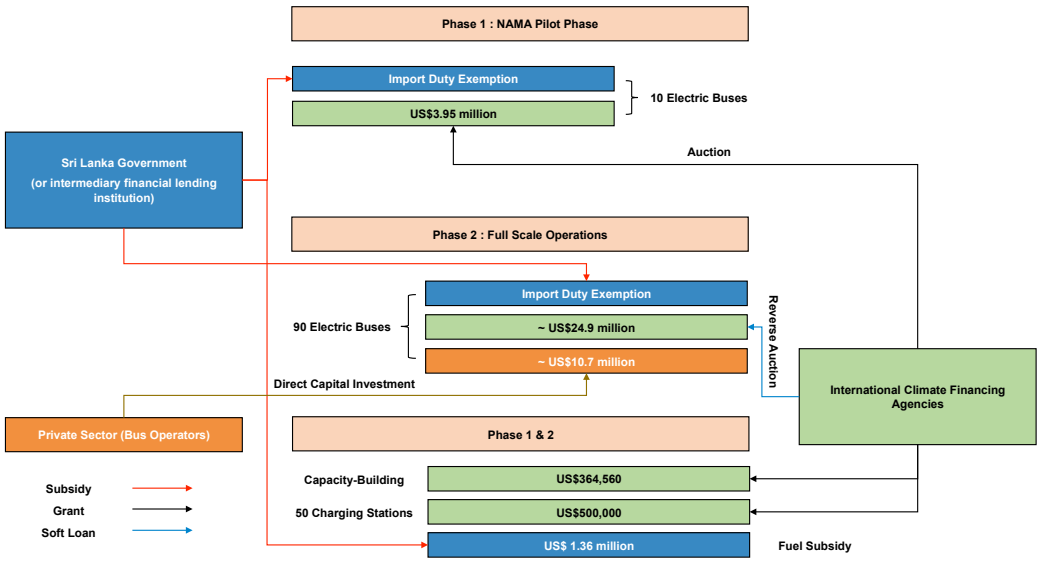
** Currently 0 as the value for import tax exemption per bus is yet to be decided. The total values are liable to change depending on the value of import tax exemption that is finally decided upon by the Government of Sri Lanka.*

Table 24. NAMA Intervention - Phase 2 and Total Financing

(US $)	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Total
Phase 1	-	4,698,855	562,855	562,855	562,855	562,855	1,210,855	562,855	562,855	562,855	562,855	-	10,412,550
Phase 2	-	-	42,289,695	5,065,695	5,065,695	5,065,695	5,065,695	10,897,695	5,065,695	5,065,695	5,065,695	5,065,695	93,712,950
Capacity Building	44,820	55,620	55,620	55,620	48,420	48,420	28,020	28,020	-	-	-	-	364,560
Total	44,820	4,754,475	42,908,170	5,684,170	5,676,970	5,676,970	6,304,570	11,488,570	5,628,550	5,628,550	5,628,550	5,065,695	104,490,060
Sri Lankan Government	-	136,000	1,224,000	-	-	-	-	-	-	-	-	-	1,360,000
Private Sector	-	557,855	16,243,550	5,578,550	5,578,550	5,578,550	6,226,550	11,410,550	5,578,550	5,578,550	5,578,550	5,020,695	72,930,500
International Climate Finance	44,820	4,060,620	25,440,620	105,620	98,420	98,420	78,020	78,020	50,000	50,000	50,000	45,000	30,199,560
Total	44,820	4,754,475	42,908,170	5,684,170	5,676,970	5,676,970	6,304,570	11,488,570	5,628,550	5,628,550	5,628,550	5,065,695	104,490,060

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

Figure 17. Projected NAMA Financial Flows



8.4.1 Phase 1 - NAMA Pilot (Demonstration)

Phase 1 introduces 10 electric buses owned by the Government in to the Galle BRT, in a pilot project whose aim is to generate awareness about the NAMA and highlight its importance for the transport sector. While the ownership of the eBuses will lie with the Government, operation of the buses on the BRT will be carried out through private operators, as directed by the MoT.

