JICA Pilot Study for Project Formation for Prioritized Public Project for Urban Development and Poverty Reduction in Thailand

Final Report

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JAPAN INTERNATIONAL COOPERATION AGENCY

ORIENTAL CONSULTANTS CO., LTD.

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Table of Contents

PART 1: SHORT LIST PROJECTS

Overseas Economic Cooperation Operations (OECOs), a part of JBIC providing Japanese ODA loans and the grant aid dispersed by the Foreign Ministry has been merged with the cooperation agency into one organization, 'New JICA' in 1st October 2008. In this report, operations and documents until 30th September 2008 are described as "former JBIC," and those from 1st October are described as JICA.

List of Tables

List of Figures

Abbreviation

AFC	Automated Fare Collection
ALRO	Agricultural Land Reform Office
AOT	Airport of Thailand
ATC	Area Traffic Control
BAAC	Bank for Agriculture and Agricultural Cooperatives
BMA	Bangkok Metropolitan Administration
BRT	Bus Rapid Transit
BTS	Bangkok Transit System
CCTV	Closed Circuit TV
CDM	Clean Development Mechanism
CHE	Commission of Higher Education
CMU	Chimangmai University
CNG	Compressed Natural Gas
CTS	Chiang Mai Transit System
CU	Chulalongkorn University
DD	Detailed Design
DOH	Department of Highways
DOR	Department of Rural Roads
DPT	Department of public Works and Town Planning
EEEC	Energy and Environmental Engineering Center
EGAT	Electric Generating Authority of Thailand
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
EOJ	Embassy of Japan
FIO	Forest Industry Organization
FIRR	Financial Internal Rate of Return
FS	Feasibility Study
GDP	Gross Domestic Product
GPS	Global Positioning System
HEI	Higher Education Institute
IEE	Initial Environmental Evaluation
IPP	Independent Power Producer
ITS	Intelligence Transport System
JBIC	Japan Bank for International Cooperation
LED	Light Emitting Diode
LRT	Light Rail Transit

MEA	Metropolitan Electricity Authority
MNRE	Ministry of Natural Resources and Environment
MOE	Ministry of Education
MOF	Ministry of Finance
MRTA	Mass Rapid Transit Authority of Thailand
MWA	Metropolitan Waterworks Authority
NESDB	National Economic and Social Development Board
NHA	National Housing Authority
ODA	Official Development Assistance
OTP	Office of Transport and Traffic Policy and Planning
PDMO	Public Debt Management Office
PEA	Provincial Electricity Authority
PMC	Project Management Consultant
PPP	Public Private Partnership
RFD	Royal Forest Department
RID	Royal Irrigation Department
RMUT	Rajamangala University of Technology
RTG	Royal Thai Government
SPP	Small Power Producer
SRT	State Railway of Thailand
TOR	Terms of Reference
VSPP	Very Small Power Producer

Summary of the Project (Renewable Energy Project)

1. Name of the Project

Country: Thailand

Name of the Project: Renewable Energy Project

2. Necessity and Rationale of Assistance from JICA

(1) Current Situation of Energy Sector in Thailand

In Thailand, primary energy consumption has doubled, and electric power consumption has tripled in 15 years from 1990 and 2005. Imported primary energy occupies 47% of the total primary energy supply in 2005, and petroleum products (fuel oil and diesel) for generating electricity have increased from 703 million liters to 2,097 millions liters in the same period.

Per capita carbon dioxide emission has also been increasing. The emission volume in 2005 was 3.65 ton per capita, which is lower than the world average (4.37 ton per capita) but higher than the average in Asia & Pacific (2.87 ton per capita). Annual growth rate of the emission amount in 15 years from 1990 to 2005 is 6.0%, the highest level in the East and the Southeast Asian countries.

(2) Current Energy Policy in Thailand

Thai Government announced policies for efficient energy such as 1. Utilization of natural gas which is produced in Thailand, 2. Research & development and promotion of utilization of alternative energy, and 3. Structural reform of energy industry so as to contribute to competitiveness of industries in 2001, and the Government also emphasized necessity of research & development of renewable energy such as biomass and solar power in the 9th National Economic and Social Development Plan (2002 – 2006). Importance to develop alternative energy is also described in the 10th National Economic and Social Development Plan (2007 – 2011).

Energy Planning and Policy Office (EPPO) under the Ministry of Energy sets a national energy strategy from 2005 to 2011. The strategy aims to limit energy consumption growth and to increase a proportion of renewable energy to the total energy consumption, and has the four pillars such as: 1. efficient use of energy, 2. development of renewable energy, 3. stable supply of energy and 4. improvement of national energy supply system based on regional energy center.

In Thailand, electric power supplier consists of EGAT (Electric Generating Authority of Thailand), IPP (Independent Power Producer, larger than 90MW), SPP (Small Power Producer, from 1MW to 90MW), VSPP (Very Small Power Producer, less than 1MW), MEA (Metropolitan Electricity Authority) and PEA (Provincial Electricity Authority). EGAT is responsible for producing electric power and maintain national backbone. IPP, SPP and VSPP are private power supplier, and selling electric power to EGAT, MEA or PEA, in accordance with their capacity. In order to use domestic resource efficiently and to open up an opportunity for remote areas to participate in electricity generation, regulation to purchase from VSPP has prepared by Ministry of Energy.

(3) Necessity of the Project

As described in the previous section (1) and (2), utilization of renewal energy is one of the important issues for energy sector in Thailand. Percentage of renew al energy to the total primary energy supply was 16% but the percentage to source of energy for electric power generation was marginal in 2005. As of October 2007, there are 77 SPP and

VSPP project being operated in Thailand. In almost of the projects bagasse, wastes of sugar cane, and rice husk were used as fuel for the power generation. The project intends to use woody biomass, residue at plantations, and is expected to introduce biomass power generation project at mountainous area where forest industry is the main role for the regional economy. If the project goes well, woody biomass which is now treated as wastes can substitute fossil fuel. As described in section (1), volume of petroleum products used for power generation has been rapidly increasing. The project will contribute to decrease import of crude oil which costs around USD 120 per barrel as of August 2008. The second point of the project is reduction of carbon dioxide emission. Carbon dioxide emission from fossil fuel such as petroleum, natural gas and coal increases abundance of carbon in atmosphere; On the other hand, carbon dioxide emission from biomass doesn't increase abundance of carbon in atmosphere (so called carbon neutral) because carbon is accumulated by the biomass. That is why substitution from fossil fuel to biomass is going to reduce carbon dioxide emission in atmosphere. The last point is employment creation for local villagers. The project needs a lot of manpower to collect and transport biomass. Although target plantations provide job opportunity to local villagers to maintain commercial forest now, such works will provide more job opportunity to them. Increase of income for local villagers from the job creation is recognized as an economic benefit of the project.

In Thailand, rate of electrification recorded 98.6% in village level and 84.4% in household level in 2004. The rate has already reached to the high level, and primary objectives of the project are not to increasing rate of electrification but to promote expected four benefits.

3. Objectives of the Project

The objective of the project is to construct gasification & power generation facility and to generate electric power from collected residues in FIO plantations. FIO which is operation and maintenance body of the project provides produced electric power to PEA though PEA grid, and receive power supply fee from PEA based on the contract agreement.

4. Scope of the Project

1) Location:

FIO proposed 99 plantations located in 28 provincials in Thailand. Total area of the plantations is 844,944 rai (135,191ha).

2) Scope / Component of the Project

The project has the following scope/components.

a. Overall flow of the project

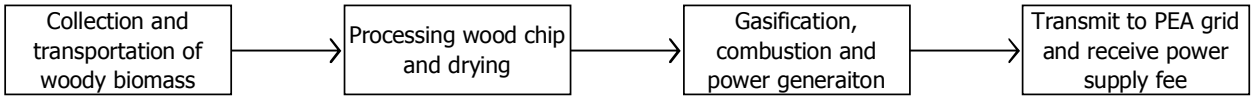


Figure 1 Overall Workflow of the Project

Overall work flow of the project is illustrated as Figure 1. Waste parts of commercial woods such as branch and root are collected by hired local villagers and transported to a power plant facility located in FIO plantation or FIO local office. Collected biomass will be processed to wood chip and dried. Dried wood chip was put into gasification and power generation plant. Gases such as CO, CH_4, H_2, etc are generated in gasification facility and combustion inside

of gas generator. Generated electric power is transmitted to PEA grid, and transformed from 380Voltage to 22kV. Based on a contract agreement with PEA, FIO receive power supply fee.

b. Target species and biomass volume:

FIO intends to use Teak (*Tectona*) and Eucalyptus for collecting biomass. Teak tree is harvested 30 years after planting, and used for material of furniture. Commercial Teak woods have thinning every ten years, and generate 4 ton of biomass (residue). FIO also intends to plant Leucaena (*Leucaena leucocephala*) which can be harvested every three years. Since the tree is very vigorous and come well anywhere, it is not necessary to take care of it after planting. All the part of Leucaena is used for biomass and the volume amounts to 1.2 ton per rai.

The other specie for the project is Eucalyptus. It is harvested every 5 years after planting, and used for pulp. Volume of the harvested Eucalyptus tree is 15 ton per rai, and percentage of wastes is 25%. That is why biomass volume is 3.75 ton per rai.

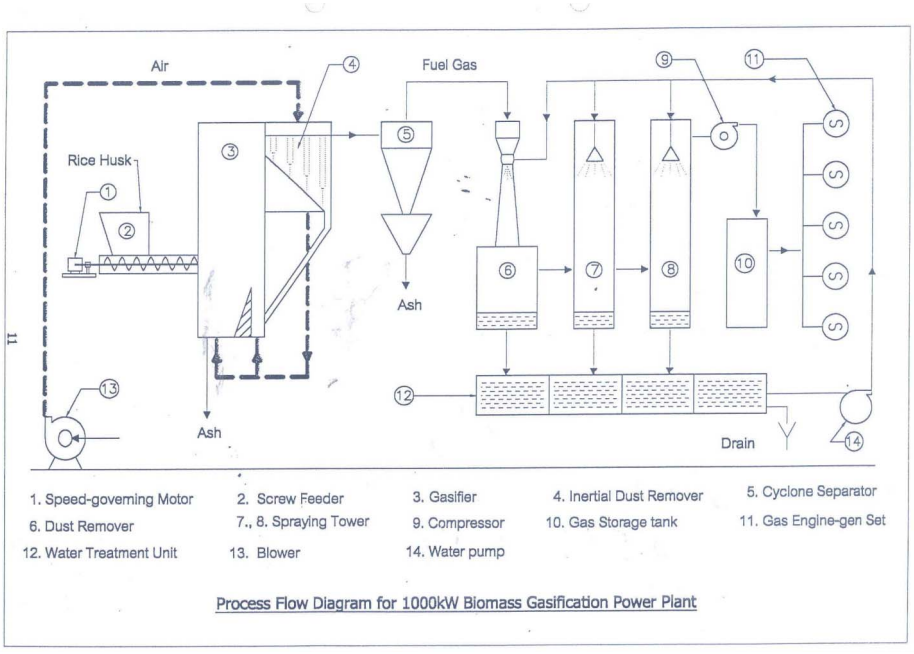
From information on biomass generation above, necessary plantation area to accommodate 1MW electric power plant (generation of 30 ton of biomass per day) is: 11,250 rai for Teak and Leucaena plantation and 12,000 rai for Eucalyptus plantation.

c. Methodology to Generate Electric Power and Necessary facilities

Direct combustion and gasification are commercially viable methods to generate electric power. Direct combustion is traditional and proven system but gasification will be employed in this project from the following reasons: 1. Flexibility in scale of facility, 2. low investment, 3. easy and convenient for operation & maintenance, and 4. low operating cost.

The following facilities are needed to gasification and power generation plant.

- Wood chipper: produce wood chip
- Gasification and power plant system: Consisting of Fuel feeding device, Gasification System, Gas purifying and cooling system, Power generation system, Control system and water treatment unit (Figure 2)
- Transformer and transmission line: From 380 Voltage to 22kV
- Tractor: transporting collected biomass



Process Flow Diagram for 1000kW Biomass Gasification Power Plant

3) Project Cost and Amount of the Loan

Two typical biomass power generation projects (1MW power generation and 400kW power generation) are assumed here. Project cost will be indicated in Table 1 and 2. Almost facilities and equipment will be procured from inside of Thailand, but only gas generators will be imported from China.

Table 1 Cost Estimation for 1MW Biomass Power Plant

Item	Cost (000 Baht)	Lifetime (years)	Remarks
Biomass Gasification - Power Generation Plant	43,791	20 years (Generator 10 years)	1MW circulating fluid bed gasifier (CFBG) Power generator from China (18.5 million Baht) Includes cost for installation works and commissioning, etc
Wood Chipper	2,000	10 years	Processing 30 ton per day
Tractor	2,000	10 years	2 tractors (60 horse power)
Transformer and transmission line	1,700	15 years	From 380V to 22kV, 100 meter transmission line
Contingency	2,475	-	5%

Table 2 Cost Estimation for 400kW Biomass Power Plant

Item	Cost (000 Baht)	Lifetime (years)	Remarks
Biomass Gasifier-Power Generation Plant	25,406	20 years (Generator 10 years)	400kW Down-draft gasification facility Power generator from China (8.6 million Baht) Includes cost for installation works and commissioning, etc
Wood Chipper	1,000	10 years	Processing 12 ton per day
Tractor	1,000	10 years	1 tractor (60 horse power)
Transformer and transmission line	1,700	15 years	From 380V to 22kV, 100 meter transmission line
Contingency	1,455	-	5%

Table 3 O&M Cost for 1MW Biomass Power Plant

Item	Cost per year (000 Baht)	Remarks
Biomass Gasification-Power Generation Plant	700	200,000 for gasification facility and 500,000 for generator
Wood Chipper	2,250	250 Baht per ton
Tractor	1,200	50,000 Baht per month per one tractor
Transformer and transmission line	50	-
Biomass collection cost	5,400	60 persons; 300 Baht per day; 300 days

Table 4 O&M Cost for 400kW Biomass Power Plant

Item	Cost (000 Baht)	Remarks
Biomass Gasification -Power Generation Plant	350	200,000 for gasification facility and 150,000 for generator
Wood Chipper	900	250 Baht per ton
Tractor	600	50,000 Baht per month per one tractor
Transformer and transmission line	50	-
Biomass collection cost	2,160	24 persons; 300 Baht per day; 300 days

4) Schedule

In total 11 months are needed from design to completion of commissioning in a project. Breakdown of tasks is indicated in Table 5.

Table 5 Procurement Schedule

Design	1 month
Construction works and manufacturing equipment	2 months
Transportation of equipment	3 months
Installation of equipment	3 months
Test and commissioning	2 months

5) Implementation Organization

Executing Agency is Forestry Industry Organization (FIO). FIO is a state enterprise which conserves and earns profit from commercial forest owned by the Thai Government.

6) Environmental & Social Considerations

a. Environmental Impacts / land acquisition, resettlement

(1) Environment

It is necessary to conduct IEE and EIA before the implementation of the project although impact on the natural environment is limited described below.

Water: Used in recirculation mode with zero discharge. Occasional PH adjustment and simple treatment may be needed.

Air: Gasifier does not release gas to the atmosphere. Combustion in user equipments (connected to gasifier) is much cleaner compared to liquid fuels.

Solid waste: Charcoal can be sold as fuel. Biological ash can be returned to the soil

Noise: Noise level is lower than liquid fuel facility.

(2) Natural Environment

No specific issue is considered.

(3) Social Environment

No specific issue is considered. No need for land acquisition and resettlement

5. Project Effects

1) Internal Rate of Return (IRR) – from standpoint of economic and financial consideration

a. FIRR

1MW Power Generation Project

Cost: Installation cost and O&M cost is indicated in Table 1 and Table 3.

Revenue: 17.3 million Baht per year (3.0 Baht per 1kWh; 7,200MWh)

Loss of electric power: Power loss rate is assumed as 10%

Project Life: 30 years

FIRR: 11.0%

400kW Power Generation Project

Cost: Installation cost and O&M cost is indicated in Table 2 and Table 4.

Revenue: 6.9 million Baht per year (3.0 Baht per 1kWh; 2,880MWh)

Loss of electric power: Power loss rate is assumed as 10%

Project Life: 30 years

FIRR: 3.0%

b. EIRR

1MW Power Generation Project

Economic Benefit: Value added to villagers (biomass collection); Saving of petroleum products (1.7 million liters, 36.7 million Baht per year); CO_2 reduction (3,909 ton per year, 4.5 million Baht per year)

Economic Cost: Biomass collection cost (payment to local villagers) is excluded from the economic cost.

Project Life: 30 years

EIRR: 75.3% (w/o CO_2 reduction 53.4%)

400kW Power Generation Project

Economic Benefit: Value added to villagers (biomass collection); Saving of petroleum products (0.7 million liters, 14.7 million Baht); CO2 reduction (1,564 ton per year, 1.8 million Baht)

Economic Cost: Biomass collection cost (payment to local villagers) is excluded from the economic cost.

Project Life: 30 years

EIRR: 67.6% (w/o CO_2 reduction 47.8%)

FIRR values are larger than discount rate (2.88%) and EIRR values are larger than opportunity cost of capital in Thailand (real term) which is 12%. That is why both of 1 MW power plant project and 400kW power are financially and economically feasible.

2) Qualitative Effects

FIO expects demonstration effect to private plantations. It will collect woody biomass from the private plantations and show benefit of the biomass power generation project. In the long run, it is expected that private plantations will start same kind of biomass power generation projects, generate new income source for forest industry, and use woody biomass effectively.

6. Others

1)	Necessity of F/S:	FIO has not conducted a feasibility projects for the project yet.
2)	Remarks:	It is necessary to conduct pilot project at selected plantations to make clear the following points: 1. Actual collection volume of woody biomass in FIO plantation and the surrounding private plantations; 2. Making clear actual collection volume of biomass at steeper plantations; 3. Confirming performance of 1MW biomass gasification and power plant system which is the biggest scale by using Thai gasification technology; 4. Research & develop efficient use of wastes such as leaves and biological ash, etc. It is also necessary to assess 99 target plantations from the point of population density around the plantation, expected biomass collection volume, etc. The assessment should be conducted during the pilot project period. The Study Team proposes to establish two units, Technical Support Office at FIO headquarter and Project Unit in each project plantations.
3)	Maturity of the Project:	The project is not so matured yet. As described below the project should be started after pilot projects.

Summary of the Project (Public Transport Improvement Project)

1. Name of the Project

Country: Thailand

Name of the Project: Public Transport Improvement Project

2. Necessity and Rationale of Assistance from JICA

(1) Current Situation of Transportation Sector in Thailand

In Thailand, many cities have been urbanized due to the movement of people from rural area with the mainly purpose of working, especially in Bangkok, Chiang Mai, Phuket, and other major regional cities. From the statistics, it is found that the numbers of population of those provinces are increasing. The increasing of population would introduce the social problem, traffic congestion problem, and environmental problem. Moreover, the total area of road space and demand of vehicle is unbalanced as the number of vehicles still increases rapidly but the road capacity is limited. In other words, the demand is much more than the capacity. That is the reason why the traffic congestion problem cannot be solved in Bangkok and other urban area in Thailand.

The new mass transit systems (sky train and subway) are available in Bangkok. However, many people are still using their own private car because their network coverage is insufficient. Moreover, other main public transport like the bus system is not efficient due to the problem of safety and long travel time.

(2) Current Transportation Policy in Thailand

The 10th National Economic and Social Development Plan (2007-2011) has followed the royal philosophy of "Sufficient Economy" as the guiding principle of national development and management. Its main point is to save the operating cost from the transportation sector by introducing the intermodal transport, mass transit system, and alternative energy. This would improve the quality of life of Thai people.

(3) Necessity of the Project

The severity of traffic congestion in Bangkok and other urban areas are increasing. Therefore, the urban transport development project is considered to be the one of the highest priorities in Thai Government which would help the quality of life in urban area to be better as well as the environment. If the public transport is better than the present one, people may shift their modes from private transport mode to public transport mode so the traffic on the road will be mitigated. However, the cost of investment is relatively high. Thai government could not support all projects so the foreign loan such as Japanese ODA Loan is very necessary to accomplish the whole project in order to improve the public transport in Bangkok and other regional cities.

3. Objectives of the Project

The objectives of the project are

- To mitigate the traffic congestion in Bangkok and other regional city
- To develop the better urban area in terms of quality of life and environment
- To reduce the poverty by introducing the better public transport system with the reasonable fare which will reduce the cost of transport

4. Scope of the Project

7) Location:

This improvement project includes several public transport projects from Bangkok, Chiang Mai, Nakornratchasrima (Korat), Phuket, Udon Thani, Kornkaen, Nakornsawan, Pattaya, Hat Yai, Surat Thani, and Nahornsrithammarat.

8) Scope / Component of the Project

The public transport improvement project includes the following items.

- Construction of Bangkok BRT2 (Morchit-Government Center)
- Construction of Bangkok BRT3 (Chongnonsri-Suksawat)
- Detailed Design and Construction of Chiang Mai Transit System
- Feasibility Study of Public Transport in Other Regional Cities
- Feasibility Study and Implementation of Area Traffic Control (ATC) in Regional Cities

9) Project Cost and Amount of the Loan

(Unit: Million Yen)

Item	Foreign		Domestic		Total	
	Total	Loan	Total	Loan	Total	Loan
Consultant Service						
Bangkok BRT2 Morchit - Government Center (PMC+CSC)	94	94	141	84	234	178
Bangkok BRT3 Chongnonsri - Suksawat (PMC+CSC)	72	72	108	65	180	137
Chiang Mai Transit System (PMC+CSC)	409	409	614	368	1,023	777
Public Transport in other regional cities (FS+DD)	750	750	1,125	675	1,875	1,425
Area Traffic Control (ATC) in Regional Cities (FS+DD)	169	169	253	152	422	321
Sub-total	1,494	1,494	2,241	1,344	3,734	2,838
Land Acquisition (if applicable)						
Bangkok BRT2 (Morchit-Government Center)	0	0	0	0	0	0
Bangkok BRT3 (Chongnonsri - Suksawat)	0	0	0	0	0	0
Chiang Mai Transit System	0	0	313	0	313	0
Sub-total	0	0	313	0	313	0
Construction/Implementation						
Bangkok BRT2 (Morchit - Government Center)	2,083	2,083	3,124	1,874	5,206	3,957
Bangkok BRT3 (Chongnonsri - Suksawat)	1,599	1,599	2,398	1,439	3,997	3,038
Chiang Mai Transit System	9,091	9,091	13,637	8,182	22,728	17,273
Area Traffic Control (ATC) in Regional Cities	3,750	3,750	5,625	3,375	9,375	7,125
Sub-total	16,523	16,523	24,784	14,870	41,306	31,393
Total Cost	18,017	18,017	27,338	16,214	45,353	34,231

Note: Exchange Rate 100 yen = 32 baht

10) Schedule (From 2009 to 2012, totally 42 months)

	2009	2010	2011	2012
Consultant Service				
Bangkok BRT2 Morchit-Government Center (PMC+CSC)				
Bangkok BRT3 Chongnonsri-Suksawat (PMC+CSC)				
Chiang Mai Transit System (PMC+CSC)				
Public Transport in other regional cities (FS+DD)				
Area Traffic Control (ATC) in Regional Cities (FS+DD)				
Land Acquisition (if applicable)				
Bangkok BRT2 (Morchit-Government Center)				
Bangkok BRT3 (Chongnonsri-Suksawat)				
Chiang Mai Transit System				
Construction/ Implementation				
Bangkok BRT2 (Morchit-Government Center)				
Bangkok BRT3 (Chongnonsri-Suksawat)				
Chiang Mai Transit System				
Area Traffic Control (ATC) in Regional Cities				

11) Implementation Organization

Executing Agency for Bangkok BRT: Bangkok Metropolitan Administration (BMA)

Executing Agency for BRT Projects in regional cities: Local authorities such as, Chang Mai Provincial Administration and municipalities for other local city projects; If some local authorities are not capable to implement the project, the government may assign Mass Rapid Transit Authority of Thailand (MRTA) to give a technical assistance.

12) Environmental & Social Considerations

a. Environmental Impacts / land acquisition, resettlement

(4) Environment

EIA are not required for Bangkok BRT2 and BRT3 projects as well as Chiang Mai Transit System project. For Chiang Mai Transit System, IEE has been completed in March 2007.

(5) Natural Environment

This project supposes to have minimal negative impacts on the natural environment because it is located in urbanized area without vulnerable fauna and flora.

(6) Social Environment

This project supposes to have impacts on noise, vibration, air pollution, traffic accidents, resettlement, land use change, and separation of local community. However the influenced area could be limited since the alignment is at the middle of roadway. Accordingly this project supposes to have minimal negative impacts on social environment. The land acquisition and resettlement may impact the social environment but relatively low as the projects mainly locate on the main roads.

5. Project Effects

3) Internal Rate of Return (IRR) – from standpoint of economic and financial consideration

FIRR and EIRR of Bangkok BRT 2&3 project, Chiang Mai Transit System and total project are calculated as the following table. All FIRR values are larger than discount rate (real interest rate of 20 years Government Bond as of July 2008 which is 2.47%), and all EIRR values are larger than opportunity cost of capital in Thailand (real term) which is 12%. That is why Bangkok BRT 2&3 project, Chiang Mai Transit System and total project are financially and economically feasible.

Unit: Percent

	Bangkok BRT 2 & 3	Chang Mai Transit System	Total
FIRR	14.0	0.4	6.0
EIRR	27.4	32.6	29.3

4) Qualitative Effects

The analysis result shows that the application of mass transit improvement in Bangkok, Chiagmai and other regional cities as well as the improvement of area traffic control and ITS system will result in reduction of private car usage. This will result in the reduction of total vehicle kilometer and travel time of the system as well as reduction of CO_2 and other hazardous emissions. The improvement will also contribute to the reduction of traffic accident in urban area.

6. Others

4) Necessity of F/S:

Feasibility studies of Bangkok BRT2, BRT3 and Chiang Mai Transit System have been completed. Only pre-feasibility study of Phuket BRT has been completed so feasibility study would be required for the next step. For other regional cities, the feasibility studies have not been studied yet.

For Area Traffic Count (ATC), the feasibility study is available only in Bangkok. But it is required to be revised in order to update the technologies. In other regional cities, the feasibility studies are not available.

5) Remarks:

None

6) Maturity of the Project:

Bangkok BRT2 and BRT3 are in the process of detailed design. For Chiang Mai transit system, the preliminary design has been completed in March 2007.

For the government approval, this project has not been approved yet. Therefore, land acquisition and resettlement are not yet undertaken.

Summary of the Project (Higher Education Sector – 1)

1. Name of the Project

Country: Thailand

Name of the Project: The Second Thailand-Japan Technology Transfer Project (TJTTP-II)

2. Necessity and Rationale of the Project

During 1980's – 1990's, Thailand enjoyed the highest level of economic development - averaging almost 9% annually. After currency crisis in 1997-1998, GDP was dropped to -10.5% but Thai economy rapidly recovered GDP for 4.8% in 1999. However, Thai GDP could not return to 9% of growth rate as before because economic structure was dramatically changed since 1998 due to rapid technology development in ICT sector. In this change, market of cheap labor force was getting shrunk and expanded skilled/educated work force market. For the sustainable economic development, government expressed paradigm shift of manufacturing and announced restructuring of manufacturing and services sector, which shares almost 84% of GDP (40% for manufacturing and 44% for service) with 56% of work force (18% for manufacturing and 38% for service) keeping 6.3% of average annual growth in 2005. Restructuring of manufacturing sector means to input skilled/educated work force to industry sector and increase quality of products, changing production and improve productivity. Since changing approach of production will be supported by research activities, government announced 15 years Long-Range Plan on Higher Education (in 2007) and the Policy on Education (in 2008), which is summarized into #10 National Plan, and expressed to increase quality of education and lecturers and to increase number of lecturers and skilled/educated work force.

Chulalongkorn University (CU), as a leading university in Thailand, already experienced the Project (Thailand-Japan Technology Transfer Project, Phase-I) during 1998 until 2005, and acknowledges guideline and administration of Japanese ODA Loan Project. Furthermore, CU already has 49 of Research Profile supported by University of Tokyo, established academic network with universities in Japan and organized the project implementation unit and administration process These resources may remove most of obstacles to take off the Project and accelerate project implementation.

3. Objectives of the Project

To incubate technology at the interdisciplinary based research unit with universities in Japan pursuing specific research outcomes to improve quality of products, and transfer technology to Thai industry for sustainable economic development in Thailand.

4. Scope of the Project

1) Location: Bangkok, Thailand

2) Scope / Component of the Project

Component 1: Academic Fellowship Component

a. Component consists of three programs, which are 1)Degree, 2) Non-Degree and 3) Visiting Scholar Programs.
b. Degree program is established to obtain Master and Doctoral Degree study in Japan
c. Non-Degree program focuses on exchange of researches outcomes and academic training dispatching researcher at CU to counterpart universities in Japan.
d. Visiting Scholar program is utilized to invite professors from Japan to CU to exchange academic opinion, to confirm direction of research, timeframe, outcomes, responsibility, etc. with researchers at CU and to give lectures, attending workshop, symposium, etc to enhance state-of-the-technology at CU and industries.

Component 2: Research Activity Enhancement Component

a. This component covers three programs, which are 1) Management of Intellectual Property Right Program, 2) Public-Private Partnership Management Program and 3) Funding and Academic System Development Program
b. Management of Intellectual Property Right Program is to strengthen existing Technology Licensing Organization (TLO) at CU to introduce rules and regulations established in Japan, to study practical example in Japan and to conduct comparative study between Thailand and Japan.
c. Public-Private Partnership Management Program is to support completion of research agreement between CU and private company avoiding confliction of interests, sharing of patent right, intellectual property right and other right to be officially acknowledged.
d. Funding and Academic System Development is a program how to evaluate research outcomes establishing evaluation criteria supported by University of Tokyo and evaluate appropriate amount of funding conducting Cost-Effective Analysis (CEA).

Component 3: Procurement Component

a. The component consists of three programs which are; 1) Enhancement of Research Equipment Program, 2) IT Infrastructure Improvement Program and 3) Library Development Program.
b. Enhancement of Research Equipment will be conducted renewal, improvement or substitute of existing equipment according to the experimental protocol established by research unit.
c. IT Infrastructure Improvement is to update existing IT network at CU to meet to application and the latest technology such as to apply new technology of proxy system, Video-LAN, wired to wireless network, Giga network, electronic library and publishing, etc.
d. Library Development covers enrichment of library collection both in ordinary hardcover library at laboratory and web-site data search.

3) Project Cost and Amount of the Loan (Requested amount: JPY 7,057.6 million, Project Cost: JPY 8,251.0 million, of which Yen Loan Amount: JPY 7,057.6 million)

(unit: JPY million)

Currency Portion / Cost Item	Foreign Currency Portion		Local Currency Portion		Overall Cost		
	Overall	JICA	Overall	JICA	**Overall**	**JICA**	(%)
Component 1: Academic Fellowship	1,729.0	1,729.0	741.0	-	**2,470.0**	**1,729.0**	70%
Component 2: Research Activity Enhancement	255.5	255.5	109.5	-	**365.0**	**255.5**	70%
Component 3: Procurement	3,500.0	3,500.0	-	-	**3,500.0**	**3,500.0**	100%
Price Escalation	274.2	274.2	42.5	-	**316.8**	**274.2**	
Contingency	274.2	274.2	42.5	-	**316.8**	**274.2**	
Consulting Services	1,013.6	1,013.6	253.4	-	**1,267.0**	**1,013.6**	80%
Total	7,046.5	7,046.5	1,188.9	-	**8,235.5**	**7,046.5**	86%

Exchange Rate: USD1.00 = JPY 107.26, USD1.00 = THB 33.3213, THB1 = JPY 3.08408

* Exchange rate between USD and JPY is announced by Bank of Tokyo Mitsubishi UFJ on Aug. 5, 2008

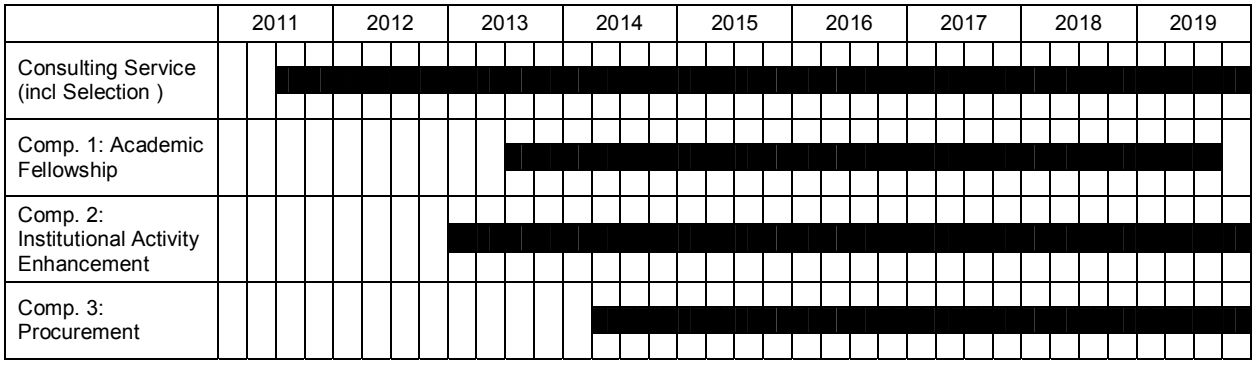
**Exchange rates between USD and THB, THB and JPY are announced by Bank of Thailand on Aug. 4, 2008.

Price Escalation: Foreign Currency Portion (5 %), Local Currency Portion (5 %)

Contingency: 5%

Time of Cost Estimation: August 2008.

4) Schedule (Planed schedule is: Jul. 2011 – Dec. 2018 for 102 months)



5) Implementation Organization

Executing Agency: Ministry of Education

Operation & Maintenance System: Chulalongkorn University, Bangkok, Thailand

6) Environmental & Social Considerations

Environmental Impacts / land acquisition, resettlement

(1) Environment

No specific issues considered. Ordinary care for laboratory waste.

(2) Natural Environment

No specific issue is considered.

(3) Social Environment

No specific issue is considered.

5. Project Effects

1) Internal Rate of Return (IRR) – from standpoint of economic and financial consideration

a. EIRR

Not calculated

b. FIRR

Not calculated

2) Quantitative Effects

The project contributes to technology oriented economic growth though enhancement of quality of higher education and quality of lecturers.

6. Others

1) Necessity of F/S: Not required

2) Remarks: SAF (SAPROF) will be required to survey present situation of CU in terms of joint research activities, update Research Profile, capacity and ability of Technology Licensing Organization, use of equipment purchased under Phase-I, etc.

3) Maturity of the Project: Still need close investigation how to make outcomes and implementation scheme and schedule.

Summary of the Project (Higher Education Sector – 2)

1. Name of the Project

Country: Thailand

Name of the Project: Medical Network Development Project at Chiangmai University

2. Necessity and Rationale of the Project

Chiangmai University (CMU) has Maharaj Nakorn Chiang Mai Hospital, on the Suan Dok campus attached to Faculty of Medicine, consists of four hospital buildings: an old 7-story building (constructed more than 50 years before), the 15-story Sujinno Building in 1983, and the 15-story Sripat Building is in 1996 and another. These hospitals facilitated a total of 1,800 beds and 400 auxiliary beds, accumulated number served patient is 896,721 out-patients and 45,793 in-patients until the end of 2006. Total number of patient served becomes 1,000,000 patients in 2008. Faculty of Medicine is the core of medical service in this region covering 15 million of population in 17 provinces keeping 400 of faculty staff, 1,000 of medical students, 1,200 of nurse and 5,000 of hospital employee. However, due to decrepit of hospital building, lack of functionality and insufficient floor space made longer queue time for out-patient, which became 1-1.5 days. At the same time, CMU supports “30 Bahts treatment” according to the government policy, therefore, number of patients were getting increase. They wait for their turn laying down on the outer space of building because most of patients belong to poverty group in Northern Thailand and enough money to defay accommodation. In this situation, absorbing congestion and reducing queue time for patient is urgent needs to avoid advancement of disease and to secure timely access to medical services. However, existing resources in terms of humanware, software and hardware at CMU is not enough to resolve the issues. Special assistance is necessary to break through the situation. Furthermore, CMU dispatches medical specialists to most of provincial and secondary hospitals in this region. In order to keep a level of medical service, create number of medial specialist and update medical knowledge database are also urgent needs.

Human development and economic development are acknowledged as the priority areas for Thailand according to the National Plan Economic development is based on increase of productivity both in quality- and quantity-wise, which depends on accessibility to sufficient level of medical care in timely manner, and secure “30 Bahts treatment”. There is a lot of discussion on this scheme, however, CMU has to support “30 Bahts treatment” as the public university to contribute to social welfare and to support economic development of Thailand.

3. Objectives of the Project

As the center of medical services in Northern Thailand, CMU produces sufficient number of medical specialist and builds database for medical knowledge and technique, establishing medical network in this region and facilitating medical hardware to contribute social welfare and economic development of Thailand.

4. Scope of the Project

1) Location: Chiang Mai, Thailand

2) Scope / Component of the Project

Component 1: Academic Fellowship Component

a. Component consists of three programs, which are 1) Degree, 2) Non-Degree and 3) Visiting Scholar Programs.

b. Degree program is established to obtain Master and Doctoral Degree study in Japan.

c. Non-Degree program focuses on dispatching researchers and medical specialists who need training or study the latest medical technique.
d. Visiting Scholar program is utilized to invite professors from Japan to CMU for exchange of opinion on research activities, and conduct lectures, workshops, symposium, conference, etc to establish medical knowledge database and the latest medical technique.

Component 2: Institutional Development Component

a. The component focuses on 1) Hospital Management Improvement, 2) Curricula Development and 3) Enhancement of International Collaboration and Joint Researches.
b. Hospital Management Improvement is established to accommodate modern medical administration system to reduce out-patient queue time, to plan effective medical services flow, to establish functional medical administration, etc
c. Obtaining ISO also is one of the targets.
d. Update of curricula and new course development will be conducted supported by universities in Japan.
e. Enhancement of International Collaboration and Joint Researches is necessary component to maintain the latest medical knowledge and technique. In order to improve quality of medical care, collaboration with universities in Japan and conducting joint research is indispensable.
f. Main area of joint research will be preventive medicine and infectious disease.
g. Scheme development for remote medical diagnosis is included in this component.

Component 3: Procurement Component

a. Procurement of equipment, improvement of IT infrastructure and library development is included in this component.
b. Procurement of equipment covers medical equipment for hospital, research equipment for research unit and equipment for students.
c. Improvement of IT infrastructure is important solution for remote medical diagnosis between CMU and universities/hospitals in Japan.
d. Establishment of digital library is utilized to build up medical knowledge database too. Medical specialists access to up to date medical knowledge and technique through web-site.

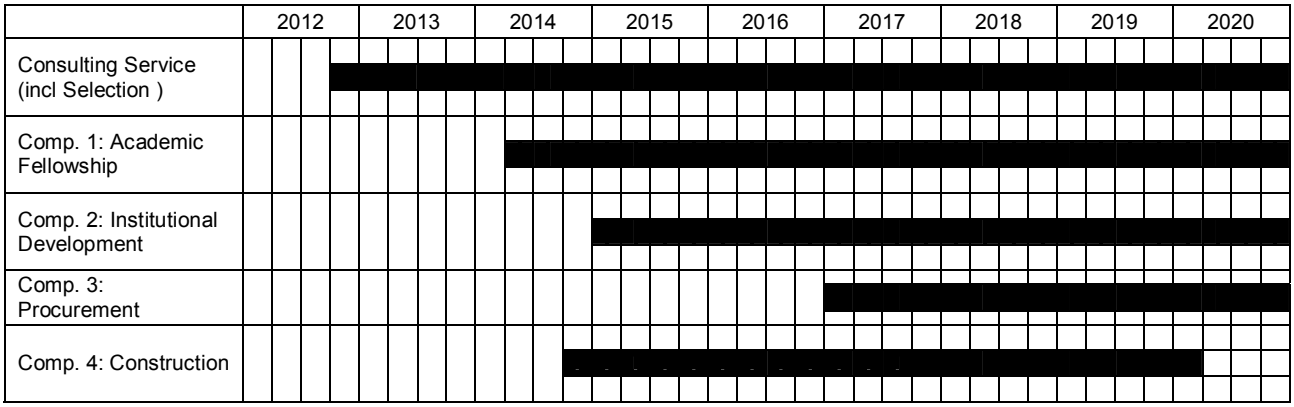
Component 4: Construction Component

a. Design, construction supervising, completion of operation and maintenance scheme are included in this component.
b. Effective disposal of medical waste has to be planed with the highest priority.
c. Suggestion for functional design of a hospital will be made by counterpart universities / hospital in Japan.
d. Construction supervising must be done with the greatest care for environmental issue in terms of dust, waste water, noise, vibration, traffic, etc not to interrupt medical services conducted by Maharaj Nakorn Chiang Mai Hospital.
e. Operation and Maintenance scheme have to be developed to minimize medical waste.

3) Project Cost and Amount of the Loan

No cost estimation provided.

4) Schedule (Planed schedule is: Oct. 2012 – Dec. 2020 for 99 months)



5) Implementation Organization

a. Executing Agency: Ministry of Education

b. Operation & Maintenance System: Chiangmai University, Chiang Mai, Thailand

6) Environmental & Social Considerations

Environmental Impacts / land acquisition, resettlement: The hospital will be constructed on the Suan Dok campus.

(1) Environment

Special attention is necessary type of medical waste. Facilitate waste disposal and complete waste disposal contract are necessary.

(2) Natural Environment

No specific issue is considered.

(3) Social Environment

No specific issue is considered.

3) Internal Rate of Return (IRR) – from standpoint of economic and financial consideration

a. EIRR

Not calculated

b. FIRR

Not calculated

4) Quantitative Effects

The project contributes to enhancement of Maharaj Nakorn Chiang Mai Hospital in terms of quality and quantity.

6. Others		
1)	Necessity of F/S:	Not required
2)	Remarks:	SAF (SAPROF) will be required to confirm current status, to establish possible target and outcomes, to estimate project cost, to survey necessary administration process, permission and documentation, etc after completion of drawings of a hospital.
3)	Maturity of the Project:	The project is not so matured yet. Firstly, conformance between existing situation and target, cost estimation, implementation plan, how to establish network in the region, collaboration scheme with regional hospital, etc have to be planed. Secondary, it is necessary to decide research activities such as direction, framework, expected outcomes, etc. Thirdly, at least single Counterpart University in Japan has to be decided. The reliable Implementation Program has to include all of these issues.

