INITIATIVE FOR CLIMATE ACTION TRANSPARENCY - ICAT

SELECTION OF APPROPRIATE POLICY, ACTION, TARGETS FOR DEVELOPMENT OF AN MRV SYSTEM FOR THE TRANSPORT SECTOR OF THE KINGDOM OF CAMBODIA

Initiative for Climate Action Transparency - ICAT –

MEASUREMENT, REPORTING AND VERIFICATION FRAMEWORK FOR THE TRANSPORT SECTOR IN THE KINGDOM OF CAMBODIA

Deliverable 1: Report on selection of appropriate policy/ action / targets for development of MRV for the transport sector of Cambodia

DISCLAIMER

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, photocopying, recording or otherwise, for commercial purposes without prior permission of UNOPS. Otherwise, material in this publication may be used, shared, copied, reproduced, printed and/ or stored, provided that appropriate acknowledgement is given of UNOPS as the source. In all cases the material may not be altered or otherwise modified without the express permission of UNOPS.

PREPARED UNDER

The Initiative for Climate Action Transparency (ICAT), supported by Germany, Italy, the Children's Investment Fund Foundation and the ClimateWorks Foundation.

The ICAT Secretariat is managed and supported by the United Nations Office for Project Services (UNOPS)

Acknowledgement

The Royal Government of Cambodia (RGC) ratified the United Nations Framework Convention on Climate Change (UNFCCC) in 1996 and the Paris Agreement in 2017. The country submitted her Intended Nationally Determined Contributions (INDCs) in 2015 and the Updated NDCs in 2020 to the UNFCCC.

The transport sector plays a significant role in GHG emissions reduction. As such, several mitigation actions related to the transport sector were submitted to the UNFCCC through the updated NDCs. Tracking progress made in implementing and achieving NDCs is a requirement of the Enhanced Transparency Framework (ETF). Therefore, having a Measurement, Reporting, Verification (MRV) system in place is essential for Cambodia to achieve these targets in a standard and transparent manner.

The UNEP-DTU Partnership is providing a technical assistance to the RGC under this ICAT project, which aims to design an MRV system for selected mitigation actions in the transport sector of the Kingdom of Cambodia. A Team of National Experts, and International Experts of Climate Smart Initiatives (Pvt) Ltd (ClimateSI), were selected to support the Cambodian Team for this project.

Appreciating the invaluable contribution extended from all stakeholders related to the assignment, we would like to extend our sincere thanks and gratitude to: Dr. Tin Ponlok, Secretary of State of the Ministry of Environment; H.E. Dr. Vann Monyneath, Secretary General, the General Secretariat of the National Council for Sustainable Development (GSSD); Dr. Hak Mao, Director of the Department of Climate Change of the GSSD; and the Ministry of Public Works and Transport, for cooperating, facilitating, and assisting with this assignment by granting necessary approvals, making relevant officers available for participation for the discussions, and providing necessary information.

We appreciate the contributions and continued support extended by the participants and other key stakeholders for the discussions, while attending to their routine duties.

We would also like to appreciate senior researchers of the UNEP-DTU Partnership, for their kind contribution in supervising, reviewing, editing, and providing valuable inputs to improve the quality of this report.

List of Acronyms

ADB	Asian Development Bank
AFD	Agence Française de Développement
AFOLU	Agriculture, Forestry and Other Land Use
BAU	Business as Usual
CCAP	Climate Change Action Plan
CNG	Compressed Natural Gas
GACMO	Greenhouse Gas Abatement Cost Model
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GMS	Greater Mekong Sub-regions
GSSD	General Secretariat of the National Council for Sustainable Development
INC	Initial National Communication
INDC	Intended Nationally Determined Contribution
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Processes and Product Use
JICA	Japan International Cooperation Agency
LPG	Liquefied Petroleum Gas
MoP	Ministry of Planning
MPWT	Ministry of Public Works and Transport
MRV	Measurement, Reporting, and Verification
NCSD	National Council for Sustainable Development
NDC	Nationally Determined Contribution
NIS	National Institute of Statistics
RGC	Royal Government of Cambodia
SDGs	Sustainable Development Goals
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change

Glossary of Terms

Adaptation	Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.
Capacity building	In the context of climate change, the process of developing the technical skills and institutional capability in developing countries and economies in transition to enable them to effectively address the causes and results of climate change.
COP	Conference of the Parties. The supreme body of the Convention. It currently meets once a year to review the Convention's progress. The word "conference" is not used here in the sense of "meeting" but rather of "association". The "Conference" meets in sessional periods, for example, the "fourth session of the Conference of the Parties."
Greenhouse gases (GHGs)	The atmospheric gases responsible for causing global warming and climate change. The major GHGs are carbon dioxide (CO2), methane (CH4) and nitrous oxide (N20). Less prevalent but very powerful greenhouse gases are hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and Sulphur hexafluoride (SF6).
Intergovernmental Panel on Climate Change (IPCC)	Established in 1988 by the World Meteorological Organization and the UN Environment Programme, the IPCC surveys world-wide scientific and technical literature and publishes assessment reports that are widely recognized as the most credible existing sources of information on climate change. The IPCC also works on methodologies and responds to specific requests from the Convention's subsidiary bodies. The IPCC is independent of the Convention.
Mitigation	In the context of climate change, a human intervention to reduce the sources or enhance the sinks of greenhouse gases. Examples include using fossil fuels more efficiently for industrial processes or electricity generation, switching to solar energy or wind power, improving the insulation of buildings, and expanding forests and

	other "sinks" to remove greater amounts of carbon dioxide from the atmosphere.
MRV	Measurement, Reporting and Verification. A process/concept that potentially supports greater transparency in the climate change regime.
National communication	A document submitted in accordance with the Convention (and the Protocol) by which a Party informs other Parties of activities undertaken to address climate change. Most developed countries have now submitted their fifth national communications; most developing countries have completed their first national communication and are in the process of preparing their second.
NDC	According to Article 4 paragraph 2 of the Paris Agreement, each Party shall prepare, communicate, and maintain successive nationally determined contributions (NDCs) that it intends to achieve. Parties shall pursue domestic mitigation measures, with the aim of achieving the objectives of such contributions
Non-Annex I Parties	Refers to countries that have ratified or acceded to the United Nations Framework Convention on Climate Change that are not included in Annex I of the Convention.
Ratification	Formal approval, often by a Parliament or other national legislature, of a convention, protocol, or treaty, enabling a country to become a Party. Ratification is a separate process that occurs after a country has signed an agreement. The instrument of ratification must be deposited with a "depositary" (in the case of the Climate Change Convention, the UN Secretary-General) to start the countdown to becoming a Party (in the case of the Convention, the countdown is 90 days).

Table of Contents

List of Tables

List of Figures

1 Introduction

1.1 Background

Cambodia is highly vulnerable to the adverse effects of climate change, in particular, the rise of sea level, and increases in the frequency and intensity of disasters (especially droughts and floods). According to the Global Climate Risk Index, Cambodia was ranked 12th out of 181 countries as the most climate risk-prone country in the period 1999-2018, indicating high vulnerability to extreme weather events (Eckstein et al., 2020). Beyond extreme weather events, climate change also results in slow-onset events that could present significant negative implications for the most vulnerable populations, and all sectors such as agriculture, industry, forestry, and infrastructure, etc.

