KINGDOM OF CAMBODIA

Nation, Religion, King

Climate Change Strategic Plan For For Climate Change Adaptation And Greenhouse Gas Mitigation In Transport Sector

MINISTRY OF PUBLIC WORKS AND TRANSPORT

2013

PREFACE

Transport is an inevitable foundation of our daily life. It supports economic development and growth. Meanwhile, it also accounts for greenhouse gas (GHG) emissions worldwide through emission of carbon dioxide, which subsequently has adverse impact on climate change. Over the last three decades, carbon dioxide emissions from transport have risen than those from all other sectors and are projected to rise more rapidly in the future. Improving energy efficiency and reducing transport emissions are among the greatest challenges that transport sector is today facing. It needs to be worked more intensively at national and global collaboration to find the best way forward.

The transport sector is one of the major sources of greenhouse gases that contribute to climate change. As such, there are two linkages between surface transportation and climate change that are important from a policy and transportation planning perspective: 1) global transportation is responsible for a significant portion of climate change through the emission of vehicular greenhouse gases, and 2) a changing climate could have serious consequences on the resiliency and performance of surface transportation systems in response to environmental conditions.

In the parlance of today's policy and planning language, the first issue leads to strategies to mitigate the impact of transportation-related GHG emissions, whereas the second issue leads to strategies to adapt the transport system to changes in environmental conditions. Therefore, the Ministry of Public Works and Transport established Working Group to spearhead the formulation of a "National Strategic Plan for Climate Change Adaptation and Greenhouse Gases Mitigation in Transport Sector." The strategies have been categorized into two main strategies: mitigation of GHG emissions in transport sector and climate change adaptation in transport sector.

On behalf of the Ministry of Public Works and Transport, I would like to take this opportunity to express my gratitude to MPWT's technical working group and especially to Ministry of Environment for providing the technical guidance and assistance to develop this national strategic plan.

Phnom Penh, 31 /December/2012

H.E. Tram Iv Tek
Minister of Public Works and Transport

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Acronyms and Abbreviations

ADB	Asian Development Bank
BOT	Build Operate Transfer
CO	Carbon Monoxide
DWT	Dead Weight Ton
GMS	Greater Mekong Sub-Region
HC	Hydrocarbon
MDG	Millennium Development Goal
MoE	Ministry of Environment
MPWT	Ministry of Public Works and Transport
MRD	Ministry of Rural Development
NSDP	National Strategic Development Plan
OFID	OPEC Fund for International Development
OPEC	Organization of Petroleum Exporting Countries
RAMP	Road Asset Management Project
SEZ	Special Economic Zone
SKRL	Singapore Kunming Rail Link
SSCA	State Secretariat of Civil Aviation

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Executive Summary

Transport plays an important role in economic growth. The transport sector in Cambodia is under the management of the Ministry of Public Works and Transport (MPWT). The MPWT is responsible for developing specific national policy concerning all public works construction, by establishing the principles of law and relevant regulations and cooperating with diverse organizations to develop the country. It is also responsible for building, maintaining and managing all transport infrastructure of national and provincial roads, bridges, ports, railways and waterways.

The road network in Cambodia consists of 5,486 km of national road (2,114 km are 1st digit and 3,372 km are 2nd digit), 6,607 km of provincial road and 33,005 km of rural road (as of September 2011). The railway originally consisted of the northern line from Phnom Penh to Poipet (386 km) on the Thai border, and the southern line from Phnom Penh to Sihanoukville (266 km). Among the ports in Cambodia, only Sihanoukville Port and Phnom Penh Port handle international containers. The total length of Cambodia's navigable inland waterways is 1,750km, comprising the Mekong River (30% of the total length), Tonle Sap (15%), and Basac (5%). Other waterways, making up 5%, allow ships to travel in shallow waters, with a depth that can only transport goods from 100 to 150 tons.

The transport sector in Cambodia suffered direct and indirect damage caused by flooding; not only to roads but also to drainage structures and other connecting infrastructure, like bridges and culverts. As a result of inadequate compaction, water erosion caused by flooding damages most embankments and slopes, and road drainage systems are often not adequate, especially with respect to low-lying roads. In addition, technical specifications of roads are not suitable for climate change adaptation. According to MPWT, in 2011, 16 out of 24 provinces and municipalities were inundated and over 1.5 million people were affected. Total national and provincial roads affected by flooding were 186 lines, with the length of damage being 718.08 km. Twenty provincial and national bridges were damaged.

The number of registered vehicles, such as motor cycles, cars, minibuses, buses, pick-ups and trucks has increased dramatically since 2005, and reached more than 307,000 vehicles in 2009. However, the number of registered automobiles gradually declined in 2010 and 2011. Road accidents are a serious problem in Cambodia. According to data from MPWT, there were 5,007 road accidents in 2011, in which 1,890 people were killed, 4,910 severely injured and 3,644 slightly injured.

The common problems of the transport sector in big urban centers are congestion, fatalities and injuries due to traffic accidents. Furthermore, an increasing demand for mineral oil fuels creates air pollution. Transport activities adversely affect cities' development, causing increased noise levels, loss of urban livability and loss of green spaces. In particular, the high growth of transport increases CO2 emissions, compared to other economic sectors.

To address activities to reduce greenhouse gas emissions in the transport sector, and to cope with the impact of climate change on transport infrastructure in Cambodia, the MPWT has formulated a "National Strategic Plan for Climate Change Adaptation and Greenhouse Gas Mitigation in Transport Sector."

Strategic Framework for Climate Change Adaptation in Transport Infrastructure:

- **Strategy 1:** Repair and rehabilitate the existing road infrastructure and ensure effective operation and maintenance system;
- **Strategy 2**: Design and construct a road drainage system to meet changing conditions expected with climate change;
- **Strategy 3**: Enhance adaptation capacity of road networks to extreme climate events;
- **Strategy 4**: Capacity building and institutional strengthening.

Strategic Framework for Greenhouse Gas Mitigation in Transport Sector:

- **Strategy 1**: Raise public awareness about climate change caused by greenhouse gas emissions from the transport sector;
- **Strategy 2**: Enhance inspection and maintenance of vehicles;
- **Strategy 3**: Promote public transport in major cities;
- **Strategy 4**: Mitigation and low carbon development;
- **Strategy 5**: Capital-intensive urban transport infrastructure development and planning;
- **Strategy 6**: Efficient and proven transport technology;
- **Strategy 7**: Improve petroleum-based fuel;
- **Strategy 8**: Shift long distance freight movement from trucks to trains;
- **Strategy 9**: Enhance traffic management;
- **Strategy 10**: Promote efficient driving.

Indicators

General Information:

- Department of Public Works and Transport - City/Province Amount 24
- Bureau of Public Works – Khan Amount 8
- Bureau of Public Works – District/City Amount 159
- Total road Length 44,919 km (2010)
- Bridge Amount 4,060 bridges
- Railway Length 650 km (2011)
- International Port Amount 3
- Domestic Port Amount 5
- Public Enterprise Amount 4
- Ferry Amount 84 (3 State-owned: Steung Treng 1, Svay Chrum 1, Neak Loeung 1)

	Completed Important Indicators	Unit	2010	2011
	Public Officials, Employees, Labor			
	Central Administration	People	2,327	1,683
	Provincial/City Administration	People	1,931	1,811
	Entity in charge of finance	People	138	128
	Public enterprise	People	1,582	1,563
	Total	People	5,978	5,185
	Total Road Network in Cambodia	km	44,919	45,101
	NR 1 digit (08 lines)	km	2,114	2,114
	NR 2 digits (45 lines)	km	3,372	3,372
	PR 3 digits and 4 digits (280 lines)	km	6,427	6,607.44
	Rehabilitated road paved with AC/DBST 1 digit and 2 digits	km	2,852	3,881
	Vehicle Registrations			
	Tourist car	Vehicle	15,599	22,127
	Minibus	Vehicle	2,410	2,894
	Bus	Vehicle	226	404
	Pick-Up	Vehicle	3,750	5,199
	Truck	Vehicle	2,173	2,888
	Motorcycle	Vehicle	236,328	218,217
	Total	Vehicle	260,486	251,729
	Registered Vehicle	Vehicle	1,652,051	1,903,780
	State of Traffic Accidents			
	Number of traffic accidents	Case	5,518	5,007
	Died	People	1,649	1,890
	Slightly injured	People	4,990	4,910
	Seriously injured	People	4,550	3,644
	Died percentage per 10,000 vehicles		9.94	9.92
	Died percentage per 100,000 people		11.94	13.45

I. INTRODUCTION

After the implementation of the Win-Win policy by the Government in 1998, the Cambodian population now lives in full peace. Cambodians are working together to reduce poverty, focusing on re-developing the country after having been destroyed by more than two decades of civil war. Political stability brought essential development activities, and international development financing also played an important role.

Presently, under the leadership of Samdech Akka Moha Sena Padei Techo HUN SEN, Prime Minister of the Kingdom of Cambodia, the country has changed greatly, mainly in the field of transport infrastructure. The number of roads paved with AC/DBST across Cambodia has increased. Through MPWT, roads and bridges are being built, renovated and linked to every city-province-rural area all over the country, and connected to other countries in the region. This facilitates transport activities of the population, to enhance families' and the country's economies.

The continuous rehabilitation and construction of physical infrastructure remains a priority of the second phase of the Government's "Rectangular Strategy", of the fourth legislative term of the National Assembly. The Government has stated that the transportation network plays a pivotal role in leading economic growth, and is indispensable to economic activities for internal, regional and global integration; it is an efficient way to alleviate poverty and improve living standards and national protection.

Transport interacts with the natural environment in a number of different ways. Recently, the country frequently experienced floods and droughts that caused considerable economic losses and social and environmental impacts. The primary road network is threatened by floods which are believed to be caused by climate change. Changes in rainfall patterns, particularly wetter conditions with greater flows and higher water levels in catchment areas, can damage road and rail transport infrastructure. Higher moisture levels in soil make roads weaker, and with heavy rains, the capacity of cross-drainage structures and bridges may be exceeded, leading to flooding, impassability and expensive repairs. Changes in land use and poor land management can increase erosion. In addition, the transport sector is one of the major sources of greenhouse gas emissions, especially CO_2 emission. The transport sector consumed a large amount of fuel, which is the main source of air pollutants and greenhouse gases. The emissions from the transport sector will increase from 785 GgCO equivalents in 2000 to 11,376 GgCO in 2050 with motorbikes, cars, pickups and trucks as the main emitters (Ministry of Environment (MoE) 2010).

Cambodia's transport system development is a crucial element in the economic growth of the country and in improving the quality of life of its people. The MPWT is responsible for cutting across

the operation, ownership, management and regulation of the entire sector. However, rural roads and air transport are not under the responsibility of MPWT.

