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HARMONIZING METHODOLOGIES FOR ASSESSING GREENHOUSE GAS IMPACTS OF POLICIES AND ACTIONS OF TRANSPORT SECTOR IN SRI LANKA

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Deliverable 2

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Climate Smart Initiatives (Pvt) Ltd

March 2019

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PUBLISHED BY

Climate Change Secretariat, Ministry of Mahaweli Development and Environment

Ministry of Transport and Civil Aviation

PREPARED UNDER

Initiative for Climate Action Transparency (ICAT) project supported by the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety, the Children´s Investment Fund Foundation (CIFF), the Italian Ministry for Environment, Land and Sea Protection, and ClimateWorks

The ICAT project is hosted by the United Nations Office for Project Services (UNOPS)

Acknowledgement

According to the Sri Lankan Nationally Determined Contributions (NDCs) submitted by the Government of Sri Lanka to the United Nations Framework Convention on Climate Change (UNFCCC) in 2016, and the Sri Lanka's Readiness Plan for Implementation of Intended Nationally Determined Contributions (INDCs) in 2016, the establishment of a national MRV (Measuring, Reporting & Verification) system is considered as a national priority. Sri Lanka has also to present the status of achieving the NDC goals in 2020. In this context, Sri Lanka has been looking for assistance from various parties to support the establishment of its national MRV system in the transport sector.

This initial report on Assessment of monitoring reporting and verification (MRV) of mitigation actions and institutional arrangement for transport sector in Sri Lanka is the first deliverable of the assignment on developing a national MRV System for Transport Sector in Sri Lanka under the project Initiative for Climate Action Transparency (ICAT). This report was produced under the direct guidance and supervision of Climate Change Secretariat (CCS) of Ministry of Mahaweli Development and Environment (MMDE), Ministry of Transport and Civil Aviation (MTCA), and UNEP DTU Partnership.

To carryout this task, UNEP DTU Partnership awarded a short Term International Consultancy Contract to Climate Smart Initiatives (Pvt) Ltd (ClimateSI). In this regard, Climate Smart Initiatives (Pvt) Ltd wishes to express its gratitude to UNEP DTU partnership and ICAT for facilitating Sri Lanka to develop this national transport sector MRV system.

Our appreciation is also extended to Mr.G.S. Withanage (the secretary of MTCA), Mr. Thilakarathne Banda (additional secretary of MTCA), the heads and the staff of all the institutions under MTCA, the head and staff of CCS, and the heads and the staff of other relevant ministries. We also express our profound thanks to Dr. Sunimal Jayathunga (Director of CCS) and Mr. S.S.A. Kularathne (Director of MTCA) for providing their invaluable guidance, comments and suggestions through out this assignment.

We appreciate the regular guidance, feedback and supervision provided by Fatemeh Bakhtiari (Senior Researcher, UDP) and Subash Dhar (Senior Economist, UDP) in the design and preparation of this report.

Finally, ClimateSI wishes to thank all those who helped and contributed to make this assignment a success.

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Climate Smart Initiatives (Pvt) Ltd.

Sri Lanka.

List of Acronyms

AD	Activity Data
AFOLU	Agriculture, Forestry and Other land Use
BUR	Biennial Update Reports
BAU	Business As Usual
CAGR	Compound Average Growth Rate
CCS	Climate Change Secretariat
CDM	Clean Development Mechanism
CTF	Common Tabular Format
COP	Conference of the Parties
CMA	Conference of the Parties serving as the meeting of the Parties to the Paris Agreement
EDGAR	Emission Database for Global Atmospheric Research
EF	Emission Factor
GEF	Global Environment Facility
GFEI	Global Fuel Efficiency Initiative
GHG	Greenhouse Gas
IPPU	Industrial Processes and Product Use
INDC	Intended Nationally Determined Contribution
IPCC	Intergovernmental Panel on Climate Change
JICA	Japan International Cooperation Agency (Prepared by Japan Weather Association)
LULUCF	Land Use, Land Use Change and Forestry
MMDE	Ministry of Mahaweli Development & Environment
MMWD	Ministry of MegaPolis & Western Development
MoF	Ministry of Finance
MoH	Ministry of Highways
MoPRE	Ministry of Power & Renewable Energy
MoPS	Ministry of Petroleum Resource Development

MTCA	Ministry of Transport & Civil Aviation
MRV	Monitoring, Reporting, and Verification
NAMA	Nationally Appropriate Mitigation Action
NDC	Nationally Determined Contribution
NTC	National Transport Commission
SNC	Second National Communication
UDA	Urban Development Authority
UNFCCC	United Nations Framework Convention on Climate Change

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1. Introduction

1.1. Background

The Paris agreement stipulates that the temperature rise shall be limited to 2^0C compared to pre-industrialization period. Within this context, 178 Parties to the United Nations Framework Convention on Climate Change (UNFCCC) communicated mitigation actions (Nationally determine contributions - NDCs, which consists of mitigation goals, policies and projects). These mitigation actions will support to achieve the expected temperature goal under the Paris agreement. that they will undertake to meet the expected temperature goal under the Paris agreement. Under the Paris Agreement, it was agreed that all countries will provide emissions data and track progress against their contributions. Measurement, reporting and verification (MRV) systems will be a significant component in effectively tracking and improving the implementation of mitigation actions articulated under countries' Nationally Determined Contributions (NDCs) (CDKN Global 2016).

Reiterating the need to build mutual trust and confidence and to promote effective implementation, Article 13 of the Paris Agreement established an enhanced transparency frame-work for action and support. The purpose of the transparency framework of action is to provide a clear understanding of climate change actions taken by countries in light of the objectives of the Convention, including clarity and the tracking of progress towards achieving Parties' individual NDCs. This framework is thus one of the central pillars for enhancing information on NDC implementation and raising the ambition to meet the Paris Agreement's goal of staying well below 2 degrees.

Decision 1/CP.21 states that the modalities, procedures and guidelines of this transparency framework are to build upon and eventually supersede the measurement, reporting and verification (MRV) system established under COP-16 in Cancun and COP-17 in Durban. The existing MRV arrangements agreed during these COPs will thus form the basis for the new enhanced transparency framework.

Article 4 on mitigation and NDCs states that the Parties shall account for their NDCs and that, in communicating them, they must provide all the information necessary for clarity, transparency and understanding. In this context, Article 13 prompts the conclusion that, under this framework, countries will have to monitor and report information on their mitigation actions in a way that provides clarity and allows the level of progress made in achieving the mitigation targets specified in their NDCs to be tracked.

1.1.1 National GHG Emissions

According to Sri Lanka's second national communication (SNC) total GHG emissions excluding Land Use Change and Forestry (LUCF) in 2000 was approximately 19 MtCO2e, which represented less than 0.1% of global emissions (EDGAR, 2017). As per SNC, Carbon Dioxide (CO_2) emissions have shown the highest contribution (58% of total GHG emissions in 2000), which is followed by Methane (CH_4) and Nitrous Oxide (N_2O) (36% and 6% of emissions in 2000 respectively).

As shown in table 1, the energy sector, which includes the transport sector emissions as well, has the largest share of total national GHG emissions (61.4% of total national emissions in 2000).

Table 1: Breakdown of GHG emissions by sector[1]

Sector	$MtCO_2e$ in year 2000 (CO_2, CH_4 and N_2O)	%
Energy (Power, Transport, Energy use in Industry)	11.562	61.4%
Industry	0.492	2.6%
Agriculture	4.709	25.0%
Land Use Change & Forestry	0.045	0.2%
Waste	2.033	10.8%

Source: Second national communication 2012, MMDE

1.1.2 GHG Emissions in transport sector

Sri Lanka's transport sector GHG emissions is growing rapidly and it is 5 $MtCO_2e$, which represents 35% of Sri Lanka's net total CO_2e emissions, and almost half of the emissions from the energy sector in the year 2000. The majority of emissions come from road transport, representing 88% of total CO_2e emissions from the transport sector.

Table 2. Breakdown of emissions in transport sector by emission type and sub-sector in 2000[2]

Sub-sector	Emissions ($MtCO_2e$) in the year 2000						
	CO_2	CH_4	N_2O	CO	NOx	NMVOC	SO_2
Road Transport	4.444	0.00047	0.00004	0.131	0.047	0.025	0.0075
Railway Transport	0.080	0.00001	0	0.0001	0.001	0.00022	0.00015
Air Transport	0.497	0	0.00001	0.0007	0.002	0.00035	0.00016
Sea Transport	0.037	0	0	0.0005	0.00075	0.0001	0.00017
Total	***5.058***	***0.00048***	***0.00005***	***0.134***	***0.051***	***0.025***	***0.008***

Source: Second national communication 2012, MMDE

1.1.3 NDCs of Sri Lanka

While Sri Lanka takes adaptation measures as a priority given its high vulnerability to climate change, the country is committed to contribute to global mitigation efforts. Sri Lanka has put forth two key goals for climate change mitigation as part of its NDCs submitted in accordance with the Paris Agreement under UNFCCC:

- Reduce GHG emissions in the energy sector against the Business-As-Usual (BAU) scenario by 4% unconditionally and an additional 16% conditionally by 2030
- Reduce GHG emissions against BAU scenario by 10% in other sectors (transport, forests, industries and waste) by 3% unconditionally and an additional 7% conditionally by 2030

[1] ClimateSI converted the original figures, which were in Gg, to Mt.

Sri Lankan NDCs cover five main sectors: energy, transport, industry, forestry and waste, and it was submitted to UNFCCC in April 2016. In addition, "Readiness Plan for Implementation of INDCs" was also prepared by MMDE in 2016 to facilitate the implementation process of NDCs by identifying policy and institutional gaps, as well as technical capacity and resources required to implement the NDCs.

1.1.4 Transport sector NDCs

Sri Lankan NDCs related to transport sector consists of eleven main NDCs and thirty one sub NDCs. The main NDCs are listed here.

1. Establish energy efficient and environmentally sustainable transport systems by 2030.
2. Upgrade of Fuel Quality Standards (FQS) to reduce harmful emissions that cause environmental pollution and health hazards.
3. Reduce unproductive transport systems from current usage.
4. Shift passengers from private to public transport modes.
5. Enhance the efficiency and quality of public transport modes.
6. Reduction of GHG emissions in the maritime sector.
7. Gazette new emission standards to reduce GHG emissions.
8. Encourage and introduce low emission vehicles such as electric and hybrid.
9. Reduce traffic congestion in order to reduce GHG emission.
10. Reduction of GHG emissions in the aviation sector.
11. Establishment of a database management system for monitoring NDCs of transport sector.

1.2. Objectives & Outcomes

This report on harmonizing methodologies for assessing greenhouse gas impacts of policies and actions of transport sector in Sri Lanka is the second report in a series of reports prepared to achieve the objectives of the ICAT and its assistance in developing national MRV system for the transport sector in Sri Lanka.

