Japan International Cooperation Agency (JICA)
Ministry of Public Works and Transport, Lao People's Democratic Republic








Basic Data Collection Study on Low-Emission Public Transport System in Lao PDR

Final report

October 2012

ALMEC CORPORATION

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JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
MINISTRY OF PUBLIC WORKS AND TRANSPORT

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The rate used in the report is

USD1.0= JPY79.4=LAK8,402
(average in 2012)

Electrci tariff=803LAK/kWh=0.093USD/kWh
Gasoline price=10,670LAK/L=1.27USD/L
Diesel price=9,650LAK/L=1.15USD/L
(price in October 2012)

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ABBREVIATIONS

AGL	Allianz General Laos
AC	alternating current
ADB	Asian Development Bank
AEC	ASEAN Economic Community
AFD	Agence Francaise de Develiooement
AGR	annual growth rate
ALS	area licensing scheme
ARF	additional registration fee
ARRA	American Recovery and Reinvestment Act
ASEAN	Association of Southeast Asian Nations
ASTM	America Society for Testing and Materials
B2G	business to government
BAT	best available technology
BMU	Bundesministerium fur Umwalt, Natursh utz und Reaktorsicherhei
BOCM	bilateral offset credit mechanism
CAAM	China Association of Automotive Manufactures
CAP	Clean Air Action Plans
CAR	Cooperate Automotive Research
CBD	central business district
CBS	central bus station
CBU	completely built up unit
CCF	Climate Change Fund
CDIA	Cities Development Initiative for Asia
CDM	clean development mechanism
CDV	clean diesel vehicle
CEA	Commissariat à l'énergie atomique et aux énergies alternatives
CEM	Clean Energy Ministerial
CEPT	common effective preferential tariff
CIA	Central Intelligence Agency
CIF	cost insurance and freight
CMI	compulsory motor insurance
CNG	compressed natural gas
CO	carbon monoxide
COE	certificates of entitlement
COM	European Commission Communication
CPO	crude palm oil
CTF	Clean Technology Fund
CVRP	Clean Vehicle Rabate Project
DANIDA	Danish International Development Agency
DECC	Department of Energy and Climate Change
DEM	Department of Energy and Mines
DfT	Department for Transport
DHUP	Division of Housing and Urban Planning
DISM	Department of Intellectual Property, Standardization and Methodology
DLSW	Department of Labor and Social Welfare
DLT	Department of Land Transport

DNA	Designated National Authority
DOE	Department of Energy
DONRE	Department of Natural Resources and Environment
DOT	Department of Transport
DOT	Division of Transport
DPWT	Department of Public Works and Transport
DST	Department of Science and Technology
DTE	Division of Transport Techniques and Environment
EASTS	Eastern Asia Society for Transportation Studies
EC	European Commission
EDB	Economic Development Board
EDL	Electricite du Laos
EGCI	European Green Cars Initiative
EIA	Environmental Initial Assessment
ELAB	E-mobility and Labor
EMA	Energy Market Authority
EMAS	experimental small hybrid concept car
eMO	Electromobility
EPA	Environmental Protection Agency
ERIA	Economic Research Institute for ASEAN and East Asia
ERTRAC	European Road Transport Research Advisory Council
ESC	Environmentally Sustainable City
EST	environmentally sustainable transport
ETP	European Technology Platform
EU	European Union
EUR	Euro
EV	electric vehicle
EVI	Electric Vehicle Initiative
EVSE	electric vehicle supply equipment
EWEC	East-West Economic Corridor
FCEV	fuel cell electric vehicle
FDI	foreign direct investment
FY	fiscal year
F/S	feasibility study
GBP	British Pound
GDP	gross domestic product
GFCI	Ground Fault Circuit Interruption
GHG	greenhouse gas
GIS	Geographic Information System
GIZ	Die Deutsche Gesellschaft für Internationale Zusammenarbeit
GMS	Greater Mekong Sub-region
GPS	global positioning system
GRDP	gross regional domestic product
GVR	Green Vehicle Revata
GVW	gross vehicle weight
HEV	hybrid electric vehicle
HIS	household interview survey
HRD	human resource development
HTAS	high-tech automotive system
HV	hybrid vehicle

IAI	Initiative for ASEAN Integration
ICE	internal combustion engine
ICT	information and communication technology
IEC	information and education campaign
IEE	intelligent energy Europe
IGES	Institute for Global Environmental Studies
ILO	International Labor Organization
INC	Initial National Communication
IPCC	Intergovernmental Panel on Climate Change
IPP	independent power producer
IRG	international research group
ISO	International Organization for Standardization
IT	information technology
ITA	investment tax allowance
ITS	intelligent transport systems
IWT	inland waterway transport
JASIC	Japan Automobile Standards Internationalization Center
JICA	Japan International Cooperation Agency
JPY	Japanese Yen
KL	Kuala Lumpur
LAK	Lao Kip
Lao PDR	People's Democratic Republic
LADWP	Los Angeles Department of Water and Power
LCDs	the least developed countries
LCV	light commercial vehicle
LCV	low carbon vehicle
LDC	least developed country
LEV	low emission vehicle
LGU	local government unit
Li-ion	lithium ion
LNG	liquefied natural gas
LNTA	Laos National Tourism Administration
LPG	liquefied petroleum gas
LSB	Laos Statistical Bureau
LTA	Land Transport Authority
LUCF	land use change and forestry
MC	motorcycle
MEA	Metropolitan Electricity Authority
MEM	Ministry of Energy and Mines
MES	Ministry of Education and Sports
METI	Ministry of Economy, Trade and Industry
MFN	Most Favored Nation
MKE	Ministry of Knowledge Economy
MLIT	Ministry of Land, Infrastructure, Transport and Tourism
MIRDC	Metal Industries Research and Development Center
MLSW	Ministry of Labor and Social Welfare
MLTM	Ministry of Land, Transport and Maritime Affairs
MOE	Ministry of Environment
MOES	Ministry of Education and Sports
MOF	Ministry of Finance

MOH	Ministry of Health
MOI	Ministry of Interior
MOIC	Ministry of Industry and Commerce
MOICT	Ministry of Information Communication Technology
MOIT	Ministry of Industry and Trade
MOITT	Ministry of Industry and Information Technology
MOJ	Ministry of Justice
MONRE	Ministry of Natural Resources and Environment
MOST	Ministry of Science and Technology
MOU	memorandum of understanding
MPI	Ministry of Planning and Investment
MPS	Ministry of Public Security
MPTC	Ministry of Post, Telecom and Communication
MPV	multi-purpose vehicle
MPWT	Ministry of Public Works and Transport
MRT	mass-rapid transit
MRV	measurement, reporting and verification
MSS	minimum service standard
MV	motor vehicle
MVUC	motor vehicles user's charge
NAIGT	New Automotive Innovation and Growth Team
NAMA	Nationally Appropriate Mitigation Actions
NAP	national automotive policy
NAPA	national adaptation plan of action
NBCA	national biodiversity conservation area
NEV	neighborhood electric vehicle
NGO	non-government organization
NGV	natural gas vehicle
NMT	non-motorized transport
NOx	nitrogen oxides
NPE	National Platform for Electric Mobility
NPVC	Nam Papa Vientiane Capital
NR	national road
NSCCC	National Steering Committee on Climate Change
NSEC	North-South Economic Corridor
NSEDP	National Socio-Economic Development Plan
NTC	National Training Council
NTC	National Transport Committee
NUOL	National University of Laos
OD	origin and destination
ODA	official development assistance
OECD	Organization for Economic Co-operation and Development
OEM	original equipment manufacturer
OLEL	Office for Low-Emission Vehicles
OLEV	online electric vehicle
PA	protected area
PARF	Preferential Additional Registration Fee
PCD	Pollution Control Department
PDD	project design document
PEM	palm oil methyl eater

PFI	private finance initiative
PHEV	plug-in hybrid electric vehicle
PHP	Philippine Peso
PIU	project implementation unit
PKKNPA	Phou Khao Khouay National Protected Area
PM	particulate matter
PME	palm oil methyl ester
PPP	public and private partnership
PPP	purchasing power parity
PR	public relations
PT	public transport
PTT	Petroleum Authority of Thailand
QBCM	quick battery charging machine
R&D	research and development
RE	rural electrification
REN	renewable energy
REPI	Renewable Energy Promotion Institute
SAE	Society of Automotive Engineers
SEA	south east asia
SEC	South Economic Corridor
SEDP	socio economic development plan
SGD	Singapore Dollar
SME	subject matter expert
SP	stated preference
STEA	Science, Technology and Environment Agency
SEZ	special economic zone
SU:GRE	Sustainable Green Fleets
SUV	sports utility vehicle
SWOT	strength, weakness, opportunity, and threat
TA	technical assistance
TAAC	Taiwan Automobile Research Consortium
TDM	transport demand management
TEPCO	Tokyo Electric Power Company
TfL	Transport for London
THB	Thai Baht
THC	total hydrocarbons
TIDES	technology innovation and development scheme
TISI	Thai Industrial Standards Institute
TLC	Ho Tay Limited Liability Company
TOE	tons of oil equivalent
TSP	total suspended particulate
TVET	technical vocational education and training
TWN	Taiwan
UCLA	University of California, Los Angeles
UDAA	Urban Development and Administrative Authority
UK	United Kingdom of Great Britain and Northern Ireland
ULV	ultra lightweight vehicle
UNCRD	United Nations Centre for Regional Development
UNECE	United Nations Economic Commission for Europe
UNESCO	United Nations Educational, Scientific and Cultural Organization

UNFCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organization
USA	United States of America
USABC	United State Advanced Battery Consortium
USD	United States Dollars
V2G	vehicle-to-grid
V2H	vehicle-to-home
VAT	value added tax
VCM	vehicle control module
VCSBE	Vientiane Capital State Bus Enterprise
VND	Vietnamese dong
VOC	vehicle operating cost
VOC	volatile organic component
WHO	World Health Organization
WS	workshop
WTP	water treatment plant
ZEV	zero emission vehicle

Main Text

1. INTRODUCTION

1.1 Study Context

1.1 During the period 2000–2010, in association with the country's economic growth, which has been on a positive track since 2005, i.e., at a rate of more than 7% annually. Lao PDR's passenger traffic and the number of registered passenger vehicles in the capital city of Vientiane increased at about 1.5 and 3.4 times, respectively. The significant increase in traffic volume has caused traffic congestion in the urban areas of Vientiane and other cities, especially in the morning and evening peak hours, thereby affecting the socio-economic activities of citizens and worsening the urban environment. As the economy will likely grow further, it is estimated that by 2030 the number of passenger cars in Vientiane will be 2.7 times its 2010 figure, while the average travel speed will decrease to about 20 kilometers per hour (km/h).

1.2 In order to attend to and avert the country's worsening traffic problems, the Japan International Cooperation Agency (JICA) implemented *"The Study on Master Plan of Comprehensive Urban Transport in Vientiane in Lao PDR"* in 2008, which proposed the development and maintenance of its road network and the improvement of its public transport system. Based on this study, the Japanese government has vigorously provided the Lao government with various types of support including the procurement of public buses through the grant aid scheme.

1.3 As the country's transport mainly runs on petroleum, this has implications on the country's environment and foreign exchange receipts. Tourism, which is one of the country's major economic drivers accounting for 15–20% of foreign exchange receipts, will likely suffer due to traffic congestion, noise, and air pollution. "Laos, Simply Beautiful" is the country's tourism slogan, highlighting the unique character and tranquil atmosphere that even its big cities, such as Vientiane and Luang Prabang, are characterized with. Moreover, since Lao PDR depends entirely on imported fuel, this too has ramifications on the national financial and energy security. It is therefore necessary to promote a modal shift to public transport as well as introduce low-emission and more environment-friendly transport systems.

1.4 Lao PDR is rich in clean energy resources. In fact, it can supply more than 30 times the domestic demand for hydroelectric power, thereby suggesting the possible development of a zero-emission transport model, one that does not generate CO_2 by utilizing hydroelectricity as energy source, in the early development stage of the country's transport sector. Investment in needed infrastructure to fit this new model will likely bring about investment in other sectors as well.

1.2 Study Objectives and Coverage

1.5 The study's objectives are as follows:

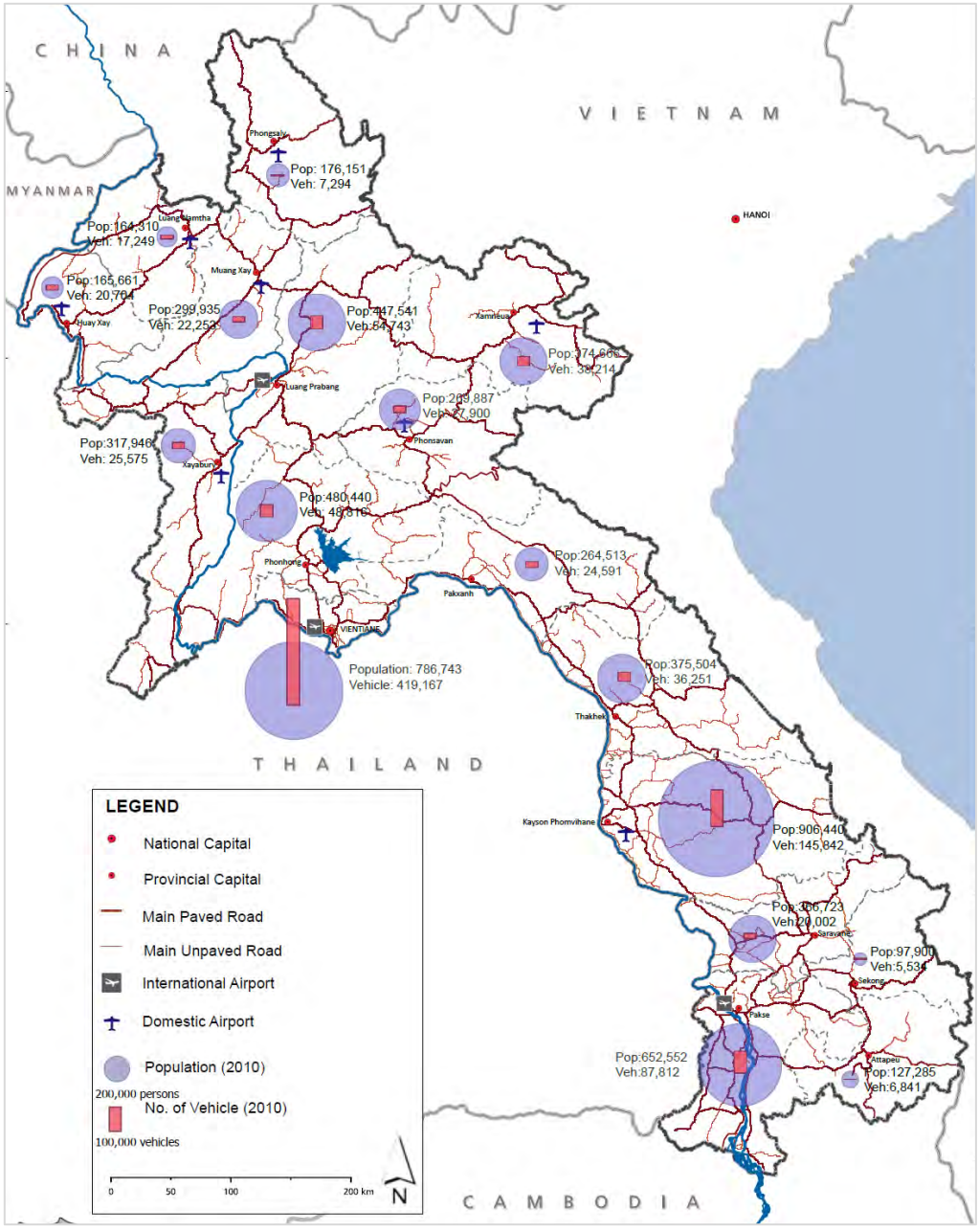
(i) To collect general information that will be useful in introducing low emission transport systems, such as electric vehicles which will use the clean energy resources of Lao PDR;

(ii) To analyze preliminarily the feasibility of introducing low emission transport systems and their impact on various sectors; and

(iii) To propose a model project which intends to collect demonstration data and obtain lessons for eventual replication across the country.

1.6 The study area covers the entire Lao PDR and its neighboring countries in terms of information collection, while planning will be done for priority cities in Laos.

Figure 1.2.1 Study Area



Source: JICA Study Team

1.3 Implementation of the Study

1) Main Tasks

1.7 The overall Study implementation was briefly as follows (see Figure 1.3.1):

(i) **Task 100:** The status of EV/PHEV introduction and promotion in EV developed countries and ASEAN countries, as well as the development of EVs/PHEVs in terms of technologies, were reviewed and summarized. In order to collect the latest information, the Study Team also visited China, Korea and Taiwan that have accelerated the EV development.

(ii) **Task 200:** Laws and regulations related to EV/PHEV introduction and promotion in Japan, the role of stakeholders in EV/PHV town concept and its support mechanism of Japanese government were reviewed and summarized.

(iii) **Task 300:** Based on the situation analysis on Lao PDR, the opportunities and constraints to introduce EV/PHEV to Lao PDR were clarified. Furthermore, the current conditions of four major cities (Vientiane Capital, Luang Prabang, Kayson Phomvihane and Pakse) were reviewed to clarify the opportunities to introduce EVs.

(iv) **Task 400:** The website was opened under the website of Department of Transport (DOT), Ministry of Public Works and Transport (MPWT) both in English and Lao. In addition, newsletters were issued three times to provide further information on EVs.

(v) **Task 500:** Interviews with relevant agencies at the central government level were conducted to share the information, promote the awareness on EVs, and clarify the role of relevant agencies. At the same time, the mandate in relevant agencies was analyzed to assess their capacity.

(vi) **Task 600:** The transport situation analysis for four major cities (Vientiane Capital, Luang Prabang, Kayson Phomvihane and Pakse), transport corridors and rural areas were conducted, highlighting several issues were identified.

(vii) **Task 700:** The driving behavior survey, the transport attitude survey, SP survey and urban transport condition survey were conducted to identify the specification of appropriate EVs for Lao PDR, transport problems, people's awareness on EVs, demand of EV use and so on.

(viii) **Task 800:** Several candidate model projects were identified in priority cities as well as rural areas and along the national road transport corridors. Those candidate projects were assessed by stakeholders to select the priority Model Project for next steps.

(ix) **Task 900:** The required number of charging stations and its development cost were estimated based on the forecasted number of EVs in 2015, 2020 and 2030.

(x) **Task 1000:** Preliminary financial and economic analysis on introducing EVs in Lao PDR was conducted, comparing the cost between baseline scenario and EV introduction scenario. The price of EV in the future is not defined yet, so that several sensitivity analysis was also done.

(xi) **Task 1100:** Preliminary social and environmental analysis on introducing EVs in Lao PDR was conducted, comparing baseline scenario with EV introduction scenario. Reduction of pollutants and CO2 were also estimated.

(xii) **Task 1200:** Three components were proposed as a Model Project, which is composed of field demonstrations in Vientiane Capital and Luang Prabang, and the EV introduction support program.

(xiii) **Task 1300:** The Study Team has contacted with the relevant institutions and

companies in Japan to clarify the possible cooperation.

(xiv) **Task 1400:** Four workshops were held in 27th April, 5th July, 24th August and 27th September 2012. Participants were invited from the central and local government, university, private sector and international organizations. In addition to those workshops, the Study Team visited three cities (Hanoi, Bangkok and Jakarta) with JICA and DOT. The purpose of visit was to share the information and experiences on EV development among the neighboring countries as well as to propose develop EV society in ASEAN.

(xv) **Task 1500:** To date, five reports were submitted including this report (Inception Report, Progress Report 1, Progress Report 2, Draft Final Report, and Final Report).

2) Stakeholder Participation

1.8 To date, a series of meetings with various organizations and stakeholders have been carried out.

(a) **Progress Report Workshop 1:** This was held on 27th April 2012 to explain the Study progress and preliminary concepts of development strategies of EVs in Lao PDR as well as relevant agencies made presentations on the climate change, renewable energy development and the development strategies on environmentally sustainable transport (EST).

(b) **Progress Report Workshop 2:** This was held on 5th July 2012 to explain the development strategies of low-emission transport system in Lao PDR and the concept of candidate model projects. The development strategies and candidate model projects were discussed during the workshop as well as collecting the opinion through questionnaire survey for the participants.

(c) **Progress Report Workshop 3:** This was held on 24th August 2012 to explain the proposed priority projects, to discuss on the role of the government to introduce and promote EVs and business opportunities of EVs. This workshop was composed of presentation by the Study Team, DOT and private company and group discussions by public and private sectors.

(d) **Final Workshop:** This was held on 27th September 2012 to share understanding on the outputs of the Study and the proposed Model Project. This workshop also included presentation by MOF on taxation on EV, and MEM on power supply.

(e) **Individual Meetings with Government Organizations:** In order to understand the current situation of Lao PDR and its major cities and to collect the information, individual meetings were held with agencies relevant to this Study, such as the MPWT, MONRE, MOF, MOIC, MEM, MOES, to discuss their respective mandates. A series of meeting and collected documents were listed in ***Appendix 1.1*** and ***Appendix 1.2***.

(f) **Individual Meetings with Other Bodies:** In order to understand the situation of the actions on EVs by other organization, individual meetings with private companies were held in Lao PDR and Japan. (see ***Appendix 1.1***)

3) Supplemental Survey

1.9 In order to collect further information and data, supplemental surveys and site visit were conducted as follows;

(a) **Vehicle Operating Condition Survey:** This was conducted to get data on the coordinates, elevation, and speed of vehicles during operation, as well as the temperature in the area, battery room, and battery surface. These data will be analyzed to determine the specifications of the EV/PHEV and equipment for the charging station which will be proposed for Lao PDR. The specifications of the EV/PHEV comprise fuel cost (kip/km), operating range (km), battery capacity (kWh), maximum speed (km/h), and gradient performance. The specification of the charging equipment includes electric supply capacity and location. (see ***Appendix 1.3***)

(b) **Key Informant Interview:** This is being conducted to clarify the issues faced by the Vientiane capital through interviews with stakeholders such as the central and local governments, universities, private companies, monks, etc. At the same time, interviews are conducted to get the opinion on EV introduction in Vientiane Capital.

(c) **Transport Attitude Survey:** This was conducted to clarify the transport activities in major cities (Vientiane Capital, Luang Prabang City and Kayson Phomvihane City), transport problems and improvement needs, and demand for future transport systems. The survey was conducted as a questionnaire survey to residents, workers, public transport drivers, etc. (see ***Appendix 1.4***)

(d) **Stated Preference Survey (SP Survey):** This was conducted to clarify the needs of EVs/PHEVs and the public transport system in Vientiane Capital. The survey can identify the status of introducing and promoting EVs/PHEVs and public transport. (see ***Appendix 1.5***)

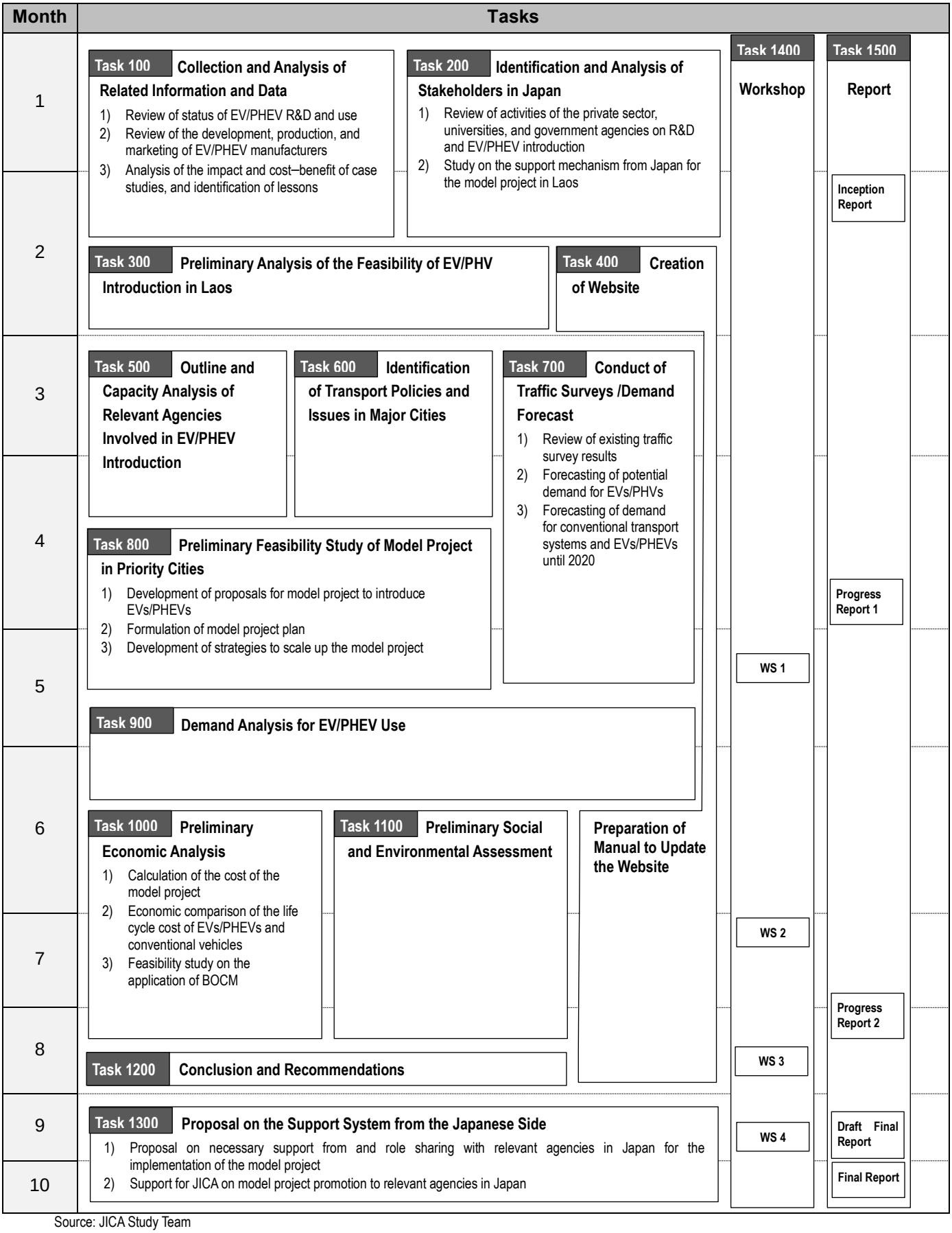
(e) **Urban Transport Condition Survey:** This was conducted to obtain a basic data for analyzing the vehicle use condition of residents, their willingness to use EVs and the opinion on realizing EV society in Lao PDR. The survey target was residents, EV users (e-minibus, e-bicycle and e-motorcycle) and tourists in Vientiane Capital and Luang Prabang City. (see ***Appendix 1.6***)

(f) **Survey on Capacity to Introduce and Promote EVs:** This was conducted to analyze the capability and possibility of private sector to participate the Model Project. The survey contents were composed of vehicle use condition of companies/enterprises and their willingness to use EVs and its condition. The survey was conducted for companies/enterprises in Vientiane Capital and Luang Prabang. (see ***Appendix 1.7***)

(g) **Interview Survey on the Interests of EV related Private Sector in Japan:** This survey intended to find out interests and opportunities to participate in various activities for introduction of EVs in Lao PDR.

(h) **Site Visit:** It was conducted to collect further information and the demand on EVs introduction of the local government. Site visit included Luang Prabang, Savannakhet, Champasack and village in Vientiane Province. During the site visits, the Study Team also visited related agencies.

Figure 1.3.1 Study Framework



Source: JICA Study Team

1.4 Country Profile

1) Laos in the Region

1.10 Lao PDR is a member of the Association of Southeast Asian Nations (ASEAN) since 1997. However, there is a big disparity among the ASEAN countries. Lao PDR is still one of the least developed countries (LDCs) in the world due to its low income level, poor condition of human assets and high economic vulnerability. Among the ASEAN countries, Cambodia and Myanmar are also LDCs. Although, the economic growth rate of Lao PDR is the second highest in ASEAN which posted 8.8%/year in the period of 2005 – 2010, the GDP and the GDP per capita of Lao PDR was still much lower than that of other ASEAN countries. The GDP of Lao PDR contributed only 0.3% of the total regional GDP in 2010.

1.11 Tourism development is one of the main economic activities in Laos, but Lao PDR shared only 3.4% of the total number of tourists in ASEAN, ranking 7th overall together with Cambodia. Lao PDR is still not well-known by the foreigners as tourist destinations. Shares of intra-ASEAN and extra-ASEAN tourists remain imbalanced: About 80% of tourists are from Southeast Asia.

Table 1.4.1 GDP of ASEAN Countries

	Million USD at 2010 Prices		Share in ASEAN (%)		AGR (%/year)		Per Capita at Current Prices (USD)	
	2005	2010	2005	2010	'00-'05	'05-'10	2005	2010
ASEAN	1,444,785	1,865,647[1)]	100	100	5.0	5.2	1,617	3,111[1)]
Brunei	11,965	12,371	0.8	0.7	2.1	0.7	25,753	29,675
Cambodia	8,593	11,629[1)]	0.6	0.6	9.3	6.2	455	814[1)]
Indonesia	535,708	706,752	37.1	37.9	4.7	5.7	1,300	2, 974
Lao PDR	4,410	6,736	0.3	0.3	6.3	8.8	464	1,077
Malaysia	191,036	237,959	13.2	12.8	4.7	4.5	5,319	8,423
Myanmar	31,220	45,428[1)]	2.2	2.4	12.9	7.8	216	742[1)]
Philippines	157,013	199,591	10.9	10.7	4.6	4.9	1,159	2,123
Singapore	163,334	222,699	11.3	11.9	4.0	6.4	28,498	43,117[1)]
Thailand	267,706	318,908	18.5	17.1	5.1	3.6	2,709	4,992
Vietnam	73,801	103,574	5.1	5.6	7.5	7.0	637	1,174[1)]

Source: Japan ASEAN center
1) Estimated

1.12 The leaders of ASEAN countries agreed to accelerate the establishment of the ASEAN Economic Community (AEC) by 2015 and to transform ASEAN into a region with free movement of goods, services, investment, skilled labor, and free flow of capital. Lao PDR is expecting the benefit from establishment of AEC for its socio-economic development. However, there are also fears to increase competition among ASEAN countries.

1.13 In order to help accelerate the pace of sub-regional economic cooperation, the economic corridor approach to sub-regional development was adopted by the GMS countries. Three priority GMS economic corridors were identified, namely, the East–West Economic Corridor (EWEC), the North–South Economic Corridor (NSEC), and the Southern Economic Corridor (SEC) (see Figure 1.4.1). Of which, East-West Corridor, North-South corridor, Northeastern corridor and Central corridor pass Lao PDR. From a broader perspective, the development of GMS economic corridors offers a means for the less-developed member countries of the ASEAN to catch up with the more economically advanced member countries and to reinforce the market integration process that is increasing in East Asia.

Figure 1.4.1 Location of GMS Corridors

Source: ADB

2) Socio-Economic Situation

1.14 **Population:** While the population has increased continuously, the household size became smaller. Younger generation tries to get own houses in suburban areas due to lack of land in the urban center. As a result, the cities are expanded. The expansion of the cities is already seen in the major cities. In addition, more people migrate to cities to seek better opportunities for live, work and study. The acceleration of urbanization may accelerate the development of industry and service sectors. However, many provinces lag behind of the above trend. The population distributes unevenly over the country. The population in rural provinces is still very low, and they live scattered which makes provision of public infrastructures difficult and inefficient.

1.15 **Economy:** Lao PDR's GDP increased from LAK36,466 billion in 2005 to LAK55,694 billion in 2010, with a 8.8% annual growth rate. The economic structure has been changed from agricultural dominated economy to service sector one. Main economic activities of Lao PDR are rice cultivation, electricity generation and tourism. Lao PDR has abundant natural resources compared to neighboring countries. Therefore, the economic activities which can make efficient use of those natural resources are the trigger of socio-economic development of Lao PDR. However, the disparity among provincial GRDP per capita widened. In the period of 2006 – 2010, the highest average GRDP per capita was USD2,148 in Vientiane Capital, and the lowest was only USD397 in Houaphanh province. The provinces in the central region posted relatively higher GRDPs per capita.

1.16 **Trade:** Lao PDR's main export goods are minerals (45%), electricity (10%) and garments (13%), while main import goods are machineries and production equipment (47%) and vehicles (11%). Export values of Lao PDR have been dramatically increased with 23% of annual growth rate in the period of 2005 – 2010. However, the foreign trade balance is still in deficit. The import of petroleum products accounted for 17.2% in the total amount of import value in 2010. More than 95% of the petroleum products are transport fuel (gasoline and diesel). The total selling volume of transport fuels increased from 362 million litters in 2005 to 721 million litters in 2011. In terms of the cost, it was USD5,575 billion in 2011 increased from USD2,151 billion in 2005. The total amount of petroleum cost has increased due to motorization and increase in the petroleum price in the world. Motorization and increase in the petroleum price will increase further in the future, and it must strain the national finance.

1.17 **FDI:** The sector share of FDI was totally changed compared to 2005 and 2009. While hydropower sector received the highest share of FDI (77%) in 2005, it reduced to only 5% in 2009. On the other hand, mining and fuel and service sectors increased its share from 8% to 46% and 1% to 30% in the period of 2005 – 2009, respectively. The main products from the mining are gold, silver and copper. The investment in service sector is mainly support service such as banking, insurance, etc. The main investment countries are Vietnam, Thailand and China.