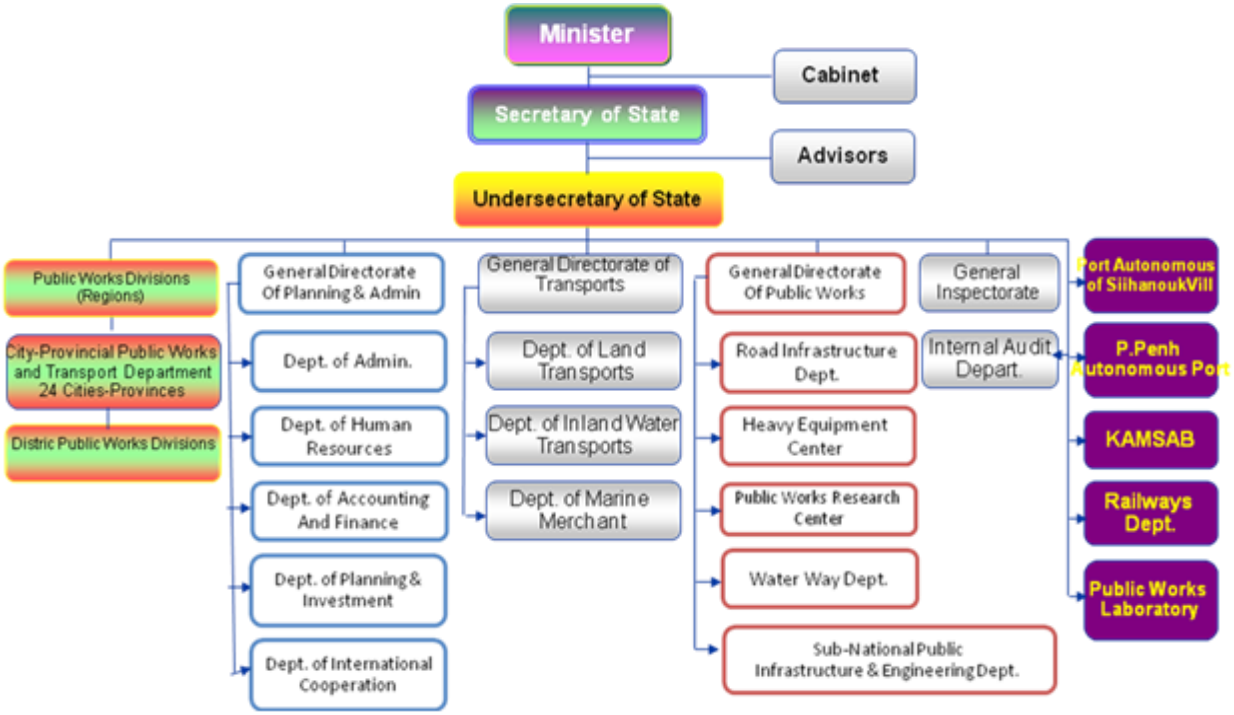


Figure 1: Organizational Structure of Ministry of Public Works and Transport

II. Current Status of Transport Sector in Cambodia

2.1 Transport infrastructure status in Cambodia

2.1.1 Road

A Cambodian road network is part of the Asian Highway (AH) No.1, No.11 and No. 123. Cambodia occupies 1,339 km out of 140,479 km of total AH (Wikipedia, 2010)[1]. The road network in Cambodia consists of 5,486 km of national road (2,114 km are 1st digit and 3,372 km are 2nd digit), 6,607 km of provincial road and 33,005 km of rural road (as of September 2011). The national roads are mostly primary road networks linking Phnom Penh to provincial capitals and important centers of population and economic activity (Fig. 2).

[1] Cambodia occupied 1,339 km out of 140,479 km of total AH (Source: Wikipedia, 2010)

Table 1: Road network length

Road classification	Length (Percentage)	No. of Bridges (Percentage)	Bridge length (Percentage)	Management Authority
1-digit national roads	2,114km (5%)	589 (14.5%)	17,643m (23.1%)	MPWT
2-digit national roads	3,372km (7%)	698 (17.2%)	15,710m (20.6%)	
3-,4-digit provincial road	6,607km (14%)	904 (22.3%)	16,309m (21.4%)	
Rural road	33,005km (73%)	1,869 (46.0%)	26,559m (34.8%)	MRD
Total length	45,101km (100%)	4,060 (100%)	76,221m (100%)	

Source: MPWT and MRD

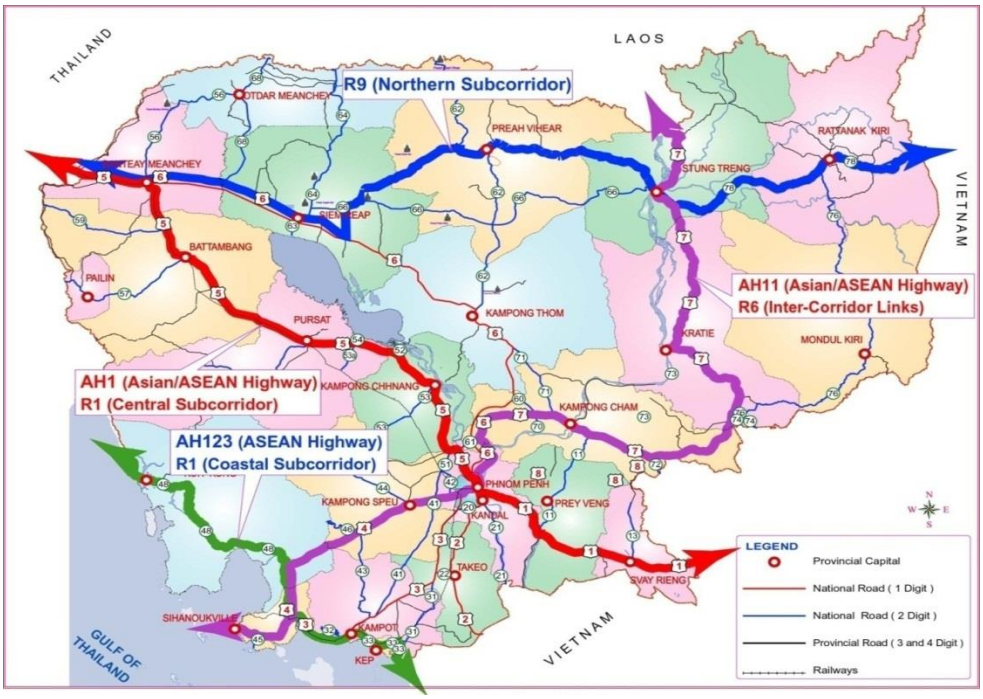


Figure 2: International highway (ESCAP, GMS & AH) (Source: MPWT)

2.1.2 Railway

The railway originally consisted of the northern line from Phnom Penh to Poipet (386 km) on the Thai border, and the southern line from Phnom Penh to Sihanoukville (266 km) (Table 2 and Fig. 3). The section of the northern line to Sisophon (338 km from Phnom Penh) is in a state of disrepair, while the final section from Sisophon to Poipet (48 km) no longer exists; it was destroyed during the civil war of the 1970s, and now requires replacement. At Poipet, the northern line used to connect with the Thai railway, and the southern line connected with the Sihanoukville port. Once they are functioning again, both of Cambodia's rail lines are expected to become part of the Greater Mekong Sub-region (GMS) Southern Economic Corridor and will help Cambodia become more competitive by offering faster and less expensive transport.

Table 2: Situation of Railway Facilities

Item	Northern Line (N/L)	Southern Line (SL)
Length (km)	386km	266 km
Section	Phnom Penh - Kampong Chhnang – Pursat – Battambang – Sisophon – Poipet	Takeo-Kampot-Sihanoukville
Station (number)	49 (Current Operation 7)	27 (Current operation 7)
Construction Year	1929-1942	1960-1969

Source: MPWT

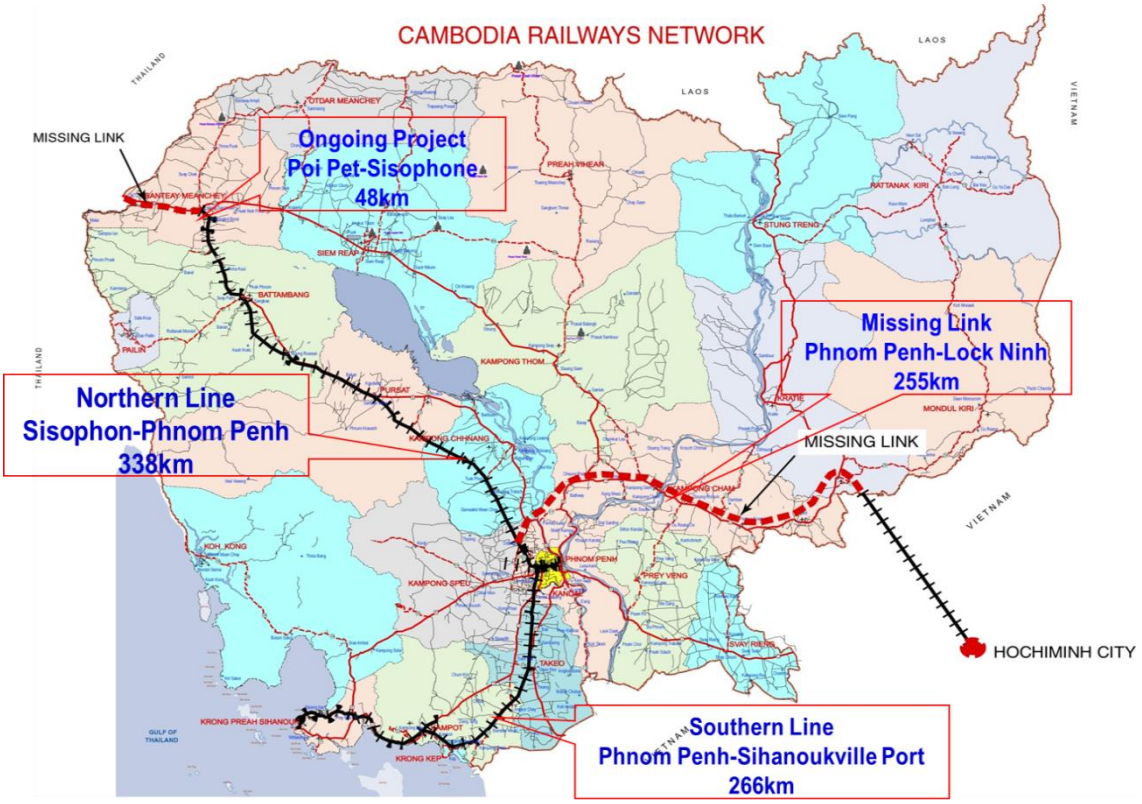


Figure 3: Cambodia Railway Network (Source: MPWT)

2.1.3 Maritime and waterway

Among the ports in Cambodia, only Sihanoukville Port and Phnom Penh Port handle international containers. Others are extremely small sea or river ports, such as Koh Kong port, Sre Ambel port and Kampot port, with the exclusion of the petroleum jetty in Sihanoukville city and Oknha Mong Port (Fig. 4).

Waterway transport is an important economic lifeblood to Cambodia. MPWT is in charge of managing the waterway transport network, along the Mekong River and tributaries, and the network of the Tonle Sap and Basac Rivers, which have a total length of 1,750 km. Year-round navigation is possible through 580 km length and one-third of the width of the river. Inadequate dredging and navigation aids have been impediments to increased use of these waterways.

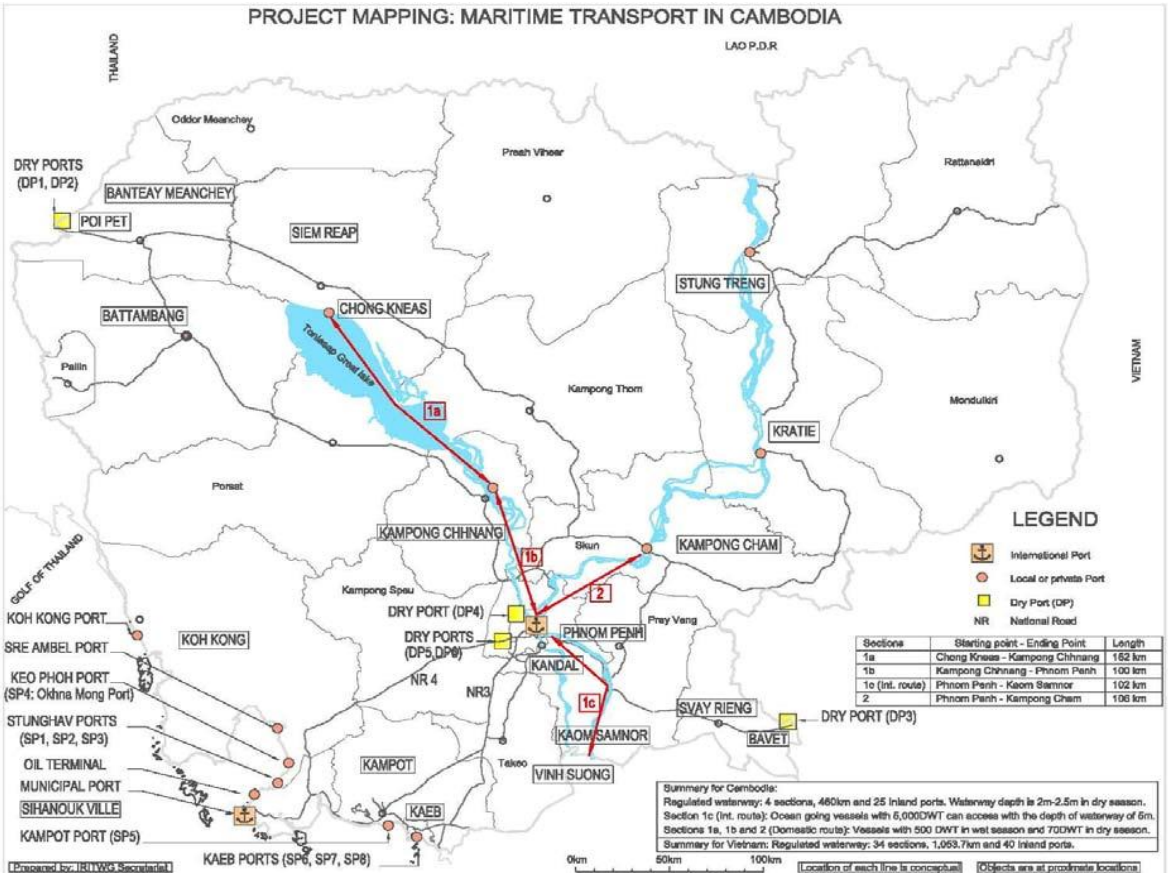


Figure 4: Local sea ports in Cambodia (Source: MPWT)