Summary of the Project (Higher Education Sector – 3)

1. Name of the Project

Country: Thailand

Name of the Project: Rajamangala University of Technology Capacity Building Project

2. Necessity and Rationale of the Project

In the past, Thailand was acknowledged as a cheap and unskilled labor supplier in the world. Economic development in 1980's – 1990's, GDP underwent almost 9% annually, which was supported by sufficient number of labor with high rate of population growth during 1950's – 1970's but it was dropped from 3.0% in 1950's to 0.82% in 2005. After currency crisis in 1997-1998, Thai economy recovered soon, however, GDP could not return back to the one in glory period in 1990's because of paradigm shift of manufacturing sector. Un-skilled/educated work force does not meet to sophisticated manufacturing process using ICT from 1998. In order to respond to this paradigm shift, Thai government accentuated reformation of overall education sector. Especially, higher education sector is requested development of three areas, which are 1) rise the quality of education, 2) develop teacher's curricula, adjust teacher production and develop teachers of quality, and 3) support production and development of a work force in the Policy of Education. Since this approach must be carried out nation-wide level, 15 Years Long Range Higher Education Plan also focuses on development of university network and decentralization of academics.

Rajamangala University of Technology (RMUT) is acknowledged as Rajamangala Institute of Technology, a consolidation of 9 universities spreading out in all area of Thailand, which was affiliated to the Commission of Higher Education (CHE) since 2005. RMUT produces 6,500-7,000 students annum in Science and Technology field with 1,165 of academic staffs. This number becomes quite big work force in Thailand. However, problem is quality of education. In RMU, all of 32% of lecturers are Bachelor degree holders and almost 80% of lecturers are mere lecturers (ajarn). In other words, Ph.D lecturer is only 7% and Associated or Assistant Professor shares only 20 %. Especially, percentage of Ph.D holds lecturers are only 7% or 79 persons out of 1,165 lecturers. This ratio is too low compare to national average, which is 26%, to deliver quality education to students. In this situation, student may not access to advanced technology from lecturers and quality of education may not be maintained. Since advantage of RMUT is location of campus and number of graduates, where campus is spread out all over Thailand and produce 6,500 – 7,000 students annum with S&T background, increase quality and number of lecturer will dramatically contribute to increase number of skilled/educated work force to manufacturing sector at the nation-wide level and accelerate decentralization of academics and economy.

The concept for increase quality of education and lecturers, and produce number of lecturers and skilled/educated work force completely meet the Policy on Education. Further, decentralization of the country and development of university networking, which is expressed on the 15 Year Long-range Plan on Higher Education, is also fit to the substance of RMUT.

3. Objectives of the Project

To accelerate human resource development upgrading quality of education, to increase number of lecturers in science and technology fields at the nation-wide level and to develop skilled/educated work force to support quality of products for Thai industry.

4. Scope of the Project

1) Location: 9 universities in Thailand (Thanyaburi, Krungthep, Phra Nakhon, Ratanakosin, Lanna, Srivijaya, Isan, Suvanabhumi and Tawanok)

2) Scope / Component of the Project:

Component 1: Academic Fellowship Component

a. Component consists of three programs, which are 1) Degree, 2) Non-Degree and 3) Visiting Scholar Programs.
b. Degree program is established to obtain Master and Doctoral Degree study in Japan.
c. Non-Degree program focuses on dispatching Master Degree holder lecturers or researchers from Thailand to Japan for short term training in a specific academic field.
d. Visiting Scholar program is utilized to invite professors from Japan to Thailand for exchange of opinion on research activities, and conduct lectures, workshops, symposium, conference, etc .

Component 2: Institutional Development Component

a. This component consists of two programs that are 1) New Course and Curricula Development Component and 2) Enhancement of International Collaboration.
b. New Course and Curricula Development will be conducted supported by counterpart universities in Japan to respond to social demands.
c. New Course Development also includes study of credit transfer or credit exchange system among 9 university consolidation and universities in Japan. Considering Degree Program component at RMUT, lecturers will go to Japan to obtain Master and Doctoral Degree. Some university may fall into shortage of credit or may not deliver appropriate lectures to students due to lack of lecturers. Credit transfer or credit exchange system may replenish credits to students to complete the course at RMUT.
d. Enhancement of International Collaboration Component is the component to complete academic agreement between RMUT with universities in Japan in terms of accepting candidate of Degree and Non-Degree Program, dispatching Visiting Scholars to RMUT and conducting joint researched with RMUT.
e. This component also explore possibility of credit exchange among RMUT and counterpart universities in Japan to enhance dispatching Degree and Non-degree candidates from RMUT to Japan and accept exchange students from Japan to RMUT.

Component 3: Procurement Component

a. The component consists of three programs which are; 1) Procurement of Teaching and Research Program, 2) IT Infrastructure Improvement Program and 3) Library Development Program.
b. Procurement of Teaching and Research Equipment will be conducted purchasing equipment according to the curricula and syllabus to meet to number of students.
c. IT Infrastructure Improvement is to update existing IT network to meet to application and the latest technology.
d. Library Development covers enrichment of library collection both in ordinary hardcover library at laboratory and web-site data search.

3) Project Cost and Amount of the Loan (Requested amount: JPY 13,785.5 million, Project Cost: JPY 15,119.0 million, of which Yen Loan Amount: JPY 13,785.5 million)

(unit: JPY million)

Currency Portion / Cost Item	Foreign Currency Portion		Local Currency Portion		Overall Cost		
	Overall	JICA	Overall	JICA	**Overall**	**JICA**	(%)
Component 1: Academic Fellowship	7,717.6	7,717.6	857.5	-	**8,575.1**	**7,717.6**	90%
Component 2: Institutional Development	139.4	139.4	34.8	-	**174.2**	**139.4**	80%
Component 3: Procurement	3,350.0	3,350.0	-	-	**3,350.0**	**3,350.0**	100%
Price Escalation	560.3	560.3	44.6	-	**605.0**	**560.3**	
Contingency	560.3	560.3	44.6	-	**605.0**	**560.3**	
Consulting Services	1,451.9	1,451.9	363.0	-	**1,814.9**	**1,451.9**	80%
Total	13,779.5	13,779.5	1,344.5	-	**15,124.2**	**13,779.5**	91%

Exchange Rate: USD1.00 = JPY 107.26, USD1.00 = THB 33.3213, THB1 = JPY 3.08408

* Exchange rate between USD and JPY is announced by Bank of Tokyo Mitsubishi UFJ on Aug. 5, 2008

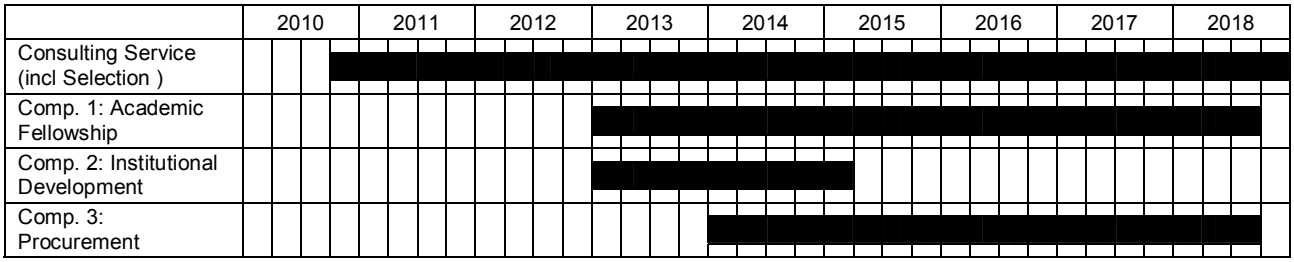
**Exchange rates between USD and THB, THB and JPY are announced by Bank of Thailand on Aug. 4, 2008.

Price Escalation: Foreign Currency Portion (5 %), Local Currency Portion (5 %)

Contingency: 5%

Time of Cost Estimation: August 2008.

4) Schedule (Planed schedule is: Oct. 2010 – Dec. 2018 for 99 months)



5) Implementation Organization

a. Executing Agency: Ministry of Education

b. Operation & Maintenance System: Rajamangala University of Technology, Thanyaburi, Thailand

6) Environmental & Social Considerations

a. Environmental Impacts / land acquisition, resettlement

(1) Environment

No specific issue is considered. Ordinary care for laboratory waste.

(2) Natural Environment

No specific issue is considered.

(3) Social Environment

No specific issue is considered.

5) Internal Rate of Return (IRR) – from standpoint of economic and financial consideration

a. EIRR

Not calculated

b. FIRR

Not calculated

6) Quantitative Effects

The project contributes to improve technical experts who will play an important role in future economic growth of Thailand in terms of quality and quantity.

6. Others

1)	Necessity of F/S:	Not required
2)	Remarks:	SAF (SAPROF) will be required to confirm current status for students and lecturers, equipment list, implementation scheme, availability of counterpart universities in Japan, credit exchange system among consolidation, and treatment of vacant lectures while lecturers go to Japan, etc to review project cost and timeframe.
3)	Maturity of the Project:	Almost matured. Direction, implementation scheme, outcomes, etc are within the range of previous experience of JICA. The thing to be confirmed is listed in 2) to decide loan amount and overall schedule.

PART 1: SHORT LIST PROJECTS

Chapter 1 INTRODUCTION

1.1 Study Background

Thai economic expansion is based upon “dual track policy” which seeks both strengthening grass roots economy for reduction of poverty and disparity, and strengthening of international competitiveness to enlarge the market place. As a result, Thailand has become a middle income country with sufficient international competitiveness. Along with the stable strengthening of Thai economy, Thai National Economic and Social Development Board (NESDB) formulates further strategy namely “the framework for socio-economic restructuring”, to sustain economic growth early in the 21st century to catch up with the developed countries. This restructuring focuses on delivering priority strategies for further economic development by 2008 such as development of value-added agriculture and industries, expansion of service industries, formulation of efficient policies, and downsize of public organizations.

However, on the other hand, the social conflicts generated from the economic disparity between urban and rural, and between rich and poor is going to be a critical political issue. The Royal Thai Government (RTG) is gradually required to put more emphasis on the economic adjustment policies to tackle social frictions of disparity and inequalities of opportunity between rich and poor which are generated from globalism, international competitiveness, and liberalization of trade, information, service and human movement in a borderless world. The RTG accordingly needs to balance both macro economic growth policy as well as social and economic adjustment policy simultaneously.

The Tenth National Economic and Social Development Plan (2007-2011), which adopts the philosophy of “sufficient economy (Setakij Porpiang)” as the guiding principle of national development and management. This principle philosophy is initiated by the King and adopted to the Ninth Plan (2001-2006), so that Tenth Plan is prepared along with the same policy direction with the Ninth Plan. In the Tenth Plan, Thailand’s core development challenges over the medium-term fall into the three categories, namely, to make further progress in reducing poverty, to increase productivity and competitiveness for sustainable growth, and to manage economic growth and protect the environment to achieve balanced and sustainable development.

The RTG has formulated various types of the public projects along with the 9th and 10th Plan. Former "Mega-project" scheme is defined as a big challenge to drastically forward the many projects rationalizing along the above policies.

The RTG is considered foreign fund including Official Development Assistance (ODA) as a potential alternative source of finance because of the concessional fund source. The RTG may take into account Japanese ODA loan as one of the potential financial sources for these projects.

Accordingly, it is important to identify the potential priority projects and assist the formulation of them from the preparation stage. In this regards, JICA (former JBIC at that time) selects Global Headquarters of Oriental Consultants Co., Ltd. to conduct "Study Implementation Program on JICA Pilot Study for Project Formation for Prioritized Public Project for Urban Development and Poverty Reduction in Thailand".

1.2 Study Objectives

The objective of the study is to identify the potential priority projects, which are appropriate for Japanese ODA policies as well as fulfilling Thai government policies, and then to form some "Potential Collaboration" projects from those projects.

1.3 Terms of Reference

The Study shall first of all concentrate in identifying potential projects through gather information regarding major projects in several government agencies to identify project scope, current status and level of preparation of the projects. The Study Team will confirm the priority of the potential projects along the new government policy and implementation plan. The future policy on utilization of foreign aid shall be taken into account. This is indispensable process to choose high potential projects as the candidate of future Japanese ODA loan. Potential Collaboration project, which is the project aiming at contributing long-term partnership between Thailand and JICA, will be selected by the JICA and NESBD from the high potential projects.

To perform the Study along the approach mentioned above, the Study shall consist of the following four TORs:

<u>TOR 1: Develop profiles of the potential public projects, which are identified as priority projects by RTG</u>

- confirming the roles of the former "Mega-projects" in the context of latest development policy in Thailand based on consultation with related ministries and departments
- identifying the projects of the former "Mega-projects" and new priority projects through the existing data and interviews with related ministries and departments.
- collecting basic information on the projects confirmed above, through interviews with

related ministries and departments (project scope, cost, necessity of the projects, scale of environmental impact including land acquisition and resettlement)

- developing profiles of the projects

TOR 2 Screen the potential projects confirmed in Task 1 and develop shortlist

- setting criteria for screening the projects based on the consensus of the executing agencies
- screening
- developing shortlist based on the result of screening process

TOR 3: Clarify project scope and status of preparation of the projects in shortlist

- confirming the progress of Master Plan, Feasibility Study, Basic design and Detailed Design (clarify status of the approval in Thai government through interview)
- confirming the progress of land acquisition and resettlement, Initial Environmental Evaluation (IEE) and Environmental Impact Assessment (EIA)
- selecting "Potential Collaboration Projects"

TOR 4: Formulate the potential collaboration projects

- reviewing the validity of demand forecast and cost estimation
- considering the implementation framework and financial plan
- developing the draft Terms of Reference (TOR) for RTG to conduct necessary studies
- confirming current status of environmental issues including land acquisition and resettlement based on the "JBIC Guideline for Confirmation of Environmental and Social Considerations"[1]

[1] Although a part of JBIC providing Japanese ODA loans has been merged with the cooperation agency into one organization, 'New JICA,' JBIC Guideline for Confirmation of Environmental and Social Considerations will be applied for Japanese ODA Loan projects for a while.

Chapter 2 OUTLOOK OF PROJECTS IN THAILAND

2.1 Mega-projects

2.1.1 Outline of Mega-project Scheme

The Mega-Project scheme was initiated by the Royal Thai Government (RTG) under Thaksin's premiership in January 2006. The scheme aims at realization of intensive investment for prompt infrastructure development with total budget of 1,700 billion baht (approximately 43 billion USD or 4,800 billion yen) within 5 years from 2007 to 2011. The scheme covered wide 9 fields of services including 1) transport and logistics system, 2) water resource, 3) natural resource, environment and energy 4) information and communication, 5) agriculture, 6) science and technology, 7) medical treatment and public welfare, 8) culture and education and 9) defense. There are 72 projects over the 9 fields under the Mega-project at the plenary stage (except for the projects under the field of "defense").

The scheme planned to obtain implementation budget from several sources such as national budget, revenue from state enterprises, domestic borrowings and external borrowings. For this purpose, the Mega-project scheme adopted an unique procurement method, namely "proposal method", which requests project proposal including financial proposal from "partner" who is a organization to particulate in the Mega-project. The partner has no limitation in eligibility either domestic or foreign organization, public or private organization, or single or JV/consortium, but the following requirements must be satisfied:

- Partner should have K: Knowledge, T: Suitable and affordable technology, M: best management in operation and maintenance and F: best financing options.
- Partner and Thailand should be in Win-Win relation through the project implementation.
- Public debt ratio must be less than 50% if the partner considers foreign loan as a financial source.

The Mega-project scheme was expected to contribute in improving efficiency of Thai economy in mid & long term point of view as well as in economic growth through intensive public investment. However, the scheme was substantially canceled by extending the deadline of proposal submission to no-time-limit.

2.1.2 Current Status of Projects listed in "Mega-projects"

The Mega-projects scheme identified totally 72 projects. After the Mega-project scheme, the RTG screened the projects listed in the Mega-project and revise priority for implementation. Major points of revision are consistency with new government policy of alleviation of economic gaps between rural and urban and rich and poor as well as environmental sustainability. The projects with well preparation are also taken into account. By this revision of the project priority, some of the projects under the Mega-project are proceeded forward realization, some are pending and the others are abolished. Table 2.1 shows current status of projects listed in Mega-projects. Out of 72 projects, 13 projects were implemented or were being implemented with domestic finance including government budget and funding, while 11 projects have already been canceled. 35 projects have not been yet implemented but still in the project list of the implementing agencies. The 13 projects which have implemented or are now implementing are 2 highway projects, 1 railway project, 5 energy projects, 2 telephone projects, 3 IT projects.

Table 2.1 Current Status of Mega-Projects by Sector

	Done/ Doing	Existing with Priority	Cancelled	Unknown current status	Total
Transport and Logistics	3	20	3	0	26
Water Resources	0	5	0	0	5
Natural Resources, Environment and Energy	5	2	0	0	7
Information and Communications	5	2	0	1	8
Agriculture	0	3	1	0	4
Science and Technology	0	0	2	5	7
Medical and Public welfare	0	3	2	0	5
Culture and Education	0	0	3	7	10
Total	13	35	11	13	72

Source: JICA Pilot Study Team

Current status of the projects in the Mega-projects is shown in Table 2.2 and Table 2.3.

Table 2.2 Current Status of Mega-Projects (1/2)

Field	Project Title	Org.	Mega
Mass Transit (MT)	Light Green Line Extension 1	BMA	○
	Light Green Line Extension 2	BMA	○
	The Red Line Rail System Project, Bang Sue-Hua Lamphong-Makkasan-Hua Mak Section	SRT	○
	The Red Line Rail System Project (Bang Sue – Rangsit)	SRT	○
	The Red Line Rail System Project (Bang Sue-Talingchan)	SRT	○
	MRTA Purple Line, Bang Yai to Rat Burana, Bang Sue to Rat Burana Section	MRTA	○
	MRTA Blue Line Extension, Bang Sue to Tha Pra and Hua Lumphong to Bang Kae	MRTA	○
	MRTA Orange Line Phase 1, Thailand Cultural Center to Bang Kapi Section	MRTA	○
Highways (HW)	Intercity Motorway between Bangpa-in - Nakhonratchasrima	DOH	○
	Intercity Motorway between Bangyai-Banpong	DOH	○
	Intercity Highway between Pattaya - Sathahip	DOH	○
	Intercity Motorway between Nakhon Pathom – Cha-am	DOH	○
	Intercity Motorway between Bangpa-in - Nakhonsawan	DOH	○
	Bangplee – Suksawat expressway	ETA	Done
	Ramindra – Outer Ring-Road expressway	ETA	Doing
Railway (RW)	Track Doubling Project from Chachoengsao – Laem Chabang Section	SRT	Doing
	Linkage of airport-land transport and port (Savanabumi-Bangkok-deep sea port)	SRT	X
	Tak-Mae Sod Railway Construction Project	SRT	X
	Track Rehabilitation Phase 4	SRT	X
	Track Rehabilitation Phase 5	SRT	○
	Track Rehabilitation Phase 6	SRT	○
Other Transport (OT)	The Project of Regional Truck Terminals	MOT,DLT	○
	Common Ticketing Project	OTP	○
	National Logistic Improvement Project	OTP	○
	Pak Bara Deep Sea Port	MD	○
	Damming Chao Phraya and Nan River for Improvement of Navigation	MD	○
Urban Development (UD)	Low Cost Housing Project (Bann Eua-Arthorn Project)	NHA	○
Water Resource (WR)	Integrated Water Resource Management	MNRE	△
	Aquifer Storage and Recovery Project	MNRE	△
	Ground Water Management	MNRE	△
	Integrated Irrigation System Management	MOAC	○
	On-farm Water Management	MOAC	○
	Biodiversity Information Management	MNRE	△
	Waste Management: Realization of Waste to Energy and Beyond	MNRE	△
Agriculture (AG)	Dairy Industry Modernization	MOAC	○
	Thailand Food Traceability	MOAC	○
	Tuna Fishing Fleets	MOAC	○
	Water Management for Agricultural Use	MOAC	X

Source: JICA Pilot Study Team

Table 2.3 Current Status of Mega-Projects (2/2)

Field	Project Title	Org.	Mega
Energy (EN)	New Combined Cycle Power Plant Block 1	EGAT	Doing
	North Bangkok Combined Cycle Power Plant Block 1	EGAT	Doing
	South Bangkok Combined Cycle Power Plant Block 1	EGAT	Doing
	Extension of High Voltage Transmission Line No.12	EGAT	Doing
	Extension of High Voltage Transmission Line No.12	EGAT	Doing
	Solar Energy Research and Development	MST	Y
	Fuel Cell for Alternative Energy Sources	MST	Y
	International Standard Testing and Calibration Laboratory	MST	X
	Bio Research and Development	MST	Y
	Establishment of a World Class-University of S&T	MST	Y
	Bio World Education Centre	MST	Y
	Research and Development Center of Alternative Energy for Sustainable Development	MST	Y
Technology & Science (TS)	Fixed Telephone network expansion	TOT	Done
	Domestics Telecom Network Expansion	TOT	Done
	The Replacement of the SPC switching with the Next Generation Network (NGN)	TOT	○
	The expansion of Broadband IP (Internet Protocol) Network	TOT	○
	IT-Driven Cluster Development Project	MOC	X
	Intellectual Property Center Project	MOC	Doing
	Thailand's E-Logistics Project	MOC	Doing
	E-Service for Industrial Modernization	MOI	Done
Education (ED)	The E-learning Project	MOED	Y
	Releasing Students' Brain Power via Project-Based Learning	MOED	Y
	Modernized Curriculum and Instruction	MOED	Y
	Establishment of a World Class University of Science and Technology	MOED	Y
	Modernization of Vocational Education Commission	MOED	Y
	Top-School Global Link	MOED	Y
	Enrichment of the Leaning Environment	MOED	Y
Public Health (PH)	E-Health (E-consultation, E-appointment, E-learning)	MOPH	△
	Regional Tertiary Medical Center	MOPH	△
	Flu Vaccine (research and production)	MOPH	X
	Production of Anti-viral active（Antivirals active phamaceutical ingredient）	MOPH	X
Culture (CL)	World Buddhism Gateway	MOC	X
	Value Creation for Contents Industry in Thailand	MOC	X
	Heritage Conservation Institute	MOC	X

Note:

○	Exisiting Project
△	Existing Project at Policy Level (Project Profile could not be prepared)
Done/ Doing	Project Completed/ Already Started
Y	Not Confirm / Waiting for a Meeting
X	Cancelled

Source: JICA Pilot Study Team

2.2 New Projects

Under the principle philosophy of "sufficient economy" in Tenth National Economic and Social Development Plan, The RTG gradually change their policy, priority of projects to emphasize more on social frictions, poverty reduction and economic disparity and inequality. There is a great impact on the policy shift from the change of cabinet in 2006. New cabinet accelerated such policy shift. Along with this, each implementing agency has formulated new projects and reviewed priorities of the previous projects. Table 2.4 shows major new projects of each implementing agency which are focused on the relatively large scale projects to be considered as a substitution or a replacement of the Mega-projects. 57 new projects are identified. Each implementing agency develops own 5 year plan or 5 year project list and most of the new projects were selected from them. Out of 57 projects, 22 projects are in the field of transport and logistics, 12 projects are in the field of water resources development, and 10 projects are in the field of natural resources, environment and energy.

Table 2.4 Current Status of New Projects

Field	Total
Transport and Logistics	22
Water Resources	12
Natural Resources, Environment and Energy	10
Information and Communications	4
Agriculture	5
Science and Technology	2
Medical and Public welfare	2
Culture and Education	0
Total	57

Source: JICA Pilot Study Team

Current status of the new projects is shown in Table 2.5 and Table 2.6.

Table 2.5 New Projects (1/2)

Field	Project Title	Org.
Mass Transit (MT)	BRT Don Muang – Minburi - Suvarnabhumi	BMA
	BRT Suwannabhumi-Bangna	BMA
	BRT Minburi-Samrong	BMA
	BRT Chongnonsri - Suksawasd	BMA
	Chiangmai BRT	OTP
	Mass Transit Development in Regional Cities	OTP
Highways (HW)	The Chao Phraya River Crossing Bridge at Nonthaburi 1 Road Construction Project	DOR
	Extension of Ratchaphruk Road-Kanjanapisake Road (NS)	DOR
	Extension of Ratchaphruk Road-Kanjanapisake Road (EW)	DOR
	Ratchaphruk Road Widening (Rattanathibet-Petchakasem Section)	DOR
	Nakorn In-Wiphawadi Rangsit Connecting Road Network Project	DOR
	Highway Improvement from 2 lanes to 4 lanes Phase 2	DOH
	Srinakarin-Bangna-Samutprakarn Expressway	ETA
	Srirat-Outer Ring Expressway	ETA
	Srirat-Dao Khanong Expressway	ETA
	Collector/Distribution (C/D) Road	ETA
	Third Stage Expressway, South Route S2	ETA
	Third Stage Expressway, North Route	ETA
	Bangpoon-Thanyaburi-Outer Ring Expressway	ETA
	Suwannabhumi Expressway (M1)	ETA
Railway (RW)	Track Doubling Project from Chachoengsao – Kaeng Khoi and 3 Chord lines	SRT
Airport (AP)	Suvarnabhumi Airport Phase 2 Development Project	AOT
Urban Development (UD)	Urban development project at 5 southern provicnes	DPT
	Urban Renewal: Din Daeng Community	NHA
Environment (EV)	Solid Waste Management Project in BMA	BMA
Water Supply (WS)	8th Bangkok Water Supply Project	MWA
Flood Control (FC)	Flood Control Project	DPT
Agriculture (AG)	Project for Revitalization of the Deteriorated Environment in land Reform Area through Integrated Agriculture Development/ Stage 1 – Extension Period (2008-2100)	ALRO
	Project for Revitalization of the Deteriorated Environment in land Reform Area through Integrated Agriculture Development/ Stage 2	ALRO
	Sustainable Development for Agricultural Security and Natural Environment Conservation in Land Reform Areas.	ALRO
	Integrated Water Management Project for Existing Lam Pao and Huai Luang Reservoirs (Luang-Pao-Chi Water Diversion Project)	RID
	Mae Wong River Water Resource Development Project	RID
	Mae Kuang Udomtara Reservoir Inflow Augmentation Project (Mae Ngat-Mae Tang-Mae Kuang Water Diversion) Stage 1	RID
	Mae Kuang Udomtara Reservoir Inflow Augmentation Project (Mae Ngat-Mae Tang-Mae Kuang Water Diversion) Stage 2	RID
	Pha Chuk Diversion Dam Project	RID
	Medium Scale Project of Klong Wang Ta Nod Basin	RID
	Siew Yai Irrigation Improvement Project	RID
	Maharaj Irrigation Improvement Project	RID
	Lam Ta Kong Irrigation Improvement Project	RID
	Petchaburi Irrigation Improvement Project	RID
	Loan for Renewable Energy	BAAC
	Loan for Food Safety	BAAC

Table 2.6 New Projects (2/2)

Field	Project Title	Org.
Energy (EN)	The Renewable Power Generation Program	MNRE, FIO
	Distribution System Reliability Improvement Project, 3rd stage	PEA
	Distribution System Dispatching Center Improvement Project	PEA
	Power Distribution System Reinforcement Project,7th stage	PEA
	Transmission System and Substation Development Project, 9th stage	PEA
	Transmission System Development for Power Purchase from Nam Ngam 3 and Nam Theun 1 Hydroelectric Projects	EGAT
	Transmission System Expansion Project No.11(TS.11)	EGAT
	The Replacement of Overhead Line by Underground Cable System Plan in 2008 – 2013	MEA
	The Tenth Power Distribution System Improvement and Expansion Plan in 2008 - 2011	MEA
Technology & Science (TS)	National Mobile Phone Network Project	TOT
	Asia – America Gateway (AAG)	CAT
	Deployment of Cellular Network Type CDMA 2000 1xEV-DO in 51 Provinces (Extended)	CAT
	E-Government Project	MICT
	Shipyard Industry	MOI
	Upstream Steel Manufacturing	MOI
Public Health (PH)	Development and Production of Doctors and Staff in Public Health	MOPH
	Secondary Excellence Service Center	MOPH
	Primary Excellence Service Center	MOPH

2.3 Project List

The JICA Pilot Study Team identified totally 92 projects through investigating latest status of the projects in the Mega-projects and newly prioritized projects, as indicated in Table 2.7. Out of 92 projects, 35 projects are originated from the Mega-projects, which are “Existing with Priority” project in previous Table 2.1. And, the remaining 57 projects are newly prioritized by the each implementing agency, according to previous Table 2.4 (Table 2.5and Table 2.6 list up each project). Regarding the field of the projects, 42 projects are in the field of transport and logistics, 17 projects are in the field of water resource development, and 12 projects are in the natural resources, environment and energy.

Table 2.7 Number of Projects

Field	Mega projects	New	Total
Transport and Logistics	20	22	42
Water Resources	5	12	17
Natural Resources, Environment and Energy	2	10	12
Information and Communications	2	4	6
Agriculture	3	5	8
Science and Technology	0	2	2
Medical and Public welfare	3	2	5
Culture and Education	0	0	0
Total	35	57	92

Source: JICA Pilot Study Team

2.4 Project Profile

Project information in details is compiled as Project Profile attached in Appendix, which aims at providing project information to the NESDB and JICA as well as screening the project to select short-listed projects and potential collaboration projects. The information in the project profiles are gathered through review of report and interview surveys to the relevant agencies. The project profile includes:

- Consistency with Policies (project rationale and priority in Thai Government)
- Project Scope (expected output, scope of work, estimated project cost, project duration)
- Contribution to Socio-economy in Thailand (economic development, environmental improvement, poverty reduction)
- Environmental Considerations (impacts on natural environment, impacts on social environment)
- Maturity of Project
- Financial Consideration

2.5 Analysis on Necessary Fund

Out of 92 projects, 74 projects has preliminary estimate of project cost, even there are large difference in accuracy of the estimate. Table 2.8 shows anticipated project costs by year from 2007 to 2018. With 74 projects, total project cost accounts for approximately 1,351.9 Billion Baht (approximately 36,613.8 Million USD) up to 2018. Annual necessary funds for carrying out the projects are in the range between 8.4 Billion Baht (2018) ~ 242.5 Billion Baht (2011) a year, depended on the project implementation schedule.

On the other hand, Table 2.9 shows national budget overview of Thailand for past 5 years from 2002 to 2007. Investment budget accounts for approximately 10.1% (2006) to 12.6% (2004) of total government budget in Thailand. In average of the past 5 years, it is approximately 11.2 %. Meanwhile, national budget continuously increases in the same period in accordance with the increase of GDP. The investment budget accounts for approximately 1.8 % (2003) to 2.2 % (2007) of the GDP in the same period.

Considering the balance between the anticipated project cost and investment budget in national budget, implementation of the projects seems to be large burden on the Thai national investment budget, if all the projects would be carried out by the national budget. Accordingly, the RTG shifts policy to utilize foreign some external financial resources such as foreign public loan and foreign private investment under PPP.

Table 2.8 Anticipated Project Cost

Year	2007	2008	2009	2010	2011	2012
Anticipated Project Cost (mil. Baht)	70,616.1	119,657.8	171,540.7	221,038.9	242,527.4	201,672.8

Year	2013	2014	2015	2016	2017	2018	total
Anticipated Project Cost (mil. Baht)	129,141.6	83,360.8	54,171.8	34,000.6	15,722.6	8,414.6	1,351,865.5

Source: JICA Pilot Study Team

Table 2.9 Annual Public Investment Budget

(million baht)

Year	2003	2004	2005	2006	2007	Average
Government Budget (a)	967,455	905,000	1,200,000	1,360,000	1,566,200	1,199,731
Investment Budget (b)	108,956	114,299	131,694	137,991	179,594	134,507
Proportion (b/a, %)	11.3	12.6	11.0	10.1	11.5	11.2
GDP (current price) (c)	5,917,386	6,489,847	7,087,660	7,830,329	8,180,084	7,101,061
Proportion (b/c, %)	1.8	1.8	1.9	1.8	2.2	1.9

Source: PDMO

Chapter 3 SCREENING OF THE PROJECTS

3.1 Overall Process

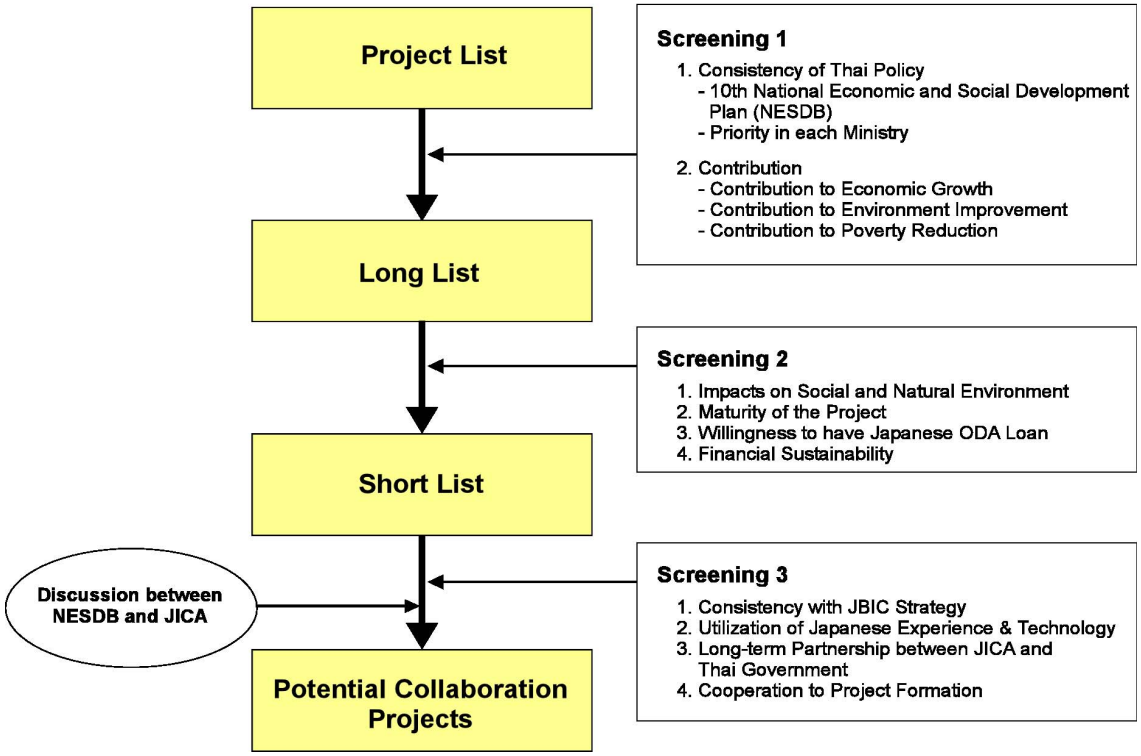
The project list completed in the Chapter 2 can be recognized as future project list. The JICA Pilot Study Team makes project evaluation to identify higher priority projects which can be implemented urgently due to better project preparation including better social acceptance in implementation. For this purpose, the selection process consists of two steps of screening. First screening is to identify long listed projects and Second screening is to identify short listed projects.

As the first screening, the JICA Pilot Study Team evaluates the projects in the project list organized in Chapter 2 in order to identify higher priority projects which are defined as the project well functioning along the national development policies and strategies as well as expecting larger contribution to the Thai society from economic, social and environmental view points. The projects identified in this process are defined as “long listed project” in this study.

As the second screening, JICA Pilot Study Team then evaluates the projects in the long list to identify the projects could be urgently implemented. The evaluation is mainly made from the maturity of project preparation as well as anticipated negative impacts from project implementation point of views. Financial sustainability of the projects as well as willingness of use of foreign cooperation like JICA is also important criteria for the second screening. The projects identified in this process are defined as “short listed project” in this study too.

Screening process above described with the criteria in each screening examining in the following section (section 3.2.2 and section 3.3.2) are explained to NESDB in the interim report and are finally approved by NESDB with certain revision reflecting comments from NESDB.

The selection of short list projects is carried out following the process illustrated in Figure 3.1.



Source: JICA Pilot Study Team

Figure 3.1 Overall Screening Process

3.2 1st Screening

3.2.1 Criteria for 1st Screening

(1) Consistency to Thai Policy

Consistency to 10th NESDB Plan

The Tenth National Economic and Social Development Plan (the 10th Plan) then rises "Green and Happiness Society " as development visions where people live by morals, intelligence, nice family, strong community, peaceful society, quality, stable and fair economy, good environment and sustainable natural resources under the democratically governed constitutional democracy under the region of the King and survive gracefully. The 10th Plan emphasizes again on "sufficient economy" and "human centered development" following the 9th Plan, and points out that Thailand's core development challenges over the medium-term fall into the three categories, namely, to make further progress in reducing poverty, to increase productivity and competitiveness for sustainable growth, and to manage economic growth and protect the environment to achieve balanced and sustainable development. The "balance" is taken into account as a key concept of policy-directions in the 10th Plan particularly between

materialism and human mind, between self-dependence and competitiveness, between self-responsibility and social safety net, and between rural and city. To realize it, the 10th Plan sets 5 development strategies such as:

1) Strategy on developing Thai citizen and society to the society of intelligence and learning through:

- Morality and knowledge
- Physical and mental health in good surroundings
- Peaceful society

2) Strategy on boosting community and social strength as a farm based country through:

- Management on strong community
- Strengthening of community economy
- Efficiency of community to live harmoniously with natural resources and environment

3) Strategy on restructuring the economy to be more balanced and sustainable one through

- Manufacturing restructure for better productivity, value-added on goods and services and uniqueness of Thailand
- Safety net on economic system
- Fair competitiveness and equal distribution

4) Strategy on developing basis of biological diversity and to maintain resources and environment through:

- Maintaining natural resources and ecological balance
- Building good environment for better life quality and sustainable development
- Developing values of biological diversity and local wisdom

5) Strategy on stimulating good governance in the country's management through:

- Encouraging and developing democracy and good governance as a part of Thai society
- Motivating people to participate in ruling the country
- Forming efficient government sector with good governance, focusing on service instead of control and working with development partner
- Decentralizing more to province and local community
- Supervising private sector to keep fairness and good governance
- Reforming laws, regulations, procedures regarding socio-economic development for equal opportunity
- Enhancing stability in country's management for balance and sustainability

Consistency to 5 year Plan and Project Priority of each Implementing Agency

Each government agencies in the RTG regularly develops own 5 year plan to break-down national policy which shows in the NESDB 5 year plan. The 5 year plan normally includes a sort of project implementation program with indicating investment schedule during the coming 5 years. The project identifies in the 5 year plan mean priority project to be implemented but it does not yet mean budgeting commitment in advance.

(2) Contribution

Contribution is the criteria to assess positive aspects of the project. The following three aspects are taken into account:

- Contribution to Thai Economy
- Contribution to Environment
- Contribution to Poverty Reduction

Contribution to Thai Economy

Contribution to Thai Economy is the criteria to assess magnitude of positive impacts of the project on the Thai economy, in particular anticipated numbers of beneficiaries and economic ripple effects are taken into account, which may be emerged through:

- Improving efficiency of economic activities
- Improving productivity
- Increasing production
- Reducing cost and wasteful time
- Mitigating damages caused by disasters

Contribution to Environment

Contribution to Environment is the criteria to assess positive impacts of the project on the environment. The following aspects are taken into account for the assessment:

- Reduce pollutants
- Decreasing greenhouse gas
- Preserve natural resources and endowments
- Provision of substitution measure to reduce environmental negative impacts

Contribution to Poverty Reduction

Contribution to Poverty Reduction is the criteria to assess positive impacts of the project on reduction of poverty and economic disparity as well as of gap between urban and rural areas.

The following aspects are taken into account for the assessment:

- Stimulating local economy
- Improving basic human needs in the local community
- Improving accessibility to market and city
- Increasing job opportunities
- Encouraging productivity in rural area

3.2.2 Criteria and Scoring System

Scoring system is proposed to numerically identify the higher priority projects based on the criteria in the 1st screening, as shown in Table 3.1.

Table 3.1 Criteria ad Scoring System in the 1st Screening

Items	Point	Contents		
		0%	50%	100%
1.1 Thai Policy	**1.0**			
(1) Consistency in Development Policy of NESDB	**0.5**	Not consistent with the 10th Plan of NESDB [0.0]	Consistent partially with the 10th Plan of NESDB [0.25]	Consistent with the 10th Plan of NESDB [0.5]
(2) Priority in the Ministry/ Organization	**0.5**	Low priority in the Ministry or Organization [0.0]	Medium priority in the Ministry or Organization [0.25]	High priority in the Ministry or Organization [0.5]
1.2. Contribute to Socio Economy of Thai	**1.0**			
(1) Economic Viability	0.4	Minor contribution to economic activities [0.0]	Proper contribution to economic activities [0.2]	Large contribution to economic activities EIRR is appropriate [0.4]
(2) Environmental Improvement	0.4	Slight contribution to environmental improvement [0.0]	Moderate contribution to environmental improvement [0.2]	Remarkable contribution to environmental improvement [0.4]
(3) Poverty Reduction	0.2	Some contribution to poverty reduction [0.0]	Certain contribution to poverty reduction [0.1]	Large contribution to poverty reduction [0.2]
Total	**2.0**			

Source: JICA Pilot Study Team

3.2.3 Results of the 1st Screening

The JICA Pilot Study Team selects the project with more than 75 % of total score or 1.5 marks as long listed project. As a result, totally 42 projects are identified through the 1st screening.