Objective of the Initiative for Climate Action Transparency (ICAT)

Monitoring, reporting and verification of the progress on NDC implementation is needed to meet country's international reporting requirements, and "to build mutual trust and confidence and to promote effective implementation, an enhanced transparency framework for action and support, with built-in flexibility which takes into account Parties' different capacities and builds upon collective experience." (Article 13.1 of the Paris agreement). MRV of NDCs is also important to meet domestic requirements. These could include reports: (a) to the parliament and the public in order to improve transparency; and (b) to policy-makers informing decisions on changes to the existing mitigation or adaptation actions. ICAT was founded to respond to these critical need to support improved transparency and capacity building under the Paris Agreement. The primary objectives of ICAT are to;

a) Strengthen institutional and human capacities in countries to develop and implement domestic system to MRV mitigation policies and actions (MPAs); and

b) Develop tools and guidance that can be used for an effective system for MRV MPAs implementation.

In order to achieve these objectives in the implementing countries, ICAT has three implementing partners: UNEP DTU Partnership; Voluntary Carbon Standard (VERRA); and World Resource Institute (WRI). Roles of the implementing partners are to coordinate with the implementing country, and the selected consultants to achieve the objectives of ICAT project in the implementing country.

Objective of ICAT project in Sri Lanka

With the view of achieving above mentioned objectives, the ICAT agreed to facilitate building a national MRV system for Sri Lankan transport sector based on a request from Sri Lanka. During a stakeholder consultation held in Sri Lanka, it was identified that Sri Lanka does not have a transport sectorMRV system. Most of the experience in the MRV area is limited to energy sector. In addition, there are some ongoing MRV activities in energy sector under energy NAMA coordinated by UNDP Sri Lanka. However, there were not many MRV related activities in transport sector, which represents 50% of energy sector emissions. Further the transport sector is becoming the largest GHG contributor in Sri Lanka due to the rapid growth in the sector. In order to address this rapid growth of transport sector emissions and to meet the international obligation on reporting the status of achieving transport sector NDCs, it is vital to develop an affective national MRV system. As such, it was agreed between Climate Change Secretariat (CCS) under the Ministry of Mahaweli Development & Environment (MMDE), Ministry of Transport & Civil Aviation (MTCA), and UNEP DTU Partnership to prioritize the development of MRV system for the transport sector.

Objective of the ICAT project in Sri Lanka is to fill the gaps of MRV and institutional needs for reporting of NDCs by developing an affective national MRV system through enhancing existing institutional set up for the transport sector NDCs.

The assignment will focus on reviewing existing MRV and institutional arrangement within transport sector, identification of appropriate methodologies to measure GHG impacts of prioritized NDCs, design of MRV system, which includes: establishing institutional arrangement (roles an responsibilities, reporting channel), designing data management system, developing reporting templates; and identifying necessary legal arrangements. This will facilitate a robust and continuous national MRV system. The consultant will work in close cooperation with National Focal Point, UDP representative and national experts to deliver the expected output.

Output of ICAT project in Sri Lanka

i. A report on the assessment of existing MRV & Institutional arrangement in transport sector

ii. A report on selected methodologies for assessing the impacts of GHG emissions on transport sector policies and actions

iii. A report on designing MRV system and establishment of roles & responsibilities for transport sector

1.3. What is a MRV system?

According to the Bali action plan which brought about the term MRV, climate change mitigation actions, mainly GHG emission reductions shall be implemented in a measurable, reportable and verifiable manner. Measurement, Reporting and Verification (MRV)[2] are key elements for: (a) ensuring greater transparency, accuracy and comparability of information with regard to climate change in order to identify good practice, foster a learning process, and allow an international bench marking; (b) recognition and visibility of mitigation achievements to raise ambitions of other countries; (c) attribution of quantified impacts to policies; (d) accounting national and international progress; (e) identifying gaps and international support needs; and (f) creating access to international public and private finance.

According to the "handbook on Measurement Reporting and Verification for developing country parties"[3] published by UNFCCC, MRV is applied in three areas:

(a) MRV of emissions (estimation of emissions at national, regional, sectoral levels);

(b) MRV of NAMAs (MRV of the impacts of mitigation policies and actions); and

(c) MRV of support (MRV of financial flows/technology transfer/capacity building and their impacts).

[2] Page 18 of https://www.transparency-partnership.net/system/files/document/mrv-tool-4-2.pptx__0.pdf

[3] https://unfccc.int/files/national_reports/annex_i_natcom_/application/pdf/non-annex_i_mrv_handbook.pdf

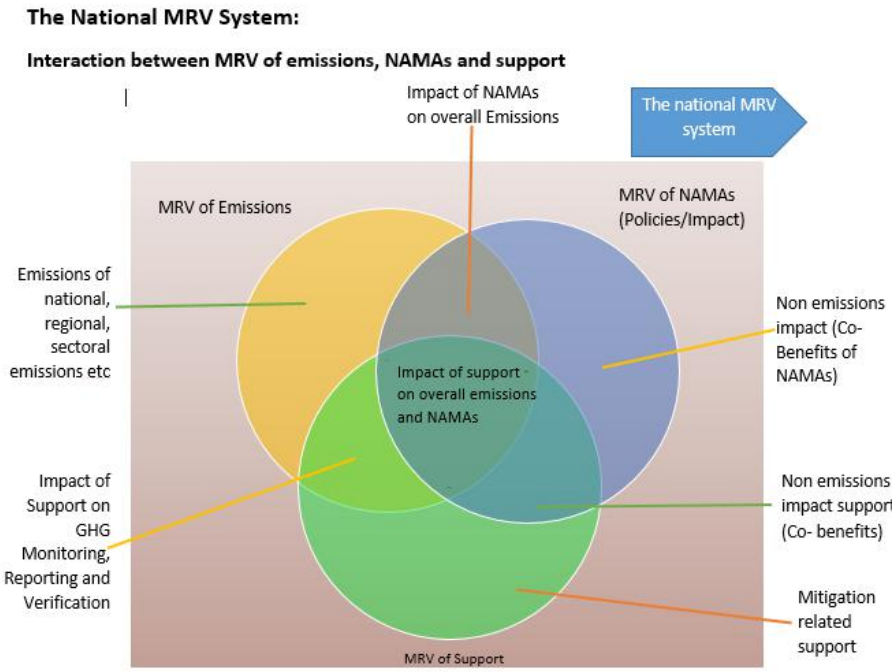

Figure 1: Interaction between MRV of emissions, NAMAs and support adapted from "Handbook on Measurement Reporting and Verification for developing country parties, 2014

- ✓ MRV of GHG emissions refers to estimating, report-ing, and verifying actual emissions over a defined period of time. This type of MRV can be performed at national level, or by organizations and facilities. For example, national GHG inventories include an account of emissions from a country for a particular period, are reported to UNFCCC, and undergo some form of review.
- ✓ MRV of mitigation actions involves assessing (ex-ante or ex-post) GHG emissions reductions and/or sustainable development (non-GHG) effects of policies, projects, and actions, as well as monitoring their implementation progress. It also involves assessing progress toward mitigation goals. An example would be a national government estimating the GHG and job growth-related impacts of its home insulation subsidy program. While MRV of GHG emissions measures actual emissions, MRV of mitigation actions estimates the change in emissions and other non-GHG variables that results from those actions.
- ✓ MRV of support focuses on monitoring the provision and receipt of financial flows, technical knowledge, and capacity building, and evaluating the results and impact of support. An example of this kind of MRV would be developing countries tracking climate-specific finance received through bilateral or multi-lateral channels.

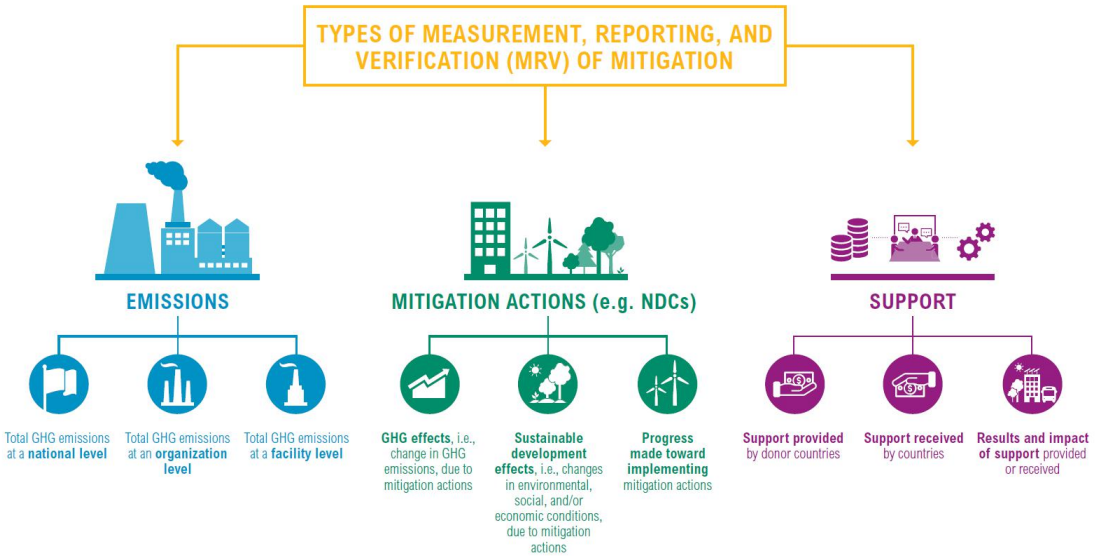

Figure 2: Various Types of Mitigation-related MRV, Source: MRV 101: Understanding measurement, reporting, and verification of climate change mitigation by WRI, 2016

MRV of mitigation actions

Mitigation action refers to national interventions and commitments, such as goals[4], policies[5] and projects[6], undertaken by a government to reduce GHG emissions. In Sri Lanka context, mitigation actions will be the NDCs communicated by Sri Lankan goverment to UNFCCC in 2016. MRV of mitigation actions generally includes estimating, reporting, and verifying their GHG and sustainable development effects, as well as monitoring their implementation.

MRV of mitigation actions involves an assessment of the effects and implementation progress associated with mitigation actions:

- **GHG effects** refer to actual or projected changes in GHG emissions and removals—as opposed to absolute levels of emissions and removals—due to the implementation of mitigation actions. MRV of GHG effects involves estimating changes in emissions resulting from all significant GHG effects of a mitigation action.

- **Sustainable development effects** refer to changes in environmental, social, and/or economic conditions that occur as a result of mitigation actions.

- **Implementation progress** refers to monitoring, reporting, and verifying conformity with agreed modalities and approaches, and assessing progress made toward the implementation of a mitigation action.