Table 1.4.2 Socio-Economic Profile of Lao PDR

			Actual		Forecast		AGR (%/year)		
			2005	2010	2020	2030	'05 - '10	'10 - '20	'20 - '30
Demography	Total (000)		5,622	6,256	7,043	7,753	2.2	1.2	1.0
	Urbanization (%)		27.1	29.7[2)]	44.2[1)]	53.1[1)]	4.0	2.9	1.9
	Household Size (person)		5.9	6.1	5.2	4.5	0.7	-1.6	-1.4
	Poverty Rate (%)		33.5[3)]	27.6[4)]	-	-	-3.8	-	-
Economy @ 2010 price	GDP (LAK billion)		36,466	55,694	114,743[2)]	204,488[2)]	8.8	7.5	5.9
	GDP by Sector (%)	Primary	45.0	30.3	-	-	-	-	-
		Secondary	29.5	27.7	-	-	-	-	-
		Tertiary	25.5	42.0	-	-	-	-	-
	Per Capita	LAK million	6.5	8.9	16.3	26.4	6.6	6.2	4.9
		USD	784	1,077	1,971	3,192	6.6	6.2	4.9
	Trade (USD million)	Export	870	2,481	-	-	23.3	-	-
		Import	1,120	2,845	-	-	20.5	-	-
		Net Trade	-250	-364	-	-	-7.8	-	-
	Petroleum Selling Volume	Volume (million Litter)	361.7	720.9[5)]			12.2		
		Amount (LAK billion)	2,151	5,575[5)]			17.2		
	FDI	No. of Projects	143	208[6)]			9.8		
		Amount (USD million)	1,041	3,450[6)]			34.9		

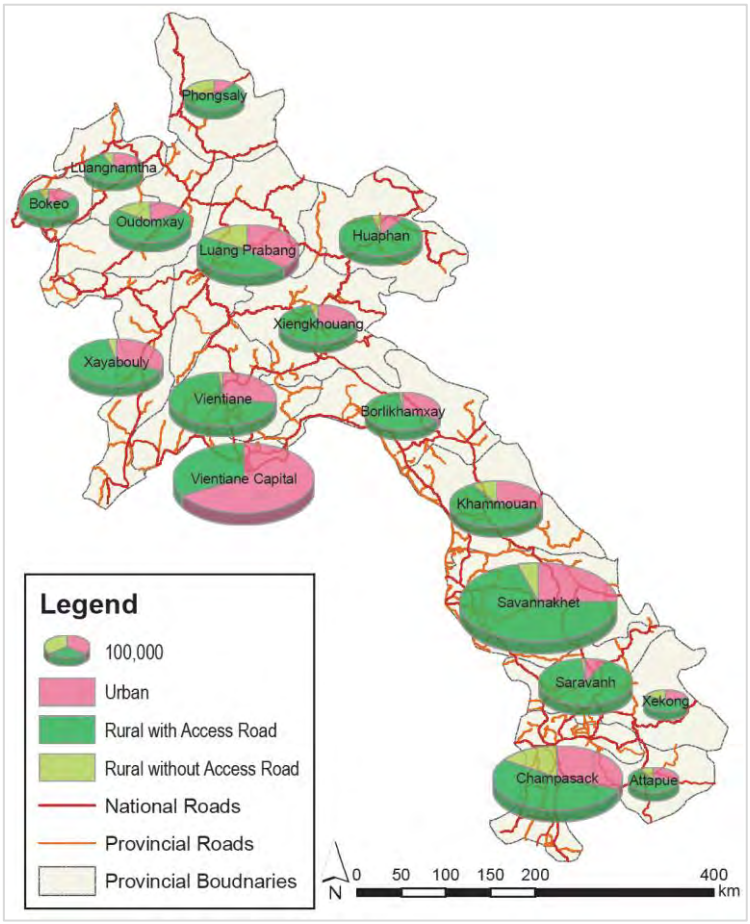
Source: Statistical Yearbook of Lao PDR, data from Ministry of Industry and Commerce, Lao PDR Economic Monitor (WB),

1) Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat

2) World Bank prediction

3) data in 2002, 4) data in 2007, 5) data in 2011, 6) data in 2009

Figure 1.4.2 Population Distribution of Lao PDR in 2010



Source: JICA Study Team based on the data from LSB

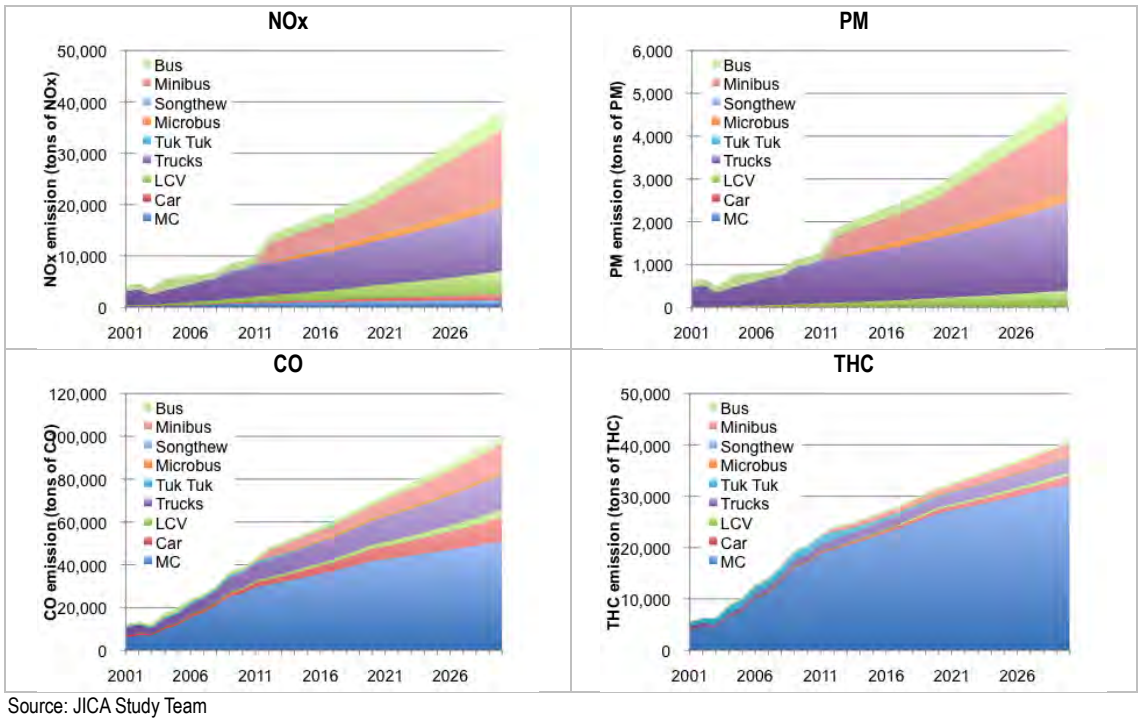
3) Environmental Situation

1.18 **Natural Environment:** Lao PDR is rich in forest and has high biodiversity with at least 8,100 different species of flora and fauna. However, forest coverage decreased significantly 70% in 1940 to 40% in 2010 and heavy losses in biodiversity resources have occurred due to variety of threats including human activities. Decreasing forest has been bringing serious impacts on carbon pools and biodiversity in Lao PDR, too. In order to protect forest and biodiversity, there are 21 different National Biodiversity Conservation Areas (NBCAs) with 29,775 km^2 and many smaller Protected Areas (PAs).

1.19 **Air Pollution:** Air quality in Lao PDR is expected to worsen due to motorization and industrialization if adequate mitigation measures are not taken immediately, especially in Vientiane Capital, where the number of vehicles has grown rapidly and the number of industry is increasing. Air pollution is a major environmental risk to human health. There are two types of air pollution in Lao PDR. The one is caused by fuel combustions and industrial processes (urban type). Another is brought by field and forest burning causing wide spread haze (local type). In regard to the vehicle related standards, Lao PDR has standards for new vehicle and fuel both gasoline and diesel. As for in use vehicle, there is the vehicle inspection standard and compulsory inspection system. However, its implementation is very weak.

1.20 Major air pollutants emissions in the transport sector in Lao PDR were estimated by the Study Team. Every air pollutants increased rapidly. Based on the demand forecast of vehicles, air pollutants emissions will increase more than double in 2030 compared with the current situation. Significant air pollution will be expected to happen especially along the trunk roads and traffic congested area.

Figure 1.4.3 Air Pollutants Emissions from Transport Sector



Source: JICA Study Team

Note: LCV (light commercial vehicle) includes pick-up trucks, vans and SUVs.

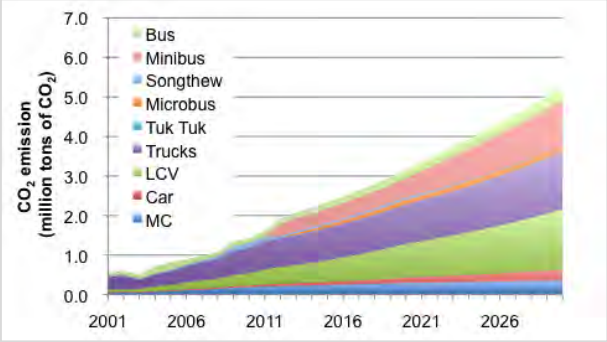
1.21 **Climate Change:** In Lao PDR, the importance and necessity of climate change adaptations and mitigations are getting increasing. The country is significantly vulnerable to climate change impacts due to its high dependence on agriculture sector and weak

infrastructure. Energy is highly dependent on hydropower which is affected by rainfall to a great extent. On the other hand, the draft of Second National Communications of Lao PDR said that large amount of CO2 has been released from deforestation and land use change.

1.22 Lao government ratified the United Nations Framework Convention on Climate Change (UNFCC) in April 1995 and the Kyoto Protocol in February 2003. Department of Natural Disaster Management and Climate Change of MONRE is the Designated National Authority (DNA) of Lao PDR. The government formulated “Strategy on Climate Change of the Lao PDR” in March 2010.

1.23 CO2 emissions from the transport sector in Lao PDR were estimated by the Study Team (see Figure 1.4.4). It has been increasing rapidly from 643,410 t CO2/year in 2001 to 2,179,297 t CO2/year in 2011. It is estimated that it will continue to increase more rapidly and reach at 3,832,668 t CO2/year in 2020 and 6,286,348 t CO2/year in 2030. The highest contributor is trucks and LCV.

Figure 1.4.4 CO_2 Emissions from Transport Sector



Source: JICA Study Team

1.24 **Noise:** Road traffic is the most important and serious source of noise in urban area. Noise and vibration from motor vehicles are supposed to be getting worse in urbanized area in Lao PDR. However there is no continuous or intensive measurement even in Vientiane.

1.25 **Waste:** The generation of solid waste in urban areas in Lao PDR is increasing, and it has potential to affect the quality of surface and groundwater. Expanding urban populations with poor solid waste management system is compounding the level of pollution. The current annual waste generation is 270,000 tons. Domestic waste accounts for the bulk of it. The average daily urban waste production is 0.75 kg/capita. The main issue of waste management is uncontrolled waste collection storage. In most settlements, the solid waste that is collected is deposited in uncontrolled open dumps that are a significant environmental, aesthetic and health hazardous. Over two-thirds of municipal waste could be recycled, but the current scale of recycling in Lao PDR is still very modest.

1.26 **Others:** Other environmental concerns include deteriorating water quality due to the pressure of rapid economic development and urbanization, increasing hazardous chemicals due to industrialization, increasing soil erosion due to deforestation, slash-burn agriculture, etc., increasing toxic wastes by mining activities, and so on.

4) Energy

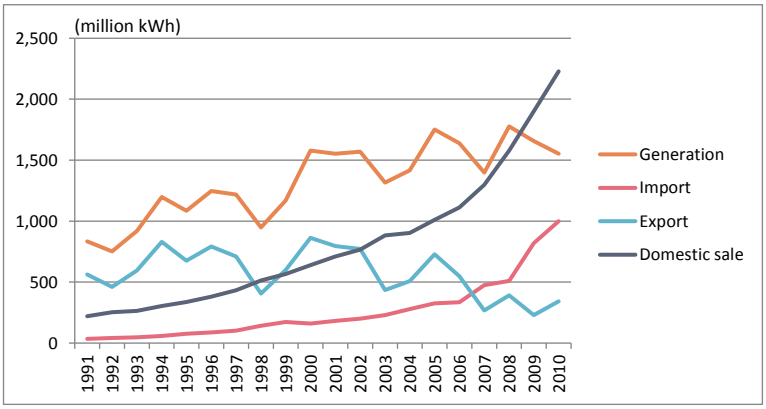
1.27 **Energy Sources and Consumption:** While the energy sources of Lao PDR are mainly traditional fuels such as wood and charcoal (69%), fossil-fuel use is only 17% which is equivalent to 0.9 tons of TOE. The fuel consumption of Lao PDR is still very low

compared with those of other developing countries. Major energy consumers are residents (51%) and transport (21%) sectors. 71% of households in the country access to power supply, but the rest cannot due to lack of infrastructure and lack of financial capacity. The biggest consumer is Vientiane Capital which accounts for 43% of total domestic electric consumption and has highest electric consumption per capita (1,250 kWh). National average electric consumption per capita is only 596 kWh. It is expected that the demand for energy by the transport sector has increased due to rapid motorization.

1.28 **Renewable Energy Resources:** While Lao PDR lacks conventional energy resources, it has abundant renewable energy resources. Hydropower is the most important renewable energy resource of Lao PDR, with a technical potential of around 26,000 MW. In addition to this, small-scale hydropower plants are expected to generate 2,000 MW in total. Besides hydropower generation, many other kinds of renewable resources are already underutilization including biofuels from crops, small solar system, and so on.

1.29 **Power Supply:** While EDL is in charge of transmission and distribution of power supply, EDL-gen and independent power producers (IPPs) function as power generators. The power source of Lao PDR is 99% hydropower and 1% fossil fuel (imported power). As of 2011, there are 10 EDL hydropower plants (387 MW) and five IPP hydropower plants (2,162 MW). While 0–10% of generated power by each IPP is supplied for domestic use, the rest is sold to neighboring countries. The total power generation of EDL has gradually increased, but the amount of export has dramatically increased too. This is because the Laos government prefers exporting its power to promote an image of being the “battery” of ASEAN and also to gain revenue from taxes, royalties, etc. According to the power development plan of EDL, there will be power shortage before 2016. However, the planned more than 60 new power plants can satisfy the domestic power demand after 2016.

Figure 1.4.5 Power Generation and Distribution by EDL and EDL-gen in Lao PDR



Source: Annual Report 2010 of EDL

1.30 **Domestic Electric Tariffs:** Electric tariffs are classified by voltage and purpose of use. According to the annual report of EDL 2010, the average tariff is 559 LAK/kWh (≈6.7 cent/kWh) in 2010 (total consumption = 2,228 GWh, total profit = LAK1,245 billion), which is still low[1]. However, the tariffs have increased 1.6% within 2012 and will increase 2%/year from 2013 to 2017. It will be a burden on household financial account in near future.

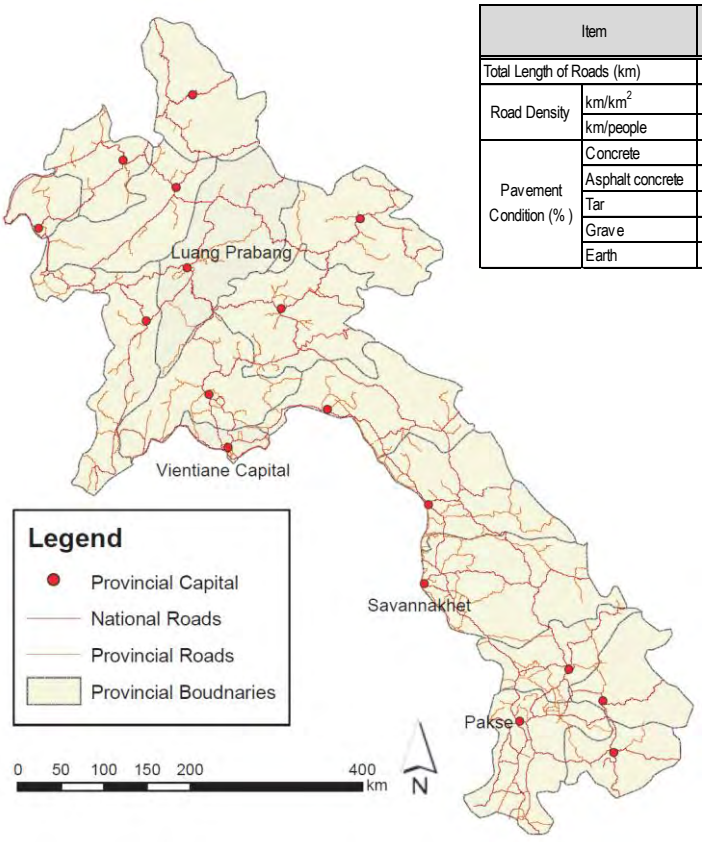
[1] Electric tariff of the neighboring countries in 2009: Thailand = 10.0 cent/kWh; Vietnam = 5.3 cent/kWh, Cambodia = 20.0 cent/kWh, Myanmar = 3.4 cent/kWh.

5) Transportation

1.31 **Overall:** Lao PDR has three main transport modes, i.e., land, inland water, and air. However about 88% of freight traffic and 95% of passenger traffic are carried by land transport. In the period 2005–2010, the total volume of freight and passenger traffic increased significantly from 1,676 million person-km and 260 million tons-km to 2,556 million person-km and 513 million tons-km, respectively. At the same time, the share of land transport in passenger traffic and freight traffic increased from 88.3% and 86.3% to 84.5% and 87.9%, respectively.

1.32 The total length of roads increased from 25,090 km in 2000 to 39,585 km in 2010, which is about 1.5 times in 10 years. However, the pavement rate is only 1.7%. In comparison with the road conditions in other ASEAN countries, the pavement rate of Lao PDR is the third lowest (14.8%). On the other hand, road density is not so low, because the land and population of Lao PDR are very small against road length.

Figure 1.4.6 Transport Network in Lao PDR



Item		2005	2010	AGR (% /year): '05–'10
Total Length of Roads (km)		33,861	39,585	3.2
Road Density	km/km^2	0.14	0.17	3.2
	km/people	0.006	0.006	1.0
Pavement Condition (%)	Concrete	0.0	0.2	-
	Asphalt concrete	0.0	1.5	-
	Tar	13.5	13.7	3.4
	Grave	34.3	35.0	3.6
	Earth	52.2	49.5	2.1

Source: JICA Study Team based on the data from DOT of MPWT

1.33 **Motorization:** The number of vehicles had increased dramatically in the period of 2005 – 2010. While the motorcycle is still the main vehicle type for Lao people, the growth rate of car (20.2%/year) is higher than that of motorcycle (18.2%/year). The motorization is just started in Lao PDR. Considering the GDP per capita of Lao PDR, the car ownership rate is relatively high. Many people can afford the car because many cheaper cars such as Korean and Chinese are imported and people can pay in installments without any security.

1.34 The increase in the number of vehicles varied by province. While the share of the total number of vehicles is constantly high in Vientiane Capital (41.2%), the increase rate

of the number of vehicles in Vientiane Capital (15.0%/year) is lower compared with other provinces (17.1%/year in national average). Northern provinces have relatively higher increase rates (20–33% a year). There is no big difference in the shares of vehicle types among the provinces. Motorcycle shares 75–85% of the total number of vehicles, followed by car (10–25%).

Table 1.4.3 No. of Vehicles in Lao PDR

	No.			AGR (%)		
	2001	2005	2011	'01-'05	'05-'11	'01-'11
Motorcycle	168,379	337,719	899,436	19.0	17.7	18.2
Car[1)]	33,967	66,969	202,022	18.5	20.2	19.5
Others[2)]	18,145	25,718	40,400	9.1	7.8	8.3
Total	220,491	430,406	1,141,858	18.2	17.7	17.9

Source: DOT of MPWT

1) including sedan, pick-up, van and SUV

2) including three wheeler, truck and trailers and buses

1.35 **Traffic Safety:** The number of traffic accidents and the number of traffic accidents per 1,000 vehicles increased significantly from 2,295 and 3.6 in 2007 to 6,462 and 5.8 in 2010. Fortunately, the damage caused by traffic accidents is still low (60% of damaged vehicles had only minor damage). The main cause of traffic accidents is drunk driving and the main traffic violation is driving without a license. More than 30% of the total traffic accidents occurred in Vientiane Capital.

1.36 **Traffic Pollution:** Traffic pollution mainly refers to air pollution, noise, and vibration. Unfortunately, there are no official monitoring data for this in Lao PDR. However, black smoke can easily be seen from the exhaust pipes of vehicles. Noise is generated by motorcycles and three-wheelers. Vibration can be felt when heavy trucks pass by. These problems affect people's health, that is, they cause asthma, hypertension, and ischemic heart disease, lower respirations infections, and other illnesses. The causes of traffic pollution can be traced from both infrastructure and vehicles.

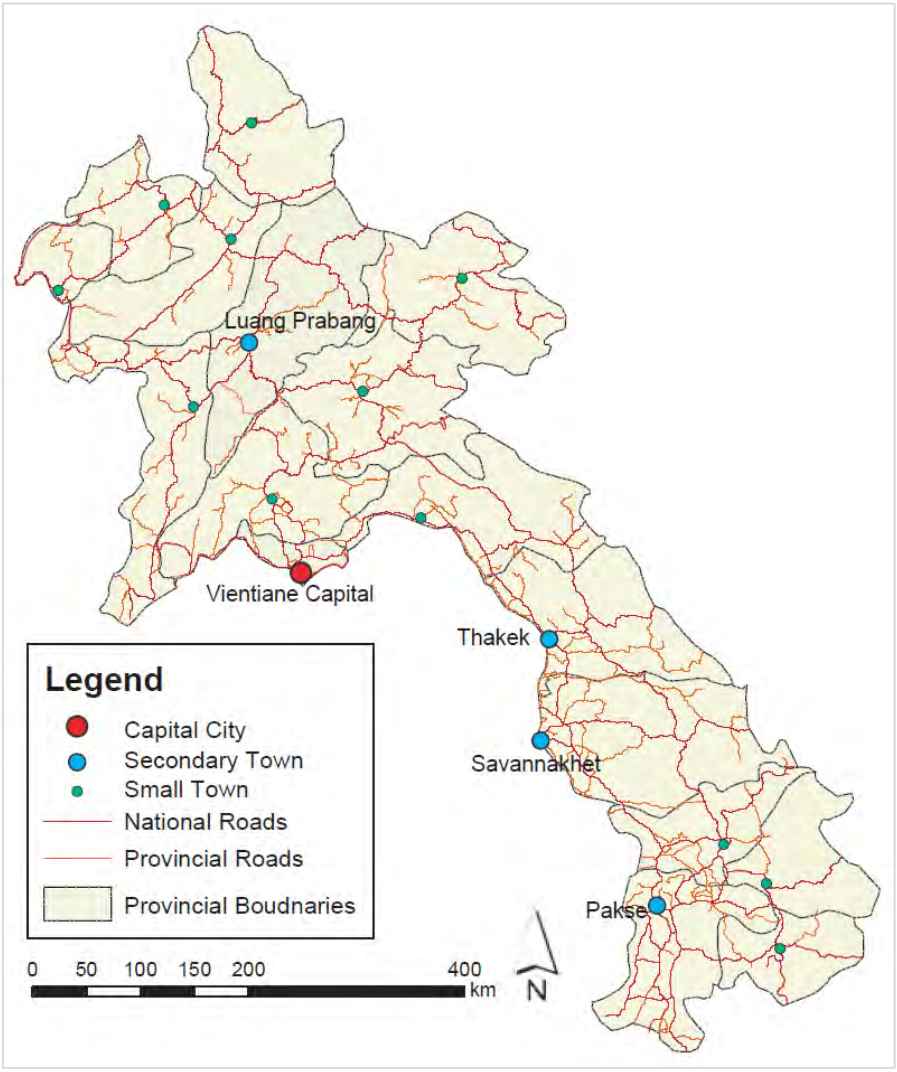
1.37 **Transport Industries:** The transport industry in Lao PDR is composed of second-hand car assemblies, motorcycle assemblies, and some vehicle parts industries. There is no brand-new car assembly factory in Lao PDR.

6) Urbanization and Urban Centers

1.38 While urbanization in Lao PDR is still low as well as neighboring countries (Thailand: 34% in 2010, Vietnam: 30% in 2010, Cambodia: 20% in 2010), it increased gradually. The progress of urbanization is uneven. Only Vientiane Capital has very high urbanization (69%), but it decreased. (see Figure 1.4.7)

1.39 The urban hierarchy of Lao PDR has three categories, namely capital city, secondary town and small town. It goes without saying that Vientiane Capital is the capital city of Lao PDR. In addition, there are four secondary towns which are composed of Luang Prabang City (Luang Prabang Province), Thakek (Khammouane Province), Kayson Phomvihane City (Savannakhet Province) and Pakse City (Champasack Province). Luang Prabang is a center for the Northern provinces as well as the center of tourism in Lao PDR. Vientiane and Savannakhet are centers for economic development, investment promotion, and modernization of surrounding districts in central provinces. Pakse is an economic, technical and science center for the Southern provinces.

Figure 1.4.7 Urban Hierarchy of Lao PDR



Source: JICA Study Team based on the data from DHUP of MPWT

7) Tourism

1.40 **Tourist Arrivals:** The number of tourists has increased significantly from 2.6 million in 2005 to 5.6 million in 2010. Of which, 70-80% of tourists is from Southeast Asia. In 2010, Thailand, Vietnam, and China were the top three countries in terms of the number of tourists in Lao PDR. Regarding the number of tourists by province, the provinces which share the border with neighboring countries have relatively higher share of the number of tourists (Vientiane Capital = 18%, Savannakhet =16%, Champasak = 5%, etc.).

1.41 There are air and land entry ports for tourists including two Friendship Bridge and four internationals airports. However, there are direct air connections only with ASEAN countries (Thailand, Vietnam, Malaysia and Cambodia) and China.

1.42 **Tourist Sites:** Lao PDR has become popular with tourists for its relaxed style of living and for retaining the atmosphere of "old Asia". The country has 849 natural sites (e.g. NPAs), 435 cultural sites (e.g. temples) and 209 historical sites (e.g. world heritage site). Those sites are concentrated in Champasak, Khammoune, Bokeo, Oudomxay, Vientiane and Phongsali provinces. There are also two world heritage sites in Luang Prabang and Champasak provinces.

1.43 **Tourist Expenditure and Revenues:** In 2010, revenue from tourism in export value ranked second with a share of 17.6% (381 million USD). Tourism revenue accounted for about 5% of the GDP, and this has not fluctuated in 2006 – 2010. Usually, day trippers such as Thai and Chinese spend only 12–20 USD/day while overnight tourists and international tourists spend 30–52 USD/day and USD75/day, respectively. In accordance with the increase in the number of tourists, revenue from tourism also increased rapidly at 21.1%/year of annual growth.

1.44 Satisfaction Rate of Tourists: In 2009, the Laos National Tourism Administration (LNTA) conducted a tourist satisfaction survey with 841 samples. Results showed that more people considered “nature,” “atmosphere,” and “people” when they planned to visit Lao PDR. Respondents said they were highly satisfied with the nature (3.9 points) and people (4.1 points) of Lao PDR. As for atmosphere, they were relatively satisfied (3.6 points). The lower score must have been due to the deterioration of traffic conditions, streetscape, and air, thereby lessening the satisfaction of tourists.

1.45 Tourism Development and Promotion in Government Plans: The overall goal of the tourism development and promotion for 2006–2020 is to make Lao tourism the main sector in the country and in the region. Thus, Lao PDR plans to promote an integrated and modernized tourism industry with balanced management between macro and operational levels. All infrastructures will be linked and integrated both in the country and in the region. Tourism activities and products will be diversified.

1.46 In order to develop tourism sector further, the development strategies for 2006–2020 are (i) to develop Lao PDR as globally know tourism site, (ii) to develop and promote tourism in Lao PDR in compliance with actual capacity, (ii) to develop and promote tourism sector in line with local socio-economic development, (iv) to strengthen tourism cooperation with international organizations and other countries, (v) to continue to update regulations and conditions to facilitate the entry-exit process in Lao PDR, and (vi) to continue to improve tourism organizational and management capacities.

8) Government Revenue and Expenditure

1.47 The balance of revenue and expenditure of Lao PDR has indicated deficit. Although the increase rate of revenue is higher than that of expenditure, the balance was still deficit in 2008. The state revenue had dramatically increased in the period of 2003 – 2008 with 23.2% of annual growth rate. The main source of state revenue is from taxes (69.2%). Besides this, the grant aids have relatively high share (13.7%). On the other hand, the main item for expenditure was recurrent in 2008 (53.8%). While the total expenditure increased more than double in the period of 2003 – 2008, the ratio to revenue of public investment declined from 60.2% to 39.7%.

Table 1.4.4 State Finance and Public Investment Program

				2003 (FY)	2008 (FY)	Share (%)		AGR: '03 - '08 (%/year)
						2003 (FY)	2008 (FY)	
State Revenue	Total Domestic Revenue	Custom-Tax Income		2,010	5,793	68.1	69.2	23.6
		Non-Custom Tax Income	National Treasury Income and Others	577	764	19.5	9.1	5.8
			Income from Enterprises	106	588	3.6	7.0	40.7
			Wood Resources Income	225	78	7.6	0.9	-19.1
			Sub-total	908	1,429	30.8	17.1	9.5
		Total		2,918	7,222	98.9	86.3	19.9
	Grant Aids Projects and Others			33	1,143	1.1	13.7	103.3
	Total Revenue			2,951	8,365	100	100	23.2
	Ratio to GDP			13.1	18.1	-	-	6.7
State Expenditure	Recurrent			1,595	5,643	38.2	53.8	28.7
	Public Investment			1,777	3,324	42.6	31.7	13.3
	Debt Payment			759	1,486	18.2	14.2	14.4
	Others			41	31	1.0	0.3	-5.8
	Total Expenditure			4,172	10,484	100	100	20.2
	Ratio to Revenue of Public Investment			60.2	39.7	-	-	-8.0
Balance of Revenue and Expenditure				-1,221	-2,119	-	-	11.6

Source: MPI

1.48 More than 70% of public investment was contributed by foreign investment. Both of domestic and foreign investment had slightly declined in the period of 2003 – 2008. At the same time, the sector share was changed significantly. In 2003, communication sector had more than 40% share of public investment which decreased to 0.1% only in 2008. The main investment sector in 2008 was education (34.6%), followed by healthcare (17.5%). Thus, the social sector received more investment in 2008.

1.49 The public investment in the public works and transport sector is concentrated on road and bridge developments (76%). While the project size of road is very small, that of bridge is very high. The road and IWT related projects are mainly funded by the domestic sources. On the other hand, the fund for aviation project is mainly international funds.

2. DEVELOPMENT STRATEGIES OF LOW-EMISSION TRANSPORT SYSTEE IN OTHER COUNTRIES

2.1 Overview of Alternative Fuel Vehicles

1) Types of Alternative Fuel Vehicles

2.1 In order to attend the climate change as well as reduce the fossil fuel use, many kinds of alternative fuel vehicles are available in the market or under development. In general, the alternative fuel vehicles (sometimes called as new generation vehicles) are composed of electric vehicles (EVs), hybrid electric vehicles (HEVs), plug-in hybrid electric vehicles (PHEVs), natural gas vehicles (NGVs), bio-fuel vehicles (bioethanol vehicles, bio-diesel vehicles), fuel cell electric vehicles (FCEVs) and hydrogen vehicles.

(1) Electric Vehicle (EV)

2.2 EVs are propelled by an electric motor (or motors) powered by rechargeable battery packs. From the outside, it is difficult to find the difference between EVs and internal combustion engine (ICE) vehicles, yet there are a lot of differences. For example, the gasoline engine is replaced by an electric motor which gets its power from an array of rechargeable batteries through a controller. The silence during the driving EVs is also big difference from the ICE vehicles.

2.3 Advantage of EVs are energy efficiency, environmental friendliness, stronger acceleration, requiring less maintenance, reducing energy dependence, and so on. EVs are generally charged at home, so that the charging station in the city is not necessary to build as much as the number of gas stations. However, it is good to provide those facilities to make sure that users can charge just in case.

(2) Hybrid Electric Vehicle (HEV)

2.4 HEVs are powered by an internal combustion engine and an electric motor, which uses energy stored in batteries. The extra power provided by the electric motor allows for a smaller engine. Additionally, the battery can power auxiliary loads like sound systems and headlights and reduce engine idling when stopped. Together, these features result in better fuel economy without sacrificing performance.

2.5 HEVs cannot plug into off-board sources of electricity to charge the battery. Instead, the vehicle uses regenerative braking and the internal combustion engine to charge. The vehicle captures energy normally lost during braking by using the electric motor as a generator and storing the captured energy in the battery. The energy from the battery provides extra power during acceleration.

(3) Plug-in Hybrid Electric Vehicle (PHEV)

2.6 PHEVs have an internal combustion engine or other propulsion source and an electric motor, which uses energy stored in batteries. PHEVs generally have larger battery packs than HEVs do. This makes it possible to drive moderate distances using just electricity (about 15 to 65-plus km in current models).

2.7 During urban driving, most of a PHEV's power comes from stored electricity if the battery is charged. The internal combustion engine powers the vehicle when the battery is mostly depleted, during rapid acceleration, or when intensive heating or air conditioning is required. Some heavy-duty PHEVs work the opposite way, with the internal combustion

engine used for driving to and from a job site and electricity used to power the vehicle's equipment or control the cab's climate while at the job site. Plug-in hybrid electric vehicle batteries can be charged by an outside electric power source, by the internal combustion engine, or through regenerative braking. During braking, the electric motor acts as a generator, using the energy to charge the battery.

(4) Natural Gas Vehicle (NGV)

2.8 NGVs are alternative fuel vehicles that use compressed natural gas (CNG) or liquefied natural gas (LNG) as a clean alternative to other fossil fuels. Natural gas can be used in all classes of vehicles – motorcycles, cars, vans, light and heavy duty trucks, buses, lift trucks, locomotives, even ships and ferries. Natural gas can be used either by converting an existing gasoline or diesel engine, or by using a purpose built natural gas engine.

(5) Bio-fuel Vehicle

2.9 A bio-fuel vehicle is a vehicle that uses renewable fuel sources, such as vegetable oil and animal fats, to power and run a diesel engine. A biodiesel fuel car can use 100% biodiesel sources to power a car engine, or it can combine natural oils and fats with regular petroleum diesel to create a biodiesel blend. But animal fats or vegetable oils cannot use as fuel straightly. They have to undergo a chemical reaction, known as transesterification, in which the fat or oil is purified and reacted with alcohol to form esters and glycerol. The end product can be used alone or mixed with regular petroleum fuel.

2.10 There are many benefits of bio-fuel vehicles. For example, sources such as vegetable oil and animal fats are always available. Bio-fuel reduces carbon dioxide emissions and monoxide emission. Furthermore, bio-fuel is non-toxic and biodegradable

(6) Fuel Cell Electric Vehicle (FCEV) and Hydrogen Vehicle

2.11 FCEVs and hydrogen vehicle are still at the stage of research and development. FCEVs are a type of hydrogen vehicles, which turn an electric motor and power the vehicles by producing electricity through the chemical reaction of hydrogen and oxygen. Fuel cell electric vehicles produce no CO2 or any harmful emissions whatsoever

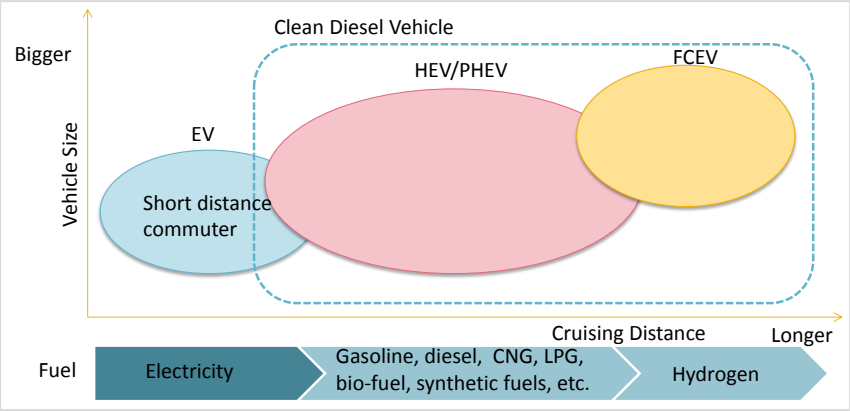
2.12 In terms of the practicality of the above alternative fuel vehicles, HEVs have high economic efficiency. EVs and PHEVs highly depend on the performance and cost of batteries. NGVs and bio-fuel vehicles depend on the fuel supply system. LPG vehicle has practicality, but it has low priority in terms of CO_2 reduction. Clean diesel vehicle is good option as replacement of existing diesel vehicle. The secure of resources for bio-diesel is one of the issues for bio-diesel vehicle. FCEVs and hydrogen vehicle are still under development.

2.13 Each alternative fuel vehicle has each advantage and disadvantage. Therefore, the market for each vehicle is temporarily considered based on the vehicle size and cruising distance. (see Figure 2.1.1)

2.14 Considering the situation of Lao PDR, EVs are one of the good options to introduce. While Lao PDR depends on 100% import for fossil fuel, the country can generate electricity from own sources. The size of cities is small, so that the limited cruising distance of EVs is not a big problem. HEVs have high economic efficiency and are more practical for long distance driving, but they still need fossil fuels. Furthermore, 99% of power supply in Lao PDR is generated from hydropower plants. Therefore, Lao PDR can

realize the real low-emission transport system including the source of energy. Many other countries use thermal power plants to generate power. Thus, even if those countries introduce and promote EVs, GHGs are caused at the power generation side.

Figure 2.1.1 Market for Each Type of Alternative Fuel Vehicle



Source: New Generation Vehicle Strategies 2010

Table 2.1.1 Features of Alternative Fuel Vehicles

	Cruising Distance	Environmental Performance		Cost		Main Issues
		CO2	Emission Gas	Vehicle	Operation	
EV	· Light vehicle: - 160km · Small vehicle: - 230km	· No CO2 emission at operation	· No emission at operation	· 3–4 times	· Depends on the electric tariff · Battery exchange: once in 7 years for Li-ion battery	· Improvement of battery performance · Cost reduction of batteries · Reduction of vehicle price · Development of charging station
Gasoline HEV	· More than gasoline vehicle	· About 50% reduction	· Less than gasoline vehicle · NOx: 50% reduction · SPM: very little	· 1–1.4 times	· Increase in fuel efficiency · Battery exchange; once in 5 year	· Improvement of battery performance · Cost reduction of batteries · Reduction of vehicle price
Diesel HEV	· More than gasoline vehicle	· 20% reduction	· 20% reduction	· 1.4 times	· Increase in fuel efficiency · Battery exchange: once in 7 years for Li-ion battery	· Reduction of vehicle price · Reduction of vehicle weight
PHEV	· More than gasoline vehicle	· More than 60% reduction	· More than 30% reduction	· 1.4–2 times	· Increase in fuel efficiency dramatically · Battery exchange: once in 7 years for Li-ion battery	· Improvement of battery performance · Cost reduction of batteries
NGV	· 2t truck: 190–290 km · Bus: 170–230 km	· 20% reduction	· Very small emission	· 1.4–2 times	· Depends on the price of CNG	· Establishment of fuel supply system
Bio-ethanol	· Same as existing vehicle	· Depends on bio-fuel	· Depends on bio-fuel	· Same	· Same	· Establishment of fuel supply system
Biomass	· Same as existing vehicle	· Depends on bio-fuel	· Depends on bio-fuel	· Same	· Same	· Ensurement of resources for biomass
FCEV	· Same as existing vehicle	· No CO2 emission at operation	· No emission at operation	-	-	· Under research and development
Hydrogen Vehicle	· Too short	· No CO2 emission at operation	· NOx increase	-	-	· Under research and development

Source: New Generation Vehicle Strategies 2010

2) Electric Vehicles and Plug-in Hybrid Electric Vehicles

2.15 An electric vehicle is an old idea whose time has come. Electric vehicles may be powered entirely by a battery that is recharged by plugging it to an electricity supply network, or a battery working in combination with ICE (known as plug-in hybrid EV or PHEV). Some manufacturers are betting on the electric-only option, while others believe that a bridging technology is a key to mass acceptance and, therefore, hybrids.