2.1.4 Aviation

Aviation is not under the management of MPWT. The State Secretariat of Civil Aviation (SSCA) is the major player in the Aviation Sector in Cambodia. It is the administrator and regulator of civil aviation, the operator of several domestic airports and the body in charge of the development of civil aviation in a national context. While the SSCA does not directly manage or operate the Phnom Penh, Siem Reap or Sihanoukville international airports, and the Kampong Chhnang domestic airport, it does have an important role in regulation of the broader administration of government-owned airports such as these, and has ultimate oversight for the licensing, certification and approval of development at all of the airports. The four airports mentioned above have been contracted out and committed to private sector consortia on a Build-Operate-Transfer (BOT) basis for the purposes of day-to-day management, operations, and maintenance and capital improvement.

2.2 Transport status in Cambodia

2.2.1 The Number of Vehicles Registered

The number of registered vehicles such as motor cycles, cars, minibuses, buses, pick-ups and trucks has increased dramatically since 2005, and reached more than 307,000 vehicles in 2009. However, in 2010 the number of registered vehicles decreased, while driving license holders increased dramatically (Fig.5). In addition, the increasing number of registered automobiles, including heavy vehicles, light vehicles and motor cycles is approximately 19% each year, with the number of those vehicles reaching almost 1,400,000 automobiles in 2009. The number of registered automobiles gradually declined in 2010 and 2011 (Fig.6).

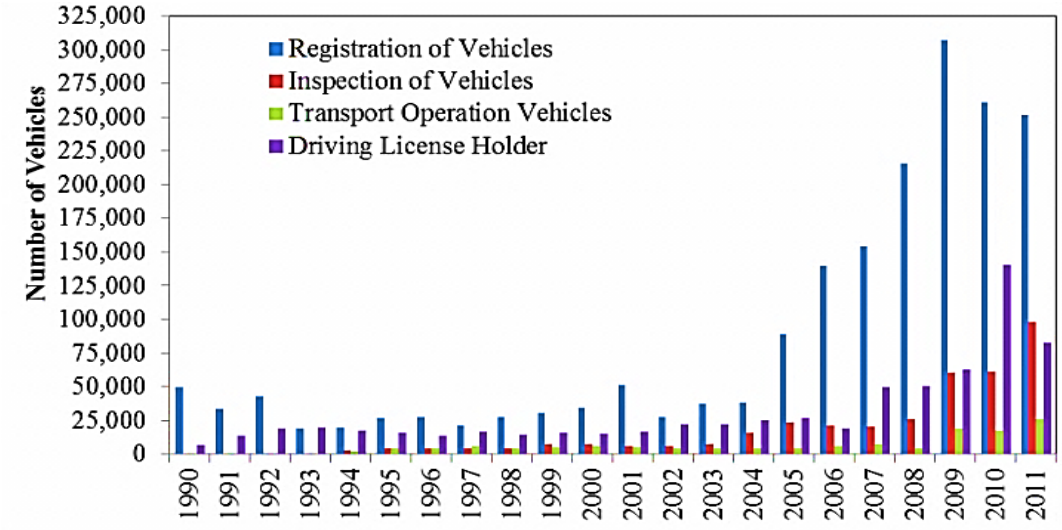


Figure 5: Number of vehicles (Source: MPWT)

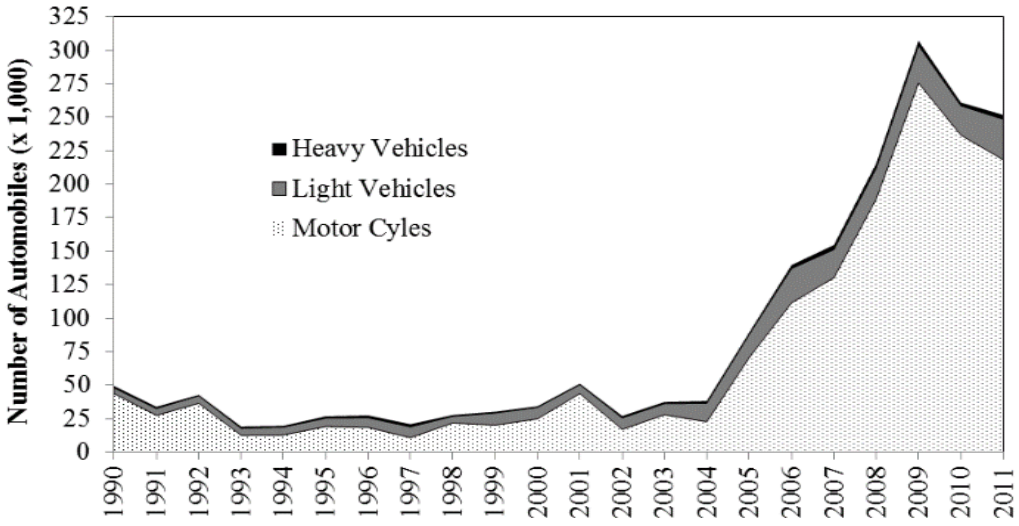
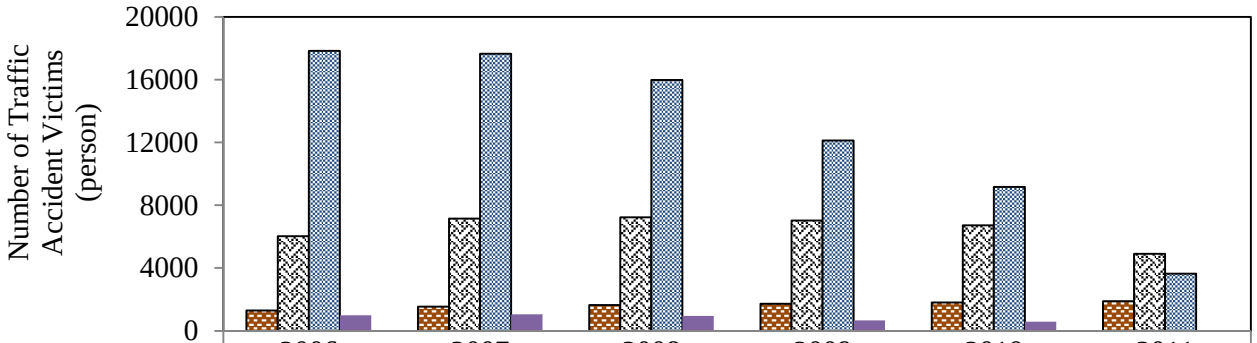


Figure 6: Number of registered automobiles (Source: MPWT)

2.2.2 Road Accident

Road accidents are a serious problem in Cambodia. According to data from MPWT, there were 5,007 road accidents in 2011, in which 1,890 persons were killed, 4,910 severely injured and 3,644 slightly injured (Fig. 7). Over 90% of the accidents were caused by human error.



	2006	2007	2008	2009	2010	2011
Fatalities	1292	1545	1638	1717	1816	1890
Severe injuries	6033	7150	7226	7022	6718	4910
Slight injuries	17836	17655	15985	12117	9170	3644
Unknown	985	1053	947	663	583	0

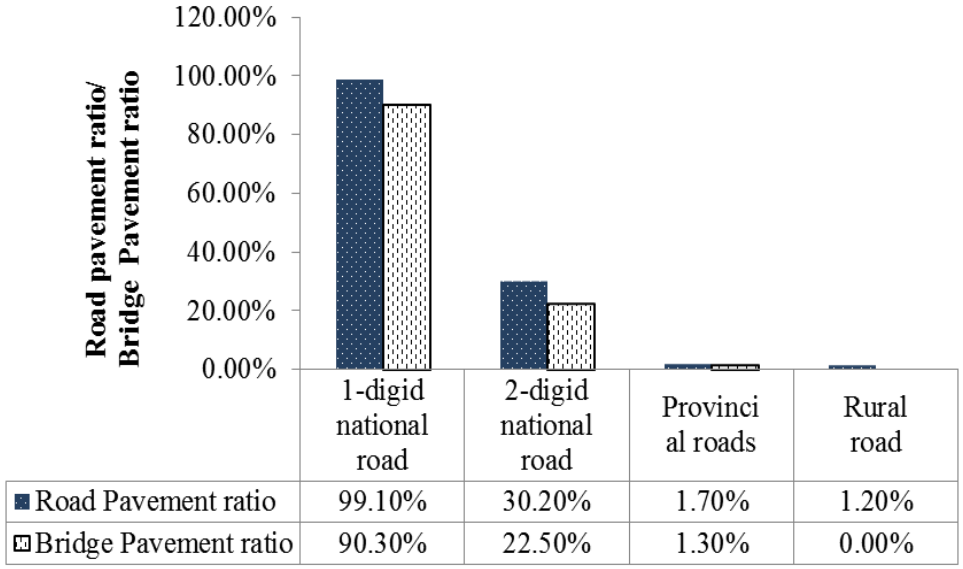
Figure 7: Number of traffic accident victims in Cambodia 2006-2011 (Source: MPWT)

2.3 Development of transport infrastructure

2.3.1 Road development

The rehabilitation and construction of the single-digit National Road Network is now nearing completion. The main national roads (asphalted) now connect Phnom Penh with almost all provincial capitals, and link to major cross-border check points with neighboring countries. Significant progress has been made to put in place regional and sub-regional roads (such as the Asia-Pacific Region, ASEAN, and the GMS), that will serve as economic corridor routes, and international transit routes facilitating transportation.

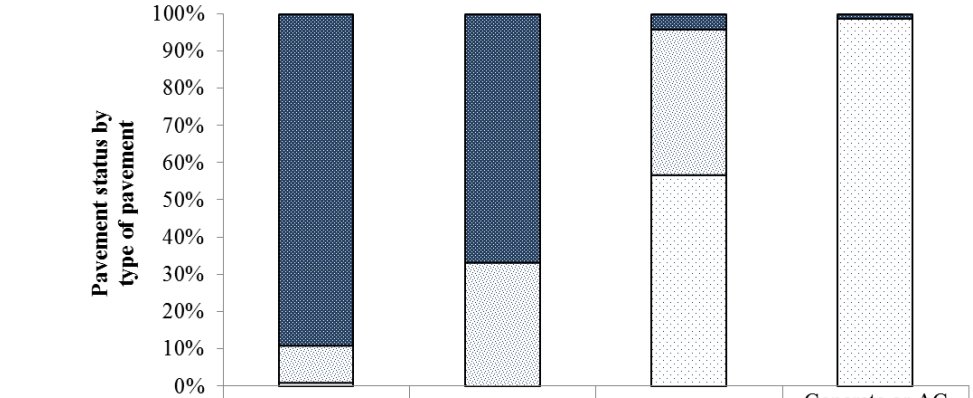
Figures 8 and 9 show pavement and bridge status in 2004 and 2009, under the management of MPWT. Several road and bridge improvement projects have already been completed. The budget for those projects came mainly from sources such World Bank, ADB, Japan, Korea, China, Vietnam and Thailand, as grants and loans. Currently, MPWT and its development partners are largely targeting secondary national roads and roads that link to other GMS countries. To cross Cambodia's many rivers and streams, permanent bridges are also essential transport infrastructure. In 2010, Cambodia had 2,121 bridges on the national and provincial road network, and many more on the rural network.