Funding for the 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. US$395,000 per bus (US$3.95 million for 10 buses), and will be covered by international climate financing agencies in the form of grants.

The MoT would then lease out these buses to the private sector to operate on the BRT as per their directions and regulations. This would be done through a bidding process wherein the highest private sector bidders would get the operation permits/leases. The revenue collected from sale of permits/leases would be used by the MoT to provide free electricity to these buses for a period of one year. Any surplus funds would be channelled back to Phase 2. The private sector would recover their investment in the purchase of operation permits/leases as well as associated O&M expenses through fare collection from commuters using the bus service.

This should help raise awareness among the private bus operators about the new technology in eBuses and increase their interest for participation in Phase 2.

The design parameters for the disbursement of these funds are as follows.

- **Purchase of eBuses**
  All the 10 eBuses allotted for the pilot phase shall be purchased by the Government through funds received from the international climate financing agency in the form of a grant, amounting to US$395,000 per bus (US$3.95 million for 10 buses).

- **Operation of eBuses (Auctioning of operating permits/leases)**

  i. Financial bids for operating permits/leases to operate the 10 eBus for a period of 10 years, will be invited from private operators who have met the initial eligibility criteria. The permit/lease will be provided to the operator with the highest bid, i.e. the highest amount pledged for the permit/lease on an annual basis. Every bidder will be required to bid over and above a minimum price for the permit/lease, set by the Government.

  ii. The revenue generated from the sale of permits/leases will be used by MoT to bear the cost of free electricity to be provided to each of the 10 eBuses for a period of one year amounting to a total of US$0.14 million (US$13,600 per bus per year). This will act as an incentive to private operators participating in the pilot phase, as early adopters of a new technology.

  iii. Any surplus revenues from the sale of permits/leases will be channelled into Phase 2 of the NAMA intervention i.e. the NAMA's full scale operations.

All other costs of operations and maintenance (including cost of replacement batteries) for operation of the eBuses are expected to be covered by the private operators through the collection of revenues from commuters using the bus service.

8.4.2 Phase 2 - Full Scale Operations of the NAMA

Phase 2 of the NAMA involves the start of the NAMA's full scale operations with the introduction and operation of the remaining 90 eBuses on the Galle BRT. The financing for Phase 2 will cover the entire differential cost of the 90 buses open to the private sector, i.e. US$24.9 million.

This differential amount shall be made available 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 prevailing market rate.

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

The disbursement of the loans will be done on the basis of the lowest bids (reverse auctioning) and it is likely that the whole amount will not 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 of that portion possibly being carried out at rates higher than those at which it was received, thereby acting as an additional revenue generating source for the government.

The design parameters for the financing of Phase 2 are elaborated below.

- **Invitation to bid**
  Financial bids from an operator will be invited, if and only if, the aforementioned operator has committed to investing at least 30 per cent 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 from the NIE (received at a rate of interest far lower than prevailing market rates, thus making it a very attractive option).

- **Funding for the lowest bidder**
  EBus permits and the funds subsequently allotted 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 by the Government of Sri Lanka) providing the NIE a claim over the asset, i.e. the eBus (or eBuses) owned by the NEE, in the event of a 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 at least 50,000 km per year (approximately 40 per cent of the expected average total distance to be travelled by a bus on the BRT every year),
  - iii. sells an eBus before the end of its expected lifetime 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 lower than market cost, on the condition that the eBus continues to operate on the Galle BRT until the end of its remaining lifespan.

8.4.3 Phases 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 will 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 the taxation of eBuses meant for the BRT by exempting them from import duties. 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 with a fuel subsidy for the first 12 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 US$1.36 million.
- **Charging station infrastructure & capacity-building**
  The following costs will be covered through grants from international climate financing agencies:
  - i. the purchase and installation of 50 charging stations for the electric bus fleet, each costing approximately US$10,000 (infrastructure development),
  - ii. capacity development and training for the NAMA, to a tune of approximately US$365,000 (for details see Table 22 and 23 above).