(1) Benefits and Drawbacks of EVs/PHEVs

2.16 EVs/PHEVs offer a number of benefits and are the closest near-market clean technology. Widespread adoption of EVs will bring the following benefit for countries:

(i) **Energy Security:** It is a risk for countries to depend on fossil fuel as energy sources, especially if they need to import. On the other hand, EVs are operated by the secondary energy which is generated from renewable energy and other forms. Therefore, EV use can reduce the dependence on fossil fuel.

(ii) **Global Warming:** If the electricity is generated by renewable energy or nuclear power, CO2 emission of EVs is very low. However, if the electricity is generated by coal, CO2 emission of EVs exceeds that from ICE vehicles.

(iii) **Emission:** EVs do not cause any pollutants while running. It is zero emission vehicles, so that it is effective to improve the air quality in the urban area.

2.17 In addition to the above benefits, EVs also have benefit for users as follows;

(i) **Performance:** The driving pleasure is one of the advantages of EVs. It has smooth linear acceleration and strong torque at low speed. So it is fun to drive.

(ii) **Comfort:** Well-built EVs are very quiet and has low vibration.

(iii) **Economy:** Energy efficiency of EVs is nearly 90%, compared to 25% of ICE vehicles. Therefore, energy cost of EVs is generally lower than fuel cost of ICE vehicles.

(iv) **Convenience:** EVs can be charged at home and/or office. So users do not need to go to gas stations.

(v) **Store Energy on EVs:** EV batteries can store energy at times of low demand and then feed this back to the grid at peak times, or to power other appliances to avoid peak power rates.

2.18 While there are many benefits from EVs, there are still some drawbacks to introduce EVs in the society.

(i) **Price:** The biggest drawback of EVs is its cost. In spite of huge investment of OEMs, suppliers and material manufacturers, EV manufacturer's suggested retail price is much higher than that of ICE vehicle, because most of the EV components are newly designed including body, chassis, climate control and controlling system.

(ii) **Range:** The range of EVs is shorter than that of ICE vehicle. However, PHEV and range-extended EVs do not have any range anxiety. For pure EVs, the charging infrastructure is the critical issue to penetrate

(2) Development Situation of EVs in the World

2.19 Worldwide, many kinds of vehicles are already battery-powered; the early adopters are the smaller and lighter electric bicycles, electric motorcycles, and electric cars (sedans,

minivans). Sedan-type EVs are beginning to enter the market in large scale (such as the LEAF of NISSAN, Volt of General Motors, e-6 of China's BYD). Most of the larger-scaled vehicles are still under development for practical reasons: large vehicles require more energy and bigger batteries. Nearly all the R&D are focused on private cars, very little is being done on technologies for public transport such as electric paratransit, electric three wheelers. The inflection point is expected to occur in 10 to 20 years, when the technology matures and various scales of EVs become widely available in the market (see Table 2.1.2).

2.20 An alternative path that is happening in several developing countries is the retrofitting of existing ICE vehicles with EV conversion kits. While practical and less disruptive, the conversion may hide the hidden defects and unsafe features of the original unit. It is a short-term, palliative measure. The tuktuk is easy to convert into battery-powered ones as was done in several localities in the Philippines, but it does not remedy the inherent defects on the existing tuktuk. The change in weight distribution may exacerbate the problem.

Table 2.1.2 Status of EV Technologies and Their Application as Products

Purpose	Vehicle Type		Representative Car Model	Capacity (person)	Current		2020		2030 (expectation)
					Technology	Product	Technology	Product	
Private Use	Bicycle		Bridgestone, SANYO	1	○	○	○	○	Cost reduction Improvement of durability
	Motorcycle		Terra Motors:SEED48	1	○	○	○	○	
			Yamaha: E-03	1	○	○	○	○	
	Compact Car		TOYOTA: COMS	1	○	○	○	○	
	Sedan		NISSAN:LEAF	5	○	○	○	○	
	Van		MITSUBISHI: MINICAB-MiEV	2-4	○	○	○	○	
			NISSAN:e-NV200[1)]	5	○	▲	○	○	
	Pick-up		Via Motors: VTRUX[1)]	3	○	▲	○	○	
Public Transport	Para-transit	3--wheeler	Tuktuk Factory	4-5	○	▲	○	○	It will be commercialized.
		Songthaew	MITSUBISHI: MINICAB-MiEV TRUCK	12[2)]	○	▲	○	○	
	Bus	Low-speed	Pick-up cart	16	○	▲	○	○	
		Mini	Takeoka Motor Craft: TU	15	○	▲	○	○	
		Medium	Waseda: WEB-03	28	▲	▲	○	▲(○)	Delay the commercialization due to the requirement of many batteries
			BYD: K9	28	▲	▲	○	▲(○)	
		Large	-	58	▲	▲	○	▲(○)	
Others	Tractor (alke: ATX)			610kg	○	▲	○	○	It will be commercialized.
	Waste collection (alke: ATX200E AR)			2,000L	○	▲	○	○	
	Boat		Duffy	10-16	○	○	○	○	Cost reduction

Source: compiled by JICA Study Team based on various resources

○: there is a product at marked price/ possible to put on the market

▲: possible to produce as made-to-order at current market price/ possible to produce but the quality is still not good,

(○): Possible in integration with support system

1) start to produce from 2013

2) MINICAB-MiEV is not supposed to be used as passenger transport, so that the specification of the vehicle does not mention the passenger capacity. However, in terms of the size of vehicle, it is equivalent to the existing small songthaew in Lao PDR.

Figure 2.1.2 Existing Electric Vehicles in the World

Private Use	Electric bicycle/ Electric motorcycle/ Electric three-wheeler		
	Private (Bridgestone) 	Private (Tera Motors) 	Commercial (Elec Trike, demonstration stage) 
	Sedan/Van/Pick-up		
	Private (NISSAN, produce from 2013) 	Commercial (MITSUBISHI) 	Commercial (Via Motors, deliver from 2013) 
EV Taxi/ EV Rental	EV Taxi (MITSUBISHI) 	EV Rental (NISSAN) 	Electric Motorcycle Sharing (YAMAHA) 
Para- transit	E-motorcycle is available, but no case of e-motorcycle taxi 	Electric Tuktuk (Bangkok) 	Electric Jeepney (Manila) 
Bus	Electric Minibus (Bremen) 	Electric Bus (Osaka) 	Electric City Bus (Adelaide) 
Others	Electric Boat (USA) 	Electric Patrol Car (Scotland) 	Electric Farmer's Vehicle (Scotland) 
	Solid Waste Collection Vehicle (Italy) 	Cleaning Vehicle (Barcelona) 	Ultra Compact EV (TOYOTA) 

Source: compiled by JICA Study Team based on various resources

2.2 EV Technology Development Strategies in Japan

1) Background

2.21 In 1970s, public and private sectors conducted EV development project which was supported by the Ministry of International Trade and Industry (present Ministry of Economic, Trade and Industry (METI)), but it could not achieve to develop the market for EVs. In 1990, Zero Emission Vehicle (ZEV) Mandate was created in USA, and EVs were reviewed. As a result, inherent technologies for EVs such as motors, batteries, charging equipment, etc. were made big progress. After 1996, TOYOTA (RAV4EV), HONDA (EV PLUS) and NISSAN (Hypermini) were on sale. Hypermini on sale in 2000 got a first designation of type as new platform. It was a trigger for EV development nowadays. On the other hand, Prius HEV (TOYOTA), which has been on sale since 1997, is a gasoline vehicle but use electricity as secondary power source. Prius HEV made an opportunity to pay attention on electricity use for vehicles. In 2009, MITSUBISHI Motors started to sell i-MiEV which is electric version of i (gasoline vehicle of MITSUBISHI). In 2010, NISSAN started to sell LEAF. These EVs made progress for full-fledged stage of EVs in Japan.

2) National Policy

2.22 In 2007, METI formulated the “Next-Generation Vehicles and Fuel Initiative” which has promoted battery development projects for new-generation vehicles, fuel cell development projects and technology development projects on energy ITS.

2.23 In April 2010, a Research Committee on Strategies for Next Generation Vehicles, led by METI, published “Strategies for New-Generation Vehicles 2010”. The strategies contain six strategies: (i) overall strategy, (ii) battery strategy, (iii) resource strategy, (iv) infrastructure development strategy, (v) system strategy, and (iv) international standardization strategy. The objectives and action plan for each strategy are shown in Table 2.2.1. In addition to these action plans, it is also necessary to approach development issues and incentive policies with concrete plans and actions.

2.24 The Research Committee had three working groups for each strategy that are composed of university, Automobile Association, power utilities, auto manufacturers, Petroleum Association and other research institutes.

2.25 The target share of HEV and EV/PHEV in the total new vehicle sales is as follows;

(i) HEV: 20-30% in 2020, 30-40% in 2030

(ii) EV/PHEV: 15-20% in 2020, 20-30% in 2030

2.26 As of March 2012, while the total sales unit of EVs was 19,879 EVs (i-MiEV=5,842, LEAF=14,037), that of Prius HEV was more than 1.2 million. The number of registered EV in each prefecture is about 100 EVs. However, it is notable that Kanagawa, Tokyo, Aichi, Osaka and Okinawa have more than other prefectures (1,574 EVs, 1,394 EVs, 737 EVs, 553 EVs and 307 EVs, respectively). On the other hand, Yamagata and Akita have only 7 EVs and 9 EVs, respectively.

Table 2.2.1 Strategies, Objectives and Action Plan in Strategies for New-Generation Vehicles

Strategy	Objective	Action Plan
Overall	・ Become a development and production base for new-generation vehicles	・ Set a penetration target ・ Diversify the fuel types ・ Add high value on the parts/components ・ Promote the low-carbon industry
Battery	・ Secure battery R&D and related leading-edge technologies	・ Improve the capacity of Li-ion batteries ・ Develop post-Li-ion batteries ・ Create volume efficiency by propagation of EV ・ Develop environment for secondary use of batteries
Resource	・ Maintain supply of rare metals ・ Establish resource recycling systems	・ Maintain resources strategically ・ Develop rare metal free battery and motor ・ Establish recycle system for batteries
Infrastructure development	・ Install 2 million standard charging stations and 5,000 rapid charging stations	・ Intensively develop infrastructure at market preparation stage ・ Establish a roadmap for promotion as a priority
System	・ Export vehicles as part of a system, such as smart grid model	・ Create new business model at EV/PHEV town ・ Assess the field demonstration of new-generation energy society system ・ Standardize internationally based on the assessment and develop of business
International standardization	・ International standardization strategically lead by Japan	・ Standardize internationally the battery capacity and assessment measure of safety ・ Standardize internationally the charging connector system ・ Strengthen the institutional arrangement for standardize by together with public and private sectors ・ Develop human resource for standardization

Source: The Strategies for New-Generation Vehicles 2010

3) Related Plan/Strategies

2.27 A subsidy for the introduction of EV/PHEV and charging stations, which has introduced to the market, was started in the “Promotion Project of Clean Energy Vehicles” by METI. The subsidy is provided for private companies and local governments. The subsidy rate is less than 50%. The budgets for 2010 and 2011 were JPY29.2 billion and JPY44.4 billion, respectively.

2.28 Besides this, MLIT also started to provide a subsidy for clean vehicles to promote developing charging stations, introducing low-emission public transport system in tourist sites, and developing tourism sector. Business enterprises which aim to develop a business utilizing EVs (E-bus, E-taxi) in tourist sites have been invited.

2.29 Moreover, MLIT has considered the laws on the standard and safety for realization of society with ultra-lightweight vehicles (ULVs) using single or two-person vehicles. The short-period field demonstrations were conducted in Tokyo, Fukuoka, Toyota, Kyoto, Yokohama, Gunma and Aomori prefectures. ULVs are mainly electric vehicles.

2.30 In the “Next Generation Vehicles Strategic Plan 2010,” the METI promoted EV/PHEV town projects by cooperating with 18 prefectures conducting field demonstrations of EV/PHEV system since 2009. The projects focus on “creation of initial demand,” “development of charging station,” “promotion of public awareness” and “implementation of impact assessment.” The progress of the projects is reported through the progress report of Best Practice of EV/PHEV town concept.

2.31 Six main actions have been taken for stimulating initial demand in EV/PHEV town.

(i) Introduction of EV/PHEV as government official vehicles: people who are responsible for promoting EV projects need to know the benefits of EV/PHEV. In addition, the compatibility of EV in that area can be analyzed from the operation data of those official vehicles. Official vehicles are also useful for promotion activities, like test driving events.

(ii) Conducting test-driving events and exhibitions: test-driving events are more effective than exhibitions, because people can experience the comfortableness of the EV.

(iii) EV car-sharing/rental/taxi: this can be one of the promotion activities to make people know about EV. Furthermore, these activities can also act as a business model.

(iv) Branding and website: EV has different characteristics from conventional vehicles, so it is important to inform the public about those characteristics. Websites are a useful means to promote and disseminate information to many people.

(v) Introduction of subsidy and tax reduction: subsidy and tax reduction/exemption is an effective way to directly appeal to potential consumers.

(vi) Other preferential measures: priority parking space for EV/PHEV can be one measure, together with free or cheap charging stations. Parking fees can be discounted for EV/PHEV. Similar discounts can also be provided at toll roads.

2.32 In addition to providing incentives on EVs, it is also useful to provide incentives for installing charging stations in public spaces. Charging stations can be installed at convenience stores, rest areas (Michi no Eki), commercial buildings, gas stations, automobile dealer shops, transport terminals, government buildings, etc. It is important to provide the location information of charging stations to users, so that people can travel without worry about the charging.

4) Case Study of EV Town and Other Projects

2.33 Budget for EV/PHEV town is provided by METI, MLIT and MOE. Local governments utilize those budgets in accordance with local plans. The organization of EV/PHEV town project is composed of the local government, relevant agencies, educational institute, private enterprises, and so on. Although the following is a general structure of organizations, the role-sharing is not clearly defined.

(i) Relevant government agencies of industry, environment and energy: One of the agencies becomes a secretariat to carry on budget management in cooperation with the central government, planning and progress management. Officers of relevant municipalities under a prefecture are also members of the project organization.

(ii) Private enterprises: Each enterprise has own role as follows; automobile manufacturers = preparing EVs, battery manufacturers = developing battery and charging infrastructures, electronic equipment manufacturers = developing information systems plan such as ITS, power company = supporting development of charging infrastructures, bus/taxi/rental car companies = operating EVs and providing services, and tourism association = creating contents of tourism development.

Table 2.2.2 Development Situation of the First Eight EV/PHEV Towns in Japan

		Aichi	Aomori	Kanagawa	Kyoto	Tokyo	Nagasaki	Niigata	Fukui
Population in 2009 (000)		7,410	1,380	9,010	2,630	12,990	1,430	2,380	810
Area (km^2)		5,164	9,607	2,416	4,613	2,187	4,095	12,583	4,189
No. of vehicles in 2011 (000)		4,980	100	3,940	1,330	4,420	920	1,810	650
CO_2 emission from transport sector (000t)		12,490	-	-	-	-	-	-	-
Implementation body	Local government	✔	✔	✔	✔	✔	✔	✔	✔
	Auto manufacturer	✔	✔	✔	✔	✔	✔	✔	✔
	Electric utility	✔	✔	✔	✔	✔	✔	✔	✔
	Battery manufacture	-	✔	✔	✔	-	✔	-	-
	University/Research institute	-	✔	✔	✔	-	✔	✔	✔
	Others	✔	✔	✔	✔	✔	✔	✔	✔
Prefectural budget of EV/PHEV town '09 (JPY million)		17.6	260[1)]	-	-	-	56.3		6.3
Introduction situation of EV/PHEV	Introduction No. in 2009	140	20	266	111	18	100	34	21
	Introduction No. in 2010	100	-	-	-	-	-	-	-
	Target No. in 2013	2,000	≒400	3,100	5,000	15,000	-	2,000	1,500
Utilization of EV/PHEV	Car-sharing/Rent a car	△	△	○	○	○	○	○	△
	Taxi	△	-	○	○	○	△	○	-
Preferential treatment system of tax		-	△	○	○	○	○	○	△
Introduction subsidy (difference from base car)		○	-	○	○	○	○	○	○
Preferential treatment system	EV priority parking	△	-	-	○	-	△	△	-
	Discount of parking fee	△	△	○	○	○	-	△	△
	Discount of highway fee	-	△	○	-	-	-	-	-
Charging stations	No. in 2009	63	11	164	71	130	15	8	2
	No. in 2010	138	-	-	-	-	-	-	-
	Target No. in 2013	100	110	1,100	7,050	-	-	15	-
	Subsidy	-	-	Yes	Yes	Yes	△	Yes	-
Reduction of CO_2 (ton)	2009	3	-	-	-	-	-	-	-
	2010	162	-	-	-	-	-	-	-

Source: Best Practice of EV/PHEV Town, Action Plan of each EV/PHEV Town

1) Accumulation of 5-year (2009-2013）

△ under consideration, ○ under implementation

(a) Case 1: Aomori Prefecture

2.34 In Aomori, EVs were introduced for tourism site as Park & EV Ride project, and E-buses were introduced for visitors using a high speed railway. The possibility of Park & EV Ride has been studied in the Oirase mountain stream area which is one of the national parks. Therefore, EVs use in this area was introduced to protect environment in the national park. Park & EV Ride is that people come to Oirase area by ICE vehicles, and then change to EVs to visit tourism sites in this area. Besides this, electric bus[1] was introduced for the high speed railway users, such as tourists and business persons, to increase the number of passengers. The electric bus runs between Shichinohe Towada station (new station) and Shichinohe town. The electric bus is a medium-sized bus with a

[1] Electric buses were also introduced in Tokyo (Tokyo station – Harumi Futo with contactless charging) and Kyoto City (Route bus with contact charging) as field demonstration.

25 passenger capacity, and runs on Li-ion batteries, which Flat Field Co. Ltd. converted from Liesse of Hino. One rapid charging station and one standard charging station were also built. The electric bus needs to be charged every two rounds, at which time the driver takes a rest.

(b) Case 2: Kanagawa Prefecture

2.35 Kanagawa prefecture started to promote an EV project to solve environmental problems. It aimed to deliver 3,000 EVs/PHEVs by 2014. The main policies consist of i) an installation subsidy, ii) a subsidy for development of rapid charging stations, iii) a reduction in the automobile acquisition tax and automobile tax (5 years), iv) a 50% discount on parking fees in areas under the management of prefecture, and v) a 50% discount on highway tolls.

2.36 A subsidy for purchase by country is 1/4 of the price difference from basic vehicle, and the subsidy for purchase by prefecture is a half of subsidy by country. In general, the subsidies are JPY700,000 – 950,000 by country and JPY350,000 – 480,000 by prefecture. 1,740 people received the subsidy in the period of fiscal year 2009 – 2011. The prefecture plans to cease the subsidy in 2012 when the number of recipient reaches to 3,000. The subsidy is very effective to promote EV/PHEV purchase. It is expected that the number of EV/PHEV in Kanagawa reaches 3,000 vehicles in 2012.

2.37 A subsidy that covers 1/3 of the construction cost for installation of rapid charging stations is also provided to private companies. By the end of 2011, there were 106 rapid charging stations and 350 standard charging stations.

(c) Case 3: Gifu Prefecture

2.38 Three cities were selected for conducting the field demonstration in the semi-mountainous area (Takayama City, Gero City and Nakatsugawa City). Project sites have faced on the difficulty of its cold weather, difference of elevation and depopulation of gas stations. EVs were introduced to improve accessibility and mobility in the semi-mountainous area. Nine monitor drivers were invited and they used EV for one month as field demonstration. EVs do not have any problem with cold weather and difference of elevation during the spring. EV users also were able to save about 100 USD/month for travel cost.

(d) Case 4: Nagasaki Prefecture

2.39 In Goto area in Nagasaki prefecture, which is a UNESCO World Heritage Candidate site, the introduction of EV/PHEV with next-generation car-navigation ITS on taxis and car rentals has been supported by the local government. This is a field trial for future driving tourism to preserve a clean tourism environment. To help improve convenience to drivers, detailed local tourism information, such as tourism sites, events, charging stations, restaurants and other relevant information, are sent to the car-navigation systems from ITS spots. It is also expected that EV/PHEV will promote the local tourism industry. 199 consortium members, including local government agencies, manufacturers, universities and local enterprises, have taken actions.

2.40 The target of the project in 2011 was as follows;

(i) Number of EVs and PHEVs: 140 and 2 respectively

(ii) Number of standard charging stations and rapid charging stations: 33 sets at 24

locations and 27 sets at 15 locations respectively

(iii) ITS spots: 20

(iv) Number of cars rented in the period from April 2010 to November 2011: 14,707

5) Technology Development

2.41 From the viewpoint of vehicle types, development of small cars had a priority. Of which, i-MiEV (MITSUBISHI) and LEAF (NISSAN) were established mass production system which went ahead of other countries. The passenger cars have wide users, and it is usually sold even the price is high. Therefore, those types of EVs were developed first. However, the technologies to develop EVs for vans and small trucks do not have big difference from the technologies for small type of EVs.

2.42 NISSAN got a major order of taxis in New York, and plans to sell an electric van (e-NV 200) which is the same types of vehicle of taxis for New York. MITSUBISHI sold an electric small van (Minicab MiEV) and plans to sell an electric small truck within 2012. Thus, the electrification of commercial vehicles is also promoted.

2.43 Electric buses are developed by ISUZU, MITSUBISHI FUSO and MITSUBISHI Heavy Industries in EV/PHEV town project. There are several electric buses such as MITSUBISHI Heavy Industries E-bus and HINO Ponocho E-bus. However, they do not yet reach to the level for marketing.

2.44 Regarding the electric bicycles (e-bicycles), bicycle manufacturers sell e-bicycles with Li-ion which became gradually popular in the city. Some manufacturers also sell electric motorcycle (e-motorcycle), yet e-motorcycles are not popular as well as e-bicycle.

2.45 The development of batteries for EV/PHEV is key technologies for EV diffusion. Targets for battery development were set in 2006 (see Table 2.2.4). The production cost of Li-ion batteries depends on its technology development and viability of mass producing them, so it is difficult to forecast the cost at this point; however, a battery being developed in China with a cost of 30,000 JPY/kWh may affect the World battery market in the near future.

Table 2.2.3 Target of Battery Development in Japan

	Energy Density (Wh/kg)	Power Density (W/kg)	Cost (JPY/kWh)
2008	100	1,000	100,000 – 200,000
2015	150	1,200	About 30,000
2020	250	1,500	About 20,000
2030	500	-	About 10,000

Source: NEDO

6) Value-chain

2.46 In addition to conventional vehicle production system, new technologies such as batteries, motors, inverters, air conditioners, brakes, steering, communication systems and others are required for EVs. Charging equipment is also one of new technology developments as infrastructure system.

2.47 Because i-MiEV and LEAF are in mass production, most of technologies were already achieved the practical level for production. Remaining issues are cost reduction of batteries and increase in the battery capacities. However, it is expected that those issues

will be solved in the near future, and batteries for EVs will be in mass production. Moreover, not only large companies joined the EV business, but also several small vehicle production companies were established such as Sim Drive, Elec Tike, etc. as well as companies related to conversion business from ICE vehicles to EVs.

2.48 Regarding the battery production, each automobile manufactures established their own battery production companies. For example, TOYOTA has Prime Earth EV Energy, NISSAN has Automotive Energy Supply and MITSUBISHI has Lithium Energy Japan. At the same time, they also seek cooperation with other battery production companies. The situation will be changed depending on the expansion of the industries, including cooperation with foreign companies.

2.49 EVs industry requires some trillion yen of investment to renovate industrial structures. The development policy of economic sector and country influences on Japanese future. The followings are expected change of value chain from ICE vehicles to EVs. Some of the new EV related businesses were already launched.

(i) Battery material industry and battery recycle industry will be developed in accordance with expansion of new battery industry;

(ii) The existing motor industry will expand;

(iii) In addition to existing auto manufacturers, small EV manufactures will increase;

(iv) If EVs are applied to a part of infrastructure system of smart grid, balance of power supply and its demand will change;

(v) Charging equipment industry will be created to operate EVs; and,

(vi) Application of social information system such as ITS to EVs operation, i.e. charging system, will be researched.

7) Findings from Japanese Experiences

2.50 Japan is one of the most active on EV development and introduction in the world. Private sector including auto manufacturers, electric companies, parts manufacturers, and various EV ventures are involved R&D, production, and marketing activities. Many related projects have active support and involvement of the central and local government. The government subsidy is provided for EV purchase and EV infrastructure installation. This subsidy also supports EV manufacturers indirectly.

2.51 EV/PHEV town project which includes many kinds of field demonstration increase consensus of the society on EV introductions. Experiencing EVs is much more effective to promote people’s awareness on EVs than just providing information on EVs by web-site, newspaper, etc.

2.3 EV Technology Development Strategies in EV Developed Countries

1) Overviews

(1) Target for Propagation of EV in EV Developed Countries

2.52 The EV developed countries, which have a high vehicle ownership, aim to develop EV/PHEV as an alternative cleaner mode of travel to address environmental problems. The target of these countries for the propagation of EV ranges from 1% to 5% of the total number of vehicles by 2020. Although the target vehicle numbers seem to be large compared to the current number of electric vehicles, it is still small when compared to the total number of vehicles. (see Table 2.3.1)

2.53 It is expected that the quality of EV will improve and prices will reduce gradually through further research and investments by governments and auto industries, in particular, in the EU, individual EU member countries, and the USA. In recent years, the governments and auto industries have vigorously conducted field demonstrations to market EV.

Table 2.3.1 EV Propagation Targets of EV Advanced Countries

		USA	England	France	Japan
Current No. of EV		345 ('10)	8,000 ('09)	-	11,105 ('10)
2015 (Total No. of EV)		More than 1 million	0.24 million	-	-
2020	Total No. of EV	2 million	0.8-1.6 million	2 million	2 million
	% in Total Vehicle	0.8	4.7	2.7	5.3

Source: Strategies for New-Generation Vehicles 2010, 2011-2012 EV introduction strategies and charging infrastructure business in the world

(2) Development Strategy to Achieve Propagation Targets

2.54 The EV developed countries have strived to institute legislations and standards to make EV commercially viable, and to robustly support EV technology research and development. They, in general, uphold the EV development with wide-ranging policies, i.e. environmental management, energy development, climate change controlling measures and the expansion of the auto industry. Developed countries have a responsibility to reduce greenhouse gas emissions, which is one of the motivations to promote EV development. EV development policies include how to promote and how to improve existing EVs.

2.55 New agencies have been established in EV developed countries in line with their EV policies, i.e. research committee on strategies for next generation vehicles, the office for alternative fuel vehicles, national platform for e-mobility, etc. An important aspect of these agencies is that they are cross-sectoral agencies covering all key stakeholders, public and private.

2.56 Various strategies have been carried out to achieve the specific propagation targets. The common strategies adopted by the EV developed countries are i) field demonstrations, ii) priority adoption for public sector usage, iii) financial incentives, iv) exemption from traffic management measures, and v) promotion to the public. More detail actions of EV developed countries are shown in Table 2.3.2.

(i) **Field demonstrations:** Field trials for public acceptance of EV have been done in EV developed countries. They aim to identify potential glitches for practical application and to expedite EV related technologies and infrastructure development, which results in reduction of EVs production costs. It is notable that the field trials have been

concurrently implemented in many cities, in cooperation with automobile companies, local governments and universities.

(ii) **Priority adoption for public sector usage:** Public sector adoption is significant to spur the practical implementation of high cost vehicles and infrastructures at the initial stage of development. Official vehicles include vehicles for government officers and public enterprises like postal service, solid waste collection, etc.

(iii) **Financial incentives for EV users:** Incentives include purchase rebate, tax reduction, and reduction of electric tariff for EV users while deterrents are taxation of high-emission vehicles users. The subsidy for purchase in generally not only for EV/PHEV but also for other alternative fuel vehicles in order to promote all kinds of alternative fuel vehicles. The tax reductions introduced to import tax, vehicle acquisition tax, corporation tax, etc. The tax reduction is effective only for a limited period. In past field trials, charging costs at public charging stations were usually free or lower than market price.

Government incentives for PHEV have been established by various national and local governments in EV developed countries as a financial incentive for users to purchase PHEVs. The amount of these incentives varies depending on battery size and the vehicle all-electric range.

- USA: Federal government granted tax credits for new qualified PHEV, and the American Recovery and Reinvestment Act of 2009 (ARRA) also indicates federal tax credits for converted EVs, though the credit is lower than for new PHEV. The tax credit for new PHEV is 7,500 USD in the maximum amount allowed as a tax credit. In California State, the Clean Vehicle Rebate Project (CVRP) was established in order to promote the production and use of zero-emission vehicles. Rebates are provided on a first-come first-served basis and are expected to end in 2015. Vehicles can be purchased or leased, and rebates can be up to USD5,000 per light-duty vehicle for individuals and business owners. Certain zero-emission commercial vehicles are also eligible for rebates up to USD20,000.
- EU: 15 of the 27 EU member states provide tax incentives for EVs and also levy carbon dioxide related taxes on passenger cars as a disincentive. The incentives consist of tax reductions and exemptions, as well as of bonus payments for buyers of PHEVs.

(iv) **Exemption from restrictions:** The restrictions can be applied to areas and parking. EVs/PHEVs are allowed to enter certain restricted areas, like tourist sites (e.g. Zermatt of Switzerland). However, there is no case where only EVs/PHEVs are allowed to enter restricted areas of a city center. Priority parking spaces for EV are provided in some cities.

(v) **Promotion to the society and users:** Besides field trials, to further promote the understanding of EV/PHEV, exhibitions of EV/PHEV, seminars and test-drive events have been conducted. In addition to those, information by Internet and educational events are also provided.

Table 2.3.2 EV Development Strategies of EV Developed Countries

	National Policy/Strategy	Promotion/ Incentive	R&D
USA	・ "One Million Electric Vehicles on the Road by 2015" Plan in the Energy Environmental Plan of the American Recovery and Reinvestment Act of 2009 (ARRA) by DOE ・ Blueprint for a Secure Energy Future (2011) ・ Zero Emission Vehicle (ZEV) regulation ・ Clean Air Act. ・ Clean Fuels regulations (LEV I, LEVII)[1)]	・ USD2.4 billion was lent to three EV production plants in Tennessee, Delaware and California. ・ USD2.0 billion was provided to 30 companies of battery and EV related parts. ・ The EV Projects of ECOtality Inc. [2)]	・ Large scale field demonstrations (California, Hawaii, Israel, Denmark, Australia, Canada and Japan) ・ Field demonstrations: EV/PEHV for testing battery, HEV driving technique, power electronics, motor and advanced technologies (2009) ・ Vehicle-to-Grid (V2G): Francisco, Boulder, Austin, New York, etc.
EU	・ Sustainable energy development. ・ A European strategy on clean and energy efficient vehicles (2010) ・ DIRECTIVE 2009/33/EC	・ European Green Cars Initiative (EGCI): EUR5 billion (2009 – 2013) for research on renewable energy and traffic flow ・ Sustainable Green Fleets (SU:GRE): the Intelligent Energy Europe Project supported by Intelligent Energy Europe (IEE)	
England	・ Infrastructure development carried out to attract the enterprises and increase EV demand. ・ Energy White Paper ・ Low Carbon Transition Plan ・ Carbon Plan	・ Subsidy for PHEV: 25% of purchasing price (max GBP5,000) ・ Access to charging stations at 10 GBP/year in London	・ Integrated Delivery Program ・ The Ultra-Low Carbon Vehicle Demonstrator Project ・ The Low Carbon Van Public Procurement Program ・ Field demonstrations in nine cities
France	・ Grenelle I & II Law ・ Energy White Paper ・ Renewable energy development strategy with high environmental quality ・ Climate Plan ・ Electric Vehicles Plan (2009)	・ Subsidy for EV purchase ・ Taxation on high-emission vehicles ・ Tax reduction for low-emission corporate vehicles	・ Promotion of R&D on CO2 low-emission vehicles and field demonstration project with Demonstration Fund ・ Field demonstration of car-sharing with 3,000 EV in Paris (2011-)
Germany	・ Long-term Energy Concept ・ E-mobility National Development Plan ・ Infrastructure development vision as a comprehensive system, including charging stations and renewable energy related infrastructures.	・ Negative view against subsidy	・ Research project on E-mobility and Labor (ELAB) ・ E-mobility system research ・ E-mobility Forum ・ DRIEV-E Program ・ E-performance research project ・ "Model Regions of Electric Mobility" project (2009-)
Others	・ Spain: Energy Saving and Efficiency Strategy Action Plan 2008 - 2012, Electric Mobility Plan ・ Netherland: Energy Innovation Agenda, E-mobility action plan ・ Switzerland: Energy Schweiz ・ Austria: National Implementation Plan for Electric Mobility	・ Subsidy for EV purchase ・ Tax reduction for owners of EV ・ Provision of EV parking without charge. ・ Subsidy for commercial EV	・ Netherland: Electric Vehicle Testing project, High-Tech Automotive Systems (HTAS)

Source: compiled by JICA Study Team based on various sources

1) Low Emission Vehicle program

2) Private company in San Francisco, USA which is active for clean electric transportation and storage technologies.

(3) Perspective of Technical Development of Battery and Cost

2.57 Batteries are a key technology for the commercial viability of EV/PHEV. The quality of batteries directly affects the lifetime of EVs, and battery price is a major factor of deciding the price of EV. Li-ion batteries are now the mainstream for EV, so most of the research focuses on Li-ion battery technology. Compared to other batteries, the advantages of Li-ion batteries are their high power density, long lifetime and low self-discharge. (see Table 2.3.3)

Table 2.3.3 EV Action on Battery Development in EV Developed Countries

Country	Battery Development Situation
USA	・ Advanced battery development project: United States Advanced Battery Consortium (USABC) (1991-), Freedom Cooperate Automotive Research (Freedom CAR) (2001-) ・ Li-ion battery development for PHEV: Vehicle Technology Program (2009-)
EU	・ Standardizing the EV on charging process.
Germany	・ Innovationsallianz Lithium Ionen Batterie 2015
France	・ STEEV: research on next generation Li-ion battery development

Source: compiled by JICA Study Team based on various sources

2) USA

(1) National Policy

2.58 In 2008, the president set an ambitious goal of putting 1 million advanced technology vehicles on the road by 2015, which would reduce dependence on foreign oil and lead to a reduction in oil consumption of about 750 million barrels through 2030. To reach that goal, the president proposed in his budget a new effort to win the future by supporting advanced technology vehicle manufacturing and adoption in the U.S. through new consumer rebates, investments in R&D, and competitive programs to encourage communities that invest in advanced technology vehicle infrastructure.

2.59 In 2009, the American Recovery and Reinvestment Act of 2009 (ARRA) which is an economic stimulus package was signed into law by the president. The main objectives of ARRA was to save and create jobs almost immediately and provide temporary relief programs for those most impacted by the recession and to invest in infrastructure, education, health, and “green” energy. From the funding of ARRA, Department of Energy (DOE) awarded USD2.4 billion to 48 projects for manufacturing EVs, vehicle batteries and components. In addition, 2,500 to 7,500 USD/vehicle is provided as subsidy for EV purchase to promote EVs.

2.60 In 2011, DOE has released *“One Million Electric Vehicles by 2015”*, an analysis of advances in EV deployment and progress to date in meeting President’s goal of putting one million electric vehicles on the road by 2015. The expected number of EVs by 2015 is 1,222,200 including 505,000 GM Chevrolet Volt, 300,000 NISSAN LEAF and 195,000 Fisker Nina. As December 2010, there are 345 EVs and about 1.9 million HEV.

(2) Case Study of Projects

2.61 **Case Study 1: The EV Project:** This project was conducted by the ECOtality Company for propagation of EVs and development of charging stations as well as deployment of advanced technologies such as batteries, HEV drive technology, power electronics, and motors. The project period is from October 2009 to September 2012 with DOE budget of USD230 million.