[4] A commitment by an entity to reduce, limit the increase of, or enhance the removal of GHG emissions, or to reduce GHG emissions intensity by a specified quantity, to be achieved by a future date.

[5] Interventions to reduce GHG emissions made or mandated by a government, institution, or other entity, and may include: laws, directives, and decrees; regulations and standards; taxes, charges, subsidies and incentives; information instruments; voluntary agreements; implementation of new technologies, processes, or practices; and public or private sector financing and investment.

[6] Aspecific activity or set of activities intended to reduce GHG emissions, increase the storage of carbon, or enhance GHG removals from the atmosphere.

1.4. Scope

Scope of this report, which is the second of three reports on building national MRV system for transport sector of Sri Lanka, is to: (a) select methodologies for assessing the impacts of GHG emissions on transport sector policies and actions; and (b) to present the explicit gaps within the available methodologies.

1.5. Limitations

There are 11 NDCs and 31 sub NDCs for the transport sector. However, it is not possible to cover all NDCs and sub NDCs due to the limited time and budget. As such, CCS & MTCA together with UNEP DTU Partnership agreed to prioritize the NDCs and Sub NDCs based on a quantitative method, which has been explained in the first of three reports on building national MRV system for transport sector of Sri Lanka.

While selecting the methodologies to measure the GHG effects of policy and actions, the priority was given to UNFCCC CDM methodologies for project related methodologies and ICAT methodologies for policy related methodologies. When there are difficulties to apply such methodologies, other methodologies such as JICA and IPCC quantification approaches were used.

1.6. Methodology

The assessment is conducted in four steps. First, desk review of existing transport sector MRV methodologies and tools[7] relevant to prioritized NDCs is conducted using the publicly available data. Secondly, those identified methodologies were reviewed using nine criteria[8]. Thirdly, one methodology for each prioritized sub NDC was selected based on its merit. Finally, stakeholder consultation[9] was held to build capacities of relevant stakeholders on how to use the selected methodologies.

Methodology to identify prioritized mitigation actions

In order to identify the prioritized mitigation actions (policies and projects for each prioritized NDCs), two criteria (likelihood of the implementation, data availability) will be applied. Then, each criteria will be given a weight between 1 (least possibility) and 5 (highest possibility) with a discussion between MTCA, CCS of MMDE and ClimateSI (the consultant). In addition, selection of the prioritized mitigation actions will be further validated during workshop held for all institutions under MTCA and CCS of MMDE. Please refer to annex 4 for further information on the identification of prioritized mitigation actions.

7 Annex 1: List of transport sector methodologies reviewed.

8 Annex 2: The criteria used to assess and select most appropriate methodologies.

9 Annex 3: List of institutions to build the capacity building on the methodologies

2. Selecting MRV standard in the transport sector

2.1. Mapping methodologies for MRV of transport sector

In order to track the progress of achieving the NDCs, in particular, mitigation actions (policy and projects), it is important to establish an appropriate MRV system for measuring the GHG effects of those mitigation actions. As such, the general assessment was conducted to identify the MRV methods, which have been developed to measure the GHG effects of mitigation actions.

As shown in table 1, there are different MRV methods to measure the GHG effects of mitigation actions.

Table 1: Methods for MRV of Mitigation Actions

Type of MRV	MEASUREMENT		REPORTING	VERIFICATON
	Method	**Data Requirements**		
GHG effects	**For mitigation goals and policies:** ■ *GHG Protocol Mitigation Goal Standard for mitigation goals set by governments* ■ *GHG Protocol Policy and Action Standard for mitigation policies* ■ *Guidance to be developed for tracking of nationally determined contributions by countries as per the Paris Agreement* **For mitigation projects:** ■ *Methodological guidance developed under the Clean Development Mechanism (CDM)* ■ *GHG Protocol Project Standard* ■ *Gold Standard* ■ *Verified Carbon Standard (VCS)*	**For mitigation goals:** ■ *National GHG inventory* ■ *Other data requirements may include data on emissions and removals from the land sector, transferable emissions units (e.g., carbon credits and tradable allowances), depending on the kind of goal* **For mitigation policies and projects:** ■ *Defined by GHG emissions quantification method and the policy / project type* ■ *Typical include activity data, emission factors, and socio-economic data*	■ *To domestic stakeholders* ■ *To the UNFCCC as part of National Communications, Biennial Reports, and/or Biennial Update Reports* ■ *To donors supporting the implementation of goals, policies, and projects* ■ *Any reporting requirements developed in future as per Paris Agreement for post-2020 contributions* **For mitigation projects:** ■ *To the relevant program (e.g., CDM or emissions trading program) under which the project has been undertaken*	■ *May be prescribed by domestic laws* ■ *Under the UNFCCC, review is carried out as part of International Consultation and Analysis (ICA) and International Assessment and Review (IAR) processes* ■ *The Paris Agreement sets up a technical expert review process for the information provided by countries* ■ *For credited mitigation projects, verification prescribed by crediting scheme (e.g. CDM, VCS, Climate Action Reserve (CAR))*

Source: MRV 101: Understanding measurement, reporting, and verification of climate change mitigation by WRI, 2016

2.2. Prioritized transport sector mitigation actions (polices and projects)

As described in the first report of the assignment, "Assessment on MRV and Institutional arrangement of transport sector in Sri Lanka", five NDcs and 11 sub NDCs were prioritized in order to develop a transport sector MRV system in Sri Lanka. Further aforementioned report also list the policies and projects with respect to the implementation of the prioritized NDCs and sub NDCs.

Following the approach proposed under the methodology sub section of this report (sub section 1.6), few mitigation actions (projects and policies) were prioritized in order to select appropriate GHG methodology to assess GHG effects of those mitigation actions. Annex 4 of this report stipulated the the prioritization process. Summary of the prioritized mitigation actions under each sub NDC can be found in Table 2.

Each sub NDC can have two selected methodologies: policy related methodology; and project related methodology. Those selected methodology can be used to quantify the GHG effects of any policy (with policy related methodology) or any project (with project related methodology) under the prioritized sub NDC. Any project and another one for project. Same methodology for policySince the mitigation actions under each sub NDC can use same methodology. The selected mitigation actions will be used under the 3rd deliverable, "A report on designing MRV system and establishment of roles & responsibilities for transport sector", to quantify the GHG effects of those identified mitigation actions. In addition, these selected mitigation actions will be used in this report to assess the data availability in order to quantify GHG effects.

Table 2: Summary of prioritized transport sector mitigation actions (policies and projects)

Category	NDC	Sub NDC	Policy	Project
Traffic management	4 - Passenger shift from private to public	4.1: Introduced park & ride system	Establish multi-modal transport centers with park and ride facilities (Vision 2025, National transport policy 2009)	**1. Introduce park & ride system near RTS Stations for easy access - LRT Line** 2. Introduce park & ride system near express way 3. Park & ride system at Multi -modal Transport Hubs 4. Park & ride system connect to Cycle paths
	9 - Freight shift from Road to Rail	9.4: Transport of heavy loads by railway	Deregulation of freight tariff (National transport policy 2009)	1. Prima flour transportation Transportation of 15000 tons of flour by train per month using 15 wagons from china harbor to Galle and Seeduwa as per the agreement signed on 27.06.2017. 2. Holicim Lanka Pvt. (2015) Coal transportation from railway station of China harbor to Maho railway station 3. Lime stones

				The right to use the rail track for the transport of lime - stones using their own locomotives and wagons from Aruwakkalu. Railway also provides locomotives on hire to the Company to transport lime stones **4. <u>Petroleum products</u>** From main installations to Bulk depots
Improving the railway system	5 - Improving efficiency of railway system	5.1: Electrification of railway	Electrification of railway (Vision 2025, National transport policy 2009)	**1. Electrification of Panadura - Veyangoda railway line**
		5.2: Purchasing new (improved) rolling stocks		**1. Procurement of 06 Power sets,** 2. Procurement of 10 Locomotives, 3. Procurement of 9 Power sets and 12 Locomotives for upgrade the up Country Train service, 4. Rehabilitation of 200 abandoned carriages with the assistance of private sector
Improving the road transport	8 – Introduce electric vehicles	8.3: Introduce electric buses 8.4: Introduce other electrified vehicles such as cars	1. Introduce electric vehicles (Presidential Manifesto 2015, Vision 2025, National transport policy 2009) 2. **Import tax for electric vehicles** will be reduced while same for fossil fuel vehicles will be increased (only for cars and three wheeler, Presidential Manifesto 2015, Vision 2025, National transport policy 2009, budget 2018). 3. **Carbon tax based on the age of the vehicles and the engine capacity (budget).**	1. **1 Introduce 15 electric buses (budget 2018)** 1.2 Introduce 250 electric and 750 hybrid buses in main towns in western province and expressway (reference?) 2.1 Tax reduction for electric cars 2.2 Tax increase for fossil fuel cars and diesel three wheel. 3.1 Apply annual carbon tax for motor cycle (Rs. 0.5/cubcm3 less than 5 years), cars (Rs. 0.5/cubcm3 less than 5 years), passenger buses (Rs. 1000 for less than years) while electric vehicles do not have to pay carbon tax
Improving	7 –	7.1-7.4	1. Original emission standard	

the regulations	Introduce new emission standards		was introduced in 2008 2. **Original emission standard was amended in 2015**	

Source: Assessment on MRV and Institutional arrangement of transport sector in Sri Lanka, 2019

2.3. Identifying methodologies for assessing GHG effects of mitigation actions relevant to prioritized NDCs

After identifying prioritized NDCs and sub NDCs under 1st deliverable (A report on the assessment of existing MRV & Institutional arrangement in transport sector) and prioritized mitigation actions in the previous sub section of this report, the methodologies/guidance/manuals available for those prioritized mitigation actions were explored. Table 2 lists those methodologies available for each prioritized sub NDC.

Table 2: List of relevant transport sector MRV standard/guidance

NDC	Sub NDC	Policy/ Project	Methodology/Guidance/manual/etc
4 - Passenger shift from private to public	4.1: Park & ride[10]	Project - LRT line	JICA- Transport / Railway (Passenger) / Modal Shift ACM0016: Mass Rapid Transit Projects --- Version 4.0
9 - Freight shift from Road to Rail	9.4: Transport of heavy loads by railway	Project	UNFCCC CDM AM0090: Modal shift in transportation of cargo from road transportation to water or rail transportation - version 1.1.0
5 - Improving efficiency of railway system	5.1: Electrification of railway	Project	Transport / Railway (Passenger) / Electrification JICA Climate-FIT Version 2.0, March 2014
	5.2: Purchasing new (improved) rolling stocks	Project	JICA - Transport / Railway (Passenger) / Modal Shift
8 – Introduce electric vehicles	8.3: Introduce electric buses	Project	UNFCCC CDM AMS III.C - Emission reductions by electric and hybrid vehicles - version 15.0
	8.4: Introduce other electrified vehicles such as cars	Policy	ICAT Transport Pricing Guidance
7 – Introduce new emission standards	7.1-7.4	Policy	IPCC Methodology

[10] The park and ride is a sub component of the mass transit. Almost all proposed park and ride system in Sri Lanka is a part of mass transit, in particular, light railway transit (LRT). further there are no methodologies to quantify the GHG effects of only the park and ride. As such, here we intend to measure the GHG effects of entire mass transit system (LRT) without limiting it to the park and ride.