The Royal Government of Cambodia (RGC) has a strong commitment to addressing climate change and accelerating the transition to a climate-resilient, low-carbon, sustainable mode of development. Therefore, the country supports global efforts against climate change through being a Party to the United Nations Framework Convention on Climate Change (UNFCCC) since 1996 the Kyoto protocol since 2002, and the Paris Climate Agreement in 2017. Accordingly, Cambodia submitted her Intended Nationally Determined Contribution (INDCs) in 2015 and the updated NDCs in 2020, indicating ambitious targets to reduce GHG emissions and to strengthen adaptation capacity in line with the government's national development plans.

1.1.1 Trend of Global Emissions and the Transport Sector

Global GHG emissions continued to grow in 2019, reaching a record high of 59.1 $GtCO_2e$, including land-use change (52.4 $GtCO_2e$ emissions without land-use change). Fossil fuel-based CO_2 emissions (from fossil fuels and carbonates), which is 65% of the total GHG emissions, are the main source of GHG emissions as well as the main driver for the growth in GHG emissions (UNEP, 2020). The transport sector accounts for 24% of direct CO_2 emissions from fuel combustion in 2019 (IEA, 2020) [1]. Within the transport sector, road transport is, by far, the biggest emitter, accounting for more than half of all transport-related GHG emissions.

[1] IEA. Tracking Transport 2020. https://www.iea.org/reports/tracking-transport-2020

Rapidly growing mobility-needs and private vehicle ownership counteract global efforts to reduce global GHG emissions from the transport sector (McCollum et al., 2018). In order to meet the Paris Climate Agreement targets of limiting global warming to well below 2°C and aiming for 1.5°C, total global transport sector emissions need to be limited to 2–3 billion tCO_2e in 2050 from 8 billion tCO_2e in 2019 (Gota et al., 2018).

1.1.2 National GHG Emissions

Cambodia submitted her Initial National Communication (INC) (based on 1996 data) and Second National Communication (SNC) (based on 2000 data) to the UNFCCC in 2002 and 2015, respectively. According to the SNC, GHG emissions of Cambodia for the year 2000 were 47.7 million tCO_2e, while the removal was 48.2 million tCO_2e. The net GHG emissions of Cambodia for the year 2000 were recorded as – 0.5 million tCO_2e (GSSD, 2015). Therefore, Cambodia remained as a net carbon sink in the year 2000.

First BUR of Cambodia was submitted in 2020, which included emissions from 1994 to 2016. The GHG inventory includes CO_2, CH_4, N_2O, and HFC emissions from Energy; Industrial Processes and Product Use (IPPU); Agriculture, Forestry and Other Land Use (AFOLU); and Waste sectors. Table 1.1 gives the GHG emission trends of each sector. The total GHG emissions in 2016, including the FOLU was 163.6 million tCO_2e. The FOLU is the largest emission source among all sectors in Cambodia (GSSD, 2020).

Table 1.1 Trends of emissions by sectors (total GHGs, million tCO_2e using the GWP of AR4)

Sector	1994	2000	2005	2010	2015	2016
Energy	2.7	3.1	3.5	5.3	8.4	9.6
IPPU	0.004	0.006	0.013	0.493	1.0	1.8
Waste	1.5	1.9	2.1	2.4	2.7	2.8
Agriculture	11.2	13.0	15.3	18.1	18.1	18.4
FOLU	27.0	27.0	27.0	131.0	131.0	131.0
Total	15.4	18.0	20.9	26.3	30.1	32.6

(Note that it is 29% of the GHG émissions in 2019 (USEPA, 2020) (see reference. https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions). This may be due to emissions- fugitive and conversion and transportation of fuels.

(Without FOLU)						
Total (With FOLU)	42.5	45.0	48.0	157.3	161.1	163.6

Source: GSSD, 2020

1.1.3 GHG Emissions in the Transport Sector

Cambodia's First Biennial Updated Report indicated the high fuel consumption in the transport sector due to the expansion of the sector, which has led to an increase in GHG emissions. As illustrated in Figure 1.1, the transport sector accounts for 5.1 million tCO_2e in 2016, which represents the largest share of GHG emissions within the energy sector (GSSD, 2020).

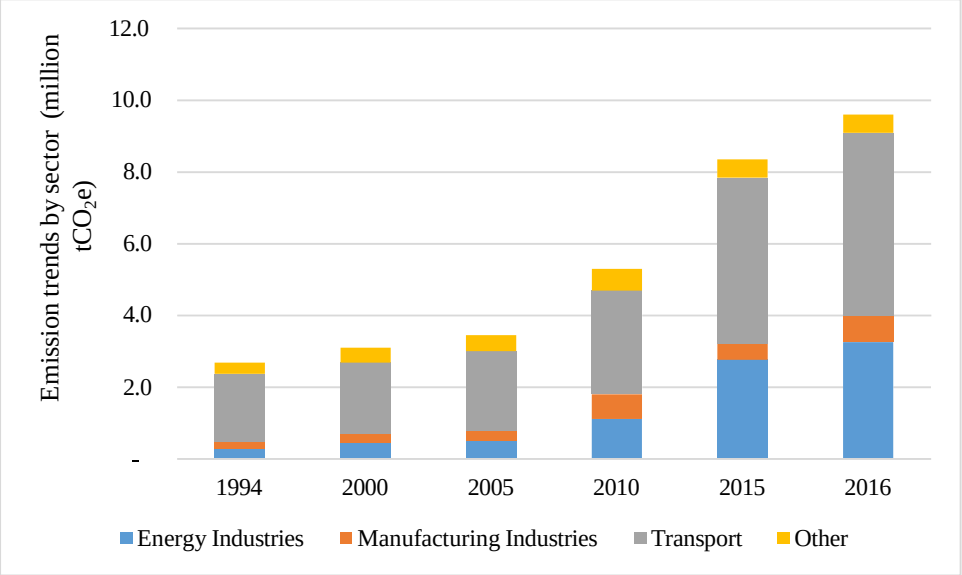

Figure 1.1: Emission Trends from 1994 to 2016, Source: GSSD, 2020

GHG emissions from the transport sector continue to increase in parallel with the growing number of vehicles. As illustrated in Figure 1.2, the transport sector will be the sector with the largest GHG emissions by 2050 (10.8 million tCO_2e), followed by energy industries, manufacturing industries, and commercial and residential sectors (GSSD, 2015).