	1-digid national road	2-digid national road	Provinci al roads	Rural road
Road Pavement ratio	99.10%	30.20%	1.70%	1.20%
Bridge Pavement ratio	90.30%	22.50%	1.30%	0.00%

Figure 8: Road pavement ratio (as of 2009) and ratio of permanent bridges (as of 2004)

(Source: MPWT)



	Earth (km)	Laterite (km)	DBST (km)	Concrete or AC (km)
Provincial roads	2,437	3,895	101	9
2-digit national roads	273	1,923	949	0
1-digit national roads	20	0	1,381	716

Figure 9: Pavement status by road classification (as of 2009) (Source: MPWT)

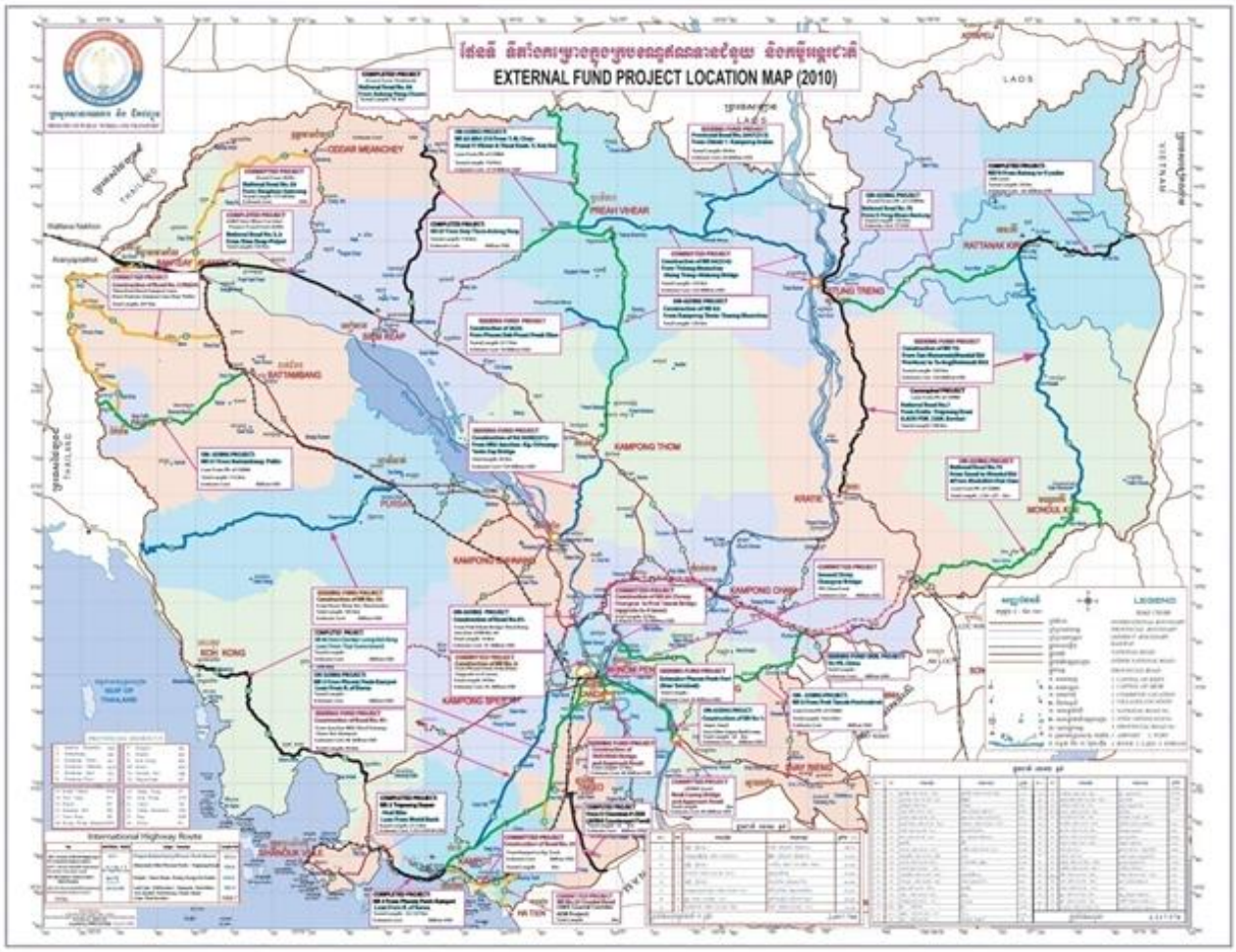


Figure 10: Road project map (Source: MPWT)

2.3.2 Railway development

Upgrading or strengthening selected parts of the main line will also be undertaken, along with building additional sidings and terminals to facilitate connectivity with water and road transport. At Poipet, a GMS cross-border rail facility and rail and road freight terminal are to be built. To achieve the link to Vietnam, a new railway line must be built, through Phnom Penh to Ho Chi Minh City. Cambodia must rehabilitate the existing railway system to link with the Singapore-Kunming Rail Link (SKRL), which runs through Singapore, Malaysia, Thailand, Cambodia, Vietnam, Lao P.D.R. and Myanmar, before ending at Kunming in China. It must fix the missing link and construct the newly proposed line from Batdeng to Loc Ninh, Vietnam.

At present, transportation of passengers and goods on the railways is quite limited. Plans are being prepared to rehabilitate and expand this mode of transportation and to integrate it into the regional railway network.

- Southern Line 266 km to sea port terminal will be completed at the end of July 2013.
- Northern Line 386 km (Phnom Penh-Poipet) will be completed by 2015.

- For railway connecting points between Cambodia/Thailand, MPWT of Cambodia and the State Railway of Thailand continue to discuss the reconstruction of the railway bridge at the border. Regarding Cambodia and Vietnam, the MPWT and MoT has signed an agreement for a railway connecting points at Trapeang Sre (Cambodia) to Hoa Lue (Vietnam).

2.3.3 Maritime and waterway development

Phnom Penh Autonomous Port (PPAP)

The new container terminal at Phnom Penh Port (Port No. 3) is being constructed due to restrictions in running the first two, as well as reaching capacity. The third port, which is located 25 km downstream from the second port in Phnom Penh (on NR1 along the Mekong River), is funded by China. The initial capacity is 120,000 TEUs/year and total capacity is 300,000 TEUs/year. The new port occupies 12ha, with a berth area of 22m x 300m.

In 2011, PPAP maintained, repaired and developed its own infrastructure as follows:

- Land grabbing and pumping at the floating terminal and concrete terminal, periodic maintenance on the land surface of 14,409 m2 and the maintenance of the Inland Container Depot (ICD) on the surface of 93,949 m2, measuring the depth of the river, the basement condition, and river bank condition from Kbal Koh Ta Prom to Koh Prak, and at the Sovannaphoum Company. Checking and maintaining traffic buoys from Phnom Penh to Kampong Cham, and establishing more traffic signs at Prolay Sdao.
- Constructing a new container terminal on 30 hectares of land, located in Kandal Leu village, Leuk Dek commune, Kien Svay district, Kandal province, with a capacity of 120,000 TEUs in the first stage.

Sihanoukville Autonomous Port (PAS)

The development of Sihanoukville port has taken place in several stages:

- 1986-1987: Conducted a feasibility study on the Development of Sihanoukville Port and Rehabilitation of Old Jetty, with technical assistance from the former Union of Soviet Socialist Republics (USSR) by using the National Budget.
- 1993: Adapted Cargo Transport Facilities from General Cargo to Containerized Cargo Transport System.
- 1996: Rehabilitation of Old Jetty using ADB's fund.
- 1997-Present: PAS's development using Japanese ODA loans.

- Sihanoukville Port Urgent Rehabilitation Project, loan from Japan. The work is dredging the port basin and approach channel: 758,800m^3(-9m), construction of container berth at 240m long (-11.5m), container yard pavement: 54,000m^2, access road and diversion road: 16,800m^2.
- Sihanoukville Port Urgent Expansion Project, loan from Japan. The work is dredging of port basin and approach channel: 622,000m^3 (-10m), construction of container berth at 160m long (-11.5m), reclamation works, administration one-stop service building.
- Sihanoukville Port SEZ Development Project, loan from Japan (IRITWG, 2010).
- Project to develop "Paehou Bomnorng" port of Sihanoukville Autonomous Port (2008–2014) to extract oil at the bottom of the sea, and Chakthea port for pumping seeds, under concessional loan from Japan.

2.4 Existing policy and plans in transport sector

2.4.1 Transport infrastructure

Over the past 15 years, the Government strategy has been to restore, reconstruct and modernize the country's core transport system[2]. Early Government strategies focused on restoring the arterial transport system and on supporting regional and global integration of the national economy.

In 2000, the Government prepared a Five-Year Road Master Plan (2000–2005) that pursued three objectives: (i) rehabilitate and reconstruct the main national roads, thereby improving land transport throughout Cambodia; (ii) build road links to neighboring countries, opening up some of the more remote areas of the country to international trade and tourism; and (iii) develop a sustainable road maintenance program, thereby ensuring that investment in road rehabilitation and reconstruction would generate sustainable benefits.

In June 2006, the Government adopted the National Strategic Development Plan (NSDP)[3], which spells out its strategies to reduce poverty rapidly and to achieve the Cambodia Millennium Development Goals (CMDGs)[4]. The NSDP included the following road subsector priorities: (i) finalize and enact a Road Law; (ii) prioritize, rehabilitate and reconstruct as many roads as possible; (iii) expand the rural road networks; (iv) address, in a humane manner, resettlement issues and the plight of people affected by road construction works; (v) ensure proper prioritized maintenance of all roads; (vi) use labor-intensive measures as much as possible, especially for constructing and maintaining rural roads; and (vii) involve the private sector in constructing and maintaining roads and

[2] ADB. 2008. Country Operations Business Plan – Cambodia 2008-2010. Manila.
[3] Kingdom of Cambodia. 2007. National Strategic Development Plan 2006-2010. Phnom Penh, Cambodia.
[4] Kingdom of Cambodia. 2005. Achieving the Cambodia Millennium Development Goals: 2005 Update. Phnom Penh, Cambodia.

bridges in cases where costs could be recovered by tolls. The quantitative target to be achieved during the NSDP period (2006–2010) was to upgrade an additional 2,000 km of national and provincial roads, raising the total of such upgraded roads to 4,100 km. In the railway subsector, the priority was to rehabilitate the Southern Line to handle higher volumes of cargo traffic from Sihanoukville Port.

2.4.2 Transport

MPWT released the Motor Vehicle Technical Inspection Procedure in 2000. Vehicle inspection is a procedure mandated by the RGC, and undertaken by the Department of Land Transport, MPWT, where a vehicle is inspected to ensure that it conforms to regulations governing safety and emissions. In Article 6, the procedure states that:

- For petrol engines, the concentration of carbon monoxide (CO) must not exceed 5% of the amount set in testing equipment, and the concentration of hydrocarbon (HC) must not exceed 1,200ppm for 4-stroke engines and 7,800ppm for 2-stroke engines;
- For diesel engines, the amount of black smoke must not exceed 50% of the amount set in testing equipment.

Article 48 in the Cambodian traffic law states that, "all vehicles, trailers, semi-trailers, motorbikes or motor-tricycles which are moving along the road shall have certificates of technical inspection by the Ministry of Public Works and Transport". New vehicles are required to have a technical inspection before registration. A technical inspection is also required upon change of vehicle ownership. New four-wheel vehicles require a technical check once every two years; and new motorcycles once every four years. Second-hand four wheel vehicles are required to have a technical check every year; second-hand motorcycles, once every two years.