All prioritized sub NDCs have at least one MRV methodology to quantify the GHG effects while sub NDC 4.1 has two MRV methodologies. In the following tables, each identified methodology will be reviewed against the nine criteria listed in annex 2 in order to select the appropriate methodology for each sub NDC. Table 3 demonstrates the assessment of two MRV methodologies available for sub NDC 4.1 against the nine criteria listed in annex 2 in order to select most appropriate methodology. Except sub NDC 4.1, only one MRV methodology is available for each sub NDC. Though the assessments were conducted against nine criteria listed in annex 2, the available methodology will be used to quantify the GHG effects after understanding its strengths and weaknesses. Assessments of MRV methodologies for remaining sub NDCs (except for sub NDC 4.1) is in annex 5.

Assessing the MRV standard/guidance against nine criteria

Table 3 : Assessing the MRV standard/guidance for park and ride (light railway transit) under sub NDC 4.1

MRV Guidance/Methodology	CDM : ACM0016 Large-scale Consolidated Methodology: Mass rapid transit projects_Version 04.0	JICA : JICA- Transport / Railway (Passenger) / Modal Shift
Scope or Purpose	The scope of this methodology includes the establishment and operation of rail-based or bus-based mass rapid transit systems (MRTS) in urban or suburban districts of a host city.	This provides guidance to estimate **baseline and project emissions** for passenger modal shift from existing transport modes to MRT, monorail, LRT, BRT and trunk bus.
GHG Assessment Boundary	➢ The spatial extent of the project boundary encompasses the larger urban zone of the city in which the project takes place. ➢ The project only includes emission reductions from the MRTS lanes ➢ The project boundary also includes the power plants connected physically to the electricity system that supply power to the project, and/or the captive	The **physical boundary for estimating GHG emissions includes the operation of MRT (Mass Rapid Transit)** etc.

			power plant.	
Estimating Baseline Scenario		Parameters	Baseline BE_{py} : Baseline emissions per surveyed passenger *p* in year *y* (t CO2) $FEX_{p,y}$: Expansion factor for each surveyed passenger *p* surveyed in year *y* (each surveyed passenger has a different expansion factor) P_y : Total number of passengers in year y P_{SPER} : Number of passengers in the time period of the survey (1 week) P : Surveyed passenger (each individual) Y : Year of the crediting period Calculating BE_{py} $EF_{pkm,i,y}$: Emission factor per passenger-kilometer of mode *i* in year *y* (g CO2/pkm) $BTD_{P,y,i}$: Baseline trip distance per surveyed passenger *p* using mode *i* in year *y* (pkm) i : Relevant vehicle category	BPKMy : Passenger transportation volume/activity by the project in year y (passenger-km/y) Py : Number of passengers transported by the project in year y (passenger/y) BTDPy : Average trip distance of the passenger of the project activity in year y (km) MSi,y : Share of passengers by transport mode i in the baseline scenario in year y (%) EFPKM,i : CO2emission factor per passenger kilometer for transport mode i (t-CO2/passenger-km) $EF_{PKM,i} = (EF_{KM,i} / OR_i)$ EFKM,i : CO2 emission factor of transport mode i (t-CO2/km) ORi : Average occupation rate of transport mode i (passenger/vehicle)
Estimating Project Scenario	Ex-ante	Parameters	Project DPE_y : Direct project emissions in year *y* (t CO2) IPE_y : Indirect project emissions in year *y* (t CO2) Direct project emission (DPE_y) $EC_{PJ,j,y}$: Quantity of electricity consumed by the project	ECPJ,y: Electricity consumption associated with the operation of the project activity in year y (MWh/y) EFelec: CO2emission factor of the grid electricity(t-CO2/MWh)

			electricity consumption source *j* in year *y* (MWh/yr) $EF_{EL,j,y}$: Emission factor for electricity generation for source *j* in year *y* (tCO_2/MWh) $TDL_{j,y}$: Average technical transmission and distribution losses for providing electricity to source *j* in year *y* j : Sources of electricity consumption in the project <u>Indirect project emission (IPE_y)</u> $IPE_{p,y}$: Indirect project emissions per surveyed passenger *p* in year *y* (g CO2) $FEX_{p,y}$: Expansion factor for each surveyed passenger *p* in year *y* P_y : Total number of passengers in year y P_{SPER} : Number of passengers in the time period of the survey (1 week) P : Surveyed passenger (each individual) Y : Year of the crediting period <u>Calculating IPE_{py}</u> $EF_{pkm,i,y}$: Emission factor per passenger-kilometer of mode *i* in year *y* (g CO2/pkm) $IPTD_{P,y,i}$: Indirect project trip distance per surveyed passenger *p* using mode *i* in year *y* (pkm) i : Relevant vehicle category	

Availability of emission factor data base	Country specific values /IPCC default values in 2006 IPCC Guidelines on National GHG Inventories	Default factors JICA Climate-FIT Version 2.0, March 2014 Appendix tables 1,2,3 and 7
Monitoring Framework	The requirement for monitoring framework describe in the methodology under chapter 6. Other necessary guidelines are given under appendix.	Not discussed
Reporting Framework	CDM Standard reporting formats to UNFCCC	Not discussed
Verification Framework	Standard CDM verification procedure	Not discussed
Strength/Advantages	Indirect project emission also consider when calculating total project emission	
Weaknesses	Require more data and parameters to measure GHG effects.	Absence of reporting and monitoring frame work

2.4. Selecting appropriate MRV standard to identify the GHG impact for Sri Lanka

In sub section 2.3, transport MRV methodologies were analyzed and reviewed against 9 criteria listed in annex 2. Then most appropriate methodology was selected based on the strengths, weaknesses, and international recognition. When there is UNFCCC CDM methodology is available to measure the GHG effects of mitigation action, UNFCCC CDM methodology was used by default as it has high level of international recognition against other methodologies. Based on this analysis, table 4 provides a detailed list of methodologies selected.

Table 4: Detailed list of selected MRV standard/guidance

NDC	Sub NDC	Policy/ Project	Mitigation action	Methodology/Guidance/manual/etc
4 - Passenger shift from private to public	4.1: Park & ride	Project	Light Rail Transit System with park and ride facilities	ACM0016: Mass Rapid Transit Projects Version 4.0
9 - Freight shift from Road to Rail	9.4: Transport of heavy loads by railway	Project	Transporting Petroleum products via train from main installations to Bulk depots	UNFCCC CDM AM0090: Modal shift in transportation of cargo from road transportation to water or rail transportation - version 1.1.0
5 - Improving efficiency of railway system	5.1: Electrification of railway	Project	Electrification of Panadura - Veyangoda railway line	Transport / Railway (Passenger) / Electrification JICA Climate-FIT Version 2.0, March 2014
	5.2: Purchasing new (improved) rolling stocks	Project	Procurement of 06 Power sets	JICA - Transport / Railway (Passenger) / Modal Shift
8 – Introduce electric vehicles	8.3: Introduce electric buses	Project	Introduce 50 electric buses (budget 2018)	UNFCCC CDM AMS III.C - Emission reductions by electric and hybrid vehicles - version 15.0
	8.4: Introduce other electrified vehicles such as cars	Policy	Reduction of Import tax for electric vehicles Introducing carbon tax for the vehicles	ICAT Transport Pricing Guidance
7 – Introduce new emission standards	7.1-7.4	Project	Amendment to emission standard in 2015	IPCC Methodology

In addition to selecting the appropriate MRV methodologies to quantify the GHG effects, the parameters required and the sources for these parameters were also identified as part of this assessment. Annex 7 provides the information on the relevant parameters and their source.

3. Conclusion and next steps

Based on the analysis of this report, methodologies listed in table 5 were identified to quantify the GHG effects of the mitigation actions under the prioritized NDCs.

Table 5: Summary of the selected methodologies

Selected NDC	ICAT - Transport Pricing Guidance	UNFCCC CDM AMS III.C	UNFCC CDM : ACM0016	JICA- Transport / Railway (Passenger) / Modal Shift	JICA - Transport / Railway (Passenger) / Electrification	UNFCCC CDM AM00090	IPCC Methodology
4.1			√				
5.1					√		
5.2				√			
7							√
8.3		√					
8.4	√						
9.4						√	

For 7 prioritized sub NDCs need 7 different MRV standards, which consists of the standards/guidance from ICAT (1), UNFCCC CDM (3), JICA (2) and IPCC (1). In addition to identifying the prioritized MRV standards/guidance, the analysis also found the parameters required to assess the GHG effects and its sources for prioritized mitigation actions.

However, there are few methodological gaps that were identified during this assessment as described below:

Methodological gaps:

- ✓ ICAT pricing guidance: ICAT pricing guidance can be applied to quantify GHG effects of two policies: financial incentives to encourage EV imports; and financial disincentives to discourage old, fossil fuel based vehicles (carbon tax). However, this guidance can apply only one policy at a time to quantify the GHG effects. As such, this can lead to double counting of emissions when there is more than one GHG reduction policy in the transport sector. Therefore, we expect to apply only one GHG reduction policy, "financial incentives o encourage EV imports" while other policy will be included while the methodology issue is resolved or developing sectoral baseline using GACMO model. Please refer to annex 7 for more information.
- ✓ IPCC methodology: To quantify the GHG effects when a country introduce an emission standard/amendment to the emissions standards is not available. Further IPCC Tier 1,2 and 3

approach to quantify the GHG effects of mobile combustion (Tier 1: Emission = Fuel sold * emission factor of fuel from equation 3.2.1, Tier 2: same as previous equation with county specific emission factor from equation 3.2.4, and Tier 3: Emission = distance * emission factor + emission during warm up from equation 3.2.5), can not be directly applied to quantify the GHG effects when the country introduced an amendment to the emission standards. Through the Vehicle Emission Testing (VET) programme under the Ministry of Transport and Civil Aviation (MTCA), CO2 emissions and fuel type of each vehicle were available for several vehicles. Then, we managed to improve the IPCC Tier 2 equation in order to quantify the GHG emissions at vehicle level for an identified sample of vehicles which have undertaken the vehicle emission test.