The cost of operations and maintenance (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.

9. NAMA Measurement, Reporting and Verification

9.1 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 benefits 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 use of electric buses on the Galle BRT, and the related anthropogenic emissions by GHG sources and the associated sustainable development benefits 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.

9.2 Measurement and Monitoring of GHG Emissions Reductions

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

9.2.1 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 (CDM, 2015). This methodology was found to be most suitable and appropriate to determine the emissions in the baseline as well as in the 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).

9.2.2 Baseline Emissions (Diesel Fuelled Articulated Buses)

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

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

Table 25. Baseline Emissions

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.

Using the formula 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 (EFBL,km) is determined as follows:

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

Table 26. The Baseline Emission Factor

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 1.
t	—	Year counter for the annual improvement (dependent on age of data per vehicle category)

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

9.2.3 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:

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

Table 27. Project Emissions

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 100.

Using the formula 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 (EFPJ,km,y) is determined as follows:

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

Table 28. The Project Emissions Factor

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	per cent	Average technical transmission and distribution losses for providing electricity in the year y

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

9.2.4 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:

$$ER_y = BE_y - PE_y - LE_y$$

Table 29. Emissions Reduction

Parameter	Unit	Description
ER_y	tCO_2	Emissions reductions in year y
BE_y	tCO_2	Baseline emissions in year y
PE_y	tCO_2	Project emissions in year y
LE_y	tCO_2	Leakage emissions in year y

Since the project activity does not involve any fossil fuel switching measures, leakage calculation is not required and hence "leakage emissions" are 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 decrease of approximately 24 per cent in emissions with respect to the baseline over a period of 10 years. With an increase in the scope and scale of the project, the emission reductions can be expected to increase further.

9.2.5 Measurement and Monitoring

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

Table 30: Monitored Emissions Parameters

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	—

The aforementioned parameters are detailed below.

Table 31. Details of Monitored Emissions Parameters

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 the IPCC Guidelines for National Greenhouse Gas Inventories as well as national energy data sources, such as the 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)

9.3 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.

9.3.1 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.

Table 32. Monitored SD Parameters

Domain	Parameter	Data Unit
Environment	Air pollution (SO_x)	kt/year
Social	Frequency of eBuses along the BRT	Bus/Hour
Growth and Development	Number of eBuses on the BRT	Bus
	Capacity-building (training/outreach programmes 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

Given the absence of a BRT before 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.

Table 33. SD Parameters Baseline and Project Values

Sr. No.	Parameter	Data Unit	Baseline Value	Project Value
1	Air pollution (SO_x)	kt/year	79.3	45
2	Frequency of eBuses along the BRT	Bus/hour	0	30
3	Number of eBuses on the BRT	Bus	0	100
4	Capacity-building	Event	0	22
5	Cost savings from increased energy security	US$/bus	0	30,159
6	Jobs created	Job	0	100
7	Private operators involved	Operator	0	50

9.3.2 Measurement and Monitoring

The SD benefits achieved due to the NAMA need 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.

Table 34. Details of Monitored SD Parameters

Air Pollution

Parameter	Concentration of air pollutants in the atmosphere
Data Unit	kt/year
Description	The amount of pollutants in the atmosphere. In the case of the NAMA intervention, SO_x values will be measured.
Source of Data	Measurement
Frequency	Monthly
Measurement Procedure	Monitor the concentration of pollutants in the atmosphere in and around the BRT

Frequency of eBuses along the BRT

Parameter	Frequency of eBuses
Data Unit	Bus/hour
Description	Number of eBuses available at every stop along 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 operators (NEEs) and the NAMA implementer (NIE)

Capacity building

Parameter	Number of events/programmes 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 the NIE, the 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	US$/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 the 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)

Details of the SD indicators chosen for the Sri Lanka Transport NAMA are provided in Annex C.