2.62 The field demonstration has been conducted in California, Oregon and Washington D.C. with 8,300 EVs/PHEVs (NISSAN LEAF: 5,700, Chevrolet Volt: 2,600) and 15,000 charging stations.

Figure 2.3.1 EV Project of ECOtality

NISSAN Leaf	Chevrolet Volt	Charging Station
		

Source: ECOtality

2.63 **Case Study 2: Smart-Grid City:** Vehicle-to-grid (V2G) describes a system in which EV/PHEV communicate with the power grid to sell demand response services by either delivering electricity into the grid or by throttling their charging rate. This system enables discharging of electricity from both battery and power grid, so that the EV can be used as battery infrastructure. In many cities of the USA, many private companies conducted field demonstrations of V2G from 2009 in cooperation with public agencies.

2.64 For example, Bolder City has conducted V2G project leading by Grid Point Company. The project aims to investigate and develop integrated system of smart grid and EVs. In the project, the charging volume and time are controlled by grasping the condition of battery and location and driving distance at the center using Vehicle Control Module (VCM). VCM is the equipment for control charging which was deployed by Grid Point Company.

2.65 **Other Cases:** Los Angeles propagated 2,000 EVs and 106 charging stations by the end of 2011. Private sector and public sector share the data on EVs and provide subsidy for EV/PHEV. Main organizations are composed of Department of Water and Power (LADWP), the C40-Clinton Climate Initiative, UCLA's Anderson School of Business and Luskin Center.

(3) Technical Development and Production System

2.66 Seven automobile manufacturers join the development and production of EVs, namely GM, Ford, Tesla Motors, Fisker Automotive, Coda Automotive, Smith Electric Vehicles and Navistar. In terms of the government support, USD2.4 billion was lent to develop EV plants in Tennessee, Delaware and California. USD2 billion were provided to 30 companies of battery, battery materials, motor and other EV components.

(4) Findings from EV/PHEV Programs and Policies in USA

2.67 Rapid technology development of EVs by private sector is supported by huge amount of the government subsidy. The Zero Emission Vehicle (ZEV) Mandate also forces large auto manufactures to develop EVs further. In the success case to promote EVs, the development of charging stations plays important role together with social system. The convenient use of charging stations in the society encourages EV uses. Therefore, the EV infrastructure development should be integrated with transport planning and urban planning.

3) EU

(1) Union Policy

2.68 European Commission has considered broad scope and various EV/HEV as part of advancing sustainable energy development.

(2) Related Plan/Strategies

2.69 EU member states perceive the GHG emission and environmental pollution from transport sector as one of the major impediments to the sustainable development for the EU member states, so that EU Commission has issued and formulated wide-range of legislation, initiatives and programs, i.e. alternative fuels, hybrid vehicle and EV, in order to reduce the GHG emission in transport sector.

2.70 Directives 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC indicates that the community and the member states should strive to reduce total consumption of energy in transport. In the Directives, it points out that the principal means of reducing consumption of energy, among others, are increasing the share of electric vehicles in production. It states that the member states shall establish mandatory national targets consistent with a 20% share of energy and a 10% share of energy from renewable sources in transport and in community energy consumption, respectively by 2020.[2] A part of EU strategies also focuses on the standardization of EV and charging process.

(i) **European Commission Communication (COM (2010) 186 final):** It details several actions aimed at encouraging the development of “green” vehicles and the market uptake of those vehicles. The strategies cover i) alternative fuels, such as bio-fuels or gaseous fuels (LPG, CNG and biogas), ii) battery electric vehicles or the plug-in rechargeable type and iii) hydrogen fuel cell vehicles. The Commission has proposed a regulation on type-approval requirements for two- and three-wheelers and quadricycles. It is also expected for a future proposal on fuel consumption of, and CO2 from, heavy-duty vehicles. It will further evaluate whether the promotion of EVs will not lead to the detriment of low carbon electricity already expected from meeting the requirements of the Renewable Energy Directive, Directive 2009/28/EC. It underlines that employees in the automobile industry must have suitable skills in the field of green vehicles and to make up for such skills in the workforce, the Commission launched initiatives to encourage retraining and upskilling from the European Social Fund. It also focuses on the electric safety requirement, development of charging interface, infrastructure development, generation and distribution of electricity, and recycle of batteries

(ii) **Directive 2009/33/EC:** It is a directive on the promotion of clean and energy-efficient road transport vehicles. It proposes that a possible approach could be based on the internalization of external costs by using lifetime costs for energy consumption, CO2 emissions, and pollutant emissions linked to the operation of the vehicles to be procured as award criteria, in addition to the vehicle price. In addition, public

[2] “Directives 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC” Official Journal of the European Union. 5 June 2009.

procurement could give preference to new Euro standards. The earlier use of cleaner vehicles could then improve air quality in urban areas.

(iii) **Sustainable Green Fleets (SU:GRE):** It is a European program of Intelligent Energy Europe (IEE) supported by IEE. It aims to electrify the vehicles and boats of tourist sites in Spain, France, Greek, Italy, Croatia and Austria.

(iv) **European Green Cars Initiative (EGCI):** It aims to promote research on the use of renewable and non-polluting energy resources, safety, technology to solve the traffic flow problems and infrastructures for smart energy. The fund is EUR5 billion (≈ USD6.4 billion) for 2009 – 2013.

(v) **European Road Transport Research Advisory Council (ERTRAC):** It is the European Technology Platform (ETP) for Road Transport and prepared the "European Roadmap for the Electrification of Road Transport". In the roadmap, it is expected that the number of EV production will reach 5 million by 2020.

4) England

(1) National Policy

2.71 In 2009, the UK Government launched a 5-year plan for cutting CO2 emissions from road transport, which includes incentives for the purchase of PHEVs and EVs. At the same time, Office for Low-Emission Vehicles (OLEL) was established as cross-ministerial organization. The OLEL has led development and promotion of EV/HEV and other alternative fuel vehicles in England. The Government has already committed 400 million GBP (≈ 630 million USD) of support to encourage development and uptake of ultra-low emission vehicles such as low carbon vehicle (LCV) innovation platform, LCV integrate delivery program, LCV public procurement program and EV consumer incentive package. Infrastructure development has been conducted to invite the EV related industry. It is expected that the number of EV/PHEV will be 0.8 – 1.55 million by 2020. The preferential treatment for EV purchase and use are as follows:

(i) Purchase the vehicle generating less than 75gCO2/kg: subsidy for 25% of vehicle price or maximum GBP5,000 (≈ USD7,800); and

(ii) Use: exempt from annual road user tax and exempt from automobile registration tax for five years.

(2) Related Plan/Strategies

2.72 The subsidy for development of charging station was provided to London City, Milton Keynes City and North East England in 2010, northern part of England, Manchester City, Midlands, Northern Ireland and Scotland in 2011. The target of charging station provision is 4,000 locations for public spaces, 2,500 locations for offices and factories, and 2,000 locations for housing.

2.73 Field demonstrations have been conducted in nine cities, and information on best practice of appropriate development of charging station will be shared.

2.74 The propagated number of vehicles by 2010 ware 1,574 EV/PHEV (1,498 passenger cars and 69 e-buses) and 78,496 HEV. In London, the city aims to use 40 EVs and 20 HEVs for the Olympic Games in 2012.

(3) Case Study of Projects: SOURCE LONDON

2.75 London City has the EV promotion plan called “SOURCE LONDON”. This plan is led by Department for Transport (DfT: GBP9.3 million (≈ USD14.6 million)) and Transport for London (TfL: GBP5.7 million (≈ USD9.0 million)). Main purpose is promoting EV infrastructures for registered EV/PHEV (EV: 23 types, van: 18 types, motorcycle: 15 types). Charging station is usable freely at 10 GBP/year (≈16 USD/year). The target is 25,000 charging stations by 2015. There were 238 charging stations and 17,000 EV in 2011, and it is expected to increase up to 1,300 charging stations by 2013.

Figure 2.3.2 Charging Station in London

Source: JICA Study Team

(4) Technical Development and Production System

2.76 As December 2009, New Automotive Innovation and Growth Team (NAIGT) was established, which is an industrial leading organization. NAIGT has discussed on the technical roadmap of EVs for England.

2.77 Ford, NISSAN, Lotus, MAHL E,MEL, Millbrook, MIRA, mi Technology, Perkins, Pi Technology, Prodrive, Ricard, RLE, Roush, TRW Conekt, TWI and Zytek joined EV development and production. NISSAN plans to establish EV plants by 2013, which accommodates 50,000 EVs production in a year.

(5) Findings from EV/PHEV Programs and Policies in England

2.78 In the similar to USA, England also focuses on the development of charging infrastructures at national and local level. In England case, there was a big event which was Olympic Games in July to August 2012. Therefore, this opportunity became one of the targets to increase the number of EVs. Showing a large number of EVs in this kind of event can appeal the presence of the country to the world.

5) France

(1) National Policy

2.79 As countermeasures to global warming, there is a plan to reduce 1,760 ton of CO2 emission by 2020 from 2007 amounts. As a part of this, it was proposed to deploy and promote EV/PHEV. The government also prioritizes the expansion and development of the vehicle industry. The propagation and installation target is 2 million EV/PHEV and 4.4 million charging stations (50% for home) by 2020.

(2) Case Study of Projects: Autolib

2.80 Autolib is a project to promote EV/PHEV through EV public rental system for citizens and tourists with 3,000 EV for car sharing (Bluecar (Bollore, Lithium Polymer secondary battery)) and 1,120 sharing stations. The test operation of the project was

started in October 2011 with 66 EVs and 33 sharing stations, leading by Ministry of Environment, Paris City, Bollore Group. The full-scale project was started since December 2011. The project covers expansion Paris. The city plans to expand the project with 1,740 EVs and 1,100 sharing stations by June 2012.

Figure 2.3.3 Autolib Station in Paris

Source: Autolib

2.81 The project is evaluated relatively positive. Registration car is very reasonable (10 EUR/day (≈13 USD/day) or 5 EUR/half-hour (≈6 USD/half-hour)). Autolib stations are adjoined to the stations of bicycle sharing system (Velib) and railway stations, so that it can realize very convenience transfer. In general, it is very hard to find the parking space in Paris, but Autolib solves this problems. However, the promotion is still not enough to monitor the reduction of GHG and traffic congestions. Sometimes it is also hard to find the available EV to use.

(3) Technical Development and Production System

2.82 France focuses on the development and standardization of EVs and Li-ion batteries. Therefore, the government announced to provide EUR120 million (≈ USD155 million) for EV development by 2012. Renault-NISSAN and CEA (French Atomic Energy and Alternative Energy Commission) plan to establish battery plants which can accommodate 100,000 – 350,000 batteries production in a year.

(4) Findings from EV/PHEV Programs and Policies in France

2.83 Popularity of sharing the private transport mode is one of the strengths in France. Sharing system enable many people to experience on EVs with low cost. Furthermore, when the system is success, people also do not need to buy expensive EVs. People can just use sharing EVs when they need it, and people do not need to worry about the parking place because they can park at the sharing lots in the city.

6) Germany

(1) National Policy

2.84 Energy and Climate Program was formulated in 2007, and the environmental protection policy is actively promoted. As a part of this, energy and climate change problems are approached comprehensively by the development of electro mobility (e-mobility). In 2009, National Development Plan of e-Mobility was formulated, which is expected to increase the number of EV up to 1 million by 2020 and 5 million by 2030. Furthermore, the development of charging stations and standardization are also focused on. In May 2011, additional support of EUR1 billion (≈USD1.3 billion) was decided to achieve the target of 2020.

(2) Related Plan/Strategies

2.85 E-Mobility project aims to develop EV related infrastructure in accordance with the

progress of vehicle deployment in eight selected regions and cities.

(i) Phase 1 (2009 - 2011): R&D of new parts/components, test the grid integration and establish facilities for simulation, develop public charging stations, and research and demonstration of integration of renewable energy

(ii) Phase 2 (2012 - 2016): develop charging station in many towns and areas, R&D of grid integration (road management), initial test, and deploy advanced charging system and energy conversion system

(iii) Phase 3 (2017 - 2020): field test a complete system with realistic conditions, develop charging stations for the whole country, and integrate the grid, initial test of rapid charging and wireless chargers

(3) Case Study of Projects

2.86 **Case Study 1: E-Mobility Berlin (Field Demonstration in Berlin City):** BMW (Mini-E) and Vattenfall Company (Sweden) have started a field demonstration of EVs in Berlin City with 250 EV and 100 charging stations. It is supposed to increase the number of EV up to 100,000 by 2020. The project is led by Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU). EUR15 million (≈ USD19 million)/4years are provided for field test for market development.

Figure 2.3.4 Field Demonstration

Source: E-Mobility Berlin

2.87 In addition, Daimler and RWE have also conducted a field demonstration leading by BMU. This project period is from 2009 to 2012 with EUR9 million (≈ USD11.6 million) of budget. The project evaluates 500 charging stations, 100 EV, settlement system of accounts, the way of payment, and systems.

2.88 350 EVs and 220 charging stations were propagated by the end of 2011 in Berlin. The projects include various educations such as development, production and how to use. In 2011, the Berlin Agency for Electromobility (eMO) was established by Berlin partner and TSB Innovation Foundation. eMO shares the EV data with the government organizations and universities to improve EV production and transport systems. In E-Mobility Berlin project, introduction of EVs enable some works conducting at midnight due to silence of EVs. There is also field demonstration of transfer between EV and public transport (pedecle).

2.89 **Case Study 2: MeRegio/MeRegioMobile:** This is affiliated project of E-Energy Project of Ministry of Industry, leading by EnBW Energie Barden-Württemberg. The project has been conducted in Land Baden-Württemberg, Stuttgart City and Göppingen City in the period of 2008 – 2012 with EUR1 billion (≈ USD1.3 billion) of budget.

2.90 In the project, several demonstration are conducted including 700 charging stations, cogeneration with smart meter at 2,000 household and EV use for eco-generation at home. 500 E-bikes and 200 E-bicycles (e-roller) were installed by this project

(4) Technical Development and Production System

2.91 In 2010, the government announced to be a leader of electric mobility in the world in the National Platform for Electric Mobility (NPE) which is joined by organization of public, private and academy. The government plans to provide EUR2 billion (≈USD2.6 billion) for NPE.

2.92 Germany aims to introduce one million EVs and 0.5 million fuel battery vehicles by 2020. Opel, Volkswagen, BMW, Porshe, Daimler and Audi have advanced development of EVs.

(5) Findings from EV/PHEV Programs and Policies in Germany

2.93 Unlike other EV developed countries, Germany does not provide any financial incentives for EV users. The government considers to start financial incentives after realizing the mass production of EVs and installing charging infrastructures. The field demonstrations of EVs in Germany are mainly led by auto manufacturers for market development as well as testing charging system.

2.4 EV Development Strategies of China, Korea, and Taiwan

1) China

(1) Background

2.94 The automobile market in China has grown dramatically. According to the statistical data of China Association of Automotive Manufacturers (CAAM), the sales unit of vehicles increased from 2.3 million units in 2001 to 13.6 million units in 2009. At the same time, the total amount of vehicles owned and produced in China exceeded that in the USA, making the former the top automobile country in the world. The sales unit of vehicles has continued to increase even after 2009.

2.95 Chinese government aims to increase the influence of Chinese automobile and its component manufacturers in the world market. Therefore, the government formulated various policies to sustain and accelerate the growth of Chinese automobile industry. While the government looks at the economic development in long-term, environment and energy problems due to acceleration of motorization are raised as urgent issues. Therefore, it is essential for China to introduce energy saving vehicles and new energy vehicles. Regarding the new energy vehicles, the difference between Chinese technologies and developed countries' technologies is not as big as that for ICE vehicles. So EVs industry is an industry with bright prospects for China.

2.96 According to the "Energy-Saving and New Energy Automobile Industry Plan (2011–2020)," the automobile industry is one of the important fundamental industries in China, and it is also a symbol representing the competitiveness of a country. It is predicted that the ownership level of automobiles in China by 2020 will reach 0.2 billion vehicles, consuming 0.4 billion tons of fuel a year. Energy, security, and environmental issues will further worsen. It is therefore necessary to realize a new type of industrialization by promoting energy-saving and new energy vehicles. Such industrial transformation is inevitable to realize a sustainable society in China.

(2) National Plans and Policies

2.97 In China, China's Five-Year Plan for National Economic and Social Development (Five-Year National Plan) has been made every five years since 1953. Currently, the 12th Five-Year National Plan (2011–2015) is under the implementation. Since the 8th Five-Year National Plan (1991–1995), the research on EVs has been formally positioned in the Five-Year Plan, because the EV development has important strategic significance in China. In the 8th and 9th Five-Year Plans, R&D and pilots were focused, while in the 10th and 11th Plans, small-scale production and further pilots were promoted. A system of EV technologies has been preliminarily established in China, based on a much more active deployment during the Beijing Olympic Games (2008) and Shanghai Expo (2010). To realize the industrialization of EV business across the whole country, especially to keep the competitive position in the global EV market, a large-scale national pilot, called "Ten Cities, Thousand Vehicles Program" has been implemented since 2009.

2.98 It is planned that the industrialization of EV business will be realized by the following three steps, as shown in the Specific Plan for EV in the 12th Five-Year National Plan.

(i) **Step 1 (2008-2010):** New-energy vehicles in the public service sector are deployed in large-scale and medium-scale cities. In the pilot during the Olympic Games in 2008,

595 EVs were actually operated. The "Ten Cities, Thousand Vehicles Program" was initiated in 2009 and in the same year 13 cities participated in the program and about 5,000 energy-saving and new-energy vehicles were put into the operation. In 2010, the number of cities increased to 25 cities and the number of energy-saving and new-energy vehicles reached about 8,000 vehicles.

(ii) **Step 2 (2010-2015):** The industrialization of hybrid vehicles will be realized. Small-sized EVs as the representative EV will be deployed as a large-scale pilot. Small-scale fuel cell vehicles will be tested in the public service sector. The platform of next-generation "purely electricity-powered vehicles" will be developed, where the fuel cell vehicles will be positioned as representative types of the vehicles. Scientific and technological foundations will be provided to realize the 1% goal of "purely electricity-powered vehicles" sales in the total number of vehicles with same classes of vehicles. By 2015, 400,000 chargers and 2,000 charging/swapping stations will be installed.

(iii) **Step 3 (2015-2020):** The large-scale industrialization of "purely electricity-powered vehicles" will be further promoted. And the industrialization of next-generation "purely electricity-powered vehicles" will be initiated.

2.99 In 2010, the number of energy-saving and new-energy vehicles (including HEVs, EVs, FCEVs, CNG vehicles, LNG vehicles, LPG vehicles) produced in China reached 20,729 vehicles, in which passengers cars were 13,337 vehicles (occupying 65%),and commercial vehicles were 7,352 vehicles (35%). For the sales, 19,888 relevant vehicles were sold (passenger cars: 12,271 (64%), commercial vehicles: 7,117 (36%)). Comparing to those in 2009 (production: 5,294; sales: 5,209), the production and sales increased by 292% and 282%, respectively. In 2010, there were 180 types of energy-saving and new-energy vehicles registered (HEVs, EVs and FCEVs: 163, others: 17), which are listed in the promotion directory published by the central government.

2.100 In February 2009, the Ministry of Finance (MOF) and Ministry of Science and Technology (MOST) jointly released "Interim Management Measures of Subsidy Funds for Promoting Energy-Saving and New-Energy Automobile", saying that those vehicles listed in "Directory of Vehicle Types Promoted in Energy-Saving and New-Energy Automobile Pilot Program" (currently, nearly 200 types) are subsided.

Table 2.4.1 Main Policies by City

Category	City Name	Main Policy Type
First type	Shanghai, Changchun, Shenzhen, Hangzhou, Hefei	Subsidies for private vehicles and the promotion in the public service sector
Second type	Beijing, Chongqing, Dalian, Jinan, Wuhan, Changsha, Kunming, Nanchang, Tianjin, Haikou, Zhengzhou, Xiamen, Suzhou, Tangshan, Guangzhou	The promotion in the public service sector such as buses, car rental, official business, sanitation, postal services and other public services
Third type	Chengdu, Harbin, Lanzhou, Luoyang, Xinxiang, Jinhua, Zhuzhou, Shantou, Guiyang, Wuhu, Taizhou, Nanjing, Wuxi, Liuzhou, Liaocheng, Xiangtan	Supported by local policies or having existing industry bases

Source: compiled by JICA Study Team based on various sources

(3) "Ten Cities, Thousand Vehicles Program"

2.101 This Program was jointly initiated by MOST, MOF, National Development and Reform Commission, and Ministry of Industry and Information Technology (MOITT), China

in January 2009. It was planned that within three years 10 cities would be selected per year and 1,000 new-energy vehicles would be deployed mainly in the public sectors (e.g., public transportation systems, taxi, municipal services, and postal services) of each city, by providing financial subsidies from both central and local governments. 21 cities already prepared relevant policies and/or plans to promote the deployment of energy-saving and new-energy vehicles.

2.102 The first group of selected cities has 13 cities: Beijing, Shanghai, Chongqing, Changchun, Dalian, Hangzhou, Jinan, Wuhan, Shenzhen, Hefei, Changsha, Kunming, and Nanchang in 2009. The second group is composed of seven selected cities: Tianjin, Haikou, Zhengzhou, Xiamen, Suzhou, Tangshan, and Guangzhou in 2010. The third group has 5 cities: Shenyang, Chengdu, Huhehaote, Nantong, and Xiang yang in 2011.

2.103 In May 2010, MOITT issued a document that clearly determined the investment directions, for example, 1) cruising range with a full charge of battery should be at least larger than 100 km; 2) maximum speed should be faster than 80 km/h; and, 3) the life expectancy of EV-related major parts should be longer than 100,000 km.

2.104 By the end of 2010, there were more than 100 types of EVs, most of which were commercial vehicles. About 79% of EVs adopted lithium-ion rechargeable batteries. Personal passenger vehicles exceeded 1,000 vehicles. Since the promotion of EVs is mainly in the public sectors, commercial vehicles are the major player in the EV market.

2.105 The total number of energy-saving and new-energy vehicles already reached 11,814 vehicles in 2010. Among those vehicles, buses occupied 55.4%, followed by passenger cars (35.6%), and commercial and special vehicles (9.1%). Focusing on the type of vehicle power, EVs are 27.5%, HEVs are 66.9%, PHEVs are 0.1%, FCEVs are 5.0%, and others are 0.5%. Regarding the introducing condition by cities in 2010, the most active city was Shanghai, which introduced 1,217 vehicles, followed by Hefei City (774 vehicles) and Shenzhen City (720 vehicles).

Table 2.4.2 The Number of Energy-saving and New-Energy Vehicles

Year		2009	2010	Total
Passenger Cars	EV	480	972	1,452
	HV	935	1,642	2,577
	PHEV	0	2	2
	FCEV	90	80	170
	Others	0	0	0
Commercial Vehicles/ Special Vehicles	EV	365	442	807
	HV	5	0	5
	PHEV	0	0	0
	FCEV	100	160	260
	Others	0	0	0
Buses	EV	464	528	992
	HV	2,935	2,384	5,319
	PHEV	0	6	6
	FCEV	84	80	164
	Others	0	60	60
Total		5,458	6,356	11,814

Source: Yearbook 2011 of Energy-Saving and New Energy Vehicles in China

Table 2.4.3 The Number of New-Energy Vehicles in Chinese Pilot Cities in 2010

Selected Cities		Passenger Cars					Commercial Vehicles/ Special Vehicles					Buses					Total
		EV	HV	PHEV	FCEV	Others	EV	HV	PHEV	FCEV	Others	EV	HV	PHEV	FCEV	Others	
1	Beijing	50	0	0	0	0	30	0	0	0	0	0	60	0	0	0	140
2	Shanghai	0	350	0	80	0	270	0	0	100	0	181	150	6	80	0	1,217
3	Tianjin	0	0	0	0	0	42	0	0	0	0	50	122	0	0	0	214
4	Chongqing	0	243	0	0	0	0	0	0	0	0	2	50	0	0	0	295
5	Changchun	0	0	0	0	0	0	0	0	0	0	0	100	0	0	0	100
6	Dalian	0	405	0	0	0	52	0	0	0	0	36	60	0	0	0	553
7	Hangzhou	157	4	2	0	0	12	0	0	0	0	0	235	0	0	0	410
8	Jinan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	Wuhan	0	0	0	00	0	0	0	0	0	00	0	200	0	0	0	200
10	Shenzhen	53	310	0	0	0	0	0	0	0	0	0	357	0	0	0	720
11	Hefei	585	0	0	0	0	0	0	0	0	0	188	1	0	0	0	774
12	Changsha	0	0	0	0	0	3	0	0	0	0	0	572	0	0	0	575
13	Kunming	50	0	0	0	0	5	0	0	0	0	0	83	0	0	60	198
14	Nanchang	0	230	0	0	0	0	0	0	0	0	0	70	0	0	0	300
15	Haikou	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	Zhengzhou	77	0	0	0	0	25	0	0	0	0	25	25	0	0	0	152
17	Xiamen	0	0	0	0	0	3	0	0	0	0	0	37	0	0	0	40
18	Suzhou	0	0	0	0	0	0	0	0	0	0	0	41	0	0	0	41
19	Tangshan	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	10
20	Guangzhou	0	100	0	0	0	0	0	0	60	0	26	144	0	0	0	330
21	Shenyang	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	Chengdu	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	10
23	Nantong	0	0	0	0	0	0	0	0	0	0	0	47	0	0	0	47
24	Xiangyang	0	0	0	0	0	0	0	0	0	0	0	30	0	0	0	30
25	Huhehaote	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total		972	1,642	2	80	0	442	0	0	160	0	528	2,384	6	80	60	6,356

Source: Yearbook 2011 of Energy-Saving and New Energy Vehicles in China

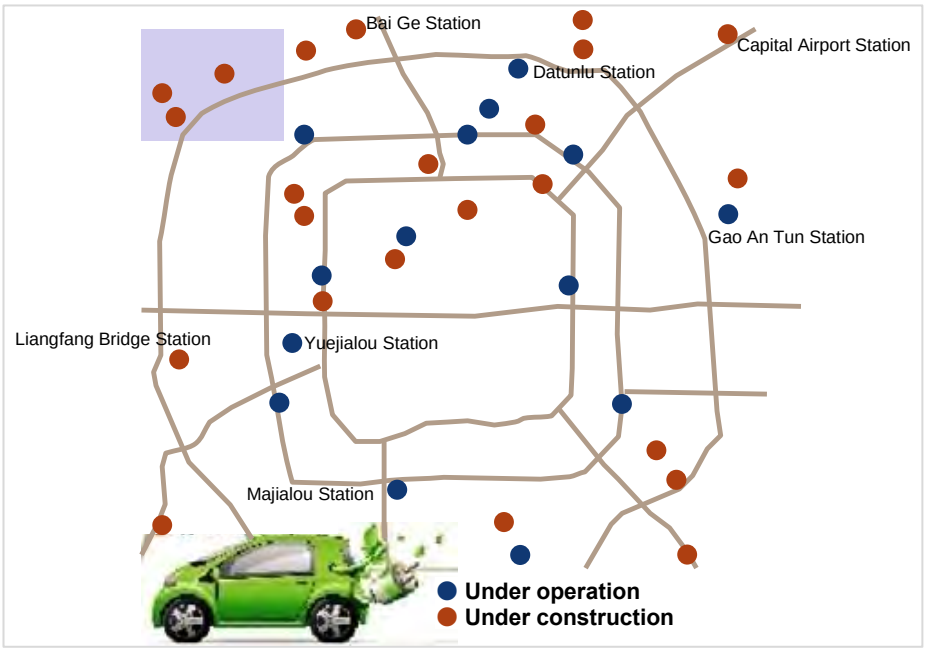
(a) Beijing

2.106 The total number of energy-saving and new-energy vehicles are planned to reach 5,000 vehicles in 2012. However, according to the interview to expert in Beijing (March 2012), the actual planned number of EVs is 2,920 (street-cleaning EVs (8-ton): 72, waste collection EVs (8-ton):57, waste collection EVs (2-ton): 871, E-buses: 1,000, EV taxi: 600, postal vehicles: 20, EVs for municipal service: 100, and EVs for police: 200).

2.107 According to Beijing Electricity Corporation, by 2015, Beijing will build a battery charging and swapping system with three levels: several ten large-scale concentrated charging stations, 256 charging/swapping stations, and 210 small-scale stations. For example, there is a charging and swapping station built at Gao An Tun (see Figure 2.4.1), which makes use of electricity from waste burning. 1,104 batteries can be simultaneously charged. Currently, it is mainly used by EV street cleaning and waste collection vehicles, E-buses, and EV taxi. The accumulated swapping capacity reached 146,000 vehicle times. Every year, 9,706 tons of CO2 can be reduced. At the same time, this station also installed 1,280 solar panels with the electricity generation capacity of 267,200 kWh, which can

reduce 400 tons of CO2 per year. Within 2012, eight charging and swapping stations and 2,000 chargers will be constructed to support the operation of 5,000 EV buses.

Figure 2.4.1 Map of Battery Charging/Swapping Stations in Beijing



Source: A news issued on March 19 2012, http://www.chinaev.org/DisplayView/Normal/News/Detail.aspx?id=12746

2.108 An interesting measure to promote the EV is that people who want to buy an EV do not need to participate in the lottery of number plate and are not restricted to the rule of number plate control measures.

(b) Shanghai

2.109 In 2011, Shanghai was designated as the 1st International Electric Vehicle Pilot City in China under the Electric Vehicles Initiative (EVI)[3], which was jointly proposed by China and the U.S. at the Clean Energy Ministerial (CEM) held in Washington D.C. on 19 – 20th July 2010, aiming to promote EVs demonstration in urban areas. One can see that China has been very actively promoted the EVs, focusing on not only the domestic market, but also the global market.

(c) Chongqing

2.110 Based on the new-energy automobile industry development plan in Chongqing City, a new energy automobile industry system will be established by 2015, under which the production capacity will reach 1,880,000 vehicles and sale revenues will reach one trillion RMB (≈USD 158 billion). An automaker with the annual production capacity of one million vehicles will be fostered, two automakers with the annual production capacity of 100,000–150,000 vehicles, 5–8 automakers with relatively competitive capacity for the whole vehicle and its parts.

(d) Changchun

2.111 It was planned that during 2010-2012, 16,000 PHEVs and EVs would be deployed by making full use of subsidies from both central and local government. However, this plan

[3] http://www.iea.org/work/workshopdetail.asp?WS_ID=504 (Accessed on April 5, 2012)

has not been approved.

(e) Dalian

2.112 In September 2009, the World Economic Forum was held in Dalian. This event became the important trigger in Dalian to promote the energy-saving and new-energy vehicles. After that, Dalian City decided to carry out the project called “33511”, which means Dalian will create 3 low-carbon bus lines and 3 zero-emission tourism areas, and also put into market 500 hybrid taxis, 100 business vehicles and 100 rental pure EVs. The intended goal is almost achieved.

2.113 It is planned to introduce 5,000 energy-saving and new-energy vehicles, construct four rapid battery swapping stations and 500 chargers, production capacity of 15,000 EVs and 5,000 hybrid vehicles and EV buses by 2015. By 2020, it is planned that EVs occupy 10% of the total automobile sales, and the EV production capacity reaches 200,000 vehicles.

2.114 In 2010, a taxi company with only HEVs was established with the support from the local government. In addition, 222 hybrid buses, 111 EV sightseeing buses, 500 hybrid taxi vehicles, hybrid public vehicles, and 13 EV passenger cars were introduced by July 2011.

2.115 In 2010, on the basis of smart grid project, Dalian built seven charging stations and 200 chargers, and two big battery swapping stations started its construction. In 2012, totally there are more than 2,000 charging facilities widely spreading in oil stations, residential zones and parking lots. When the swapping stations are finished, the buses will use the swapping system. In that case, the vehicle owner will not buy the battery but rent with no risk of maintenance and usage and the battery operator will take the rent and manage the batteries intensively which will be more professional and good for the battery duration. In 2012, one swapping station is completed and provides swapping service for 50 buses. For the above construction, the government provided subsidies.

(f) Hangzhou

2.116 It is planned that, the production capacity of auto-manufacturers will reach 11,000 vehicles (10,000: energy-saving and new-energy passenger cars; 1,000 commercial vehicles) by 2012, 90,000 vehicles (85,000: energy-saving and new-energy passenger cars; 5,000 commercial vehicles) by 2015, and 220,000 vehicles (200,000: energy-saving and new-energy passenger cars; 20,000 commercial vehicles) by 2020.

(g) Jinan

2.117 By 2010, 100 hybrid buses were operated and traveled about eight million km and transported more than 15 million passengers.

(h) Wuhan

2.118 By the end of 2010, 872 energy-saving and new-energy vehicles were operated, including 400 hybrid buses, 50 hybrid passenger cars, 80 street cleaning and waste collection EVs, 340 small-sized tourism vehicles and two EV-type multi-purpose vehicles (MPVs) for electricity supply services. In total, the accumulated travel distances by those vehicles were 42,357,300 km: 18,916,100 km for hybrid buses and 448,100 km for hybrid passenger cars. By the end of 2010, the reduced CO_2 emissions were about 74.9 million tons (2.5 million tons by hybrid buses and 87,600 tons by hybrid passenger cars). The total energy savings were about 2.3 million liters (0.9 million liters by hybrid buses and 3,800

liters by hybrid passenger cars).

(i) Shenzhen

2.119 It is planned to build 22,200 charging stations and chargers for both buses and private vehicles. By 2010, 30 charging stations are under operation (25 for buses) and 2,329 chargers in residential areas, parking places and governmental facilities will be constructed by 2011. By 2012, 5% parking places in residential areas and 10% parking places in public facilities will have chargers.

(j) Hefei

2.120 It is planned to introduce 22,500 new-energy vehicles (public sector: 1,400; private vehicles: 21,100) and build 20 charging stations and 30,000 chargers for private vehicles during 2010–2012. It is estimated that fuel consumption will be saved by about 27,000 tons, CO_2 will be reduced by about 79,000 tons, THC by 2.7 million tons, NOx by 543,000 tons.

(k) Suzhou

2.121 By 2012, it is planned to deploy 1,000 new energy vehicles (in 2010: 100; in 2011: 300; and, in 2012: 600). Average distance for failure of hybrid buses is 1,710 km.

(l) Guangzhou

2.122 In 2010, one charging station with a capacity of charging 50 E-buses, one public charging station for private vehicles, 10 slow-speed chargers and one charging station for FCEVs were put into operation. For the E-bus charging station, it has an area of 1,000 m^2, average battery swapping time is about 10–15 minutes, charging time for a battery is about 90 minutes, and charging time for the whole vehicle is about 60–80 minutes.

(m) Chengdu

2.123 Up to 2010, 10 E-buses operated in Chengdu City traveled 127,000 km, transported 600,000 passengers. As a result, 109,000 liters of diesel were saved and 16 tons of CO2 was reduced.

(n) Xiangyang

2.124 On 27th April 2010, Xiangyang City and Dongfeng Motor Corporation signed an agreement, saying that a manufacture base for energy-saving and new-energy vehicles with the production capacity of one million vehicles and relevant products will be constructed in the period of 2010 - 2015. The construction was started in October 2010.

(4) Technology Development

2.125 The policy on R&D of new-energy vehicles has been already carried for nearly 10 years. The Electric Vehicle Key Projects (important projects related to electric vehicles) in the 10th 5-year plan was launched in 2001 under Department of Science and Technology (DST) of the State Council. This project was designated as a part of High Technology Research and Development Program (863 Program).

2.126 Energy Saving and New Energy Vehicle Key Project were launched by DST during 11th 5-year Plan. Overall concept of this project is called 3 x 3 R&D mechanism. The first 3 means three types of completed vehicle technologies, namely FCEVs, HEVs and EVs. Another three means three kinds of core technologies (powertrain system, motor for driving and batteries). 863 plans play important role to develop research on basic technologies for energy saving and new energy vehicles, establish supply system between

auto manufacturers and parts manufactures, promote social awareness on energy saving and new energy vehicles, and develop market of energy saving and new energy vehicles.

2.127 Participants on 863 plans have increased since 2001, and it reached some hundreds including private enterprises, universities and research institutes. Regarding the past activities, 863 plans focused on basic research and technology development in the period of 2001 – 2005 and research on technologies of core parts, body control and platform in the period of 2006 – 2008. Since 2008, in parallel with research and development of technologies, many field demonstrations have been conducted, including examination, test operation, and so on. From those activities, it can be seen that more than certain level of technologies are accumulated in the participated universities and institutes. In the period of 2011 – 2015, it is expected that the energy saving and new energy vehicles will be put in the practical use and in the market.