Following equation derived from IPCC Tier 2 approach by ClimateSI will be used to quantify GHG when Sri Lanka introduced amendment to the vehicle emission standards.

$$CO_2 \text{ emissions (Kg)} = \left(\left(\frac{V\ CO_2}{V\ Exhaust} \right) * \left(\frac{D\ CO_2}{D\ Exhaust} \right) \right) * IA * D\ Fuel$$

- $V\ CO_2$ = Exhaust CO_2 Volume
- V Exhaust = Total Exhaust Volume
- $D\ CO_2$ = Density of CO_2
- D Exhaust = Density of Exhaust Air
- IA = Inlet Air fuel amount
- D Fuel = Density of Fuel

Next steps:

Using the identified MRV standards/guidance, the parameters and its sources, the GHG effects of prioritized mitigation actions will be quantified in the next report (A report on designing MRV system and establishment of roles & responsibilities for transport sector). Same information will also be used while designing the institutional arrangement for the proposed MRV under next report..

ANNEXES

Annex 1: List of transport sector methodologies reviewed

- Reference Document on Measurement, Reporting and Verification in the Transport Sector, February 2016, GIZ, http://transferproject.org/wp-content/uploads/2017/09/Reference-Document-on-MRV-in-the-transport-sector.pdf
- Transport Pricing Guidance Guidance for assessing the greenhouse gas impacts of transport pricing policies, May 2018, ICAT, http://transferproject.org/wp-content/uploads/2017/09/Reference-Document-on-MRV-in-the-transport-sector.pdf
- Intergovernmental Panel on Climate Change (IPCC) Methodology - Mobile Combustion (Chapter 3), https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_3_Ch3_Mobile_Combustion.pdf
- Policy and Action Standard Road Transport Sector Guidance Draft, May 2015, Greenhouse Gas Protocol (GHG Protocol) by World Resource Institute, https://ghgprotocol.org/sites/default/files/standards_supporting/Transport%20-%20Additional%20Guidance.pdf
- UNFCCC Clean Development Mechanism Methodologies,

  - AMS-III.C Emission reductions by electric and hybrid vehicles, https://cdm.unfccc.int/methodologies/DB/AWVYMI7E3FP9BDRQ646203OVPKFPQB

  -AMS-III.S Small-scale Methodology: Introduction of low-emission vehicles/technologies to commercial vehicle fleets Version 04.0, https://cdm.unfccc.int/methodologies/DB/CAEL7OU5NIMXWM9E4RU2C4MV9WHXJN

  - ACM0016: Mass rapid transit projects, https://cdm.unfccc.int/methodologies/DB/FXQBDV16UML49NJN03U1QQTEY9J90E

  - AM0031: Bus rapid transit projects, https://cdm.unfccc.int/methodologies/DB/V9E3KQAI5433N8ZF5N7SNKIXE79JTL

  -AMS-III.U: Cable Cars for Mass Rapid Transit System, https://cdm.unfccc.int/methodologies/DB/I7O8EX3R0PA22GNGBJMH2FHCOIL03L

  -AM00090 : Modal shift in transportation of cargo from road transportation to water or rail transportation, https://cdm.unfccc.int/methodologies/DB/4DOIK2WYP8P3AGAVJKT0CHY1NXJ4QP

- Japan International Cooperation Agency (JICA) Methodologies

  - 3. Transport / Railway (Passenger) / Modal Shift, https://www.jica.go.jp/english/our_work/climate_change/c8h0vm00000137cc-att/M03_Railway_Passenger_MS_E.pdf

  - 4. Transport / Railway (Passenger) / Electrification, https://www.jica.go.jp/english/our_work/climate_change/c8h0vm00000137cc-att/M04_Railway_Passenger_Elec_E.pdf

- 5. Transport / Railway (Freight) / Modal Shift, https://www.jica.go.jp/english/our_work/climate_change/c8h0vm00000137cc-att/M05_Railway_Freight_MS_E.pdf

- 6. Transport / Railway (Freight) / Electrification, https://www.jica.go.jp/english/our_work/climate_change/c8h0vm00000137cc-att/M06_Railway_Freight_Elec_E.pdf

-6. Traffic and Transportation /Bus (BRT, Trunk Bus），https://www.jica.go.jp/english/our_work/climate_change/pdf/mitigation_06.pdf

Annex 2: The criteria used to assess and select most appropriate methodologies.

1. Scope of methodology
2. GHG assessment boundary
3. Applicability
4. Process of estimating baseline emission
5. Process of estimating project emission
6. Availability of emission factor database
7. Monitoring framework
8. Reporting Framework
9. Verification Framework

Annex 3: List of institutions to build the capacity building on the methodologies

1. Ministry of Mahaweli Development and Environment
2. Climate Change Secretariat
3. Ministry of Transport and Civil Aviation
4. Ministry of Megapolis and Western Development
5. Ministry of provincial council and local development
6. Ministry of Petroleum Resource Development
7. Department of Sri Lanka Railways;
8. Sri Lanka Transport Board;
9. National Transport Medical Institute;
10. Department of Motor Traffic;
11. National Transport Commission;
12. Vehicle Emission Testing;
13. Civil Aviation Authority;
14. Lakdiva Engineering;
15. Urban Development Authority
16. Ceylon Petroleum Corporation
17. Ceylon Petroleum Storage Terminal Limited

Annex 4: Prioritization of the mitigation actions to identify a methodology

Category	NDC	Sub NDC	Policy	Project	Likelihood of the implementation	Data availability	Total
Traffic management	4 - Passenger shift from private to public	4.1: Introduced park & ride system	Establish multi-modal transport centers with park and ride facilities (Vision 2025, National transport policy 2009) *Likelihood of the implementation: 5* *Data availability: 1* *Total:* 6	**1. Introduce park & ride system near RTS Stations for easy access - LRT Line** 2. Introduce park & ride system near express way 3. Park & ride system at Multi -modal Transport Hubs 4. Park & ride system connect to Cycle paths	5 2 4 2	4 1 2 1	9 3 6 3
	9 - Freight shift from Road to Rail	9.4: Transport of heavy loads by railway	Deregulation of freight tariff (National transport policy 2009) *Likelihood of the implementation: 3* *Data availability: 2* *Total:* 5	5. <u>Prima flour transportation</u> Transportation of 15000 tons of flour by train per month using 15 wagons from china harbor to Galle and Seeduwa as per the agreement signed on 27.06.2017. 6. <u>Holicim Lanka Pvt. (2015)</u> Coal transportation from railway station of China harbor to Maho railway station 7. <u>Lime stones</u> The right to use the rail track for the transport of lime - stones using their own locomotives and wagons from Aruwakkalu. Railway also provides locomotives on hire to the Company to transport lime stones **8. <u>Petroleum products</u>**	4 4 3	2 2 1	6 6 4

				From main installations to Bulk depots	5	4	9
Improving the railway system	5 - Improving efficiency of railway system	5.1: Electrification of railway	Electrification of railway (Vision 2025, National transport policy 2009) *Likelihood of the implementation: 3* *Data availability: 4* *Total: 7*	**2. Electrification of Panadura - Veyangoda railway line**	3	4	7
		5.2: Purchasing new (improved) rolling stocks		**1. Procurement of 06 Power sets,**	5	4	9
				2. Procurement of 10 Locomotives,	4	2	6
				3. Procurement of 9 Power sets and 12 Locomotives for upgrade the up Country Train service,	4	2	6
				4. Rehabilitation of 200 abandoned carriages with the assistance of private sector	4	2	6
Improving the road transport	8 – Introduce electric vehicles	8.3: Introduce electric buses 8.4: Introduce other electrified vehicles such as cars	4. Introduce electric vehicles (Presidential Manifesto 2015, Vision 2025, National transport policy 2009) *Likelihood of the implementation: 4* *Data availability: 4* *Total: 8* 5. **Import tax for electric vehicles** will be reduced while same for fossil fuel vehicles	2. **1 Introduce 15 electric buses (budget 2018)** 1.2 Introduce 250 electric and 750 hybrid buses in main towns in western province and expressway	4 3	5 2	9 5
				2.1 Tax reduction for electric cars	5	3	8
				2.2 Tax increase for fossil fuel cars and diesel three wheel.	5	3	8

			will be increased (only for cars and three wheeler, Presidential Manifesto 2015, Vision 2025, National transport policy 2009, budget 2018). *Likelihood of the implementation: 5* *Data availability: 3* *Total: 8* 6. **Carbon tax based on the age of the vehicles and the engine capacity (budget).** *Likelihood of the implementation:5* *Data availability: 4* *Total: 9*	3.1 Apply annual carbon tax for motor cycle (Rs. 0.5/cubcm3 less than 5 years), cars (Rs. 0.5/cubcm3 less than 5 years), passenger buses (Rs. 1000 for less than years) while electric vehicles do not have to pay carbon tax	5	4	9
Improving the regulations	7 – Introduce new emission standar	7.1-7.4	Original emission standard was introduced in 2008 **Original emission standard was**				

	ds		**amended in 2015** *Likelihood of the implementation: 5* *Data availability: 4* *Total: 9*				

Annex 5: MRV requirements under IPCC methodology

MRV Guidance/Methodology		IPCC Methodology
Monitoring Framework		For CO2 emissions, the inventory compiler should compare estimates using both the fuel statistics and vehicle kilometer travelled data. Any anomalies between the emission estimates should be investigated and explained. The results of such comparisons should be recorded for internal documentation. Revising the following assumptions could narrow a detected gap between the approaches: Off-road/non transportation fuel uses; Annual average vehicle mileage; Vehicle fuel efficiency; Vehicle breakdowns by type, technology, age, etc.; Review of emission factors If default emission factors are used, the inventory compiler should ensure that they are applicable and relevant to the categories. If possible, the default factors should be compared to local data to provide further indication that the factors are applicable. For CH4 and N2O emissions, the inventory compiler should ensure that the original data source for the local factors is applicable to the category and that accuracy checks on data acquisition and calculations have been performed. Where possible, the default factors and the local factors should be compared Activity data check The inventory compiler should review the source of the activity data to ensure applicability and relevance to the category. Section 3.2.1.3 Chapter3 provides good practice for checking activity data. Where possible, the inventory compiler should compare the data to historical activity data or model outputs to detect possible anomalies. The inventory compiler should ensure the reliability of activity data regarding fuels with minor distribution; fuel used for other purposes, on- and off-road traffic, and illegal transport of fuel in or out of the country. The inventory compiler should also avoid double counting of agricultural and off-road vehicles.
Reporting Framework		It is not practical to include all documentation in the national inventory report. However, the inventory should include summaries of methods used and references to source data such that the reported emissions estimates are transparent and steps in their calculation may be retraced. This applies particularly to national models used to estimate emissions from road transport, and to work done to improve knowledge of technology-specific emission factors for nitrous oxide and methane, where the uncertainties are particularly great. This type of information, provided the documentation is clear, should be submitted for inclusion in the EFDB. Confidentiality is not likely to be a major issue with regard to road emissions, although it is noted that in some countries the military use of fuel may be kept confidential. The composition of some additives is confidential, but this is only important if it

		influences greenhouse gas emissions.
Verification Framework		Comparisons with independently compiled estimates: Comparisons with other independently compiled inventory data on national level (if available) are a quick option to evaluate completeness, approximate emission (removal) levels and correct category allocations. Although the inventory compiler is ultimately responsible for preparing the national greenhouse gas inventory, other independent publications on this subject may be available e.g., from scientific literature or publication by other institutes or agencies. For example, national level CO2 emissions estimates associated with the combustion of fossil fuel are compiled by the International Energy Agency (IEA) and the Carbon Dioxide Information and Analysis Centre (CDIAC). Estimates of emissions of other pollutants are available from the Emission Database for Global Atmospheric Research (EDGAR) (http://www.mnp.nl/edgar/). If independently compiled datasets use IPCC Tier 1 methodologies, the same considerations discussed above will apply. For actual verification need to be done once the project complete, using the technology based activity data