9.4 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.

Table 35. Monitored NAMA Support Parameters

International Finance

Parameter	International Financial Support
Data Unit	US$
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	US$
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

9.5 Monitoring, Reporting and Verification (MRV) Management Framework

The main responsibility for the MRV system for the Sri Lanka transport NAMA lies with the Ministry of Mahaweli Development and Environment i.e. the NA. The database and the compliance system will be set up by the NA. The NA may however delegate some of the tasks to the organizations operating the intervention, i.e. the NEEs.

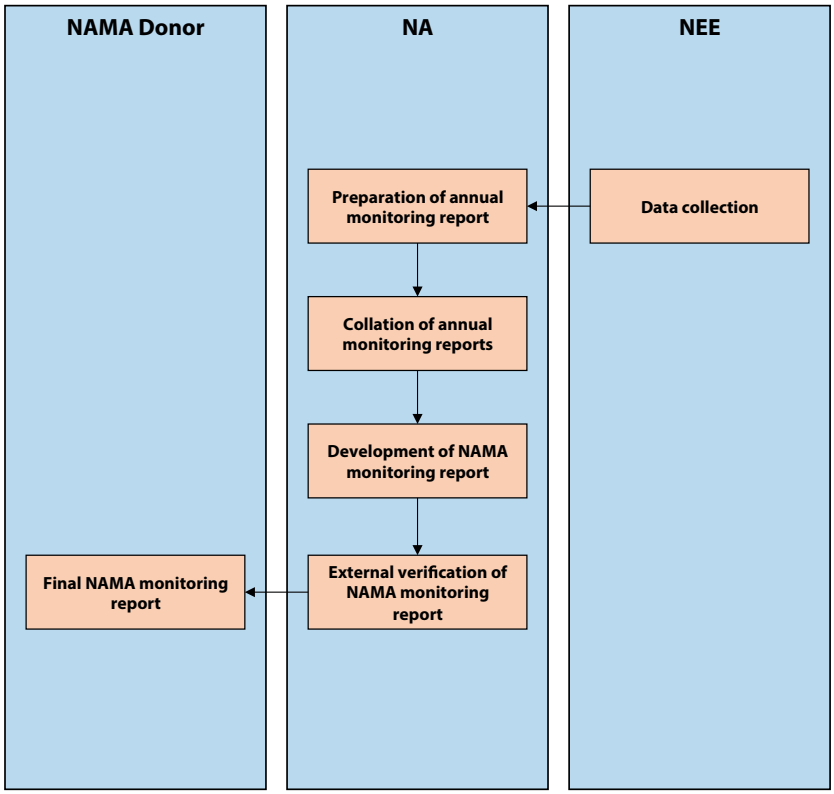
The process flow for the MRV management framework is as follows.

- The monitoring agency, which in the case of the Sri Lanka Transport NAMA is the NA, will collect the data according to the monitoring plan (as part of their approved application), ensuring that they fulfil all related requirements such as record keeping and quality control.
- The NA collects all the data from the various NEEs, 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 on the SD indicators, and the financial performance of the NAMA activities.

- The NA 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).

The following figure illustrates the management flow as described above.

Figure 18. NAMA MRV Management Process Flow



9.6 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.

9.7 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 that 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 are used, but NAMA-specific verification rules should be developed in the future.