Table 3.2 Project Long List (results of the 1st Screening) (1/2)

ID	Project Title	Org.	Mega	New	Total	1.1 Thai Policy			1.2 Contribution			
						Sub Total	(1) NESDB	(2) Org. Priority	Sub Total	(1) Economy	(2) Env.	(3) Poverty
MT-1	Light Green Line Extension 1	BMA	○		1.90	**1.00**	0.50	0.50	**0.90**	0.40	0.40	0.10
MT-2	Light Green Line Extension 2	BMA	○		1.90	**1.00**	0.50	0.50	**0.90**	0.40	0.40	0.10
MT-3	BRT Don Muang – Minburi - Suvarnabhumi	BMA		○	1.90	**1.00**	0.50	0.50	**0.90**	0.40	0.40	0.10
MT-4	BRT Suwannabhumi-Bangna	BMA		○	1.90	**1.00**	0.50	0.50	**0.90**	0.40	0.40	0.10
MT-5	BRT Minburi-Samrong	BMA		○	1.90	**1.00**	0.50	0.50	**0.90**	0.40	0.40	0.10
MT-7	Chiangmai BRT	OTP		○	1.90	**1.00**	0.50	0.50	**0.90**	0.40	0.40	0.10
MT-8	Mass Transit Development in Regional Cities	OTP		○	1.90	**1.00**	0.50	0.50	**0.90**	0.40	0.40	0.10
MT-9	The Red Line Rail System Project, Bang Sue-Hua Lamphong-Makkasan-Hua Mak Section	SRT	○		1.90	**1.00**	0.50	0.50	**0.90**	0.40	0.40	0.10
MT-10	The Red Line Rail System Project (Bang Sue – Rangsit)	SRT	○		1.90	**1.00**	0.50	0.50	**0.90**	0.40	0.40	0.10
MT-11	The Red Line Rail System Project (Bang Sue-Talingchan)	SRT	○		1.90	**1.00**	0.50	0.50	**0.90**	0.40	0.40	0.10
MT-12	MRTA Purple Line, Bang Yai to Rat Burana, Bang Sue to Rat Burana Section	MRTA	○		1.90	**1.00**	0.50	0.50	**0.90**	0.40	0.40	0.10
MT-13	MRTA Blue Line Extension, Bang Sue to Tha Pra and Hua Lumphong to Bang Kae	MRTA	○		1.90	**1.00**	0.50	0.50	**0.90**	0.40	0.40	0.10
MT-14	MRTA Orange Line Phase 1, Thailand Cultural Center to Bang Kapi Section	MRTA	○		1.90	**1.00**	0.50	0.50	**0.90**	0.40	0.40	0.10
OT-3	National Logistic Improvement Project	OTP	○		1.90	**1.00**	0.50	0.50	**0.90**	0.40	0.40	0.10
EN-1	The Renewable Power Generation Program	MNRE, FIO		○	1.90	**1.00**	0.50	0.50	**0.90**	0.40	0.40	0.10
UD-1	Urban development project at 5 southern provicnes	DPT		○	1.80	**1.00**	0.50	0.50	**0.80**	0.40	0.20	0.20
AG-1	Project for Revitalization of the Deteriorated Environment in land Reform Area through Integrated Agriculture Development/ Stage 1 – Extension Period (2008-2100)	ALRO		○	1.80	**1.00**	0.50	0.50	**0.80**	0.20	0.40	0.20
AG-2	Project for Revitalization of the Deteriorated Environment in land Reform Area through Integrated Agriculture Development/ Stage 2	ALRO		○	1.80	**1.00**	0.50	0.50	**0.80**	0.20	0.40	0.20
AG-3	Sustainable Development for Agricultural Security and Natural Environment Conservation in Land Reform Areas.	ALRO		○	1.80	**1.00**	0.50	0.50	**0.80**	0.20	0.40	0.20
AG-4	Integrated Water Management Project for Existing Lam Pao and Huai Luang Reservoirs (Luang-Pao-Chi Water Diversion Project)	RID		○	1.80	**1.00**	0.50	0.50	**0.80**	0.20	0.40	0.20
AG-5	Mae Wong River Water Resource Development Project	RID		○	1.80	**1.00**	0.50	0.50	**0.80**	0.20	0.40	0.20
AG-6	Mae Kuang Udomtara Reservoir Inflow Augmentation Project (Mae Ngat-Mae Tang-Mae Kuang Water Diversion) Stage 1	RID		○	1.80	**1.00**	0.50	0.50	**0.80**	0.20	0.40	0.20
AG-7	Mae Kuang Udomtara Reservoir Inflow Augmentation Project (Mae Ngat-Mae Tang-Mae Kuang Water Diversion) Stage 2	RID		○	1.80	**1.00**	0.50	0.50	**0.80**	0.20	0.40	0.20
AG-8	Pha Chuk Diversion Dam Project	RID		○	1.80	**1.00**	0.50	0.50	**0.80**	0.20	0.40	0.20
AG-9	Medium Scale Project of Klong Wang Ta Nod Basin	RID		○	1.80	**1.00**	0.50	0.50	**0.80**	0.20	0.40	0.20
AG-10	Siew Yai Irrigation Improvement Project	RID		○	1.80	**1.00**	0.50	0.50	**0.80**	0.20	0.40	0.20
AG-11	Maharaj Irrigation Improvement Project	RID		○	1.80	**1.00**	0.50	0.50	**0.80**	0.20	0.40	0.20
AG-12	Lam Ta Kong Irrigation Improvement Project	RID		○	1.80	**1.00**	0.50	0.50	**0.80**	0.20	0.40	0.20
AG-13	Petchaburi Irrigation Improvement Project	RID		○	1.80	**1.00**	0.50	0.50	**0.80**	0.20	0.40	0.20

Table 3.3 Project Long List (results of the 1st Screening) (2/2)

ID	Project Title	Org.	Mega	New	Total	1.1 Thai Policy			1.2 Contribution			
						Sub Total	(1) NESDB	(2) Org. Priority	Sub Total	(1) Economy	(2) Env.	(3) Poverty
AG-18	Loan for Food Safety	BAAC		○	1.80	**1.00**	0.50	0.50	**0.80**	0.20	0.40	0.20
WS-1	8th Bangkok Water Supply Project	MWA		○	1.80	**1.00**	0.50	0.50	**0.80**	0.20	0.40	0.20
MT-6	BRT Chongnonsri - Suksawasd	BMA		○	1.70	**1.00**	0.50	0.50	**0.70**	0.40	0.20	0.10
HW-6	Intercity Motorway between Bangpa-in - Nakhonratchasrima	DOH	○		1.70	**1.00**	0.50	0.50	**0.70**	0.40	0.20	0.10
HW-7	Intercity Motorway between Bangyai-Banpong	DOH	○		1.70	**1.00**	0.50	0.50	**0.70**	0.40	0.20	0.10
HW-8	Intercity Highway between Pattaya - Sathahip	DOH	○		1.70	**1.00**	0.50	0.50	**0.70**	0.40	0.20	0.10
HW-10	Intercity Motorway between Bangpa-in - Nakhonsawan	DOH	○		1.70	**1.00**	0.50	0.50	**0.70**	0.40	0.20	0.10
AP-1	Suvarnabhumi Airport Phase 2 Development Project	AOT		○	1.70	**1.00**	0.50	0.50	**0.70**	0.40	0.20	0.10
OT-2	Common Ticketing Project	OTP	○		1.60	**1.00**	0.50	0.50	**0.60**	0.40	0.20	0.00
UD-3	Low Cost Housing Project (Bann Eua-Arthorn Project)	NHA	○		1.60	**1.00**	0.50	0.50	**0.60**	0.20	0.20	0.20
HW-1	The Chao Phraya River Crossing Bridge at Nonthaburi 1 Road Construction Project	DOR		○	1.60	**1.00**	0.50	0.50	**0.60**	0.40	0.20	0.00
HW-2	Extension of Ratchaphruk Road-Kanjanapisake Road (NS)	DOR		○	1.55	**0.75**	0.25	0.50	**0.80**	0.40	0.40	0.00
HW-3	Extension of Ratchaphruk Road-Kanjanapisake Road (EW)	DOR		○	1.55	**0.75**	0.25	0.50	**0.80**	0.40	0.40	0.00

3.3 2nd Screening

3.3.1 Criteria for 2nd Screening

(1) Impacts on Social and Natural Environment

Impact on Social and Natural Environment is the criteria to assess negative environmental impacts from the project. The project which has large environmental impacts needs to pay great efforts to obtain social consensus for project implementation with careful mitigation and compensation measures. It is a significant factor to take care in the course of the project preparation. The impact is assessed based upon the size and duration of impacts anticipated and the items to be considered are followed by EIA system in Thailand as well as JBIC guideline, which are:

Social Environmental Impacts

- Requirement of resettlement
- Changing living livelihood (traffic accidents, fragmentation of community etc.)
- Damage of cultural assets
- Changing landscape
- Influence on minority groups

Natural Environmental Impacts

- Lower air and water quality
- Increasing waste
- Producing soil contamination
- Increasing noise and vibration
- Causing land subsidence and sediment
- Emitting odors
- Changing eco-system, hydrology, topography and geology
- Requirement of landfill site management
- Damaging protected area
- Increasing greenhouse gas

(2) Maturity of the Project

Maturity of the Project is the criteria to assess the level of project preparation. For the project implementation, there are several technical, environmental and financial determinations. The project also required to satisfy formal approvals and institutional requirements during the

project preparation. It is of great necessity to clarify the current preparation if the project is willing to be carried out immediately. The following project preparatory actions are particularly important to assess the maturity of the project:

- Feasibility Study
- Design (or performance specifications or configurations)
- Approvals of department, ministry and cabinet
- Approval of EIA
- Approval of Resettlement Plan (if necessary)

(3) Willingness to have Japanese ODA loan

Due to expansion of financial capacity, the RTG has several financial options such as utilization of own public budget, procurement of capital from domestic market, PPP and utilization of foreign finance so on. Willingness to have Japanese ODA loan is the criteria to assess potentiality to utilize Japanese ODA loan for project implementation.

(4) Financial Sustainability

It is currently required to carefully examine cost efficiency of the project to optimize financial burden from public investment projects. In particular, the project which expects to earn fees should be basically sustained own financial viability under beneficiaries pay principle.

3.3.2 Criteria and Scoring System of the 2nd Screening

Scoring system is proposed to numerically identify the higher priority projects based on the criteria in the 2nd screening, as shown in Table 3.4.

Table 3.4 Criteria ad Scoring System in the 2nd Screening

Items	Point	Contents		
		0%	50%	100%
2.1 Impacts on Natural &Social Environment	**1.0**			
(1 Impacts on Natural Environment	0.5	- Serious impacts on environment - Damage on reserved area [0.0]	Recoverable impacts on environment [0.25]	Minimal impacts on environment [0.5]
(2) Impacts on Social Environment	0.5	- Serious impacts on social environment - Land acquisition is required in large scale - Resettlement of more than 200 HH is required [0.0]	- Recoverable impacts on social environment - Land acquisition is required in small scale - Resettlement of less than 200 HH is required [0.25]	- Minimal impacts on social environment - Few land acquisition are required - Few resettlements are required [0.5]
2.2 Maturity of Project Preparation	**1.0**			
(1) F/S	0.2	Not yet conducted [0.0]	On-going [0.1]	Already completed [0.2]
(2) Design	0.2	Not yet conducted [0.0]	On-going [0.1]	Already completed [0.2]
(3) Government Approval	0.2	Not yet conducted [0.0]	- Approved by Ministry Level - Waiting the Cabinet approval [0.1]	Already approved [0.2]
(4) EIA	0.2	Neither IEE or EIA has not yet conducted [0.0]	IEE is completed. EIA is on-going [0.1]	- EIA is completed - EIA is not required [0.2]
(5) Resettlement	0.2	- Not yet conducted - Budget is not confirmed with resettlement plan. [0.0]	Resettlement is on-going [0.1].	- Resettlement is not required - Resettlement is completed [0.2]
2.3 Willingness	**1.0**	- Own budget is expected - Other donor is under negotiation [0.0]	Japanese ODA loan is one of the budget resources [0.5]	Japanese ODA loan is the highest potential of budget resources [1.0]
2.3 Financial Sustainability	**--**	- Financial sustainability can not be expected - FIRR is negative [C]	Implementation organization needs subsidy [B]	- Financial sustainability is expected (not any loss caused by project) - FIRR is appropriate - Financial sustainability can not be adopted [A]
Total	**3.0**			

Source: JICA Pilot Study Team

3.3.3 Results of the 2nd Screening

The JICA Pilot Study Team identifies totally 28 projects through the 2nd screening.

Table 3.5 Project Short List (results of the 2nd Screening)

ID	Project Title	Org.	Mega	New	Total	2.1 Impact			2.2 Maturity						2.3 Willing-ness	2.4 Financial Sustain-ability
						Total	1.1 Env.	1.2 Social		2.1 F/S	2.2 D/D	2.3 Approval	2.4 EIA	2.5 Resettlement		
AG-1	Project for Revitalization of the Deteriorated Environment in land Reform Area through Integrated Agriculture Development/ Stage 1 – Extension Period (2008-2100)	ALRO		○	**2.90**	**1.00**	0.50	0.50	**0.90**	0.20	0.20	0.10	0.20	0.20	**1.00**	**A**
AG-2	Project for Revitalization of the Deteriorated Environment in land Reform Area through Integrated Agriculture Development/ Stage 2	ALRO		○	**2.90**	**1.00**	0.50	0.50	**0.90**	0.20	0.20	0.10	0.20	0.20	**1.00**	**A**
AP-1	Suvarnabhumi Airport Phase 2 Development Project	AOT		○	**2.70**	**1.00**	0.50	0.50	**0.70**	0.20	0.10	0.10	0.10	0.20	**1.00**	**A**
EN-1	The Renewable Power Generation Program	MNRE, FIO		○	**2.60**	**1.00**	0.50	0.50	**0.60**	0.10	0.10	0.00	0.20	0.20	**1.00**	**A**
WS-1	8th Bangkok Water Supply Project	MWA		○	**2.55**	**0.75**	0.25	0.50	**0.80**	0.20	0.10	0.10	0.20	0.20	**1.00**	**C**
AG-11	Maharaj Irrigation Improvement Project	RID		○	**2.50**	**1.00**	0.50	0.50	**1.00**	0.20	0.20	0.20	0.20	0.20	**0.50**	**B**
AG-10	Siew Yai Irrigation Improvement Project	RID		○	**2.40**	**1.00**	0.50	0.50	**0.90**	0.20	0.10	0.20	0.20	0.20	**0.50**	**A**
AG-3	Sustainable Development for Agricultural Security and Natural Environment Conservation in Land Reform Areas.	ALRO		○	**2.40**	**1.00**	0.50	0.50	**0.40**	0.10	0.00	0.10	0.00	0.20	**1.00**	**A**
AG-12	Lam Ta Kong Irrigation Improvement Project	RID		○	**2.40**	**1.00**	0.50	0.50	**0.90**	0.20	0.10	0.20	0.20	0.20	**0.50**	**B**
AG-13	Petchaburi Irrigation Improvement Project	RID		○	**2.40**	**1.00**	0.50	0.50	**0.90**	0.20	0.10	0.20	0.20	0.20	**0.50**	**B**
MT-11	The Red Line Rail System Project (Bang Sue-Talingchan)	SRT	○		**2.40**	**0.50**	0.50	0.00	**0.90**	0.20	0.20	0.20	0.20	0.10	**1.00**	**B**
HW-1	The Chao Phraya River Crossing Bridge at Nonthaburi 1 Road Construction Project	DOR		○	**2.40**	**0.50**	0.50	0.00	**0.90**	0.20	0.20	0.20	0.20	0.10	**1.00**	**B**
MT-10	The Red Line Rail System Project (Bang Sue – Rangsit)	SRT	○		**2.40**	**0.50**	0.50	0.00	**0.90**	0.20	0.20	0.20	0.20	0.10	**1.00**	**C**
HW-3	Extension of Ratchaphruk Road-Kanjanapisake Road (EW)	DOR		○	**2.35**	**0.75**	0.50	0.25	**0.60**	0.20	0.20	0.00	0.20	0.00	**1.00**	**B**
MT-1	Light Green Line Extension 1	BMA	○		**2.30**	**1.00**	0.50	0.50	**0.80**	0.20	0.20	0.20	0.20	0.00	**0.50**	**A**
MT-2	Light Green Line Extension 2	BMA	○		**2.30**	**1.00**	0.50	0.50	**0.80**	0.20	0.20	0.20	0.20	0.00	**0.50**	**A**
AG-7	Mae Kuang Udomtara Reservoir Inflow Augmentation Project (Mae Ngat-Mae Tang-Mae Kuang Water Diversion) Stage 2	RID		○	**2.30**	**1.00**	0.50	0.50	**0.80**	0.20	0.10	0.10	0.20	0.20	**0.50**	**A**
AG-9	Medium Scale Project of Klong Wang Ta Nod Basin	RID		○	**2.30**	**1.00**	0.50	0.50	**0.80**	0.20	0.10	0.10	0.20	0.20	**0.50**	**B**
MT-9	The Red Line Rail System Project, Bang Sue-Hua Lamphong-Makkasan-Hua Mak Section	SRT	○		**2.30**	**0.50**	0.50	0.00	**0.80**	0.20	0.20	0.20	0.10	0.10	**1.00**	**B**
MT-7	Chiangmai BRT	OTP		○	**2.20**	**1.00**	0.50	0.50	**0.70**	0.20	0.20	0.10	0.20	0.00	**0.50**	**A**
AG-5	Mae Wong River Water Resource Development Project	RID		○	**2.20**	**1.00**	0.50	0.50	**0.70**	0.20	0.20	0.10	0.20	0.00	**0.50**	**A**
MT-13	MRTA Blue Line Extension, Bang Sue to Tha Pra and Hua Lumphong to Bang Kae	MRTA	○		**2.20**	**0.50**	0.50	0.00	**0.70**	0.20	0.20	0.10	0.20	0.00	**1.00**	**B**
MT-6	BRT Chongnonsri - Suksawasd	BMA		○	**2.10**	**1.00**	0.50	0.50	**0.60**	0.20	0.20	0.00	0.20	0.00	**0.50**	**A**
MT-12	MRTA Purple Line, Bang Yai to Rat Burana, Bang Sue to Rat Burana Section	MRTA	○		**2.10**	**0.50**	0.50	0.00	**0.60**	0.20	0.20	0.00	0.20	0.00	**1.00**	**B**
HW-2	Extension of Ratchaphruk Road-Kanjanapisake Road (NS)	DOR		○	**2.10**	**0.50**	0.50	0.00	**0.60**	0.20	0.20	0.00	0.20	0.00	**1.00**	**B**
OT-2	Common Ticketing Project	OTP	○		**2.00**	**1.00**	0.50	0.50	**0.50**	0.10	0.00	0.00	0.20	0.20	**0.50**	**A**
AG-18	Loan for Food Safety	BAAC		○	**2.00**	**1.00**	0.50	0.50	**1.00**	0.20	0.20	0.20	0.20	0.20	**0.00**	**B**
MT-14	MRTA Orange Line Phase 1, Thailand Cultural Center to Bang Kapi Section	MRTA	○		**2.00**	**0.50**	0.50	0.00	**0.50**	0.10	0.20	0.00	0.20	0.00	**1.00**	**C**

PART 2: POTENTIAL COLLABORATION PROJECTS

Chapter 4 SELECTION OF POTENTIAL COLLABORATION PROJECTS

4.1 Overall

Up to Chapter 3, the short-listed projects are selected as potential projects for Japanese ODA Loan. JICA may have a continuous discussion with Thai side regarding future Japanese ODA with utilizing the list.

In addition, the potential collaboration project is defined as a project requiring support for project formation at this stage, which is expected to contribute to long-term partnership between Thailand and JICA especially after Thailand develops into an upper-middle-income country. The selection is made from short listed projects through holistic discussions mainly focusing the following criteria:

- Consistency with JICA Strategy;
- Utilization of Japanese experience and technology;
- Long-term partnership between JICA and Thai Government; and
- Cooperation to Project Formation.

Potential Collaboration Project regarding its definition, selection criteria above mentioned as well as selected three projects mentioned in the following section such as the renewable energy project, urban transport improvement project and human resource development projects are explained to NESDB in the interim and are finally approved by NESDB.

4.2 Selection Criteria

(1) Consistency with JICA Strategy

JICA (former JBIC at that time) has developed “Basic Strategy of Japan’s ODA Loan” in 2005 as own operation plan along with Japan’s ODA policy. JICA emphasizes four focal areas such as (1) poverty alleviation, (2) infrastructure provision for sustainable growth, (3) global issues and peace construction, and (4) human resource development. In particular, it is foreseen that Thailand would continue to be developed in future to join a member of upper-middle-income countries. Accordingly, JICA recognizes necessity to shift the scope of assistance from traditional infrastructure-based assistance. In this regard, JICA puts more emphasis on correction of its deteriorated urban environment, closing of regional and income gaps which are negative results of fast economic growth for Thailand, and human resource

development. In light of this recognition regarding Thailand, JICA emphasizes (1) improvement of urban strategy functions including environmental improvement, (2) reduction of economic and income gaps by promotion of rural development and poverty alleviation, and (3) human resource development.

The project which can be categorized in the focused attention above has to be paid higher priority for the selection as potential collaboration projects.

(2) Utilization of Japanese Experience and Technology

JICA strategy mentioned above also pointed out to place high priority on intellectual cooperation with and technical assistance to regional development. Meanwhile, an application of Japanese experience and technology is considered as one of important tools for more closed cooperation and understandings between two countries. Accordingly, as the intellectual and technical assistance, utilization of know-how accumulated through Japanese experience and technology would be taken into account in the selection criteria.

(3) Long-term Partnership between JICA and Thai Government

Japanese ODA in principle aims at not only cooperating development of recipient country but also strengthening long-term relationship between two countries through project implementation. For maintaining long-term partnership with Thailand, projects to be implemented under Japanese ODA loan need to be met with project demand which may be changed depending on social and economic dynamics. In this regard, this study pays more attention on the project with different style of service, different development target or something new besides just traditional infrastructure development project, as a next generation project.

(4) Cooperation to Future Project Formation

This study aims at not only finding potential projects for future Japanese ODA loan also cooperating in project formation of potential collaboration projects. In this regard, the study team intends to provide technical support based on the Japanese know-how in the course of the study. Accordingly, for selecting potential collaboration projects, this study gives more attention on the project which requires more cooperation for future project formation.

4.3 Results of Selection

The following projects are selected as potential collaboration project:

- The Renewable Power Generation Program
- Bus Rapid Transit (BRT) systems in Chiang Mai and Bangkok

4.3.1 The Renewable Power Generation Program

The renewable power generation program is the project to promote alternative energy development with the aim of energy-saving and reduction of CO2 as well as to reduce a risk of forest fire. The project generates electricity by using biomass technology. This is an environmental project with energy saving and CDM as well as poverty reduction project in rural area which are two of the focused issues of the JICA strategy. In addition, the project has wide possibility to utilize Japanese Biomass technology or gasification technology for improving efficiency of project.

4.3.2 Bus Rapid Transit System in Chiang Mai and Bangkok

Bus Rapid Transit (BRT) System is a conventional feeder system of urban railway with relatively lower project cost and short construction period. There are plans for Bangkok and Chiang Mai. The project area includes regional cities other than Bangkok and Chiang Mai because OTP, which has experience of the Traffic Planning and Management Sector Loan[2] and capability to conduct Japanese ODA loan project, proposed to formulate a comprehensive project including regional cities which are in serious urban transportation problem, and finance for the projects are not yet in sight. The project aims at contributing modal shift of urban transport from motor vehicle to rail system by providing feeder system, and can be expected to reduce CO_2 emission. Accordingly, the project can be categorized as an environmental project and expected to be future CDM project, which is one of the focused issues of the JICA strategy. The project, particularly bus system and traffic IT devices have certain potential to utilize Japanese technology as well.

4.4 Additional Project for Human Resources Development

There are several projects identified regarding education and human resource development in the Mega-projects, but, there is very limited information gathered to be complied in the project profiles. Accordingly, there is little project information which has potential to be implemented under Japanese ODA loan at the ministry and department levels. Even though, human resource development is one of focused attention of the JICA strategy, so that the JICA Pilot Study Team finds “seeds” of the future project such as:

- The Second Thailand –Japan Technology Transfer Project (TJTTP-II)
- Medical Network Development Project at Chiangmai University
- Rajamangala University of Technology Capacity Building Project

The projects have been prepared by university concerned such as Chulalongkorn University, and Rajamangara University of Technology in accordance with improve capacity and quality of

[2] Traffic Planning and Management Sector Loan (4,148 million Yen; loan agreement in September 1998) intended to establish policies and plans, under coordination by OCMLT, in order to attain efficient usage of roads and improvement of traffic safety, and to strengthen the institutional framework for the development and operation of the transportation sector.

higher education regarding science and IT related technology to respond increasing requirements of engineers who lead future advancement of industrial structure of Thailand. While, the project of Chiangmai University is prepared for improving capacity of doctors, physicians and nurses in both quantity and quality to improve medical service of Chiangmai University hospital which is a core medical center in Northern Region. However, these projects have not yet been confirmed in details including project scope, implementation scheme and schedule so on. Accordingly, these projects are required to be refined their project scope and, implementation scheme and schedule to be implemented under Japanese ODA loan.

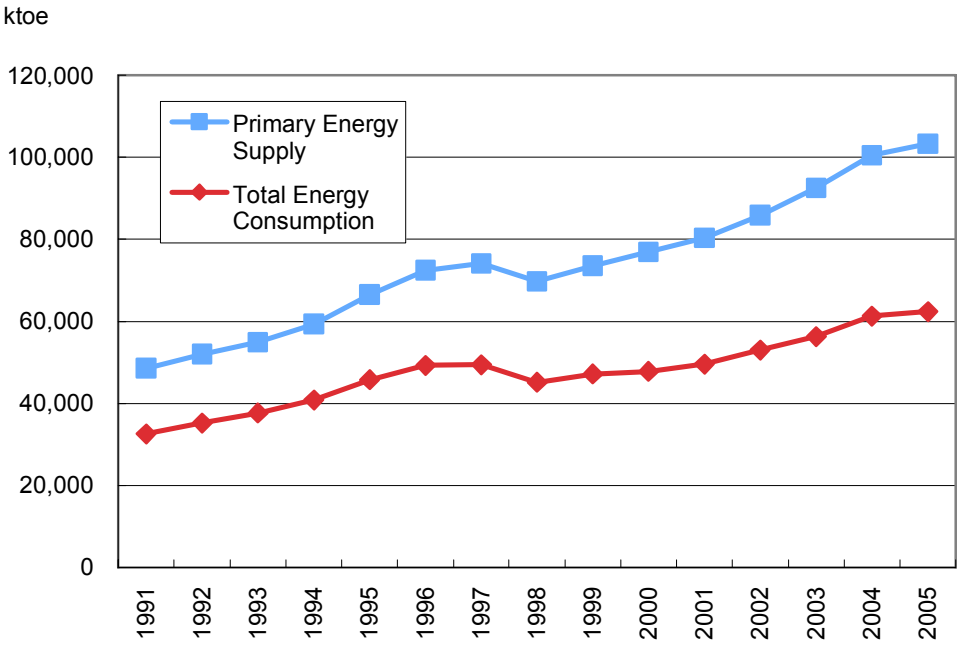
Even these projects are not potential collaboration projects, the JICA Pilot Study Team will collaborate with agencies concerned to preliminary formulate each project for sharing project information among agencies concerned including the NESDB and JICA.

Chapter 5 RENEWABLE ENERGY PROJECT

5.1 Policies on Global Warming Issue in Thailand

5.1.1 Situation of Energy Consumption

In Thailand, supply and consumption of primary energy has increasing rapidly. Figure 5.1 illustrates change of primary energy supply and energy consumption from 1991 to 2005. Both of the supply and the consumption had decreased after the Financial Crisis in 1997; however, they have started growing again since 1999. Annual average growth rate during 1998 and 2005 is 5.8% for the primary supply and 4.7% for total energy consumption, respectively.



Source: Pocket Thailand in Figures 10th Edition 2007
Note: ktoe = kilo ton of oil equivalent

Figure 5.1 Change of Primary Energy Supply and Total Energy Consumption

Table 5.1 indicates compositions of the primary energy supply and the final energy consumption in 2005. 52% of the primary energy came from domestic resource. Natural gas from domestic resource occupied 20% of total primary energy supply; otherwise, Thailand also imported natural gas which amounted to 8% of the total supply. Percentage of

renewable energy to total primary energy supply was 16%, and 2nd position in domestic energy resource. Percentage of import was 47% of the total primary energy supply and almost of the import was occupied by crude oil (40% of the total primary energy supply).

Table 5.1 Supply and Consumption of Primary Energy in Thailand in 2005

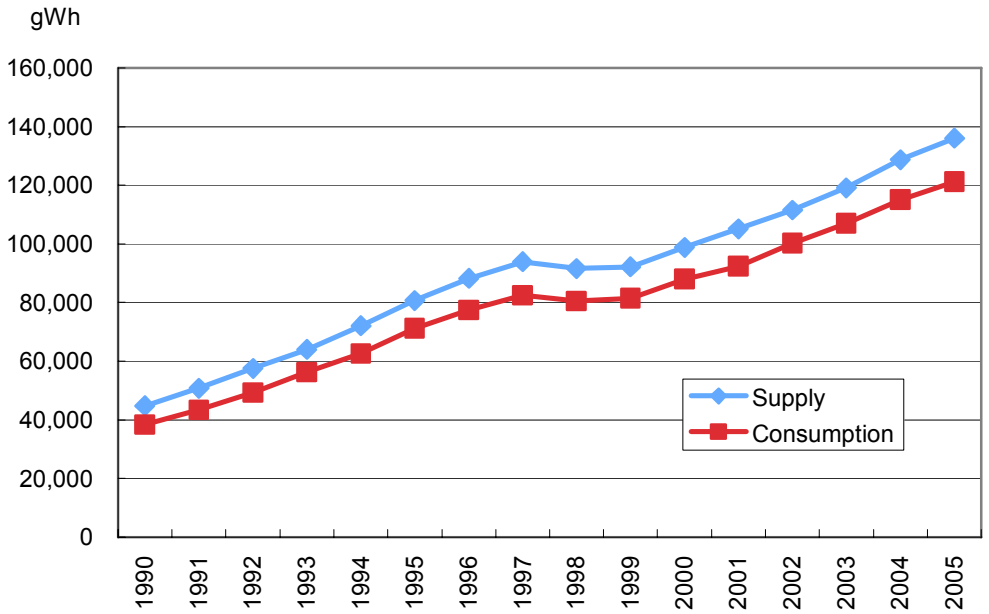
Unit: ktoe

Primary Energy Supply		Final Energy Consumption by Economic Sectors	
Domestic	53,640	Agriculture	3,207
Lignite	5,983	Mining	125
Crude oil	5,704	Manufacturing	22,643
Condensate	3,156	Construction	152
Natural gas	20,534	Residential and commercial	12,779
Hydro-electric	1,605	Transportation	23,491
Renewable energy	16,658		
Import	48,351	Non-energy Use	3,408
Bituminous	3,879	Transformation	30,537
Other coal	1,531	Losses	1,060
Crude oil	41,308	Own uses	5,900
Natural gas	8,236		
Petroleum products	1,980		
Electricity	377		
Renewable energy	22		
Export	-8,982		
Change of stock	1,311		
Total	103,302	Total	103,302

Note: ktoe = kilo ton of oil equivalent
Source: Pocket Thailand in Figures 10th Edition 2007

The highest percentage in final energy consumption was transport (23%) followed by manufacturing (22%) and residential and commercial (12%). 40% of the final consumption was not used as energy, and most of them were transformed into another form (30%).

Power supply and consumption have been increasing rapidly. Figure 5.2 illustrates change of power supply and consumption. Growth of supply and consumption had stopped after the financial crisis as well as the primary energy supply and consumption. However, it has increased more rapidly than primary energy supply and consumption. Power supply and consumption has tripled in 15 years during 1990 and 2005; otherwise, supply and consumption of the primary energy has doubled in the same period.



Source: Electric Power in Thailand 2005, Ministry of Energy
Note: Consumption does not include station service and line loss.

Figure 5.2 Change of Electricity Supply and Consumption

Table 5.2 indicates supply of electricity by source of energy. Natural gas, which is exploited within the country, has been occupying 70% of the total source of energy. Coal and lignite has been in the 2nd position (15 to 17% between 2002 and 2005). Other sources are minor, and biomass including woody biomass[3] is included in "Others", which is marginal in this table.

Table 5.2 Supply of Electricity by Source of Energy

Unit: gWh

	2002	2003	2004	2005
Hydro	7,471	7,299	6,040	5,798
Fuel oil	2,616	2,941	7,138	8,244
Diesel	168	180	551	414
Coal and lignite	16,652	16,807	17,993	18,334
Natural gas	69,538	76,332	80,489	85,703
Others	2	2	2	2
Sub-total*	96,447	103,561	112,213	118,495
Import	2,812	2,479	3,388	4,419
Export	-273	-296	-372	-642
Total	98,986	105,744	115,229	122,272

Source: Electric Power in Thailand 2005, Ministry of Energy
Note: Excluding co-generation from Small Power Producer (SPP), etc

[3] In general the word "biomass" includes all of plants and animal matters used to provide power or energy.

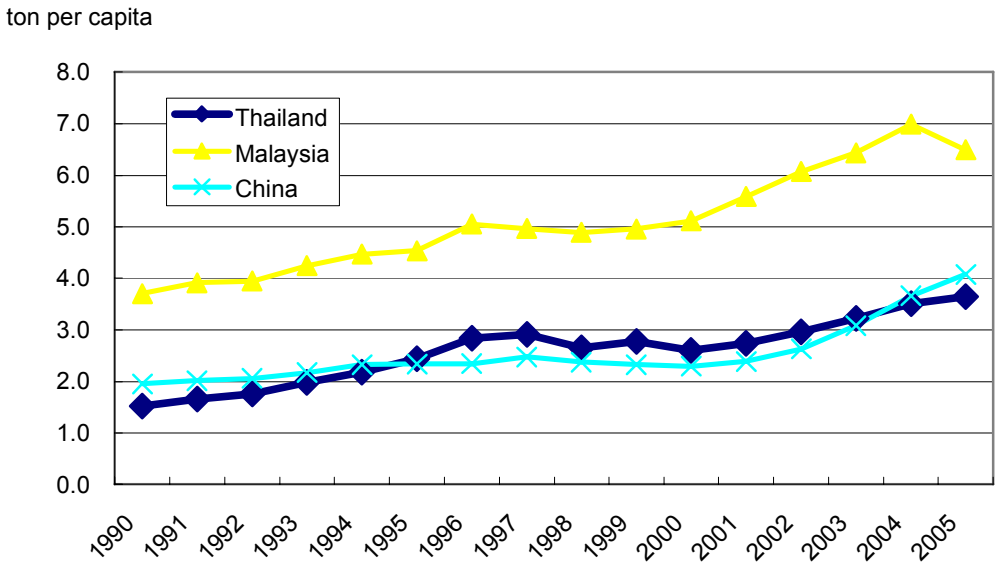
Table 5.3 Consumption of Petroleum Products by Economic Activities

Unit: million liters

	2002	2003	2004	2005
Agriculture	3,509	3,827	4,071	3,708
Mining	19	26	37	30
Manufacturing	4,821	4,937	5,090	4,383
Electricity	703	757	1,832	2,097
Construction	169	175	194	174
Residential and commercial	2,729	2,792	2,813	2,979
Transportation	23,980	25,475	27,654	28,379
Total	35,930	37,989	41,691	41,750

Source: Oil and Thailand 2005, Ministry of Energy

Share of fuel oil was only 7% in 2005; however, it has increased more than triple, from 2,616 gWh to 8,244 gWh in 4 years. Petroleum for power generation has also tripled from 703 million liters to 2,097 million liters in the same period, as indicated in Table 5.3. Although the share of electricity was only 5% in 2005, it seems to increase rapidly in accordance with rapid increase of the power consumption.



Source: Energy Information Administration Web site (http://www.eia.doe.gov/emeu/international/carbondioxide.html)

Figure 5.3 Per Capita Carbon Dioxide Emissions from the Consumption and Flaring of Fossil Fuels

In such circumstances, consumption of carbon dioxide is also increasing. Figure 5.3 indicates per capita carbon dioxide emissions from consumption and flaring of fossil fuels from 1990 to 2005. Amount in Thailand in 2005 was 3.65 ton per capita, which is lower than the world average (4.37 ton per capita) but higher than the average in Asia & Pacific (2.87 ton per capita). Annual growth rate in 15 years from 1990 to 2005 is 6.0%, the highest level in the East and the

Southeast Asian countries[4].

5.1.2 Policies

(1) Energy Policy

Thai Government announced the following energy efficient policies in 2001.

- Utilization of natural gas which is produced in Thailand,
- Research & development and promotion of utilization of alternative energy, and
- Structural reform of energy industry so as to contribute to competitiveness of industries

And the Government also emphasized necessity of research & development of renewable energy such as biomass and solar power in the 9th National Economic and Social Development Plan (2002 – 2006). Importance to develop alternative energy is also described in the 10th National Economic and Social Development Plan (2007 – 2011).

Energy Planning and Policy Office (EPPO) under the Ministry of Energy sets a national energy strategy from 2005 to 2011. The strategy aims to limit energy consumption growth (from energy consumption: economic growth = 1.4:1 in current proportion to 1:1) and to increase a proportion of renewable energy to the total energy consumption (from 0.5% to 8%).

EPPO set the following four pillars to achieve the target.

- Efficient use of energy,
- Development of renewable energy,
- Stable supply of energy and
- Improvement of national energy supply system based on regional energy center.

(2) Electrical Power Policy

In Thailand, electric power supplier consists of EGAT (Electric Generating Authority of Thailand), IPP (Independent Power Producer, larger than 90MW), SPP (Small Power Producer, from 1MW to 90MW), VSPP (Very Small Power Producer, less than 1MW), MEA (Metropolitan Electricity Authority) and PEA (Provincial Electricity Authority).

[4] The second highest country is Taiwan (5.3%), and the third is China (5.0%).

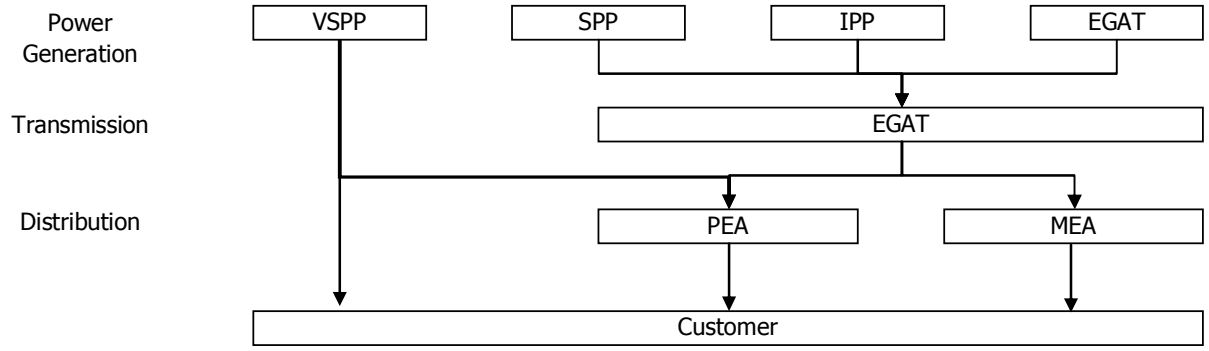


Figure 5.4 Relation of Power Suppliers

EGAT is responsible for producing electric power and maintain national backbone. IPP, SPP and VSPP are private power supplier, and selling electric power to EGAT, MEA or PEA, in accordance with their capacity. In order to use domestic resource efficiently and to open up an opportunity for remote areas to participate in electricity generation, regulation to purchase from VSPP has prepared by Ministry of Energy. Such relations are illustrated in Figure 5.4. Currently, MEA and PEA have to purchase electric power from VSPP around 3.0 Baht per 1kW[5].

5.1.3 Biomass Projects

As of October 2007, there were 54 SPP and 23 VSPP projects available in Thailand[6]. Total installed capacity is 1,130 MW, and 551.8 MW is sold to the PEA and the MEA. The most popular fuel for the SPP and VSPP was bagasse, waste part of sugar cane, and rice husk/ rice straw followed that. Other minor fuels are oil palm wastes, biogas and municipal solid waste (MSW). Woody biomass such as residue at plantations and sawdust at sawmills are not used for biomass power supply project to date.

Although information about combustion system is not indicated in collected data, almost of the projects using bagasse and rice husk/straw, palm oil wastes and MSW are direct combustion system, but gasification technology is used for biogass projects.

5.2 FIO Forests

Forest Industry Organization (FIO) is a state enterprise regarding to conservation and earning profit from its plantations which is provided by the Royal Forest Department (RFD). The organization was established in 1947, and became a state enterprise under the Ministry of

[5] Information from FIO and Study on CDM case studies in Thailand October 2005
[6] Original data is collected from the following web pages: http://www.efe.or.th/download/SPP&VSPP_Oct07.xls and http://www.efe.or.th/download/map_Oct.07pdf.

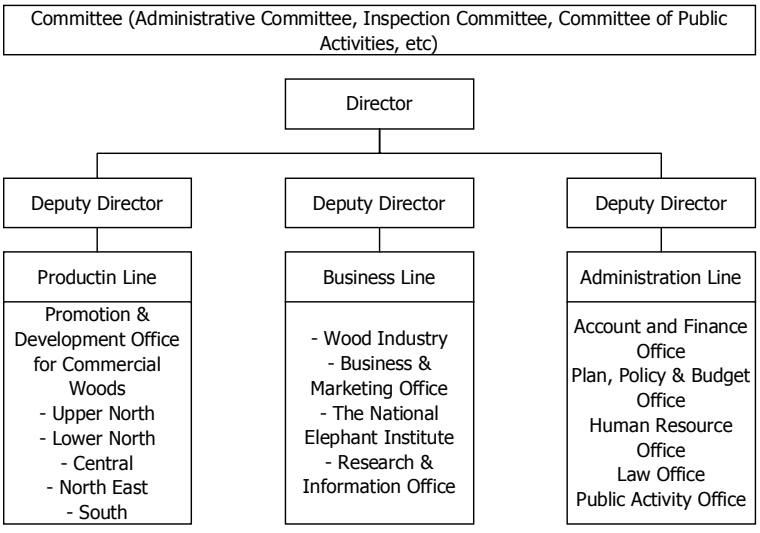
Agriculture and Cooperative in 1956. In 2003, the organization has moved to the Ministry of Natural Resource and Environment.

FIO has the following vision and missions. FIO has wide range of roles. It is not only commercial activity of plantations but also supporting local communities though activities of forest industry and pioneer for private plantation businesses. In such context, FIO is also expected to start a woody biomass power project to achieve energy policy target.

Vision: Main organization in developing economic forest to be basis for sustainable development which follows "sufficient economy".

Mission:

- To conserve and develop commercial woods in FIO plantations,
- To promote sustainable growth of forest industry not only for national forests but also for private plantations,
- To support forest industry business and forest service business,
- To research and develop commercial woods to develop forest industry,
- To support local communities around FIO plantations by providing job opportunity and training skills on forestry, and
- To conserve and rehabilitate natural resources and environment.



Source: Annual Report of FIO in 2007

Figure 5.5 Organization of FIO

Figure 5.5 illustrates organization of FIO. Some committees such as administrative committee, inspection committee and public activity committee set direction of activities. Under these committees, Director manages daily activities of FIO. Three lines (production line, business line and administration line) are set under the Director.

Table 5.4 and Table 5.5 indicate profit and loss and balance sheet, respectively. 60% of income came from sales of commercial wood such as teak and Eucalyptus, and 30% of income comes from production from crude rubber. Due to price hike of crude rubber, production and income from crude rubber is increasing in recent years.

Table 5.4 Profit and Loss of FIO in 2006 and 2007

Unit: 000 baht

Items	2007/12/31	2006/3/31
Income	1,518,257	1,410,213
Expense	1,409,619	1,321,063
Profit before interest payment	108,637	89,149
Interest Payment	26,300	33,434
Net Profit	82,337	55,715

Source: FIO annual report in 2007

Balance Sheet of FIO indicates that business situation of FIO seems to be stable and solid due to high proportion of non-current asset to the total assets, and small percentages of non-current liability and high percentage of equity to total liability & equity.

Table 5.5 Balance Sheet of FIO in 2006 and 2007

	2007/12/31	2006/3/31
Assets		
Current Assets	239,432	238,751
Non-current Assets	2,802,648	2,791,216
Total Assets	3,042,080	3,029,967
Liability & Equity		
Current Liability	176,226	272,201
Non-current Liability	822,947	797,197
Total Liability	999,173	1,069,398
Equity	2,042,907	1,960,570
Total Liability & Equity	3,042,080	3,029,967

Source: FIO annual report in 2007

Table 5.6 indicates area of FIO plantations by species of wood. In total FIO has 186 places with total area of 1,167,793 rai (186,847 ha). The table shows that Teak (5,78103 rai) and Eucalyptus (200,955 rai) are the major species in the FIO plantations. In the northern plantations, Teak tree is the major specie; on the other hand, Eucalyptus is the major specie in the northeastern plantations.