Annex 5: **Assessing the MRV standard/guidance against nine criteria**

Annex 5.1: Assessing the MRV standard/guidance for Electrification of the railway system from Veyangoda to Panadura under sub NDC 5.1

MRV Guidance/Methodology		JICA - Transport / Railway (Passenger) / Electrification
Scope or Purpose		Railway Electrification (Passenger Transport)
GHG Assessment Boundary		The physical boundary for estimating GHG emission reduction by operating of the electrified railway without indicating modal shift effects (Because NDC 5.1 was not discussed of transportation capacity enhancement along with electrification)
Estimating Baseline Scenario	Parameter 1	$FC_{BL,i,y}$ = Consumption of fuel i associated with the operation of the existing railway in year y (t / year)
	Parameter 2	NCV_i = Net calorific value of fuel i (TJ/t)
	Parameter 3	$EF_{fuel,I}$ = CO_2 emission factor of fuel i (tCO2/TJ)
Estimating Project Scenario	Parameter 1	$EC_{PJ,y}$ = Electricity consumption associated with the operation of the project activity in year y (MWh/y)
	Parameters 2	EF_{elec} = CO2 emission factor of the grid electricity
Availability of emission factor data base		Emission Factor of Fuel – Default value (IPCC) Emission factor of the grid electricity – Local value (National Energy balance)
Monitoring Framework		Not discussed in the methodology
Reporting Framework		Not discussed in the methodology
Verification Framework		Not discussed in the methodology
Strength/Advantages		Baseline emissions of Electrification and model shift has been separately calculated in methodology. So that it will be more practical for the users.
Weaknesses		Absence of reporting and monitoring frame work

Annex 5.2 : Assessing the MRV standard/guidance for purchasing new rolling stock for Department of Railway under sub NDC 5.2

MRV Guidance/Methodology		JICA : JICA- Transport / Railway (Passenger) / Modal Shift
Scope or Purpose		Railway Transport (Passenger) / Modal shift
GHG Assessment Boundary		The physical boundary for estimating GHG emissions includes the operation of efficient transport system(railway, monorail,LRT)
Estimating Baseline Scenario	Parameter 1	$BPKM_y$ = Passenger transportation volume/activity by the project in year y (passenger-km/y)
	Parameter 2	$MS_{i,y}$ = Share of passengers by transport mode i in the baseline scenario in year y (%)
	Parameter 3	$EF_{PKM,i}$ = CO_2 emission factor per passenger kilometer for transport mode i (t-CO_2/passenger-km)
Estimating Project Scenario	Parameter 1	$EC_{PJ,y}$ = Electricity consumption associated with the operation of the project activity in year y (MWh/y)

	Parameters 2	EF_{elec} = CO2 emission factor of the grid electricity
	Parameter 3	$FC_{PJ,i,y}$=Consumption of fuel i associated with the operation of the project activity in year y (t / year)
	Parameter 4	NCV_i = Net calorific value of fuel i (TJ/t)
	Parameter 5	$EF_{fuel,i}$ = CO_2 emission factor of fuel i (t-CO_2/TJ)
Availability of emission factor data base		Emission Factor of Fuel – Default value (IPCC) Emission factor of the grid electricity – Local value (National Energy balance)
Monitoring Framework		Not discussed in the methodology
Reporting Framework		Not discussed in the methodology
Verification Framework		Not discussed in the methodology
Strength/Advantages		Project emissions are estimated in the case of the project activity using fossil fuels or electricity separately.
Weaknesses		Absence of reporting and monitoring frame work

Annex 5.3 : Assessing the MRV standard/guidance for Gazette new emission standards to reduce GHG emissions under sub NDC 7

MRV Guidance/Methodology		IPCC Methodology
Scope or Purpose		Mobile combustion associated with Road transport, off road, Railway, Civil aviation, water borne navigation
GHG Assessment Boundary		National level GHG Inventory , within specific period of time
Estimating Baseline Scenario	Parameters	Fuel consumption associated with each types of vehicles • Total vehicle km / year • Total passenger km/ year • Total fuel consumption/ year Net calorific value of fuel i CO2emission factor of fuel a
	Sources	• Statistic Report of National transport Commission • CPC • IPCC Guideline
Estimating Project Scenario	Parameters	CO_2 emission from all types of vehicle Fuel consumption associated with each types of vehicles Emission factors of CH_4 and NO_2
	Sources	• Statistic Report of National transport Commission • CPC

		• VET • IPCC
Availability of emission factor data base		Key priority is given to country specific emission factors. If those are not available, IPCC default emission factors specified in the same reference can be used.
Monitoring Framework		Monitoring requirements are stipulated in detail. Please refer annex 6.
Reporting Framework		Reporting requirements are stipulated in detail. Please refer annex 6.
Verification Framework		Verification requirements are stipulated in detail. Please refer annex 6.
Strength/Advantages		Easy to apply and adapt.
Weaknesses		Country specific emission factors are not available

Annex 5.4: Assessing the MRV standard/guidance for introducing electric buses under sub NDC 8.3

MRV Guidance / Methodology		UNFCCC CDM AMS III.C - Emission reductions by electric and hybrid vehicles - version 15.0
Scope or Purpose		This methodology applies to project activities introducing new electric and/or hybrid vehicles that displace the use of fossil fuel vehicles in passenger and freight transportation.
GHG Assessment Boundary		The project boundary is comprised of: (a) The vehicles of the project; (b) The geographic boundaries where the project activity vehicles are operated; (c) The providers of the charging service to the project activity vehicles, including the charging equipment and stations of the project activities vehicle, electric supply sources (e.g. a grid and/or renewable energy generation source connected by a dedicated line to the charging stations) and other ancillary facilities.
Estimating Baseline Scenario	Parameters	$EF_{BL,km,i}$: Emission factor for baseline vehicle category *i* (g CO_2/km) $DD_{i,y}$: Annual average distance travelled by project vehicle category *i* in the year *y* (km) $N_{i,y}$ Number of operational project vehicles in category *i* in year *y* SFC_i Specific fuel consumption of baseline vehicle category *i* (g/km) $NCV_{BL,i}$: Net calorific value of fossil fuel consumed by baseline

			vehicle category *I* (J/g) $EF_{BL,i}$ Emission factor of fossil fuel consumed by baseline vehicle category *i* (g CO_2/J) IR^t : 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 all baseline vehicle categories is 0.99 *T :* Year counter for the annual improvement (dependent on age of data per vehicle category)
Estimating Project Scenario	Ex-ante	Parameters	Not discussed specifically, but for the validation Ex ante methods can be used $EF_{PJ,km,i,y}$ Emission factor per kilometre travelled by the project vehicle type *I* (t CO_2/km) $N_{i,y}$ Number of operational project vehicles in category *i* in year *y* $DD_{i,y}$ Annual average distance travelled by the project vehicle category *i* in the year *y* (km) $SEC_{PJ,km,i,y}$ Specific electricity consumption by project vehicle category *i* per km in year *y* in urban conditions (kWh/km) $EF_{elect,y}$ CO_2 emission factor of electricity consumed by project vehicle category *i* in year *y* (kg CO_2/kWh) $SFC_{PJ,km,i,y}$ Specific fossil fuel consumption by project vehicle category *i* per km in year *y* in urban conditions (g/km) $EF_{PJ,i}$ CO_2 emission factor of fossil fuel consumed by project vehicle category *i* in year *y* (g CO_2/J) $NCV_{PJ,i}$ Net calorific value of the fossil fuel consumed by project vehicle category *i* in year *y* (J/g) TDL_y Average technical transmission and distribution losses for providing electricity in the year *y*
Availability of emission factor data base			country specific data or IPCC default value)
Monitoring Framework			The applicable requirements specified in the "General guidelines for SSC CDM methodologies" (e.g. calibration requirements, sampling

		requirements) are also an integral part of the monitoring guidelines specified in the tables 6.1 V4 shall be referred by the project participants
Reporting Framework		CDM Standard reporting formats to UNFCC
Verification Framework		Standard CDM verification procedure
Strength/Advantages		All the necessary parameters for the calculation and monitoring has been given in the methodology document.
Weaknesses		Require more data and parameters to measure the GHG effects

Annex 5.5: Assessing the MRV standard/guidance for introducing other electrified vehicles such as cars under sub NDC 8.4

ICAT Transport Pricing Guidance can be applied for policies under this NDC while UNFCCC CDM AMS III C, which has been described under NDC 8.3, can be applied for projects under this NDC.

MRV Guidance/Methodology		ICAT Transport Pricing Guidance for policy
Scope or Purpose		This guidance provides general principles, concepts and a stepwise method for estimating the GHG impacts of following types of transport pricing policies. Fuel subsidy removal Increased fuel tax or levy Road pricing (road tolls and congestion pricing) Vehicle purchase incentives for more efficient vehicles
GHG Assessment Boundary		The GHG assessment boundary defines the scope of the assessment in terms of the range of GHG impacts that are included in the assessment. (a) Reduced GHG emissions from reduced vehicle kilometres travelled (VKT) in road transport (LDV/HDV) (a) Reduced GHG emissions from use of less GHG-intensive modes (b) Reduced GHG emissions from more efficient VKT
Estimating Baseline Scenario	Parameters	<u>Baseline</u> $F_{i,j,y}$: Total fuel energy *i* (from gasoline / diesel / electricity) used per mode *j* of passenger transport (road / rail) in year y $PKM_{i,j,y}$: Total PKMs travelled per mode *j* of passenger transport (road / rail) in year y $d_{i,j,y}$: Vehicle kilometres travelled (with fuel type *i*, mode *j*, in year *y*). $l_{j,y}$: Average (per VKT) number of persons travelling in same vehicle (with mode *j* in year *y*).