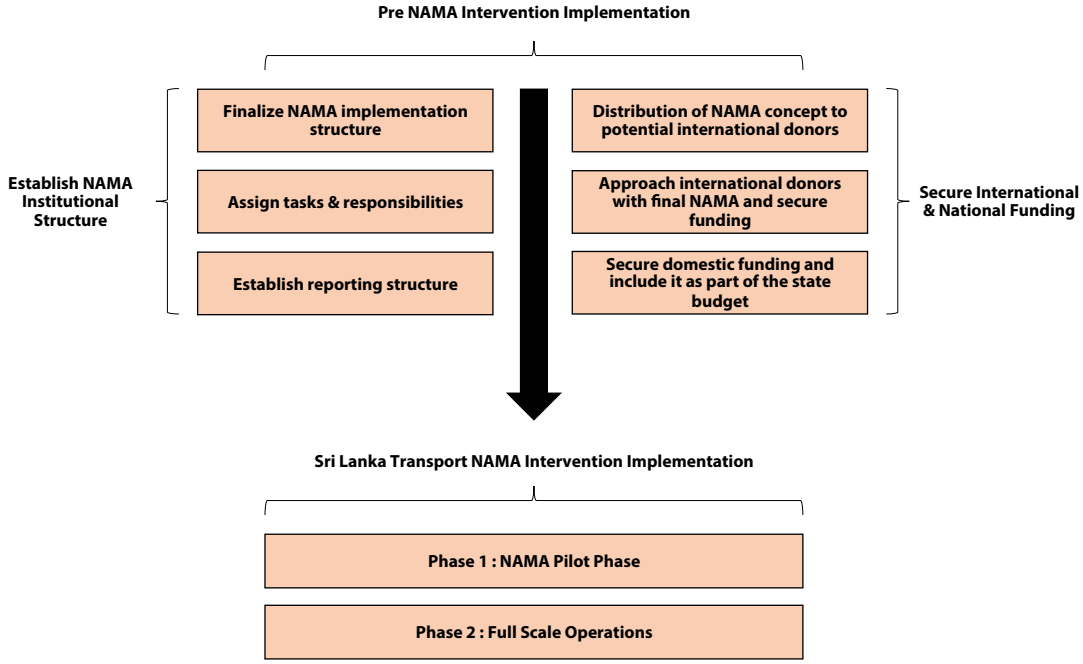
The goal of verification is to have an independent third party auditor ensure that the NAMA is operating as planned and that the measuring and reporting system is being implemented as planned. The verification process also ensures that emissions reductions and SD benefits are real and measurable.

10 The NAMA Implementation Plan

10.1 The 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 19. NAMA Implementation Flow



10.2 Establishing the 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 the NAMA Coordinating Authority (NCA) and the NAMA Implementing Entity (NIE), to the various organizations/ministries as proposed in Chapter 6 – NAMA Implementation Structure.

- **Assignment of tasks and responsibilities**
  Once the roles have been assigned, the jurisdictions, along with associated tasks and responsibilities of each of the NAMA implementation entities, need to be defined and assigned to the concerned entity. These tasks and responsibilities have also been detailed in Chapter 6 – 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 6 – 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.

10.3 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 and in the sector for which the NAMA is being developed. 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, the 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.

10.4 Implementation of the 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 5 – NAMA Technical Intervention (Sections 5.3, 5.4 and 5.5) and Chapter 8 – NAMA Costs and Finance (Section 8.4). The following table gives a summary of the implementation timeline:

Table 36. Sri Lanka Transport NAMA 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																				
11	Announcement of results of bids																				
12	Contract signing																				
13	Release of payment																				

N°	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
14	Purchase and operation of 90 new eBuses (total of 100 eBuses operational)																				