To enhance road safety in Cambodia, MPWT has formulated the Cambodia National Road Safety Action Plan 2006-2010 and 2011-2020. The latest road safety action plan 2011-2020 aims to reduce the fatality rate by 50% by 2020.

In 2000, a sub-decree on air pollution control and noise disturbance was put in place under the MoE. The sub-decree included air quality standards for ambient air quality, emission limits for stationary and mobile sources, as well as limits for hazardous substances in the air. Mobile emissions standards are part of the sub-decree on Air Pollution Control and Noise Disturbance. These standards, however, only delineate motorcycles among other vehicles (Table 3) and have not been further classified according to vehicle size.

Table 3: Mobile Emissions Standards

Vehicle	Fuel	CO (%)		HC (ppm)	
		A(>5 years old)	B (<5years old)	A(>5years old)	B(<5years old)
2-stroke motorcycle	Petrol	4.5	4	10,000	3,000
4-stroke motorcycle	Petrol	4.5	4	10,000	2,400
All kinds of vehicles	Petrol	4.5	4	10,000	800
All kinds of vehicles	Diesel	_	_	_	_

CO= Carbon monoxide, HC = hydrocarbon, ppm = parts per million.
Note: This standard applies to noise emission control of mobile sources into the atmosphere.
A: refers to all kinds of vehicles used more than five years from year of production.
B: refers to all kinds of vehicles that are newly imported and/or within five years from year of production.
Source: Ministry of Environment 2000.

In August 2010, MPWT began to formulate the National Transport Policy, through which the RGC has committed to: (i) continue and speed up construction, restoration and development of new transport infrastructure for all sectors; (ii) strengthen better transport management; (iii) improve availability of year-round affordable transport services for individual and commercial users; (iv) improve transport service safety, security and environment; (v) increase access to transport facilities for the poor and provide more work opportunities in the regions; (vi) rationalize its transport institutions and develop human resources; (vii) encourage private sector participation in development of infrastructure and transport services; (viii) disseminate more information to the population about transport for encouraging more participation; (ix) encourage transport service practice across borders (MPWT, 2010)[5].

III. Climate Change and the Transport Sector in Cambodia

3.1 Climate in Cambodia

Cambodia's climate is governed by monsoon, and characterized by two major seasons: from May to early October, strong prevailing winds from the southwest bring heavy rains and high humidity, and from November to April, winds and humidity are low. The average annual rainfall is 1,400 mm in

[5] Ministry of Public Works and Transport (2010): National Transport Policy

the central low regions and may reach 5,000 mm in certain coastal zones. The annual average temperature is 28ºC, with a maximum average of 38ºC in April, and a minimum average of 17ºC in January. Cambodia rarely suffers from extreme weather events such as typhoons or even severe storms, as it is protected by surrounding mountain ranges. Storms occur most frequently during the period from August to November, with the highest frequency in October. The country experiences floods, which result from heavy rains that fall locally and upstream in the Mekong Basin between May and October (MoE, 2002).

The following are climate trends for Cambodia observed between 1960 and 2003. Mean annual temperatures have increased by 0.8°C since 1960, at a rate of about 0.18°C per decade. The rate of increase is most rapid in the drier seasons (December-January-February and March-April-May), increasing 0.20-0.23°C per decade, and is slower in the wet seasons (June-July-August and September-October-November), increasing 0.13-0.16°C per decade.

3.2 Impacts of Climate Change on Transport Infrastructure

The main natural hazard to which Cambodia is exposed is flood, followed by drought, occasional epidemics and storms. During the 20-year period from 1987 to 2007, floods affected the greatest number of people and caused the greatest amount of damage. Cambodia's vast flood plain is one of the country's most prominent geographical features. This makes large portions of the country naturally susceptible to annual flooding, particularly along the Tonle Sap and Mekong river watersheds. In certain years, however, flooding becomes excessive and results in the loss of human life, destruction of crops and livestock, and damage to homes and the already fragile network of community infrastructure (e.g. schools, health centers, local roads and bridges).

Major flooding events affecting a significant part of the population occur every five years or so (in 1961, 1966, 1978, 1984, 1991, 1996, 2000, 2001 and 2002). One of the worst floods in the country's history occurred in 2000, where the National Committee for Disaster Management (NCDM) reported that an estimated 750,618 families representing 3,448,624 people, including 85,000 families or 387,000 people, were temporarily evacuated from their homes and villages. Three hundred and forty seven (347) people, 80% of whom were children, were killed, and total physical damage was estimated at US$150 million. In 2001, floods caused the death of 62 people (70% children) and an estimated US$20 million damage, and in 2002, 29 people (40% children) were killed and damage estimates were US$14 million.

Typhoon Ketsana hit Cambodia between September 29 and October 5, 2009. The damage and loss caused by Ketsana in the infrastructure sector (US$28.7 million) was concentrated in the transport subsector (US$25.5 million). Typhoon Ketsana damaged road networks in 18 provinces (urban, national, provincial and rural roads). The transport sector in Cambodia suffered both direct and indirect damages, not only to the roads but also to drainage structures and other connecting infrastructure, such as bridges and culverts. Total direct damage to the transport sector was estimated at US$14.39 million (Table 4).

Table 4: Summary of Effects of Typhoon Ketsana on Transport Sector

No	Province Name	Damage Length (km)	Damages (USD)	Losses (USD)	Total (USD)
1	Kampong Thom	58.90	945,595.80	1,171,821.46	2,117,417.26
2	Battambang	34.70	1,392,491.29	1,085,385.27	2,477,876.56
3	Kampot	8.21	473,973.00	729,316.42	1,203,289.42
4	Kep	11.90	464,000.00	307,070.78	771,070.78
5	Kratie	11.60	326,000.00	234,790.20	560,790.20
6	Stung Treng	14.98	407,320.00	292,529.40	699,849.40
7	Ratanak Kiri	75.40	1,704,127.46	551,633.38	2,255,760.84
8	Oddar Meanchey	25.71	456,310.59	771,101.96	1,227,412.55
9	Banteay Meanchey	65.11	1,369,749.43	612,460.78	1,982,210.21
10	Kampong Cham	12.14	463,477.73	1,075,706.43	1,539,184.16
11	Pailin	27.00	405,200.00	203,616.58	608,816.58
12	Mondul Kiri	32.50	937,600.00	257,095.10	1,194,695.10
13	Siem Reap	183.74	3,448,567.60	2,955,944.17	6,404,511.77
14	Kampong Chhnang	36.25	367,458.75	65,403.07	432,861.82
15	Preah Vihear	30.60	1,204,337.23	525,493.86	1,729,831.09
16	Kandal	0.70	11,682.80	114,455.38	126,138.17
17	Koh Kong	0.25	4,960.00	70,688.87	75,648.87
18	Preah Sihanouk	0.08	5,980.24	35,344.44	41,324.68
TOTAL		**629.77**	**14,388,831.91**	**11,076,698.15**	**25,465,530.06**

Source: PDNA Team Elaboration (2009).

According to MPWT, in 2011, 16 out of 24 provinces and municipalities were inundated, and over 1.5 million people were affected. The damage from the 2011 flooding is expected to exceed that of floods in 1996 and 2000. Total national and provincial roads affected by flooding were 186 lines and the damaged length was 718.08 km. There were 20 provincial and national bridges damaged.

3.3 Vulnerability of Transport Sector in Cambodia

Most roads were constructed in the 1920s and 1930s to serve light vehicular traffic. Approximately 2,400 km of the national road network was paved with asphalt or bituminous material, but over the years, through negligence (due to civil war from 1970-1998) and the effects of flooding and traffic, much of this pavement has disappeared. Therefore, most of the secondary national road network was unpaved (laterite). Whole and partial sections of unpaved roads are easily damaged and destroyed by flooding. Heavy transport and vehicles are another factor damaging the road network, in addition to poor quality foundations, sub-grading and their exposure to prolonged wet conditions. As a result of inadequate compaction, water erosion caused by flooding damages most embankments and slopes, and there are often no, or inadequate, road drainage systems, especially with respect to low-lying roads. In addition, technical specifications of roads are not suitable for climate change adaptation.

3.4 Climate Responses of Transport Sector

The Cambodian Road and Bridge Design Standard and Construction Specifications were established in 1999 by MPWT and are to be used for the design and construction of all new roads and bridges, and related rehabilitation work in Cambodia. This covers Road Geometry Standards, Road Pavement Standards, Road Drainage Standards, Bridge Design Standards and Bridge Construction Specifications, which are useful for climate preparedness activities in transport infrastructure in Cambodia.

In response to flooding, MPWD established the Department of Sub-National Public Infrastructure and Engineering (SPIED), which is responsible for roads in cities, towns and provinces, public gatherings, drainage system plans and waste water treatment stations, environment and public service systems, road engineering work and road flooding protection systems in cities and provinces. In 2011, SPIED constructed a main drainage system of 7.348 km and a sub-drainage system of 6.126 km in Siem Reap province. Drainage and culvert systems have been monitored regularly by the department to repair and maintain the systems and protect them from damage caused by extreme flooding events.

In 2011, inspection and evaluation was done on the road flooding system in Kampong Chhnang, Kampong Thom, Battambang, Preah Vihear, Siem Reap, Kratie, Svay Reng, Prey Veng, Stung Treng, Pursat, Pailin, Kampong Cham, Banteay Meanchey and Kampong Speu provinces. It covered roads of **double bituminous surface treatment** (DBST), Macadam roads, laterite roads, bridges, culverts (box-culvert and pipe culvert) and drainage systems.

After inspection and evaluation of road flooding, the sub-national public infrastructure and engineering department repaired 331.76 km of Laterite road, 91.90 km of DBST road, and 21.722 km

of pavement concrete construction road (PCC), with a width from 5m to 8m. Concrete bridges were repaired, covering 978.89m in length and 7m to 8m in width, and Bailey-Bridges were repaired covering 7.35m in 49 locations. There were 271 m of U-Drain culverts repaired in 43 locations. Pipe-culverts were repaired in 354 locations and spill-ways were repaired in six places in other provinces. SPIED concentrates on the drainage system plan and waste water treatment station in Phnom Penh city, Preah Sihanouk, Battambang and Siem Reap provinces, to release sewage water out of the city, town or waste water treatment station, to protect against flooding. The department planned to repair roads, bridges and flooding projects in Step-2, in 2011-2012, to protect against infrastructure damage caused by climate change.

MPWT is mandated to take immediate action to respond to flooding. All national and provincial roads will be assessed by MPWT, either during or immediately after flooding to see if they need to be reconstructed, repaired or maintained. The assessment will be sent to the Ministry of Economy and Finance (MEF) to get approval to finance the maintenance and rehabilitation activities. Heavy transport and vehicles will not be allowed to use flooded and damaged roads.

3.5 Environmental problems in the transport sector in Cambodia

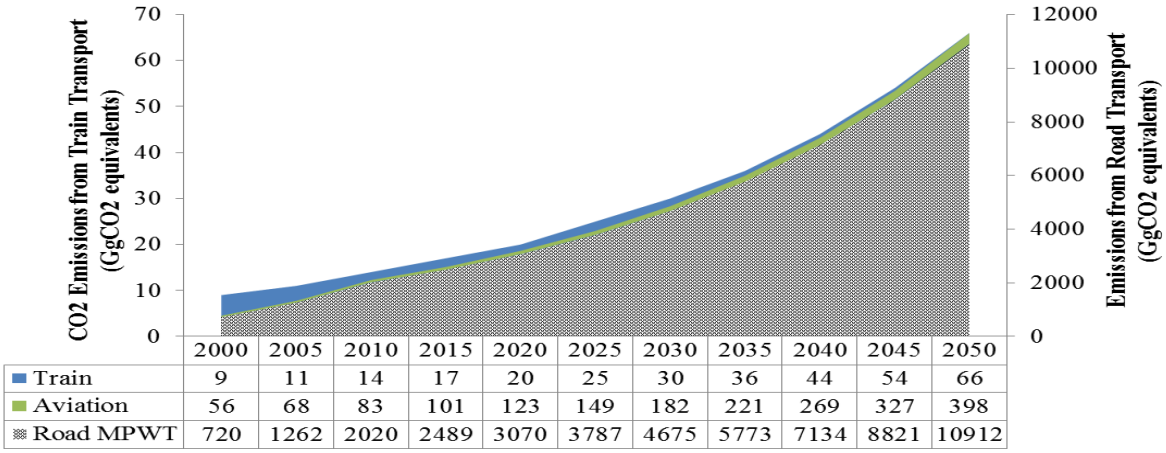
Greenhouse gas emissions from motorized vehicles and transport are raising and contributing to local and regional problems through the emission of carbon monoxide, lead, sulphur oxides and nitrogen oxides.