			$sfc_{i,j,y}$: Specific fuel consumption. Average consumption per VKT in municipal, regional or national fleet Calculating $F_{x,i,y,}$ p_i, : Density of fuel type i NCV_i : Net Calorific value of fuel type i
Estimating Project Scenario	Ex-ante	Parameters	1. Average value of the rebate 2. Vehicle retail price 3. Market Share 4. Per km emission reduction 5. Annual New Vehicle Sale 6. Average life time km per vehicle
Availability of emission factor data base			country specific data or IPCC default value
Monitoring Framework			Available (Chapter 11 of methodology) To monitor progress and estimate GHG effects ex-post, users need to collect data on parameters during and/or after the policy implementation period. Methodology provides the parameters need to be monitored, parameter type, potential sources to collect date, suggested monitoring frequency and addresses the needs of decision makers and other
Reporting Framework			Available (Chapter 12 of methodology) Recommended information report (a) General Information (b) Objectives of Assessing the GHG Impacts of Pricing Policies (c) Steps and Assessment Principles (d) Describing the Policy (e) Identifying Impacts: How Pricing Policies Reduce GHG Emissions (f) Estimating Baseline Emissions (g) Estimating GHG Impacts Ex-Ante (h) Estimating GHG Impacts Ex-Post (i) Monitoring Performance Over Time
Verification Framework			
Strength/Advantages			Exist proper monitoring and reporting system
Weaknesses			Not mentioned about a verification framework

Annex 5.6: Assessing the MRV standard/guidance for transport of heavy loads by railway under sub NDC 9.4

MRV Guidance/Methodology	JICA - Transport / Railway (Freight) / Modal Shift	UNFCCC CDM AM0090: Modal shift in transportation of cargo from road transportation to water or rail transportation - version 1.1.0
Scope or Purpose	Transport / Railway (Freight) / Modal Shift	Modal shift in transportation of cargo from road transportation to water or rail transportation
GHG Assessment Boundary	(1) Development of transport system(s) that can realize an efficient freight transport such as railway. (2) The baseline transport modes should be road transportation such as trucks and trailers etc. The physical boundary for estimating GHG emissions includes the operation of the railway.	The spatial extent of the project boundary encompasses the complete route, from origin to destination, involved in the transportation of the cargo described in the CDM-PDD, including complementary modes of transport i.e. from the facility to the port or station and vice versa. The project boundaries do not include production facilities where the cargo is produced or facilities that will use those cargo. Only transportation of the cargo is included within the boundary.

Estimating Baseline Scenario		Parameters	BTKMy : Freight transportation activity/volume by the project in year y (t-km/y) $MS_{i,y}$: Share of freight by transport mode i in the baseline scenario in year y (%) $EF_{TKM,I}$: CO_2 emission factor per ton kilometer for transport mode i (t-CO_2/t-km) NCV_i : Net calorific value of fuel i (TJ/t) $EF_{fuel,I}$: CO_2 emission factor of fuel i (t-CO_2/TJ)	T_y :Amount of cargo transported by the project transportation mode in year *y* (tonne) *AD* : Distance of the baseline trip route (km) EF_{BL} : Baseline emission factor for transportation of cargo (g CO_2 per tonne.km, i.e. g CO_2 per tonne of cargo and km travelled) $FC_{BL,i,x}$: Amount of fuel *i* consumed by the trucks in year *x* (liter or m^3) $EF_{CO2,i,x}$: CO_2 emission factor of fuel *i* consumed by the trucks in year *x* (g CO_2/GJ)[11] $NCV_{i,x}$: Average net calorific value of fuel *i* consumed by the trucks in year *x* (GJ per liter or m^3) $F_{RT,BL}$: Factor to account for non-empty return trips in the baseline scenario (fraction) T_x : Amount of cargo transported in trucks in year *x* (tonne) $T_{RT,x}$: Amount of cargo transported in trucks in the return trips in year *x* (tonne) RTD_x : Distance of the return trip route in year *x* (km)
Estimating Project Scenario	Ex-ante	Parameters	$EC_{PJ,y}$; Electricity consumption associated with the operation of the project activity (railway) in year y (MWh/y) $EC_{PJ,y}$: Electricity consumption associated with the operation of the project activity (railway) in year y (MWh/y)	$FC_{i,j,y}$: Is the quantity of fuel type i combusted in process j during the year y (mass or volume unit/yr) $COEF_{i,y}$: Is the CO2 emission coefficient of fuel type i in year y (tCO2/mass or volume unit) $W_{c,i,y}$: Is the weighted average

[11] If the fuel is blended with biofuel, the emission factor of the blend shall be calculated assuming an emission factor of zero for the biofuel.

			$FC_{PJ,i,y}$: Consumption of fuel i associated with the operation of the project activity (railway) in year y (t/y) EF_{elec}: CO_2 emission factor of the grid electricity (t-CO_2/MWh) NCV_i : Net calorific value of fuel i (TJ/t) $EF_{fuel,I}$: CO_2 emission factor of fuel i (t-CO_2/TJ)	mass fraction of carbon in fuel type i in year y (tC/mass unit of the fuel) $P_{i,y}$: Is the weighted average density of fuel type i in year y (mass unit/volume unit of the fuel) $NCV_{i,y}$: Is the weighted average net calorific value of the fuel type i in year y (GJ/mass or volume unit) $EF_{CO2,i,y}$: Is the weighted average CO2 emission factor of fuel type i in year y (tCO2/GJ) $PE_{EC,y}$: Project emissions from electricity consumption in the project activity in year *y* (tCO_2) $T_{R,T,y}$: Amount of cargo transported by the project transportation mode in the return trips in year y (tonne) $PE_{CR,y}$: Project emissions from transportation of cargo in complementary routes in trucks in year *y* (tCO_2) $FC_{i,j,y}$: Is the quantity of fuel type i combusted in process j during the year y (mass or volume unit/yr) $COEF_{i,y}$: Is the CO2 emission coefficient of fuel type i in year y (tCO2/mass or volume unit)
Availability of emission factor data base			Default values	Default emission factors for diesel for trucks, barges and ship fuel oils
Monitoring Framework			Not discussed	Following parameters will be monitored under different frequencies • The project transportation mode in year *y*

			• The origin and destination point and transportation route of the cargo transported by the project transportation mode in year *y* • Type of cargo transported by the project transportation mode in year *y* • Amount of cargo transported by the project transportation mode in year *y* • Amount of cargo transported by the project transportation mode in the return trips in year *y*
Reporting Framework		Not discussed	CDM Standard reporting formats to UNFCC
Verification Framework		Not discussed	Standard CDM verification procedure
Strength/Advantages		Does not set any limitation for cargo type	A descriptive methodology which provide guidelines on calculating, monitoring, reporting and verification
Weaknesses		Do not discussed about monitoring, reporting and verification frameworks	Set limitations to cargo type

Annex 6: Summary of the parameters required to quantify GHG impacts and their sources

Selected NDC	Parameters required to quantify GHG impacts	Source
4.1	**Baseline Scenario**	
	P_y : Total number of passengers in year y	Megapolis JICA -LRT Feasibility report
	P_{SPER} : Number of passengers in the time period of the survey (1 week)	Orion Consultancy (international) CEA (Local Consultancy)
	n_{ihsp} : Number of passengers selected in the station *sp*, in stratum	Orion Consultancy (international) CEA (Local Consultancy)
	N_{ihsp} : Total number of passengers in the station *sp*, in stratum	Megapolis JICA -LRT Feasibility report
	$EF_{pkm,i,y}$: Emission factor per passenger-kilometer of mode *i* in year *y* (g CO2/pkm)	Megapolis JICA -LRT Feasibility report
	$BTD_{P,y,i}$: Baseline trip distance per surveyed passenger *p* using mode *i* in year *y* (pkm)	Megapolis JICA -LRT Feasibility report
	Project Scenario	
	$EC_{PJ,j,y}$: Quantity of electricity consumed by the project electricity consumption source *j* in year *y* (MWh/yr)	Megapolis JICA -LRT Feasibility report
	$EF_{EL,j,y}$: Emission factor for electricity generation for source *j* in year *y* (tCO_2/MWh)	Megapolis JICA -LRT Feasibility report
	$TDL_{j,y}$: Average technical transmission and distribution losses for providing electricity to source *j* in year *y*	Megapolis JICA -LRT
	$FEX_{p,y}$: Expansion factor for each surveyed passenger *p* in year *y*	Orion Consultancy (international) CEA (Local Consultancy)
	P_y : Total number of passengers in year y	Megapolis JICA -LRT Feasibility report
	P_{SPER} : Number of passengers in the time period of the survey (1 week)	Orion Consultancy (international) CEA (Local Consultancy)
	$EF_{pkm,i,y}$: Emission factor per passenger-kilometer of mode *i* in year *y* (g CO2/pkm)	Megapolis JICA -LRT Feasibility report
	$IPTD_{P,y,i}$: Indirect project trip distance per surveyed passenger *p* using mode *i* in year *y* (pkm)	Orion Consultancy (international) CEA (Local Consultancy)
5.1	**Baseline Scenario**	
	$FC_{BL,i,y}$ = Consumption of fuel i associated with the operation of the existing railway in year y (t / year)	Department of Railway
	NCV_i = Net calorific value of fuel i (TJ/t)	Ceylon Petroleum Cooperation (CEYPETCO)
	$EF_{fuel,I}$ = CO_2 emission factor of fuel i (tCO2/TJ)	IPCC Guidlings
	Project Scenario	
	$EC_{PJ,y}$ = Electricity consumption associated with the operation of the project activity in year y (MWh/y)	Feasibility report(Ministry of Transport & Civil Aviation)