2.128 Main EV manufactures includes China FAW Group Corp, Dongfeng Motor, China Changan Automobile Group, China South Locomotive and Rolling Stock Corporation Limited and China Dongfang Electric Group. Battery companies include China Bak Battery, inc., Citic Guoan Mengguli, Winston Battery Limited, Tianjin Lishen Battery, Harbin Guangyu Power Supply, Chang Sheng Electrical Company, and so on.

(5) Findings from EV/PHEV Programs and Policies in China

2.129 In China, EV/PHEV policies and programs have been quantitatively evaluated from the technological viewpoint in the sense that there are clear national targets of technological development at the very detailed level such as battery and engine and travel speed. Only those vehicles meeting the national targets are registered in the national promotion list and are qualified to be subsidized by both central and local governments. Same types of new energy vehicles are usually produced by different auto manufacturers and tested in different cities. As a result, the better ones will be further promoted, but the worse one will die out.

2.130 In addition to the technological evaluation, economic and environmental effects are also targeted. Unfortunately, none of the cities selected by the “Ten Cities, Thousand Vehicle Program” has a comprehensive set of evaluation indicators.

2) Taiwan

(1) Background

2.131 Taiwan is suitable to develop EVs. Firstly, the distance from north to south of Taiwan is only 400 km and from west to east is only 150-200 km. The short cruising range is the biggest limitation of EVs, so that it is convenience to use EVs in small area. Furthermore, the electric power in Taiwan is quite sufficient. Taiwan’s ICT (Information and Communication Technology) level is very high which could be applied on EVs.

2.132 In April 2010, the Executive Yuan of Taiwan determined the Action Plan and Promotion Strategy of Intelligent Electric Vehicles. Ministry of Economic Affairs (MEA) and some related ministries will invest TWN9.7 billion (≈ USD326 million) to promote the development of EV industry in six years.

2.133 One goal of Taiwan is to become the world paragon developing the intelligent EV and to achieve the objective of Low-carbon Island. The other goal is to become the global leader of e-motorcycle standard and become the design and production base of e-motorcycle and its key components.

(2) Promotion plan

(i) **Frist stage: 2010-2013:** This period is called as start-up period. During this period, they plan to push forward 10 pilot cases totally with 3,000 vehicles. At the same time, 3,000 charging posts will also be set up. Among all the EVs, 185 units are used as the government cars and state enterprises' cars.

(ii) **Second stage: 2013-2016:** This stage is the growth period through incentive to develop the market in Taiwan and China in order to create the top 10 intelligent EV manufactory. The goal of total sales unit in this period is 60,000 EVs with 45,000 EVs in Taiwan and 15,000 EVs in China.

(iii) **Third stage: 2016-2030:** This is the long-term plan for objective of 1.2 million EVs to the whole world. At that time, Taiwan hopes to become the top 5 biggest EV export country.

(3) Strategy

2.134 In order to promote EVs, some ministries cooperated to declare five basic strategies which are listed as below.

(i) **Make environmental protection and energy conservation standards:** This part is mainly under the charge of Bureau of Energy. It is expected to obsolete the high consumption and high pollution vehicles through making the environment and energy law stricter.

(ii) **Promote the pilot cases:** These cases are under the cooperation of Department of Transportation who is responsible for public transport, MEA who is charge of the part of sedan and motorcycle industry development and also the Bureau of Environment Protection. After these cases with the addition of the advanced ICT, Taiwan expects to get some successful promotion experiences as the foundation for the future.

(iii) **Increase the incentive to buy EVs:** Since the EVs is almost double price of conventional one, the government wants to increase the incentive to encourage private consumer to buy it. This is also the global common method in the promotion of EVs. The incentives include reduction of purchasing tax, oil tax exemption, subsidy for purchase, free charging and so on.

(iv) **Improve the EV using environment:** As stated in the consumers' preference survey, the main consideration of consumers is the completeness of the infrastructure construction. So the government will set up charging station widely.

(v) **Assist the industry development:** Taiwan expects to promote the development of auto manufactures and components producers through the EV plan. During the plan implementation, Taiwan also encourages the cooperation with some other countries like Philippines and France.

(4) Projects Introduction

2.135 There are two on-going projects, one committed and three under planning. Here below is the current status of the projects.

2.136 **The world's big Taichung: Green Transportation:** This project is implemented in Taichung and the project period is from 1st May 2011 to 30th April 2013. This project mainly focuses on the official business vehicles, including business vehicles, police cars and inspection vehicles, and state enterprises' cars such as Taiwan Electric Company.

2.137 This project includes 51 domestic EVs from Luxgen and 49 NISSAN LEAF. Many specific parking spaces are set for free parking in public parking lots, and many charging station are installed to provide charging service by free of charge. Totally 161 AC charging stations will be installed. The government also organized more than 150 advertise campaigns.

2.138 **Taipei metropolitan low-carbon tourism:** This project is the only one in Taiwan for the populace to experience EVs. It is proposed and implemented by the Geshang Car Leasing Company in Taipei. This project will take three years starting from 1st September 2011. 100 domestic EVs will be provided at the Banqiao station for tourism car rental. Correspondingly 100 charging stations will be set up spreading in Taipei city and New Taipei city including some famous tourism attractions and some big building parking lots.

2.139 Banqiao station is the terminal of the MRT in Taipei and the transportation here is very convenient. Tourists can rent the EVs at a low price than conventional one due to the subsidy by the government to company. And the parking and charging are all free of charge. In 2012, 20 EVs and 15 charging stations are already available. 150 persons have experienced it.

2.140 This project also planned to design nine special tourism corridors for EVs. The EVs are required to equip the guiding system including the information of entertainment places and charging stations. This project will contribute to the goal of Taipei low-carbon tourism.

2.141 **The low-carbon intelligent electric vehicles in Tainan:** This project just passed the discussion at the beginning of 2012 and will last for two years. This is the biggest project of about half a billion TWN (≈USD17 million) investment of which 46% are subsidized by the central government. This project will put 200 EVs into use, and 201 AC charging stations will be set up including a solar energy charging station, which is the first renewable station in Taiwan.

2.142 It is the first case using the business to government (B2G) business model. These EVs will be used for the official business access, water conservancy inspection or tourism business access.

(5) Technology Development

2.143 R&D of EVs has been led by Taiwan Automobile Research Consortium (TAAC) which is composed of Industrial Technology Research Institute, Automotive Research and Testing Center, Metal Industries Research and Development Center (MIRDC), Chung Shan Institute of Science and Technology and Hua-chung Automobile Electric Technology Center. The most of staffs in the above research institute have Ph.D. in various field and studies in the famous universities in Europe and U.S. The EV development has been advanced by those staffs. Regarding the standardization of EV related standards, Taiwan has negotiated with Europe, U.S. and China. TAAC also cooperate with private enterprises. 75 enterprises are conducting joint research in four fields which are motor and inverter, secondary batteries and charging equipment, vehicle body and STOBA. STOBA is promoted by Taiwan as safety measures for Li-ion secondary batteries. Moreover, Automotive Research and Testing Center has led to establish standards for crash safety of EVs and safety of Li-ion secondary batteries.

Figure 2.4.2 EV Made in Taiwan

Source: 2012 EV Taiwan

(6) Findings from the EV Development Strategies

2.144 Taiwan recognizes that the small size of the country is suited to use EVs. Therefore, the government has already committed to promote EVs, especially e-motorcycles. Furthermore, the realizing EV society will build new vehicle industry system, and it can be an opportunity for Taiwan to develop their industries. Therefore, the government set the target of the technology development for EV society, considering the current level of own industries and the area of expertise.

3) Korea

(1) Background

2.145 Korean government does not want to be the first one to open the EV market. The auto companies also try to keep their pace and do not want to have any risk to lose the leading position by opening new market.

2.146 In Korea, three central ministries are related with EVs. Ministry of Knowledge Economy (MKE) provides financial support, focusing on battery EVs and charging technology. Ministry of Environment (MOE) provides EVs to public or private. Ministry of Land, Transport and Maritime Affairs (MLTM) sets the regulations.

2.147 In December 2010, the central government issued “green car propagation vision and strategies”. Green car means EVs, PHEVs, HEVs, FCEVs, clean diesel vehicles (CDVs). In 2011, progress of the propagation of green cars was discussed. As a result, it is possible to achieve the propagation target of 10,000 HEVs in 2011, yet it is difficult to achieve 800 EVs in 2011. Furthermore, EV propagation target in 2012 is 4,000 units, but it seems to be also difficult to achieve as well as 2011.

2.148 The central government started providing some environmental friendly product and some project for EVs. With the project, Kia managed to build some electric passenger vehicles such as blue-on. There is also a smart grid project in Jeju Island starting from 2009. There is no any active plan for the EV market now and just want to follow up the government policy.

(2) Promotion project

2.149 **Testing projects from Ministry of Environment:** From 2011, the MOE started some testing projects for EVs manufactures in Korea in the sense of consumers. MOE bought vehicles and gave them to the public authorities. For example, Cartree did the safety test of the vehicles. They assigned some EVs to their employees and asked them to

drive every day and gave the impression of the EV back such as how they felt about the battery. The project included BlueOn (EV of KIA), NEV and public buses. All of them are PHEVs.

2.150 There is another project starting from the end of 2011 which is a testing project using blue-on. The central government provided some budget for the city government or public authority to subsidize 50% of the price if they want to buy EVs, in which case they can use the EVs for public purpose. They also have the plan to build the charging station for that location.

2.151 **Projects of Ministry of Knowledge Economy:** MKE, dealing with the government policy of making products like mobile phones and vehicles, has some projects of EVs. One is started from 2011. MKE wants to provide money for the mid-size compact electric vehicles. The project leader is KIA. They want to make very nice EV based on the platform of Elantra (sedan of Hyundai). This is a very big project which will be ended in 2013.

2.152 **Projects of Ministry of Land, Transport and Maritime Affairs:** One of the projects started in 2011 which is led by KIA. It is about making e-bus but focusing on the motors. It uses very small motors. Since the motor is small and consume less electricity, there is no loss of the power.

2.153 One other project organized by the MLTM started in December 2010. It aims at the automatic battery swapping, and the goal is to change the battery in 30 seconds or the maximum is less than one minute. The battery swapping station will be built in the bus stops. The government is supposed to provide about USD40 million for this three years' project. The cost of one installation is about USD800,000. The main part of this project is battery swapping model. The key technique is the quick battery changing machine (QBCM). For that, a mid-size company, specialized in auto-machine and communication and robot, is participating in this project. And also the professors from the department of mechanics, department of auto-motor engineering, department of electric engineering who specialized in wireless communication and battery companies and national institute who test the vehicles' electric safety. Totally there are 13 companies and institutes in the project.

2.154 There are some other bus projects founded by MLTM such as the online electric vehicle (OLEV) whose driving force is very strong. This project initiated in 2009, founded by the ministry of education and technology for two years and then MKE for one year. All the ministries declared the project and the project itself is very good for EV development. It collects the electricity from the pavement which is called wireless EV. Since the driving force is very strong, they can build a line in 2012.

(a) Other projects for E-bus

2.155 As for the e-buses, the Hyundai also has own commercial model. They modify the e-bus with the C-engine and low platform bus. The Korea Fiber also modifies the buses as electric ones. There are buses testing around the Namson area freely. Those two companies are making the plug-in electric buses. For charging, they need to stop for 20-30 minutes every time.

(3) Technology Development

2.156 Four automobile manufacturers joined EV development in Korea; HYUNDAI, Kia,

Renault Samsung and CT&T Company.

(i) HYUNDAI: Hyundai Motor Company released the "BlueOn" in September 2010, which is the first full speed EVs in Korea. BlueOn is a low-volume production version of the EV concept of "i10 Electric" which was shown at the Frankfurt Motor Show in 2009. 30 BlueOn will be introduced to the government organizations as a field demonstration in October 2010. The field demonstration is planned for two years to develop and evaluate charging infrastructures.

(ii) KIA: In September 2010, KIA Motors Company showed “POP” in Paris Motor Show which is a small EV concept car with a capacity of three passengers. While the release date is not announced yet, the company supposes POP as the mass production car.

(iii) Renault Samsung Motors Company: In May 2009, Renault Samsung announced to start putting “SM3” in mass production from 2011 which is a medium-sized sedan. Firstly, it will be used for car rentals and public vehicles in Jeju area as field demonstrations. And then, from 2013, it will be mass-produced for public use.

(iv) CT & T Company: This is a business venture which expands the market of small EVs to the world. In 2002, the company was established to develop and sale EVs for public roads. However, EVs were not allowed to run on the public roads at that time, so that the company shifted to produce golf carts. After that, the company also produced the neighborhood electric vehicle (NEV) which is for low-speed and short-distance vehicles and expanded the market to U.S. and other countries. In 2009, the small EVs with the full-scale aluminum alloy chassis, called “e-ZONE” were produced and on sale. In Korea, e-ZONE is classified into low-speed EVs which has maximum speed of 60km/h, and is allowed to drive in the certain area only. However, CT&T Company has been applying the Corporate Rehabilitation Law in 2012.

(4) Findings from the EV Development Strategies

2.157 Korea does not take an initiative to develop EV market. On the other hand, the government focuses on the EV battery development which is a key for EV technology and its cost. In 2011, Korea has the biggest share of EV battery in the world. Korean batteries are applied for GM, Ford, Renault, and so on. Furthermore, Korea also focuses on other battery related technologies such as battery exchange system instead of charging, wireless charging system, and others. They have tried to make those technologies use in practical. Various attempts for public bus transport are also notable.

2.5 EV Development Strategies of ASEAN Countries

1) Overview

2.158 When it comes to EV manufacturing, ASEAN countries are still on the primitive stage. But when it comes to deployment or utilization, these countries are not far behind as many have begun to formulate their respective strategies for introducing EV, – especially after 2010. The EV adoption strategies in each country vary according to: (i) economic development situation, (ii) presence of vehicle industries in the country, (iii) energy resource and supply condition, and (iv) policy support for technologies and funding by foreign countries (see more detail in Table 2.5.1).

2.159 Not surprisingly, Singapore, Thailand and Malaysia are more aggressive in pushing for wider adoption of EVs. These countries are in the upper bracket of economic development. They have proceeded to perform EV research and development in-country, and plan to conduct field demonstrations by importing finished recreational vehicles (RVs) initially. At the same time, their governments intend to build the support infrastructure needed by EV users. The basic incentives take the form of reduced taxes for EV manufacturers, as well as for EV purchasers.

2.160 An impetus for EV is the presence of domestic vehicle and/or parts/components production. This sector provides the internal push for EV introduction. A case in point is the existence of many EV manufacturers and conventional vehicle manufacturers in India. However, the high cost of EVs in combination with low per capita income pose a barrier to wider adoption. In New Delhi, only electric two-wheelers appear to be entering the market. The Government is also not yet active in installing charging stations for EVs.

2.161 The presence of alternative energy sources domestically is another macro-economic factor. For example, Indonesia has abundant CNG deposits which emit lower GHG. It also produces oil. Therefore, there is no urgency for Indonesia to introduce EVs at present or in the medium-term.

2.162 The Philippines got strong support from ADB to implement a national program to convert its old fleet of more than 200,000 gas-powered three-wheelers into electric. This was how the Philippines started on the EV road map.

2.163 Vietnam is not yet active in seizing opportunities for EV adoption. However, there are local initiatives, such as joint venture between a local government and Chinese or Japanese enterprises. The number of e-motorcycle is expected to increase gradually.

Table 2.5.1 EV Development Situation of ASEAN

	National Policy/Strategy	Promotion/ Incentive	R&D
Thailand	・Low-emission car project (2007) ・Government agreement to conduct a field test operation of i-MiEV of MITSUBISHI as EV introduction policy (2010) ・Aims to be a center of production and export of EV to South-east Asia, and promote EV strongpoint concept.	・import tax reduction: hybrid vehicles (2010) ・10% tax reduction system for purchasing low-emission vehicles	・Field test operation of i-MiEV (2010 -) ・2 EV manufacturers: Alternative fuel vehicles, golf cart, shuttle bus, etc.
Singapore	・Green Vehicle Revata (GVR) Scheme ・EV Test Bed Project	・SGD20 million for field demonstration in order to put EV to practical use. ・Plan of subsidy: EV users and installation charging station	・Planned field test operation by MITSUBISHI Motors. ・Installation of charging station ・Establishment of a development facility of power semiconductor for EV (German)
Malaysia	・EV Development Strategies ・National Automotive Policy (NAP) ・Invitation of HV/EV auto manufacturer is under negotiations, ・Domestic enterprise aim to sell EV by 2013 ・Promotion plans to develop EV by 2013.	・Permission for 100% of foreign investment for the production of EV/HV with exemption of corporation tax, subtraction of investment tax, and provision of subsidy for R&D. ・Exemption of tariff and excise tax: completed EV/HV less than 2,000 cc by 2015.	-
Philippines	・National EV plan ・Focus on public transport with light-weight vehicles, such as E-trikes and E-jeepneys	・USD100 million from Clean Technology Fund (CTF) to replace fuel-based trikes with E-trikes ・20 E-trike (Li-ion battery) piloted in Manila with ADB assistance (2011) ・Proposed exemption of EV imports and manufacture from excise taxes ・Preferential treatment to EV against time/day use restriction is under discussion.	・The ADB loan also entails expects emergence of e-trike manufacturing with capacity for exports
Indonesia	・Low Price Green Car Program ・Promotion to shift from gasoline vehicle to CNG and LPG vehicles.	-	・Developed EV of “MarLIP” by Lembaga Ilmu Pengetahuan Indonesia with low quality (2003)
Vietnam	・Approval of the test operation of EV by Ho Tay Limited Liability Company (TLC)	-	・Plan to produce E-bile in Vietnam: joint company of China and Vietnam, and Japanese venture companies

Source: compiled by JICA Study Team based on various sources

2) Indonesia

(1) Background

2.164 The air pollution is the biggest environmental problem in Indonesia. 80% of air pollution is caused by transport sector because serious traffic congestions. Although the vehicle ownership is high due to the cheap gasoline price which is subsidized about 50% by the government, the infrastructure development is delayed compared to the demand. Furthermore, many old vehicles which have low-energy efficiency do not pass the standards for vehicle emissions.

2.165 In Jakarta, the number of registered vehicles has increased with 11% of annual growth rate. Of which, 35% is for personal use, 54% is for motorcycles use, and 9% is for commercial vehicles use. Only 1% is for public transport such as buses and taxis. Furthermore, best-selling vehicles are small vans and SUVs. HEVs are sold little. In Indonesia, the import tariff is very high. Especially HEVs is luxury goods, so that it is impossible to reduce the tax. EVs are more expensive than HEVs. Therefore, there is less opportunities to introduce EVs. Instead, it is more effective to increase CNG vehicles and LPG vehicles to reduce air pollution, because those vehicles are relative cheap.

2.166 The emission regulation is established based on Euro 2. However, fossil fuels sold in many gasoline stations in rural area is not supported to this regulation. Jakarta and Environmental Management Bureau issued new regulation on vehicle emission management in 2010 to introduce more strict emission standards. However, Indonesia except Jakarta lags 10 years behind the developed countries in its emission standards.

(2) National Policy

2.167 In May 2011, the Ministry of Industry introduced the Low Cost and Green Car program to support the national manufacturing industry and establish Indonesia as a major production hub. This program aims to develop industrial clusters by inviting foreign auto manufacturers. However, the participants to this program have to have 60-80% of local parts procurement rate.

2.168 In 2011, Presidential Regulation of the Republic of Indonesia No. 61 Year 2011 on the National Action Plan for Greenhouse Gas Emissions Reduction was issued encouraging the use of EV as a means to reduce GHG. The Ministry of Science and Technology is a leading agency for EVs, yet there are no related regulations and laws. In response, automakers like Toyota, Honda, MITSUBISHI and other companies established EV-related projects. However, very little progress has happened in the absence of tax incentives EV import coupled with non-existent infrastructure (e.g. charging station). As of 2012, the possible incentives for HEV are under study.

2.169 The policy is geared towards protecting the environment by way of reducing fossil fuel consumption. While Indonesia produces oil, it is forced to import as demand outstrips local supply. With local production of gas, the government also tries to promote a shift from gasoline/diesel vehicles to CNG/LPG vehicles.

(3) Related Activities

2.170 As far back as July 2003, a local company (Lembaga Ilmu Pengetahuan) brought in 10 EV to test the market. With its price tag (less than IDR45 million (≈USD4,673)), low speed (40km/h maximum), low horse power (at 5.5 HP as in golf carts), and long charging time of 8 hours/charge, the market failed to take off.

2.171 In July 2011, MITSUIBISHI introduced its new generation EV (i-MiEV) at the Jakarta International Motor Show 2011. It received favorable reviews from governments and the public. It remains to be seen whether EV use will grow in Indonesia.

(4) Findings from EV Development Situation in Indonesia

2.172 The cheap price of fossil fuel and the local production of gas discourage to introduce EVs in Indonesia. In addition, introducing EVs cannot solve the very heavy traffic congestions in Jakarta, so that the government is interested more about mass rapid transit (MRT). However, there is a possibility to introduce EVs in small area such as Bali, Batang, etc. for tourism use.

2.173 In terms of the technical aspect, thorough pilot projects by auto manufacturers, it is identified the difficulty to promote EVs without tax incentives for import as well as the development of charging infrastructures

3) Malaysia

(1) National Policy

2.174 The government has always aspired to have a viable automotive manufacturing industry. Based on the revised New Auto Policy for FY 2011, the production of alternative fuel vehicles is to be promoted via;

(i) Allowing 100% foreign ownership in the manufacturing of HV/EV, grant of tax exemption for 10 years, provision of investment tax allowance (ITA) and subsidy for R&D; and,

(ii) 100% exemption from tariff and excise tax on completed HV/EV (less than 2,000 cc) by the end of 2015.

2.175 In addition, the Government is wooing HV/EV auto and parts manufacturers to invest in Malaysia and to look at the ASEAN market.

2.176 In March 2012, Minister of Energy, Green Technology and Water said that Malaysia will increase the number of dispatched EVs, and EVs will share 10 -15% of vehicle market by 2020. The number of HEVs has increased gradually due to the preferential treatment on environmental friendly vehicles by the government. As of the end of June 2012, there are about 8,000 HEVs and 11 EVs in Malaysia. Of which, nine EVs are manufactured by Proton and the remaining is by MITSUBISHI.

(2) Related Actions

2.177 **Proton:** The country's designated national car maker, Proton, displayed its experimental small hybrid concept car (EMAS) at the Geneva Motor Show in March 2010. Proton aims to roll out EMAS as the official government car starting in 2013. After the Geneva show, Proton began testing prototypes in Britain and will conduct further tests in Malaysia before launching a fleet of 30 to 50 vehicles in mid-January of 2012. The government plans to build 10 charging stations, mostly around its administrative capital Putrajaya, as part of the pilot test for the car.

2.178 **TOYOTA and HONDA:** The two Japanese car makers, Toyota and Honda, have included their hybrids cars in their local product line ups since 2009. There is as yet no plan to produce HV/EV in Malaysia. The tax preferential treatment has chopped off 25% from the sticker price of Prius and Civic hybrid cars. Honda expects to sell 10,000 of its Jazz hybrid car in 2012.

2.179 **Edaran Tan Chong Motor:** In May 2012, Edaran Tan Chong Motor announced a pilot program of NISSAN LEAF. In this program, 10 LEAF will be introduced in Klang Valley as feasibility study in the practical conditions. The program will last for maximum three years to collect the feedback from the users.

2.180 **Rapid KL (bus operator):** Rapid KL plans to introduce E-buses by 2014. 15 E-buses from Europe and 20 E-buses from China will be purchased. This plan aims to realize zero-emission public bus system and to reduce the environmental stress.

(3) Findings from EV Development Situation in Malaysia

2.181 Unlike other ASEAN countries, the government in Malaysia focuses on EVs as an opportunity to develop auto industries in the country. High demand of EVs can be expected in domestic and international market in near future, so that the government aims to promote EVs made in Malaysia.

2.182 At the same time, it is expected that the installation of charging stations can encourage people to use EVs. Therefore, the government also focuses on the EV infrastructure development.

4) Philippines

(1) National Policy

2.183 Unlike the other countries in the region, the introduction of EVs started as disparate private initiatives at the local levels without the benefit of a national policy. It was a case of the tail wagging the dog. The E-jeepney (a kind of 4-wheeld paratransit) started in 2007 as part of the project funded by the Dutch DOEN Foundation that envisaged leasing of an initial 50-strong fleet to different cities of the country. The pilot deployment occurred in two cities – Makati in Metro Manila and Bacolod in the provinces. Progress was very slow, hampered by absence of government regulations on the registration and licensing of electric vehicles. The numbers were more encouraging in E-Trikes (3-wheeled public transport based on electric motorcycles). The e-trikes surfaced in several cities (Makati, Mandaluyong, Davao, Surigao, Puerto Princesa, etc.) at different parts of the country. They were either promoted by assemblers or NGOs, rather than by the government. Because the licensing of tricycles was done by the local governments, the introduction of e-trikes occurred more rapidly than e-jeepneys. Absence of a national policy notwithstanding, two private sector EV-players recently showcased their electric mini-bus and electric coach bus. In both cases, the technologies are imported or adaptation of foreign-made components.

2.184 What may pass for a national strategy is a program of the Department of Energy to replace the more than 200 thousand ICE tricycles in the country with E-trikes. The program was launched in January 2012. The initial target of the E-trike project is to deliver 20,000 E-trike within three years. It is supported by the ADB, which arranged an initial funding of USD100 million from the Clean Technology Fund. The project will scale-up a pilot program (introduced in Mandaluying City in 2011 with support from ADB) for the entire Philippines and capitalize on lessons from the early adopters, with the expectation of attracting investments in battery manufacturing and establishing local manufacturing capability for e-Trikes at the rate of 3,000 e-Trikes a month. As the first developing country taking this initiative to develop locally designed and produced e-Trikes retailing for about USD 4,000 - 5,000, it also hope to create a potential export market to the other ASEAN countries.

2.185 The legal vacuum for EV is belatedly being addressed. In March 2012, a proposed Law hurdled second reading at the lower house of Congress. The Bill provides incentives for the manufacture, assembly, conversion and importation of electric, hybrid and other alternative-fuel vehicles. It also aims to lay down the groundwork for the widespread use of hybrid and alternative fuel vehicles in the country, lessen dependence on imported fossil fuel, and mitigate the deleterious effects of carbon emission. Once enacted into law, local assembly or manufacture of eco-friendly vehicles shall be exempt from various taxes for 9 years, while imported completely built up units (CBU) shall enjoy tax exemption for 4 years.

(2) Related Projects

2.186 **E-trike Project of Local Governments:** There are more than 600 thousand tricycles in the Philippines. Nearly all are used as public transport for hire – in the cities and rural areas of the country. They all started as sidecars to 2-stroke gas-fueled motorcycles that produced more GHG than ordinary cars on a per unit basis. That was the original impetus – initially to retrofit, change to 4-stroke, shift to LPG, and more recently convert to electric.

2.187 Several cities in the Philippines started their own pilot programs to introduce E-trike for commercial use. All started independently of each other, based on conventional lead-acid battery– because of their cost and availability. The cities in Metro Manila were Mandaluyong, Taguig, and Makati. Outside the capital region, e-trikes were introduced in cities of Surigao, Puerto Princesa, Panabo and Davao. Commercial interest was the driver in two of them, while non-governmental organizations (NGOs) and environmental advocacy groups were the initiators in the other places. Mandaluyong City was exceptional, in that it was supported by ADB as well as NGOs. Research on the experiences of early adopters revealed that the use of e-Trikes increased the daily incomes of drivers by as much as 50%, largely due to the differential in fuel cost.

2.188 In the Philippines, commercial interest is high that EVs is the future of transport. In November 2010, the first Philippine Electric Vehicle Summit was held by the newly-formed Electric Vehicle Association of the Philippines. Sonsoring organizations included the World Wide Fund for Nature, Save the Air Partnership for Clean Air, and the Institute for Climate and Sustainable Cities.

2.189 The downside to the bottoms-up introduction of EV was the absence of standards. Each supplier or manufacturer improvised and crafted the E-vehicle pretty much by their own. These have spawned a plethora of designs and different specifications for e-Trikes, as shown in Figure 2.5.2 below. Furthermore, they encountered several legal obstacles concerning licensing or registration of EVs, as well as importation of components.

Figure 2.5.1 E-trike Variants in the Philippines

ADB-funded E-Trike

Davao-made e-Trike

E-Trike in Puerto Princesa

E-Trike in Bonifacio Global City

Source: Inception Report, Sustainable Urban Transport in Davao City (ADB, Jan 2011)

2.190 **E-Jeepneys:** The introduction of the electric version of the ubiquitous jeepneys occurred almost simultaneously as those for e-Trikes, but on a more limited scope. The city of Makati was an early bird. In 2007, it leased a number of E-Jeepney units and deployed them in the Makati CBD. This was a pilot program funded directly by appropriation from the city treasury. Designated as the Green Route, it offered free rides. Among all LGUs in the country, Makati has consistently generated cash surplus and could easily afford subsidy to its public transport. Its proponents claim mileage of 120-km per overnight charge. The E-Jeepney was also introduced in a resort, as part of its marketing campaign on eco-tourism. The technology – based on heavy lead-acid batteries, is currently under evaluation by the University of the Philippines.

Figure 2.5.2 E-Jeepney Variants in the Philippines

Source: Inception Report, Sustainable Urban Transport in Davao City (ADB, Jan 2011)

2.191 **Electric Bus:** For larger vehicles, like 36-seater minibuses and 60-seater coach buses, there are as yet no units in the field. In 2011, a private company offered to introduce and operate a fleet of electric minibuses in Makati – using imported components from China. In March 2012, another company from Taiwan affiliated with a large provincial bus operator has brought in one electric bus to test-bed and market the technology. It is still unclear when these two new entrants would get to the stage of E-jeepneys and E-trikes amidst a skeptical market.

(3) Findings from EV Development Situation in Philippines

2.192 The introduction of EVs in Philippines started by private initiatives at the local level, so that many e-jeepney and e-trike were introduced quickly in many places of the country. The fast movement of the project is one of the advantages to be carried out by private sector. On the other hand, the government is not ready for introduce EVs in Philippines. The private sector faces on several legal obstacles concerning licensing or registration of EVs, as well as importation of components.

2.193 The economic benefit of e-trike is obvious. It increases the daily incomes of drivers by as much as 50%. The one reason why it can bring a big benefit is that e-trikes were produced locally with low cost.

5) Singapore

(1) National Policy

2.194 EV market can contribute to protect environment, so that the government plans to strengthen the cooperation with private enterprises to put EVs in practical use. Singapore aims to be a living laboratory to invite EV related industries. The Economic Development Board (EDB) will develop subsidy system and charging infrastructure in cooperation with Energy Market Authority (EMA) and Land Transport Authority (LTA).

2.195 Unlike the Philippines, the approach of Singapore is more top-down rather than bottom up. Also, it is focused on private, rather than public transport. The Singapore Government partnered with MITSUBISHI Motors of Japan in November 2010 to pilot EV in the city with seed money of SGD20 million (≈USD16 million). For a start, the test-bed has involved three outdoor and two indoor charging stations and has tested five MITSUBISHI i-MiEVs and four smart electric drive Daimler vehicles. The number of electric cars taking part in this test-bed is expected to grow to 95 EVs before the trial ends in 2013. By then, there will also be 63 charging stations.

2.196 Besides, the government launched EV demonstrations covered the whole country in June 2011. The participants include MITSUBISHI. The demonstrations have been conducted to develop charging infrastructures and examine the issues on subsidy to promote EVs. Although the demonstration on EVs in nationwide is rare case, but this would be possible due to small size of the country.

2.197 In addition, the Singapore Government has provided SGD16.1 billion (≈USD12.8 billion) towards research and development in EV for 2011–2015. Apparently, Infineon Technologies AG (from Germany) has decided to establish a research facility for power semi-conductor for EV.

Figure 2.5.3 i-MiEV Planned to Use in Singapore

Source: MITSUBISHI

(2) Related Actions

2.198 An inter-agency Electric Vehicle Taskforce was created to oversee the test-bed and announced the launch of the electric vehicle test-bed in June 2011. The taskforce is led by EMA and LTA. The National University of Singapore's Energy Studies Institute has been appointed to lead a Cost Benefit Analysis on the data.

2.199 The field demonstration test has looked at the vehicles operability and cost, suitability of the business model, driving experience and barriers to adoption, consumer's acceptance, level of penetration of electric vehicles at current and proposed level of incentives and the level of infrastructure development required to meet the expected demand from EVs in the coming years. Companies that want to participate in the test-bed can apply for the Enhanced Technology Innovation and Development Scheme (TIDES-PLUS) which waives all vehicle taxes such as Additional Registration Fees (ARF), Certificate of Entitlement (COE), road tax and excise duty for six years. The LTA said the current price of a MITSUBISHI i-MiEV is about SGD90,000 (≈USD71,300), after waiving vehicle taxes under the TIDES-PLUS scheme.

2.200 The German components maker Bosch Gmbh was chosen to set up the charging network. The initial stations will charge a vehicle fully within eight hours, to be followed by quick charging stations that give a full charge in 45 minutes. Singapore-based Green lots, an electric vehicle charging systems company, are supplying Bosch with the tamper- and

weather-proof chargers – which are made in Singapore. The chargers incorporate smart features, such as controlling power supply to prevent brown-outs in the building where the chargers are installed; and storing usage history. Each charger is reported to costs around USD 4,000 – 5,000. Besides the electric vehicle trial, several property developers – including Australia's Lend Lease and Singapore's CDL Group – are also in talks with Green lots to install about 100 chargers in 40 to 50 buildings in the city state.

(3) Findings from EV Development Situation in Singapore

2.201 In similar way to EV developed countries, Singapore also started from the field demonstration to promote EVs as well as EV infrastructure development. The field demonstration is good to identify the issues on EVs before going to full-fledged stage of promotion. In addition, tax reduction on EVs can encourage auto manufacturers to join the field demonstrations.

6) Thailand

(1) National Policy

2.202 Thailand is yet to pursue ZEV policy. Understandly so, because it has abundant natural gas. Converting existing cars to natural gas is therefore preferred as it leads to lower CO2 emission. The Ministry of Industry introduced tax incentives to encourage deployment of low-emission vehicles – but these are currently limited to reduced sales tax, reduced cooperation tax for vehicle manufacturers, and lower tariff for related machines and components. Completely-built EV is not yet covered.

2.203 As the current hub of car manufacturing in the ASEAN region, Thailand aims to become also as the center of production of EV for the South-east Asian market. Several companies have already rolled out three-wheel EV. Toyota Thailand has begun production of Camry-hybrids and as well as the Prius. Local demand is still inchoate due to the prohibitive price. An imported MITSUBISHI i-MiEV costs about THB2.8 million (≈ USD89,800) – with half of the price accounted for by taxes. Even the price of three-wheel EV produced in Thailand is double of engine one.

(2) Related Actions

2.204 **Metropolitan Electricity Authority (MEA):** In September 2011, MITSUBISHI Motors signed MOU with MEA. MITSUBISHI lent MEA 1 i-MiEV for feasibility study for nine months. This study is composed of study on battery technologies, electric vehicle technologies, EV infrastructure, government policies in other countries, and impacts to MEA. Since September 2011, the MEA cooperates with Chulalongkorn University to study more about charging system including standard of charger.

Figure 2.5.4 i-MiEV and Charging Stations at MEA

Source: MEA, Thailand

2.205 Besides MEA, in July 2011, MITSUBISHI Motors also agreed to conduct a field test operation in cooperation with PEA ENCOM. The objective is to determine the social acceptability of EV in Thailand. Furthermore, MITSUBISHI Motors partnered with Petroleum Authority of Thailand (PTT) on the development of rapid charging infrastructure.

2.206 **Latisha Enterprise Co., Ltd:** Latisha Enterprise has developed electric three-wheeler using lead-acid battery for the Thai market and as an alternative to the traditional Samlor. With a cruising range of50km per charge, and a maximum speed of50km/h, the e-Trike is being sold at THB200,000 (≈ USD6,400). The company has ambitions to export the e-Trike.

Figure 2.5.5 E-trike produce by Thailand

Source: TSP Tools company

(3) Production System

2.207 There are several EV production companies including Electric Vehicle (Thailand), Clean Fuel Engineering Enterprise, Latisha Enterprise Co., Ltd and TOYOTA TUSHO ELECTRONICS Co., Ltd. However, they produce only electric three-wheelers and electric golf cars. There is no company which produces electric passenger vehicles.