Table 5.6 FIO's Plantations

Unit: rai

Organization	Species					Other area	Total
	Teak	Teak-mixed	Eucalyptus	Pararubber	Non-teak		
Upper Northern (41)	295,011	5,662	10,408	-	24,907	1,568	337,557
Institute of elephant Care (1)	14,002	100	1,077	-	-	-	-
Lower northern (36)	201,652	5,465	11,325	-	6185	-	224,626
Central (25)	55,767	8,945	29,290	1,349	38,788	3,324	137,463
Southern (28)	58	1,400	23,602	32,934	109,502	-	167,496
Northeastern (55)	11,613	3,325	125,254	215	126,961	18,103	285,472
Total (186)	578,103	24,897	200,955	34,499	306,344	22,995	1,167,793

Note: 1 rai = 0.16ha = 0.0016km^2
Source: Forest Industry Organization

5.3 Project Concept

5.3.1 Rationale/Justification of the Project

FIO expects the following four (4) benefits from the renewable energy project. The first one is employment creation for local villagers. The project needs a lot of manpower to collect and transport biomass. Although FIO plantations provide job opportunity to local villagers to maintain commercial forest now, such works will provide more job opportunity to them. Increase of income for local villagers from the job creation is recognized as an economic benefit of the project, and estimated when Economic Internal Rate of Return (EIRR) is calculated.

The second one is substitution of fossil fuel by woody biomass which is treated as wastes now. As described in 5.1.1, volume of petroleum used for power generation has been rapidly increasing. The project will contribute to decrease import of crude oil which costs USD around 120 per barrel as of July 2008. Expected reduction volume of petroleum will be considered as one of economic benefit of the project, and estimated as well as employment generation for local villagers.

The third one is reduction of carbon dioxide emission. Carbon dioxide emission from fossil fuel such as petroleum, natural gas and coal increases abundance of carbon in atmosphere; On the other hand, carbon dioxide emission from biomass doesn't increase abundance of carbon in atmosphere (so called carbon neutral) because carbon is accumulated by the biomass. That is why substitution from fossil fuel to biomass is going to reduce carbon dioxide emission in atmosphere. Expected CO_2 reduction volume will be also estimated in calculation of EIRR. FIO has a role to introduce and conduct Clean Development Mechanism (CDM) projects by the Thai Government. FIO can play the role though the renewable energy project.

The last one of the project is to demonstrate renewable power generation by use of woody biomass to private plantation businesses. As described in 5.1.1, renewable energy including woody biomass is the second major primary energy supply source; however, it is marginal rile in terms of energy source for power generation. FIO intends to show the benefits of the project mentioned above to the private plantations which are located in the surrounding of the FIO plantations. That is why FIO is planning to purchase biomass from the surrounding plantations in its business plan. FIO also expect that private plantations will starts the biomass power generation project, and private sectors including local villagers have more benefits from their resources in the long run.

In Thailand, rate of electrification recorded 98.6% in village level and 84.4% in household level in 2004[7]. The rate has already reached to the high level, and primary objectives of the project are not to increase rate of electrification but to promote expected four benefits.

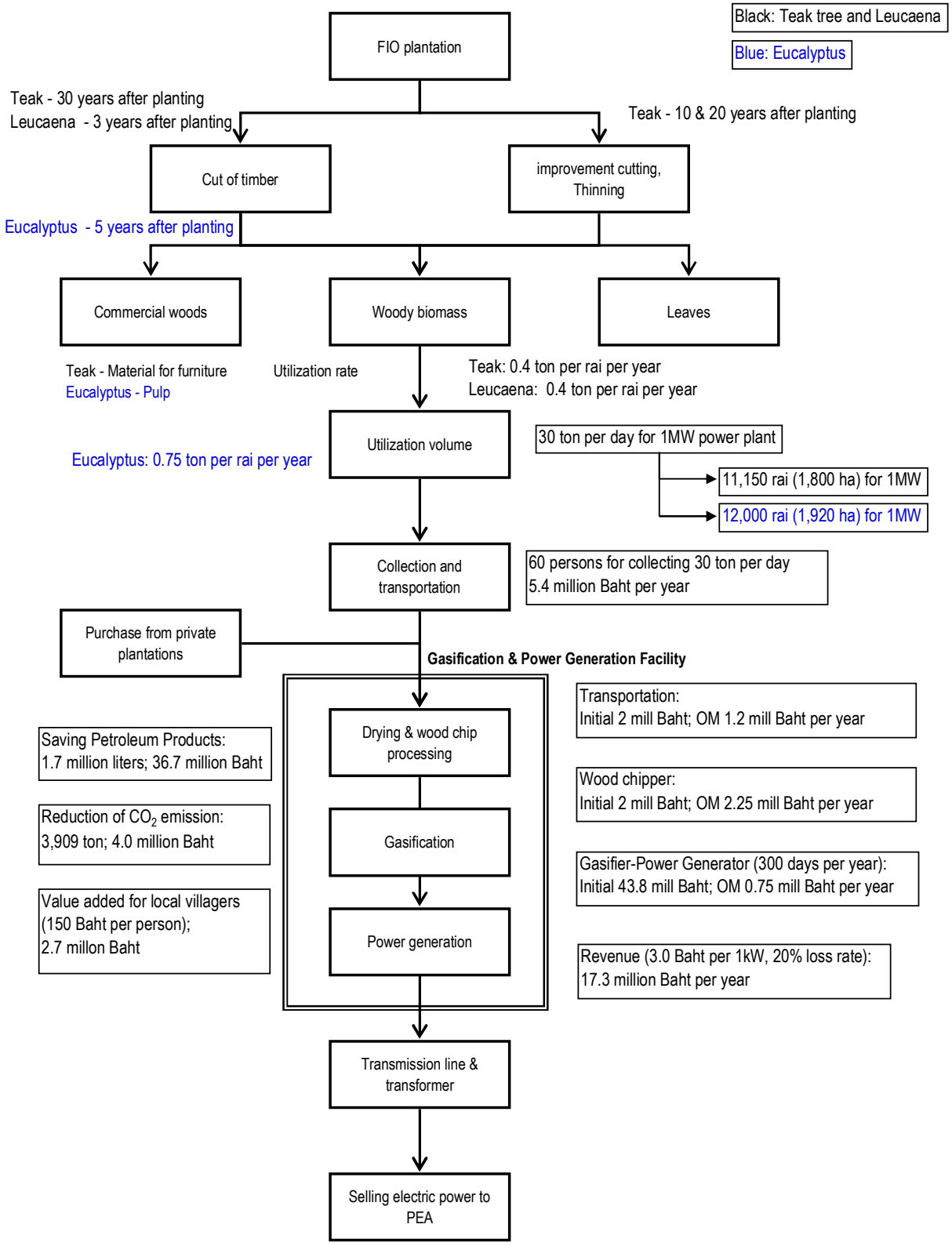
5.3.2 Overall Project Flow

Overall work flow of the project is illustrated as Figure 5.6. Residues (a waste part of logged woods such as branch, wood and other kind of species; hereinafter described as “biomass”), which are generated from logging, improvement cutting and thinning are, are collected by local villagers. FIO shall also purchase and collect biomass from the surrounding private plantations.

Collected biomass shall be dried and broken down into woodchip, and put into gasification facility. The woodchip shall be divided into gas (H_2, CO and CH_4), tar and residual carbide inside of the gasification facility. Generated gas shall be transferred and burned at gas turbine generator, and combustion gas shall drive a turbine to create electricity.

Created power shall be transferred to Provincial Electrical Agency (PEA) grid though transmission line prepared by this project. FIO receive service charge from PEA for providing electric power.

[7] Data from “Thailand in Figures 11th Edition 2005-2006”.



Source: Study Team

Figure 5.6 Overall Work Flow and Figures for 1 MW Power Plant Project

5.3.3 Endowed Biomass Resources

In the Renewable Energy Project, three kinds of species, Teak, Eucalyptus and Leucaena are identified as fuel for gasification power generation. Each of specie has the following characters.

(1) Teak

Teak tree (academic name is *Tectona*) is the most major products in FIO plantations. Teak tree originally came from Thailand, and the harvested tree is used for material of furniture. Teak tree is harvested 30 years after planting, and has thinning and improvement cutting every 10 years.

Teak Tree

thinned Teak wood

Teak trees generates 4 ton of biomass (waste part of thinned woods and timbers) per 1 rai when it has thinning & improvement cutting and harvesting[8]. Since thinning & improvement cutting and harvesting are done in every 10 years, average biomass volume would be 0.4 ton per rai per year.

Teak tree in natural forest had been cutting down, and it is one of important export goods for Thailand until 1980s. In 1989, logging of teak tree from natural forest had prohibited, and only commercial tree can be cut down after that. After logging of natural Teak trees, of commercial Teak trees are planted, and these trees are growing (20 to 30 years old now). Under such situation, production of Teak tree is increasing in recent years.

[8] Information on biomass volume comes from FIO headquarter and local offices the study team visited. The information is assessed by local consultant hired from Forest Research Center, Faculty of Forestry, Kasetsart University.

(2) Leucaena

Leucaena (academic name is *Leucaena Leucocephala*) is a small tropical tree native to Mexico. It is used for a variety of purposes such as firewood, fiber and livestock feed. FIO introduced the tree for 20 years ago to produce livestock feed. Since the tree is very vigorous, it can be seen anywhere in FIO plantation now.

FIO is planning to planting the Leucaena tree between Teak woods and harvest more biomass. Due to its vigorous character, Leucaena is expected to generate 1.2 ton biomass per rai without care in three (3) years, that is to say 0.4 ton per year[9].

Leucaena (Giant Epil-Epil)

(3) Eucalyptus

Eucalyptus is also major economic wood following Teak tree at FIO plantations. It comes from Australia, and Harvested tree is used for pulp (material of paper).

Eucalyptus tree is also rapid growing and economically efficient tree. It is harvested five (5) years after planting, and when it comes to the period of harvesting, it unpeels bark by itself. The bark is also a part of biomass. After harvesting, the next generation of tree grows up from the stubble; in total three generations of tree comes from the original stubble (15 years).

Volume of harvested Eucalyptus tree is 15 ton per rai, and 25% of the tree is not used as pulp. That is why volume of biomass volume is 3.75 ton, and volume of biomass per rai per year is 0.75 ton. These results are consistent with the previous studies in Thailand and Japan.

[9] Leucaena generates 2,000 – 20,000 kg of biomass per hectare per year. It is equal to 320kg to 3.2 ton per rai per year.

Eucalyptus tree

The next generation of tree
from the stubble

5.3.4 Calculation of Biomass Volume

Based on the section 5.3.3, necessary area for generating biomass is introduced from the following calculation. According to FIO, 30 ton of biomass is needed to operate 1MW power plant. The figure is consistent with some experiences in Japan and biomass power generation cases using rice husk.

In cease of Teak plantations in which Teak tree and Leucaena are planted, annual average biomass volume is 0.8 ton per rai per year. On the other hand, necessary biomass volume per year is 9,000 ton (30 ton x 300 days[10]). Therefore, 11,250 rai (9,000/0.8 = 11,250, 1,800 hectare) is needed to operate 1MW power plant.

In cease of Eucalyptus plantation, annual average biomass volume is 0.75 ton per rai per year. Necessary biomass volume per year is 9,000 ton, as same as Teak plantation. Therefore, 12,000 rai (9,000/0.75 = 12,000, 1,920 hectare) is needed to operate 1MW power plant.

In these calculations, it is assumed all of the biomass in each plantation is collected. However, it is difficult to collect all of biomass if plantation is located mountainous and steeper place. That is why biomass collection volume should be assessed before the project will be carried out.

5.3.5 Power Generation Process

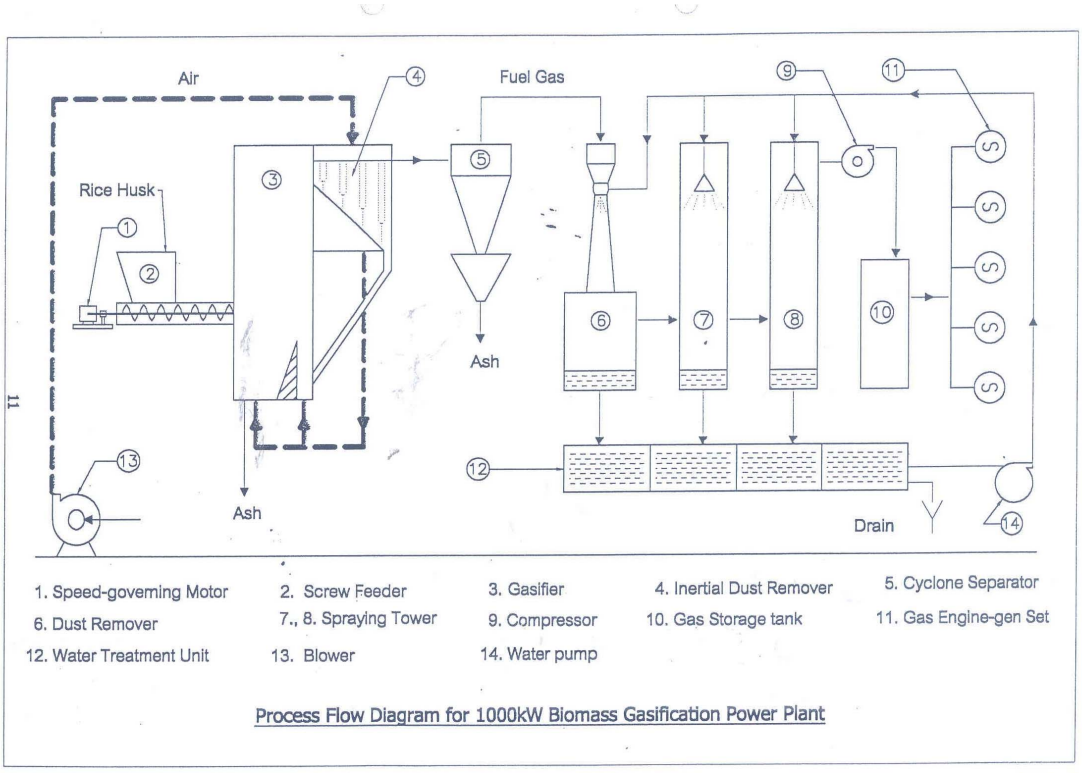
There are two commercially viable methods to burn biomass and generate electric power.

[10] It is necessary to prepare time for maintenance of gasification power plant facility. In this project operation of the plant is set as 300 days per year.

The first one is direct combustion, burning biomass at boiler and electric power is generated at steam turbine engine. It is the traditional technology and many examples both in Thailand and Japan.

The other method is gasification. It is new technology and suitable system for small scale power plant like this project. In comparison with direct combustion, gasification has the following advantages.

- More flexibility in scale: Since energetic efficiency of gasification is twice as high as direct combustion, gasification system can prepare more flexible scales.
- Low investment cost: Gasification power plant can save the investment cost average up to 50-60% in the same capacity.
- Easy and convenient for operation & maintenance: Due to more simple system, gasification power plant can be easily operated and maintained.
- Low operating cost and quick return of investment: Due to simple system, operating and maintenance cost of gasification system is very low.



Source: Energy and Environment Engineering Center, Faculty of Engineering, Kasetsart University

Figure 5.7 Process Flow of Gasification Power Plant

Figure 5.7 illustrates process flow of a typical gasification power plant. Collected biomass will be processed to wood chip and dried. Dried wood chip was put into gasification and power generation plant. Gases such as CO, CH4, H2, etc are generated in gasification and combustion inside of gas generator.

There are two methods in gasification facility. The first one is fixed bed reactor, and the other one is fluidized bed reactor. In fixed bed reactor, parameters such as temperature, pressure are not controlled; otherwise, these parameters are controlled in the fluidized bed reactor. Comparison of both methods is illustrated in Table 5.7.

Table 5.7 Comparison of Fixed bed Reactor and Fluidized Bed Reactor

	Fixed Bed Reactor	Fluidized Bed Reactor
commercial viability	5-200kW	200kW-1MW
Capacity of Plant	Suitable for smaller plant(10kW-200kW)	500 kW to 1.5 MW
Energy Efficiency	Less efficient because heat loss more	More efficient because use exhaust gas for increasing temperature in the furnace
Constraint	1. Biomass size 4-10 cm 2. Moisture content <25% 3. Manual system control need 2 operators (no skill)	1. Biomass size 5-10 mm 2. Moisture content >25% 3. Semi automatic computer system control with 3 well train operators
Initial Cost	Cheaper because mechanism of the reactor is more simple	More expensive because more equipments
O&M Cost	Cheaper than Fluidized Bed Reactor because wood chips will not be moved inside of reactor and only air will be controlled	More expensive than Fixed Bed Reactor because wood chips will be agitated and many parameters such as temperature and pressure will be controlled by sensors and computers.

Source: Energy and Environment Engineering Center, Faculty of Engineering, Kasetsart University

Gasification Facility

Gasification Facility (Red) and 15kW Gas Engine (Green)

Figure 5.8 15kW Gasification Power Plant at Thong Pha Phum Plantation

The Ministry of Energy of Thai government is promoting research and development of gasification technology. The first prototype is 15kW plant, currently being operated at Thong Pha Phum plantation in Kanchanaburi province (Figure 5.8).

After 15kW facility, Energy and Environmental Engineering Center (EEEC), Faculty of Engineering, Kasetsart University has developed 30kW gasification power plant and 80kW power plant. The 30kW power plant, which used wood chip as fuel, was developed for the technical cooperation project between Ministry of Energy and the Ministry of Industry, Mines and Energy of Cambodia Government. And the 80kW power plant, which use rice husk as fuel was a test plant.

After 80kW plant, the EEEC had developed 400kW power plant which use rice husk as fuel at Thanyaburi, Pathum Thani Provice with the assistance of Ministry of Energy in 2008. EEEC is designing new 400kW power plant which will use woody biomass as fuel now.

As described above, gasification facility has being developed by Thai technology. However, gas turbine engine which is larger than 200kW has to be imported from Japan or China.

5.4 Project Implementation Scheme

(1) Target FIO Plantations

Out of 186 plantations, FIO selected 99 plantations in 28 provinces as potential project sites. List of plantations with area expected power generation is indicated in Table 5.8. Table 5.9 is combination of list of candidate plantations provided from FIO (From column one to column six) and list of FIO plantations collected from Ministry of Natural Resource and Environment. List of all candidate plantations is indicated in Appendix of this chapter. FIO selected these candidate plantations from expected biomass volume. That is why plantations in the southern part of Thailand planting rubber tree which does not generate woody biomass so much and narrow plantations are excluded from the potential sites.

Table 5.8 Candidate Plantations

Phase	No of plantations	Area (Rai)	Capacity of power supply (MW)
Phase 1	9	138,452	17.0
Phase 2	20	312,917	35.0
Phase 3	30	233,467	30.0
Phase 4	30	126,207	28.5
Phase 5	10	844,944	16.0
Total	99	1,655,987	126.5

Note: Concept of phased development is introduced by the FIO.
1 rai = 0.16ha = 0.0016km^2
Source: Forest Industry Organization

Table 5.9 Candidate Plantations and Species

From FIO						From Ministry of Natural Resource and Environment				
No.	Province	Location	Area (Rai)	Private (Rai)	MW	Teak	Euca-lyptus	Non-teak	Others	Total
Phase 2: 20 locations 35MW										
1	Chiang Mai	Doiborlung	12,350	2,000	1			12,350		12,350
2	Chiang Mai	Chaiprakarn	11,441	2,000	1	11,441				11,441
3	Tak	Pobphra	14,775	2,000	2	13,775				13,775
4	Tak	Chiangthong	10,800	2,000	1	10,800				10,800
5	Nam	Nakoenman	11,668	2,000	1	11,688				11,688
6	Pisanulok	Nam Tak	18,807	2,000	2	18,175				18,175
7	Pisanulok	Lum nam wang tong fang kawa	17,760	2,000	2	17,760				17,760
8	Phrae		20,424	2,000	2	19,174	1,250			20,424
9	Phrae	Maeman	17,571	2,000	2	17,571				17,571
10	Phrae	Wangchin	14,323	2,000	2	14,323				14,323
11	Phrae	Maesoy	10,734	2,000	1	10,734				10,734
12	Mae Hong Son	Salawin	12,727	2,000	1	5,206				5,206
13	Lampang		17,965	2,000	2					
14	Sukothai	Srisachanalai	15,646	2,000	2	15,646				15,646
15	Utaradit	Thapla	15,255	2,000	2	15,363				15,363
16	Karnchanaburi	Saiyok	23,649	2,000	3	23,649				23,649
17	Karnchanaburi	Kringkravier	16,302	2,000	2	16,302				16,302
18	Nakhorn-rachasima	Pasoongnuen Project	10,760	2,000	1		8,900	1,860		10,760
19	Sri Saket	Pasonlaor Project (1)	10,760	2,000	1		10,700			10,760
	Sri Saket	Pasonlaor Project (2)	5,530		1		5,530			5,530
	Sri Saket	Pasonlaor Project (3)	10,580	2,000	1		10,580			10,580
20	Surin	Huay Kaew	13,090	2,000	2	6,340	16,590			22,930
Total			312,917	42,000	35	227,947	53,550	14,210	0	285,007

Note: Information indicated above is the Phase 2 project as an example of the whole project prepared by FIO. List of the whole phases of the project is indicated in the Appendix of this chapter.

Source: FIO and Ministry of Natural Resource and Environment

In plantations located in the upper north or the lower north, Teak tree is the most dominant species. On the other hand, Eucalyptus is the most dominant in the north-eastern region. For example, Teak tree is major specie in provinces such as Chiang Mai, Tak Nam, and Eucalyptus is major specie in provinces such as Nakhomrachasima, Sri Sake and Surin in Table 5.9.

Currently FIO intends to conduct the project in five phases, and expects to generate 126.5MW electric power as indicated in Table 5.8. However, feasibility study of the project and detailed assessment of each plantation have not conducted yet. Expected capacity of power plant in each plantation calculated by FIO is indicated in the 6th column of Table 5.9. The figure

seems to overestimate in comparison with estimation of biomass volume by the Study Team in section 5.3.4. For example, FIO expects to generate 2 MW electric power plant at Pobphra plantation (No. 3), which area is 1,4775 rai. However, the Study Team estimated 22,500 rai (11,250 x 2) of Teak plantation is needed to generate 60 ton of biomass daily. It is difficult to expect power plants with capacity of 2 to 3 MW in the FIO lists. Collection rate of biomass is not considered in the FIO lists. Some plantations in particular in upper north and lower north are located at mountainous area, and it is difficult to collect all generated biomass. In such plantations, collection rate, percentage of collection of biomass to total generated biomass should be considered.

5th column of Table 5.9 is area of the surrounding private plantations from which woody biomass will be collected. Although volume of woody biomass which will be equivalent with 2,000 rai of the plantation is expected, it is not sure how much volume of the woody biomass will be collected from each plantation.

In this report, two typical cases are analyzed. The first one is 1MW power plant, which seems to be the biggest capacity in the FIO project. The second one is 400kW power plant, which seems to be the most common capacity and maximum gasification capacity by use of Thai technology.

Necessary biomass volume is 30 ton per day for 1MW power plant, and 12 ton per day for 400kW power plant.

(2) Schedule

In total 11 months are needed from design to completion of commissioning for both of 1MW power plant and 400kW power plant. Breakdown of tasks is indicated in Table 5.10.

Table 5.10 Procurement Schedule

Design	1 month
Construction works and manufacturing equipment	2 months
Transportation of equipment	3 months
Installation of equipment	3 months
Test and commissioning	2 months

Source: Energy and Environment Engineering Center, Faculty of Engineering, Kasetsart University

5.5 Project Cost

5.5.1 Gasification and Power Generation Plant

Investment costs of gasification and gas power plant (both of 1MW and 400kW) are estimated as Table 5.11, and breakdown cost of 1MW plant is indicated as Table 5.12. These costs are

estimated from an experience of 400kW rice husk power plant at designed and developed by Energy and Environment Engineering Center, Faculty of Engineering, Kasetsart University11 in 2008.

Table 5.11 Investment Cost for Gasification and Power Generation Plant

Capacity	Cost (Baht)
1MW	43,791,200
400kW	25,406,400

Source: Energy and Environment Engineering Center, Faculty of Engineering, Kasetsart University

Table 5.12 Breakdown of 1MW Power Plant

Items	Cost (Baht)
Design	519,250
Equipment	34,466,140
Civil Construction	2,102,240
Installation	5,140,240
Commissioning	1,563,110
Total	43,791,200

Source: Energy and Environment Engineering Center, Faculty of Engineering, Kasetsart University

Out of equipment cost, costs of gas generator are 18.5 million Baht for 1MW generator and 8.6 million Baht for 400kW generator, respectively[12].

Table 5.13 O&M Cost and Lifecycle of Gasification Power Plant

Items	O&M Cost per year (Baht/year)	Lifecycle of Facility (years)
1MW capacity		
Gasification facility	200,000	20
Gas generator	500,000	10
400kW capacity		
Gasification facility	200,000	20
Gas generator	150,000	10

Source: Energy and Environment Engineering Center, Faculty of Engineering, Kasetsart University

As described in 5.3.5, operation and maintenance cost for gasification power generation plant is cheaper. As indicated in Table 5.13, operation and maintenance costs are 700,000 Baht

[11] Cost information is collected by sub-contracted Thai expert.
[12] Cost for 400kW engine came from 400kW gasification Power Plant at Thanyaburi in 2008, and cost for 1 MW generator was estimated by EEEC of Kasetsart University. These data is collected by sub-contracted Thai consultant.

(200,000 + 500,000) per year for 1 MW system, and 350,000 Baht (200,000 + 150,000) per year for 400kW system. Lifetime of facilities is 20 years for gasification facilities and 10 years for gas generators.

5.5.2 Transmission Network and Transformer

Investment cost for transmission network and transformer is 1,700,000 Baht for both of 1MW system and 400kW system. Table 5.14 indicates breakdown of the cost.

Table 5.14 Breakdown of Transmission Network and Transformer

Items	Cost (Baht)
Transformer from 380 kV to 22kV	600,000
Power cable (100 meter)	300,000
Equipment for Control and Protection	500,000
Connection Fee for PEA	300,000
Total	1,700,000

Source: Energy and Environment Engineering Center, Faculty of Engineering, Kasetsart University

Operation and maintenance cost of transmission network and transformer is only 50,000 Baht per year. Lifetime of transmission network and transformer is 20 years.

5.5.3 Wood chipper

Investment costs for wood chipper are estimated as 2,000,000 Baht for 1MW system which produces 30 ton of woodchip per day, and 1,000,000 Baht for producing 12 ton of woodchip per day[13].

Engine of wood chipper is fuel engine or motor. That is why O&M cost for wood chipper is expensive, and estimated as 250 Baht per ton. That is why annual O&M costs are 2.25 million Baht (250 x 30 ton x 300 days) for 1MW system, and 0.9 million Baht (250 x 12 ton x 300 days) for 400kW system.

Lifecycle of wood chipper is 15 years for both systems.

5.5.4 Tractor for Conveyance of Collected Biomass

Collected biomass is transported to a gasification and power plant which is located at FIO plantation or FIO local office. Tractor which costs 1 million Baht with 60 horse power is used to transport the biomass[14]. Two (2) tractors are needed for 1MW system, and one (1) tractor

[13] These cost information is collected by sub-contracted Thai Consultants from EEEC of Kasetsart University and assessed by the Study Team though investigation of information on the Web.
[14] Information of the cost was collected at local office of FIO.

is needed for 400kW system.

O&M cost for tractor is 50,000 Baht per month, most of which is fuel cost. O&M costs are 1.2 million Baht (50,000 x 2 x 12) for 1MW system, and 0.6 million Baht (50,000 x 1 x 12) for 400kW system. Lifetime of tractors is 10 years.

5.5.5 Workers for Collection of Biomass

Waste generated from logging and thinning & improvement cutting at each plantation is collected by local villagers. According to managers of FIO local office in Kanchanaburi Province and Chachoengsao Province, they are hiring local villagers at a rate of 120 to 150 Baht per day now, and it is possible to hire labors for collecting biomass at FIO plantation at Chachoengsao Province which has abundant local villagers surrounding of the plantation.

According to FIO, two (2) persons can collect one (1) ton of biomass per day. That is why necessary numbers of labors are 60 persons for 1MW system and 24 persons for 400kW system. If daily payment is set as 300 Baht, annual payments for labor are 5.4 million Baht (300 x 60 persons x 300 days) for 1MW system, and 2.16 million Baht (300 x 24 persons x 300 days) for 400kW system, respectively.

5.6 Environmental Considerations

Table 5.15 indicates screening of the project by JBIC Guidelines for Confirmation of Environmental and Social Considerations (April 2002). Although environmental impact of the project seems to be limited, IEE and EIA have to be prepared in the next step because the project includes combustion of biomass.

Table 5.15 Screening of the Project by JBIC Environment Guideline

Category	Environmental Item	Main Check Items	Confirmation of Environmental Considerations
1 Permits and Explanation	(1) EIA and Environmental Permits	1. Have EIA reports been officially completed? 2. Have EIA reports been approved by authorities of the host country's government? 3. Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? 4. In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	EIA report for the Project has not been prepared, only preliminary environmental and social consideration on Project has been studied. IEE and EIA for the Project will have to be prepared in the next step.
	(2) Explanation to the Public	1. Are contents of the project and the potential impacts adequately explained to the public based on appropriate procedures, including information disclosure? Is understanding obtained from the public? 2. Are proper responses made to comments	Public Relation for the Project to educate people nearby the Project area as well as public consultation will be done during the feasibility study and further implementation stage.

		from the public and regulatory authorities?	
2 Mitigation Measures	(1) Air Quality	1. In the case that electric power is generated by combustion, such as biomass energy projects, do air pollutants, such as sulfur oxides (SOx), nitrogen oxides (NOx), and soot and dust emitted by power plant operations comply with the country's emission standards and ambient air quality standards? 2. Do air pollutants, such as hydrogen sulfide emitted from geothermal power plants comply with the country's standards? Is there a possibility that emitted hydrogen sulfide will cause impacts on the surrounding areas, including vegetation? 3. Do air pollutants emitted from other facilities comply with the country's emission standards?	The electric power will be generated by using biomass or wood chip gasifier with gas power generator. The gas coming out of gasifier will be purifyied before send into gas engine. The purifying system includes dust removal, ash removal, and tar removal. The unit will use 3 stages of purifying devices. First, inertia dust remover gets rid of 60% of its efficiency. Second, Cyclone Separator removes 90% of its efficiency, and the third stage, wentury dust remover gets rid of 98% of its efficiency. With exhaust air treatment, the air pollutants emited from the plant facilities is expected to be within the Thai emission standard.
	(2) Water Quality	1. Do effluents (including thermal effluent) from various facilities, such as power generation facilities comply with the country's effluent standards? Is there a possibility that the effluents from the project will cause areas that do not comply with the country's ambient water quality standards? 2. In the case of geothermal power plants, is there a possibility that geothermal utilization will cause water pollution by pollutants, such as As and Hg contained in geothermal fluids? If water pollution is anticipated, are adequate measures considered? 3. Do leachates from the waste disposal sites comply with the country's effluent standards and ambient water quality standards? Are adequate measures taken to prevent contamination of soil, groundwater, and seawater by leachates?	In the gasification facilities, water scrubbing and water spraying are used for gas filtering, purifying and cooling. There are two water-spraying towers in the system. The main function of spray water is to remove coal tar and dust from the gas. The adverse flow of cooling water and gas makes the purpose to be perfectly realized. Wastewater after cooling and spraying process will be treated prior to discharge out to public drain.
	(3) Wastes	1. Are wastes generated by the plant operations properly treated and disposed of in accordance with the country's standards (especially biomass energy projects)?	The waste generated by the plant operation will be properly collected, treated and disposed of according to the local standard. Charcoal by product from the system can be sold as fuel whereas biological ash can be used as soil improvement material.
	(4) Soil Contamination	1. Has the soil in the project site been contaminated in the past, and are adequate measures taken to prevent soil contamination?	There will be no soil contamination from the project. Biological ash from the process will not be harmful to the existing soil condition.
	(5) Noise and Vibration	1. Do noise and vibrations comply with the country's standards?	Noise and vibration from the plant facility will be controlled to be within the local standard. Most of the equipment will be low movement and noise.
	(6) Subsidence	1. In the case of extraction of a large volume of groundwater or extraction of steam by geothermal power generation, is there a possibility that the extraction of groundwater or steam will cause subsidence?	There will be not much usage of water from the project, recycling of water in cooling process will be used.
	(7) Odor	1. Are there any odor sources? Are adequate odor control measures taken?	No objectionable odor will be emitted from the process.

3 Natural Environment	(1) Protected Areas	1. Is the project site located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	The project site will be selected to locate out of the protected area.
	(2) Ecosystem	1. Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? 2. Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? 3. If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? 4. Is there a possibility that localized micro-meteorological changes due to wind power generation will affect valuable vegetation in the surrounding areas? (Is there valuable vegetation in the vicinity of the wind power generation facilities?) If impacts on vegetation are anticipated, are adequate measures considered? 5. Are the wind power generation facilities (wind turbines) sited by considering the habitats and migration routes of sensitive or potentially affected bird species?	There will be no effect to the ecosystem from the project, only unused small pieces of wood and tree will be utilized.
	(3) Hydrology	1. Is there a possibility that hydrologic changes due to installation of structures, such as weirs will adversely affect the surface and groundwater flows (especially in "run of the river generation" projects)?	There will be no effect to the hydrology from the project.
	(4) Topography and Geology	1. Is there a possibility that the project will cause a large-scale alteration of the topographic features and geologic structures in the surrounding areas (especially in run of the river generation projects and geothermal power generation projects)?	There will be no effect to the topography and geology from the project.
4 Social Environment	(1) Resettlement	1. Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement? 2. Is adequate explanation on relocation and compensation given to affected persons prior to resettlement? 3. Is the resettlement plan, including proper compensation, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? 4. Does the resettlement plan pay particular attention to vulnerable groups or persons, including women, children, the elderly, people below the poverty line, ethnic minorities, and	There will be no resettlement from the project implementation; no land acquisition will be required.

		indigenous peoples? 5. Are agreements with the affected persons obtained prior to resettlement? 6. Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? 7. Is a plan developed to monitor the impacts of resettlement?	
	(2) Living and Livelihood	1. Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary? 2. Is there a possibility that the amount of water (e.g., surface water, groundwater) used and discharge of effluents by the project will adversely affect the existing water uses and water area uses?	The project will not create adversely affect the living conditions of inhabitants. In contrary, the project will generate electric power to supply outside the plant area as well as selling to external grid.
	(3) Heritage	1. Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage sites? Are adequate measures considered to protect these sites in accordance with the country's laws?	There will be no effect to the heritage from the project.
	(4) Landscape	1. Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	The project will provide better landscape to the nearby area from more proper design in landscape.
	(5) Ethnic Minorities and Indigenous Peoples	1. Does the project comply with the country's laws for rights of ethnic minorities and indigenous peoples? 2. Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples?	There will be no effect to the Ethnic Minorities and Indigenous Peoples from the project.
5 Others	(1) Impacts during Construction	1. Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? 2. If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts? 3. If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts? 4. If necessary, is health and safety education (e.g., traffic safety, public health) provided for project personnel, including workers?	Measures to reduce impact during construction will be included in the construction contract and controlled by the supervisors according to the local regulation.
	(2) Monitoring	1. Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? 2. Are the items, methods and frequencies included in the monitoring program judged to be appropriate? 3. Does the proponent establish an adequate	Environmental Monitoring as well as monitoring framework will be set by the Local Municipality.

		monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? 4. Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	
6 Note	Reference to Checklist of Other Sectors	1. Where necessary, pertinent items described in the Power Transmission and Distribution Lines checklist should also be checked (e.g., projects including installation of electric transmission lines and/or electric distribution facilities).	The connection to current electric transmission lines will be in accordance with the standard and approval of Provincial Electrical Authority (PEA).
	Note on Using Environmental Checklist	1. If necessary, the impacts to transboundary or global issues should be confirmed (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	The project will provide carbon reduction in using biomass fuel to substitute fossil fuel.

Note: * For the communication infrastructure projects, applicable items are 1 (1) (2), 3(1)(2), 4 (1)-(5) and 5(1)(2), and only these items should be checked.
1) Regarding the term "Country's Standards" mentioned in the above table, in the event that environmental standards in the country where the project is located diverge significantly from international standards, appropriate environmental considerations are made, if necessary.
In cases where local environmental regulations are yet to be established in some areas, considerations should be made based on comparisons with appropriate standards of other countries (including Japan' experience).
2) Environmental checklist provides general environmental items to be checked. It may be necessary to add or delete an item taking into account the characteristics of the project and the particular circumstances of the country and locality in which it is located.
Source: Study Team

5.7 Anticipated CO_2 Reduction

Annual electric energy accounts for 7,200 MWh (1 x 24 x 300) for 1 MW power plant, and 2,880 MWh for 400kW power plant. According to "Study on CDM case studies in Thailand", prepared by Climate Change Coordination Unit[15], which is responsible for providing collaboration and support for the prevention and mitigation of impacts arising due to climate change, CO_2 reduction of biomass power generation is 0.54290 ton per MW.

That is why reduction volume of CO_2 is 3,909 ton (7,200 MWh x 0.54290) per year for 1 MW plant, and 1,564 ton (2,880 MWh x 0.54290) per year for 400 kW plant. If these plants have been operated for 30 years, accumulated CO_2 reduction volume is 117,266 ton for 1MW power plant, and 46,907 ton for 400kW power plant.

[15] Climate Change Coordination Unit is an organization under the Office of Natural Resources and Environmental Policy and Planning, the Ministry of Natural Resources and Environment, The Government of Thailand

5.8 Economic and Financial Appraisal

(1) Introduction

Based on the project description in the previous sectors, financial and economic viability of the project is analyzed in this section. In this analysis, FIRR and EIRR of two typical projects are calculated. The first one is a plantation which can accommodate 1 MW power plant (11,250 rai for Teak plantation and 12,000 rai for Eucalyptus plantation). The second one is a plantation which can accommodate 400kW power plant (4,500 rai for Teak plantation and 4,800 rai for Eucalyptus plantation).

(2) Calculation of FIRR

Investment cost and O&M cost comes from section 5.5. The following assumptions are applied.

- Project life is 30 years.
- Five percent of contingency cost is added to each investment cost.
- In the final year of lifetime, reinvestment is conducted. For example, gas turbine engine is invested every ten years and gasification facility is invested every 20 years, respectively.
- Percentage of electrical loss is assumed as 20% in the both systems.

On the other hand, Generated electric power will be purchased by the PEA at a rate of 3.0 Baht per kWh. That is why annual revenue is 17.28 million Baht (3.0 x 1000 kW x 80% x 24 hours x 300 days) for 1 MW power plant and 6.912 million Baht (3.0 x 400 kW x 80% x 24 hours x 300 days) for 400kW power plant.

Result of FIRR is 11.0% for 1 MW power plant, and 3.0% for 400kW power plant. As of July 2008, real interest rate of state enterprise bond was 2.88% from the following formula: 6.17% (Yield of Government Bond with 20 years) + 0.41% (Spreads for State Bond) – 3.7% (core inflation ratio as of July 2008). The figure is set as discount rate in this analysis.

FIRR of 1 MW power plant (11%) and 400kW power plant (3.0%) is larger the discount rate. Therefore both projects are financially feasible.

(3) Financial Analysis

Although both of the projects are financially feasible, difference between the discount rate and FIRR of 400kW power plant project is very limited. Therefore, financial performance of the projects is examined in this section.

In this section, the following assumptions are introduced.

- Project life is 30 years.
- 70% of the initial investment cost is financed by loan form financial institutions.

- The first case is the same real interest rate of state enterprise bond (2.88%) with 20 years of lending period (5 years of grace period).
- The second case is soft loan, lower interest rate (0.25%) with 30 years of lending period (10 years of grace period)[16].

Introducing the assumptions above, internal rate of return with loan (Equity IRR) of each project will change as Table 5.16. In 1 MW power plant project, levels of Equity IRR are very high, 32.6% for 2.88% of interest rate, and 46.4% for 0.25% of interest rate. On the other hand, levels of Equity IRR are very different in 400kW power plant project. When interest rate is 2.88%, Equity IRR is 3.0%, the same level as without loan in the calculation of FIRR. However, it improves to 24.2% when interest rate is 0.25%. Soft loan can improve financial performance of 400kW power plant project a lot.

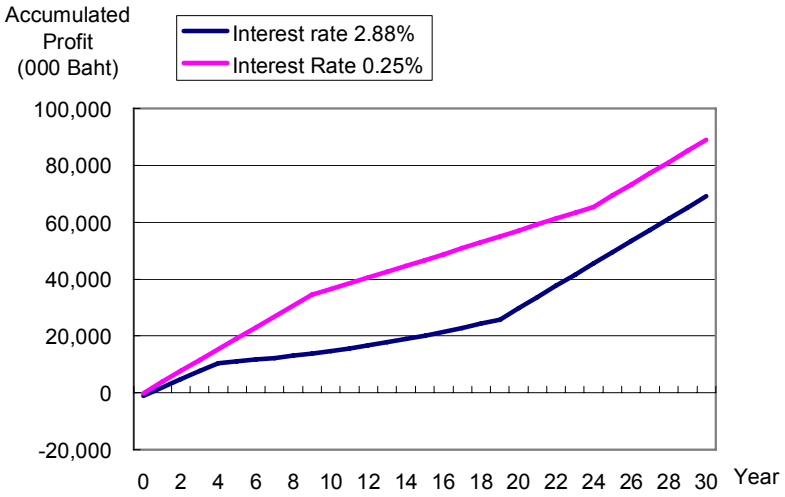
Table 5.16 Change of Equity IRR

Unit: Percent

	1 MW Plant	400kW Plant
Interest rate 2.88%	32.6	3.0
Interest rate 0.25%	46.4	24.2

Source: Study Team

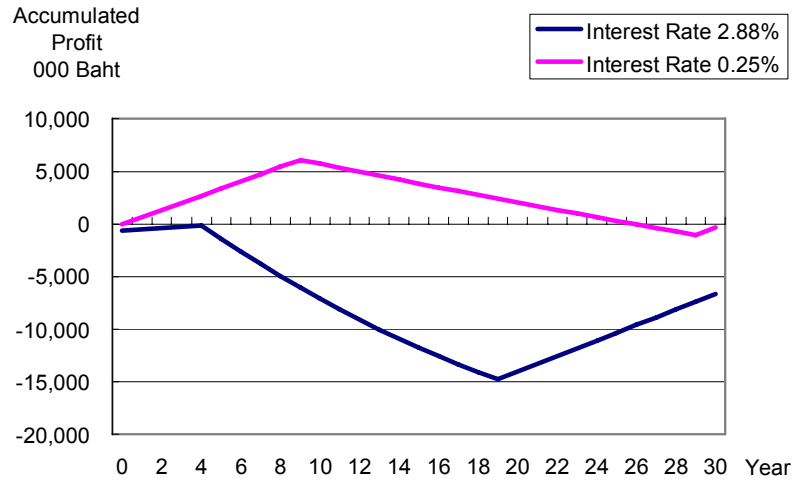
Figure 5.9 and Figure 5.10 illustrates accumulated profit in case of interest rate is 2.88% and 0.25%. Accumulated profit records plus from the first year of operation, and continue to increase in 1 MW Power Plant Project. Both of loans will provide the same kind of effect.