3.5.1 Greenhouse gas emissions from transport sector in Cambodia

Mobility of people and goods is an essential part of all social and economic activities. In Cambodia, passenger cars and trucks have become the most important modes of transport. Non-motorized transport, which in earlier times was the common form of transport, has, to a large extent, been replaced by cars in daily mobility, and by trucks for freight movement. The result of this process has been a significant change in land use patterns.

The common problems of the transport sector in big urban areas are congestion, fatalities and injuries due to traffic accidents. An increasing demand for mineral oil fuels creates air pollution, increases noise levels, and decreases urban livability and green spaces. In particular, the high growth of transport creates more CO2 emissions than other economic sectors.

In 2010, the MoE estimated CO2 emissions in the transport sector using LEAP. It estimated a growth percentage of vehicles of 4%. The results show that emissions from the transport sector will increase from 785 GgCO2 equivalents in 2000 to 11,376 GgCO2 equivalents in 2050 (Fig. 11). Motorbikes, cars, pickups and trucks are the dominant sources of the emission (Fig. 12 & Table 5).



	2000	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Train	9	11	14	17	20	25	30	36	44	54	66
Aviation	56	68	83	101	123	149	182	221	269	327	398
Road MPWT	720	1262	2020	2489	3070	3787	4675	5773	7134	8821	10912

Figure 11: Greenhouse gas emissions from transport sector (GgCO2 equivalents)

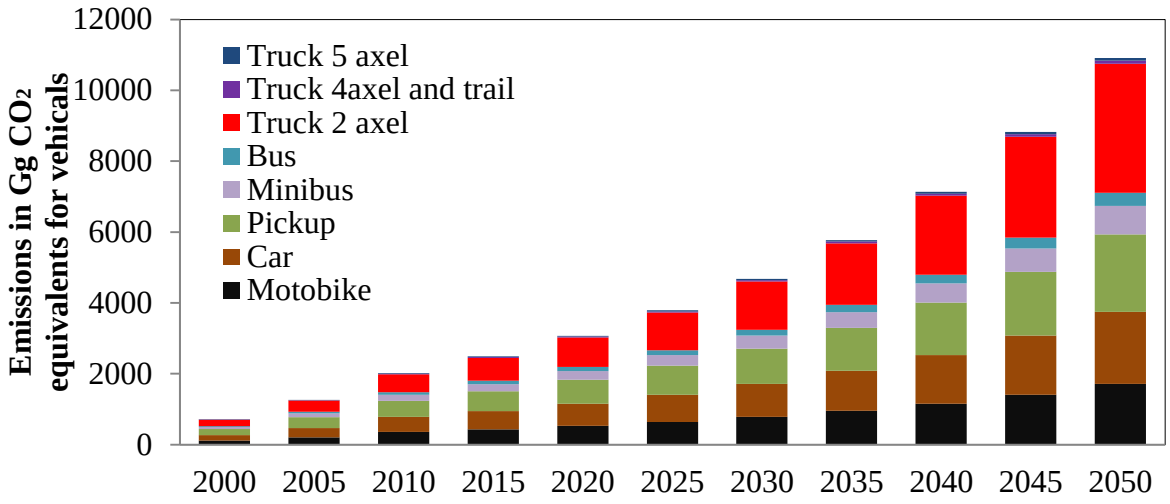


Figure 12: Greenhouse gas emission in transport sector ($GgCO_2$ equivalents) (Source: MoE 2010)

Table 5: Emissions in GgCO2 equivalents for vehicles

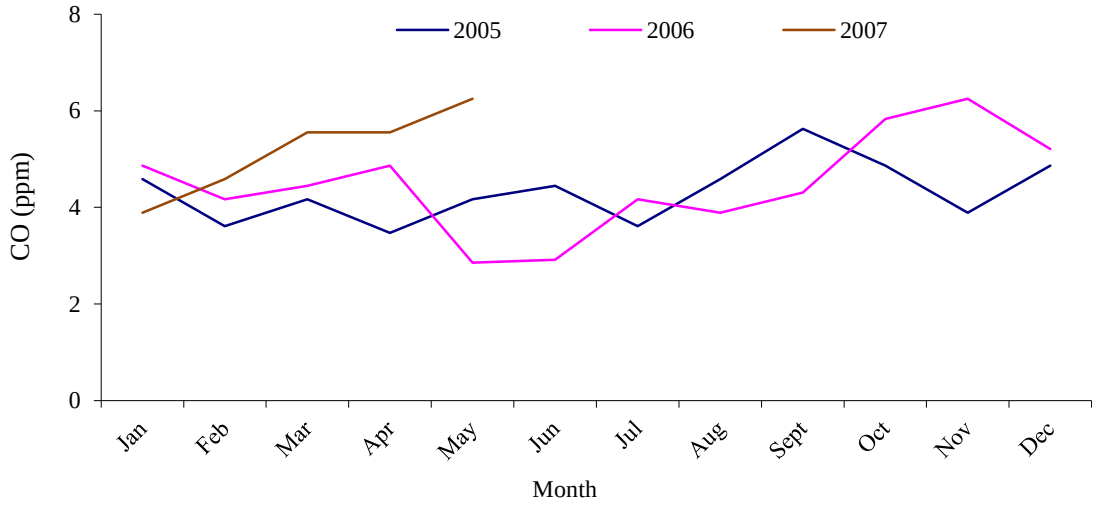
Type of Vehicles	Greenhouse Gas Emission in Transport Sector (GgCO2 equivalents)										
	2000	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Motorbike	117	203	356	433	527	642	781	950	1155	1406	1710
Car	146	267	424	516	627	763	929	1130	1374	1672	2035
Pickup	173	303	455	554	674	819	997	1213	1476	1796	2185
Minibus	55	105	168	204	248	302	368	447	544	662	806
Bus	27	47	77	93	114	138	168	205	249	303	369
Truck 2 axel	183	314	506	648	829	1062	1359	1739	2226	2849	3646
Truck 4 axel and trail	8	11	18	22	27	33	40	48	59	72	87
Truck 5 axel	11	12	16	19	23	28	34	42	51	62	75

Source: MoE 2010

3.5.2 Air pollution from transport sector in Cambodia

The growing number of used (old) vehicles in Cambodia is contributing to roadside air pollution, as most of them have neither pollution control devices nor capacity to intercept/mitigate pollutant emission. The use of fuels without clear import sources is a main factor contributing to high pollutant emissions into the atmosphere and roadside surroundings. For example, PM_{10}, CO, lead, sulfur dioxides and nitrogen oxides are not controlled, compared to fuel importation under accurate control, by competent authorities. In short, the use of low quality fuels, inefficient methods of energy production and use, the poor condition of vehicles, and traffic congestion, are major causes of increased emissions of theses pollutants into the atmosphere.

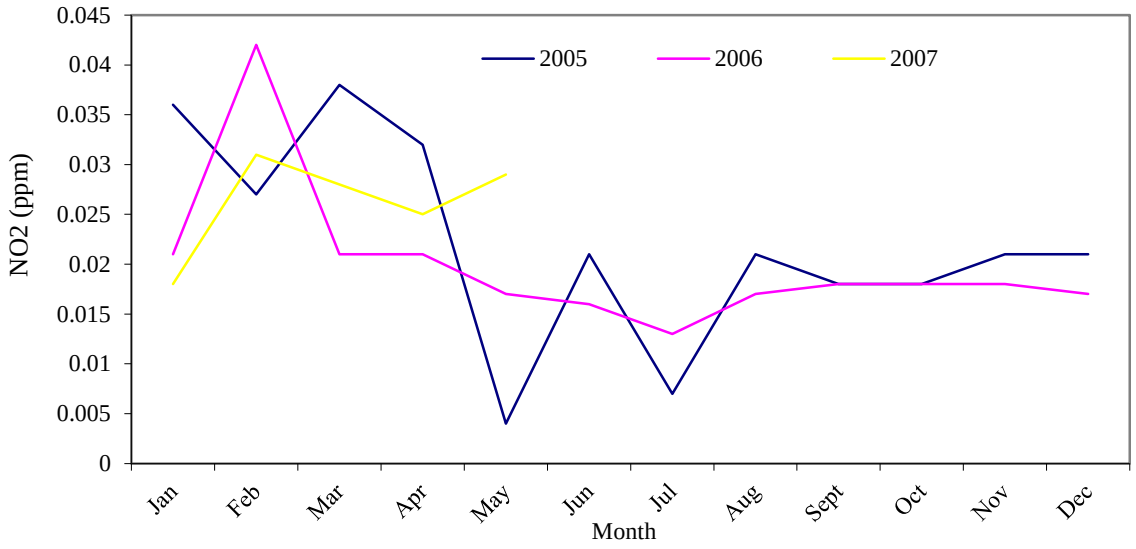
The roadside air quality context should be taken into account as an ambient air quality. It may deteriorate by various emissions from: (i) mobile and stationary sources; (ii) opened burning at dumpsite[6]; (iii) material/waste burning at public areas (e.g. burning of vehicle tires for demonstrating purpose); or (iv) other activities (e.g. recycle of disabled engine oils, lead acid batteries, plastics, etc).



The mean CO concentration in ambient air at selected areas in PP (2005-2007)

In the graphic, the mean value of CO concentration in ambient air (roadside) at and around the three selected sampling locations is in better condition (2005-2007), compared to the National Ambient Air Quality Standard. It is observed that the CO concentration increased from 4 ppm up to 6 ppm in 2007.

[6] *If surveyed area is located closed to dumpsite*



The mean NO2 in ambient air at selected areas in PP (2005-2007)

The mean value of NO_2 concentration in ambient air between 2005 and mid 2007 is in better condition too. The graphic shows that the mean concentration of NO_2 in the three observed years increased a little between January and June, and it seemed to be stable (around 0.02 ppm) in the interval of July to December.

Beside the two parameters above, SO_2 concentration was found in low levels. The maximum SO_2 concentration in 2005 was 0.083 ppm (in January) and the minimum was less than 0.0041 ppm. The mean value of SO_2 concentration from 2006 to mid 2007 was stable, with concentration less than 0.083 ppm.

IV. Climate Change Strategic Plan for Transport Sector

4.1 Strategic Framework for Climate Change Adaptation in Transport Infrastructure

Vision

Transport infrastructure will be in good condition to adapt to extreme climate events.

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Mission

To strengthen the quality of transport infrastructure to be in good condition to adapt to extreme climate events.

Goals and Objectives

To improve the quality of road infrastructure to deal with the impact of climate change.

STRATEGY 1: Repair and rehabilitate the existing road infrastructure and ensure effective operation and maintenance system

Background:

- Insufficient maintenance of rehabilitated roads
- Damage on roads/bridges by overloaded vehicles
- Lack of human resources in standard road and bridge maintenance, road and bridge standards and engineering work
- Transport infrastructure is not in good condition and is not well managed yet

Goal: To maintain and improve the quality of road networks and bridges, so they can cope with extreme climate events

Proposed Action:

- Assess the capacity of responsible institutions at central and provincial levels with respect to road maintenance works;
- Cost-effective annual road maintenance plans;
- Repair broken bridges and improve flood-prone areas;
- Establish road maintenance system standard;
- Promote private sector participation in road maintenance works to lower the Government's costs;
- Introduce new technologies to improve the quality of maintenance activities to enhance the quality of roads;
- Improve human resources of government agencies at all levels in road/bridge maintenance standards and road and bridge standards;
- Rehabilitation of national and provincial road pavement;
- Strengthen cyclone, storm surge and flood early warning systems;
- Ensure that road embankments are well-maintained to deal with the likely impacts of climate change.