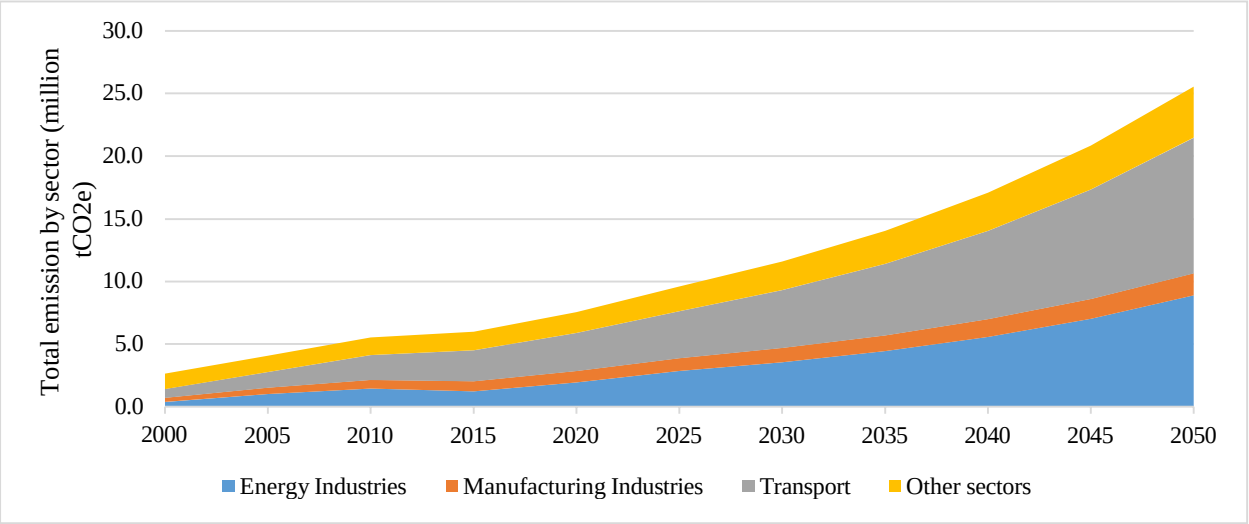

Figure 1.2: Total GHG emissions by sectors in million tCO_2e, 2000-2050, Source: GSSD, 2015

1.1.4 Cambodia's Updated NDCs and the Transport Sector

Cambodia aims to reduce GHG emissions by 42% by 2030 against the business as usual (BAU) emissions as per the updated NDCs submitted to the UNFCCC in 2020 (GSSD, 2020). Emission reductions covered FOLU, Energy, Agriculture, Industry, and Waste sectors. Table 1.2 provides information on the proposed emission reductions from each sector.

Table 1.2 Summary of BAU emissions and NDC emission reduction

Sector	BAU 2016 emissions (Million tCO_2e)	BAU 2030 emissions (Million tCO_2e)	NDC 2030 Scenario (Million tCO_2e)	NDC 2030 reduction (Million tCO_2e)	NDC 2030 emission reduction (%)
FOLU	76.3	76.3	38.2	-38.1	-50
Energy	15.1	34.4	20.7	-13.7	-40
Agriculture	21.2	27.1	20.9	-6.2	-23
Industry (IPPU)	9.9	13.9	8.0	-5.9	-42
Waste	2.7	3.3	2.7	-0.6	-18
Total	125.2	155.0	90.5	-64.5	-42

Source: GSSD, 2020

As indicated in Table 1.2, the energy sector (including the transport sector) expects a 40% emission reduction against the BAU scenario by 2030. Emission reductions from the Transport sector have been estimated based on three mitigation actions from passenger and freight transport as shown in Table 1.3.

Table 1.3 Mitigation actions/projects in Transport sector NDCs

Mitigation actions/projects	Benefits	Related SDGs
Enhance maintenance and inspection of vehicles (Piloting maintenance and emission inspections of vehicles)	1. Reduce maintenance costs 2. Reduce traffic accidents, injuries, and fatalities 3. Reduce air pollution and GHG emission 4. Innovate technology	3,5,8,9
Promote integrated public transport systems in main cities	1. Reduce traffic congestion 2. Reduce air pollution 3. Easy access to transport modes 4. GHG emissions reduction 5. Cost saving 6. Save travel time 7. Increase the comfort and safety in transport	3,5,8,9
Shift long distance freight movement from trucks to train	1. Reduce traffic congestion 2. Save travel time 3. Reduce air pollution and GHG emissions	3,5,8,9

Source: GSSD, 2020a

1.2 Objectives

1.2.1 Objectives of the project

- Develop an MRV Framework for the Transport Sector in Cambodia; and
- Develop capacity on the use of transparency-related tools, the ICAT SD assessment tool, and GACMO.

1.2.2 Objective of the deliverable

Selection of an appropriate policy/action/targets for the development of the MRV for the transport sector of Cambodia

1.3 Scope and Limitations

The scope of this study is to assess the mitigation potential and marginal abatement costs (MACs) of mitigation policies and actions of the transport sector NDCs using the GACMO

model; and to identify respective SD benefits and provide recommendations for the revision of the NDCs based on the outcome of the assessment. Further, appropriate mitigation actions related to the selected NDC components will be considered for the development of the MRV system.

Updated NDCs of Cambodia include three mitigation actions in the transport sector representing passenger and freight transport. The NDCs and related mitigation actions in transport will be prioritized in order to identify the most appropriate projects to develop the MRV system. As such, the MRV system will be developed considering one or two mitigation actions in the transport sector.

2 Methodology

Selection of appropriate mitigation actions/policies/targets for the development of an MRV system for the transport sector of Cambodia was carried out through the following six main steps.

Step1: A desk review was conducted to identify the current status of the transport sector, and to review mitigation policies and actions related to NDCs and the transparency efforts of Cambodia. Relevant policy documents were obtained from the MPWT and publicly available sources.

Step 2: An inception workshop was conducted to present initial findings related to the policy review. Findings were improved based on the feedback received at the workshop.

Step 3: Identified mitigation actions/policies were categorized under the respective NDCs.

Step 4: The NDCs were prioritized considering the criteria: i) financial feasibility, ii) political preference, iii) GHG emissions reduction and iv) SD impacts. All the criteria were assigned equal weights and each NDC was scored against these four criteria. A score between 1 (Insufficient) and 5 (Very good) was given. The scoring was based on the results of GACMO analysis, SD impact assessment, stakeholder consultation, and expert judgment. The NDCs were prioritized based on the overall scores obtained by each NDC.

The following approach was used under the four criteria mentioned above:

Financial feasibility: Under this criterion, the NDCs were assessed based on the respective MAC values. The possibility of implementing under the current economic situation in

Cambodia, budget allocations, and the availability of grants/ loans from international organizations were also considered for determining the financial feasibility.

Political preferences: Current political situation and policies that may affect the implementation of the NDCs were considered under this criterion.

Effects on GHG emissions reduction: Potential emissions reduction of each NDC, generated through GACMO were considered under this criterion.

Sustainable development impacts: Economic, Environment, and Social impacts of the NDCs were considered under this criterion.

Step 5: Mitigation projects attributed to each NDC were prioritized considering i) the likelihood of implementation and ii) the availability of data for analyses. The same process described in step 4 was followed for prioritization.