Source: Study Team

Figure 5.9 Accumulated Profit (1 MW Power Plant)

[16] These interest rate and loan condition are the same as JBIC Yen Loan for Climate Control.



Source: Study Team

Figure 5.10 Accumulated Profit (400kW Power Plant)

In 400 kW power plant project, effect of loans are different. In case of 2.88% of interest rate, accumulated profit goes down from 5th year of operation when capital repayment starts. Although accumulated profit starts to decrease from 19th year, the amount in the 30th year accounts for 6.7 million of loss. In case of 0.25% of interest rate, accumulated profit records surplus from 1st year to 25th years of operation. Financial condition will be improved a lot by using soft loan in case of 400kW power plant.

(4) Calculation of EIRR

In the renewable energy project, the following items are identified as economic benefit of the project.

- Saving of petroleum products: the project can save consumption of petroleum products.
- CO_2 reduction: the product can reduce CO_2 emission which is converted to value in money.
- Employment generation for local villagers: Creation of job opportunity is also economic benefit although payment to local villagers is a cost items in financial analysis.

According to information from Agency for Natural Resources and Energy of Japanese Government, 1 liter of crude oil generates 38.2 Mega Joule, and 1 kWh of electric power generates 9.0 MJ. That is why 1 MWh of electric power is equal to 235.6 liters of crude oil (9.0 / 38.2 x 1000 kWh).

As described in 5.7, Annual electric power is 7,200 MW for 1 MW power plant, and 2,880 MW for 400 kW plant. Saving of petroleum products is 1,743,867 liters per year for 1 MW project, and 697,547 liters per year for 400kW plant. Under the assumption that one barrel of crude

oil costs 100 US dollar, saving cost of crude oil is 36.7 million Baht for 1 MW plant, and 14.7 million baht for 400kW plant[17].

Reduction volume of CO_2 is 3,909 ton per year for 1 MW plant, and 1,564 ton per year for 400 kW plant as analyzed in 5.7. Nikkei-JBIC Carbon Quotation Index as of 4th August 2008 is 3167.9 yen per ton. As a result annual amount of economic benefit from CO_2 reduction is 4.0 million Baht per year for 1 MW plant, and 1.6 million Baht per year for 400kW plant.

FIO is planning to pay 300 baht per day for local villagers who collect biomass in the FIO plantation. According to managers of local FIO offices, current daily payment to local villagers is 120 to 150 Baht per day at FIO office and surrounding workplace. That is why a local villager can receive benefit of 150 Baht per day. Annual value added generated from the project is 2.7 million Baht (150 Baht x 60 persons x 300 days) for 1 MW plant, and 1.1 million Baht (150 Baht x 24 persons x 300 days) for 400kW plant.

Table 5.17 Result of Economic Calculation

Unit: Percent

	1 MW Plant	400kW Plant
EIRR	75.3	53.4
EIRR w/o CO_2 reduction	67.6	47.8

Source: Study Team

Table 5.17 indicates result of EIRR calculation. The value including reduction of CO_2 is 75.3% for 1 MW plant, and 53.4 % for 400 kW plant. Even if CO_2 reduction is excluded from economic benefit, the figure is still high level, 67.6% for 1 MW power plant and 47.8% for 400kW plant. Saving of CO_2 provides a huge impact on the result. Both of 1 MW project and 400 kW project are economically feasible.

5.9 Project Implementation Structure

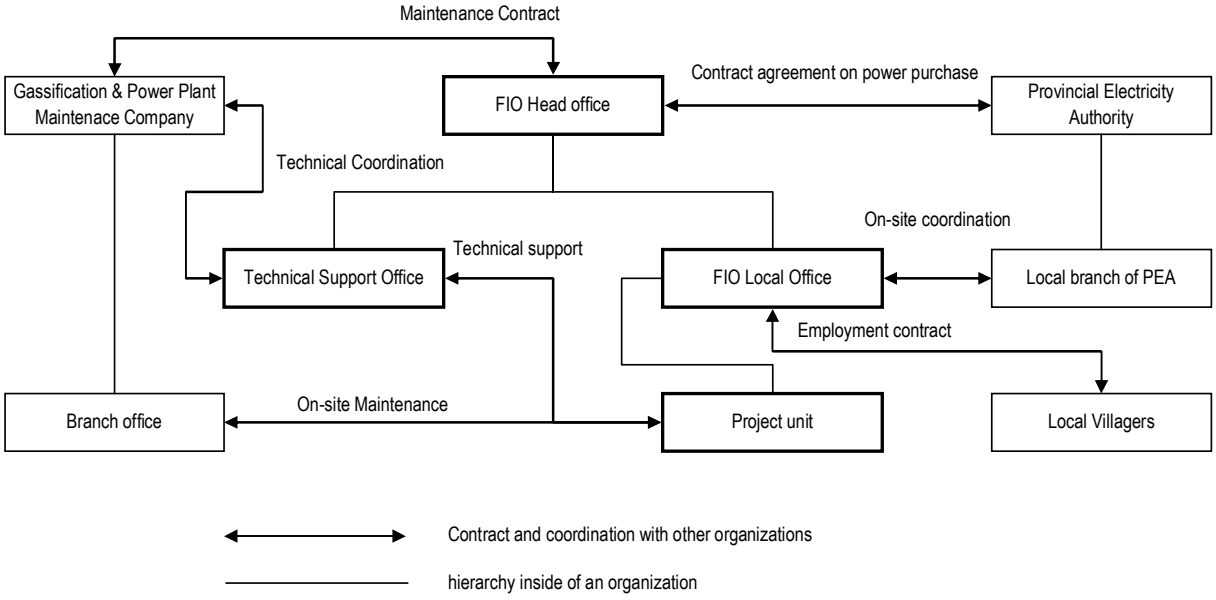
Figure 5.11 indicates project implementation structure of the Renewal Energy Project. The structure was proposed by the Study Team from assessment of current project implementation capacity of FIO, and needs to be discussed with FIO. The Study proposes to establish two units inside of FIO. The first one is “Technical Support Office” in the FIO head office in Bangkok. The second one is “Project Unit” established in each FIO plantation.

Technical Support Office is responsible for daily technical support of each project unit and works as an interface between project units and a maintenance company[18], supplier of wood

[17] 1 US dollar is equal to 33.5 Baht.

[18] It is necessary for gasification and power supply facility to have regular maintenance during the operation. FIO will maintenance contract with a maintenance company, and the company will maintain the facility regularly.

chipper and tractors.



Source: Study Team

Figure 5.11 Project Implementation Structure

FIO head office will conclude a contract with a company working for maintenance of gasification and power plant. It will also conclude a contract with PEA on power purchase. These contract and money transaction are conducted in the central level. On the other hand, daily coordination and on-site maintenance will be conducted at local office and branch office level.

Local villagers who collect biomass will be employed by each local FIO Office. Employed villagers will be managed and collection fee is provided by each local FIO office.

Project implementation capacity of the Technical Support Office and Project is limited in the beginning of the project because FIO's know-how to operate equipment and facilities for biomass power plant is limited now, and these units are newly developed. Therefore, it is necessary for the Technical Support Office to hire a consultant team which will be interface with a gasification and power plant maintenance company and PEA in the beginning of the project (three to five years). The consultant team will also provide training program service by cruising project units which will be located allover of Thailand.

In the pilot program proposed in 8.1.1, capacity building of the Technical Support Office will be included in the component. It is also proposed to analyze problems which will occur at a project site in the course of the pilot project, and to prepare training program for enhancement of project implementation capacity of the Project Units in the project.

Appendix: List of Candidate Plantations

Table 5.18 indicates candidate plantations for the project, which are selected by FIO.

Table 5.18 List of Candidate Plantations selected by FIO

From FIO						From Ministry of Natural Resource and Environment				
No.	Province	Location	Area (Rai)	Collection (Rai)	MW	Teak	Euca-lyptus	Non-teak	Others	Total
Phase 1: 9 locations 17MW										
1	Changmai	Mae-Horphra	9,246	2,000	1	9,246				9,246
2	Pitsanulok	Kao Kra-yang	15,125	2,000	2	15,125				15,125
3	Lampang		20,522	2,000	2					
4	Lampang		15,316	2,000	2					
5	Lampang		15,179	2,000	2					
6	Lampang		13,964	2,000	2					
7	Lamphun	Lumpoon	14,855	2,000	2	630				
8	Sukothai	Bandonlanhoi	14,500	2,000	2	5,720	8,485	295		14,500
9	Karnchanaburi	Thongphaphoom	19,745	2,000	2	11,698	2,662	4,036	1,349	19,745
Sun-total			138,452	18,000	17	42,419	11,147	4,331	1,349	58,616
Phase 2: 20 locations 35MW										
1	Changmai	Doiborlung	12,350	2,000	1			12,350		12,350
2	Changmai	Chaiprakarn	11,441	2,000	1	11,441				11,441
3	Tak	Pobphra	14,775	2,000	2	13,775				13,775
4	Tak	Chiangthong	10,800	2,000	1	10,800				10,800
5	Nam	Nakoenman	11,668	2,000	1	11,688				11,688
6	Pisanulok	Nam Tak	18,807	2,000	2	18,175				18,175
7	Pisanulok	Lum nam wang tong fang kawa	17,760	2,000	2	17,760				17,760
8	Phrae		20,424	2,000	2	19,174	1,250			20,424
9	Phrae	Maeman	17,571	2,000	2	17,571				17,571
10	Phrae	Wangchin	14,323	2,000	2	14,323				14,323
11	Phrae	Maesoy	10,734	2,000	1	10,734				10,734
12	Mae Hong Son	Salawin	12,727	2,000	1	5,206				5,206
13	Lampang		17,965	2,000	2					
14	Sukothai	Srisachanalai	15,646	2,000	2	15,646				15,646
15	Utaradit	Thapla	15,255	2,000	2	15,363				15,363
16	Karnchanaburi	Saiyok	23,649	2,000	3	23,649				23,649
17	Karnchanaburi	Kringkravier	16,302	2,000	2	16,302				16,302
18	Nakhorn Rachasima	Pasoongnuen Project	10,760	2,000	1		8,900	1,860		10,760
19	Sri Saket	Pasonlaor Project (1)	10,760	2,000	1		10,700			
	Sri Saket	Pasonlaor Project (2)	5,530		1		5,530			5,530
	Sri Saket	Pasonlaor Project (3)	10,580	2,000	1		10,580			10,580
20	Surin	Huay Kaew	13,090	2,000	2	6,340	16,590			22,930
Sub-total			312,917	42,000	35	227,947	53,550	14,210	0	285,007
Phase 3: 30 Locations 31MW										
1	Kampangpetch		6,021	2,000	1	4,496		1,525		6,021
2	Changmai	Mae-Lakmun	9,449	2,000	1	9,449				9,449
3	Changmai	Mae-Chaem	8,500	2,000	1	6,248	684		1,568	8,500
4	Changmai	Banluang	6,639	2,000	1	6,639				6,639
5	Tak	Thasongyang	7,362	2,000	1	7,362				7,362

6	Tak	Muang Tak	6,560	2,000	1	6,560				6,560
7	Tak	Mae la-Mao	6,101	2,000	1	6,093				6,093
8	Phrae	Maehaed	7,433	2,000	1	7,433				7,433
9	Mae Hon Son	Mae-umlong	10,731	2,000	1	5,896				5,896
10	Mae Hon Son	Mae-ukoer	8,096	2,000	1	2,411		213		2,624
11	Lampang		10,586	2,000	1					
12	Lampang		7,225	2,000	1					
13	Lamphun		10,173	2,000	1					
14	Sukhothai	Maesan	6,273	2,000	1	6,535				6,535
15	Uttaradit	Pakpad	11,315	2,000	1	11,315				11,315
16	Karnchanaburi	Ongphara/Ongkot	7,547	2,000	1		5,708	2,037		7,745
17	Karnchanaburi	Donsalap-laokwan Project	6,250	2,000	1		3,645	2,605		6,250
18	Chschoengsao	Klongtakrao	6,018	2,000	1	1,499	1,305	2,683	530	6,017
19	Nokhorn Sawan	Ladyao	5,920	2,000	1	5,920				5,920
20	Uthaithani	Paikieo-talkudu	7,440	2,000	1	1,000	1,640	4,800		7,440
21	Khnon Kaen	Nongmek-lumpuk Project	10,225	2,000	1		1,525	8,700		10,225
22	Khnon Kaen	Munchakeeree	9,248	2,000	1	8,948	480			9,428
23	Nakhorn Rachasima	Pakthongchai	6,209	2,000	1		2,049	3,685	475	6,209
24	Nakhorn Rachasima	Damkuntod	5,975	2,000	1		5,975			5,975
25	Buriram	Dongplong-kokjod Project	7,720	2,000	1			7,720		7,720
26	Buriram	Kokjod Project	5,984	2,000	1		400	5,584		5,984
27	Loei	Namsuay-Huaypladuke	8,130	2,000	1	7,120	500	510		8,130
28	Loei	Phusawan	6,795	2,000	1	2,576	3,204	1,014		6,795
29	Surin	Huay Kaew (2)	8,940	2,000	1		6,340	16,590		22,930
30	Ubonrachathai	Piboonmongsaharn	8,602	2,000	1		8,452	150		8,602
Sub-total			233,467	60,000	30	107,500	41,908	57,817		209,797
Phase 4: 30 locations 28MW										0
1	Changrai		5,605	2,000	1.0					0
2	Changmai	Pangmaidaeng	2,765	2,000	0.0	2,200		565		2,765
3	Tak	Mae sod	4,000	2,000	1.0	7,801				7,801
4	Tak	Pa pra-dang-wang chao	3,645	2,000	1.0	3,495	100	50		3,645
5	Phitsanulok	Pa song fang lum nam - Khae noi Project	4,929	2,000	1.0	2,557		2,372		4,929
6	Phetchaburi		3,761	2,000	1.0					
7	Phrae	Maesin-Maesoong	5,090	2,000	1.0	5,090				5,090
8	Phrae	Maejua	4,825	2,000	1.0	4,825				4,825
9	Phrae	Maekhompong	4,096	2,000	1.0	3,792				3,792
10	Phrae	Forestry school	3,850	2,000	1.0	700	2,150	1,000		3,850
11	Lampang		4,869	2,000	1.0					0
12	Lamphum	Maethi-Maesan	3,190	2,000	1.0	700	370	2,120		3,190
13	Uttaradit	Huaychalong-huaysrisiad	4,250	2,000	1.0	4,250				4,250
14	Phetchaburi	Nongyapong	2,906	2,000	0.5		2,906			2,906
15	Srakaew	Srakaew	5,615	2,000	1.0	60	4,472	1,803		6,335
16	Srakaew	Hyaykrai	5,200	2,000	1.0			5,200		5,200
17	Srakaew	Nongpai	3,250	2,000	1.0		1,500	1,750		3,250
18	Ubonrachathani	Pakudkuraseian Dongchee Project	5,650	2,000	1.0		250	5,400		5,650
19	Khon Kaen	Dongsum	4,076	2,000	1.0	400	1,250	2,826		4,476
20	Chaingaphum	Kornsan	4,401	2,000	1.0		4,381	20		4,401
21	Buriram	Dongkeng	5,424	2,000	1.0		1,254	4,170		5,424
22	Mukhdahan	Padongphupan-dongmoo Project	3,350	2,000	1.0		2,550	800		3,350

23	Sisaket	Khunharn	4,664	2,000	1.0		4,664			4,664
24	Sisaket	Pafengkawhuaysa la Project	3,980	2,000	1.0		3,480	500		3,980
25	Surin	Padungsaitor Project	5,459	2,000	1.0		5,459			5,459
26	Surin	Papanondin Project	3,994	2,000	1.0		3,994			3,994
27	Surin	Paphudin Project	3,447	2,000	1.0		3,447			3,447
28	Ubonrachathani	Padongkaoton Project	3,500	2,000	1.0		3,500			3,500
29	Ubonrachathani	Palankoi	3,276	2,000	1.0		3,266		10	3,276
30	Ubonrachathani	Padongnachee-K eelan Project	3,140	2,000	1.0		2,640	500		3,140
Sub-total			126,207	60,000	28.5	35,870	51,632	29,076	10	116,588
Phase 5: 10 locations 5.4MW										
1	Phethchaburi		2,481	2,000	1					0
2	Lamphun	Mae-Haad-Mar-Kaw	2,413	2,000	1	2,413				2,413
3	Lamphun	Pamaelee Project	2,040	2,000	2	2,040				2,040
4	Uttaradit	Namlee	2,300	2,000	1	2,300				2,300
5	Ubon Rachathani	Panonhungrungre ang Project	2,770	2,000	2		1,800	970		2,770
6	Kalasin	Somdet	12,508	2,000	2	3,683	8,575		250	12,508
7	Nakhon Rachasima	Lumphapeung	2,000	2,000	2			2,000		2,000
8	Mukdaharn	Mukdaharn	2,702	2,000	2		2,702			2,702
9	Srisaket	Kanthararom	2,255	2,000	2		2,165	90		2,255
10	Surin	Karpcheung	2,432	2,000	1		1,347			1,347
Sub-total			33,901	20,000	16	10,436	16,589	3,060	250	30,335
Total			844,944	200,000	126.5	424,172	174,825	108,494	1,609	700,344

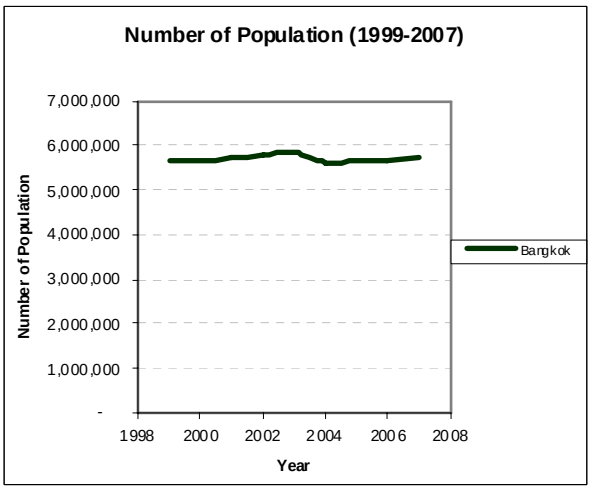
Source: FIO, Ministry of Natural Resource and Environment

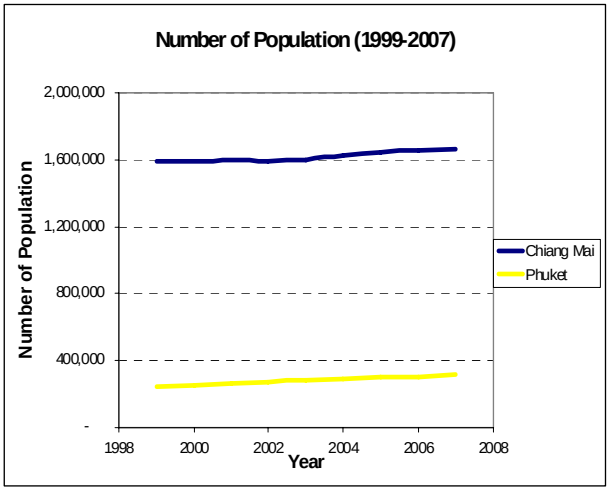
Chapter 6 PUBLIC TRANSPORT IMPROVEMENT PROJECT

6.1 Current Urban Transport

6.1.1 Urbanization in Thailand

In Thailand, many cities have been urbanized due to the movement of people from rural area with the mainly purpose of working, especially in Bangkok, Chiang Mai, Phuket, and other major regional cities. From the statistics, it is found that the numbers of population of those provinces are increasing. During the past 10 years, the urban population in major cities in Thailand has increased more than 30%. The increasing of population has introduced the social problem, traffic congestion problem, and environmental problem. Moreover, the total area of road space and demand of vehicle is unbalanced as the number of vehicles still increases rapidly but the road capacity is limited. In other words, the demand is much more than the capacity.





Chiang Mai and Phuket

Source: Web page of Department of Provincial Administration (http://www.dopa.go.th)

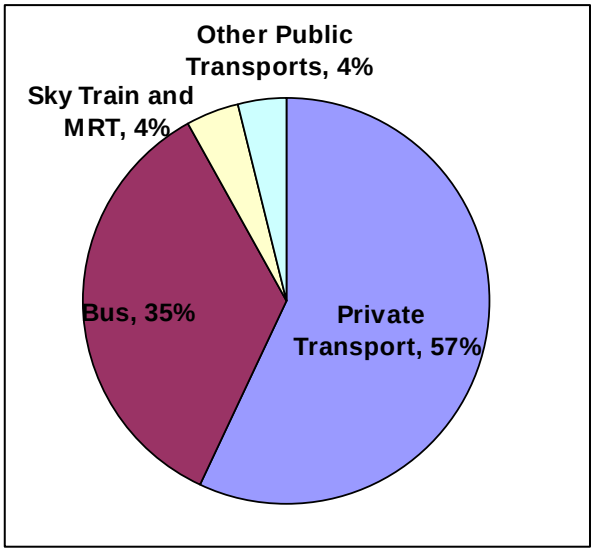
Figure 6.1 Number of Population in 3 Cities

The severity of traffic congestion in Bangkok and other urban areas are increasing. Therefore, the urban transport development project is considered to be the one of the highest priorities in Thai Government which would help the quality of life in urban area to be better as well as the environment. If the public transport is better than the present one, people may shift their modes from private transport mode to public transport mode so the traffic on the road will be mitigated.

6.1.2 Urban Transportation

(1) Bangkok

Bangkok, the capital city of Thailand, is one of the most severe traffic congestion cities in the world. From mode share in Figure 6.2, it is obvious that the transportation in Bangkok is mainly shared by private transport (car and motorcycle), about 57%. The rest (43%) is public transport, which are bus (35%), sky train, subway, ferry, and etc. The high percentage of private transport would obviously result as the traffic congestion problem. So Bangkok cannot avoid the traffic congestion problem, especially during peak hours. Moreover, from the statistics during 2004-2007, the number of vehicles increased rapidly and uncontrollably which increased approximately 700,000 vehicles per year. Even though the gasoline price is increasing nowadays, the number of vehicles is still increasing but not much as the past 4 years.



Source: Transport Data and Model Center VI

Figure 6.2 Modal Share in Bangkok

In Bangkok, the most popular public transport is a bus system, as it is cheap and network covers the whole city. However, it has problems about punctuality and safety. Currently, sky train system and subway system are operating in Bangkok. However, the number of vehicles is still increasing and traffic congestion problem cannot be solved. Traffic is always congested even though there is the sky train system above (Figure 6.3). The main reason is that the mass transit network (Figure 6.4) does not cover whole Bangkok area as well as its vicinities. So only

some groups of people can use the mass transit system which means that the available mass transit system is inefficient and insufficient. Other problem is the behavior of Bangkok people that they do not like to walk so they are prefer to use private vehicles as it is more convenience than public transport.

Figure 6.3 Bangkok Traffic Condition

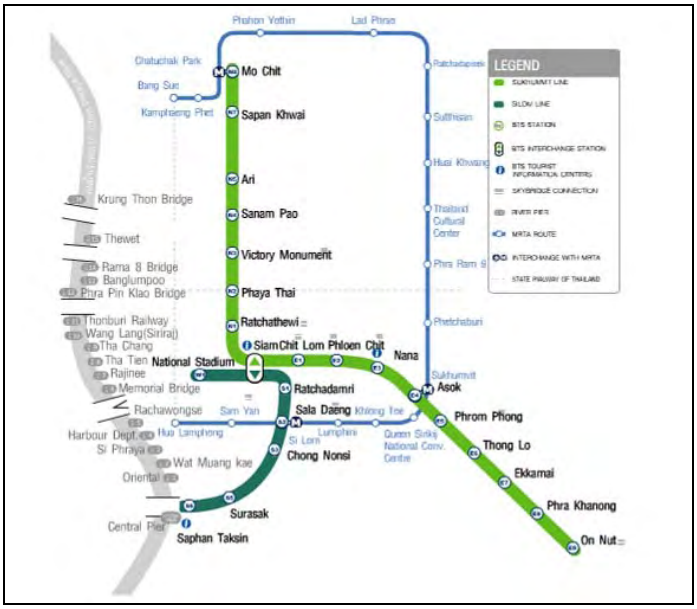


Figure 6.4 Current Mass Transit Network

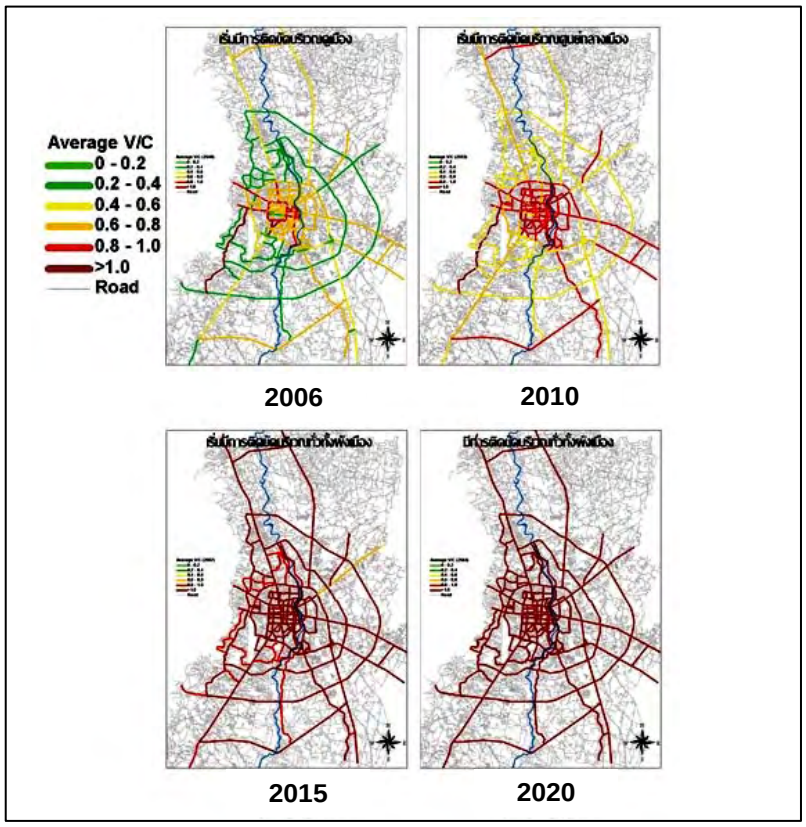
Moreover, the number of person trip is increasing continuously as the number of population increases. From Transport Data and Model Center VI, the total person trips per day was 15,652,000 in 2007 and will be 17,266,000 in 2012, or increased by approximately 1.6% per year. Therefore, if there is no better public transport system, the traffic condition will be worse.

(2) Chiang Mai

Chiang Mai is the northern province of Thailand which is the center of economic, investment,

tourism, and transportation of Northern region. Moreover, it is the regional aviation hub. The city was grown so fast which caused the migration to the center of city. As a result, many problems are occurred such as traffic congestion problem, environmental problem, accident, etc.

In 2005, there was an average of 1.8 million person-trips per day within the urban plan area, 1.6 million of which are made by its residents and 0.2 million by visitors from outside the area. Also the shares of transportation modes consist of motorcycles (43.0%), personal cars (45.4%), public transport (9.3%), and other vehicles (2.3%). The mode share above suggest very little share of public transportation. Without improvement in the public service, this figure tends to decrease and, on the contrary personal means of transportation would therefore increase, along with traffic congestion. The number of trips within Chiang Mai urban plan area has a constant increase rate at 5 – 6% per year, projecting a number of 3.8 million person-trips per day within the next ten years.



Source: Final Report of Chiang Mai Mass Transit Master Plan

Figure 6.5 V/C Ratios of Chiang Mai Roads in Future

Traffic problems cause losses, not only in terms of transportation, but also in people's economy and quality of life. Analysis and Projection of Future Transportation and Traffic Conditions, the analysis shows that the traffic conditions in the urban area of Chiang Mai would be critical within ten years. The solution is the development of a public transportation system to

encourage more usage of public transport, with the goal of increasing to no less than 25% shares of the total modes of traveling, approximately 300,000 person-trips per day in the next ten years, or approximately 500,000 person-trips per day in the next 20 years. Only with this volume of public traveling then the problems in question can be relieved. Based on the needs of the people from the public relation and public participation, the vision of Chiang Mai province, and the socio-economic growth trend of the city, the visions of the master plan of Chiang Mai Transit System is; "Chiang Mai Transit System for the Modernize, Safety, and Energy Saving."

In order to solve the traffic problem Chiang Mai, the public transport system which can attract people to use is necessary. Therefore, the number of private vehicles will be reduced. This would also relieve the pollution problem that the city is facing.

(3) Other Regional Cities

Besides Bangkok and Chiang Mai, the population in other regional cities are growing and urbanizing due to the disparity in employment and infrastructure availability in urban and rural area. Therefore, traffic congestion problem is the common problem in the other regional cities as the numbers of population and private vehicles are increasing. Moreover, most of people in those regional cities are traveling by private motorcycles. This would cause the high emitted pollution as well as the number of accidents.

OTP has conducted studies on transportation master plan for regional cities during 2000-2008. Based on the result of the studies, the study team has selected 10 regional cities to be considered for mass transit improvement as follows

- Chiang Mai
- Nakornratchasrima (Korat)
- Phuket
- Udon Thani
- Kornkaen
- Nakornsawan
- Pattaya
- Hat Yai
- Surat Thani
- Nahornsrithammarat

The location of each city is illustrated in the map of Thailand as shown in Figure 6.6.

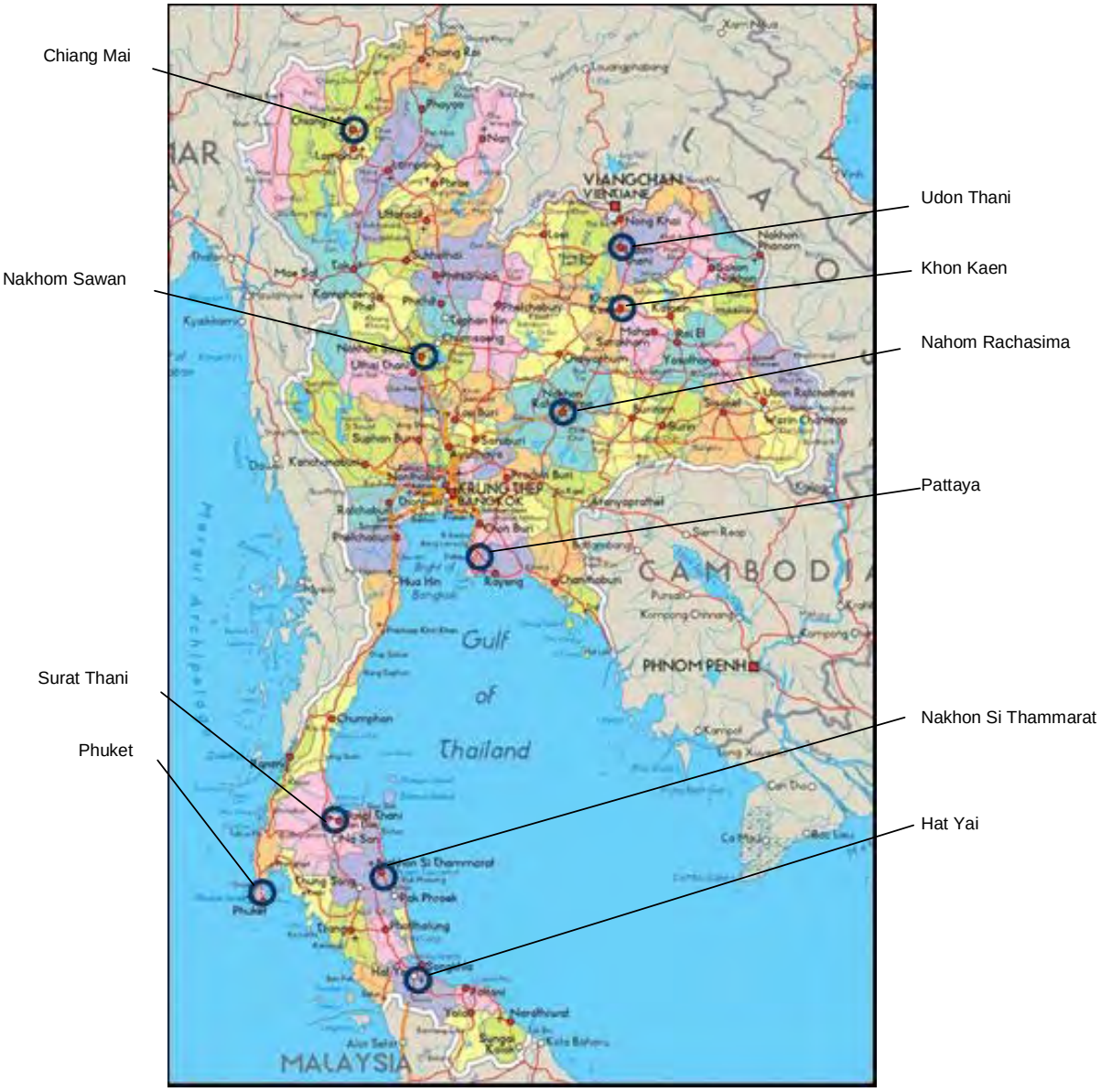


Figure 6.6 Regional Cities in Thailand

The selection of candidate cities for mass transit system improvement is based on the following criteria

- Current Traffic condition and modal share: The location that has high severity of traffic condition and poor public transport is selected. For the mode share, as private car and motorcycle is mainly contributed the traffic accident and air pollution, the location that mainly shares by private car and motorcycle is also selected.
- Metropolitan population: The densely populated area is selected because high number of population will cause the traffic congestion.
- Accident record: The location which has high accident record is selected.

Table 6.1 shows the current population in metropolitan area of the 10 selected cities.

Table 6.1 List of Major Cities in Thailand based on Population in Metropolitan area

Name of City	Population	Province
Hat Yai	157,341	Songkla
Chiang Mai	148,421	Chiang Mai
Nakhon Ratchasima	147,688	Nakhon Ratchasima
Udon Thani	142,445	Udon Thani
Surat Tani	125,934	Surat Tani
Khonkhen	119,858	Khonkhen
Nakhonsrithammarat	107,325	Nakhonsrithammarat
Pattaya	101,939	Chonburi
Nakhonsawan	93,327	Nakhonsawan
Phuket	75,146	Phuket

Source: Department of Provincial Administration Web page

6.2 Urban Transport Development Policies

6.2.1 Overall Policies

The 10th National Economic and Social Development Plan (2007-2011) have followed the royal philosophy of "Sufficient Economy" as the guiding principle of national development and management. Transportation is one of the main parts in the plan which is one of the fundamental components of people and has a major impact to the people as well. Currently, the oil price is very high so the prices of food, travel, and fundamental products are increased. Therefore, the policies were introduced and implemented in order to reduce the cost of transport and logistics as follows:

- Develop and expand the transportation networks (rail, water, pipeline, and feeder) and distribution center in order to support the intermodal transport.
- Human resource development in the logistics field which makes the logistics more efficient.
- Mass transit development in Bangkok and its vicinities should be implemented and
- Fuel type of public transport should be changed in order to reduce the operating cost. (The price of diesel is very high nowadays so an alternative energy (compressed natural gas) should be introduced in order to save the cost.)

Moreover, the plan has suggested about the change of government cars and public buses to use the new engines with the green energy (e.g. Compressed Natural Gas (CNG), biodiesel) in order to reduce the vehicle operating cost (maintenance cost and fuel consumption cost).

Therefore, the main point of the 10th National Economic and Social Development Plan is to save the operating cost from the transportation sector by introducing the intermodal transport, mass transit system, and alternative energy. This would improve the quality of life of Thai people.

6.2.2 Urban Transport Projects in Bangkok

(1) Rail Mass Transit system

On March 2008, Thai government has announced the new future mass transit development plan which is totally 424 km (Figure 6.7) to be developed by the year 2022. There are 10 lines, covering whole Bangkok area and its vicinities. However, in order to build the whole plan, it would invest lots of budget which is also one of the difficulties. Therefore, phasing and prioritization of the network are required. The government has decided the first phase for mass transit plan as shown in Figure 6.8.

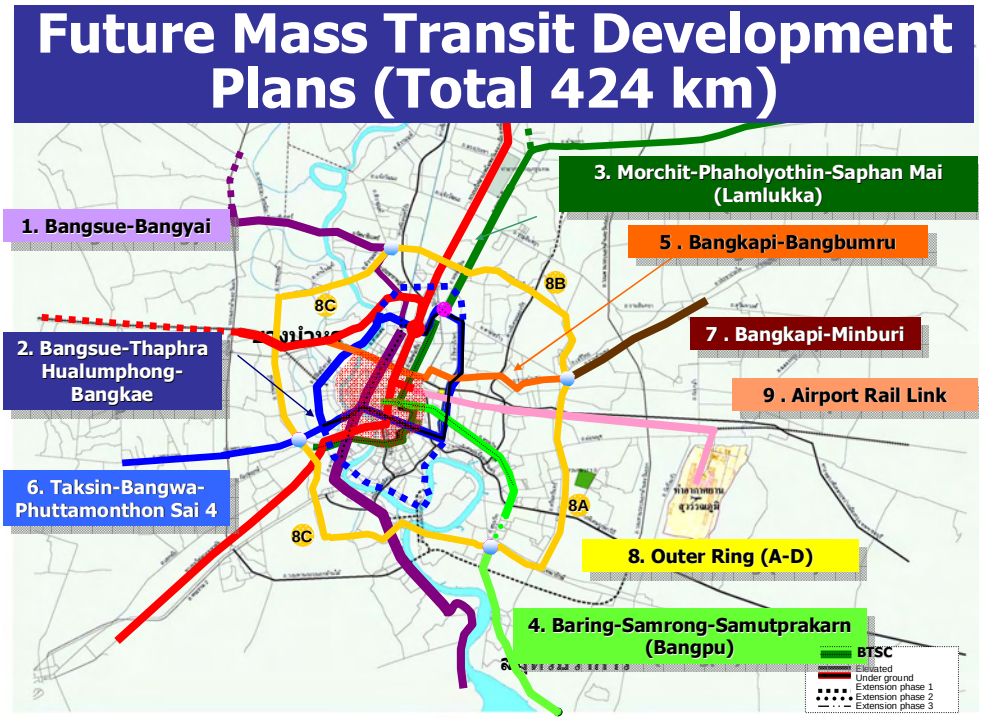


Figure 6.7 Mass Transit Development Plan

From Figure 6.8, the black line is the existing mass transit system, i.e. sky train and subway. The first phase includes the extension of sky train which is currently in the process of detailed design. For the purple line, Thai government has received Japanese ODA Loan and will bid in August 2008. In the case of blue line extension and red line, the detailed design has been completed and Thai government is waiting for the approval of Japanese ODA Loan from JICA. Therefore, the first phase of mass transit plan could be operated in 2012 if Thai government finally decides the budget for each line. These five mass transit lines would relieve the traffic congestion and environmental problem in the Bangkok and its vicinity.

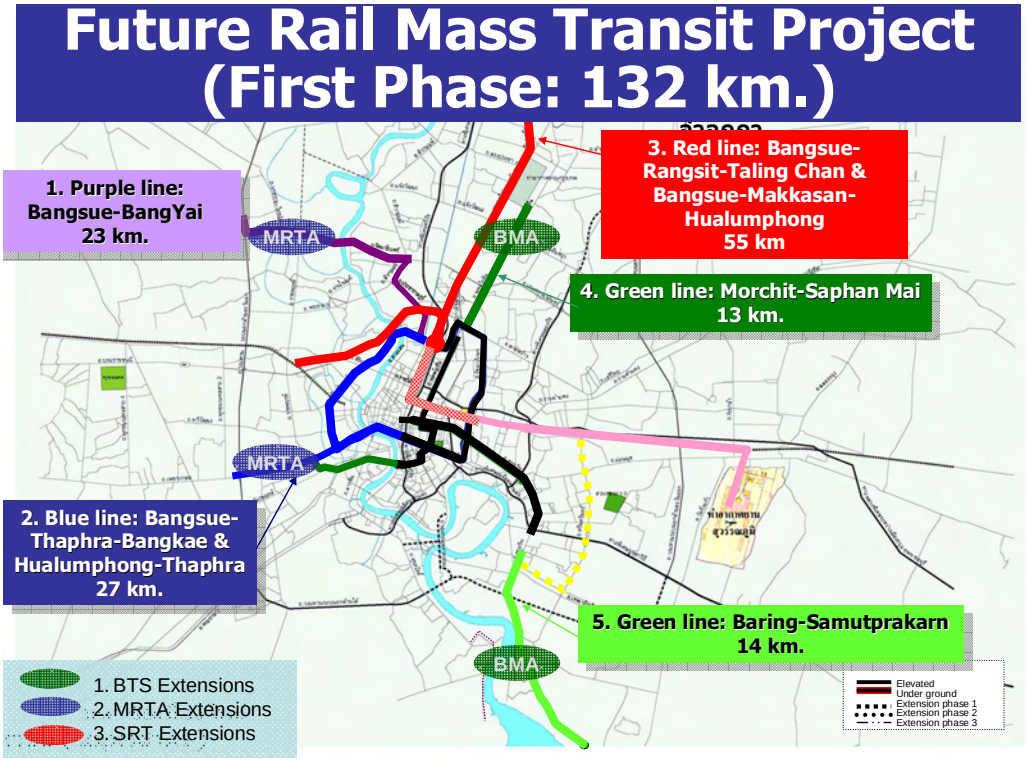


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Figure 6.8 First Phase of Mass Transit Development Plan

(2) Bus Rapid Transit (BRT)

In order to increase the coverage of mass transit system in Bangkok, BMA initiate a new project called Bangkok BRT to serve as high quality and low cost mass transit system for the people living in the areas that are not currently served by the railway mass transit. The purpose of BMA for introducing BRT to Bangkok is to fill the gap between Rail Mass Transit and Bus service. BRT can serve in the area that have high transport demand but cannot construct rail mass transit due to budget constraint.

The system of Bangkok BRT separates mass transit vehicle from regular traffic to improve efficiency of passenger movement. The system can provide 5 – 7 minutes service frequency during peak hours which is comparable to BTS and MRTA. The travel time of BRT vehicle is controlled using Intelligent Transportation System (ITS) to ensure punctuality and safety. The major advantage of BRT is relatively low investment cost only 2 – 3 million US Dollar/ kilometer. This is 12 times lower than BTS and also the construction period is 3 times shorter.

Bangkok BRT will be a new and exciting choice for Bangkok people. The system will introduce state of the art technology which consists of five major elements.

- BRT lane,
- BRT Station,
- BRT Vehicle,
- ITS System, and
- Automatic Fare Collection System.