Strategy 2: Design and construct a road drainage system to meet changing conditions expected with climate change

Background:

Road drainage problems are extreme in Cambodia. Drainage structures are expensive (a major consideration during the design stage), but the resulting high maintenance costs and the reduced traffic efficiency during maintenance operations, attributable to the lack of adequate drainage, is even more costly. The additional greenhouse gas emissions attributable to congestion, and other side-effects of maintenance operations, are significant. Due to many years of limited investment and neglected maintenance of road drainage systems, most road drainage systems have disappeared and are not be able to protect roads during flooding.

Goal: To reduce the impact of extreme climate events on the transport sector

Proposed Action:

- Construct adequate drainage facilities, as some urban roads are prone to flooding, hampering transport movement and causing heavy congestion;
- Improve arrangements for monitoring drainage system standards;
- Continue to encourage further private-sector funding of road drainage system rehabilitation and improvement works;
- Collaborate with concerned government agencies to develop an early warning system to prepare for extreme climate events.

Strategy 3: Enhance the capacity of road network to adapt to extreme climate events

Background:

Most of the national road network has been rehabilitated and is in good condition, but provincial road infrastructure cannot deal with the impact of climate change, due to limitations of the national budget and engineering work. Road and bridge standards have already been created, but they have not been fully implemented in construction work.

Goal: To improve the quality of the road network to adapt to extreme climate events

Proposed Action:

- Change engineering parameters and solutions: road elevation, maintenance routine;
- Alignment: consider climate change, avoiding permafrost zone;
- Road and bridge standards need to be fully implemented at all construction projects.

Strategy 4: Capacity building and institutional strengthening

Background:

Knowledge of government officers in the field of climate change and its impact on the transport sector is still limited. A lot of policies and development plans in the transport sector have been created, but climate change and its impacts have not been included in them.

Goal: The capacity of ministry officers, civil society and the private sector will be strengthened to meet the challenge of climate change

Proposed Action:

- Develop human resources of government agencies in the field of road, bridge and drainage system standards, climate change and transport, and environmental assessment;
- Capacity building on monitoring the impact of climate change on transport infrastructure;
- Review and revise, where appropriate, all government policies in the transport sector;
- Mainstream climate change in national, sectoral and spatial development planning.

4.2 Strategic Framework for Greenhouse Gas Mitigation in Transport Sector

Vision

The amount of greenhouse gas emissions from the transport sector will be reduced significantly.

Mission

To enhance efficient, comfortable and safe transport systems, to mitigate the emissions of greenhouse gases from the transport sector.

Goals and Objectives

The objectives of the strategies are to develop an efficient, comfortable and safe transport system, to introduce a modern public transport system, to reduce traffic congestion, to enhance inspection and maintenance of vehicles, to enhance traffic management, and to enhance the quality of fuel.

STRATEGY 1: To raise public awareness about climate change caused by greenhouse gas emissions from the transport sector

Background: People's knowledge of inspection and maintenance of vehicles, and the pollution they emit is still limited.

***Goal*:** To enhance public awareness about the impacts of the emissions of greenhouse gases from the transport sector on climate, in order to participate in mitigation activities.

Proposed Action:

- Provide training related to the impact of the emissions of greenhouse gases from the transport sector;
- Integrate greenhouse gas mitigation components in all transport development projects;
- Introduce greenhouse gas mitigation in the transport sector into education programs;
- Collaborate with concerned ministries to raise public awareness on greenhouse gas emissions from the transport sector;
- Enhance the understanding of the importance of vehicle inspection.

STRATEGY 2: Enhance inspection and maintenance of vehicles

Background:

The RGC does not give high priority to the abatement of vehicle emission control, due to limited national budget. There is little current attention paid to this matter in Cambodia by international organizations or NGOs, including technological transfer from other countries. The technical capacity of inspection staff to control emissions, through the identification of gaps in existing standards and enforcement, is also lacking.

In Cambodia, vehicle registration is required only once; there is no annual registration. In addition, there are no mandatory inspection-and-maintenance (I/M) requirements for 2- or 3-wheelers, or any designated maintenance stations. There are very few I/M stations at all[7] (Phnom Penh has two places for technical inspection by computer system, and there are two more stations in the provinces[8]). There is also insufficient knowledge of the vehicle maintenance industry, and inadequate coordination between the Department of Transport and the Traffic Police Department, particularly in terms of inspection.

[7] UNCRD 2006a
[8] MPWT 2007

The impact of not inspecting and maintaining vehicles is a potential increase in the number of accidents caused by unsafe vehicles, and an increase in pollution from vehicles which exceed acceptable emission standards.

Goal: To reduce the amount of air pollutants and the emission of greenhouse gases from vehicles

Proposed Action:

- Stop the practice of modifying heavy vehicles which do not conform to technical standards in line with legislation;
- Improve the existing I/M rules and regulations and undertake public awareness raising;
- Create a campaign to inform the public on various measures being implemented;
- Use video cameras to capture smoky vehicles and broadcast these;
- Increase taxes and import duties of old and second-hand motorcycles;
- Fine drivers of vehicles without inspection certificates;
- Educate vehicle owners or drivers on proper vehicle maintenance in driving school, to prevent engines smoking;
- Improve laboratory equipment for better analysis of air quality monitoring samples;
- Enhance the capacity of vehicle inspection and inspection staff;
- Improve vehicle inspection and maintenance system regulation of second-hand vehicles.

STRATEGY 3: Promote public transport in major cities

Background: A formal public transport system has not yet been implemented in Cambodia since the failure of a previous attempt in Phnom Penh in the mid-1990s. There is little effective travel-demand management being undertaken, particularly in terms of land-use planning and transport planning coordination.

Goal: To reduce the use of cars and motorcycles to minimize fuel consumption

Proposed Action:

- Establish a Land-Use and Public Transport Planning Committee (LPTPC) to coordinate urban development and public transport;
- Develop and implement plans for a mass transit public transport system in Phnom Penh;

- Develop and implement plans to introduce incentives for people to reduce car use and use the public transport system, once established.

STRATEGY 4: Mitigation and low carbon development

Background: Trees have already been planted in major roads in cities. However, tree planting along national and provincial roads should be promoted in order to absorb carbon emissions from vehicles. In addition, the capacity of the Government, civil society and the private sector on carbon financing is still limited.

Goal: To reduce emissions from the transport sector and promote green programs in Cambodia

Proposed Action:

- Promote the greenbelt program, with tree planting along national, provincial and urban roads;
- Build the capacity of the Government, civil society and the private sector on carbon financing to access various global climate funds;
- Mainstream assessing the carbon footprint of transport operations.

STRATEGY 5: Capital-intensive urban transport infrastructure development and planning

Background:

In Cambodia, all urban transport is road based and traffic volumes are growing rapidly. Public transport is limited to buses, as there are no subways. Phnom Penh has emerging congestion problems and there is a need for a strategic transport policy to set the proper framework. The number of motorcycles increases significantly every year, including old and new motorcycles. The growing number of motorcycles is contributing to roadside air pollution and greenhouse gas emissions.

Goal: To improve urban transport services in order to reduce travelling distance and traffic congestion

Proposed Action:

- Develop capital-intensive underground and above-ground mass transit and rapid rail systems;
- Encourage the use of bicycles and tricycles which can provide an efficient urban transport alternative;

- Improve walking and cycling facilities in the city, such as side-walks and bike paths;
- Develop a master plan for city transport.

STRATEGY 6: Efficient and proven transport technology

Background:

Vehicles and maritime transport means, which are in poor condition, have been widely used in Cambodia, causing high fuel consumption. Increasing numbers of these vehicles are contributing to roadside air pollution and greenhouse gas emissions, as most of them have neither emission control devices nor the capacity to mitigate the emissions. Alternative fuels include biodiesel, electricity, ethanol, hydrogen, methanol, natural gas, propane and "P-series" fuel. However, these alternative fuels have not been introduced in Cambodia.

Goal: To reduce the consumption of fuel by introducing advanced transport technologies, and alternative and renewable energy

Proposed Action:

- Incorporate fuel-saving features in new vehicles (e.g. cab deflector on commercial trucks to reduce air drag, thus improving fuel consumption);
- Shifting the mix of new vehicles toward more efficient models;
- Model shifts to more efficient non-capital intensive mass transit options (buses and light rail transit systems);
- Introduce technological leap-frogging to emerging sustainable transportation technology, such as electric-driven bicycles, tricycles, buses, delivery vans, trucks, electric vehicles and locomotives;
- Promote biodiesel, methanol and clean air natural gas consumption in all transport means;
- Introduce emission standards in maritime transport;
- Improve inspection and maintenance system regulations of second-hand vessels/ferries;
- Improve cargo handling systems and port facilities.

STRATEGY 7: Improve petroleum-based fuel

Background: According to the import statistics of oil in 2006, Cambodia consumes about 2.4 million liters of oil per day. The current transportation means consume about 60% of the total gasoline and diesel. It is estimated that about 1.32 million liters a day of gasoline and diesel are consumed. So far, all kinds of commercial fuels (finished products) are imported from Vietnam and Thailand without proper inspection regulations and fuel quality standards, due to a lack of technical skills and inspection facilities.

Goal: To reduce fuel consumption and greenhouse gas emissions through promoting alternative and renewable energy

Proposed Action:

- Promote low-sulfur gasoline to reduce sulfur oxide emissions from vehicles;
- Promote Fischer-Propsch diesel fuel, also referred to as synthetic diesel or gas-to-liquid (GTL) diesel, produced from natural gas using a catalytic process which has the potential to lower emissions while achieving good performance;
- Improve fuel inspection regulation and fuel quality standards;
- Enhance technical skills and facilities in fuel inspection.

STRATEGY 8: Shift long-distance freight movement from truck to train

Background: Cambodian railway systems are not in good condition, and are being restored and reconstructed. Some sections of railway line are in a state of disrepair and no longer exist. The railway system in Cambodia was destroyed during the civil war of the 1970s, and now requires replacement. Once they are functioning again, both of Cambodia's rail lines are expected to become part of the GMS Southern Economic Corridor, helping Cambodia become more competitive by offering faster and less expensive transport.

Goal: To reduce fuel consumption and traffic congestion by shifting long-distance freight movement from truck to train.

Proposed Action:

- Reconstruct the railway in Cambodia and restore the missing lines;
- Improve an efficient and cost effective railway system in Cambodia with private sector management to compete with other transport modes;

- Ensure safe and reliable rail transport operations and services;
- Reform the railway system in Cambodia and reconstruct the institutional characters of the railway;
- Encourage private companies to move their freight by train;
- Strengthen the capacity of government officers in the Department of Railways.

STRATEGY 9: Enhanced traffic management

Background:

Urban traffic congestion has grown to critical proportions in some areas, most notably in parts of Phnom Penh, where the absence of traffic control devices (i.e. signals, signs and road marking) at several critical intersections, and the poor condition of road surfaces and drainage on secondary roads and local streets, exacerbates operational inefficiencies. Lack of road user discipline, inadequate regulations, poor use of traffic management measures, and low levels of enforcement are particular problems in all urban areas, greatly reducing the effective capacity of the road systems and contributing to safety concerns for all road users. Local public transport services are provided mainly by privately owned and operated motor-cycles ('motodops') with limited regulation and low, market-driven fares, but at a high safety risk to users. Vehicle overloading (with passengers and freight on inter-urban transport services) is a common occurrence, resulting in safety hazards for individuals and damage to roads and to the vehicles themselves. Lack of planning and parking controls in urban areas has resulted in encroachment by business operators onto public property, and footpaths being used for parking. Policy making, planning and management of urban transportation, as well as control of vehicle and driver licensing and registration, is weak and divided among national, provincial and local authorities.

Goal: To improve overall efficiency of traffic circulation systems for all road users in urban and community areas, to reduce traffic congestion and fuel consumption

Proposed Action:

- Develop measures such as zone access restrictions or area licensing schemes, parking control, and segregated vehicle lanes;
- Improve urban transport management;
- Improve urban road infrastructure;
- Private participation in public transport services and infrastructure;
- Traffic law enforcement and amendment;

- Develop and improve logistics systems for freight movement.