(4) Findings from EV Development Situation in Thailand

2.208 In the same as Indonesia, the local production of gas discouraged to promote EVs in Thailand. The government provides the tax an incentive for fuel-efficiency vehicles, but it is not covered EVs. Therefore, the price of EVs including three-wheeler is still expensive. On the other hand, MEA is looking for the new business opportunities related to EVs (use more electricity, providing IT service, etc.), so that they are conducing field survey and study on charging systems.

7) Vietnam

(1) National Policy

2.209 National policy of Vietnam states to develop HEV and low-emission transport. The government focuses on public transport system rather than private vehicles. For private vehicle, the government issues only technical barrier. Furthermore, bio-fuel is more focused than EVs. Use of bio-fuel will be compulsory for big city by 2015.

(2) Related Actions

2.210 Since June 2010, the tourist route in Hoan Kiem district operated by the Dong Xuan Joint Stock company has run two tour routes each day. One rolls through trade streets and Dong Xuan market and the latter takes visitors to streets famous for their food and traditional trade as well as the historical sites.

2.211 Another electric car service for tourism was started from September 2011. Some 20 e-buses take visitors for sightseeing around West Lake and other famous landscapes

Tay Ho Company (TLC) which is a state-owned company operates this project.

Figure 2.5.6 E-buses in Hanoi

in Hoan Kiem Area

in Tay Ho Area

Source: JICA Study Team

2.212 In 2011, a joint venture of Chinese and Vietnamese entities plans to manufacture small EV with capacity fo2 2-7 passengers. Dragon (China) and Bao Goc Trading Service Company (Vietnam) will set up their plant in the economic focal zone of Lan Song Province. Incentives such as reduction of tariff and deferment of income tax are likely to be provided to the venture. The target production is 6,000 passengers EV by 2013. The parts of EVs will be procured from China. The expected price of EV is about VND20 million utilizing cheap labor cost of Vietnam. Produced EVs will be supplied to China and three countries in Indochina.

2.213 Sensing the commercial opportunities, a number of Chinese and Japanese motorbike companies such as Terra Motors are looking at introducing E-bike in the huge Vietnamese market. With the right policies in place, adoption of electric motorbikes could see rapid growths.

(3) Findings from EV Development Situation in Vietnam

2.214 The government is interested in the EV development, and some projects were already started mainly for tourism purpose. However, the concern on EV development is impact on local industries. There are many vehicle related industries, so that it is expected that they will get negative impacts if the government promotes EVs. How to change the industrial structure will be one of the key for EV development in Vietnam.

2.6 Vehicles related Taxation System in Japan and ASEAN Countries

2.215 Taxes on transport vehicles and the fuel used are part of the menu of revenue generation system available to governments. Vehicle and fuel related taxation system and its allocation are as varied as there are countries. Some of the taxes collected are earmarked for transport specific fund such as road fund, traffic safety fund, etc., while in other countries the tax proceeds go into the general fund. The tax on fuel is deemed as the more equitable as it is based on usage.

1) Japanese Case

(1) Vehicle Related Tax

2.216 There are four main tax categories for vehicles in Japan, namely automobile acquisition tax, automobile tax, light vehicle tax and automobile weight tax. The automobile acquisition tax is imposed on a vehicle purchaser. The automobile tax and the light vehicle tax are imposed on the vehicle owner annually. The automobile weight tax is imposed on the vehicle owner when the vehicle has periodic vehicle inspection.

2.217 The automobile acquisition tax is imposed on all vehicles whose standard selling prices is more than JPY0.5 million (≈ USD6,700). The automobile acquisition tax is 3% for light vehicles and 5% for others. The standard selling price for brand-new vehicles is 90% of manufacturer's suggested retail price. The standard selling price for second-hand car is calculated by brand-new price multiplying by the rate of remaining value which is decided by Japanese Government. Heavy vehicle such as trucks, buses and others are also imposed the automobile acquisition tax at5% of standard selling prices (see Table 2.6.1 and Table 2.6.2). The automobile acquisition tax used to be one of special-purpose taxes. However, it was converted to general tax in 2009.

Table 2.6.1 Rate of Remaining Value for Private Vehicle

	Brand-new	1 year	1.5 year	2 year	2.5 year	3 year	3.5 year	4 year	4.5 year	5 year	5.5 year	6 year
Private Vehicle	1	0.681	0.561	0.464	0.382	0.316	0.261	0.215	0.177	0.146	0.121	0.1
Private Light Vehicle	1	0.562	0.422	0.316	0.237	0.177	0.133	0.1	-	-	-	-

Source: List of imposed standard price and tax for automobile acquisition tax

Table 2.6.2 Example of Automobile Acquisition Tax

	Automobile Acquisition Tax
Ex 1) Purchase of Brand New Sedan Manufacturer's suggested retail price: JPY2 million	Standard selling price:JPY2 million x 90% = JPY1.8 million Automobile Acquisition Tax: JPY1.8 million x 5% =JPY90,000
Ex 2) Purchase of Second-hand Car Manufacturer's suggested retail price for brand new: JPY2 million Vehicle age: 4 years vehicle	Standard selling price:JPY2 million x 0.215 = JPY430,000 Automobile Acquisition Tax: JPY430,000 x 5% = JPY21,500

Source: JICA Study Team

2.218 The automobile tax is imposed on all vehicles except light vehicles. The owner of vehicles has to pay to his residential prefecture. The tax rates are classified into four categories (passenger car, truck, bus and others). In each category, the tax rates are classified in detail based on the purpose of use (private, business, and special use), displacement, gross shipping weight and passenger capacity. In general, private vehicles are imposed higher automobile tax. For passenger car, higher displacement vehicles have higher tax rate. For truck, higher gross shipping weight vehicles have higher tax rate. For bus, higher passenger capacity buses have higher tax rate. The special purpose vehicles

have own tax rate (see Table 2.6.3 to Table 2.6.5).

Table 2.6.3 Automobile Tax of Passenger Car (JPY)

Displacement (litter)	<= 1.0	1.0 -1.5	1.5 - 2.0	2.0 - 2.5	2.5 - 3.0	3.0 - 3.5	3.5 - 4.0	4.0 - 4.5	4.5 - 6.0	6.0 <
Private Use	29,500	34,500	39,500	45,000	51,000	58,000	66,500	76,500	88,000	111,000
Business Use	7,500	8,500	9,500	13,800	15,700	17,900	20,500	23,600	27,200	40,700

Source: Local Tax Act

Table 2.6.4 Automobile Tax of Truck (JPY)

Gross Shipping Weight (t)	<=1	1 -2	2 -3	3 – 4	4 - 5	5 - 6	6 - 7	7 - 8	8 <
Private Use	8,000	11,500	16,000	20,500	25,500	30,000	35,000	40,500	JPY40,500 +6,300 JPY/t
Business Use	6,500	9,000	12,000	15,000	18,500	22,000	25,500	29,500	29,500+ 4,700 JPY/t

Source: Local Tax Act

Table 2.6.5 Automobile Tax of Bus (JPY)

Passenger Capacity (pax)	<= 30	30 - 40	40 – 50	50 - 60	60 - 70	70 - 80	80 <
Private	33,000	41,000	49,000	57,000	65,500	74,000	83,000
Business (share)	12,000	14,500	17,500	20,000	22,500	25,500	29,000
Business (others)	26,500	32,000	38,000	44,000	50,500	57,000	64,000

Source: Local Tax Act

2.219 The light vehicle tax is imposed on the light vehicles by municipalities. The tax price is fixed by the type of vehicles. There is no difference between the tax prices of two-wheeler and three-wheeler for business use and private use. (Table 2.6.6)

Table 2.6.6 Light Vehicle Tax (JPY)

Vehicle	Type		Business	Private
motorized bicycle	Displacement: <= 50cc		1,000	
	Two-wheel	Displacement:50cc-90cc	1,200	
		Displacement: 90cc <	1,600	
	More than three-wheel (Displacement: 20cc <=)		2,500	
Light Vehicle and small-sized special motor vehicle	Two-wheel (include with side-car)		2,400	
	Three-wheel (trike and three wheel vehicle)		3,100	
	More than four wheel	Passenger	5,500	7,200
		Freight	3,000	4,000
Motorcycle			4,000	

Source: Local Tax Act

2.220 The automobile weight tax is imposed on all vehicles, which is paid when the vehicle is newly registered and taken periodic inspection. Tax price is fixed by the types of vehicles and its weight. The automobile weight tax is one of the national taxes. One third of revenue from the automobile weight tax is used for road maintenance and construction, i.e. earmarked to specific purpose.

Table 2.6.7 Automobile Weight Tax

Vehicle Category				Tax Price
Passenger Vehicle			Private	5,000 JPY/year/0.5t of vehicle weight
			Business	2,700 JPY /year/0.5t of vehicle weight
Others	Truck		Private	Vehicle weight: <=1t: 3,800 JPY /year
				Vehicle weight: 1- 2t: 7600 JPY /year
				Vehicle weight: 2 - 2.5t: 11,400 JPY /year
				Vehicle weight: 2.5 - 3t: 15,000 JPY /year
				Vehicle weight: 3t <: 15,000 JPY /year+ 5,000 JPY /t/year
			Business	2,700 JPY /year/t of vehicle weight
	Bus and special use vehicle		Private	5,000 JPY /year/t of vehicle weight
			Business	2,700 JPY /year/t of vehicle weight
	Light Vehicle	Inspect Object	Private	3,800 JPY /year
			Business	2,700 JPY /year
		Not Inspect Object[1)]	Private	5,500 JPY
			Business	4,300 JPY
			Private	11,300 JPY
			Business	8,100 JPY
	Motorcycle		Private	2,200 JPY /year
			Business	1,600 JPY /year

Source: Automobile Weight Tax Act
1) need to pay only once at the registration

2.221 In addition to above taxation system, the Green Tax System was introduced in 2002 to promote the development and usage of environmentally-friendly vehicles. In relation to automobile tax, owners of vehicles that have low emissions and are fuel efficient shall pay less tax for a set period. On the other hand, owners of older and/or larger vehicles, which have a larger impact on the environment, shall be required to pay a higher tax. While the tax reduction for low emission and fuel efficient vehicle is only for one year, the heavy taxation for old and /or larger vehicle is continued even after one year. The tax reduction rate is about 50% and the heavy tax rate is about 10%. The vehicle criteria of the tax reduction and heavy tax are shown on Table 2.6.8 below.

Table 2.6.8 Vehicle Criteria for Tax Reduction and Heavy Tax

	Types of Vehicle	Criteria
Tax Reduction	Gasoline/diesel/LPG vehicle	achieve 70% of mission reduction at emission standard of 2005 improve 25% of fuel consumption standard
	Electric vehicle	No criteria
	CNG	Vehicle weight <=3.5: achieve 75% reduction of NOx at emission standard of 2005 Vehicle weight >3.5: achieve 10% reduction of NOx at emission standard of 2005
Heavy Tax	Diesel vehicle	More than 11 years since brand new vehicle registration
	Gasoline/LPG vehicle	More than 13 years since brand new vehicle registration

Source: MLIT

2.222 Environmentally Friendly Vehicle Spread & Promotion Tax System is another tax reduction system for low-emission vehicles. The automobile acquisition tax and the automobile weight tax shall be reduced if the vehicle is low emissions and high fuel efficient. The reduction rate depends on the types of vehicles – ranging from 50% to

100%. This system can be applied not only for brand-new vehicles, but also for second-hand vehicles that pass the specific criteria.

(2) Requirement for Vehicle Owners

2.223 The tax payment mentioned above is one of the liabilities for the vehicle owners. In addition to tax payment, acquisition of parking certificate, taking out mandatory vehicle liability insurance, purchasing the vehicle recycle ticket are required for vehicle owners.

2.224 The parking certificate system is implemented to make the vehicle owner secure parking space for his vehicle, instead of using public roads for parking. The enforcement of parking makes road use fairer, road traffic smoother, and so on. If people use road as their parking space or park long time, they are punished with less than JPY200,000 of penalty.

2.225 The recycle ticket system is implemented based on the Recycle Law to avoid the illegal disposal of scrapped vehicles. When vehicle is scrapped, 80% of total weight can be recycled and remaining 20% is brought to disposal site. However, the lack of capacity of final disposal site increases the disposal price. Furthermore, the special technique is required to disassemble some part of vehicle from the view point of environmental protection. The purpose of recycle ticket is to charge disposal cost to vehicle owners in advance. It is kind of polluter pay principle. The vehicle owners are the waste generator of vehicle, so that they have to burden the disposal cost. Recycle cost (= recycle ticket) depends on the auto manufacturer, size of vehicle, model of vehicle and so on.

Table 2.6.9 Recycle Cost of Vehicle

Type of Vehicle	Recycle Cost (JPY)
Light Vehicle	7,000 – 16,000
Passenger Vehicle	10,000 – 18,000
Medium and Heavy Truck	10,000 – 16,000
Large Bus	40,000 – 65,000

Source: http://yaro-racing.jp/column/recycling.html

(3) Fuel Related Tax

2.226 There are four main fuel taxes including gasoline tax, local road tax, diesel tax and liquefied petroleum gas tax. These taxes are already included into the fuel price at the fuel station. Therefore, vehicle users usually are not aware of these taxes. Gasoline tax and local road tax are imposed on the gasoline users, diesel tax is imposed on the diesel users, and fuel gas tax is imposed on LPG users. The tax for gasoline used to be one of special-purpose taxes, but was converted to general tax in 2009. Usage of gasoline tax revenue is still mainly for road maintenance and construction. The tax prices of each tax are 48.6 JPY/L for gasoline tax, 5.2 JPY/L for local road tax, 32.1 JPY/L for diesel tax and 17.5 JPY/kg for fuel gas tax. The low fuel gas tax encourages many taxis to shift to LPG.

2) Philippines Case

2.227 In Philippines, the tax incentives for LEVs are still under consideration. A Bill has been filed in Congress that seeks to provide tax incentives for the manufacture, assembly, conversion, and importation of electric, hybrid and other alternative-fuel vehicles. If enacted into Law, the number of hybrid vehicles is expected to grow as it will bring down the selling price of such vehicles. The reduction will come from the exemption from excise tax and value-added tax (VAT) for raw material, spare parts, components, capital equipment used in the manufacture or assembly of LEVs, and completely-built-units

(CBUs) of LEVs. Alternative fuel vehicles are composed of hybrid vehicles, electric vehicles, and other types (e.g., CNG, LPG, bio-fuels vehicles).

2.228 All motor vehicles in the country are required to renew their registration every year. At renewal time, they pay a schedule of fees that are ring-fenced into a motor vehicle user's charge (MVUC). The prevailing rates are shown in Table 2.6.10 below.

Table 2.6.10 Current Motor Vehicle User's Charge for Private Vehicles

Vehicle Type	GVW	Base Rate (PHP)
Passenger Cars	<= 1,600 kg	1,600
	1,600 - 2,300 kg	3,600
	> 2,300	8,000
Utility Vehicles	<= 2,700 kg	2,000
	2,700 - 4,500 kg	2,000PHP + 40PHP/100kg of GVW over 2,700kg
Motorcycle	without sidecar	240
	with sidecar	300
Buses	> 4,500	1,800PHP + 24PHP/100kg of GVW over 2,700kg
Trucks		
Trailers	> 4,500	24PHP/100kg of GVW

Source: REPUBLIC ACT NO. 8794AN ACT IMPOSING A MOTOR VEHICLE USER'S CHARGEON OWNERS OF ALL TYPES OF MOTOR VEHICLES ANDFOR OTHER PURPOSES

2.229 All monies collected are earmarked solely and used exclusively (1) for road maintenance and the improvement of road drainage, (2) for the installation of adequate and efficient traffic lights and road safety devices, and (3) for air pollution control. All such monies collected shall be deposited in four (4) special trust accounts in the National Treasury, namely: (1) Special Road Support Fund; (2) Special Local Road Fund; (3) Special Road Safety Fund; and (4) Special Vehicle Pollution Control Fund. The distribution of collections shall be 80% for Special Road Support Fund, 5% for Special Local Road Fund, 7.5% for Special Road Safety Fund, and another 7.5% for Special Vehicle Pollution Control Fund.

2.230 Another law required the blending of ethanol into gasoline, as part of the policy to reduce the volume of imported fuel as well as improve air quality. Initially, some types of gasoline were exempted. However, starting 6-February 2012, all gasoline grades are mixed with 10% ethanol. The Philippines is one of 52 countries in the world that mandate bio-fuels.

2.231 Also, at time of renewal of car registration, all vehicles are required to undergo vehicle emission test. Failure to meet standards can deny owners registration and subject them to penalties.

3) Singapore Case

(1) Vehicle Related Tax

2.232 In addition to import duties of 45% and registration fees of SGD1,000 (≈ USD710), the Government imposes an Additional Registration Fee (ARF) based on the market value of the vehicle. The ARF is 150% of market value of the vehicle. The annual road tax is based on the engine capacity of the vehicle. The ARF is reduced if an old vehicle is scrapped when a new one is purchased. The intention of this Preferential Additional Registration Fee (PARF) is to discourage ownership of older and high-emitting vehicles

and to limit the used car market.

2.233 In 1990, the Government implemented a quota scheme under which vehicle owners are required to have Certificates of Entitlement (COEs). COEs are valid for ten years and can be obtained in public auctions held monthly by the Registry of Vehicles. Owners of vehicles more than ten years old are required to pay the prevailing quota price. The COE requirement enables the government to determine the total number of vehicles in circulation based on the country's road capacity. This program could be considered a trading system, but it is also part of package of measures to limit congestion. COE prices have increased rapidly: For cars with a capacity over 2,000 cc, they have risen from SGD 528 (≈USD375) when they were introduced in 1990 to SGD17,600 (≈USD12,500) in 1992 to over SGD100,000 (≈USD70,000) in 1994.

2.234 An element of congestion pricing was built into the COE system in 1991 with the creation of the Weekend Car scheme under which a separate category of Weekend Car COEs was created. Buyers of Weekend COEs enjoyed tax rebates on the registration fee, import duty and COE premium, up to a maximum of SGD15,000 (≈ USD10,700). They were also entitled to 70% reductions in road tax. Weekend cars could be used only on Sundays and public holidays and during off-peak hours (between 7 pm and 7 am on weekdays and after 3 pm on Saturdays). Weekend vehicles were clearly marked by red number plates that had to be welded onto the vehicle and sealed by an authorized inspection center. To drive the vehicle outside the authorized times, a SGD20 (≈ USD14) day license had to be displayed on the windshield. Owners had the right to five free day licenses a year.

2.235 One problem with the Weekend Car scheme was that many owners of large vehicles found it cheaper to purchase Weekend COEs but use their vehicles during peak periods, paying the SGD20 (≈USD14) daily license. To stop this practice, the Weekend Car scheme was replaced by an Off-Peak Car Scheme on October 1, 1994. This scheme operates like the Weekend scheme except that there is no separate category of COEs, the tax rebates have been raised from SGD15,000 to SGD17,000 (≈ USD12,000), and the annual road tax reduction has been set at SGD800 (≈USD570).

2.236 Singapore's vehicle taxes have also raised significant revenues for the government. By 1992, they accounted for 23% of total government tax revenue.

(2) Fuel Related Tax

2.237 Like most other countries, Singapore taxes motor fuels. The unleaded gasoline tax is the highest of SGD0.6 (≈USD0.43) per liter or 50% of pump prices (including taxes). Leaded gasoline is taxed an additional SGD0.15 (≈ USD0.11) per liter. Diesel is taxed at SGD0.08 (≈USD0.06) per liter. One problem that arose as a result of these taxes was that motorists purchased fuel in neighboring Malaysia, where a liter of gasoline was about SGD0.5 (≈USD0.35) cheaper. Singapore countered this practice by requiring all vehicles leaving the country to have their gasoline tanks at least half full in 1989. In 1991, the tank requirement was raised to 3/4 full.

(3) Others

2.238 As the main operator of parking facilities, the government also imposes relatively high parking fees. Parking charges within the Central Business District (CBD) are SGD0.9 (≈ USD0.64) per half hour during office hours. Outside the CBD, charges are SGD0.45 (≈ USD0.32) per half hour.

2.239 The Area Licensing Scheme (ALS) was adopted in 1975 to reduce congestion in the CBD during peak morning hours (7:30-10:15). Cars entering the CBD with fewer than four persons were required to pay a fee that rose from SGD3 (≈USD2.1) in 1975 to SGD4 (≈USD2.8) in 1976 to SGD5 (≈USD3.6) in 1980. When the fee hours were extended to the evening peak period (4:30-6:30) in 1989, the fee was lowered to SGD3 (≈USD2.1). Company cars pay twice this rate. The exemption for cars with at least four persons was removed in 1989. Motorcycles pay SGD1 (≈USD0.7) per day.

2.240 Although officials found that the fees limited vehicle use during peak hours, traffic problems between peak periods increased. As a result, the ALS was significantly modified in 1994 to include two types of licenses: a part-day license at SGD2 (≈USD1.4) for entry into the CBD during off-peak hours (10:15 am-4:30 pm) and a whole-day license of SGD3 (≈ USD2.1) to be used between 7:15 am and 6:30 pm.

2.241 The ALS had a large impact on peak-hour traffic, resulting by the end of 1975 in a 71.1% decrease in the number of private vehicles entering the restricted zone between 7:30 and 10:15. Public transportation became preferred mode of transportation after the introduction of the ALS. The 1989 expansion of the system to evening peak hours resulted in further traffic decreases and increases in average speeds of 10.8% in morning peak hours and 30.4% during the evening peak period.

2.242 The COE and other measures are credited with significantly limiting the number of vehicles in Singapore. It has been estimated that without vehicle ownership and use disincentives, the number of vehicles in Singapore would have been 400,000 by 1992 instead of the actual number of 274,000. The U.S. Federal Highway Administration, which has gathered information on traffic management in Singapore and other countries, concluded in a recent article, "The road pricing program, combined with other charges on vehicles ownership, has dramatically reduced traffic and eliminated peak-period congestion in the downtown area. In addition, air pollution has been significantly reduced, and business activities and rents in the downtown area have not suffered." These achievements are in stark contrast to severe traffic problems in other Southeast Asian cities, such as Bangkok and Jakarta.

4) Thailand Case

2.243 Latest reports emanating from various sources, including Ministry of Finance, Ministry of Commerce and Ministry of Transport, the Thai Government is going to review the country's tax structure on vehicles, with a view toward encouraging sales and production of environmentally friendly models and promoting the adoption of more advanced environmental technologies. Under the country's current taxation structure, vehicles that offer different environmental and economic benefits are faced with a complex tax structure that makes competition uneven.

(1) Import Tax

2.244 Current excise taxes vary between 50% for top-end cars and 3% for 1-ton pickup trucks. A preferential tax rate of 17% is offered on cars that comply with the government's eco-car program guidelines, while hybrid-electric, pure electric and fuel-cell cars incur an excise tax rate of 10%. Additional tax incentives are offered on cars able to run on biofuels, including the E85 gasoline-ethanol mix.

2.245 The Government wants car manufacturers to make Thailand a global production base for small cars and pickup trucks. It is doing this through its "eco-car" program,

involving cars with a maximum consumption of 1L per 20 km (about 47 mpg) and which comply with Euro IV emissions standards.

(2) Vehicle registration

2.246 The new owner of a vehicle will be issued with proof of ownership documents in the form of a registration book called the Blue Book (or Lem Tabian in Thai) which includes the owner's name and address. All registration procedures and transfers of vehicle ownership are done at the Department of Land Transport (DLT) in any local district throughout country.

2.247 Note that the annual tax is included in the vehicle registration fee and a tax sticker (that indicates a number plate or a license plate with expired date of annual tax) will also be provided by the DLT which indicates that the annual tax has been paid.

2.248 The annual tax rates are calculated depending on type and age of car as well as the engine size. For vehicles up to five years old the price is fixed depending on the engine size and type of car. After five years the tax will reduce by 10% every year up to a maximum of 50%.

(3) Insurance

2.249 There is an insurance required by law with a set premium and cover rates so called “Compulsory Motor Insurance (CMI or Por Ror Bor)” which must be bought from the DLT, or the car dealership or an insurance company. This insurance basically covers only third parties and passengers. However, there is a choice of private insurance companies that offer additional coverage to the CMI. CMI must be renewed annually.

(4) Others

2.250 For possessing a motorcycle, there are costs for an annual tax which can be paid at local DLT office. DLT office will issue tax sticker once annual tax is paid. The annual tax is charged THB100 per motorcycle. And 3rd party insurance that is “Compulsory Motor Insurance (CMI or Por Ror Bor).”

2.251 For possessing a car or motorcycle over than seven years, there are costs for vehicle inspection or roadworthiness test (or TorRorOr certificate), renewal of registration or in other word renewal of number plate/license plate, compulsory Motor Insurance (CMI or Por Ror Bor). After having all above proceeded, an annual tax fee can be paid and issued.

2.252 All cars over seven years old and motorbikes over five years old must undergo regular inspection by official test centers. Cars older than seven years and motorbikes older than five years need to undergo a safety inspection every year and be issued with a document called a TorRorOr or vehicle inspection that certifies the vehicle is roadworthy. Without the TorRorOr it is not possible to get the annual tax sticker once the car is over seven years old.

5) Lao PDR Case

2.253 In Lao PDR, vehicle related taxes are composed of import tax, excise tax, VAT, and annual road tax on vehicles use as well as import tax and VAT on fuel and surcharge.

2.254 While import tax and excise tax on vehicle are varied by the types of vehicle and size of displacement, VAT is fixed at 10% for any vehicle. Excise tax on pick-up and van is

lower than that of car. This causes many people buy pick-up and van even people do not need large vehicle. Regarding the public transport vehicle, only buses have a preferential treatment on excise tax which is only 20% of import tax and 20-25% of excise tax.

2.255 For alternative energy vehicles, while electric motorcycle has a preferential tax treatment on its excise tax, there is no special tax rate on other vehicles. Excise tax on e-motorcycles is 20% lower than that of ICE motorcycles. This is because the government wants to encourage people to shift from ICE motorcycles to e-motorcycles due to environmental reason.

2.256 In December 2011, the MOF issues the amended Tax Law. In this Law the excise tax rate in Table 2.6.2 was revised. However, as of October 2012, the MOF is drafting to the presidential decree to set the detail tax rate on vehicles. According to MOF, the excise tax will be changed to the vehicle users' tax. For the first five year from vehicle purchase, the vehicle users have to pay the same amount of excise tax. This new system will make the import cost of vehicle cheaper than now.

Table 2.6.11 Tax Rate on Vehicles

Type		Import Tax (%)		Excise Tax (%)	VAT (%)
		MFN	CEPT		
1	Bicycle	10	1	0	10
2	Motorcycle 50cc	30	1	20	10
3	Motorcycle 50 - 250cc	40	2	20	10
4	Motorcycle 250cc	40	5	20	10
5	Three-wheeler	40	5	20	10
6	Car less than 1000cc	40	20	60	10
7	Car 1000 - 1500cc	40	20	65	10
8	Car 1501 - 3000cc	40	20	75	10
9	Car more than 3001cc	40	20	90	10
10	Pick up 2 doors	30	20	20	10
11	Pick up 4 doors	30	20	25	10
12	Truck less than 5 T	30	20	10	10
13	Truck less than 5 – 20T	30	0	10	10
14	Truck more than 20T	20	0	10	10
15	Trailer	10	0	10	10
16	Bus less than 15 seats	20	0	25	10
17	Bus more than 15 seats	20	0	20	10

Source: Tariff Nomenclature of Lao PDR Based on ASEAN Harmonized Tariff Nomenclature, Decree of the President of the Lao PDR on the promulgation of the Tax Law

2.257 Besides, in August 2012, two private companies got a preferential treatment on 1% of import tax for importing electric vehicles as business purpose. This special tax rate is not under control of MOF. This is a presidential special treatment based on Investment Law. When the investor starts new business for Lao PDR and if the president considers the national benefit from that business, the investors can have this kind of special tax rate on their business.

2.258 The annual road tax is charged in the vehicle owners including motorcycle owners. This tax ranges from 5,000 LAK/year to 90,000 LAK/year according to the size of displacement for motorcycles and cars, the weight for trucks, and the number of seats for buses. The vehicles of government, diplomat, international organizations and foreign experts are exempted from this road tax.

2.259 Taxes imposed on fuel are also the same as that of vehicles (see Table 2.6.3). While the excise tax on gasoline decreased in 2011, that of diesel remained fixed. Besides those taxes, the government also imposes a surcharge, which is included in retail prices, 300 LAK/liter, to earmark for a road fund. The road fund is used to finance nationwide road maintenance.

Table 2.6.12 Fuel Taxes

Type		Import Tariff (%)		Excise Tax (%)	VAT (%)
		MFN	CEPT		
1	Super gasoline	20	5	23	5
2	Regular gasoline	15	5	22	5
3	Diesel	5	5	10	5
4	Battery	5-10	0	0	5

Source: Tariff Nomenclature of Lao PDR Based on ASEAN Harmonized Tariff Nomenclature, Decree of the President of the Lao PDR on the promulgation of the Tax Law

2.7 Summary of Cross-cutting Issues

(1) Condition of Local Energy Resource and Industries

2.260 The priority level of EV development in the country is varied by the condition of the local energy resource and local vehicle related industries as well as environmental conditions. In case of the country which is an oil-producing country or a gas-producing country, the incentive to shift to EVs is very low. On the other hand, in the case of that the country depends on the oil-producing country highly, it is good to shift to EVs in terms of energy security reason, and so on. Furthermore, the source of electricity is also important. While the electricity generated from the thermal power plant cannot maximize the benefit of the EVs, the electricity from the renewable energy can realize the clean EV use.

2.261 In the case of having local vehicle related industries, EV development will influence on the industry structures positively and may negatively. So, it is important to consider the impact on the local industry.

(2) Commitment of the Government

2.262 There is no success case which tried to propagate EVs only depending on the market mechanism. It is necessary for the government to commit the EV project and establish clear development target and strategies.

(3) Clear Role-sharing among the Stakeholders

2.263 Only the commitment of the government cannot introduce and promote EVs. It is indispensable to involve private sector. Private sector is composed of auto manufacturers, battery manufacturers, public transport providers, charging infrastructure providers, EV maintenance services, and so on. Many participants may make the role of each unclear, it will be waste of resources. So it is necessary to clarify the role-sharing between public and private sector as well as among each sector.

(4) International Support and Regional Cooperation

2.264 EV development needs many resources including financial, human, and technologies. Therefore, in general, developing countries have support from international organizations and auto manufacturers in developed countries. At the same time, it is also important to cooperate among the region, because the EV market in developing countries is still very small. Promoting EVs in the region can extend its market and attract auto manufacturers.

(5) Consideration on Local Characteristics

2.265 Local characteristics are varied by the country, region and city. In order to utilize the strengths and overcome the weakness of the place where EVs are introduced, the EV development strategies should be formulated considering the local characteristics. The experiences in other countries are useful to reflect to the own development strategies, but it is important to modify those cases for their own style. Then, the EV development strategies can match with local conditions, as well as people accept to introduce EVs in their society.

(6) EV Infrastructure Development

2.266 EV has a disadvantage on its cruising range comparing to ICE vehicles, HEVs or even PHEVs. However, it has enough range for urban use and also for fixed route transport. Considering the characteristics of EVs, actually, there are many possibilities to

use EVs both for private and public uses, especially in coordination with EV infrastructure development. One of the key factors to promote EVs is introducing EVs and installing charging stations in certain area. Enough charging stations can ease EV users' worry about the cruising range.

(7) Creation of Initial Demand

2.267 How to create initial demand is the first step of EV development. Even in developed countries, not so many people understand the EVs properly. In general, test driving is more effective than exhibition to make people understand EVs. After people understand EVs, people usually have better impression on EVs. EV promotion campaign, financial incentives (e.g. tax reduction), and introducing EVs for official use are common ways to create initial demand.

(8) Establishment of Maintenance System

2.268 It is said that the maintenance of EVs is easier than that of ICE vehicles due the less number of parts of vehicles. However, the life of EV will be shortened without appropriate maintenance. Especially hot weather also influences on the quality of EV batteries. People have to know how to maintain EVs and how to charge EVs.

2.269 Moreover, the spare parts should be easily procured. In particular, developing countries usually import EVs from other countries. In this case, how to get and where to get spare parts should be considered, otherwise the EV users need to wait for some months until they can get spare parts.

(9) Implementation of Pilot Project

2.270 The most of the countries which take action on EVs development conduct pilot project to create initial demand, verify the performance of EVs, promote the recognition of people on EVs, study on provision of incentives, and so on. Many cities conducting pilot projects have relatively higher propagation rate of EVs compared to other cities. Therefore, the implementation of pilot projects must be useful at the initial stage of EV development.

2.8 Lessons for Lao PDR Relevant to EV Development Strategy in Lao PDR

2.271 There is widespread expectation that EVs will become the next-generation vehicles. Developed countries have taken various steps to address technical and operational issues in using EVs. Meanwhile, Southeast Asian countries have also started considering them, although only to the extent of implementing field demonstrations of the progress achieved by developed countries.

2.272 While lower battery prices and improved battery capacities may further boost EV promotion, at the moment EV development really lies in the hands of big automobile manufacturers. There also remains the need to provide battery recharging infrastructure and government subsidies. Based on the experiences of other countries, Lao PDR can learn important lessons that will serve as guideposts in its pursuit of environment-friendly cities through EV use. These include the following:

(i) **Promote EVs suitable to the country's conditions:** Actions related to EVs vary by country. For Lao PDR, it does not need to get involved in technology development and EV production. It can choose the appropriate technologies and EV models which have appeared in the global market to establish the system the country needs to provide transportation services.

(ii) **Provide government commitment to promote EVs:** In order to introduce and promote EVs, the government has to support the technology development being initiated by the private sector, as well as provide a strong commitment to develop EV infrastructures and address user concerns such as pricing and cruising ranges. In many countries, governments provide subsidies for EV purchase, development of EV charging infrastructure, and conduct of model projects to promote EVs.

(iii) **Define the role of EVs:** In every country, EVs are not only involved in the transportation sector but also in the environmental and energy fields. Furthermore, because EVs are considered as multifunctional technology systems which support new urban development and new lifestyles, new services and business opportunities are being sought. Lao PDR needs to know how to use EVs to maximize the benefits from them.

(iv) **Formulate regulations:** EV technology is different from that of conventional vehicles. Therefore, many countries develop EV regulations together with EV promotion. For Lao PDR, it is necessary to formulate new regulations on EV importation, registration, as well as operation and management, which should differ from current regulations for gasoline-fed vehicles.

(v) **Involve the private sector:** In most countries, governments have led EV development. At the same time, the private sector has also been actively involved in the process. It is thus important for Lao PDR to establish a system that will encourage various stakeholders, including the government, the private sector, and research institutes/universities, to participate in EV development.

2.273 EV development and/or introduction in many countries are expected to advance further, and the situation is expected to change as technological innovations are achieved. Therefore, Lao PDR needs to monitor the situation of EV business in pioneering countries, update necessary information, as well as formulate and implement EV policies.

3. REVEIEW OF CURRENT POLICY AND PLANS RELATED TO LOW-EMISSION TRANSPROT IN LAO PDR

3.1 Overview

1) Background and Current Initiatives

3.1 The 7th 5-year National Socio-economic Development Plan (NSEDP) focuses on the environmental management as one of the important sectors. For this, it is raised that the legal and regulatory system concerning the environment should be improved, i.e. greenhouse gases and environmental-friendly technologies. Low-emission transport is a part of environmental-friendly technologies, so that the legal and regulatory system for EVs also should be improved. At the same time, introducing new and high technology vehicles, i.e. next generation vehicles such as EV, into the transport system is required for tourism development. These strategies can accelerate to realize the development vision of green, clean and beautiful Laos. Besides the NSEDP, there are several low-emission transport related policies and plans such as the Environmental Sustainable Transport Strategy, Climate Change Strategies, Renewable Energy Strategies, new tax system, environmental related standards, and others.

3.2 The Laos government considers using clean energy from hydropower generation for transport sector. For example, promoting EVs for urban transport system by public and private partnership. It is possible for Lao PDR to be a show room of EVs introducing new technologies from abroad. Development of EVs also contributes to industrial development and job creation. Furthermore, EVs can promote the image of Lao PDR as clean energy country.

3.3 The country plans to maximize the use of its hydropower capacity. Accordingly, the MPWT plans to utilize more this renewable and abundant energy source on transport. Two other ministries (MONRE and Tourism) have also expressed interest in introducing EV across Lao PDR. However, the action plan is yet to be concretized.