	EF_{elec} = CO2 emission factor of the grid electricity	www.energy.gov.lk (National Energy Balance)
	$FC_{BL,i,y}$ = Consumption of fuel i associated with the operation of the existing railway in year y (t / year)	Department of Railway
5.2	**Baseline Scenario**	
	$BPKM_y$ = Passenger transportation volume/activity by the project in year y (passenger-km/y)	Department of Railway
	$MS_{i,y}$ = Share of passengers by transport mode i in the baseline scenario in year y (%)	National Transport Commission
	$EF_{PKM,i}$ = CO_2 emission factor per passenger kilometer for transport mode i (t-CO_2/passenger-km)	
	Project Scenario	
	$EC_{PJ,y}$ = Electricity consumption associated with the operation of the project activity in year y (MWh/y)	Department of Railway
	EF_{elec} = CO2 emission factor of the grid electricity	www.energy.gov.lk (National Energy Balance)
	$FC_{PJ,i,y}$=Consumption of fuel i associated with the operation of the project activity in year y (t / year)	Department of Railway
	NCV_i = Net calorific value of fuel i (TJ/t)	Ceylon Petroleum Cooperation(CEYPETCO)
	$EF_{fuel,i}$ = CO_2 emission factor of fuel i (t-CO_2/TJ)	IPCC Guidlings
7	**Baseline Scenario**	
	Fuel consumption associated with each types of vehicles • Total vehicle km / year • Total passenger km/ year • Total fuel consumption/ year	• Statistic Report of National transport Commission • CPC
	Net calorific value of fuel i	IPCC Guideline
	CO2emission factor of fuel a	IPCC Guideline
	Project Scenario	
	CO_2 emission from all types of vehicle	VET
	Fuel consumption associated with each types of vehicles	• Statistic Report of National transport Commission • CPC • VET
	Emission factors of CH_4 and NO_2	IPCC Guideline
8.3	**Baseline Scenario**	
	Emission factor for baseline vehicle category *i* (g CO_2/km)	To be calculated
	Annual average distance travelled by project vehicle category *i* in the year *y* (km)	For Govt Buses => SLTB For Pvt Buses => RPTA

	Number of operational project vehicles in category *i* in year *y*	SLTB (Govt Buses) RPTA (Pvt Buses)
	Specific fuel consumption of baseline vehicle category *i* (g/km)	
	Net calorific value of fossil fuel consumed by baseline vehicle category *I* (J/g)	CPC or IPCC default value
	Emission factor of fossil fuel consumed by baseline vehicle category *i* (g CO_2/J)	CPC or IPCC default value
	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 all baseline vehicle categories is 0.99	Default Value (0.99)
	Year counter for the annual improvement (dependent on age of data per vehicle category)	
	Project Scenario	
	Emission factor per kilometre travelled by the project vehicle type *i* (t CO_2/km)	To be Calculated
	Number of operational project vehicles in category *i* in year *y*	TBD
	Annual average distance travelled by the project vehicle category *i* in the year *y* (km)	TBD
	Specific electricity consumption by project vehicle category *i* per km in year *y* in urban conditions (kWh/km)	From Manufacturer Specs / Tender Docs
	CO_2 emission factor of electricity consumed by project vehicle category *i* in year *y* (kg CO_2/kWh)	CEB / SLSEA (Energy Balance)
	Specific fossil fuel[12] consumption by project vehicle category *i* per km in year *y* in urban conditions (g/km)	
	CO_2 emission factor of fossil fuel consumed by project vehicle category *i* in year *y* (g CO_2/J)	CPC or IPCC default Value
	Net calorific value of the fossil fuel consumed by project vehicle category *i* in year *y* (J/g)	CPC or IPCC default Value
	Average technical transmission and distribution losses for providing electricity in the year *y*	CEB / SLSEA (Energy Balance)
8.4 (ICAT Transport Pricing Guidance)	**Baseline Scenario**	
	$F_{i,j,y}$: Total fuel energy *i* (from gasoline / diesel / electricity) used per mode *j* of passenger transport (road / rail) in year y	To be calculated
	$PKM_{i,j,y}$: Total PKMs travelled per mode *j* of passenger transport (road / rail) in year y	To be calculated
	$d_{i,j,y}$: Vehicle kilometres travelled (with fuel type *i*, mode *j*, in year *y*).	For other vehicles => VET
	$l_{j,y}$: Average (per VKT) number of persons	NTC

[12] For electric vehicle the values is 0.00.

	travelling in same vehicle (with mode *j* in year *y*).	
	$sfc_{i,j,y}$: Specific fuel consumption. Average consumption per VKT in municipal, regional or national fleet	
	p_i, : Density of fuel type i	CEYPETCO
	NCV_i : Net Calorific value of fuel type i	CPC or IPCC default Value
	Project Scenario	
	Average value of the rebate	Budget
	Vehicle retail price	Custom / Vehicle retailers
	Market Share	Custom
	Per km emission reduction	To be calculated
	Annual New Vehicle Sale	NTC or DMT
	Average life time km per vehicle	Default IPCC
9.4	**Baseline Scenario**	
	Amount of cargo transported by the project transportation mode in year *y* (tonne)	CPSTL
	Distance of the baseline trip route (km)	CPSTL
	Baseline emission factor for transportation of cargo (g CO_2 per tonne.km, i.e. g CO_2 per tonne of cargo and km travelled)	Two options are available A. onservative default values B. Historical Data
	Amount of fuel *i* consumed by the trucks in year *x* (liter or m^3)	CPSTL
	CO_2 emission factor of fuel *i* consumed by the trucks in year *x* (g CO_2/GJ)[13]	IPCC
	Average net calorific value of fuel *i* consumed by the trucks in year *x* (GJ per liter or m^3)	IPCC/ CEYPETCO
	Factor to account for non-empty return trips in the baseline scenario (fraction)	
	Amount of cargo transported in trucks in year *x* (tonne)	CPSTL
	Amount of cargo transported in trucks in the return trips in year *x* (tonne)	CPSTL
	Distance of the return trip route in year *x* (km)	CPSTL
	Project Scenario	
	Is the quantity of fuel type i combusted in process j during the year y (mass or volume unit/yr)	SLR
	Is the CO2 emission coefficient of fuel type i in year y (tCO2/mass or volume unit)	chemical composition, net calorific value
	Is the weighted average mass fraction of carbon in fuel type i in year y (tC/mass unit of the fuel)	Default values
	Is the weighted average density of fuel type i in year y (mass unit/volume unit of the fuel)	CEYPETCO

[13] If the fuel is blended with biofuel, the emission factor of the blend shall be calculated assuming an emission factor of zero for the biofuel.

	Is the weighted average net calorific value of the fuel type i in year y (GJ/mass or volume unit)	IPCC/CEYPETCO
	Is the weighted average CO2 emission factor of fuel type i in year y (tCO2/GJ)	IPCC
	Project emissions from electricity consumption in the project activity in year *y* (tCO_2)	Not applicable
	Amount of cargo transported by the project transportation mode in the return trips in year y (tonne)	SLR
	Project emissions from transportation of cargo in complementary routes in trucks in year *y* (tCO_2)	SLR
	Is the quantity of fuel type i combusted in process j during the year y (mass or volume unit/yr)	SLR
	Is the CO2 emission coefficient of fuel type i in year y (tCO2/mass or volume unit)	Calculate

Annex 7: Transport Pricing: Electric Vehicles

Methodological challenges and ways taken to address them

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1. **Approach to MRV mutually reinforcing policies targeting electric vehicles:** In Sri Lanka there are 2 mutually reinforcing policies to incentivise the import of electric vehicles. Sri Lanka attempts to MRV the resulting GHG impact of these mutually reinforcing policies using ICAT Transport Pricing guidance
   - Financial incentives to encourage EVs import
   - Financial disincentives (carbon tax increasing for older and larger vehicles) to disincentivize large, old, fossil-fuel based vehicles (so EVs become even more competitive)

     - ICAT guidance (Chapter 10) covers the policy related to financial incentives however does not cover for the second policy related to carbon tax (disincentives). UDP is together with ClimateSI working on an approach to parametrise this policy in a way that we can make use of ICAT guidance.
     - Once the assessment report is finalized, UDP/Sri Lanka will share with Verra, and Verra can share with the consultant and he can comment on the way the ICAT guidance is applied

2. **Double counting issue:** Carbon tax & EV incentives policy. These policies act simultaneously in Sri Lanka and are mutually reinforcing. The ICAT guidance allows for estimating emissions reductions for one policy at a time however how do we handle two policies at the same time since the GHG impacts cannot be added up. So what is the additional GHG reduction due to carbon tax policy, which dis-incentivises fossil fuel based vehicles and makes EVs more competitive and thus facilitates EV uptake?

The GHG impact of carbon tax & EV incentives policy is the result of the synergy of both polices, and it would be different compared to individual impacts of these policies implemented independently. Not clear how to account (and if possible to account) for the combination of multiple policies targeting electric vehicles (there could also be city-level policies, parking policies for EVs, etc. so how to account for the impact of all these interacting policies?).

   ⇨ UDP proposal: Using GACMO model to establish a sectoral / NDC baseline instead of having separate baseline for the two pricing policies.

3. **Default value of 0.3:** In Chapter 10 a default value of 0.3 for Beta coefficient has been provided to estimate the market share improvement for cleaner vehicles. However no explanation / reference has been provided as to from where the default value comes from, how it was derived. Using this

value may cause some distrust in methodological soundness of the method, if no substantiation/explanation is provided for the basis on which this value was derived.

There is a typo in Step 2 describing the approach to estimate the change the market share using the default value for beta coefficient. Initially the value of 0.3 is used and in the example 0.03. So what is the correct value, 0.3 of 0.03?

4. **Methodological guidance how to collect local/national data and conduct calculations instead of relying on the default value 0.3**.

There is no option in the ICAT guidance to choose to either use the provided default value 0.3 or collect data and estimate country-specific value to be used instead of 0.3

5. **Attribution of GHG impact to the pricing policy.** In Sri Lanka (and any other country) there could be multiple policies and individual projects implemented that affect the uptake of electric vehicles. How to attribute GHG reductions to the policies assessed with the ICAT Transport Pricing Guidance and separate the impact of other policies/projects
6. **Using the same elasticity for cars & buses**. Literature used to derive elasticities used in this guidance focuses on elasticities for cars, but for electric buses there could be different elasticities. Markets for buses and cars are different, purchasing/deployment decision-making could be different, too. Can we use the same elasticity for buses and cars or should we use another elasticity for buses?
7. **Developed vs. developing country elasticities.** Elasticities applied in this guidance come from developed countries, can we apply them to developing country contexts?

Similarly as above, can we provide methodological guidance to collect local/national data and estimate GHG reductions as an alternative of using the default value provided in the guidance?

8. Combining effects of EV pricing incentives with city-parking/road-charging incentives. In addition to EV purchase incentives, countries may also introduce incentives that reduce the cost or enhance the convenience of the use of EVs in order to facilitate their market uptake. Chapter 10 provides guidance on assessing GHG impacts of road pricing incentives. Is it possible to combine methodologically the assessment of mutually reinforcing effects of purchasing incentives for EVs with incentives that reduce the cost and enhance convenience of their use (e.g reduced or no park charges for EVs, cordon pricing only for fossil-fuel based vehicles and no cordon pricing for EVs and similar city-level incentives, providing cheap charging infrastructure in cities, etc.).
9. Calculating the average value of the rebate: The rebate value is calculated as a percentage of vehicle retail price as per the methodology. However, it is not quite sure if the import tax has to be included in the retail price.
10. It would be good to have a detailed example on how to calculate the GHG impacts of purchasing incentives.