Step 6: Stakeholder consultation was held to collect feedback and validate the results

3 Transport sector

3.1 Significance of the Transport Sector to the Socio-economic Development

The transport sector plays an important role in Cambodia's national strategic goal of promoting growth, employment, equity, and efficiency as stated in the Rectangular Strategy for Growth, Employment, Equity and Efficiency, Phase IV (RSIV). Under the RSIV, the government wants to improve transport connectivity and create logistics systems to enhance the competitiveness and diversification of the economy (RGC, 2018). Similarly, the Industrial Development Policy (2015–2025) also values the improvement of the transport network especially along the industrial corridor (RGC, 2018).

The transport sector strongly supports Cambodia's four drivers of growth: agriculture, tourism, manufacturing, and commercial and residential construction. For example, road and maritime transport are needed to transport agricultural products to neighboring and overseas countries. International air carriers and road transport bring millions of visitors and passengers in and out of Cambodia annually. Road and waterway transports boost the manufacturing industry by delivering the materials needed and exporting the finished products. The construction sector needs road and waterway transports to import materials needed for the construction (ADB, 2019).

The Phnom Penh Urban Transport Master Plan (PPUTMP) assisted by Japan International Corporation Agency (JICA) is a comprehensive and integrated transport sector master plan with the target year of 2035. The PPUTMP includes a short list of project recommendations, pre-feasibility studies for priority projects, and financial and economic analysis of the priority projects. Recommendations include a shift to public transport (combination of rail, BRT, and public bus), completion of the radial-ring trunk road network, upgrading traffic management (including a modern traffic management system, parking systems, and high-quality pedestrian environments), and institutional capacity building (JICA, 2014). Shift to public transport in Cambodia's updated NDC commitments, is in line with the recommendations given in the PPUTMP. Various public transport options in Phnom Penh are being explored by donors and investors for potential projects. These projects aim mainly to improve and introduce a more sustainable public transport system in Cambodia. Some of the projects are:

(i) Agence Française de Développement (AFD) has been studying the feasibility of an urban tram system along the north-south Monivong Boulevard.

(ii) JICA has completed the feasibility study for the proposed elevated Automated Guideway Transit (AGT) or "sky train" which would link Phnom Penh International Airport to the city center.

(iii) A feasibility study on introducing public electric buses in Siem Reap Province is being conducted by the Department of Urban Transport of the MPWT. If this project is implemented successfully, it would generate enormous economic, environmental, and social benefits. Similarly, the e-bus project would also come with remarkable environmental benefits in the tourist hotspot of Cambodia.

(iv) The Road Master Plan, which indicates the road development priorities in the short term (2015–2020), medium term (2021–2025), and long term (2026–2030) was developed by the MPWT with the support of People's Republic of China (PRC) in 2017.

(v) The MPWT is constructing the expressway from Phnom Penh to Sihanoukville which is 32% completed already (MPWT, 2021).

(vi) The MPWT is studying the feasibility of constructing an expressway from Phnom Penh to Bavet (Cambodia-Vietnam border) with the support of China Railway International Group Co., Ltd.

It is expected that above-mentioned projects would enhance Cambodia's regional economic connectivity and improve local livelihood; and simultaneously, the expressways would also reduce GHG emissions by reducing traffic congestion.

The Master Plan for Railway Network Development in Cambodia was developed in 2014. It prioritized the following projects in order to promote rail transport (ADB 2019).

(i) A railway link from Phnom Penh to the new Phnom Penh Autonomous Port (PPAP) container terminal 35 km to the north;

(ii) A new 258 km railway link from Phnom Penh to the Viet Nam border, with an estimated cost of $1.4 billion, including bridges totaling 20 km in length, which are a major contributor to the high cost; and

(iii) A multimodal logistics facility at Steung Bod on the border with Thailand, which will serve freight transport, and passenger services limited to Poipet.

Even though the master plan was prepared to enhance the utilization of rail transport, Cambodia is yet to develop the required laws and regulations to govern railway infrastructure, operation, and technical standards and specifications (ADB 2019).

3.2 Modes of Transport

3.2.1 Road Transport

Road transport is the largest subsector of the transport sector. It accounts for a modal share of more than 90% in passenger and freight transport. Further, a rapid increase was observed in the active vehicle fleet over the years. The average growth rate from 2008 to 2018 was +15.6%. In 2018, 4.52 million vehicles were recorded (Sophal 2018).

Figure 3.1 illustrates the change in vehicle ownership in Cambodia over the years.

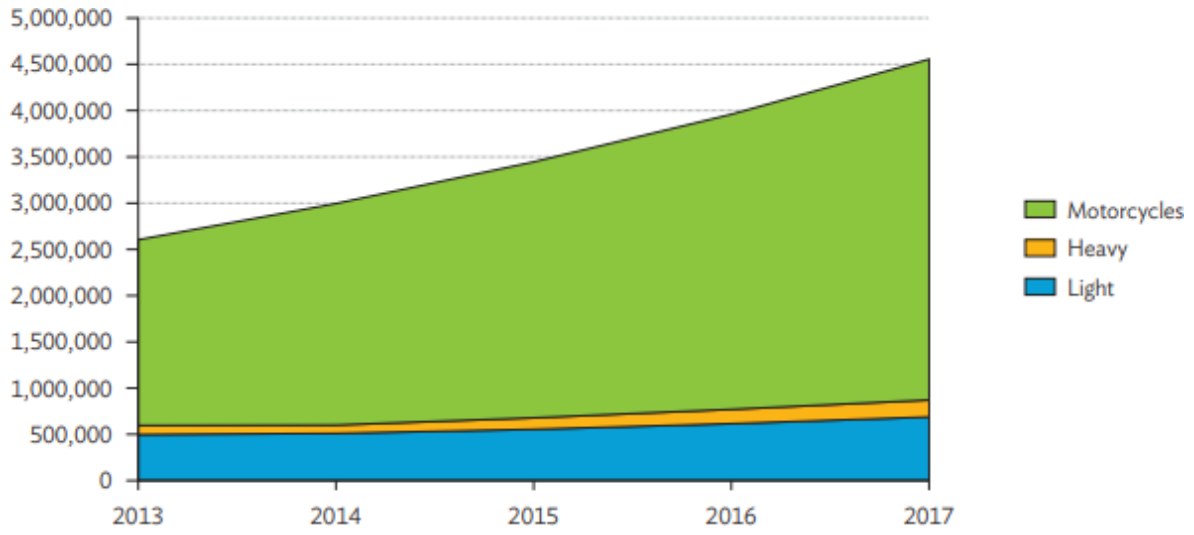

Figure 3.1 Vehicle ownership of Cambodia, Source: ADB, 2019

At present, the Cambodian road network covers approximately 61,533 km of paved and unpaved roads, including 7,261 km of national/international roads (both 1-Digit and 2-Digit roads), 9,031 km of provincial roads, and about 45,241 km of rural or tertiary roads (MPWT, 2020). In addition, road transport is often used to move goods and people within the country and between Greater Mekong Sub-regions (GMS). This mode of transport is important for social and economic development, mainly in the areas where they are the only available transport mode (ADB, 2019).

The trucking sector, which is Cambodia's major road transport industry, is fragmented. It can be classified into three segments:

(1) about 20 companies, including the biggest fleet owners, organized under the Cambodian Trucking Association, own about 2,000 trucks and focus almost exclusively on international container freight business;

(2) about 90 registered companies of different sizes, most of which qualify as small and medium-sized enterprises, own 2,870 trucks; and

(3) nonregistered microbusinesses and some small and medium-sized enterprises, with old vehicles that often run without registration or inspection (ADB, 2014).