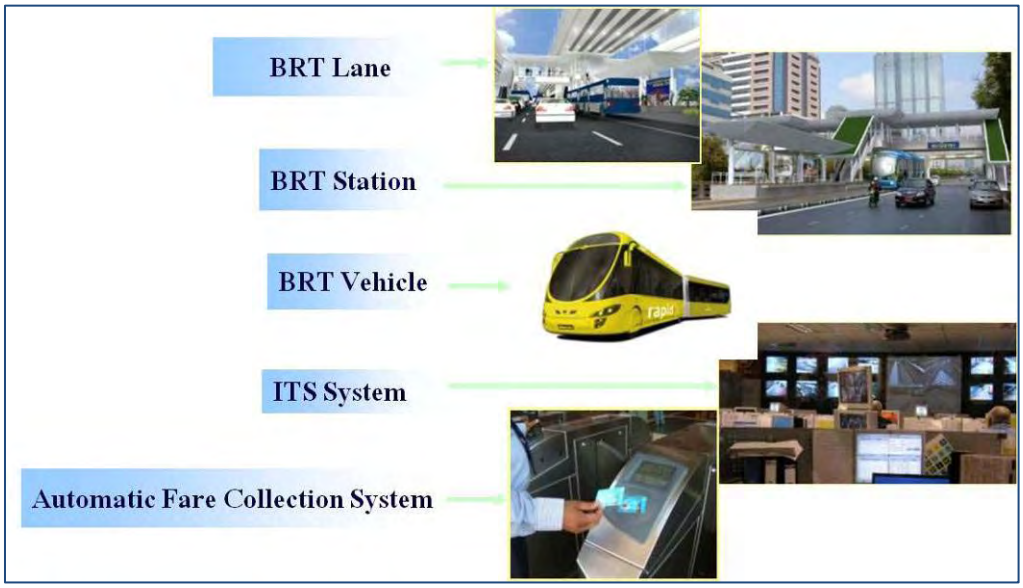


Figure 6.9 Elements of BRT System in Bangkok

BRT system will use exclusive lane on the most right hand lane to separate the system from regular vehicle traffic. The system will also have traffic light priority by using ITS system. This will provide BRT with fast operation compared to regular traffic. BRT station and platform is designed for passenger safety and convenience as the priority. BRT platform is located on the middle of the road with escalator access from the curb side. The station also provides facilities for disabled passengers.

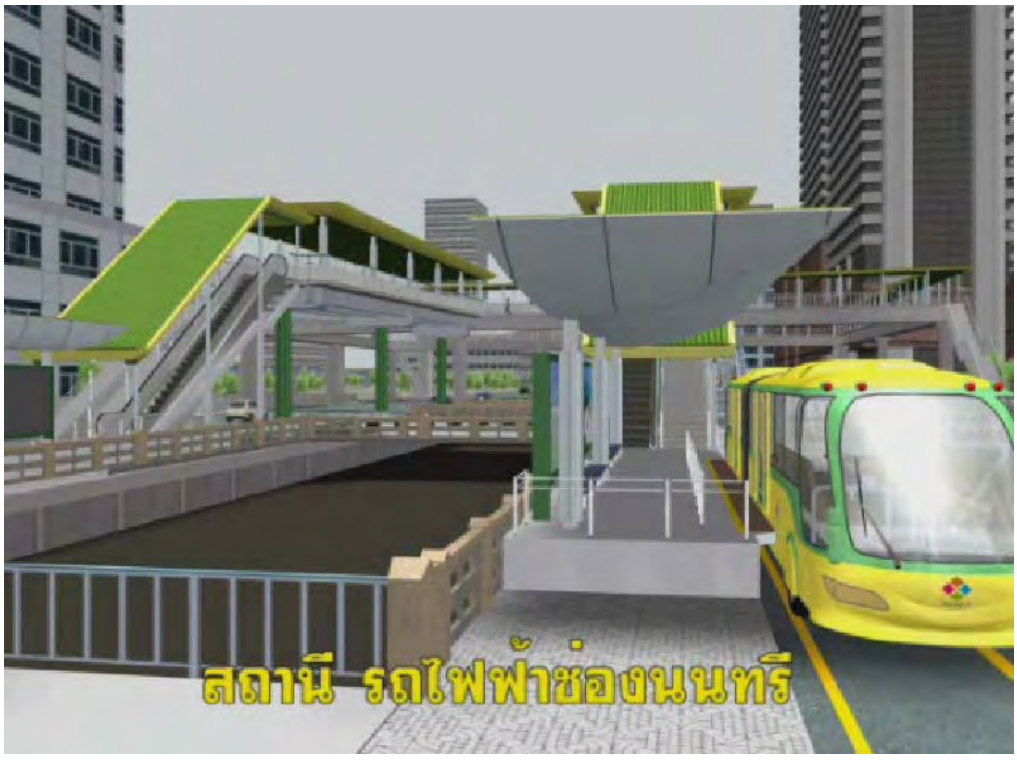


Figure 6.10 Image of BRT System in Bangkok (1)

Figure 6.11 Image of BRT System in Bangkok (2)

The initial BRT line will be introduced on the south side of Bangkok. The line is called "Bangkok BRT Yellow-Green Line 1" line which was approved by the cabinet on January 3rd 2007. This initial line will have 12 stations in total with integration to elevated skytrain at the beginning and the end of the line. The pilot project or BRT1 (Figure 6.12) will act as the feeder system to serve the mass transit system, i.e. the sky train system. It will bring people from Thonburi side to Sky Train Chongnonsri station. The total length of this line is 15 kilometer with infrastructure investment cost of about 60 million US Dollar. The project is scheduled to be finished by early 2008 with expected ridership of about 50,000 passengers per day. This line should help reduce the travel time of the people who at present take up to 1 hour 50 minutes during peak time to only 30 minutes.

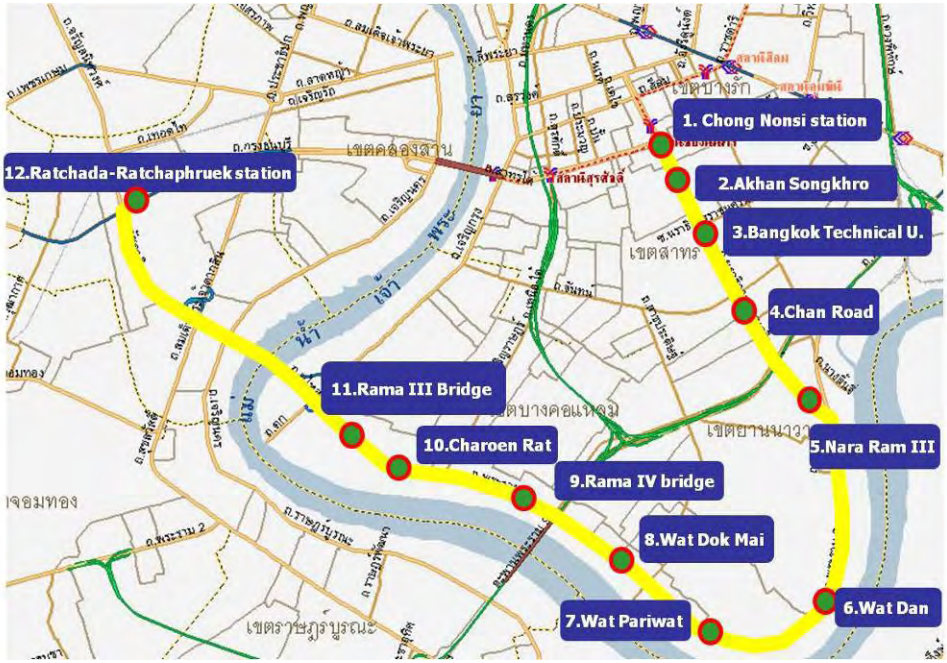


Figure 6.12 BRT Pilot Project (Chongnonsri – Ratchpruk)

Currently the construction of the first line is progressed about 70%. The system is scheduled to open in the first quarter of 2009.

Figure 6.13 Construction Progress of BRT (Chongnonsri-Ratchpruk) (1)

Figure 6.14 Construction Progress of BRT (Chongnonsri-Ratchpruk) (2)

From BRT master plan (Figure 6.15), there are totally six routes in the master plan which cover whole Bangkok as well as some part of its vicinities. BRT first route (Chongnonsri-Ratchapruk) is now constructing and will be completed by 2009. BRT2 (Morchit-Government Center) and BRT3 (Chongnonsri-Suksawat) are now in the process of detailed design. The rest will be studied in 2009. After BRT is operating, Bangkok people travel faster and reliable as BRT will run on the priority lane.

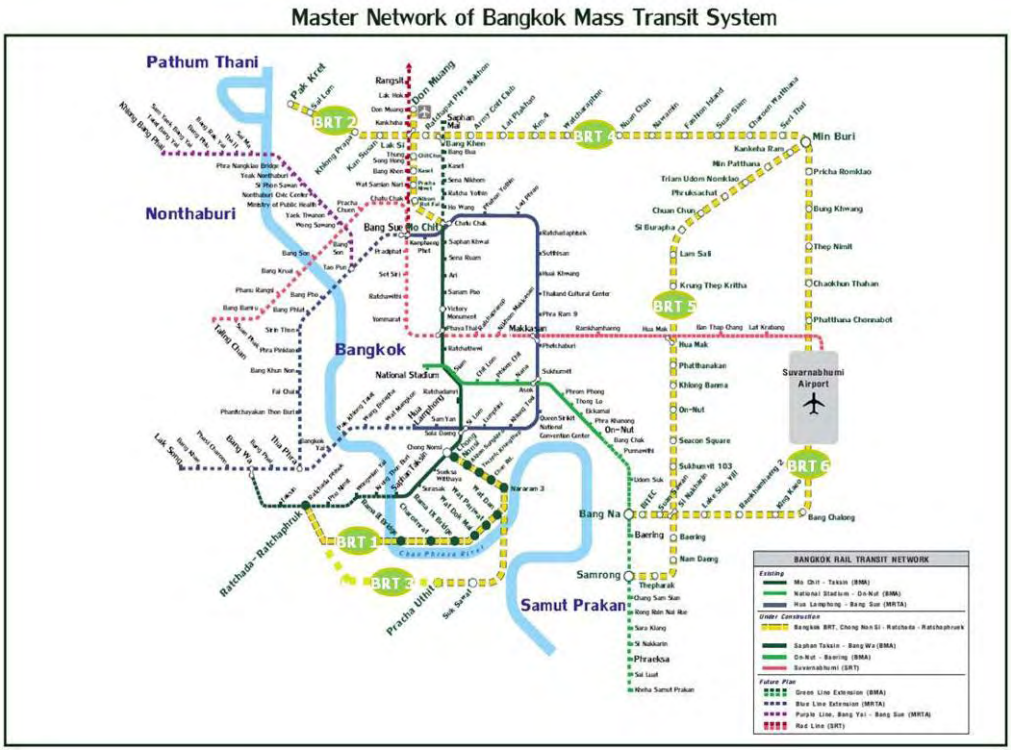


Figure 6.15 Bangkok BRT Master Plan

6.2.3 Urban Transport Projects in Chiang Mai

The Master Plan of Chiang Mai Mass Transit System has selected Bus Rapid Transit (BRT) as the most suitable mass transit for Chiang Mai City. In order to attract the most number of Chiang Mai passengers, the CTS needs to convey a modern and attractive appearance. Therefore, cutting-edge technologies has been incorporated in the design for CTS and its related systems such as the vehicle technology, Intelligent Transportation System (ITS), Automatic Fare Collection System, Communications and IT technologies, and other facilities to provide for optimum convenience of the passengers. The preliminary framework for the design can be outlined below.

- The vehicle has medium – high passenger capacity and modern appearance.
- The system has its dedicated bus ways, right-of-way (ROW) and stations that are independent of the road surface, and has its own controlling system.
- The frequency of service is high and reliable.
- The system can be integrated into other means of public transports in order to distribute the passengers throughout the entire area as well as to link with rural districts.
- The passenger fare for the system can be integrated with the shared ticketing system of other public transport modes.

6.2.4 Urban Transport Project in Other Regional Cities

At present, studies for urban transport project in other cities are limited. Only Phuket has pre-feasibility study.

(1) Phuket

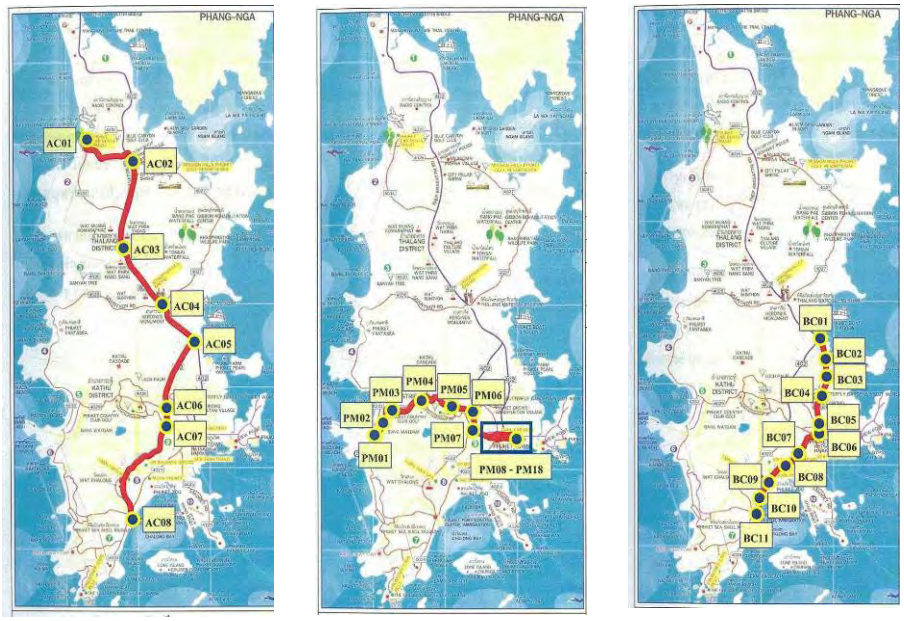
Phuket is the southern island in the Andaman Sea which has only 570 m^2. Tourism is the main revenue of Phuket. From the survey in 2004, it was found that there were 4.8 million Thai and foreign tourists travelled in Phuket and the number of tourists will increase every year. This would develop the economic and social development continuously and rapidly. Consequently, the traffic demand would increase as well. From the pre-feasibility study, it predicted that if there is no better transport plan in Phuket, the trips will increase to 400,000 trips per day in 2024 which make the traffic condition to be the same as the current traffic condition in Bangkok.

Presently, public transports in Phuket are bus, shared taxi (rot song taew), taxi, tuk-tuk, and taxi-motorcycle. (There is no data about mode share in the pre-feasibility study.) However, from the feasibility study, it could be implied that bus and shared taxi (rot song taew) which are the main public transport for Phuket people should be improved. Otherwise, people will shift their modes to private transport. Therefore, the traffic condition will be more congested in the future if there is no improvement.

In Phuket, there is a pre-feasibility study to improve the mass transit system which has been done by Office of Traffic and Traffic Policy and Planning (OTP). The plan proposed three routes

in Phuket, as shown in Figure 6.12. The mass transit system was planned to use an electric articulated bus (> 100 passengers, 18 meter long) for route 1 and medium-sized electric standard bus for route 2 and 3 (60 passengers, 12 meter long). The specification of bus should be a low-floor bus with the modern design and available space for luggage of tourists.

From Figure 6.16, Route 1 starts from Airport to Chalong Junction which composes of 8 stations with the distance of 41.4 km. In route 1, exclusive lane and share lane are mixed up due to non uniform type of roads. Route 2 starts from Patong to Khajonkiet Suksa which compose of 18 stations with the distance of 18.4 km. Route 2 is in the narrow roads so share lane type is applied. The last route starts from Bang Koo to Chalong Junction which composes of 11 stations with the distance of 16.8 km. This route passes through the community so the share lane type is applied in order to reduce the land acquisition cost and impact of community.



Route 1 **Route 2** **Route 3**

Source: Feasibility Study of Mass Transit Plan for Phuket

Figure 6.16 Routes for Phuket Mass Transit

6.3 Project

6.3.1 Rationale/Justification of the Project

Currently, traffic congestion problem is relatively severe in Bangkok and other urban areas (Chiang Mai, Phuket, and etc). Moreover, the number of private vehicles is still increasing as well as number of trips per day. Therefore, traffic condition will be worse definitely if there is no change in travel behavior and public transport improvement. It is obvious that public transport can solve traffic congestion problem. However, the public transport system in Bangkok and other urban areas are needed to be improved in order to attract private vehicle users to use the

public transport. If the number of private vehicle users reduce, traffic condition will be better as well as environment and quality of life. Global warming problem from transport sector would be diminished.

Bus Rapid Transit (BRT) will be the new public transport in Bangkok, Chiang Mai, and Phuket which provides a higher quality of service than an ordinary bus system. BRT is operating on the bus lane which separates from the car users. Moreover, BRT will get a signal priority. Therefore, BRT will go faster than other systems on the road. Punctuality and safety problems would be solved.

Some may question that why other mass transits are not applied in those cities, e.g. light rail transit (LRT), etc. LRT system is obviously better that BRT in terms of efficiency as BRT reduce the existing road capacity (either exclusive lane or share lane). However, due to cost of construction and installation, BRT is better than other mass transits. Moreover, it is easy to change the route in the future.

This mass transit improvement project includes the cost construction of Bangkok BRT2 (Morchit-Government Center), BRT3 (Chongnonsri-Suksawat) and Chiang Mai Transit System as well as the detailed design of Bangkok BRT4 (Don Muang-Minburi-Suwannabhumi), BRT5 (Minburi-Samrong), and BRT6 (Bangna-Suwannabhumi). Bangkok BRT network is shown in Figure 6.15.

6.3.2 Project Components

Bus Rapid Transit (BRT) is the bus system with the special operation. Some additional features from an ordinary bus system are required. The modern style bus with the clean engine and energy which is compressed natural gas (CNG) with the standard of EURO III or the diesel hybrid energy is introduced in the system. This can reduce the emission of carbon dioxide (CO_2) about 30% when comparing with the normal diesel engine. CCTV (Closed Circuit TV) and LED information sign are installed inside the bus. Other intelligence transportation system (ITS) is also included in the bus and at the station, e.g. GPS, electronic information sign at the station, etc. Priority signal and control center are also included in the ITS part.

The automatic fare collection system (AFC) is installed at the station to make the passengers convenience to use. The station is designed as the modern style. Lane curb is applied in order to separate the bus lane from other lanes. Moreover, the facilities for handicapped person are also installed in the bus and at the station. As this project has a purpose to reduce the number of private vehicles in the city, the Park & Ride is very important which is mostly located at the interchange station or the first outbound station or the station which has the high number of passengers. Lastly, one of the most important components is depot which is the place to store the bus and maintain the quality of bus and its components.

6.3.3 Bangkok BRT

For Bangkok BRT system, BMA expected to extend the system another 2 lines as follows

(1) BRT 2: Mochit-Government Center line

This BRT line is 13.5 km. in length and has total of 7 stations. The line will start from Mochit station with connection to BTS and MRTA. The line will stop at Horwang station which serve a approximately 4,500 passengers per day from school, office buildings and department store after the opening in 2012. BRT will continue on Donmuang Toll way and then turn in to Chang Wattana Road and stop at Laksi and TOT station. Then the line will stop at Government Center station which is the new site for many of Thai Government offices. The center is planned to attract government officials and visitors more than 60,000 people per day. The BRT line will continue along Chang Wattana road and stop at MOF before terminate at Klong Papa station.

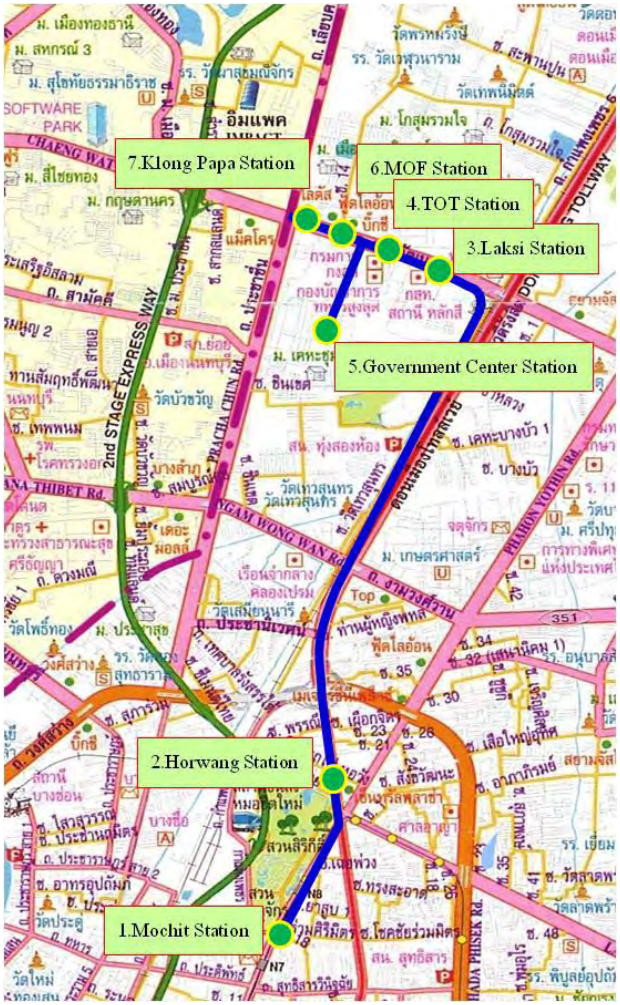


Figure 6.17 Routes for BRT2: Mochit – Government Center

(2) BRT 3: Chongnonsri – Suksawasd Line

This BRT line is 19.5 km. in length and has total of 7 stations. The line will branch off from BRT1 Chongnonsri – Rajchapreuk line. The line will start after station 5 (Nararam 3) of BRT 1 and continue on the Industrial Ring Road Bridge. The first station of this line will be Suksawasd Station. The line will go along Suksawasd road and pass through 6 additional stations before turn into BRT1 at Mahaisawan intersection. This line is expected to carry approximately 140,000 passengers per day in 2012 (Table 6.2) since it will be one of the first mass transit to service the lower Thonburi area namely Rama 2, Prachauthit and Suksawasd area.

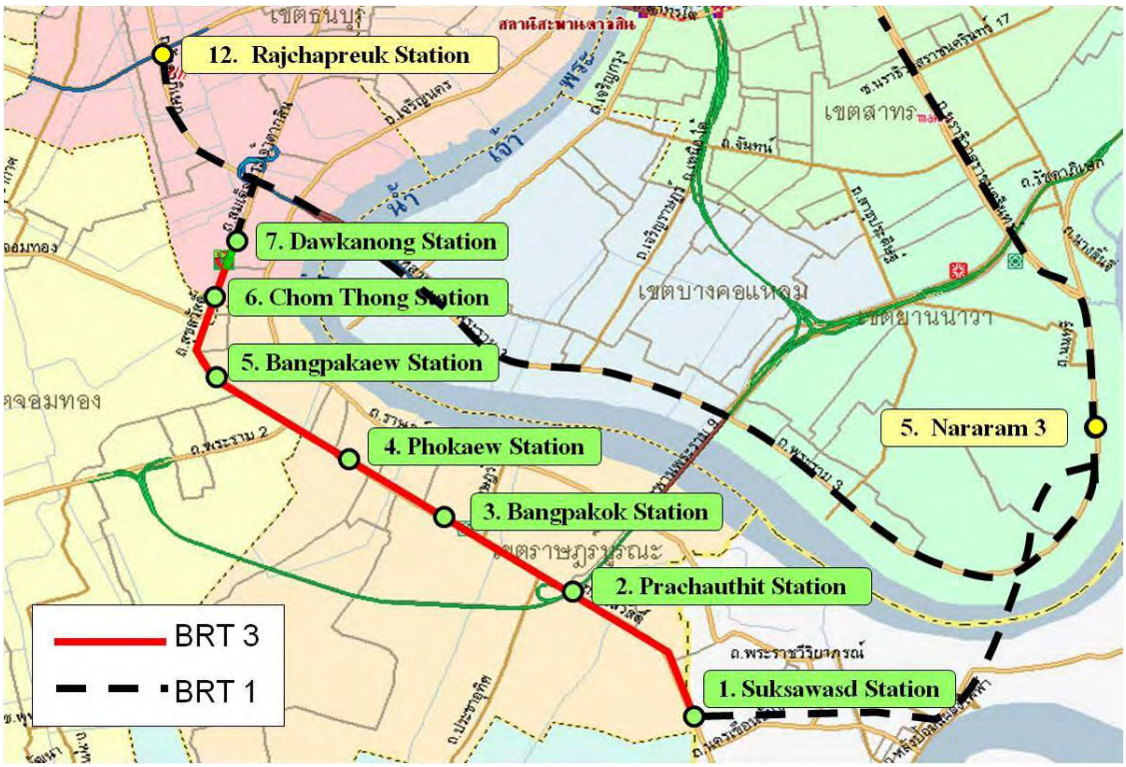


Figure 6.18 Routes for BRT3: Chongnonsri – Suksawasd

Table 6.2 Demand Forecast of BRT System (Year 2012)

		Case 1 Without Project				Case 2 With Project			
MRT		5 Line				5 Line			
BRT		BRT1	BRT2	BRT3	Total	BRT1	BRT2	BRT3	Total
Private Trips (%)		54.12				53.87			
BMR	PCU-KM (million PCU-Km /day))	231.094				230.647			
	PCU-Hour (million PCU-Hour/day)	9.674				9.623			
	Speed (Km/Hr)	23.89				23.97			
Project	Boarding (person trip/days)	110,267	NA	NA	110,267	90,074	38,927	139,928	268,928
	Pass-Km (pass-Km/day)	511,503			511,503	449,489	413,681	934,218	1,797,388
	Pass-Hr (pass-Hr./day)	20,542			20,542	18,052	8,563	42,769	69,384
	Daily Line Loading (persons/day)	37,680			37,680	28,480	21,187	35,680	85,347
	Peak Hour pphpd	5,652			5,652	4,272	3,178	5,352	12,802

Source: Calculation from eBUM model by the Study Team

Table 6.3 Demand Forecast of BRT system (Year 2022)

		Case 1 Without Project				Case 2 With Project			
MRT		5 Line				5 Line			
BRT		BRT1	BRT2	BRT3	Total	BRT1	BRT2	BRT3	Total
Private Trips (%)		57.97				57.67			
BMR	PCU-KM (million)	295.842				295.333			
	PCU-Hour (million)	14.252				14.131			
	Speed (Km/Hr)	20.76				20.9			
Project	Boarding| (person trip/days)	187,789	NA	NA	187,789	151,388	42,395	274,711	468,494
	Pass-Km (pass-Km/day)	851,024			851,024	737,28	426,944	1,840,703	3,004,930
	Pass-Hr (pass-Hr./day)	34,178			34,178	29,610	10,443	85,427	125,479
	Daily Line Loading (persons/day)	65,460			65,460	48,333	22,200	66,987	137,520
	Peak Hour pphpd	9,819			9,819	7,250	3,330	10,048	20,628

Source: Calculation from eBUM model by the Study Team

These BRT lines are expected to attract large number of passengers and enhance the integration with planned rail mass transit lines. The number of passenger in BRT system is expected to be about 270,000 passengers at opening and will reach 470,000 passengers by the year 2022, from result of calculation by the Study Team. The demand forecast model for Bangkok BRT project is the extended Bangkok Urban Model (eBUM), which is developed in the Transport Data and Model Center Project (TDMC) VI of OTP and is the recent official transportation model for BMR.

The characteristics of BRT2 and BRT3 are totally different. BRT2 is mainly running on Don Muang Toll way with shared lanes. Moreover, the BTS green line and SRT red line are its competitors. For BRT3, it is mainly running on the exclusive lanes and no competitor. The main purpose BRT2 is to serve the government officers to travel between BTS Morchit station and Government Center so the peak hour line loading (pphpd) is very high comparing with its daily boarding. For BRT3, its main purpose is to serve the residential areas, offices and schools. So the number of daily passengers of BRT3 is relatively high comparing with BRT2.

Figure 6.19 shows the selection of the transportation mode regarding the capacity and operating speed. From the eBUM model, the passengers per hour per direction (pphpd) of BRT2 and BRT3 in 2022 are 3,330 and 10,048, respectively (Table 6.3). The passenger per hour per direction (pphpd) means maximum number of passengers that travel from station to adjacent station per hour per direction. Daily Line Loading is the number of passengers that travel from station to adjacent station per day per direction. It shows that both BRT2 and BRT3 fall into the range of Bus Priority mode. Therefore, both BRT2 and BRT3 are suitable to install in Bangkok area. In other words, BRT system can handle the traffic demand in Bangkok.

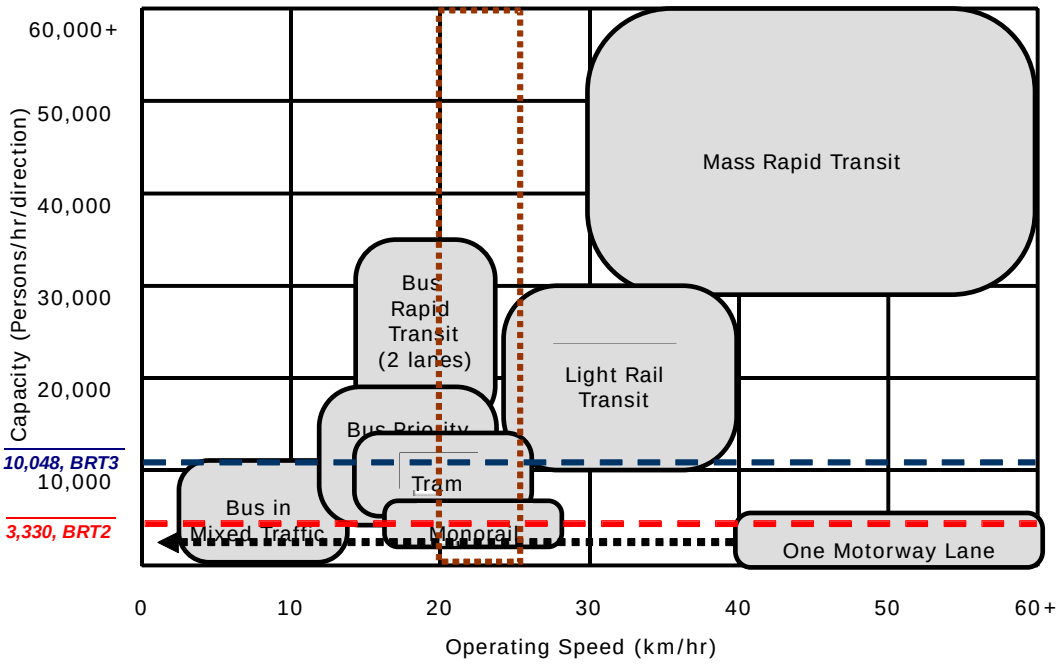


Figure 6.19 Transportation Mode regarding Capacity and Operating Speed

In the future, it could be questioned that BRT system is sustainable or not. Unfortunately, the model was executed up to year 2022 only. By applying the extrapolation method to assume the number of pphpd in future, the results of linear analysis in 2032 are 3,482 and 14,744 pphpd for BRT Line 2 and BRT Line 3, respectively. In addition, by using an interest equation An = A1 (1+x)^n (x: interest rate, n: year), the results are 3,489 and 18,864 pphpd, respectively. The analysis implies to show the overstated value but the result is still in the range so there would be no problem for applying BRT 2 and BRT 3 in Bangkok.

From the BRT preliminary operation plan, it designed to use normal bus for BRT2 and articulated bus for BRT3 which can handle 80 and 160 passengers per bus, respectively. As BRT3 will have many passengers in the peak hour, it was planned to operate as a two-bus platoon in every 2 minutes during the peak hour.

- BRT 2: 80 passenger/bus * 2 buses/ direction/ platoon * 30 bus/ direction/ hour = 4,800 passengers per hour per direction
- BRT 3: 160 passenger/bus * 2 buses/ direction/ platoon * 30 bus/ direction/ hour = 9,600 passengers per hour per direction

In the case that the passengers increase from 14,744 to 18,864 for BRT Line 3 in the year 2032, we need to expand the BRT system to 2 lane operation. In this case, there will be express BRT line which stops at big station and local line which stop at every station (just like Bogota case). In that case the system capacity is effectively double.

6.3.4 Chiang Mai BRT

The first phase of the transportation system consists of four route networks with accumulate distance of 100 kilometers. These networks were designed to cover the entire urban plan area and to link major activity areas with as minimal transport transfers and travel time as possible. The existing city moats serve as the transit center. The detailed information used during the design of the four routes include (1) physical conditions of the routes, (2) natures of land use alongside the routes, (3) traffic volume and traffic control system, and (4) appropriate locations

for the stations. The existing roads are integrated into the design to optimize its function to the transportation system, in order to organize the traffic system and traffic surface that provides for the CTS-dedicated lane and stations without additional land expropriation. The four routes can be summarized below.

(1) Route 1: City Hall – Chiang Mai Night Safari

This route runs in the north-south alignment of the Chiang Mai urban plan area, with accumulate distance of 40 kilometers. A total of 27 stations with 300 – 600 meters space in between each station, are planned. It seems that the distance between each station is shorter than usual because Chiang Mai city is set to be a pedestrian-friendly city as it is one of the most attractive cities for residents and tourists. So Chiang Mai Transit System is designed as the passenger- friendly public transport system which makes the people access to any place easily. In other words, the system is designed as the high accessibility public transport system. The major activity areas on this route include 7 public offices, 8 educational institutes, 5 medical institutes, 2 hotels, 19 historic/religious sites, and 6 tourist attractions.

Route 1 can be divided into four sections; the widths of each are (1) 15 – 25 meters between Chotana and Changphuek roads, (2) 11 – 15 meters around the city moat, (3) 21 – 30 meters between Mahidol and Haiya roads, and (4) 30 meters between Chiang Mai-Hang Dong and Ratchaphruek roads.

(2) Route 2: 700th Year Chiang Mai Anniversary Stadium – San Sai Market

This route links the western and the northeastern parts of the Chiang Mai urban plan area, with accumulate distance of 32 kilometers. A total of 29 stations with 300 – 600 meters space in between each station, are planned as passenger-friendly public transport system. The major activity areas on this route include 5 public offices, 12 educational institutes, 6 medical institutes, 9 hotels, 27 historic/religious sites, and 2 department stores.

Route 2 can be divided into four sections; the widths of each are (1) 30 – 40 meters on 700 Years Anniversary road, (2) 16 – 20 meters between Huaykaew and Suthep roads, (3) 11 – 15 meters around the moat, and (4) 18 – 20 meters between Ratanakosin and Kaewnawarat roads.

(3) Route 3: Chiang Mai Zoo – Buak Krog

This route runs in the east-west alignment of the Chiang Mai urban plan area with accumulate distance of 34 kilometers. A total of 29 stations with 300 – 600 meters space in between each station, are planned. The major activity areas on this route include 1 public office, 11 educational institutes, 6 medical institutes, 8 hotels, 25 historic/religious sites, and 5 tourist attractions.

Route 3 can be divided into three sections; the widths of each are (1) 16 – 20 meters between

Huaykaew and Suthep roads, (2) 11 – 15 meters around the moat, and (3) 11 - 18 meters between Charoenmuang and Chiang Mai – Sankhampaeng roads.

(4) Route 4: Thapae – Meng Rai (Counter Clock Wise)

This route serves Chiang Mai business and tourism district, with accumulate distance of 8 kilometers. A total of 12 stations with 300 – 600 meters space in between each station, are planned. The major activity areas on this route include 1 public office, 11 educational institutes, 2 medical institutes, 5 hotels, 12 historic/religious sites, and 2 tourist attractions.

Route 4 can be divided into three sections, the widths of each are (1) 15 meters on Sridonchai road, (2) 12.5 meters on Charoan Prathet road (4) 11.5 meters on Thapae road.

Figure 6.20 Image of Chiang Mai Transit System (CTS)

The demand forecast (calculated by sequential 4-step model) for Chiang Mai Transit System (CTS) in the 10th year after opening CTS or in 2020 is shown in Table 6.4. It was calculated in Pre-feasibility Study of Mass Transit Plan for Chiang Mai conducted by OTP in 2007, and shows the CTS with the feeder system. The reason that peak hour daily trips were very high comparing with all day trips are:

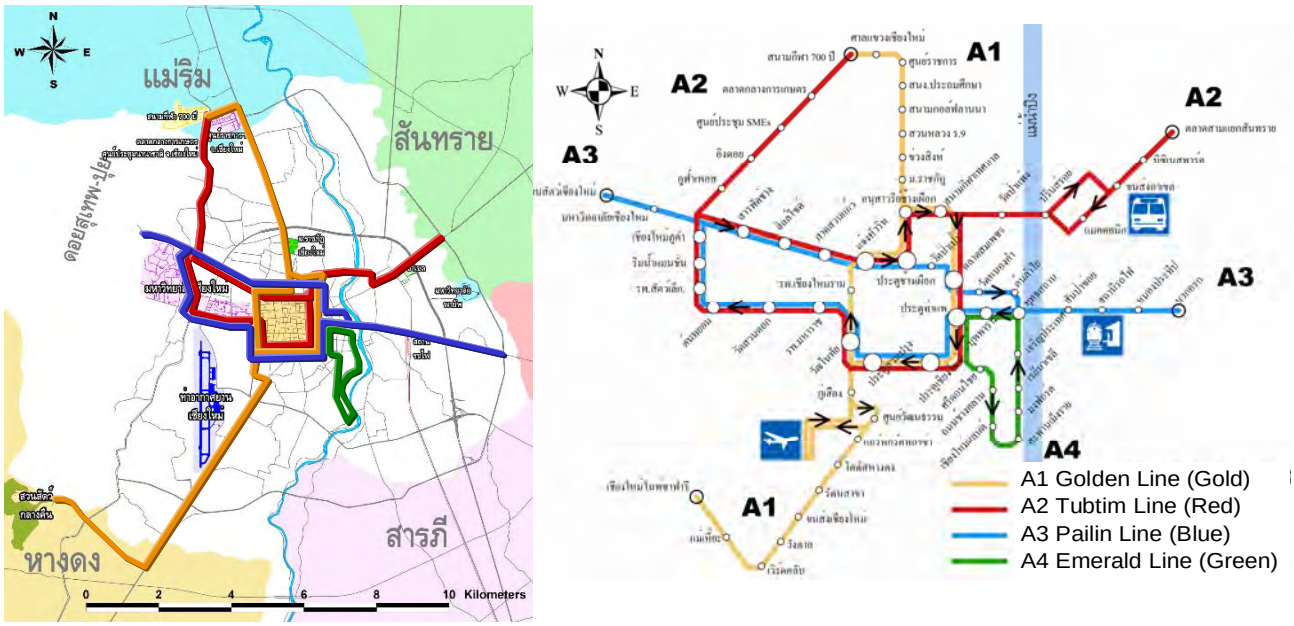


Figure 6.21 Chiang Mai Transit System (CTS)

- Lots of morning trips (about 50%) will be splitted to CST from the work trips and school trips
- The other trips (generally in off-peak period) will be splitted very small portion
- In summary, 100,489 trips will be the CST morning trips (7.00-8.00), nearly 100,000 trips will be the CST evening trips (16.00-19.00), and rests of the trips will be the CST off-peak trips.

Table 6.4 Demand Forecast for Chiang Mai Transit System in 2020

Route	Number of Passengers (trip/hr)	Number of Passengers (trip/day)
A1	34,816	104,446
A2	23,301	69,901
A3	30,761	92,282
A4	11,611	34,834
Total	100,489	301,464

Source: Pre-Feasibility Study of Mass Transit Plan for Chiang Mai

The shares of transportation modes consist of motorcycles (36.0%), personal cars (34.8%), public transport (27.5%), and other vehicles (1.8%). Percentage of public transport will increase from 9.3% in 2007 to 27.5% in 2020.

6.3.5 BRT in Phuket

(1) Demand Forecast

Before calculating the demand forecast, the operation plan and the fare structure should be determined first. According to the pre-feasibility study of Phuket BRT, there will be 15 buses each route. The headway will be 5 and 15 minutes during the peak hours and non-peak hours, respectively. The fare structure from the study is 10 baht as the basic fare plus 1.50 baht per

kilometer which not over than 60 baht. The demand was forecasted by OTP by use of the traffic and transport model for year 2011, 2016, 2021, 2026, and 2031, as shown in Table 6.5. The passenger trips will be increased to 115,900 person trips per day in 2016 and increased continuously to 163,700 person trips per day in 2031. The number of person trip per day will be increased approximately 1.66% per year. The demand forecast was calculated in 2007, and pre-conditions and methodology are adequate.

Table 6.5 Demand Forecast for Phuket BRT

Route	Number of Person Trips per Day				
	2011	2016	2021	2026	2031
Airport to Chalong Junction	40,900	45,300	50,100	55,400	58,300
Patong to Khajonkiet Suksa	25,500	29,800	34,700	40,500	45,100
Bang Koo to Chalong Junction	35,200	40,800	47,200	54,700	60,300
Total	101,600	115,900	132,000	150,600	163,700

Source: Pre-feasibility Study of Phuket BRT, OTP

(2) Design and Specification

For the stations, mostly are constructed on the ground level but some part of route 1 has three types, which are ground level, elevated level, and underpass. However, this would depend on the final decision of the government. For the Route 1, the consultant has designed the location of the station to be at underground level in the case of exclusive lane as shown in Figure 6.22. In the case of share lane, the consultant has designed the station next to the medium in order to avoid the land acquisition and underpass is applied for passenger crossing instead of the use of flyover as shown in Figure 6.23.

For route 2 and 3, the location of station is similar to an ordinary bus stop as shown in Figure 6.24.