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Annexes

Annex A: Financial Assessment

Parameter	Value	Units	Source
Conventional Articulated Bus			
Investment Cost	195,000	US$	Study of BRT on Galle Road by University of Moratuwa
Life of articulated bus	5	Years	
Fuel cost	50	SLRs/km	
Electric Bus			
Investment Cost per bus	395,000	US$	Estimate for BYD Electric Bus
Additional cost of battery	64,800	US$	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	SLRs/kWh	Estimates from Ceylon Electricity Board
Fuel cost	15.47	SLRs/km	Calculated
Other operating costs			
Driver cost	16.86	SLRs/km	Study of BRT on Galle Road by University of Moratuwa
Maintenance expenses	11.16	SLRs/km	
Road user charges	3.3	SLRs/km	
Yards & Terminals	3.3	SLRs/km	
IT service charge	9.03	SLRs/km	
Fare collection	2.11	SLRs/km	
BRT Agency fee	2.11	SLRs/km	
Regulator fee	0.53	SLRs/km	
Total Operational Cost (Excluding fuel cost)	**48.40**	**SLRs/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	US$	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 (US$)	19,500,000	0	0	0	0	19,500,000	0	0	0	0	0
Operational cost (US$)	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 (US$)	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(US$)	39,500,000	0	0	0	0	64,80,000	0	0	0	0	0
Operational cost (US$)	0	4,227,367	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 (US$)	39,500,000	4,227,367	5,578,553	5,578,553	5,578,553	12,058,553	5,578,553	5,578,553	5,578,553	5,578,553	5,578,553

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 (US$)	20,000,000	-4,367,115	-3,015,930	-3,015,930	-3,015,930	-16,035,930	-3,015,930	-3,015,930	-3,015,930	-3,015,930	-3,015,930
Net present value (NPV)	-12,454,254	US$									
Payback period	< 5	Years									
Total GHG emission reductions	37,159	tCO_2									
Marginal cost of abatement	-335	US$/$tCO_2$									

Annex 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	44,195.86[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	1,315.5

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	1,315.5
Annual average distance travelled (DD)	km	116,456
Number of operational diesel ICE buses (N)	-	100

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, available from http://www.info.energy.gov.lk/, Petroleum Data → Product Specifications

2 IPCC, 2006.

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):

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

Parameters	Unit	Value
Emission factor for electric bus ($EF_{PJ,km,l,y}$)	$kgCO_2/km$	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, available from http://www.byd.com/na/auto/ElectricBus.html

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

Annex 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 by the burning of fossil fuels due to the use of conventional buses. It therefore leads to an increase in 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 the streamlining of traffic in the city, consequently reducing traffic congestion, and 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 their 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 number of air pollution related health issues, such as asthma and other respiratory diseases. The development of the BRT should also lead to the streamlining of traffic in the city leading to a decrease in the number 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 and disadvantaged	The development of a BRT with cheap fares, especially when compared with private means of transportation, increases the level of access offered to vulnerable sections of society, thereby allowing greater development and mobility among these groups.

Domain	Indicator	Relevance to SDG including targets	Effect on indicator	Identified Impacts	Explanation of chosen indicator
Social	Quality of employment	**Promote strong, inclusive and sustainable economic growth and decent work for all**			
		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	Establishing a BRT with electric buses will lead to the growth of ancillary industries for the development and maintenance of electric vehicles, which in turn will lead to an increase in the number 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, consequently decreasing costs, and thus leading to wider 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 ultimately to the 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 in 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, leading to decreasing costs and wider adoption	The development of a successful BRT will require adoption of ICT on a significant scale. This, along with the adoption of electric buses as the NAMA intervention, should provide the impetus for the development of sustainable industries associated with 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 the 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, leading to 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 reduced dependence on imported fossil fuels which in turn provides greater cost savings. These savings can then be funneled into such sectors as education and health. The BRT, if accompanied by removal of inefficient fuel subsidies and by other policies that encourage the development of clean modes of energy, would lead to the development of a cleaner and more 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.			

Domain	Indicator	Relevance to SDG including targets	Effect on indicator	Identified Impacts	Explanation of chosen indicator
Growth & Development	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 in the development and implementation of clean and sustainable projects	The NAMA gives Sri Lanka an opportunity to build up the capacity of its regional and national institutions in the areas of development and implementation of climate change mitigation projects. This will prove beneficial especially for subsequent climate change mitigation projects that Sri Lanka decides to take up. Having already established a strong institutional structure though this NAMA, the benefits that the country can reap from subsequent projects will be higher, especially since it will need to spend less on the development of institutional structures and hence have a larger amount of financing available for 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
Growth & Development	Capacity-Building	**Strengthen and enhance the means of implementation and global partnerships for sustainable development**			
		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.	Positive	Build extensive capacity on both the national and regional levels for the development and implementation of clean and sustainable projects	The NAMA provides Sri Lanka with numerous opportunities to collaborate extensively with international agencies. Sri Lanka can use these opportunities to build capacity in line with the best practices from around the world.
		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.			