The increasing number of trucks engaged in international trade highlights the need to make border crossings more efficient, maintain road safety, and avoid overloading to maintain road quality.

3.2.2 Rail Transport

Cambodia's railway system consists of two single-track main lines with a length of 652 km. The Northern Line, which connects Cambodia's capital city of Phnom Penh and Thailand's boundary region of Poipet city, is 386 km long, while the Southern line, which connects Phnom Penh and Cambodia's International seaport Sihanoukville, is 266 km long (MPWT,2020).

Serious deterioration of the railway's infrastructure and operating conditions as a result of years of war and civil strife have led to a decline in traffic. With financial assistance from the ADB, the Government of Australia, and the Organization of the Petroleum Exporting Countries (OPEC) Fund for International Development; the government embarked on a major rehabilitation project. Initially, this consisted of the rehabilitation of the 266 km Southern Line from Phnom Penh to Sihanoukville, the rehabilitation of 335 km of the Northern Line from Phnom Penh to Sisophon, reconstruction of the missing rail link from Sisophon to the Cambodia–Thailand border (about 48 km) and the re-establishment of the railway connection across the border to Thailand. However, because of substantial cost overruns and limited funds, the scope was reduced to rehabilitating 256 km of the Southern Line, 23 km of the Northern Line, and 42 km of the missing rail link from Sisophon to Poipet. The government has rehabilitated the remaining length of the Northern Line using its resources. As such, passenger and freight transport between Phnom Penh and Poipet has increased since July 2018. At the Poipet border with Thailand, a 1.3-km cross-border rail link connecting Poipet with Arayaprathet in Thailand was officially inaugurated in April 2019 (ADB, 2019).

However, the modal share of railways for passenger and freight transport is negligible. Figure1.4 illustrates the freight volumes transported by Northern and Southern lines over the years. Containers accounted for more than 50% of the freight transport, where diesel fuel was the main bulk commodity. Despite the significant development in traffic, the level of traffic and the average haul on the Southern Line is too low to render train operations commercially and economically viable (ADB, 2019).

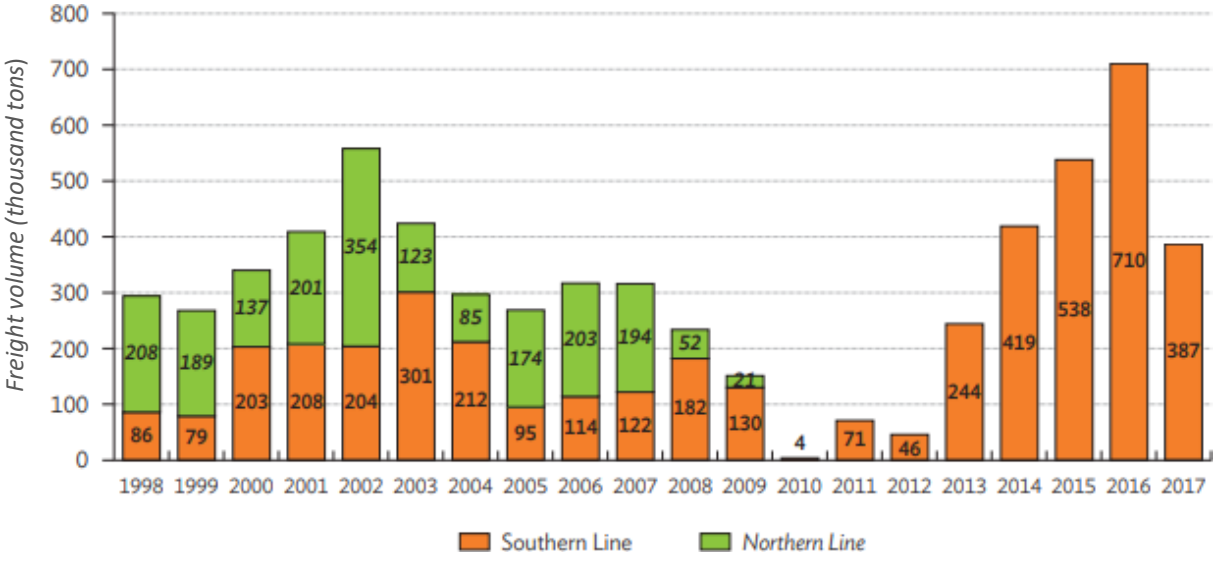

Figure 3.2 Railway freight traffic volume in thousand tons, Source: ADB, 2019

3.2.3 Waterways Transport

Domestic waterborne transport in Cambodia is still relatively limited. Waterborne transport on the Mekong River System in Cambodia consists of both inland barge traffic and seagoing vessels. The main traffic is dedicated to inland shipping for the domestic market and cross-border trade with Vietnam. The inland waterways in Cambodia are 1,750 km long. However, ships can be operated only along 580 km of inland waterways. The Mekong River, which makes up 30% of the entire inland waterways in Cambodia, is the main inland waterway. The Tonle Sap River and the Bassac River make up 15% and 5%, respectively, and all other rivers make up the remaining 50% of inland waterways. Ships longer than 110 m are not permitted along the 102 km stretch of inland waterway between Phnom Penh and the border of Cambodia and Vietnam (MPWT, 2020).

3.2.4 Air Transport

Cambodia's Tourism Development Strategic Plan for 2012–2020 projected that about 7 million foreign tourists would visit Cambodia annually by 2020 (RCG, 2012). Phnom Penh International Airport can accommodate about 5 million passengers a year and can simultaneously handle 10 aircraft. Similarly, Siem Reap International Airport can host about 5 million passengers per year and handle eight aircraft at a time, while Sihanoukville

International Airport can host about 0.5 million passengers per year and simultaneously handle four aircraft (ADB, 2019). Six million passengers travelled via Phnom Penh International Airport in 2019 by 56,018 flights operated by 35 airlines to 36 destinations; while 3.9 million passengers travelled via Siem Reap Airport by 39,750 flights operated by 31 airlines to 48 destinations. In the same year, 1.6 million passengers travelled via Sihanoukville Airport by 17,824 flights operated by 10 airlines to 11 destinations.[2.]

3.2.5 Urban Transport

Urbanization in Cambodia is still in an early stage, with only 22% of the population living in urban areas. This number is relatively low compared with urbanization in other Southeast Asian countries. The urban sprawl and uneven population distribution in the periphery of cities have resulted in large daily travel needs and high trip frequencies. Looking closely, it has been observed that private motor vehicles top the list in the transport modes, which leads to serious congestion in the cities. Even though public bus transport services are available, their practicality is limited in the cities with the result of having many private motor vehicles, private cars, and other forms of motorized transport, notably tuk tuks (ADB, 2019).