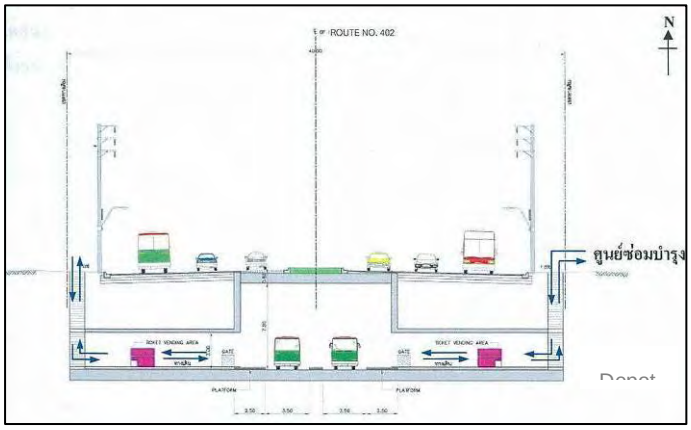


Figure 6.22 Cross Sectional of Station for Route 1 (Exclusive Lane)

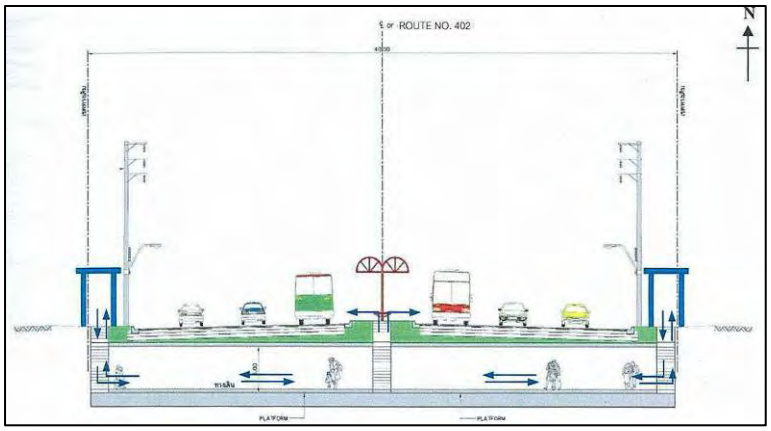


Figure 6.23 Cross Sectional of Station for Route 1 (Share Lane)

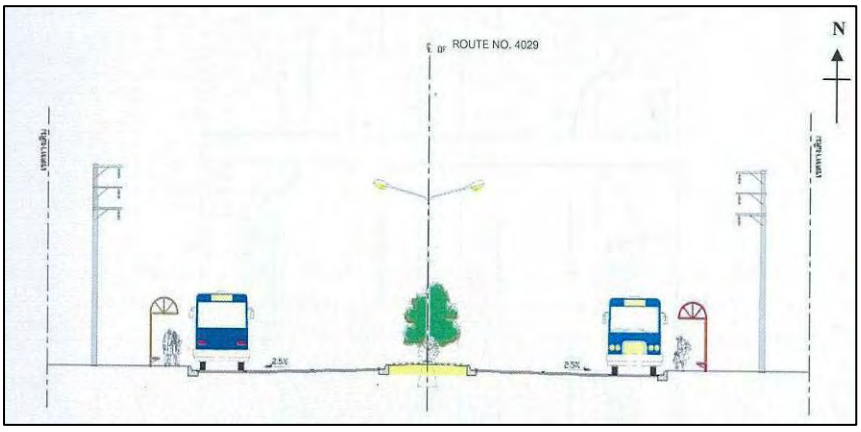


Figure 6.24 Cross Sectional of Station for Route 2 and3

The design of the lane is separated into two types, i.e. exclusive lane and shared lane. The barrier/lane curb is applied for the exclusive lane in order to separate bus from other vehicles. So the bus can go fast and safe but it is difficult to apply inside the high density area and small road. For the share lane, the noticeable color is applied on the bus lane but other vehicles can run on this lane. Only route 1 applies both lane types while route 2 and 3 apply only share lane.

(3) Project Cost

In the feasibility study, the development of Phuket Mass Transit plan has been separated into two cases as follows:

- Case 1: Exclusive lane for Route 1 and share lane for Route 2 and 3
- Case 2: Share lane for all routes

The investment is shown in Table 6.6 and Table 6.7. It is obvious that the investment for exclusive lane is about twice of investment for share lane.

Table 6.6 Investment for Project Development (Construction one by one)

Route	Investment (Million Baht)	
	Case 1	Case 2
Airport to Chalong Junction	14,714	7,064
Patong to Khajonkiet Suksa	2,843	2,843
Bang Koo to Chalong Junction	2,908	2,908

Source: Pre-feasibility Study of Phuket BRT, OTP

Table 6.7 Investment for Project Development (Construction at the same time)

Case	Investment (Million Baht)
All are “Exclusive Lane”	27,702
All are “Share Lane”	12,816
Exclusive lane for Route 1 and share lane for Route 2 and 3	20,620

Source: Pre-feasibility Study of Phuket BRT, OTP

The optimal case would depend on the detailed design and budget availability as well as public hearing.

6.3.6 Area Traffic Control (ATC)

In order to mitigate the traffic congestion problem, many related agencies have been carrying out various projects. Among them, Area Traffic Control (ATC) system project is the most significant achievement in recent years. The ATC system aims at controlling vehicular traffic flows through optimizing and coordinating traffic signals in a comprehensive manner. In Thailand, Bangkok Metropolitan Administration (BMA) has studied and planned to install but the project has been cancelled in 2001 due to the delay and some problems. Few years later in 2003, BMA has hired a consultant to study and formulate a development plan and implementation program for improvement of the BMA’s traffic management system, which accommodates the traffic management and control within the greater Bangkok area. The system is to be central for intercommunication between related agencies by using the up-to-date communication system and updated and relevant traffic database system for traffic management plan. Other regional provinces have been applied ATC, e.g. Chiang Mai, Pattaya, and etc.

Area traffic control (ATC) system is a general term that refers to a system in which all traffic signals are centrally controlled by computer. Many vehicle detectors are installed in the road network to collect traffic condition data such as traffic volume and occupancy rate. These data are sent to the control center via data communication link and processed by the computer into traffic information. Using these data, the central computer system calculates the optimum signal timing. Finally the computer controls traffic signals with the optimum timing. Basic configuration of ATC system is illustrated in Figure 6.25.

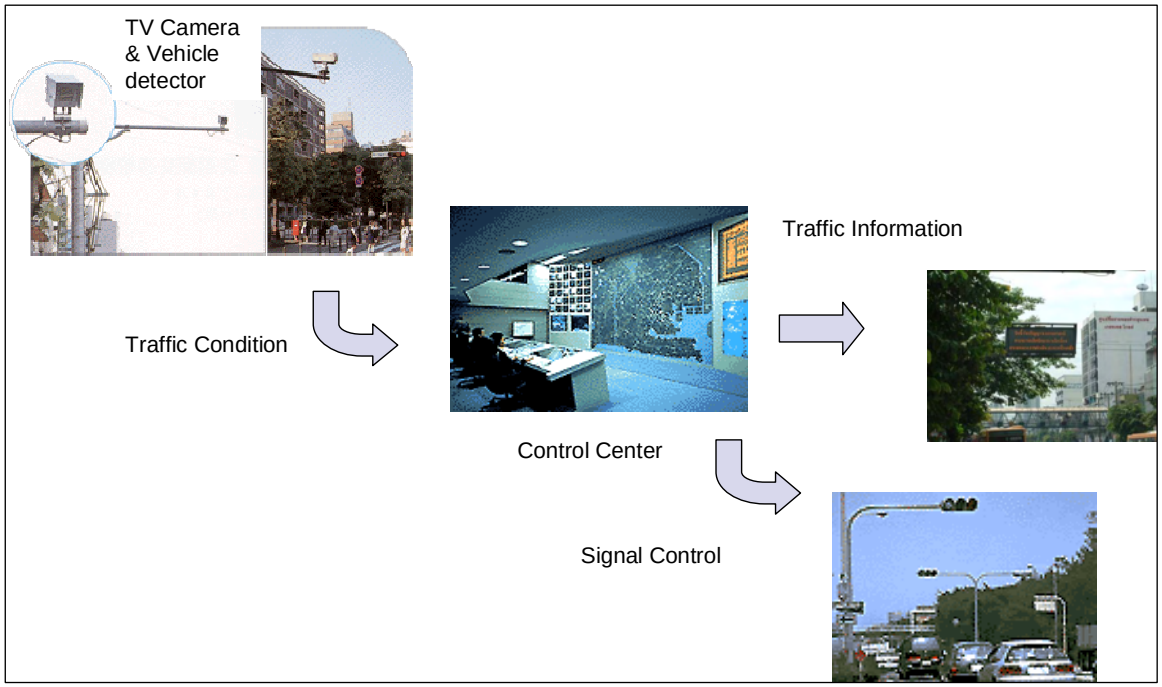


Figure 6.25 Basic Configuration of ATC System

Moreover, in order to establish the appropriate urban traffic control and management system, a traffic intelligent sign should be installed to inform drivers about traffic condition and other important information.

6.3.7 Total Project Cost

Table 6.8 shows the total implementation budget estimation for the urban transport improvement project which include

- Construction of Bangkok BRT2 (Morchit-Government Center)
- Construction of Bangkok BRT3 (Chongnonsri-Suksawat)
- Detailed Design and Construction of Chiang Mai Transit System
- Feasibility Study of Public Transport in Other Regional Cities
- Feasibility Study and Implementation of Area Traffic Control (ATC) in Regional Cities

Table 6.8 Total Project Cost

Unit: Million Yen

Item	Foreign		Domestic		Total	
	Total	Loan	Total	Loan	Total	Loan
Consultant Service						
Bangkok BRT2 Morchit-Government Center (PMC+CSC)	94	94	141	84	234	178
Bangkok BRT3 Chongnonsri-Suksawat (PMC+CSC)	72	72	108	65	180	137
Chiang Mai Transit System (PMC+CSC)	409	409	614	368	1,023	777
Public Transport in other regional cities (FS+DD)	750	750	1,125	675	1,875	1,425
Area Traffic Control (ATC) in Regional Cities (FS+DD)	169	169	253	152	422	321
Sub-total	1,494	1,494	2,241	1,344	3,734	2,838
Land Acquisition (if applicable)						
Bangkok BRT2 (Morchit-Government Center)	0	0	0	0	0	0
Bangkok BRT3 (Chongnonsri-Suksawat)	0	0	0	0	0	0
Chiang Mai Transit System	0	0	313	0	313	0
Sub-total	0	0	313	0	313	0
Construction/ Implementation						
Bangkok BRT2 (Morchit-Government Center)	2,083	2,083	3,124	1,874	5,206	3,957
Bangkok BRT3 (Chongnonsri-Suksawat)	1,599	1,599	2,398	1,439	3,997	3,038
Chiang Mai Transit System	9,091	9,091	13,637	8,182	22,728	17,273
Area Traffic Control (ATC) in Regional Cities	3,750	3,750	5,625	3,375	9,375	7,125
Sub-total	16,523	16,523	24,784	14,870	41,306	31,393
Total	18,017	18,017	27,338	16,214	45,353	34,231

Note: Exchange Rate 100 yen = 32 baht
Source: Study team

6.4 Design Review

This section will review the design of bus rapid transit system referring to the universal standard. Universal design is a relatively new paradigm that emerged from "barrier-free" or "accessible design" and "assistive technology." Barrier free design and assistive technology provide a level of accessibility for people with disabilities but they also often result in separate and stigmatizing solutions, for example, a ramp for wheelchair. Universal design strives to be a broad-spectrum solution that helps everyone, not just people with disabilities.

The design review here will consider only Bangkok BRT and Chiang Mai Transit System as Phuket BRT is not in the process of detailed design yet.

6.4.1 Bangkok BRT

Regarding the design for the disability, the design has been followed the Disability Discrimination Law of United Kingdom. It regulates that the public service should be able to serve the disability and wheelchair user conveniently. The low-floor bus will be used in the

project so disabilities and other passengers will be easy to get on and get off the bus. Location and size of the door and the seat arrangement inside the bus have been designed to make passengers move comfortably. Regarding the safety, the handrail has been designed to make passenger hold tightly. Moreover, the space for wheelchair parking and wheelchair lock down mechanism also plan to be installed inside the bus. The station has been designed with the consideration of comfortableness, safety, and utility.

6.4.2 Chiang Mai Transit System

The station should have the facility for normal people and disability, e.g. crossing road, flyover, lift, map, sign and ticket vending machine. The specification of slope should be 1:12 and the floor should have noticeable mark by the disability according to the disability law. Flyover should step with the material of coarse concrete with the width of 1.5 meter or more. And the interval of stair should have height not more than 2 meters. The toilet for disability should have the size of 1.7 meter times 1.7 meter or more. There is the regulation of elevator for disability. The entrance of the BRT should have a clearance space at least 1.40 meters. Inside the bus, the space for two wheelchairs will be available too. Moreover, there should have parking space for disability in the park & ride.

This section shows the design review followed the Japanese Barrier Free Guideline. However, it could not be compared for the whole guideline as the detailed designs for both Bangkok BRT2&BRT3 and Chiang Mai Transit System are not completed yet. Therefore, in this report, only preliminary design review is shown in the table below. The "**/**" mark is used for the matched item and the "**-**" mark is used for unavailable data.

Table 6.9 Checklists of Japanese Barrier Free Guidelines with the Consideration of Passenger Movement

Japanese Guidelines	Bangkok BRT	Chiang Mai CTS
1.Pathway 1.1 Surface: The surface of a pathway floor should not be slippery.	/	/
1.2 Width: An effective width of not less than 140 cm should be secured to make it possible for a wheelchair to make a 180-degree turn there	/	/
1.3 Difference in level: Each floor should not have different levels. When a difference is inevitable, a ramp should be established.	/	/
1.4 projections in Pathway Envelope: As a rule projections from walls and ceilings should not exist in the height of 200 cm from the floor finish. If such projections are inevitable, fences not less than 110 cm high or other measures preventing a person having bad sight using white stick from bumping against it should be provided. The measures should be easily detected by white stick.	-	-
1.5 Handrails 1.5.1 Height: Height from the finished surface of a floor to the center of a handrail: Upper handrail H =	-	-

Japanese Guidelines	Bangkok BRT	Chiang Mai CTS
about 85 cm, Lower handrail H = 65 cm		
A single handrail: H = 80-85 cm	-	-
1.5.2 Form: Round cross-section with a diameter of about 4 cm	-	-
1.5.3 Position: When a handrail is fixed to a wall surface, the space between them should be about 5 cm.	-	-
1.5.4 End: The end of a handrail should be bent towards the wall or downward.	/	/
1.5.5 Braille: The handrail of the pathway that guides persons having bad sight should be marked with the destination in Braille, presentation of which should obey JIS T0921. The mark in Braille should be accompanied by its decoded version.	-	-
When the handrail is the double handrail, at least its upper handrail should have the mark.	-	-
The mark in Braille should be hard to peel off	-	-
1.6 Lightness of a pathway: Lighting and illumination for a concourse or pathway should be bright enough for elderly persons, the physically impaired, the pregnant, and all other persons to go through it smoothly.	/	/
<u>2. Slope</u> 2.1 Width: The effective width of a slope should be least 120 cm	/	/
2.2 Inclination: The inclination of a slope should not exceed 1/12 inside and 1/20 outside of the building	/	/
2.3 Landing: A slope should be provided with a landing at least 150-cm long for every 75 cm or less of its elevation change in the inside and every 60 cm or less of its elevation change outside of the building. This is so that wheelchair users can take a rest while going up or down a slope.	/	/
2.4 End: The structure of a slope should be such that its ends smoothly merge with the floor.	/	/
2.5 Horizontal area: A horizontal area at least 150-cm long is needed where the slope meets another pathway. This is to prevent a wheelchair from bumping into people walking along the pathway.	/	/
2.6 Discernible Slope: Slope should be easily distinguished and discernible by the difference in the brightness of its color from that of the surroundings or by another means.	/	/
In case the existing slope have warning tiles at landing areas at the top and the bottom so that the existence of the warning tiles should be discernible by the difference in the brightness or its color from that of the surroundings, the slope itself should be discernible.(Temporary measures for existing facilities only)	/	/
2.7 Side wall: The slope should have walls or rises on both sides of it.	/	/
When there is no well, it should have a continuous, washboard-like wheelchair stop of 35-cm in rise on both sides of it.	/	/
2.8 Handrail 2.8.1 General:	/	/

Japanese Guidelines	Bangkok BRT	Chiang Mai CTS
The slope should be provided with handrails on both sides of it.		
The handrail should be suitable for elderly, cane users, and all other users, such as a double handrail.	/	/
2.8.2 Height: Height from the floor to the center of a handrail: Upper handrail H = about 85 cm, Lower handrail H = 65 cm	-	-
2.8.3 Form: Round cross-section with diameter of about 4 cm	-	-
2.8.4 Position: When the handrail is fixed to a wall surface, the space between them should be about 5 cm.	-	-
2.8.5 End: The end of the handrail should be bent toward the wall or downward.	/	/
The handrail should have a horizontal section about 60-cm long at both ends (head extend 30 cm and tail)	-	-
2.8.6 Braille: The upper handrail of the double handrail for a pathway that guides persons having poor eyesight should have the slope's destination written in Braille, presentation of which should obey JIS T0921. The Braille should be accompanied by its decode version The mark in Braille should be hard to peel off.	-	-
2.9 Roof to Shed Precipitation: When a slope is outside of a building, it should be provided with a roof or shed roof over it because wheelchair users, the physically impaired, and persons with poor eyesight have difficulty using umbrellas.	/	/
3. Staircase 3.1 Type: Because its steps are not uniform in shape, a winding staircase including spiral staircases should not be adopted; either a straight staircase or L-shaped staircase should be used	/	/
3.2 Width: The effective width of a staircase should be at least 120 cm.	/	/
3.3 Handrails 3.3.1 General: A staircase should be provided with handrail on each side for all type of users including elderly, cane users, short persons such as a double handrail.	/	/
A staircase more than 4-mwide should also have a handrail in the middle	/	/
3.3.2 Height: Height from the finished surface of the floor to the center of a handrail: Upper Handrail H = about 85 cm.; Lower Handrail H = about 65 cm	-	-
3.3.3 Form: The cross-section of a handrail should have a round shape that is about 4-cm in diameter	-	-
3.3.4 Position: The space between a wall and handrail should be about 5 cm. if the handrail is attached to the wall.	-	-
3.3.5 End: The end of a handrail should be bent toward the wall or downward The handrail should have horizontal sections about 60-cm long at both ends(head and	-	-

Japanese Guidelines	Bangkok BRT	Chiang Mai CTS
tail)		
3.3.6 Braille: For the convenience of the visually impaired, the upper handrail of a double handrail should be marked with the information of the staircase's destination in Braille, presentation of which should obey JIS T0921. The information in Braille should be accompanied bys its decoded version. The Braille markings should be hard of peel off. The Braille markings should be located on the horizontal area of handrail near point block installation area at both ends.	-	-
3.4 Rise and tread 3.4.1 Size: Rise: about 16 cm or less, tread: about 30-cm wide or more	-	-
3.4.2 Footboard: There should be no projection, and the riser should not be omitted	-	-
3.4.3 Finish and brightness of the tread: The finished surface of a tread should have a sufficiently bold outline throughout its whole length and thus each step should be discernible by the difference in the brightness of its color from that of the surrounding or by another means. The edge of a tread should have unified color throughout all treads means.	-	-
3.5 Sidewalk: A staircase should be provide with a sidewall or a rise on each side When there is no sidewall, there should be a rise of up to about 5-cm high.	/	/
3.6 Landing: A staircase should be provided with a landing for every 3 m or less of its height. The landing should be at least 120-cm long. The handrail on the wall side of the staircase should be continuous even on a landing	/	/
3.7 Lighting: Lighting and illumination for a staircase should be bright enough for the ages or person with poor eyesight to go through smoothly	/	/
3.8 Space under staircase: A space with a ceiling that it not high enough should not be established under the stairs. This is because the visually impaired cannot detect it with their white sticks and may bump against the ceiling. If its inevitable, the space should have a fence or other measures to keep the visually impaired away.	/	/

It could be concluded that both Bangkok BRT and Chiang Mai Transit System have been designed corresponding to the universal design in order to meet the requirements of as many users as possible. Therefore, either normal passenger or disability will use both systems without any problem.

6.5 Environmental Considerations

According to the Thai Environmental Regulation, study of Environmental Impact Assessment (EIA) is not required for the implementation of Bus Rapid Transit Project since it will use 2

lanes in the existing roads and no new dedicated roads will be constructed. However; Initial Environmental Examination shall be carried out to survey in any impact to environment nearby the project route. The most important factor will be the impact to human life, land use and quality of life that will be changed from the project. The changes will be in positive side to create better land use, higher land price and better aesthetic environment along the project area. Public consultation and social impact shall be carried out for success of the project implementation to reduce opposition from people due to reduction of normal car lanes in the existing roads.

There will be some impact during construction phase in which proper mitigation and monitor will be required to minimize the impact such as noise, dust, waste and other pollutions as explained in 5 (1) of Table 6.10. Simple environmental management plan and monitoring should be prepared to control this matter.

The Environmental Checklist for the Bus Rapid Transit (BRT) Projects: Bangkok, Chiang Mai, Other Cities according to the JBIC Guidelines for Confirmation of Environmental and Social Considerations (April 2002) have been prepared for the category of Infrastructure Project as in Table 6.10.

Table 6.10 Environmental Checklist for the Bus Rapid Transit (BRT) Projects

Category	Environmental Item	Main Check Items	Confirmation of Environmental Considerations
1 Permits and Explanation	(1) EIA and Environmental Permits	1. Have EIA reports been officially completed? 2. Have EIA reports been approved by authorities of the host country's government? 3. Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? 4. In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	IEE for the Project will be carried out during the Project fesibility study and design. There is no compulsary regulation to prepare EIA on this kind of Project. The Project will use 2 lanes in the existing road way, no new roads will be constructed.
	(2) Explanation to the Public	1. Are contents of the project and the potential impacts adequately explained to the public based on appropriate procedures, including information disclosure? Is understanding obtained from the public? 2. Are proper responses made to comments from the public and regulatory authorities?	The details of the Project will have to be explained and published to the people several times by press release, seminar and public meeting during the Project feasibility study. Regular plan in PR of the Project during implementation stage will be required to receive positive participation from people.
2 Mitigation Measures	(1) Air Quality	1. Do air pollutants, (such as sulfur oxides (SOx), nitrogen oxides (NOx), and soot and dust) emitted from the proposed infrastructure facilities and ancillary facilities comply with the country's emission standards and ambient air quality standards?	Implementation of the Project is expected to reduce air pollutants to the route area since the BRT Bus will be of clean diesel or hybrid type which will create less pollution than normal diesel or

			benzene cars. Changing of transport mode from private car to BRT will reduce air pollution in some extent.
	(2) Water Quality	1. Do effluents or leachates from various facilities, such as infrastructure facilities and the ancillary facilities comply with the country's effluent standards and ambient water quality standards?	There will be no effect to water quality from the Project, All the facilities will be fully controlled to prevent effect from the Project activities.
	(3) Wastes	1. Are wastes from the infrastructure facilities and ancillary facilities properly treated and disposed of in accordance with the country's standards?	Waste from the Project will be properly collected to be further disposed by the BRT System Operator.
	(4) Soil Contamination	1. Are adequate measures taken to prevent contamination of soil and groundwater by the effluents or leachates from the infrastructure facilities and the ancillary facilities?	There will be no effect to soil or ground water contamination from the Project.
	(5) Noise and Vibration	1. Do noise and vibrations comply with the country's standards?	Noise and vibrations will be controlled to comply with the local standard.
	(6) Subsidence	1. In the case of extraction of a large volume of groundwater, is there a possibility that the extraction of groundwater will cause subsidence?	There will be no extraction of groundwater from the Project.
	(7) Odor	1. Are there any odor sources? Are adequate odor control measures taken?	There will be no odor source from the Project.
3 Natural Environment	(1) Protected Areas	1. Is the project site located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	The Project site will not be located in the protected areas.
	(2) Ecosystem	1. Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? 2. Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? 3. If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? 4. Is there a possibility that the amount of water (e.g., surface water, groundwater) used by the project will adversely affect aquatic environments, such as rivers? Are adequate measures taken to reduce the impacts on aquatic environments, such as aquatic organisms?	There will be no effect to the ecosystem from the Project.
	(3) Hydrology	1. Is there a possibility that hydrologic changes due to the project will adversely affect surface water and groundwater flows?	There will be no effect to the hydrology from the Project.
	(4) Topography and Geology	1. Is there a possibility the project will cause large-scale alteration of the topographic features and geologic structures in the project site and surrounding areas?	There will be no effect to the topography and geology from the Project.

4 Social Environment	(1) Resettlement	1. Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement? 2. Is adequate explanation on relocation and compensation given to affected persons prior to resettlement? 3. Is the resettlement plan, including proper compensation, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? 4. Does the resettlement plan pay particular attention to vulnerable groups or persons, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? 5. Are agreements with the affected persons obtained prior to resettlement? 6. Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? 7. Is a plan developed to monitor the impacts of resettlement?	There will be no resettlement from the Project Implementation since 2 lanes in the existing road will be converted to BRT lanes, and for some roads mixed will be used lanes
	(2) Living and Livelihood	1. Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary?	The Project will provide better living conditions to people within the Project area because of proper traffic management and less private car.
	(3) Heritage	1. Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage sites? Are adequate measures considered to protect these sites in accordance with the country's laws?	There will be no effect to the heritage from the Project.
	(4) Landscape	1. Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	The Project will provide better landscape to the nearby area from more proper design in landscape to the entire route.
	(5) Ethnic Minorities and Indigenous Peoples	1. Does the project comply with the country's laws for rights of ethnic minorities and indigenous peoples? 2. Are considerations given to reduce the impacts on culture and lifestyle of ethnic minorities and indigenous peoples?	There will be no effect to the Ethnic Minorities and Indigenous Peoples from the Project.
5 Others	(1) Impacts during Construction	1. Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? 2. If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts? 3. If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts? 4. If necessary, is health and safety education (e.g., traffic safety, public health) provided for project personnel, including workers?	Measures to reduce impact during construction will be included in the construction contract and controlled by the supervisors according to the local regulation.

	(2) Monitoring	1. Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? 2. Are the items, methods and frequencies included in the monitoring program judged to be appropriate? 3. Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? 4. Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	Environmental Monitoring as well as monitoring framework will be set by the Local Municipality.
6 Note	Reference to Checklist of Other Sectors	1. Where necessary, pertinent items described in the Roads and Railways checklist should also be checked (e.g., projects including access roads to the infrastructure facilities). 2. For projects, such as installation of telecommunication cables, power line towers, and submarine cables, where necessary, pertinent items described in the Electric Power Transmission and Distribution Lines, and Oil and Gas Pipelines checklists should also be checked.	-
	Note on Using Environmental Checklist	1. If necessary, the impacts to transboundary or global issues should be confirmed (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	-

Note: * For the communication infrastructure projects, applicable items are 1 (1)(2), 3(1)(2), 4 (1)-(5) and 5(1)(2), and only these items should be checked.
1) Regarding the term "Country's Standards" mentioned in the above table, in the event that environmental standards in the country where the project is located diverge significantly from international standards, appropriate environmental considerations are made, if necessary.
In cases where local environmental regulations are yet to be established in some areas, considerations should be made based on comparisons with appropriate standards of other countries (including Japan' experience).
2) Environmental checklist provides general environmental items to be checked. It may be necessary to add or delete an item taking into account the characteristics of the project and the particular circumstances of the country and locality in which it is located.
Source: Study Team

6.6 Anticipated CO_2 Reduction

Introduction of public transport would reduce the number of private vehicle users, especially for people living and working along the project area. This will enhance the traffic flow since the vehicle speed would be increased. Moreover, the environmental condition will eventually be improved. In this report, CO_2 emission is only considered.

Characteristics Carbon dioxide is produced by a number of natural and anthropogenic sources, most relevantly by the burning of fossil fuels such as petrol and diesel in vehicles in addition to industries and power plants that burn these carbon-based fuels. CO_2 is one of the most important greenhouse gases that are expected to contribute to the increase in global temperatures through the greenhouse effect, leading to many socio-economic impacts primarily through its effects on sea levels, temperature and precipitation changes.

Considering the Bangkok BRT project, the eBUM transport model from "Transport Data and

Model Center VI" has been applied in order to obtain the traffic volume of with and without the Bangkok BRT2 and BRT3 projects for 2012 (opening year) and 2022. Then the amount of CO_2 emission for the "With" and "Without" cases is calculated by applying the formula 1. The method for evaluating the emission load is done by determination of emissions per passenger transported per vehicle category. The Specific Energy Consumption (SEC) and Emission Factor (EF) are shown in the table below.

Formula 1

$$EF_{KM,i} = \sum \left[SEC_{x,i} \times \left(EF_{CO2,x}\right) \times \left(\frac{N_{x,i}}{N_i} \right) \right]$$

Where*:*

$EF_{KM,i}$ = Transport emissions factor per distance of vehicle category i (equivalent g CO_2 per kilometer driven)

$SEC_{x,i}$ = Specific energy consumption of fuel type x in vehicle category i (litre per kilometer)

$EF_{CO2,x}$ = CO_2 emission factor for fuel type x (equivalent g CO_2 per litre)

N_i = Total number of vehicles in category i

$N_{x,i}$ = Number of vehicles in vehicle category i using fuel type x

Table 6.11 Specific Energy Consumption and Emission Factors for all Vehicle Categories (in equivalent CO_2, g/liter)

Vehicle Class	Specific Energy Consumption, SEC (l/km.)	Emission Factor, EF_{CO2} (g/l)
Cars	0.07	399
Motorcycle	0.02	68
3-wheels	0.05	116
Taxi	0.11	399
Bus	0.27	1,233
CNG Bus*	0.27	1,110
Truck	0.13	1,233

Note: * From the "CNG and Diesel Transit Bus Emissions in Review", it found that CO2 from the CNG buses were slightly lower than for the diesel buses. It was about 10% lower so EFCO2 of CNG bus is approximately 10% reduction.

Source: Vehicular Air Pollution Information System VAPIS-Bangkok Version 1.0, A Decision Support System to Test Vehicular Pollution Control Options in Bangkok, The World Bank, 1999

PCU-kilometer which accumulates the traffic within 1 kilometer buffering from the BRT route is

directly obtained from the eBUM transport model as shown in Table 6.12. Here, the 5-line mass transit plan (Figure 6.8) is taken into the consideration for both years. The CO_2 emissions of with and without cases for 2012 and 2022 are shown in Table 6.13.

Table 6.12 Total PCU-Kilometer of 1 kilometer Buffer Area along Bangkok BRT2 and BRT3 Routes

Vehicle Class	PCU-KM			
	2012-Without BRT	2012-With BRT	2022-Without BRT	2022-With BRT
Cars	6,189,258	6,081,649	8,872,997	8,716,126
Motorcycle	803,919	800,551	829,101	823,108
3 Wheels	239,827	237,551	288,625	288,453
Taxi	1,114,921	1,100,827	1,494,224	1,471,143
Bus	805,019	806,285	819,403	821,207
Truck	5,724,082	5,742,385	7,233,114	7,274,995
Total	14,877,026	14,769,248	19,537,463	19,395,032

Note: Calculated by the Study Team by use of eBUM transport model
Source: Study Team

Table 6.13 The CO_2 Emission for "Without" and "With" Bangkok BRT Projects.

Vehicle Class	Emission of CO_2 (g/day) = SEC_i x EF_{CO2} x PCU $Km._i$ (For vehicle class i)			
	2012-Without BRT	2012-With BRT	2022-Without BRT	2022-With BRT
Cars	174,154,720.87	172,893,050.63	249,670,366.93	247,850,214.47
Motorcycle	1,230,118.70	1,221,207.06	1,268,651.78	1,259,403.02
3 Wheels	1,363,053.99	1,353,179.30	1,640,395.16	1,628,436.31
Taxi	47,174,281.97	46,832,526.16	63,223,263.63	62,762,351.99
Bus	268,266,975.81	266,323,505.89	273,060,346.62	271,069,676.02
Truck	882,224,061.19	875,832,756.70	1,114,803,695.25	1,106,676,528.59
Total	1,374,413,212.54	1,364,456,225.74	1,703,666,719.36	1,691,246,610.40

Note: Without BRT means it includes BRT1 and 5-Line Mass Transit System.
With BRT means it includes BRT1, BRT2, BRT3, and 5-Line Mass Transit System.
Source: Study Team

From the above table, it is obvious that the introduction of Bangkok BRT2 and BRT3 would reduce the CO_2 emission about 0.72% and 0.73% in 2012 and 2022, respectively. Therefore, it could be implied that the introduction of Bangkok BRT2 and BRT3 would enhance the environment.

Table 6.14 Pollutant Reduction after Operating the Chiang Mai Transit System

Emitted Pollutants	Reduction of Pollutants from Transport Sector (ton/year)
NOx	2,279.16
CO	700.91
NMHC	286.06
PM10	224.10

Source: Pre-feasibility Study of Mass Transit Plan for Chang Mai, OTP

For the Chiang Mai Transit System, the CO_2 emission was not in the calculation. Only CO, NOx, NMHC, and PM10 were calculated in the feasibility study as shown in Table 6.14.

6.7 Project Implementation Plan

6.7.1 Implementation Organization

For Bangkok BRT, Bangkok Metropolitan Administration (BMA) will act as an execution agency during construction, and commissioning of the project. As for operation and maintenance, BMA will appoint Krungthep Thanakom (KT) which is a subsidiary company of BMA to operate.

For other regional cities, the local authorities will be the executing agencies. However, it depends on the capability of each local authority. If some local authorities are not capable to implement the project, the government may assign Mass Rapid Transit Authority of Thailand (MRTA) to give a technical assistance. For the operation and maintenance, the local authority and Mass Rapid Transit Authority should take part in forming new organization to oversee.

6.7.2 Implementation Phasing and Schedule

The project implementation schedule is planned during three and a half years period. The implementation program will start from 2009 until 2012 totaled 42 months.

Table 6.15 Project Implementation Schedule

	2009	2010	2011	2012
Consultant Service				
Bangkok BRT2 Morchit-Government Center (PMC+CSC)				
Bangkok BRT3 Chongnonsri-Suksawat (PMC+CSC)				
Chiang Mai Transit System (PMC+CSC)				
Public Transport in other regional cities (FS+DD)				
Area Traffic Control (ATC) in Regional Cities (FS+DD)				
Land Acquisition (if applicable)				
Bangkok BRT2 (Morchit-Government Center)				
Bangkok BRT3 (Chongnonsri-Suksawat)				
Chiang Mai Transit System				
Construction/ Implementation				
Bangkok BRT2 (Morchit-Government Center)				
Bangkok BRT3 (Chongnonsri-Suksawat)				
Chiang Mai Transit System				
Area Traffic Control (ATC) in Regional Cities				

Source: Study Team

6.7.3 Economic and Financial Appraisal

(1) FIRR of Bangkok BRT Project

Financial internal rate of return for the Bangkok BRT 2&3 Project is calculated from the following conditions.

- Project life: 24 years consisting of 2.5 years of construction/implementation, 0.5 year of test operation and 21 years of operation.
- Revenue: Revenue consists of fare box revenue and advertisement revenue, and almost revenue comes from the fare box revenue. The advertisement revenue is approximately 2% which is forecasted according to BTS data (sky train system). Annual demand forecast is calculated from Table 6.2. From the table, annual passenger number will increase from 179,000 persons in 2012 to 455,000 persons in 2032. Average tariff is set as 13 Baht per passenger.
- Expenditure: O&M cost will be 458 million Baht in 2011 and increases by 4% annually due to increase of salary and fuel cost[19]. In 2032, it will be 2,032 million Baht. The estimation of O&M cost includes Salary for staffs, Fuel cost, Maintenance cost, Payment for office and station, Vehicle tax, Station maintenance cost Office, control center, depot maintenance cost, ITS & AFC maintenance cost, and Road, walkway, lighting, landscape maintenance cost.

As a result, FIRR for Bangkok BRT project is 14.0%. The rate is higher than discount rate which is real interest rate of 20 year Government Bond as of July 2007 (6.17 – 3.7% = 2.47%).

[19] Number of passengers will increase 4.7% annually.

As a result, Bangkok BRT project is financially feasible.

(2) EIRR of Bangkok BRT Project

Economic internal rate of return for the Bangkok BRT 2&3 Project is calculated from the following conditions.

- Project life: 24 years, as same as calculation of FIRR.
- Economic Benefit: Economic benefit consists of VOC saving, travel cost saving. VOC saving and travel coast saving are calculated from
- Expenditure: Same as calculation of FIRR.

EIRR of Bangkok BRT Project is 27.4%. The rate is higher than opportunity cost of capital in Thailand (real term) which is 12%. Bangkok BRT Project is economically feasible.

(3) FIRR of Chiang Mail Transit System Project

Financial internal rate of return for the Chiang Mai Transit System Project is calculated from the following conditions.

- Project life: 24 years consisting of 3.5 years of construction/implementation, 0.5 year of test operation and 20 years of operation.
- Revenue: Revenue consists of fare box revenue and advertisement revenue, and almost revenue comes from the fare box revenue. Fare box revenue will increase 464 million Baht in 2013 to 1,019 million in 2032.
- Expenditure: O&M cost will increase from 332 million Baht in 2013 to 551 million Baht in 2032. It includes salary, fuel cost, maintenance of office, station, ITS, etc. Salary and fuel cost will increase in accordance with the growth of passengers.

As a result, FIRR for Bangkok BRT project is 0.4%. The rate is very low level because initial investment includes sunk cost items which are not used for BRT itself but also for improvement of transportation of the city. Chiang Mai BRT project is not financially feasible in itself.

(4) EIRR of Chiang Mail Transit System Project

Economic internal rate of return for the Chiang Mai Transit System Project is calculated from the following conditions.

- Project life: 24 years, as same as calculation of FIRR,
- Economic Benefit: Economic benefit consists of VOC saving, travel cost saving, and
- Expenditure: Same as calculation of FIRR.

As a result, EIRR for Chiang Mai BRT project is 32.6%. The rate is higher than opportunity cost of capital in real term in Thailand (12%). That is why the Chiang Mai BRT Project is economically feasible.

(5) FIRR and EIRR of the total Project

Net cash flow of each project, FIRR and EIRR of the total of Public Transport Improvement Project is calculated. FIRR of the total project is 6.0 percent, higher than the discount rate (2.47%). That is why the total project is financially feasible. EIRR of the total project is 29.3%, higher than opportunity cost of capital in Thailand (real term). The project is economically feasible.

Table 6.16 indicates result of FIRR and EIRR of the Public Transport Improvement Project

Table 6.16 FIRR and EIRR of Public Transport Improvement Project

Unit: Percent

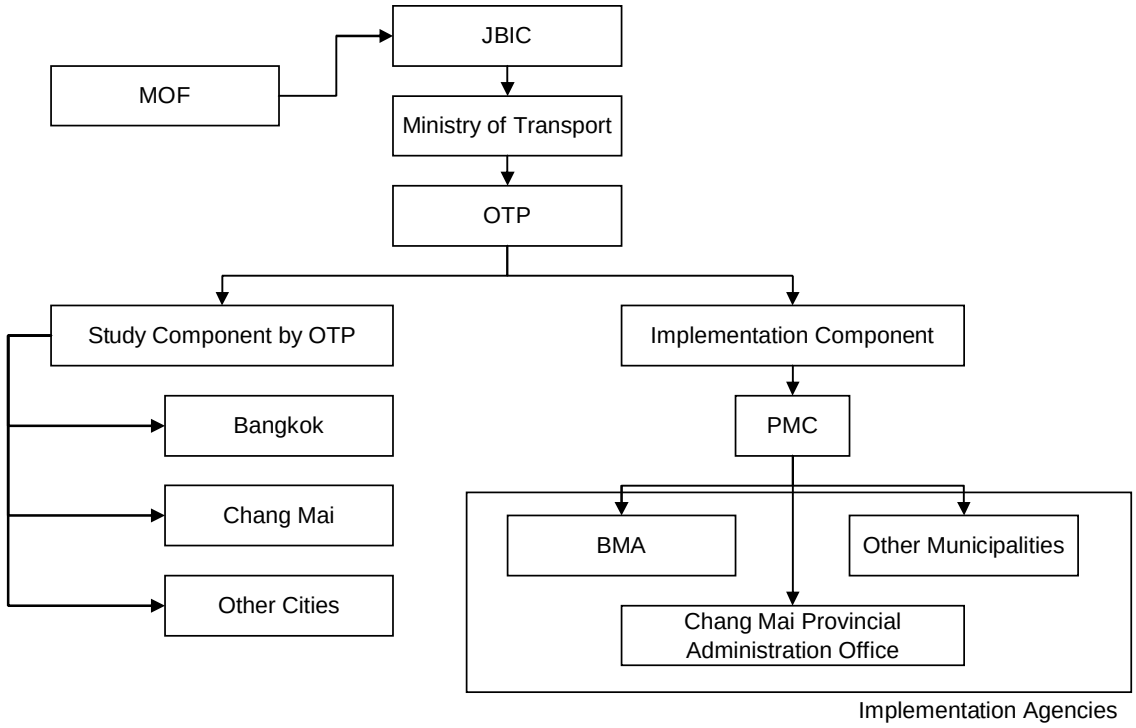
	FIRR	EIRR
Bangkok BRT2&3	14.0	27.4
Chiang Mai Transit System	0.4	32.6
Total of the Project	6.0	29.3

Source: Study Team

6.8 Further Actions

In order to proceed with the funding for urban transport improvement project, it is recommended that an implementation structure similar to “Traffic Planning and Management Sector Loan” is setup. The Ministry of Transport by OTP will act as the counterpart agency that will manage and monitor the loan and distribute to each implementation agency. The structure is shown in Figure 6.26.

BMA and Chiang Mai PAO are local government and will face difficulty in terms of procedure and politics when they lend money from foreign country. On the other hand, OTP belongs to MOT, and has experience of Traffic Planning and Management Sector Loan. OTP also conducted Pre-feasibility Study of Chiang Mai BRT project, and get involved in Bangkok BRT project. BMA and Chang Mai PAO agree with the loan implementation structure, and OTP is also willing to managing the whole project.