3.4 In August 2012, the special tax treatment was applied for an electric vehicle dealer to import EVs from China to Lao PDR. In general, the vehicle is imposed high import tax (10 – 40% of CIF price), but it was reduced to only 1%. For e-motorcycle, new excise tax rate will be applied from October 2012. In this case, the excise tax for e-motorcycle is 20% lower than that of conventional motorcycles.

3.2 MPWT: Environmental Sustainable Transport (EST)

1) Organization

3.5 In 2008, the Division of Transport Techniques and Environment (DTE) was establishes as one of the divisions of Department of Transport in MPWT to be in charge of training, environmental issues, information sharing and others. The DTE is also assigned for formulating Environmental Transport Strategies, ASEAN-Japan Transport. Information Platform Project, and so on.

2) Formulating Environmental Sustainable Transport Strategies

3.6 There is no national transport development master plan yet in Lao PDR. However, the Laos government was working on the preparation of the National Strategy and Action Plan on Environment Sustainable Transport of Lao PDR (EST strategies) since 2004 supported by the United Nations Centre for Regional Development (UNCRD). EST is a new policy vision that was proposed by the Organization for Economic Co-operation and Development (OECD) and its commitment is to plan and implement policy on transport and environment based on a long-term perspective. By presenting the specific vision for future transportation, it is expected to increase awareness for and choose transport activities and lifestyles with reduced environmental loads. The EST project is not only adopted by Lao PDR but also ASEAN as a regional action, which was initiated in 2003 by the Nagoya Conference. The conference recommended the establishment of clear environmental goals and action plans that suit local conditions and the identification of ways to achieve the goals while ensuring social and economic development.

3.7 According to the EST strategies, the main transport problems of Lao PDR are traffic pollution and traffic accidents. Traffic pollution include vehicle emissions, dust, noise, inadequate parking services, poor transport environment for non-motorized transport (NMT), and lack of people's awareness of transport problems. The lack of a national transport plan and national standards for environmental quality, as well as the weak implementation of vehicle inspection, causes these problems. The EST strategies are expected to function as tools to manage, monitor, and evaluate land transport in the country, as well as guidelines for planning and investing in the transport sector, and identifying and prioritizing the activities of the National Action Plan for the sector. There are 10 strategies to solve the above problems, as follows:

(i) To manage urban air quality to meet international standards in order to create a sustainable environment and to eradicate diseases due to transport problems. To minimize the number of road accidents, injuries, and fatalities;
(ii) To support a technical study to find out the best alternative for the transport sector such as public transport system, fuel substitution, replacement of vehicle materials to reduce noise, use of environment- and people-friendly vehicles;
(iii) To support the development of transport facilities for vulnerable road users such as women, children, and the physically challenged;
(iv) To improve legislation to support the implementation of a national EST strategy and action plan;
(v) To create and strengthen the institutional setup for EST by developing and improving the capacity to formulate, monitor, and manage standards;
(vi) To strictly enforce regulations and laws on monitoring and management under fair practices for all;

(vii) To encourage everyone to participate in planning to protect and improve the environmental impact of transport;
(viii) To continuously promote awareness on EST;
(ix) To create a financial mechanism on environmental-friendly transport and to encourage government organizations and the private sector to participate in ET fund in order to protect and improve environmental quality; and,
(x) To strengthen international cooperation in finance and human resource development relevant to EST.

3.8 Since March 2012, the MPWT has been modifying the EST strategies into land transport strategies due to outdated information and to get an approval from the Prime Minister funded by UNCRD. As of September 2012, the MPWT plans to include 5 thematic areas for new strategies as follows;

(i) Road safety;

(ii) Logistics;

(iii) Passenger transport;

(iv) Environmental sustainable transport (EST); and,

(v) Human resource development for EST.

3.9 Several topics such as road safety and transport logistics have references from the previous projects by international organization. Public transport planning and low emission transport system are waiting for the output from the JICA on-going projects. MPWT plans to finalize this strategy within 2012. .

3) Related Projects with EST

3.10 In order to realize the EST in Lao PDR, several related projects are on-going and committed as follows;

(i) **Implementing Urban Transport Master Plan:** Based on the Vientiane Urban Transport Master Plan by JICA, JICA continues to support in procurement of 42 buses with 45 seats and to provide technical assistance for Vientiane Capital State Bus Enterprises (VCSBE). The main purpose of the project is to improve urban public bus service of VCSBE and to expand its service coverage.

(ii) **Feasibility Study for Transport NAMA in Vientiane:** The project objective is to analyze the GHG reduction by implementing the transport master plan in Vientiane, to evaluate the feasibility of MRV, and to study on the feasibility of implementing transport master in Vientiane as the component of NAMA.

(iii) **CO2 Reduction in Freight Transport:** This is just three months project to install Digital Tachograph to trucks. Project is composed of one month testing, one month warning and one month training.

(iv) **Vientiane Sustainable Transport Project:** The Asian City Transport project, financed under the Climate Change Fund (CCF) was approved by the ADB in 2009. This project aims to promote urban economic development and to reduce pollution and greenhouse gas emission by developing sustainable urban transport. Pre-Feasibility Study (Pre-F/S) on this project was conducted in 2010 – 2011. As a result, four components are expected to conduct as Technical Assistance from 2012, including (i) institutional and capacity development; (ii) pilot public transport service and facilities;

(iii) parking structure and facilities; and (iv) a demonstration traffic management scheme.

(v) **ASEAN Vehicle Type Approval:** There is no own auto industry in Lao PDR now, so that Lao PDR also did not set the technical standards for vehicles. Lao PDR is also not a member of UNECE Convention, but Lao PDR regularly participates in JASIC Asia Government/Industry Meeting. This meeting is supported by Japan Automobile Standards Internationalization Center (JASIC) to aim the countries/economies in Asia to participate in the activities of World Forum for Harmonization of Vehicle Regulations (WP 29), to accede to the 1958 Agreement, and to adopt the ECE Regulations under the 1958 Agreement.

(vi) **Master Plan on Traffic Safety Park and Vehicle Inspection Centers:** In order to establish traffic safety park and vehicle inspection centers, MOU was signed between DOT and KOLAO Company in December 2011.

3.3 MONRE: Climate Change Strategies

1) Organization

3.11 The climate change policies in Lao PDR are undertaken by Department of Natural Disaster Management and Climate Change, Ministry of Natural Resource and Environment (MONRE). Main roles of the department are formulations and implementations of policies, strategies, visions and measures on natural disaster management and climate change in line with the Social-Economic Development Plan of Lao PDR. Coordination with related organizations including international organizations is also the important role.

3.12 There are seven divisions under the department including Division of Administration and Planning, Division of Information and Public Announcement, Division of Coordination and Management. There are two divisions in charge of climate change matters, Division of Climate Change Adaptations and Division of Climate Change Mitigations.

3.13 The high-level inter-agency National Steering Committee on Climate Change (NSCCC), chaired by a Deputy Prime Minister and Chairman of the National Environment Committee has been providing insight and guidance for climate change policies and programs; and Eight Technical Working Groups were also established in 2008 to assess the impacts and outline priority actions for adaptation and mitigation.

2) Major Activities

3.14 Laos government ratified the United Nations Framework Convention on Climate Change (UNFCC) in April 1995 and the Kyoto Protocol in February 2003. Department of Natural Disaster Management and Climate Change of MONRE is the Designated National Authority (DNA) of Lao PDR.

3.15 In regard to the greenhouse gas (GHG) emission inventory, the first inventory, targeted on 1990, was submitted to UNFCCC in 2000 as part of the Initial National Communication (INC). The second inventory, targeted on 2000, is now under preparation, and is planned to be submitted to UNFCCC by the end of 2012.

3.16 The first inventory covered 4 out of 6 areas identified in the IPCC Greenhouse Gas Inventory Guideline namely agriculture, energy, land use change and forestry (LUCF) and waste. The first inventory did not cover activities of the industrial sector, because the sector was assessed as having made only negligible contribution to the emissions in the base year.

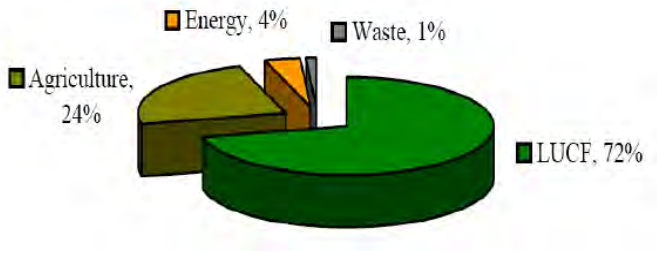
3.17 The 1990 level inventory concluded that Lao PDR was a net sink of carbon dioxide (CO_2) with the net CO_2 annual removal of 121,641 Gg (121.6 million tons) compared to 24.18 million tons of CO_2 equivalent (tCO_2e) emitted in all over the country. The land use change and forestry (LUCF) was the largest emitter of CO_2 contributing some 17 million tCO_2e (72%) mainly from the onsite burning of forests for slash and burn cultivation.

Table 3.3.1 1990 National Greenhouse Gas Inventory

	CO_2	CH_4	N_2O	CO_2-eq
Energy	414.9	22.7	0.1	928.8
Agriculture	0	271.3	0	5,696.7
LULUCF	16,628.7	29.5	0.2	17,310.2
Waste	0	11.4	0	240.0
Total	17,043.6	334.9	0.3	24,175.7

Source: Strategy on Climate Change of the Lao PDR
Unit =1,000 tons

Figure 3.3.1 1990 National Greenhouse Gas Inventory



Source: Strategy on Climate Change of the Lao PDR

3.18 Referring to the draft of second inventory, the total emission was 54,903 Gg (54.9 million tons) of CO2 equivalent (tCO2e), while the removal was only 2,047 GgCO2 (2.0 million tons), meaning that the net emission is 52,857 Gg of CO2e (52.9 million tons). Land use change and forestry sector is the key source of emission contributing 83.2% mostly from forest conversion and degradation; followed by the agricultural sector with 14.5%; the energy sector 2.0%. The emissions from energy sector especially fuel combustion was 1,042 Gg of CO2 (1.0 million tons). The total GHG emission from transport sector is 587 Gg of CO2e (0.59 million tons), and CO2 accounted for 582 Gg of CO2e (0.58 million tons). The share of transport sector was 51% of the total of energy sector.

3.19 Compared to 1990 level, the total emission increased 2.3 times from 24.2 to 54.9 million tCO2e.

3.20 In regard to the strategy on climate change adaptations and mitigations, the government formulated “Strategy on Climate Change of the Lao PDR” in March 2010. Seven sectors are identified as priority fields, and climate change adaptations and mitigations options are provided with.

3.21 In relation to adaptations, the National Adaptation Plan of Action (NAPA) was released in May 2009 and contains 45 priority projects totaling US$ 85 million within four identified sectors of priority for climate change adaptation, namely agriculture, forestry, water and water resources and health.

3) Strategies

3.22 The summary of the Strategy on Climate Change of the Lao PDR is show in the table below. The mitigation strategy of transport sector is stated as: “Low-carbon transport: by promoting the use of alternate energy operated motor vehicles, including cars and motorcycles and pursuing environmental sustainable transport strategy”. Introduction of EV/PHEV is in line with the strategy.

3.23 The strategy shows the frameworks and principles of climate change policies in

Lao PDR. Based on the strategy, Department of Natural Disaster Management and Climate Change are planning to formulate the action plans of adaptations and mitigations for each seven (7) sectors. In regard to the transport sector, Department of Transport will collaborate with Department of Natural Disaster Management and Climate Change to formulate the action plan based on the "Road Transport Development Strategy in Lao PDR (former name was The National Strategy and Action Plan on Environment Sustainable Transport, Lao PDR)".

Table 3.3.2 Summary of Strategy on Climate Change of the Lao PDR

Vision
To secure a future where the Lao PDR is capable of mitigating and adapting to changing climatic conditions in a way that promotes sustainable economic development, reduces poverty, protects public health and safety, enhances the quality of Lao PDR's natural environment, and advances the quality of life for all Lao people.
Goals
(i) Reinforce Sustainable Development Goals of the Lao PDR, including measures to achieve low-carbon economic growth; (ii) Increase resilience of key sectors of the national economy and natural resources to climate change and its impacts; (iii) Enhance cooperation, strong alliances and partnerships with national stakeholders and international partners to implement the national development goals; and, (iv) Improve public awareness and understanding of various stakeholders about climate change, vulnerabilities and impacts, GHG emission sources and their relative contributions, and of how climate change will impact the country's economy, in order to increase stakeholder willingness to take actions.
Guiding principles
(i) Climate change mainstreaming as core element: Ensure that climate change adaptation and mitigation are incorporated as a priority into the next social economic development plan, strategies, programs and projects at all levels of government, institutions, businesses and local communities, within the framework of sustainable development; with social and economic development and poverty eradication as overriding priorities; (ii) International partnerships: Work with and seek support from international partners for capacity building, development and transfer of technology to support the implementation, adaptation and mitigation strategies and actions for low carbon growth; (iii) Capacity building as a pressing priority: Build national capacities in government agencies, technical institutions, private sector and local communities in developing and implementing climate change adaptation and mitigation for policies and actions; (iv) Integrated solutions and co-benefits: Develop and implement integrated adaptation and mitigation solutions that are low-cost, improve energy efficiency, promote cleaner production, build adaptation/mitigation synergy and generate economic, environmental and socioeconomic benefits; (v) Innovative financial instruments: Elaborate appropriate financial packages to ensure optimal implementation of adaptation and mitigation action plans; (vi) Awareness, Education and Community Participation Leading the Way: Increase public awareness and understanding of climate change impacts and the need for mindset transformation towards adaptation and mitigation to mobilize communities to implement climate change adaptation and mitigation actions.
Key Strategic Priorities – Adaptation and Mitigation Options
Agriculture & Food Security, Forestry and Land Use Change, Water Resources, Energy and Transport, Industry, Urban Development, Public Health
Energy and Transport
Adaptation Options ・ Incorporating a range of possible climate change effects into the transportation investment decisions and management strategies; ・ Developing long-range transportation plans and investment strategies that are sufficiently robust to accommodate unanticipated future events; ・ Identification of the at-risk critical infrastructure, monitoring of conditions (both climate and infrastructure), changes in operation and maintenance practices, changes in infrastructure design and redesign and relocation of vulnerable infrastructure. Mitigation Options ・ Low-carbon transport: by promoting the use of alternate energy operated motor vehicles, including cars and motorcycles and pursuing environmental sustainable transport strategy; ・ Improving the public awareness on energy saving through implementing initiatives such as car free day, Earth Day and World Environment Day; and

- Seeking the opportunities under the CDM or other flexible, pragmatic financing mechanisms to undertake the development of climate-friendly renewable resources, including hydropower (including mini-hydro), biogas, solar, coal-bed and coal-mine methane, non-emission transport, and energy-efficient lighting and buildings.

Source: Strategy on Climate Change of the Lao PDR

4) CDM/BOCM

3.24 The Department of Natural Disaster Management and Climate Change of MONRE is the Designated National Authority (DNA) of Lao PDR. The project proponent who wishes to realize a project as a CDM project should submit the Project design document (PDD), an executive summary and the completed Sustainable Development Checklist Form (as shown below. +,0,- assessment) in both English and Lao language, to the DNA. The DNA Secretariat will then assess proposed CDM project activities using the PDD and the sustainable development criteria, and the documents will be assessed by a technical working group and the DNA Board. If all the information is correct, an approval letter will be issued by the DNA Board Chairperson. To date, two (2) CDM projects in Lao PDR are registered to UNFCCC. There is no transport CDM project submitted to the DNA.

3.25 In regard to other market mechanisms on climate change mitigations, one feasibility study, "New Mechanism Feasibility Study for Urban Transport Management in Vientiane, Lao PDR", was completed in transport sector in March 2012 funded by Ministry of Environment Japan. The study examined the feasibility of urban transport management based on "The Master Plan on Comprehensive Urban Transport in Vientiane Capital in Lao PDR" as the Bilateral Offset Credit Mechanism (BOCM) which Japanese government has proposed and has been working for the establishment. BOCM aims to complement current mechanism, such as the CDM.

Table 3.3.3 Sustainable Development Checklist

No.	Criteria	Assessment
1	Environment	
1.1	Contribution to mitigation of global climate change	+ Reduction or avoidance in GHG emissions 0 No significant change in GHG emissions - Increase in GHG emissions
1.2	Reduction in air pollution (emissions other than GHG) compared with the baseline scenario identified in the PDD (e.g. PM10, NO_x, SO_2)	+ Reduction in air pollutant levels compared with the baseline scenario identified in the PDD 0 No significant change in air pollutant levels compared with the baseline scenario identified in the PDD - Increase in air pollutant levels compared with the baseline scenario identified in the PDD
1.3	Reduction in water pollution compared with the baseline scenario identified in the PDD	+ Reduction in water pollutant levels compared with the baseline scenario identified in the PDD 0 No significant change in water pollutant levels compared with the baseline scenario identified in the PDD - Increase in water pollutant levels compared with the baseline scenario identified in the PDD
1.4	Reduction in soil pollution compared with the baseline scenario identified in the PDD	+ Reduction in soil pollutant levels compared with the baseline scenario identified in the PDD 0 No significant change in soil pollutant levels compared with the baseline scenario identified in the PDD - Increase in soil pollutant levels compared with the baseline scenario identified in the PDD
1.5	Sustainable use of land resources	+ Improvement of land resources 0 No significant impact on land resources - Unsustainable land use or degradation of land
1.6	Biodiversity conservation and protection of endangered species	+ Increase in indigenous biodiversity resources at the ecosystem, species and/or genetic levels, for example; extension of habitat for endangered species, multiple indigenous species activities

No.	Criteria	Assessment
		0 No significant impact on indigenous biodiversity resources at the ecosystem, species and/or genetic levels, for example; single species activities adequately addressed with corridors and buffer zones; management/implementation plan in place to protect species and their habitats; - Reduction in indigenous biodiversity resources at the ecosystem, species and/or genetic levels, for example: clearing or flooding of ecological habitats; removal and/or impact on endangered species and/or their habitat; removal of existing diverse species cover and replacement with single or dual species
1.7	Rational use of mineral resources	0 Rational use of mineral resources - Inefficient use of mineral resources
1.8	Sustainable use of forest resources	+ Improvement of forest resources 0 No significant impact on forest resources, management/implementation plan in place to mitigate the impacts - Unsustainable use or depletion of forest resources
1.9	Sustainable use of water resources	+ Improvement of water resources 0 No significant impact on water resources, management/implementation plan in place to mitigate impacts - Unsustainable use or depletion of water resources
1.10	Protection of archaeological, cultural, historical and spiritual heritage and sites	+ Enhancement of the preservation of archaeological, cultural, historical or spiritual sites 0 No significant impact on archaeological, cultural, historical or spiritual sites - Adverse impact on archaeological, cultural, historical or spiritual sites, adverse impact on people's access to archaeological, cultural, historical or spiritual sites
2	Social	
2.1	Concrete contribution to poverty alleviation (in the region the project is executed)	+ Increase of income generation opportunities for local people, improvement of livelihood of local people, in particular the poor and the disadvantaged groups 0 No significant impact on livelihoods of local people - Removal of ability of local people to access resources for income generation, displacement of people without provision of alternatives for income generation
2.2	Contribution to gender equality and social inclusion	+ Promotion of gender equity, women empowerment and social inclusion 0 No significant change in gender equity, women empowerment and social inclusion - Reduction in gender equity, discrimination against women and reduction in social inclusion
2.3	Stakeholder consultation (people directly affected by proposed project)	+ Stakeholder consultation from the beginning of the project, project designed in collaboration with stakeholders, local stakeholders support the project, participation of stakeholders in the decision making process 0 Stakeholders were consulted and minimal impact identified - No consultation of stakeholders, disregard of stakeholders' comments, consultation of stakeholders only at the end of the project design with no opportunity to modify the project, local stakeholders do not support the project or are opposed to it
2.4	All groups, both men and women, have equal access to and control over the target community benefits of the project	+ Support the most disadvantaged groups of the target communities to access to the community benefits of the project 0 Equitable access for the target communities to the community benefits of the project - Inequitable access for the target communities to the community benefits of the project
2.5	Creation of employment in the country (short term and long term) (how is dealt with a decrease in employment – job losses should be adequately compensated or provision of equivalent employment and/or income opportunities)	+ Increase in number of jobs at national/regional or local levels 0 No significant change in employment compared to the baseline; no jobs are created or lost - All jobs identified in the baseline are eliminated, job losses
2.6	Improvement of community infrastructures & services	+ Provision of community infrastructures (wells, roads, schools, public health etc.) 0 No significant impact on community infrastructures

No.	Criteria	Assessment
	(e.g. energy, drinking water, public health)	- Degradation of community infrastructures (wells, roads, schools, public health etc.)
2.7	Nuisance and risks for the people in the vicinity the project area (e.g. major accident risks, noise, dust)	+ Reduction in the risks and nuisance for people in the vicinity of the project area compared with the baseline scenario identified in the PDD 0 No significant change in the levels of nuisance and risks for the people in the vicinity of the project area compared with the baseline scenario identified in the PDD - Increase in nuisance and risks levels for the people in the vicinity of the project area compared with the baseline scenario identified in the PDD
3	Economic	
3.1	Share of project budget spent in-country	+ Significant proportion of total budget spent in country on Lao economy 0 Reasonable proportion of total budget spent in country on Lao economy - Minimal total budget spent in country on Lao economy
3.2	Reduced dependence on (imported) fossil fuels (energy projects only)	+ Reduction of dependence on fossil fuels, increased use of renewable and/or clean energy resources 0 No significant impact on dependence on fossil fuels - Increased dependence on fossil fuels
3.3	Reduced dependence on (imported) energy (energy projects only)	+ Reduction of dependence on imported energy 0 No significant impact on dependence on imported energy - Increased dependence on imported energy
4	Transfer of Technology and knowledge	
4.1	Transfer of appropriate and best available technology (BAT)	+ Best available technology in advanced industrial economies, best available technology and technology well proven, best available technology and technology can easily be maintained locally, best available technology and technology appropriate for local economic and social conditions 0 Standard technology used - Inappropriate technology, not adapted to local needs and capacity, equipment and skills for maintenance not available in Lao PDR, technology not proven, using Lao PDR as a testing ground, technology would not be allowed in investors' countries
4.2	Capacity building of local stakeholders and industries/businesses (training programs for local stakeholders)	+ Transfer of skills for use and maintenance of technology/equipment, use of local companies to install and maintain equipment, training of local technicians in areas of expertise not available in Lao PDR 0 Training of local technicians in areas of expertise already available in Lao PDR - No transfer of skills for use and maintenance of technology/equipment, no use of local companies to install and maintain equipment, reliance on international experts to install/maintain equipment

Source: Regulation on the approval procedure for proposed Clean Development Mechanism (CDM) project activities in Lao PDR

5) EV projects in the Context of Climate Change Strategy

3.26 The Department of Natural Disaster Management and Climate Change expects that introduction of EV is one of the most important measures in the mitigations in transportation sector. The department realizes that the important sectors in the climate change mitigations in Lao PDR are the land use and forestry and the energy sector. They also commented that the EV projects will bring significantly good effects to the environmental and social aspects in Lao PDR, therefore totally support the projects.

3.27 The department is one of the important organizations in regard to implementing the EV projects, especially in realizing these projects as CDM or BOCM projects. It is needed to assess environmental and social aspects of the projects in line with the Sustainable Development Checklist provided by the department. The department commented that the processes of CDM are too complicated and strict and takes a lot of time, and as for the EV projects it will be more appropriate and better to apply for BOCM.

3.28 If realizing the EV projects as BOCM projects, it may be possible to trade the GHG emission reductions obtained through EV projects to Japan. For Lao PDR side, this may bring additional revenue every year, through selling the certified emission reductions, to the project, and could improve the feasibility of the project. Moreover, Lao PDR has its unique electricity power mix, which utilizes more than 99% hydropower. The GHG emission reductions through EV projects in Lao PDR will be maximized.

3.29 Though the BOCM is the scheme under development and to be proposed by the Japanese government, the first important thing to realize the EV project in Lao PDR as BOCM project is to develop a MRV (measurement, reporting, and verification of GHG emission reductions) methodology which can be applied to EV projects. The MRV methodology is a guideline to calculate and report and verify GHG emission reductions of a project, and it should be developed for each technology or measure. There is no MRV methodology for EV projects until now. In estimating the environmental effects and management of the progress of the EV project, the estimation of emissions is significantly important in collaboration with the department.

3.4 MONRE: Pollution Control

1) Organization

3.30 There are four department in charge of environmental matters under MONRE, Department of Pollution Control、Department of Environmental Impact Assessment (EIA)、Department of Natural Disaster Management and Climate Change, Department of Environmental Quality Promotion Department. The Department of Pollution Control was established on March 5th, 2012, and its role is to assist MONRE in the duties of environmental management, specifically pollution control in the whole country.

3.31 There are five divisions under the Department of pollution Control:

(i) Administration and Planning Division
(ii) Regulation and Information Division
(iii) Employee promotion Division
(iv) Pollution Control Division
(v) Pollution management Division

2) Laws and Environmental Standards

3.32 The main law related to pollution control is the Law on Environmental Protection which entered into force at April 26th, 1999. The Law on Water and Water Resources entered into force at November 2nd 1996 is also related to pollution control. Regarding the environmental standards, there are standards in regard to air quality, emissions from vehicles and noise based on the Law on Environmental Protection and the Law on Water and Water Resources.

3.33 At present, the Department of Pollution Control has been considering to revise the law and also developing Pollution Control Decree and Strategy and Action Plan on Environmental Management or other related laws.

Table 3.4.1 Air Quality Standard

		Average (ppm TSP, PM10, Pb: mg/m3)				
		1 hour	8 hours	24 hours	1 month	1 year
Carbon monoxide	CO	24	8	-	-	-
Nitrogen dioxide	NO_2	0.16	-	-	-	-
Sulfur dioxide	SO_2	0.27	-	0.11	-	0.04
Total Suspended Particulate	TSP	-	-	0.33	-	0.10
Particulate Matter less than 10 microns	PM10	-	-	0.12	-	0.05
Ozone	O_3	0.09	-	-	-	-
Lead	Pb	-	-	-	1.5	-

Source: Agreement on the National Environmental Standards, 2010

Table 3.4.2 Vehicle Emission Standard for New Vehicles (public transport and light vehicles)

		Gasoline Engine (g/km)	Diesel Engine (g/km)
Particulate Matters	PM	-	0.05
Nitrogen Oxide	NOx	0.15	0.5
Hydrocarbon	HC	0.2	-
Carbon Monoxide	CO	2.3	0.64

Source: Agreement on the National Environmental Standards, 2010

Table 3.4.3 Vehicle Emission Standard for Used Vehicles (motorcycles)

Carbon Monoxide	CO	4.5%	Measure while parking the motorcycle at idle and no load
Hydrocarbon	HC	10,000 ppm	Measure while parking the motorcycle at idle and no load
White Smoke		30%	Measure while parking the motorcycle at idle and not load by quid acceleration the engine to 75% of maximum power rpm

Source: Agreement on the National Environmental Standards, 2010

Table 3.4.4 Vehicle Emission Standard for Used Vehicles (motor vehicles: gasoline)

Carbon Monoxide	CO	4.5%
Hydrocarbon	HC	600 ppm

Source: Agreement on the National Environmental Standards, 2010

Table 3.4.5 Vehicle Emission Standard for Used Vehicles (motor vehicles: diesel)

Smoke SHU	Filter System	50%	Measure while parking the car at load by quick acceleration the engine to maximum rpm
Smoke SHU	System Opacity	45%	
Smoke SHU	Filter System	40%	Measure while the car running steady on the roller at 60% of maximum power rpm
Smoke SHU	System Opacity	35%	

Source: Agreement on the National Environmental Standards, 2010

Table 3.4.6 Noise Standard

Maximum Sound Level (L_{max}) should not exceed 115 dB(A)	Equivalent Sound Level (L_{eq}) from Fluctuating Noise
L_{eq} 24 hour not exceeding 70 dB(A)	Equivalent Sound Level (L_{eq}) from Steady Noise

Source: Agreement on the National Environmental Standards, 2010

Table 3.4.7 Noise Standard for other places

Type of Area	Standard Value in dB(A)		
	6:00-18:00	18:00-22:00	22:00-6:00
Quiet areas: hospitals, libraries, treatment places, kindergarten and schools	50	45	40
Residential areas: hotels and houses	55	55	45
Commercial and service areas	70	70	50
Small industrial factories located in residential areas	70	70	50

Source: Agreement on the National Environmental Standards, 2010

Table 3.4.8 Noise Standard for vehicles

Types of Vehicles	Standards	Method of Measurement
Diesel vehicle	Measured at 7.5 meters: not exceeding 85 dB(A) Measured at 0.5 meters: not exceeding 100 dB(A)	Accelerate until the engine reaches maximum speed.
Benzene vehicle	Car used in ways while it stays still and its engine is running without sound of horn	Measuring while parking the car at no load by acceleration the engine to 3/4 of maximum rpm.

Source: Agreement on the National Environmental Standards, 2010

Table 3.4.9 Noise Standard for Motorcycles

Standards	Method of Measurement
Measured at 0.5 meters: not exceeding 95 dB(A) for a car used in ways, while it stays still and its engine is running without sound of horn	The engine shall be accelerated to be at 3/4 of the maximum rounds if the engine has the maximum rounds of not more than 5000 rpm. The engine shall be accelerated to be at 1/2 of the maximum rounds if the engine has the maximum rounds of more than 5000 rpm.

Source: Agreement on the National Environmental Standards, 2010

3) Environmental Monitoring and EV Projects

3.34 There is no continuous air quality monitoring station in Lao PDR, and several spot measurements have been done using mobile unit supported by Thailand Pollution Control Department (PCD) under the activity of ASEAN-Haze Cooperation. A DANIDA-funded study also monitored air quality in 2003 to 2004 in seven different sites in Vientiane, measuring TSP, PM10, NO2 and SO2. However, it was conducted only 3 consecutive days per year; therefore, the results are insufficient to assess the air quality in Vientiane. GIZ is now proposing Air Quality Monitoring Plan for Vientiane Capital. There is no routine practice of noise and water quality at all.

3.35 The results of above studies indicate that the major pollutant is PM from motor vehicles or open burning, etc. Also, other pollutants including NO2, SO2, CO and THC are important because of the increasing trends of vehicle number in Lao PDR, and it is necessary to measure the air quality more frequently so as to know the causes and situations of air quality in details.

3.36 In regard to the monitoring of the effect of EV project, for example, air quality improvement or noise reductions through introducing EVs, it is important to collaborate with the department. There is lack of equipment, facilities and capacity to monitor environment by the department, therefore enhancement of these capacity is one of the important issues.

3.5 MEM: Renewable Energy Strategies

1) Organization

3.37 The Renewable Energy Development Strategies in Lao PDR was formulated and officially approved in October 2011, which is to promote the development of renewable energies as an important component of the national economic development to ensure energy security, sustain socio-economic development, and enhance environmental and social sustainability.

3.38 In order to implement the above strategies, Renewable Energy Promotion Institute (REPI) was established in the Ministry of Energy and Mines (MEM) in 2012. The REPI is composed of four divisions, namely Renewable Energy Division、Energy Efficiency and Conservation Division、Administration Division and Rural Electrification Division.

2) Development Strategies

3.39 The development policies on the promotion and development of renewable energies in Lao PDR focus on small power development for self-sufficiency and grid connection, biofuels production and marketing, and the development of other clean energies. The main development objectives are (i) to ensure adequate energy supply, energy efficiency and conservation, (ii) to bring socio-economic benefits through the development of a renewable energy industry, contribution to poverty reduction through improved livelihoods and increased gender equality, and (iii) to ensure environmentally and socially sustainable development through the enforcement of adequate safeguards. The government aims to increase the share of renewable energies to 30% of the total energy consumption in 2025. Moreover, to reduce the importation of fossil fuels, the tentative vision is to source 10% of the total transport energy consumption from biofuels.

3.40 The scope of development strategies are for biofuels, small hydropower, other renewable energies such as solar, biomass, biogas and wind, and other alternative fuels for transport. The detailed strategies for each scope are as follows (see Table 3.5.1).

Table 3.5.1 Development Strategies on Renewable Energy

Scope	Strategies
Bio-fuels	・Issue a biofuels decree which provides an overall legal framework for setting the targets ・Establish an agency responsible for the promotion and development of biofuels and strengthen its capacity ・Formulate a biofuels action plan (biodiesel and bioethanol) as blueprint for development ・Establish a nationwide network to provide technical assistance to small-scale producers ・Provide support to research, demonstration, and field testing of high-yielding fuel crops ・Provide financing to small producers and encourage local financing institutions ・Support the establishment and development of a nationwide marketing network for biofuels feedstock ・Establish partnerships with industry players for the processing, production, blending, and distribution of biofuels ・Carry out research and demonstration of community and rural applications of biofuels
Small Hydropower	・Carry out resource assessment and prepare a development plan for small hydropower plants ・Introduce procedures for solicited and unsolicited small hydropower producers ・Introduce simplified small hydropower development framework ・Ensure grid access and promote third party sale of power ・Introduce legal framework for setting off-take tariff for small hydropower projects ・Establish framework and program to provide financing and guarantees to small hydropower projects
Solar Energy	・Carry out resource assessment to determine the potential for off-grid systems ・Prepare a solar hybrid system program specifying business modes ・Develop a framework to stimulate private sector investments in building integrated and large-scale, grid-connected

Scope	Strategies
	solar photovoltaic projects ・Undertake pilot demonstration projects, information dissemination, and training programs ・Scale up hybrid and grid-connected solar photovoltaic projects
Biogas	・Designate an agency/organization to be responsible for biogas systems and strengthen its capacity ・Carry out technical studies, identify the most appropriate business model, and prepare a long-term program ・Carry out information campaign and training programs on biogas system installation and utilization ・Secure program financing, pilot the new business model, and promote replication
Biomass Energy	・Assess biomass resources and prepare a list of priority projects ・Formulate a framework to stimulate private sector investment in power generation ・Test the developed framework ・Undertake information dissemination and training programs ・Develop biomass technology-based independent power producers
Wind Energy	・Expand the current wind measurement campaign and upgrade the current wind atlas ・Identify potential sites for grid-connected and off-grid hybrid systems and priority sites ・Carry out demonstration projects for grid-connected and hybrid wind energy systems ・Prepare wind concession framework and electricity market access framework ・Carry out information campaign and build national capacity on wind energy power generation
Other Alternative Energy Sources for Transport	・Facilitate coordination among responsible agencies ・Carry out feasibility studies and demonstration projects for alternative technologies and fuels for urban transport ・Scale up current demonstration projects on the use of biofuels in rural transport and farm machinery ・Carry out studies and demonstration projects on the use of higher blends of biofuels for freight transport ・Develop a long-term program for a sustainable transport system

Source: Renewable Energy Development Strategy in Lao PDR

3) Financial Mechanism

3.41 The lack of fund is one of the important issues to develop renewable energies in Lao PDR. Therefore, Lao government plans to provide financial incentives and financing assistance to renewable energy projects and investors. Investments in renewable energy projects are entitled to investment incentives under the Investment Law of Lao PDR, updated in 2009. The financial incentives include the followings;

(i) Import duty free on production machinery, equipment and raw materials;

(ii) Import duty free on chemical materials necessary for biofuels production within seven years;

(iii) Profit tax exemption is possible for a certain period depending on activities, investment areas and size of investments; and,

(iv) Subsidies on unit product price depending on energy type and times period.

3.42 In addition, the government will also establish a Renewable Energy (REN) Fund as sub-account to the existing Rural Electrification (RE) Fund. The Fund will be used for financial assistance, finance barrier removal activities and fund capacity building activities, etc.

4) Renewable Energy for Transport Sector

3.43 In order to achieve the vision of the Renewable Energy Development Strategies, the Ministry of Public Works and Transport is responsible for the introduction of policies that promote the use of alternative fuels in private vehicles, public transport systems, freight transport systems and aviation. Proposed road map is shown in the Table below.