3.3 Vehicle Stock

The number of registered vehicles has been increasing in line with increasing economic activity and population. As of 2020, more than 5.8 million vehicles were registered. Motorcycle registration has increased by 10% per year since 2005, and as of 2020, motorcycles represented around 85% of all vehicle registrations. There are 4,974,486 registered motorcycles, 615,133 registered cars, and 260,808 registered heavy vehicles (minibuses, buses, pick-up trucks, and trucks). As shown in Figure 1.5, motorcycles play an important role in road transport.

[2] https://www.vinci-airports.com/en/vinci-airports

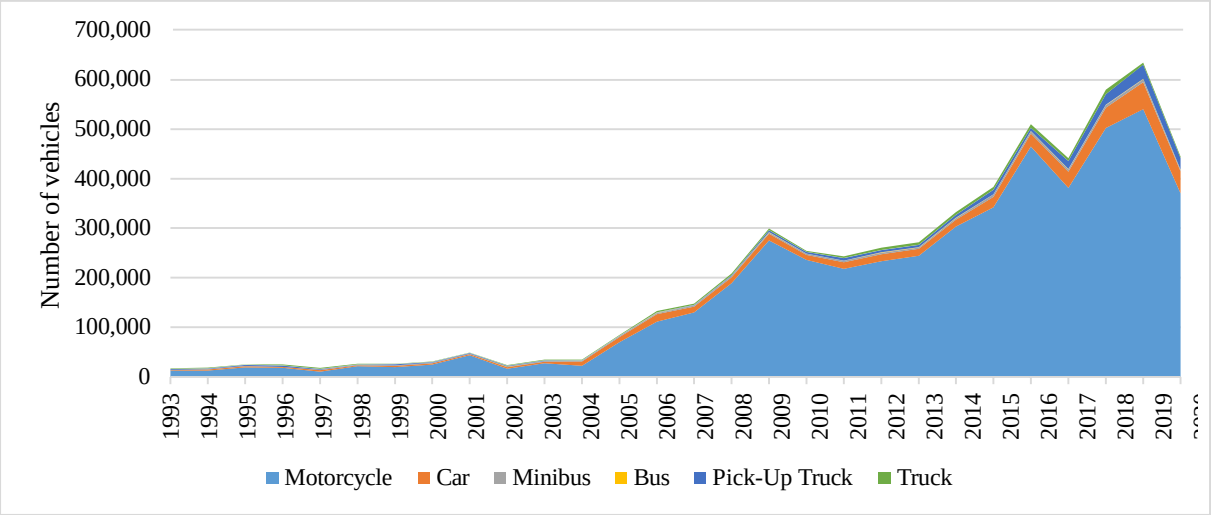

Figure 3.3 *New registration of vehicles from 1993-2020, Source: MPWT, 2021*

Gasoline and diesel are the most common types of fuels consumed by vehicles in Cambodia. As indicated in Figure 1.4, more than 90% of vehicles consume gasoline.

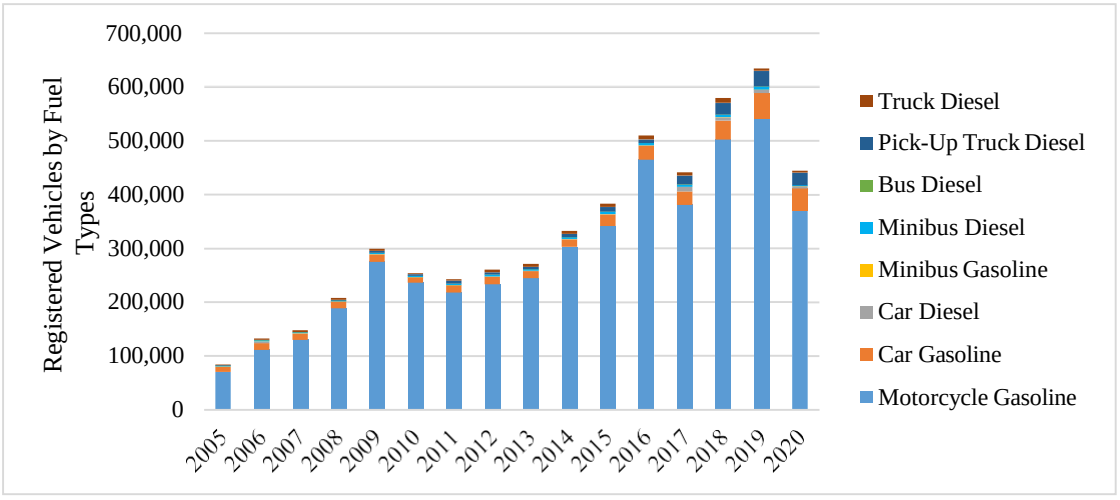

Figure 3.4 *Registered vehicles by fuel types from 2005 to 2020, Source: MPWT, 2021*

3.4 Policies and Strategies in the Transport Sector

Policies and strategies in the transport sector have been formulated in the past two decades to facilitate Cambodia's robust economic development. The formulated policies and strategies aim to enhance transport connectivity so that Cambodia could become a regional hub for trade and transit. Other policies and strategies aim to make the transport sector more sustainable and

greener for the purpose of reducing GHG emissions. The following table provides details of the policies and strategies relevant to the transport sector.

Table 3.1 Summary of policies and strategies in the transport sector

No.	Policy or Strategy	Goals relevant to transport Sector	Status	Source
1	National Strategic Plan on Green Growth 2013-2030	This strategy emphasizes the importance of green transport, such as electric trains, renewable energy-powered vehicles, electric motorcycles, and electric bicycles, to mitigate GHG emissions and pollution.	Active	National Council on Green Growth, 2013
2	National Policy on the Development of the Land Transport Sector 2021-2030	One of the strategies is to modernize the road transport sector without harming the environment. The policy also aims to limit the usable age of vehicles, especially heavy-duty vehicles. The policy would encourage the use of hybrid, clean fuel (LPG, CNG), and electric vehicles as well. Therefore, it would contribute immensely to the reduction of GHG emissions from the transport sector.	In Draft	MPWT, 2021a
3	Interim Master Plan on Intermodal Transport Connectivity and Logistics System 2020	One of the key objectives is to give importance to the construction of ring roads and feeder roads to ensure smooth traffic movement along the southern economic corridor; as well as relieving traffic congestion. Therefore, the implementation of the Master Plan would result in GHG emission reductions in the road transport sector.	Completed	MPWT, 2020
4	Climate Change Action Plan for the Transport Sector 2020-2023	One of the strategic objectives of the CCAP is to mitigate emissions from the transport sector through the following actions: 1. Improve vehicle inspection and maintenance systems, 2. Promote integrated public transport systems in major cities, 3. Promote the establishment of green belts along major roads for climate change mitigation,	In Draft	MPWT, 2020a

		4. Promote the introduction of low emission vehicles and/or low-carbon fuels, 5. Promote the modal shift for long-distance freight movement, 6. Modernization of traffic control and management in major cities to reduce traffic congestion, and 7. Promote non-motorized transport: introduce cycle paths, sideways and pedestrian zones in major cities.		