STRATEGY 10: Promotion of efficient driving

Background: With increases in the number of vehicles and the traffic volume, various problems of transport have become major social issues. Poor paving is contributing to environmental pollution, with dust from unpaved road surfaces. Inefficient driving is considered to be causing environmental pollution because of high fuel consumption. The more fuel consumed, the more emissions released.

Goal: To promote efficient driving to reduce fuel consumption and greenhouse gas emissions

Proposed Action:

- Raise awareness on smooth acceleration;
- Try to look ahead to reduce braking too often;
- Put sufficient air into tires and turn off the engine when idling;
- Turn engine off at traffic lights (especially motorbikes);
- Purchase light-colored vehicles because they need less air conditioning.
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- V. Annexes: Summary of strategies

Transport Infrastructure Adaptation to Climate Change			
Vision: Transport infrastructure will be in good condition to adapt to extreme climate events			
Mission: To improve the quality of road infrastructure to deal with the impact of climate change			
Current Situation	**Current cause**	**Strategy**	**Proposed Action**
- Insufficient maintenance of rehabilitated roads - Damage on roads/bridges by overloaded vehicles - Lack of human resources in standard road and bridge maintenance, road and bridge standards and engineering work - Transport infrastructure not in good condition and well managed yet	Road infrastructure being damaged by extreme climate events	STRATEGY 1: Repair and rehabilitate the existing road infrastructure and ensure effective operation and maintenance system	- Assess the capacity of responsible institutions at central and provincial levels with respect to road maintenance works; - Cost-effective annual road maintenance plans; - Repair broken bridges and improve flood-prone areas; - Establish road maintenance system standards; - Promote private sector participation in road maintenance works to lower Government's costs; - Introduce new technologies to improve quality of maintenance activities to enhance the quality of roads; - Improve human resources of government agencies at all levels in road/bridge maintenance standards and road and bridge standards; - Rehabilitation of national and provincial road pavement; - Strengthen the cyclone, storm surge and flood early warning systems; - Ensure that road embankments are well maintained to deal with the likely impact of climate change.
- Lack of road drainage system - Limited investment and neglected maintenance of road drainage system	Most road drainage system has disappeared and is not be able to protect roads during flooding	STRATEGY 2: Design and construct road drainage system to meet changing conditions expected with climate change	- Construct adequate drainage facilities, as some urban roads are prone to flooding, hampering transport movement and causing heavy congestion; - Improve arrangements for monitoring drainage system standards; - Continue to encourage further private-sector funding of road drainage system rehabilitation and improvement works; - Collaborate with concerned government agencies in early warning systems, in order to prepare for extreme climate events.
- Limitation of the national budget and	Road infrastructure being damaged	STRATEGY 3: Enhance adaptation capacity of road	- Change engineering parameters and solutions: road elevation, maintenance routine; - Alignment: consider climate change, avoiding permafrost zone;

engineering work for improving road quality - Lack of implementation of road and bridge standards	by extreme climate events	network to extreme climate events	- Road and bridge standards need to be fully implemented at all construction projects.
- Limited knowledge of government staff in the field of climate change and its impact on the transport sector - Climate change and its impacts have not been included in transport policies and development plans	Road infrastructure is not in good condition to deal with extreme climate events	STRATEGY 4: Capacity building and institutional strengthening	- Develop human resources of government agencies in the field of road, bridge and drainage system standards, climate change and transport, and environmental assessment; - Capacity building on monitoring the impact of climate change on transport infrastructure; - Review and revise, where appropriate, all government policies in transport sector; - Mainstream climate change in national, sectoral and spatial development planning.

Greenhouse Gas Emissions				
Vision: The amount of the emissions of greenhouse gases from transport sector will be reduced significantly				
Mission: To enhance an efficient, comfortable and safe transport system to mitigate the emissions of greenhouse gases from transport sector				
Current Situation	**Current Causes**	**Environmental Problems**	**Strategy**	**Proposed Action**
Public awareness about climate change and transport is still limited	- Improper inspection and maintenance - Inefficient driving - High fuel consumption - Increased number of vehicles	- The emissions of air pollutants - GHG emissions	STRATEGY 1: To raise public awareness about climate change caused by the emissions of greenhouse gases from transport sector	- Provide training related to the impact of the emission of greenhouse gases from transport sector; - Integrate greenhouse gas mitigation components in all transport development projects; - Introduce GHG mitigation in transport sector into education programs; - Collaborate with concerned ministries to raise public awareness on GHG emissions from transport sector; - Enhance understanding of the importance of vehicle inspection.

	- Using high emission vehicles - Traffic congestion			
- There are still a lot of non-inspected vehicles on the roads - Cambodia's vehicle registration system requires every vehicle to be registered only once - Number of modified vehicles, specifically heavy goods vehicles with one- or two-added axels to carry more weight, is rising - There are no appropriate measures to enforce laws (lack of corporation between MPWT and line ministries) - Line ministries still pay less attention to inspection and maintenance system - Capacity of professional inspection and maintenance staff is still limited	- Improper inspection and maintenance - High fuel consumption - Using high emission vehicles - Increased number of old vehicles - Inefficient driving - Increased number of non-inspected vehicles	- The emissions of air pollutants - GHG emissions	STRATEGY 2: Enhance inspection and maintenance of vehicles	- Stop the practice of modifying heavy vehicles which do not conform to technical standards in line with legislation; - Improve the existing I/M rules and regulations to undertake public awareness raising; - Create a campaign to inform the public on various measures being implemented; - Use video cameras to capture smoky vehicles and broadcast these; - Increase taxes and import duties on old and second-hand motorcycles; - Fine drivers of vehicles without inspection certificates; - Educate vehicle owners or drivers on proper vehicle maintenance in driving school, to prevent smoking vehicles; - Improve laboratory equipment for better analysis of air quality monitoring samples; - Enhance the capacity of vehicle inspection and inspection staff; - Improve vehicle inspection and maintenance system regulation of second-hand vehicles.

- A formal public transport system has not yet been implemented in Cambodia	- High fuel consumption - Using high emission vehicles - Increased number of vehicles and motorcycles - Inefficiency of traffic circulation systems - Traffic congestion - Greatly reducing the effective capacity of the road systems and contributing to safety concerns for all road users - Increased traffic accidents	- The emissions of air pollutants - GHG emissions	STRATEGY 3: Promote public transport in major cities	- Establish a Land-Use and Public Transport Planning Committee (LPTPC) to coordinate urban development and public transport; - Develop and implement plans for a mass transit public transport system in Phnom Penh; - Develop and implement plans to introduce incentives for people to reduce car use and use the public transport system, once established.
- Greenbelt program with tree planting along national and provincial roads has not been promoted - Lack of human resources in carbon financing	- The capacity of carbon absorption is low	- The capacity of carbon absorption is low	STRATEGY 4: Mitigation and low carbon development	- Promote the greenbelt program with tree planting along national, provincial and urban roads; - Build the capacity of the Government, civil society and the private sector on carbon financing to access various global climate funds; - Mainstream assessing the carbon footprint of transport operations.

- Public transport is limited to buses, as there are no subways Poor urban transport infrastructure - No capital-intensive urban transport infrastructure development and planning	- High fuel consumption - Using high emission vehicles - Increased number of vehicles - Inefficiency of traffic circulation systems - Traffic congestion - Greatly reducing the effective capacity of the road systems and contributing to safety concerns for all road users - Increased traffic accidents - Inconvenience for pedestrians - Increased number of motorcycles - Long travel distances	- The emissions of air pollutants - GHG emissions	STRATEGY 5: Capital-intensive urban transport infrastructure development and planning	- Develop capital-intensive underground and above-ground mass transit and rapid rail systems; - Encourage the use of bicycles and tricycles which can provide an efficient urban transport alternative; - Improve walking and cycling facilities in the city such as side-walks and bike paths; - Develop a master plan for city transport.
- Vehicles and maritime transport means in poor condition, with neither emission	- Inefficient use of vehicles - High fuel consumption	- The emissions of air pollutants	STRATEGY 6: Efficient and Proven Transport Technology	- Incorporating fuel-saving feature in new vehicles (e.g. cab deflector on commercial trucks to reduce air drag, thus improving fuel consumption);

control devices nor capacity to mitigate emissions - Alternative fuels have not been introduced in Cambodia	- Using high emission vehicles	- GHG emissions		- Shifting the mix of new vehicles toward more efficient models; - Model shifts to more efficient non-capital intensive mass transit options (buses and light rail transit systems); - Introduce technological leap-frogging to emerging sustainable transportation technology, such as electric-driven bicycles, tricycles, buses, delivery vans, trucks, electric vehicles and locomotives; - Promote biodiesel, methanol and clean air natural gas consumption in all transport means; - Introduce emission standards in maritime transport; - Improve the inspection and maintenance system regulation of second-hand vessels/ferries; - Improve cargo handling system and port facilities.
- High dependency on petroleum-based fuel - Lack of inspection regulations and fuel quality standard - Lack of technical skill and inspection facilities - Lack of mechanism for implementation of existing regulations	- Increasing number of fuel-based vehicles - High fuel consumption	- The emissions of air pollutants - GHG emissions	STRATEGY 7: Improve petroleum-based fuel	- Promote low-sulfur gasoline to reduce sulfur oxide emission from vehicles; - Promote Fischer-Propsch diesel fuel, also referred to as synthetic diesel or gas-to-liquid (GTL) diesel, produced from natural gas using a catalytic process which has the potential to lower emissions, while achieving good performance; - Improve fuel inspection regulation and fuel quality standards; - Enhance technical skills and facilities in fuel inspection.
- Railway system is not in good condition - Freight movement is mainly by trucks	- High fuel consumption - Traffic congestion	- The emissions of air pollutants - GHG emissions	STRATEGY 8: Shift long-distance freight movement from truck to train	- Reconstruct the railway in Cambodia and restore the missing lines; - Rehabilitate the railway's northern and southern lines and reconstruct the lines connected to the Thai and Vietnamese railway systems, and Sihanoukville port; - Introduce an efficient and cost effective railway system in Cambodia with private sector

				management to compete with other transport modes; - Ensure safe and reliable rail transport operations and services; - Reform the railway system in Cambodia and reconstruct the institutional characters of the railway; - Encourage private companies to move their freight by train; - Strengthen the capacity of government staff in the Department of Railways; - Strengthen activities in the railway transport sector and the Department of Railways.
- The absence of traffic control devices in some parts of major cities - The poor condition of road surfaces and drainage on secondary roads - Local streets exacerbate operational inefficiencies - Lack of road user discipline, inadequate regulations - Poor use of traffic management measures - Low levels of enforcement	- High fuel consumption - Using high emission vehicles - Increased number of vehicles - Inefficiency of traffic circulation systems - Traffic congestion - Greatly reducing the effective capacity of the road systems and contributing to safety concerns for all road users	- The emissions of air pollutants - GHG emissions	STRATEGY 9: Enhance traffic management	- Develop measures such as zone access restrictions or area licensing schemes, parking control and segregated vehicle lanes; - Improve urban transport management; - Improve urban road infrastructure; - Private participation in public transport services and infrastructure; - Traffic law enforcement and amendments; - Develop and improve logistics systems for freight movement.

- Vehicle overloading including passengers and freights - Lack of planning and parking controls in urban areas - Poor facilities for pedestrians - Policymaking, planning, and management of urban transportation, as well as control of vehicle and driver licensing and registration, is weak and divided among national, provincial and local authorities - Investments in urban transport are fragmented and not well coordinated	- Increasing traffic accidents - Inconvenience for pedestrians			
- Inefficient driving	- High fuel consumption - Traffic congestion	- The emissions of air pollutants - GHG emissions	STRATEGY 10: Promotion of efficient driving	- Do not accelerate fast; - Try to look ahead to reduce braking too often; - Keep sufficient space between you and the next vehicle; - Put sufficient air into tires and turn off the engine while idling; - Turn engine off at traffic light (especially motorbikes); - Purchase light-colored vehicles as they need less air conditioning.

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