Table 3.5.2 Road Map for Promotion and Development of Other Alternative Energy Sources for Transport

<table>
<tr><th colspan="5">Short</th><th colspan="5">Medium</th></tr>
<tr><th>2011</th><th>2012</th><th>2013</th><th>2014</th><th>2015</th><th>2016</th><th>2017</th><th>2018</th><th>2019</th><th>2020</th></tr>
<tr><td colspan="10">・ Facilitate coordination among responsible agencies concerning urban transport development and possible utilization of alternative transport technologies and fuels
・ Support research and development and carry out feasibility studies and demonstration projects for alternative technologies and fuels for urban transport such as electricity, fuel cells and hydrogen.</td></tr>
<tr><td></td><td colspan="9">・ Upscale the current demonstration projects concerning the use of biofuels in rural transport and farm machineries</td></tr>
<tr><td colspan="10">・ Carry out studies and demonstration projects for the use of higher blend biofuels for freight transport</td></tr>
<tr><td></td><td></td><td colspan="8">・ Based on the technical studies and demonstration projects, develop a long-term program for sustainable transport system in Lao PDR</td></tr>
</table>

Source: the Renewable Energy Development Strategies in Lao PDR

3.44 The development of bio-diesel as alternative transport fuels has already started in several provinces leading by MEM. The example of on-going and planned projects are as follows;

(i) Jatropha: The demonstration project by KOLAO Company has been conducted to use bio-diesel from Jatropha mixed with diesel. In 2011, 160,000 little of biodiesel from Jatropha was used for this project, which is cultivated in Xayabouly province. The production of bio-diesel from Jatropha aims to 15 million liter by 2015, 205 million liter by 2020 and 300 million liter by 2025.

(ii) Vernicia Montana Nut: A teak wood company in Luang Prabang province has piloted plantation of Vernicia Montana nut on area of about 10,000 ha. Vernicia Montana Nut is a native breed, so that the yield is high. The government provided about 4 million USD of loan to the company.

(iii) Oil palm: Lao PDR plans to import crude palm oil (CPO) from Thailand, and produce palm oil methyl ester (PME) in the suburban of Vientiane from the end of 2012. From 2014, the PME will be produced using local oil palm.

(iv) Bio-ethanol: In 2011, there is no production yet. However, cassava and sugar cane are highly produced. The potential for bio-ethanol is high.

5) Role of MEM in EV Projects

3.45 Besides developing renewable energy use in transport sector, the MEM will play important role in the development of EV infrastructures. The electric demand for EV use is very little, so that it will not affect to the balance of energy demand and supply of Lao PDR. However, in order to use EVs, the charging infrastructure is indispensable. Electricity to charge EVs is supplied from national grid. Therefore, the EV charging business is positioned as a part of electric industry which shall be managed by MEM in cooperation with MOIC. For this, the MEM needs to formulate a development policy for EV charging infrastructures as well as related regulations and norms. There is no similar industry in Lao PDR yet, so that MEM should consider the management body for charging infrastructures, right to develop EV infrastructures, electric tariff for EVs, and so on. In addition, EV chargers will be used by ordinary people who do not have technical knowledge on power supply. So the safety to use EV chargers is vitally important.

3.6 MOST: Standards related to Vehicles

1) Organization

3.46 The Department of Intellectual Property, Standardization and Methodology (DISM) of Ministry of Science and Technology has roles to administrate intellectual property matters and standards of industrial etc. The department has three divisions and Standards & Quality Division has the role to develop and set the standards.

2) Standards in relation to Motor Vehicle

3.47 To date, there are fuel standards, diesel and gasoline, in relation to motor vehicle. These standards specify the scope, type, characteristic, quality testing which are based on actual production situation in Lao PDR, and referenced standards of foreign countries as below:

- America Standard ASTM (America Society for Testing and Materials)
- Thai Industrial Standards Institute (TISI)
- Standard for Diesel of ASEA-PACIFIC countries, etc.

3.48 After, DISM, Prime Minister's Office collaborated with the technical Committee of Chemical and Cosmetic, National Standard council, representatives from relevant sectors and factories have complied standard's contents and proposed to higher authority for an approval and an officially notification.

3.49 The standards for biofuel are now under consideration by DISM.

3.50 There is no standard for vehicle or tuktuk itself, such as the vehicle type approval, since Lao PDR does not produce new motor vehicles or motorcycles.

3) Develop Standards for EVs

3.51 In order to introduce EVs with good quality, it is important to develop technical standards of EVs, installation standards of EV infrastructures, and so on. The processes to develop and set standards are as follows;

- Review of international standards;
- Draft the standard by DISM;
- Assessment by the technical committee;
- Public comments;
- Revision of the standard;
- Deliberation at the National Standard Council; and,
- Sign by the minister of MOST.

3.7 MOF: Taxation System

1) Organization

3.52 The Department of Tax and the Department of Custom in MOF are in charge of vehicle related taxes. The former one manages the excise taxes and VAT, and the latter one manages the import taxes. In the context of the Study, import tariff and excise tax on motor vehicles will be the main issues to be discussed with the Ministry of Finance (MOF), when EVs are introduced into Lao PDR, taken into account that the national budget is quite limited, and a subsidy like other EVs' advanced countries will encounter difficulties in being financed and in rationalizing to decision makers.

3.53 A new tax, retribution and even for changing a rate of import tariff, excise tax and retribution must need to get endorsement from the National Assembly. After the endorsement from the National Assembly, the President shall promulgate the law. Any other government agencies but the National Assembly has the authority to set and change them.

2) Taxation System on Vehicles and Fuels

3.54 In 2011, the MOF revised Tax Law to help create competitiveness and stimulate growth of domestic firms. The Amended Tax Law (№ 05/NA, 20 December 2011) is expected to come into force in 1st October 2012. In the Amended Tax Law, the Government will decrease the excise tax of fuels by 2 – 4%; while the tax rate of super gasoline remains at 25%, regular gasoline and diesel decrease from 24% to 20% and 12% to 10%, respectively. Besides the excise tax, the government also imposes a surcharge, already, which is included in retail prices, 300 Kip/liter, to earmark for a road fund. The road fund is used to finance nationwide road maintenance. According to the MOF, the Government has a policy not to set a more than one surcharge on chargeable item like fuel.[1]

3.55 In terms of the excise tax on vehicles, the rate is 10 – 90% which is varied by the types and sizes of vehicles the current law. It will increase to 25 – 100% in the new law. However, the preferential treatment is given to the electric motorcycle. The excise tax rate on e-motorcycles is 20% lower than that of gas-fed motorcycles. Furthermore, while the excise tax rate on cars increases, that of motorcycle which has less than 150cc of displacement decreases by 5 – 10%.

Table 3.7.1 Tax Rate in the Amended Tax Law (drafted version)

		Import Tax (%)[1)]		Excise Tax (%)		Turnover Tax/VAT (%)[2)]	
		MFN	CEPT	Current Law	New Law	Current Law	New Law
Fuel	Gasoline	15 – 20	5	24 – 25	20 – 25	5	5
	Diesel	5	5	12	10	5	5
Vehicle	Motorcycle	30 – 40	1 – 5	20	10 - 25	10	10
	Sedan	40	20	60 – 90	65 – 100	10	10
	Pick-up	30	20	25	30 – 60	10	10

[1] Staff of the MOF mentioned that it is considering a new tax, Environment Fund, but it is encountering difficulties to set up a mechanism and from where it can resource the Fund. Surcharging on fuels is easily acceptable and most likely rational solution, but since 300 KIP/litter surcharge is applied to fuels at present and the fuel prices are considered expensive already, the MOF thinks it is impossible to source the funding budget from the fuels.

		Import Tax (%)[1)]		Excise Tax (%)		Turnover Tax/VAT (%)[2)]	
		MFN	CEPT	Current Law	New Law	Current Law	New Law
	Van	40	20	20 – 25	25 – 60	10	10
	SUV	40	20	65 – 75	70 – 100	10	10
	Truck	20 – 30	0 – 20	10	25	10	10
	Bus	20	0	10	25	10	10

Source: MOF

1) There is no change of import tax rates.

2) The turnover tax in current Tax Law is named VAT in new Tax Law.

3.56 Bus is given preferential treatments for import tariff and excise tax, 0%, and 20 to 25% under CEPT agreement, respectively. However, it is confirm with the MOF that the preferential treatments are not applied to other public transport vehicles, like paratransit vehicles. Mini-vans are used for public transport vehicle in other countries in Asia, but under the existing regulations, there is no distinction between private and public use, and no preferential treatments for public transport vehicles. Besides that, van with less than 15 seats, which are used by many tour agents for inner city and short-trip tours and heavy capital investments for them, do not have same preferential treatments; even though the Government sets a tourism sector is one of the driving forces for economic development in a next decade and many of bus with more than 15 seats are also used in tourism sector.

3.57 Besides the excise tax, in August 2012, the preferential treatment for import tax (1%) is applied for electric cars while that of conventional vehicles is 10 – 40% varied by the type of vehicle and the size of engine displacement. However, this is decided by the government office, so that MOF cannot give any idea about the future application of this kind of special treatment.

3) Taxation Systems on EVs

3.58 According to the interview to MOF, EVs has a high possibility to receive a preferential treatment on the import tariff, but not for the excise tax, since EVs will meet the policy directions of the Government to lead the country to pursue “balanced development between economic, social development and environment preservation,” by using electricity produced with clean and renewable energy source, hydropower plant in Lao PDR, and providing a new potential to develop a battery industry in Lao as the battery of ASEAN, and reducing environmental pollutants by no exhaust fume from EVs. With regard to excise tax, the MOF explained that the Government policy of the excise tax clearly defined motor vehicles was considered as luxury goods.

3.59 One of possible ways to promote EVs in Lao PDR is to use them for public transport, mini-bus, taxi and paratransit. Public transport benefits not only passengers, but also to ease traffic congestion which results in less environment pollution, to provide equal accessibility to all citizens including vulnerable road users, to expand mobility and so on. Discussion with the MOF indicates that public transport vehicles, in addition to buses, could be eligible for preferential treatments for import tax: yet, a further study and discussion is needed among stakeholders of government agencies and private sector.

3.60 In addition, tax reduction on EVs means the tax revenue for the country will be decreased. So at the same time to consider the tax reduction on EVs, tax increase in the high emission vehicles and fuels should be also taken into the considerations.

3.8 MOES: Human Resource Development

1) Overview and Organization

3.61 The 7th National Socio-Economic Development Plan (2011-2015) indicates that labor supply, in particular skilled labors, did not meet the demand in past years due mainly to a shortage of such skilled workers in domestic labor force market. One of seven directions identified in the VII NSEDP is to increase the skills of labors for it to be appropriate with the nation's development, and draw-up investment promotion policies for economic sectors in priority development areas, production areas and in difficult and remote areas. In line with the VII NSEDP, expanding low-emission transport nationwide, including EVs, could be a potential new industrial frontier, considering EV business is still new to Asian countries, and Lao PDR is in an advanced position to develop a battery manufacturing sector by utilizing its abundant and relatively less expensive electricity, and to potentially develop peripheral industries. What is necessary for the Government to step forward is to formulate a strategic skilled worker development plan, in accordance with the state's technical vocational education and training (TVET) development plan.

3.62 The Government has already organized 9 working groups with sectoral business associations under the National Training Council (NTC), which oversees technical vocational trainings implemented by the Ministry of Education and Sports (MOES), and the Ministry of Labor and Social Welfare (MLSW).

2) Labor Market

3.63 Population census in 2005 provides an overall picture of the employment structure in Lao PDR. Among people aged 10 and above, around 67% are in the labor market as employed or unemployed. (See Figure 3.8.1).[2] According to the census, unemployment rate is relatively low, 1.4%, compared to developed countries, but it does not necessary mean labor market is balanced. The census also reveals that 46% of employed or 1.25 million people are unpaid family workers, of which around 70% of them are female. 1.15 million employed, or around 42% are self-employed, i.e. small business holders, retailers and vendors. (See Table 3.8.1). Wage employment in the private sector accounts for less than 5% of the total employment in 2005, and it is assumed the situation has not changed significantly taking into account that the employment share in manufacturing in 2010 shows little increase. Service sector shows around 3% increase, but it intends to easily embrace unpaid family workers in the sector, so it is suggested to carefully study the trend of employment in the service sector. (See Table 3.8.2).

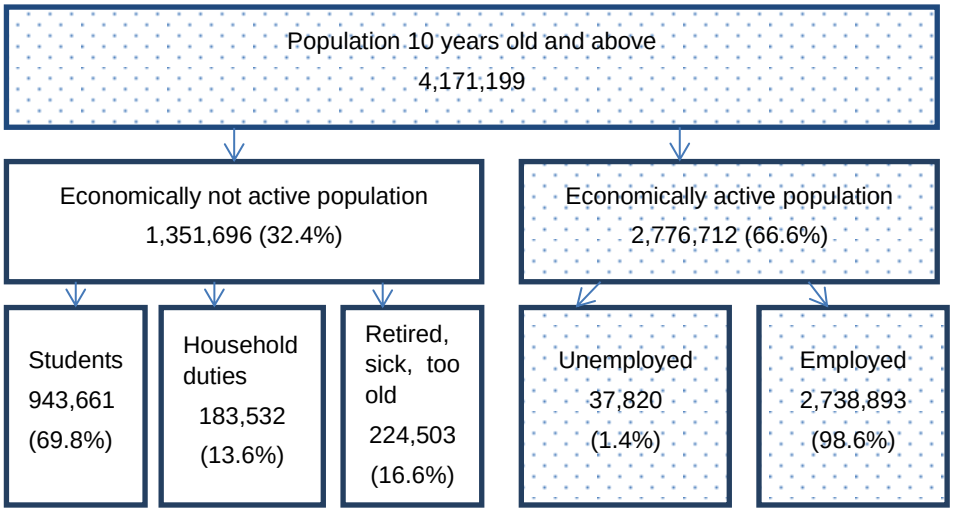
3.64 A trend of labor migration to neighboring countries is another implication of limited wage-job opportunities in Lao PDR. The ADB report[3] estimates that about 10% of Lao labor force worked in Thailand in 2004. Some Lao workers migrated seasonally, but many work in longer-term. The Thai Ministry of Labor estimated that there were at least 0.2 million Lao workers in Thailand, either registered or unregistered, while International Labor Organization (ILO) estimated 0.3 million or more were in Thailand as work force. As of 2009, Lao migrant workers are the third largest group of unskilled migrant workers in

[2] Preparing the Strengthening Technical Vocational Education and Training Project: Final Sector Assessment Report – Project Preparatory Technical Assistance TA 7299-LAO. Hafib International AB. (February, 2010)

[3] ditto.

Thailand, following those from Myanmar and Cambodia.[4] Another important issue of migration is brain drain. One research suggests emigration rate of tertiary educated (percent of total tertiary educated population) has increased to 37.25% in 2004.[5]

Figure 3.8.1 Classification of Labor Force



Source: Technical and Vocational Education and Training (TVET) - Policy Review of Lao PDR's TVET System. UNESCO Bangkok Office. March 2012.

Table 3.8.1 Employment Status by Type of Employer

Category	Employed	Share of Female	Share to the Total
Government Employee	138,388	31%	5.05%
Parastatal (semi-gov't) Employee	11,446	33%	0.42%
Private Employee	121,786	40%	4.45%
State Enterprise Employee	19,486	27%	0.71%
Employer	7,210	31%	0.26%
Own Account Worker	1,149,906	32%	41.98%
Unpaid family worker	1,260,671	71%	46.03%
Total	2,738,893	50%	98.90%

Source: Technical and Vocational Education and Training (TVET) - Policy Review of Lao PDR's TVET System. UNESCO Bangkok Office. March 2012.

Table 3.8.2 Employment Share by Economic Sector (2005 and 2010)

Economic Sector	2005	2010	Difference
Agriculture	78.5%	75.1%	-3.4%
Manufacturing	4.8%	5.5%	+0.7%
Service	16.7%	19.5%	+2.8%

Source: Technical and Vocational Education and Training (TVET) - Policy Review of Lao PDR's TVET System. UNESCO Bangkok Office. March 2012.
Note: The calculation of difference does not equal due to the original data's fraction.

3) Status of Technical Vocational Education and Training Schools in Lao PDR

3.65 Following tables show the status of TVET in Lao PDR in FY2008/2009 compiled in the ADB Sector Assessment report. Certificate in Table 3.8.4 is equivalent to junior high

[4] ditto. Original source: Thailand Migration Report. International Migration Organization. 2011.

[5] ditto

school graduate, diploma and high diploma are to high school graduate. Table 3.8.5 shows the educational background of teachers by teaching subject. Most of teachers only have educational attainment equivalent to high school level, and only few bachelor degree holders, in case of automotive technology. Most teachers have less than 5 years teaching experience, which is indicative that TVET overall is lack of experienced trainers nationwide.

3.66 TVET is regulated by the MOES and MLSW, and the Prime Minister Decree on Skill Formation and Development No.036/PM dated 22 January 2010 defines the demarcation of roles and functions between two ministries. The MOEs is responsible for vocational institutions and vocational education training, while the MLSW is responsible for national skill standard development institutions and skill testing certification. In general, the MOES provides courses for job-seekers to acquire new skills to seek for job opportunities, while the MLSW oversees vocational training for workers who want to improve their skills.

Table 3.8.3 Education Provision in Lao PDR (2008/2009)

Category	Number of Institutions			Student Enrolments		
	MOE	Other Ministries	Private	MOE	Other Ministries	Private
Primary	8,727	0	144	878,491	0	30,389
Lower Secondary	687	0	35	257,406	0	7,173
Upper Secondary	35	0	0	155,174	0	2,146
Complete Secondary	347	0	21	show in above level		
TVET	22*1	0	79	17,878	6,831	23,355
Higher Education	13	0	32	37,564	4,734	11,482

Source: Technical and Vocational Education and Training (TVET) - Policy Review of Lao PDR's TVET System. UNESCO Bangkok Office. March 2012.
Note: The number is as of May 2012. There is at least one TVET school in each province administered by the MOE.

Table 3.8.4 Total Training Enrolments in 2008-2009 by Major Occupational Groups

(unit: person)

NO.	Training Areas (Major Occupation Groups)	Certificate	Diploma	High Diploma	High Diploma Continuing	Total
1	Mechanics	0	83	0	0	83
2	Electrical Eng./Electronics Eng.	30	489	2,014	350	2,883
3	Plumbing - Metal work	0	150	0	0	150
4	Carpentry - Furniture	10	98	5	0	113
5	Construction	11	655	205	28	899
6	Automobile	0	625	287	0	912
7	Tailoring	5	101	0	0	106
8	Agriculture & Forestry	0	1,786	0	394	2,180
9	Civil Engineering	0	481	94	213	788
10	Mining	0	932	0	247	1,179
11	Electrical Power	0	383	0	192	575
12	Computer & IT	0	112	160	34	306
13	Business	0	797	4,047	1,977	6,821
14	Hospitality Industry	48	536	299	0	883
Total		104	7,228	7,111	3,435	17,878

Source: Technical and Vocational Education and Training (TVET) - Policy Review of Lao PDR's TVET System. UNESCO Bangkok Office. March 2012

Table 3.8.5 TVET Teachers by Subjects and Qualifications (2008/2009)

Subject Areas	Certificate	Diploma	High Diploma	Bachelor	Master	Total
Mechanics	0	11	10	2	0	23
Electrical/Electronics	4	33	43	11	4	95
Automotive technology	2	16	10	3	0	31
Computer & IT	0	5	7	8	1	21
Total	6	65	70	24	5	170

Source: Technical and Vocational Education and Training (TVET) - Policy Review of Lao PDR's TVET System. UNESCO Bangkok Office. March 2012

Table 3.8.6 Private TVET Provision (2008/2009)

Province	Programs 2008/2009	Total Students
Vientiane Capital	26 private TVET schools: English, business, finance, banking, marketing, IT, tourism, **automotive technology**, immigration & agriculture	8,277
Vientiane Province	5 private TVET schools: English, business, finance, banking, marketing, IT, tourism, **automotive technology**, immigration & agriculture	997
Savannakhet	7 private TVET schools: English, accounting, electricity, finance, agriculture, electronics, **automotive mechanics**	1,902
Champasak	5 private TVET schools: English, finance, banking & accounting.	1,031
Luang Prabang	6 private TVET schools: English business, banking & finance	2,499

Source: Technical and Vocational Education and Training (TVET) - Policy Review of Lao PDR's TVET System. UNESCO Bangkok Office. March 2012.

4) Technical and Vocational Education and Training for EV Introduction

3.67 EVs and related manufacturing industries will be in automobile working group. The working groups discuss about human resource development and technical qualifications that need to be acquired at technical vocational schools and formal educational facilities. As for necessary knowledge and skill development for automobile mechanics and repair shops to cope with EVs, it is indicative that the working group can be an initiating point to discuss curricula at educational facilities.

3.68 Automobile market shows steady expansion in the ASEAN region and OEMs seems to be a promising market for automobile manufacturing companies. Although it will not be a convincing business strategy for automobile manufacturing companies to develop customized vehicles for Lao market considering its small market, it will be more striking if some new models focusing on the ASEAN market are developed, and to gain more share and boost up the automobile market in the overall ASEAN.

3.9 Plans at Local Government

1) Development Plan at Local Government

3.69 At the local level, each province has the 5-year provincial socio-economic development plan (SEDP). In terms of transport sector, the provincial SEDPs focus more on infrastructure development such as roads, traffic signal, etc. There is no description related to low-emission transport system, i.e. alternative energy use for vehicles, development of public transport system, and so on.

3.70 Regarding the urban development master plan, major cities have approved urban development master plan. Vientiane Urban Development Master Plan was approved by the Prime Minister in 2012. Vientiane MP mentions the importance of public transport system, introduction of new kinds of vehicles, strict enforcement of emission standards of vehicles and introduction of traffic demand management measures. Master plans in other cities are outdated or not officially approved. Instead of following the outdated master plan Luang Prabang has the regulation on construction management. Kaysone Phomvihane has the development orientations based on Preparatory Survey on Formulation of Basic Strategies for Regional Core Cities Development in Lao PDR by JICA. Pakse has the urban development strategies based on the Pakse Urban Environmental Improvement Project by ADB. None of them mention anything related to low-emission transport systems.

2) EV related Activities in Vientiane Capital

3.71 Vientiane has operated electric bus (e-bus) as a part of public transport bus service. The small e-buses were imported from China under the decision of the Prime Minister of Lao PDR in 2009. The cost of e-buses was shared fifty-fifty between the Lao government and Vientiane Capital State Bus Company (VCSBC).

3.72 There are 3 e-buses with 8 passenger capacity and 10 e-buses with 12 passenger capacity. The e-buses were manufactured by Nanjing Lubao (Chinese electric vehicle manufacturer). The price of e-bus and battery are about 13,750 USD/bus and 1,500,000 LAK/battery, respectively. While the batteries and motor are also produced by Chinese companies, the inverter and motor controller were made by US companies. The specification of e-bus with 12 passenger capacity is shown in Table 3.9.1.

3.73 E-buses are operated along one fixed route from the central bus station (CBS) to the campus of Engineering Faculty of National University of Laos and Indian Embassy. The round trip length is about 14 km. One e-bus runs four rounds per day, i.e. 56km/day. The e-buses are operated morning and afternoon shifts. The interval of operation is about 13 minutes if all 13 e-buses are under operation. The service starts at around 6:30 AM and terminates at around 6 PM. The fare is 2,000 LAK/ride, yet VSBC is considering to increase to 3,000 LAK/ride due to increase price of parts.

Figure 3.9.1 Electric Small Bus of Vientiane Capital

12 Passenger Capacity E-bus

8 Passenger Capacity E-bus

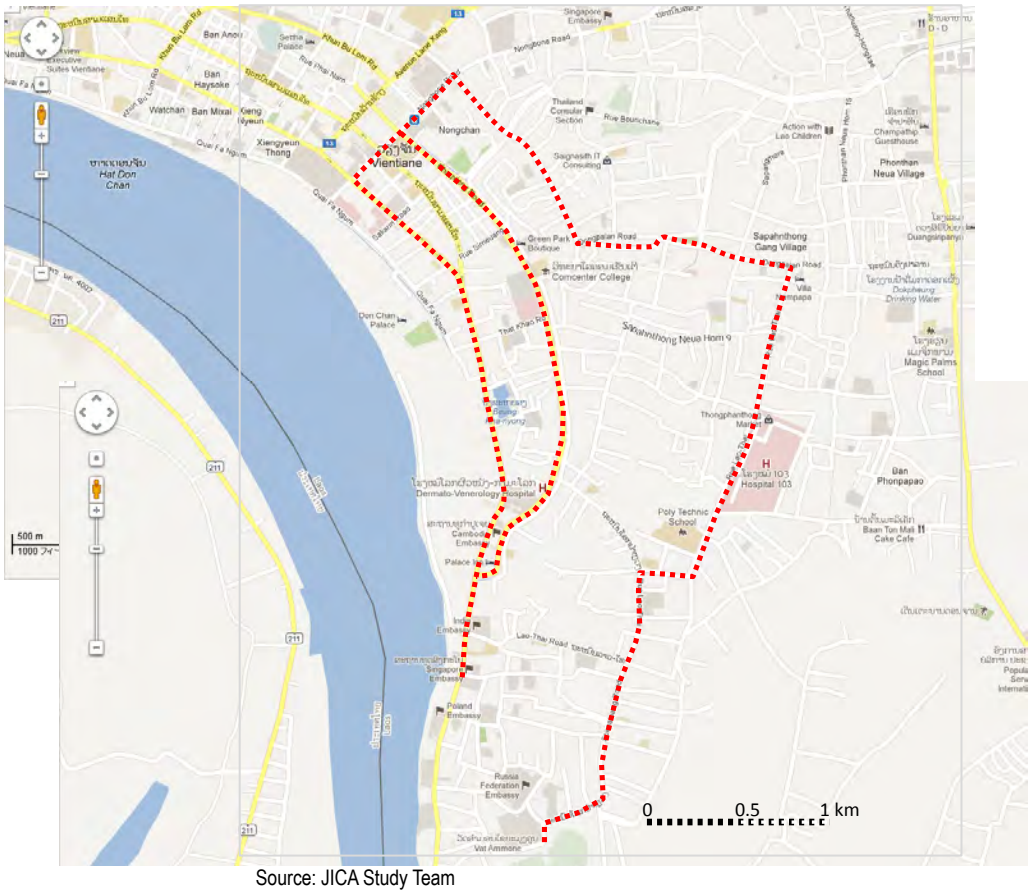
Source: JICA Study Team

Table 3.9.1 Specification Table of E-bus in VCSBC (12 passenger capacity e-bus)

Specification		Range
Dimensions	Length x Width x Height (mm)	4,480 x 1,530 x 1,950
	Tread (mm)	1,210/1,200
	Wheel base (mm)	2,640
	Curb Weight (kg)	1,170
	GVW (kg)	1,940
Performance	Minimum Turning Radius (m)	5.7
	Minimum Road Clearance (mm)	140
	Driving Range Over (km)	70
	Max Slope (%)	20
	Max Speed (km/h)	35
	Braking Distance (m)	<= 2.5 (from 20 km/h)
Motor	Type	DC motor
	Max Power (kw)	5
	Mas RPM (rpm)	1,500
Battery	Type	Lead battery
	Nominal Voltage (V)	72 (6V x 12)
	Nominal Capacity (Ah)	190
	Charging Voltage (V)	220
	Charging Time (h)	8 - 10

Source: Vientiane Capital State Bus Enterprise

Figure 3.9.2 Operating Route of E-bus



Source: JICA Study Team

3.74 One of the mechanics is in charge of maintaining 13 e-buses. However, this engineer only manages the operating condition of e-buses and charging equipment. The maintenance for e-buses is done by drivers. Thus, the bus bodies, the amount of electric

discharge of batteries, operation of charging equipment are checked by nonprofessional.

3.75 The e-buses are charged from 7 PM to 4 AM, but there is no battery management system which can check the status of charging. So the person who handles just turns off when the time comes. According to the instructions, the battery can be charged 500 – 600 times if it is charged once a day, i.e. the battery life is about two years. However, in actual condition, the batteries can be charged only about 300 times. It means battery can lasts less than one year.

3.76 The main issue of e-buses is low lifespan of batteries. When the batteries of e-buses are expired, those buses need to wait until new batteries are imported from China. While they are waiting, the number of bus service is decreased. The actual quality and lifespan of batteries are doubtful. However, it is obvious the management of e-buses and batteries are not implemented appropriately. For example, the actual number of passenger is exceed passenger capacity, the charging batteries is continues even after batteries are already full, and so on. In addition, the hot weather of Vientiane is also one of the factors to lessen the battery quality. Another difficulty is that the batteries can be bought only in China where the original batteries are produced. If the batteries are available in Lao PDR, it is relatively easier to maintain.

3.77 From the viewpoint of passengers, it is good to have electric buses due to its environmental-friendliness. However, it is not comfort to ride an e-bus without side cover. Passenger is covered with dust and vehicle emissions.

3.78 Besides e-buses, electric motorcycle and EV dealers were opened in Vientiane in 2012, respectively. While e-motorcycles are imported from Taiwan, EVs are imported from China. Those dealers will play important role to promote EVs.

3) EV related Activities in Luang Prabang

3.79 Luang Prabang had a basic study on low emission transport for the World Heritage Site, which was done by DOT of MPWT, DPWT and Business Youth Organization of Luang Prabang. The study objective is to analyze the possibility of introducing electric vehicles to the World Heritage Site. This study concluded that more concrete study is necessary before implement the project. And at the same time, Luang Prabang knew about the new JICA project to study on the introduction of low-emission transport system in Lao PDR, so that they are waiting for the results of JICA study.

3.80 As of 2012, Luang Prabang plans to public transport corridor or non-motorized corridor along Sakhaline road to protect the environment of the World Heritage Site. Division of Transport in DPWT plans to replace all existing tuktuk to electric tuktuk (e-tuktuk) if the e-tuktuk factory is built in Luang Prabang.

3.81 Besides, electric bicycle and electric motorcycle are already familiar with people in Luang Prabang, comparing other cities. Especially Taiwanese e-bicycle has good reputation. Moreover, small electric carts are also used for tourism purpose.

4) EV related Activities in Kaysone Phomvihane

3.82 Savannakhet does not have any concrete plan for public transport and introducing low-emission transport. However, the private company (ITECC) plans to introduce 40 electric buses to Kaysone Phomvihane 20 e-buses were already introduced to provide public transport service in the city. Another 20 e-buses will be introduced as school buses for students and pupils in urban area. The fare is 2,000 LAK/ride.

3.83 The e-buses were imported from Shenzhen Marshell Green Power in China. The introduced e-bus has 23 passenger capacity, which costs 25,408 USD/bus. More detail specification is as follows.

Figure 3.9.3 Electric Bus of Kaysone Phomvihane

Source: MPWT

Table 3.9.2 Specification Table of E-bus in Kaysone Phomvihane (Marshell DN-23)

Specification		Range
Dimensions	Length x Width x Height (mm)	5,800 x 2,150 x 1,800
	Wheel base (mm)	2,960
	Curb Weight (kg)	4,410
	GVW (kg)	2,570
Performance	Minimum Turning Radius (m)	6
	Minimum Road Clearance (mm)	100
	Driving Range Over (km)	60
	Max Slope (%)	20
	Max Speed (km/h)	20 - 25
Motor	Type	DC motor
	Max Power (kw)	10
Battery	Type	Lead battery
	Nominal Voltage (V)	72 (6V x 12) x 2 packs
	Nominal Capacity (Ah)	216
	Charging Time (h)	12

Source: Marshell Green

5) EV related Activities in Pakse

3.84 Pakse had two public transport projects for the city before. One is city bus loop, and another one is e-tuktuk. The bus loop service was provided by a private company in 2008. 15 buses with 12 seats were provided to the drivers as loan. However, the service was stopped in three months due to lack of management, disturbance to other transport activities, etc. This project was conducted without any kind of survey even DPWT suggested the private company to conduct a feasibility study. E-tuktuk was operated as a pilot projects. 2 e-tuktuks was installed by Thai company. However, they gave up continuing the project due to many slopes and bad road surface conditions.

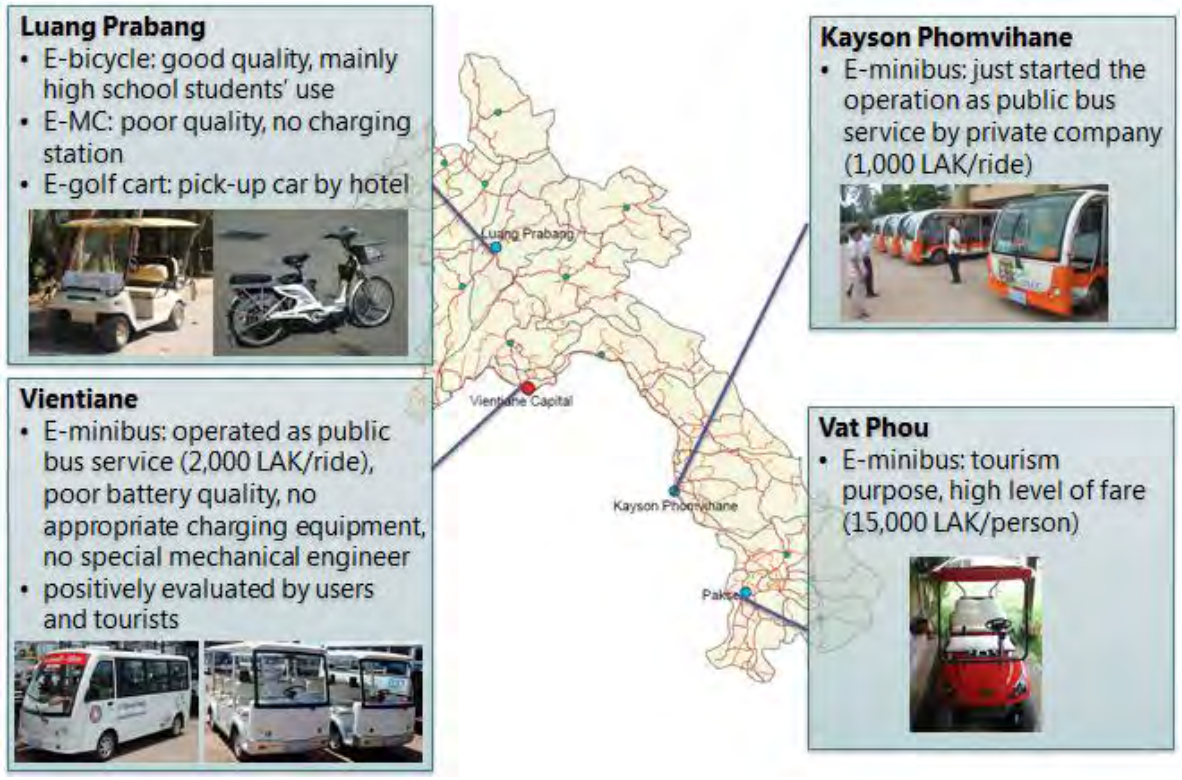
3.85 Besides Pakse City, Vat Phou which is a world heritage site in Champasak introduced small e-buses for going around the Vat Phou, which was made in China.

6) Findings from EV Development Situation in Lao PDR

3.86 The tax reductions are very useful to promote EV related business for private sector. However, on the other hand, the private sector needs to make sure the quality of introduced EVs. EV quality is strongly related to the vehicle quality and maintenance quality including charging. The spare parts also should be got easily when it needs to replace. In

parallel with giving incentives to introduce EVs in Lao PDR, it is also necessary to develop EV related regulations such as technical standard of EVs, battery quality standards, etc.

Figure 3.9.4 EV Introduction Situation in Lao PDR



Source: JIA Study Team

3.10 Summary

3.87 There are several national strategies under the Socio-Economic Development Plan (SEDP) to support developing low-emission transport system in Lao PDR. In the EST, the development of low-emission transport system is clearly mentioned as one of its components to realize the environmental sustainable transport development. In the Climate Change Strategies, low-carbon transports are promoted to use alternate energy for operating motor vehicles in order to reduce the fossil fuel use and greenhouse gas emissions. Thus, the development of low-emission transport system in Lao PDR is in line with the direction of national development orientations. However, besides above mentioned strategies, the cooperation with other ministries is also necessary to develop technical standards, human resource, tax incentives and others. So far, there is no standard related to alternative fuel vehicles including vehicle standards, standard for charging stations, etc.

3.88 At the local level, there is no plan or policy to support introducing low-emission transport system and EVs. However, EVs were already introduced in the several cities and tourism areas by private sector. In general, the impression of EVs is good for environment, but those EVs are also faced on many problems. Except e-bicycles, the common problems of EVs are short life span of batteries, unavailability of spare parts in the country, lack of human resources who can maintain EVs appropriately, and so on. In Kayson Phomvihane case, the private enterprise asks Thai mechanics to maintain their e-buses. E-motorcycles shop in Vientiane hire Chinese mechanics for maintenance. The same problems will be occurred when more EVs are introduced. Therefore, it is necessary to develop the foundation including human resources, procurement routes of spare parts, and others.