3.5 Mitigation Actions/ Projects in the Transport Sector

Various mitigation projects related to the transport sector would lead to emission reductions and technology transfers. Some of the transport sector mitigation actions and projects (within mitigation actions) related to NDCs or transparency efforts of Cambodia are:

- Enhance maintenance and inspection of vehicles
    a. Introduce 14 inspection centers by 2030[3]

Cambodia has established vehicle inspection centers to improve the conditions of the vehicle fleet. Objectives of the project are to: i) ensure road safety, ii) reduce traffic jams, and iii) reduce air pollution. Currently, 15 inspection centers are in operation all over the country (Sen David 2020). It is expected to introduce 14 more centers by 2030. Vehicle Inspection Centers undertake regular inspections, once a year for commercial vehicles and once every two years for private vehicles. Several measurements/tests are conducted during an inspection, among others: appearance inspection, speedometer testing, sound level measurement, headlight testing, slide slip testing, and weighing on a weighbridge. A certificate is issued when a vehicle passes all these tests. Vehicles that fail to meet the expected standards need to be repaired in order to obtain the certificate. Holding an expired certificate or failure to take the inspection within the required time period are subject to fines (JICA n.d.).

[3] https://www.jica.go.jp/project/english/cambodia/022/materials/c8h0vm0000drxng6-att/project_01_en.pdf https://www.khmertimeskh.com/50771514/28-percent-of-vehicles-not-registered-for-use/

Considering the emissions reductions offered by well-maintained vehicles, this mitigation project was considered for the assessment.

- Promote integrated public transport systems in main cities
    a. A pilot project to shift passengers from private cars to 23 public buses by 2021 in Phnom Penh[4]

Phnom Penh has a population of about 2.3 million as of 2019 (NIS/MoP, 2020)) and a land area of 678 km². Traffic conditions and traffic accidents in Phnom Penh have been worsening in recent years due to the rapid increase of vehicles and the lack of public transport facilities. Phnom Penh Capital Administration (PPCA) currently operates 3 bus routes with 57 vehicles; however, the service levels such as the number of routes and headways are inadequate with respect to the population. As such, the 2035 Master Plan aims to increase the modal share of public transport by 30%, initiated by a 10% increase in 2020 through a scheme of 10 bus routes. To achieve the enhancement of the transport capacity of public bus service, the existing 57 second-hand vehicles will be sold and 80 new ones including maintenance equipment would be procured. This will meet the requirements for the expansion of the number of bus routes to 5 as well (JICA 2014, 2016).

Objectives of the project are to: i) reduce traffic issues such as congestion, accidents, and air pollution; ii) increase average speed in the capital city and improve overall urban mobility; iii) reduce private-owned automobiles; iv) create employment for people; v) improve traffic flow in the capital as a pilot experiment for BRT; and vi) improve cityscape of the capital city.

Private passenger cars, motorcycles, or para-transit modes such as Motodop are still the main players in the city. It is expected that passengers will shift from these modes to public buses contributing to a reduction of emissions. This project is also considered under the assessment. However, the assessment was limited to passenger shift from cars to rail due to the limitations of the GACMO model.

- Shift long distance freight movement from trucks to train

Bulky, relatively low-value items are normally best transported by railway, in particular over long distances. However, in Cambodia, such a railway option is unavailable, which causes high

[4] https://openjicareport.jica.go.jp/pdf/12267720.pdf

transport costs for bulky goods for long distances. Lack of modal competition results in high prices and low productivity compared to road transport operations. Under these circumstances, the emergence of viable railway operations will strengthen the Cambodian logistics sector and make it more competitive (JICA 2018).

Due to the lack of data and unavailability of a specific project, this was not considered for GACMO analysis.

- E-mobility
    a. Introduce 50 electric buses in Siem Reap[5]

Along with many countries of the Association of Southeast Asian Nations (ASEAN), Cambodia also promotes the electrification of road transport or electric mobility. Cambodia encourages the use of electric buses and motorbikes. As part of promoting e-mobility projects, it is expected to introduce electric buses to Siem Reap city. A pre-feasibility study of the project has already been conducted.

Objectives of the project are to: i) reduce traffic issues such as congestion, accidents, and air pollution; ii) vitalize the city of Siem Reap in order to promote the tourism sector in that city after the Covid-19 pandemic is controlled; iii) promote sustainable development by encouraging public transport with clean energy to be in line with the National Strategic Plan on Green Growth 2013-2030; iv) promote gender inclusiveness plan such as allocating a certain percentage of drivers/maintenance staff to female workers; and v) promote private-public partnership projects.

This project was also considered for the assessment, as e-mobility will be a major contributor to reducing GHG emissions.

[5] https://www.khmertimeskh.com/50637280/indian-companies-eye-bus-project-partnership-with-cambodian-govt/

4 Mitigation Potential and Marginal Abatement Cost Assessment of Transport Mitigation Actions related to updated NDCs

Several mitigation actions and policies have been proposed and implemented by Cambodia to reduce the GHG emissions from the transport sector. However, these projects need to be analyzed further, to identify if these are environmentally sound and economically efficient.

On this, Marginal Abatement Cost (MAC), which indicates the cost of reducing emissions, equivalent to one tCO_2e, was calculated. Table 4.1 summarizes the marginal abatement cost of each mitigation action considered under each NDC.

Table 4.1 Marginal Abatement Cost of mitigation actions

No	Mitigation action in NDC	Selected project	MAC (USD/ tCO_2e)	Annual Emission reduction (tCO_2e)
1	Enhance maintenance and inspection of vehicle (Piloting maintenance and emission inspections of vehicles)	Introduce 14 vehicle inspection centers	(205.91)	599
2	Promote integrated public transport systems in main cities	Shift passengers from private cars to 23 public buses by 2021 in Phnom Penh	84.03	28,267
3	Shift long distance freight movement from trucks to train	No project available	-	-
4	Integrate e-mobility with main NDCs or introduce as a new main NDC	Promote e-mobility -*Introduce 50 electric buses*	138	928
		Promote e-mobility - *Tax incentives on EV imports*	-	-

5 Sustainable Development benefits of the Transport sector mitigation actions related to updated NDCs

As Cambodia is a developing country, it is important to achieve sustainable development goals, while reducing GHG emissions. Therefore, it is necessary to identify mitigation actions related to NDCs that can meet a wide range of environmental, social, and economic objectives. Furthermore, this will also help meet the objectives of the 2030 Agenda for Sustainable Development Goals.

This assessment will be limited to a qualitative analysis. Table 5.1 summarizes the number of specific sustainable development impacts associated with each mitigation action in the NDCs. The detailed analysis is provided in Annex I.

Table 5.1 Summary of the qualitative assessment

Mitigation action in NDC	Selected project	Identified specific impacts				
		Economic	Environmental	Social	Total	Significant impacts out of total
Enhance maintenance and inspection of vehicles	Introduce 14 vehicle inspection centers	5	5	4	14	10
Promote integrated public transport systems in main cities	Shift passengers from private cars to 23 public buses by 2021 in Phnom Penh.	5	4	7	16	13
Shift long distance freight movement from trucks to train	Shift 10% of truck cargo volume to train	3	4	4	11	6
Additional potential mitigation action to NDC revision	Introduce 50 electric buses	3	6	3	12	10

6 Select mitigation actions in NDCs to develop the MRV system

NDCs were prioritized considering the four criteria: i) financial feasibility; ii) political preference; iii) GHG emission reduction; and iv) SD impacts. All criteria were given equal weight, and then each NDC was scored against these four criteria. A score between 1 (Insufficient) and 5 (Very good) was given. The scoring was based on the results of GACMO analysis, SD impact assessment, stakeholder consultation, and expert judgment. NDCs were prioritized based on the overall scores obtained for each NDC. Data, information considered, and assumptions made to make the judgment are given in Annex II.