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 labour-intensive sectors.	Positive	Lower dependence on imported fossil fuels, increased adoption of the most up-to-date sustainable technologies, leading to greater cost savings and returns over longer periods of time and consequent increased economic growth	The introduction of electric buses in the BRT should lead to the development of ancillary industries built around electric vehicles, which in turn will lead to the creation of a new growth market 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 the most up-to-date sustainable technologies, leading to greater cost savings and returns over longer periods of time and consequently increased economic growth	The BRT will be one of the first key steps towards developing sustainable, clean transportation infrastructure in Sri Lanka.

Domain	Indicator	Relevance to SDG including targets	Effect on indicator	Identified Impacts	Explanation of chosen indicator
Economic	Income generation/ expenditure reduction/ balance of payments	**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 the most up-to-date sustainable technologies leading to greater cost savings and returns over longer periods of time and subsequent increased economic growth	The NAMA will give Sri Lanka manyopportunities to collaborate extensively with and acquire funding from international agencies. Sri Lanka can use these opportunities to understand and utilize best practices from around the world to develop and implement a strong climate change mitigation programme in the form of the transportation NAMA.
		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.			
		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 and 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 associated with the development and maintenance of electric vehicles, which will also lead to increased indigenous research and development and help create conditions which when leveraged efficiently will invite increased public/private investments.

Domain	Indicator	Relevance to SDG including targets	Effect on indicator	Identified Impacts	Explanation of chosen indicator
Economic	Asset accumulation & 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 and increased cost savings/returns, leading to increased accumulation of assets	The NAMA will give Sri Lanka many opportunities to collaborate with international leaders in sustainable development, allowing Sri Lanka to develop a network of global partnerships that it can leverage for further climate change mitigation projects, and 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.			
	Job creation	**Promote strong, inclusive and sustainable economic growth and decent work for all**			
		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 associated with electric vehicles, which in turn will lead to the creation of a new growth market 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 the 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 will also lead to an increase in partnerships between the public and private sectors in the sustainable transport sector, leading to increased sources of finance (private sector) and thus providing alternatives to address the issue of the paucity of financing for sustainable transport initiatives. This model can then also be replicated across the country.

Domain	Indicator	Relevance to SDG including targets	Effect on indicator	Identified Impacts	Explanation of chosen indicator
Institutional	Enabling Policy Environment	17.10 promote a universal, rules-based, open, non-discriminatory and equitable multilateral trading system under the WTO including through the conclusion of negotiations within its Doha Development Agenda	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	The implementation of the NAMA will require a proper organisation structure and management system of the involved entities, i.e. NIE, NEE, NCA
		17.11 significantly increase the exports of developing countries, in particular with a view to doubling the LDC share of global exports by 2020			
		17.13 Enhance global macroeconomic stability including through policy coordination and policy coherence			
		17.14 Enhance policy coherence for sustainable development.			
	Laws & Regulation	**Promote just, peaceful and inclusive societies**			
		16.8 broaden and strengthen the participation of developing countries in the institutions of global governance	Positive	An established operation management system including manuals and process description by NIE, including NEE reporting procedures will enable a proper implementation and monitoring of the interventions	A well designed national operational and management (institutional) structure that ensures that the NAMA is implemented as designed, and monitored, verified and reported on ensuring that the sustainable development impacts are measured and quantified.
		16.10 ensure public access to information and protect fundamental freedoms, in accordance with national legislation and international agreements			

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