Table 6.1 Summary of mitigation action analysis

No	Mitigation action in NDC	Selected project	MAC (USD/ tCO_2e)	Annual Emission reduction (tCO_2e)	Identified specific impacts				
					Economic	Environmental	Social	Total	Significant impacts out of total
1	Enhance maintenance and inspection of vehicles (Piloting maintenance and emission inspections of vehicles)	Introduce 14 vehicle inspection centers	(205.91)	599	5	5	4	14	10
2	Promote integrated public transport systems in main cities	Shift passengers from private cars to 23 public buses by 2021 in Phnom Penh	84.03	28,267	5	4	7	16	13
3	Shift long distance freight movement from trucks to train	No project available	-	-	3	4	4	11	6
4	Potential mitigation actions to NDC revision	Introduce 50 electric buses	138	928	3	6	3	12	10

Based on the analysis below, first and second-ranked mitigation actions are proposed to be used for the development of transport sector MRV.

Table 6.2 Scoring matrix for mitigation actions of NDCs

Mitigation action in NDC	Financial feasibility	Political preference	Effect on GHG reduction	SD impacts	Total score	Rank
Enhance maintenance and inspection of vehicles	4	4	2	4	14	2
Promote integrated public transport systems in main cities	1	4	5	5	15	1
Shift long distance freight movement from trucks to train	1	1	-	3	5	3

7 Select mitigation policy/project targets to develop the MRV system

Several projects are proposed/implemented under each mitigation action of the NDCs. It is important to identify the most effective and measurable projects to develop the MRV system. Weights between one and five, which represent insufficient to very good (1- insufficient, 2- sufficient, 3- satisfactory, 4- good, and 5-very good) were given for each project considering the likelihood of implementation and data availability to assess the GHG impacts. Weights were given based on expert judgment and stakeholder consultations. Data, information considered, and assumptions made to make the judgment are given in Annex II. To develop the MRV system, mitigation projects were ranked based on the total weight. Table 7.1 summarizes the results of the prioritization.

Table 7.1 Summary for prioritization of mitigation projects

Selected projects	Likelihood of implementation	Data availability	Total mark	Rank
Introduce 14 vehicle inspection centers	4	4	8	2
Shift passengers from private cars to 23 public buses by 2021 in Phnom Penh.	5	4	9	1
Introduce electric buses	3	2	5	3

As indicated in Table 7.1, s**hift passengers from private cars to 23 public buses by 2021 in Phnom Penh** and the **introduction of 14 vehicle inspection centers** can be proposed to develop the MRV system. However, the selection of projects will be finalized based on the feedback from the stakeholders.

8 Conclusion

Considering the outcomes of the above analyses, the following actions are proposed to be selected to develop the transport sector MRV system for Cambodia.

- Promote integrated public transport systems in main cities
    a. Shift passengers from private cars to 23 public buses by 2021 in Phnom Penh.
- Enhance maintenance and inspection of vehicles
    a. Introduce 14 vehicle inspection centers by 2030

The accuracy of the analyses depends highly on the accuracy of activity data. However, lack of activity data was identified as a crucial barrier for these analyses. Therefore, it is recommended to maintain a systematic MRV system to track the progress of mitigation actions.

9 References

ADB. 2014. *Green Freight in Cambodia, Opportunities for Market-Based Interventions.* Manila.

Asian Development Bank (2019). *Cambodia Transport Sector Assessment, Strategy, and Road Map*. Manila.

Eckstein D, Künzel V, Schäfer L, Winges M (2020). *Global Climate Risk Index*. Berlin.

Edelenbosch OY et al (2017). *Decomposing passenger transport futures: comparing results of global integrated assessment models*. Transp. Res. D 55:281–93

Gota S, Huizenga C, Peet K, Medimorec N, Bakker S (2018). *Decarbonising transport to achieve Paris Agreement targets*. Energy Efficiency. DOI: 10.1007/s12053-018-9671-3

GSSD (2015). *Cambodia's Second National Communication under the UNFCCC*.

GSSD (2020). *First Biennial Update Report of the Kingdom of Cambodia*. Phnom Penh.

GSSD (2020a). *Cambodia's Updated Nationally Determined Contribution*. Phnom Penh.

IPCC (2015). *Transport Climate Change 2014: Mitigation of Climate Change: Working Group III Contribution to the IPCC Fifth Assessment Report*. Cambridge: Cambridge University Press.

JICA (2014). *The Project for Comprehensive Urban Transport Plan in Phnom Penh Capital City*

JICA. (2014). *The project for comprehensive urban transport plan in phnom penh capital city (pputmp) final report executive summary*.

JICA. (2016). *Preparatory Survey Report on the Project for Improvement of Transportation Capacity of Public Bus in Phnom Penh*.

JICA. (2018). *Data Collection Survey on Logistics System Improvement in the Kingdom of Cambodia*.

JICA. n.d. *The Project for Modernization of Vehicles Registration and Inspection Administration System (MVRI)*.

McCollum DL et al (2018). *Interaction of consumer preferences and climate policies in the global transition to low-carbon vehicles.* Nat. Energy 3:664

MPWT (2019). *Annual Report for 2018 and Planning for 2019*. Phnom Penh.

MPWT (2020). *Interim Master Plan on Intermodal Transport and Connectivity and Logistics System*. Phnom Penh.

MPWT (2020a). *Climate Change Action Plan for the Transport Sector 2020-2023 (in draft).* Phnom Penh.

MPWT (2021). *Annual Report for 2020 and Planning for 2021*. Phnom Penh.

MPWT (2021a). *National Policy on the Development of the Land Transport Sector 2021-2030 (in draft)*. Phnom Penh.

National Council on Green Growth (2013). *National Strategic Plan on Green Growth 2013-2030*. Phnom Penh.

National Institute of Statistics/Ministry of Planning (2020). *General Population Census of the Kingdom of Cambodia 2019*. Phnom Penh, Cambodia.

RGC (2018). *Rectangular Strategy for Growth, Employment, Equity, and Efficiency: Building the Foundation toward Realizing the Cambodia Vision 2050, Phase IV of the Royal Government of Cambodia of the Sixth Legislature of the National Assembly*. Phnom Penh.

United Nations Environment Programme (2020). *Emission Gap Report 2020*. Nairobi.

Sen David. (2020). "28 Percent of Vehicles Not Registered for Use - Khmer Times."

Sophal, Kong. (2018). "Country Presentation Cambodia." in *Intergovernmental Eleventh Regional Environmentally Sustainable Transport (EST) Forum in Asia* .