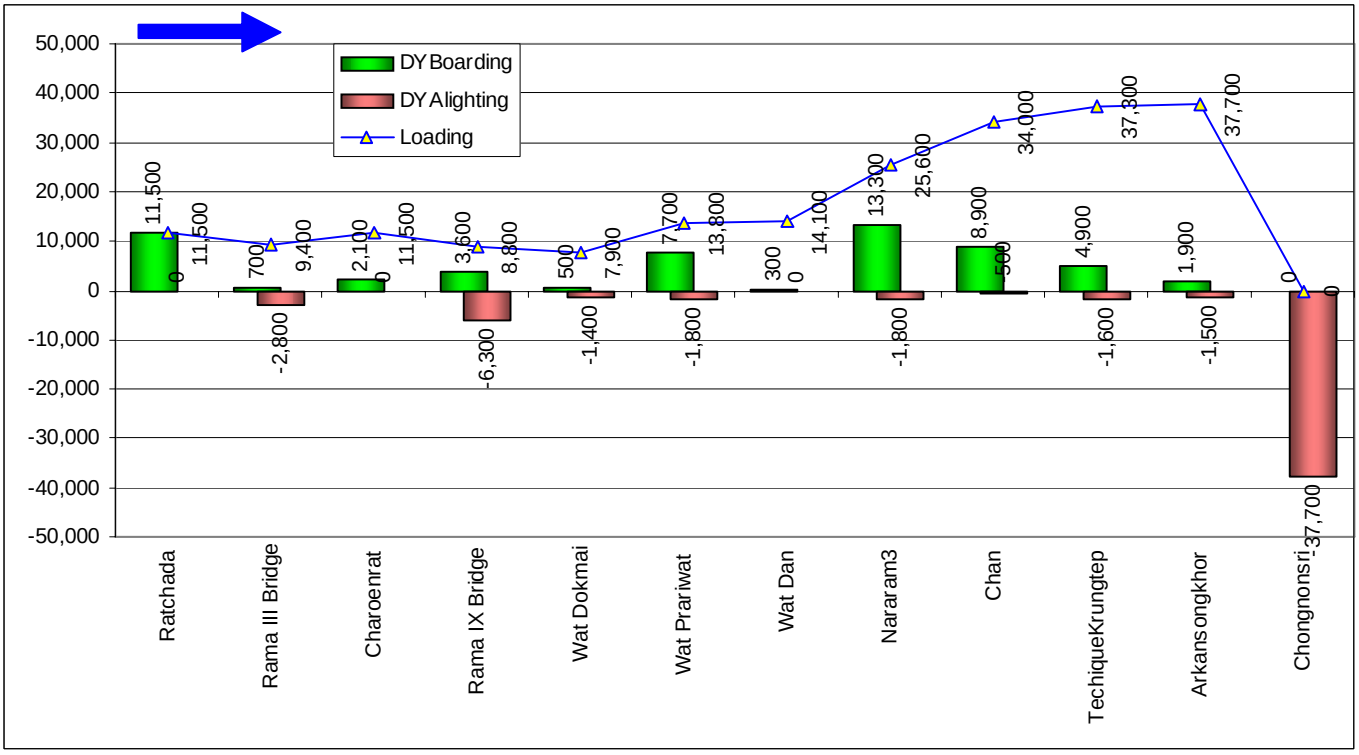
Source: Study Team

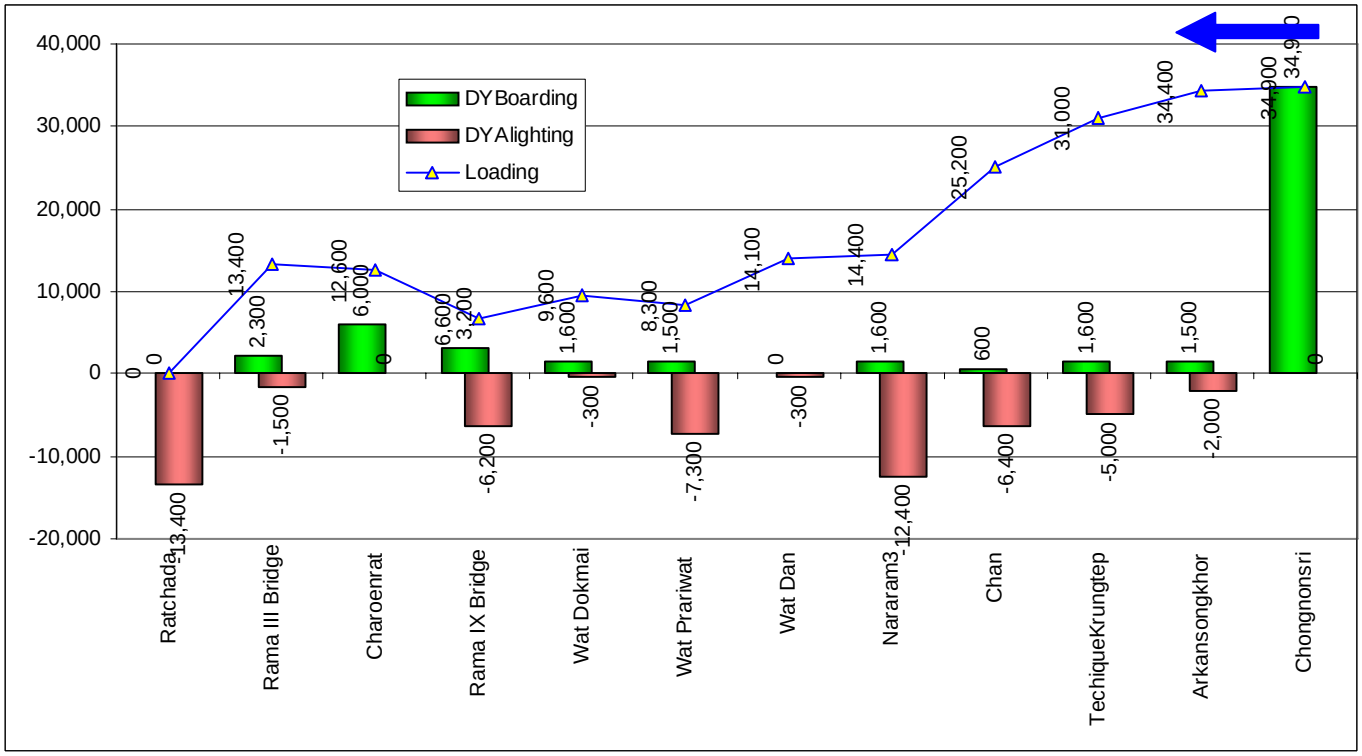
Figure 6.26 Loan implementation structure

Appendix: Line Loading of BRT Lines in Bangkok

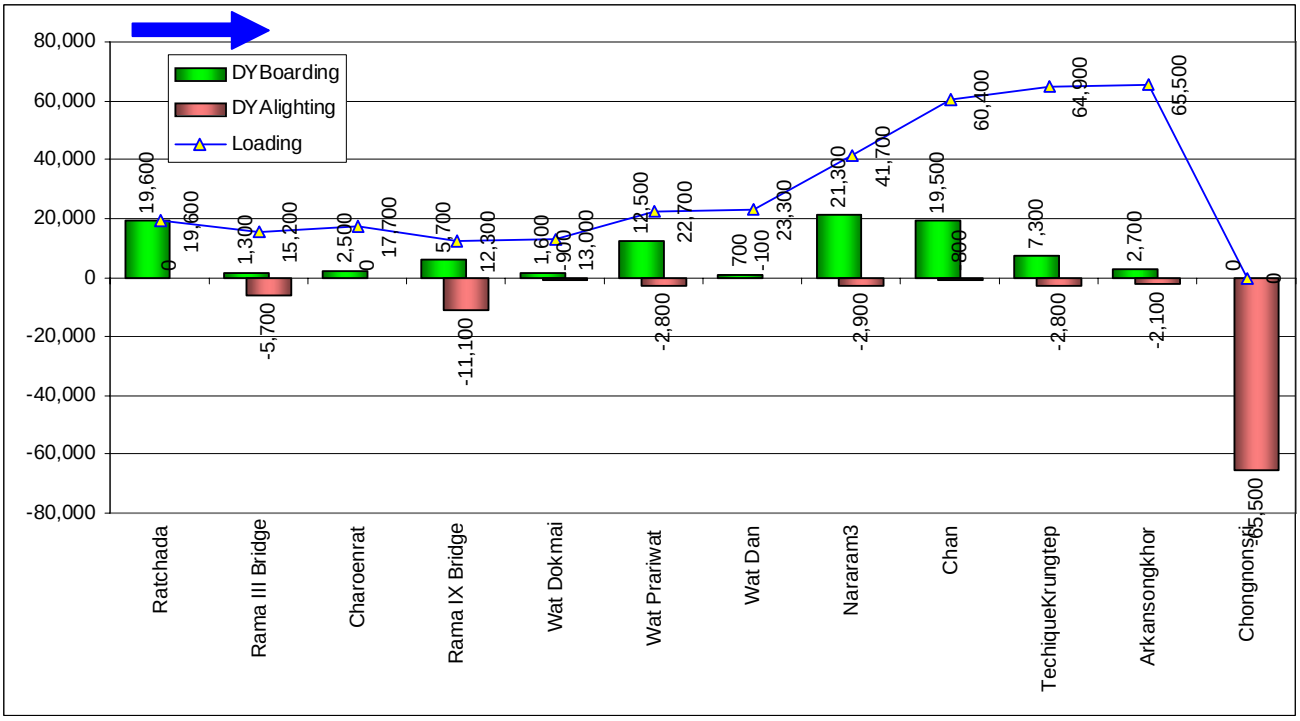
The Following graphs illustrate lording, boarding and alighting of each station of Bangkok BRT Lines (1, 2 and 3) in 2012 and 2022. Both of Without-project (Case 1) and With-project (case 2) are indicated for BRT Line 1.

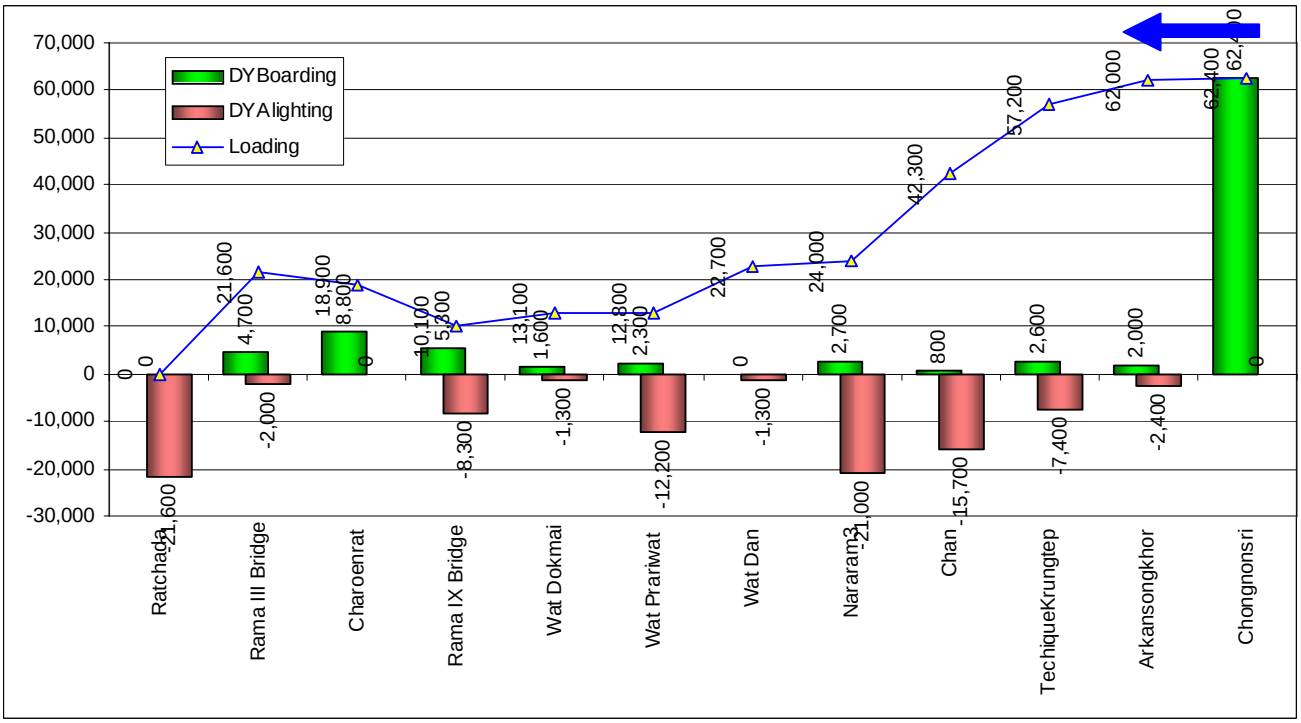
Without-project (Case 1) of BRT 1 in 2012



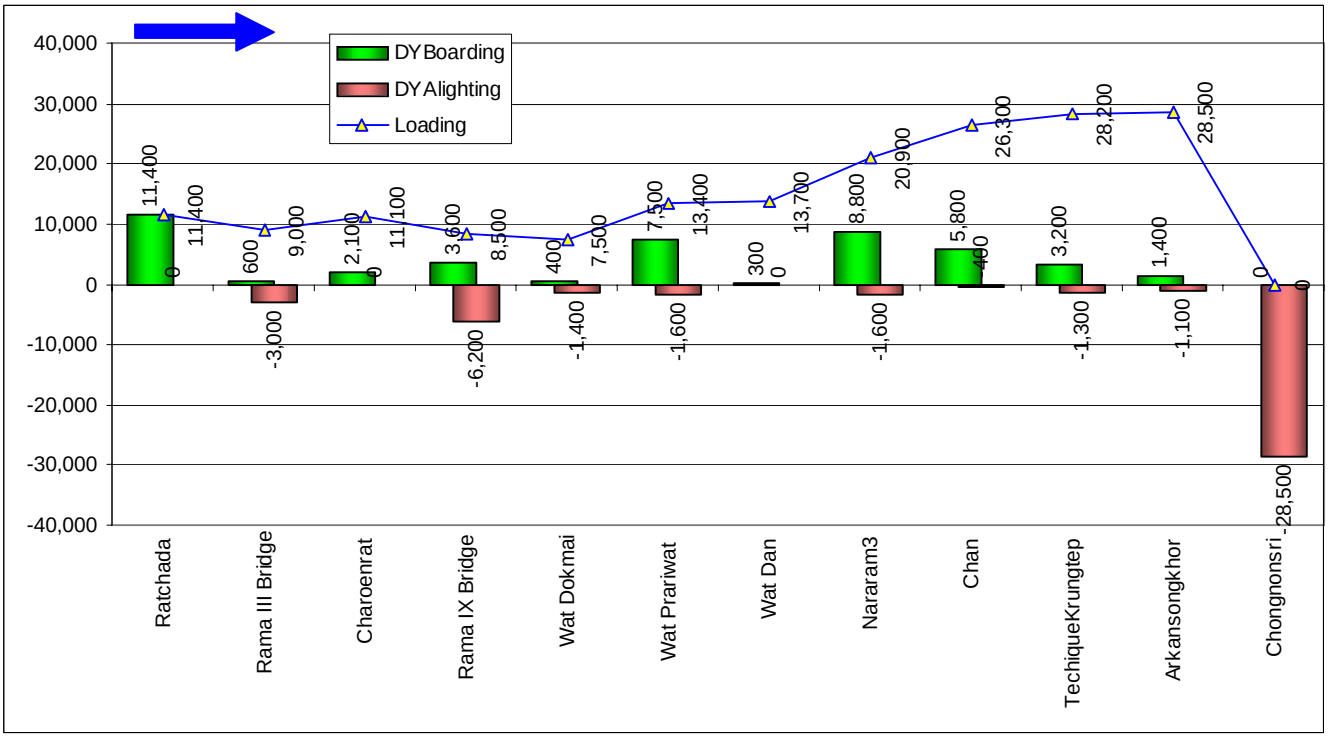


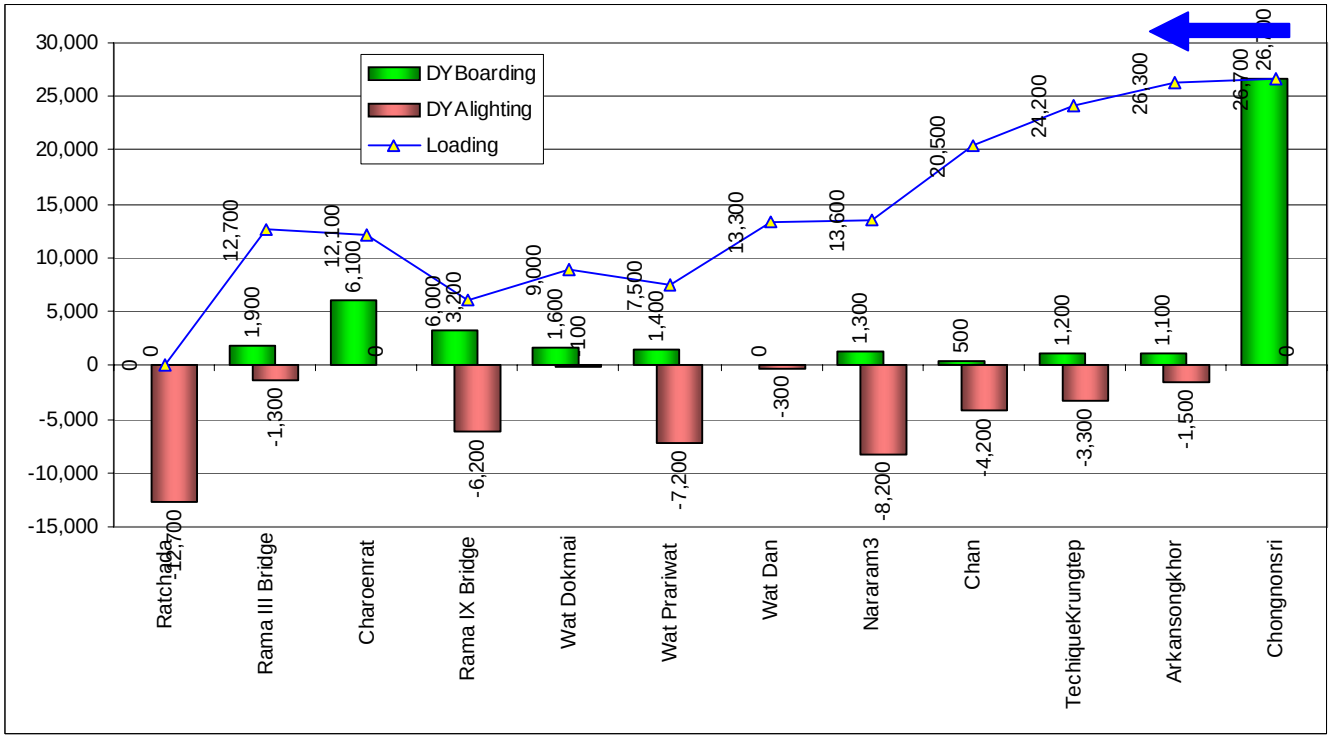
Without-project (Case 1) of BRT 1 in 2022



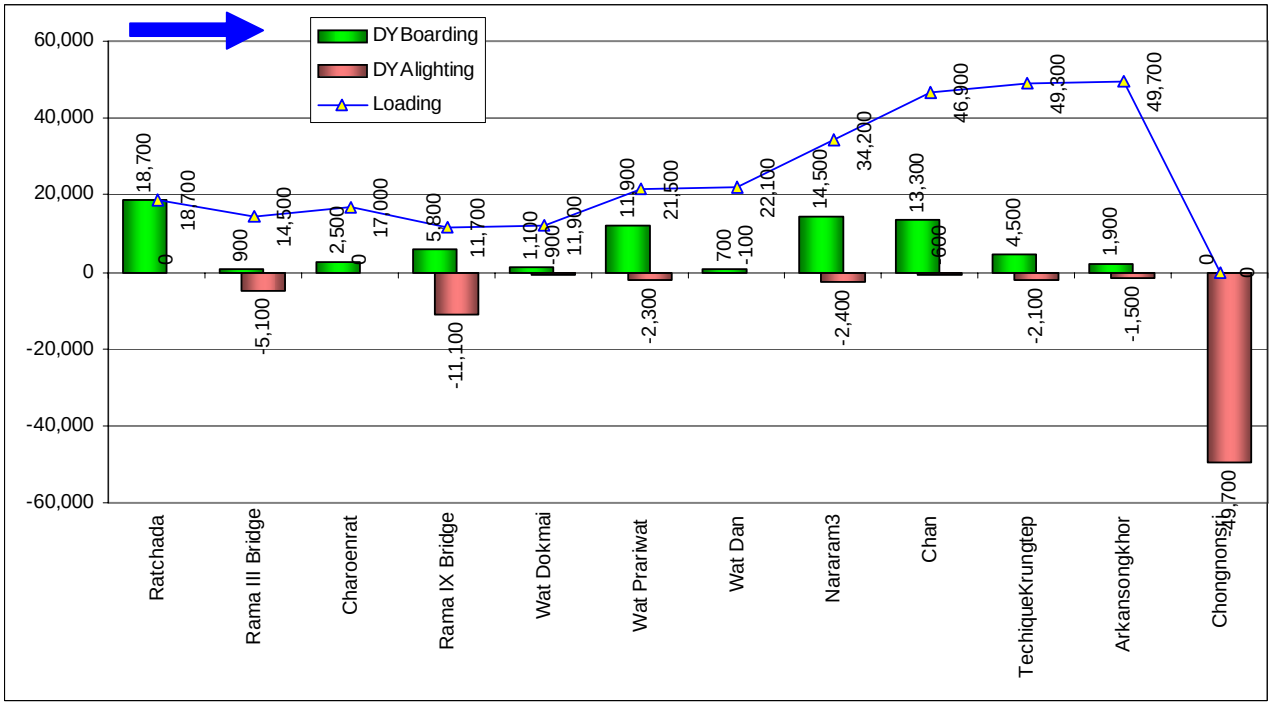


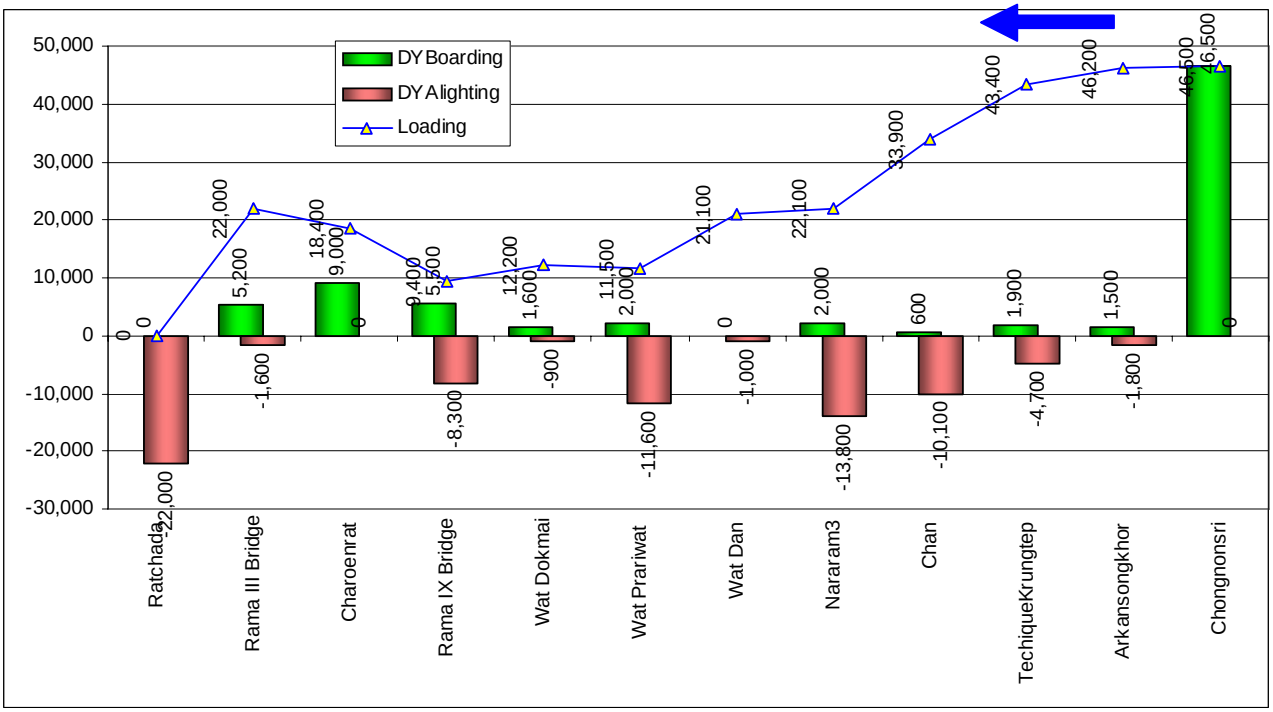
With-project (Case 2) of BRT 1 in 2012





With-project (Case 2) of BRT 1 in 2022





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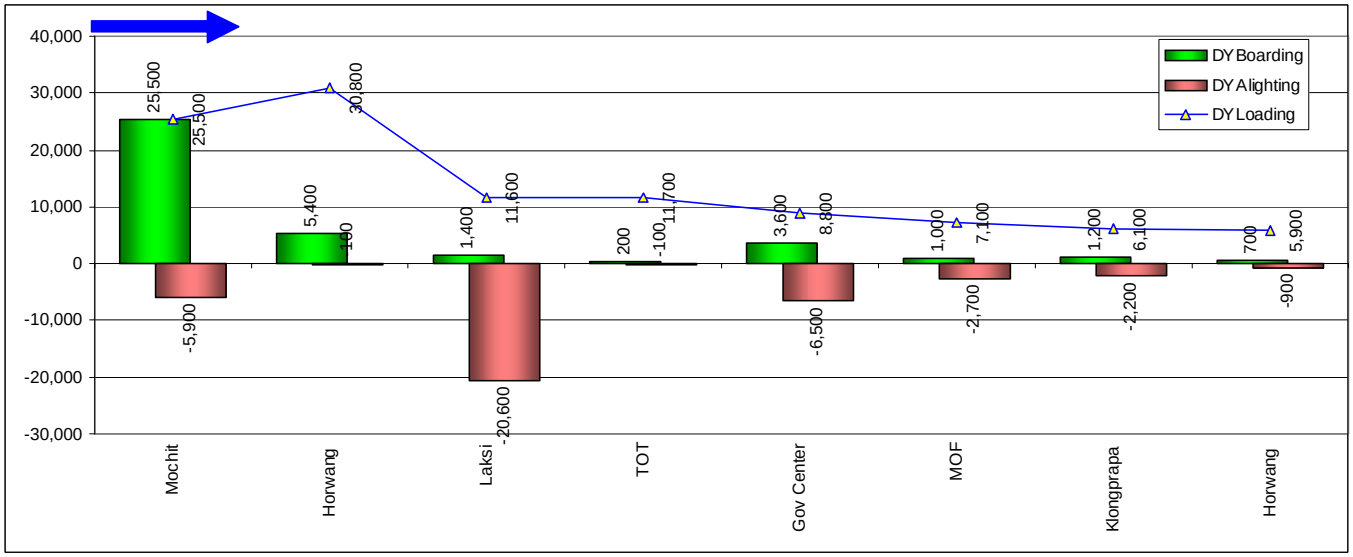

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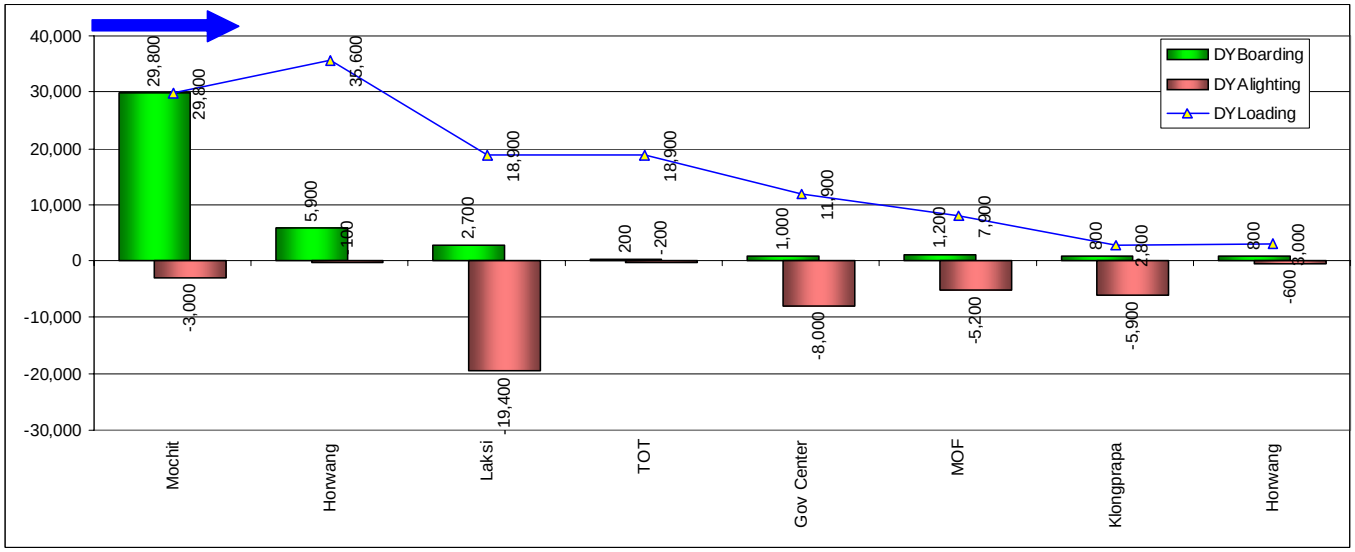

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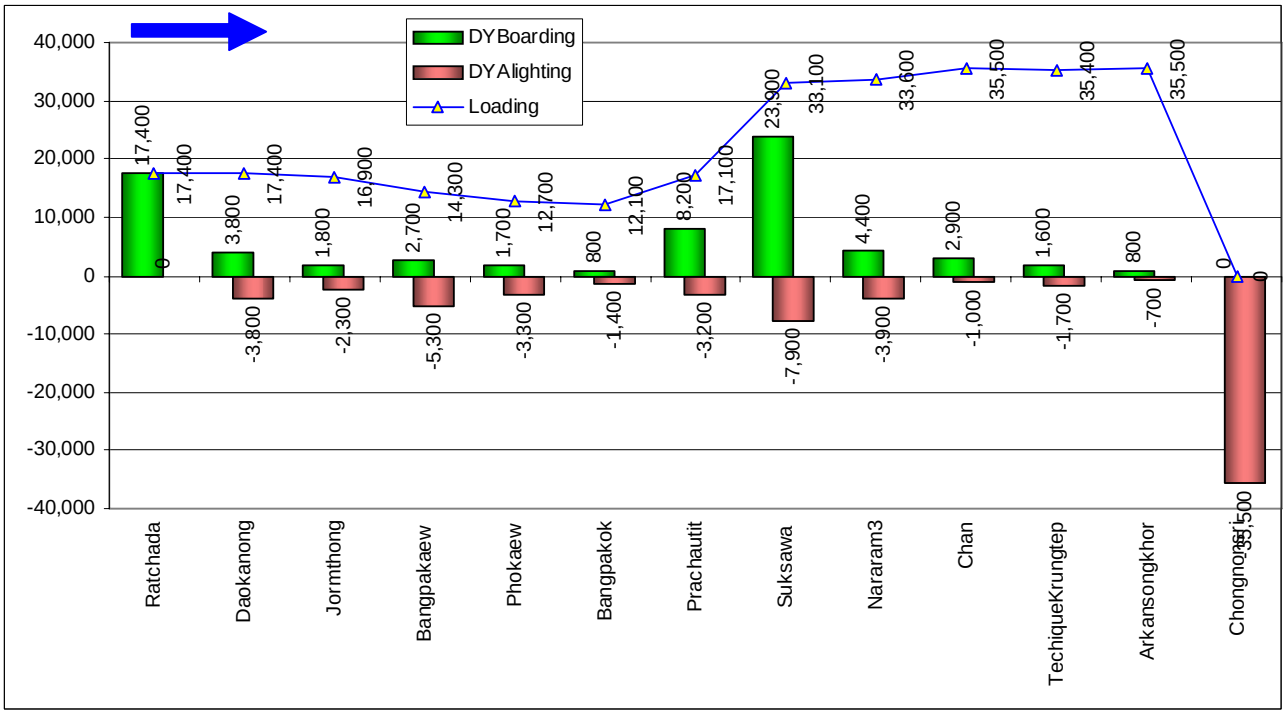

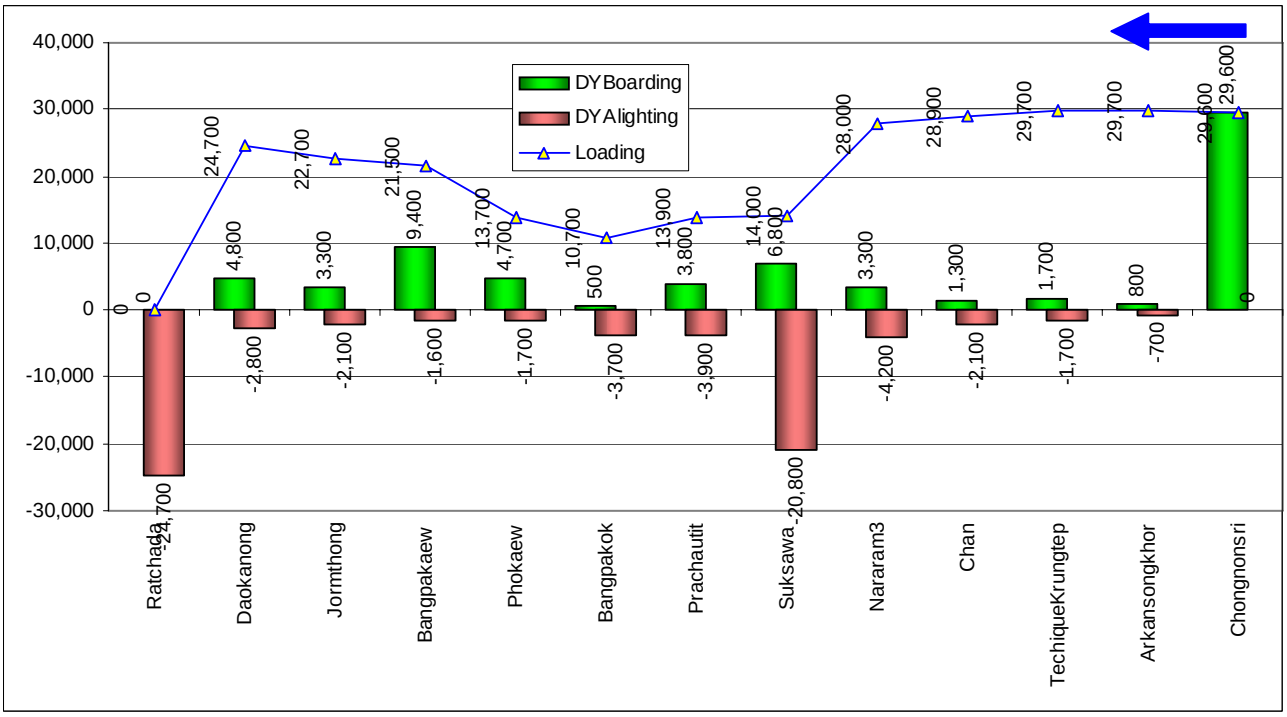

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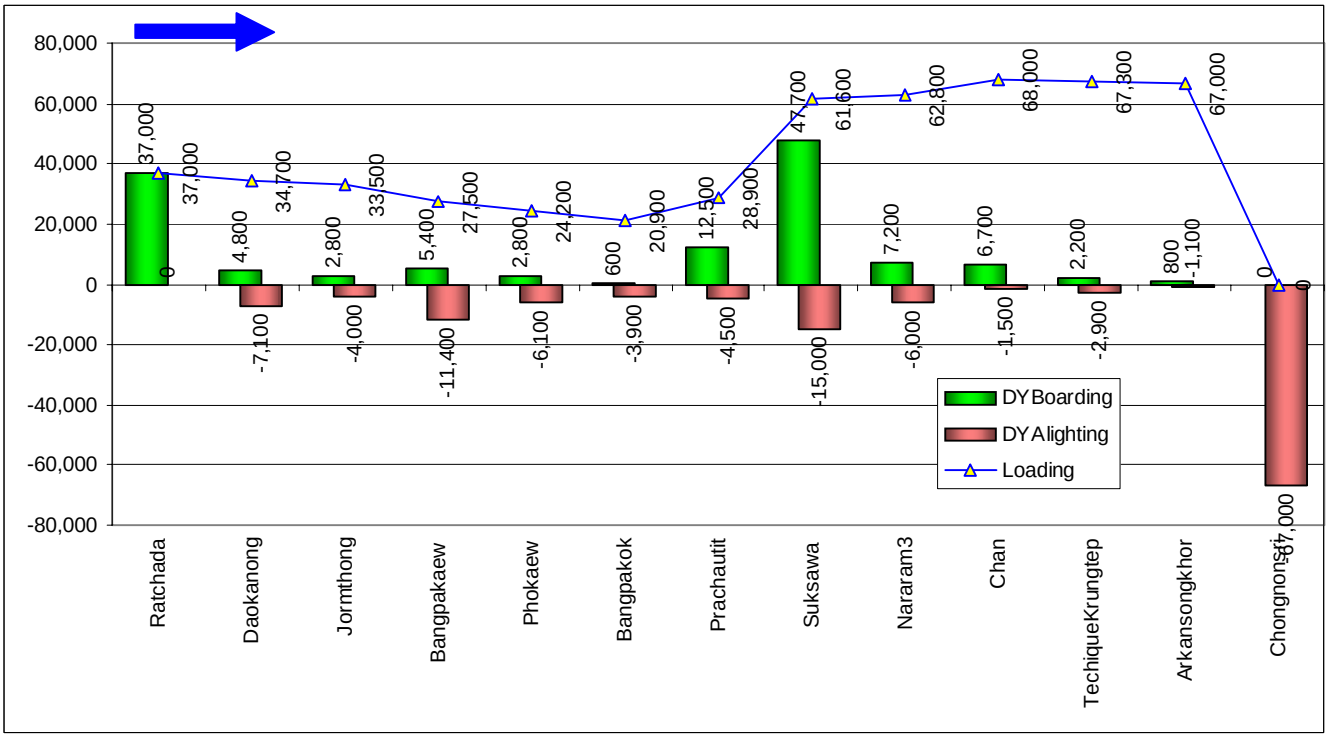
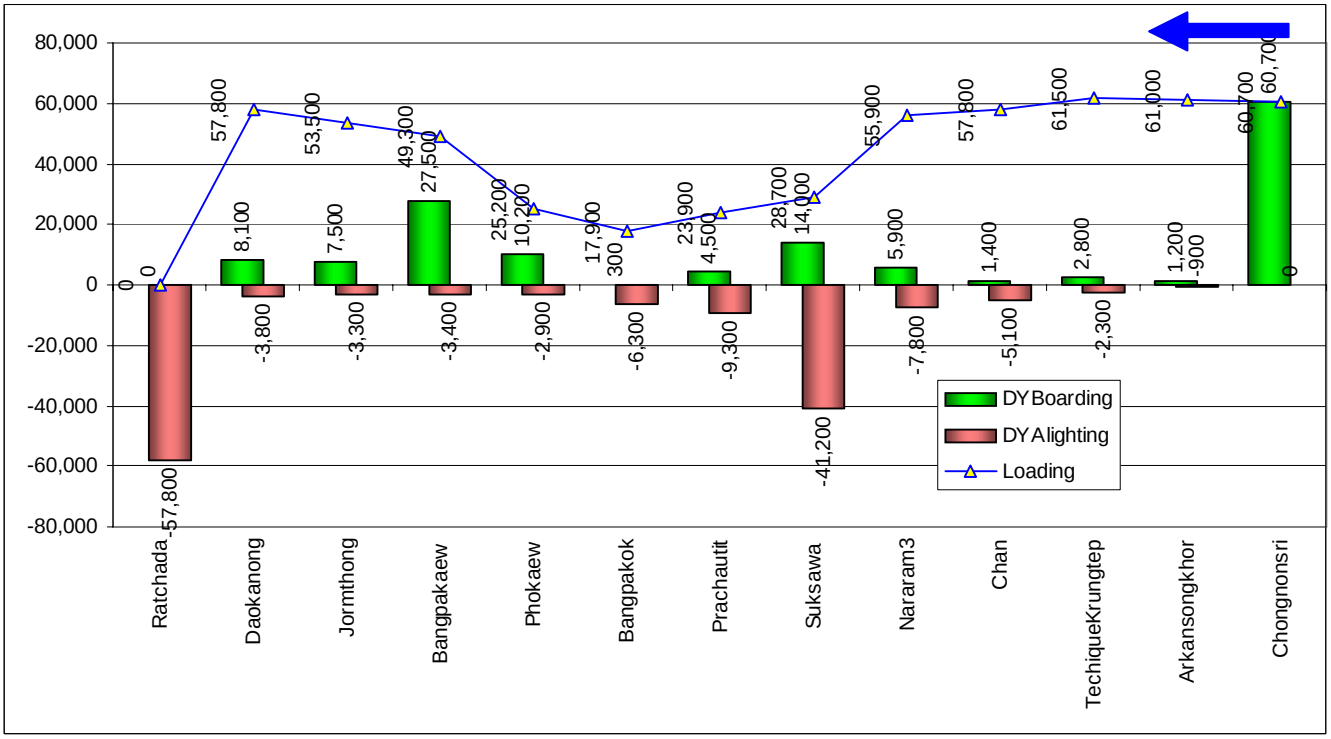




Chapter 7 HUMAN RESOURCE DEVELOPMENT PROJECT

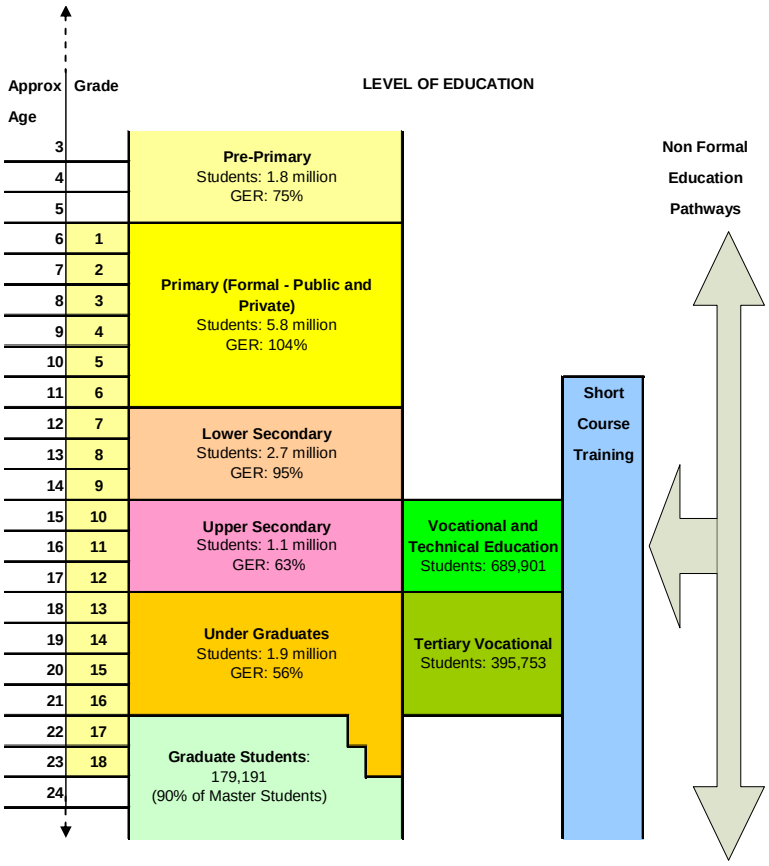
7.1 Current Status of Education Sector in Thailand

The gross enrollment rates (GER)[20] of both higher and secondary educations were extremely low during past two decades. In the Higher Education sector (H.E.), GER in 1965 was only 2%. After introduction of 9-year compulsory education and the 12-year free basic education expressed by the National Education Act in 1999, enrolment to the higher education sector grows. The GER of Higher Education Institutions (HEI) rose from 7% in 1987 to 56% in 2005. Figure 7.1 is an illustration for total number of enrolment by education level. In 2005, 14.4 million students were enrolled into the school.

Since government established 12 years of compulsory education, responsibility to access to primary and secondary education will be shifted from individual to government. This is a great decision for government. Because introduction of compulsory education means government guarantees costs and minimum level of education quality in terms of hardware, number of teacher and its quality, healthy school life, etc. This must be a heavy load to the government. Government of Thailand established National Budget for THB 1,250 billion in 2005. Overall education sector shares THB 263 billion or 21.02% of National Budget, of which THB 45.242 billion or 3.62% was allocated to Higher Education sector. Budget for overall education sector is approximately 4.9% of GDP. Situation is different from the one in Japan[21] but government of Japan allocated 3.5% of budget for education against GDP in 2004, which is the lowest ratio among advance 10 countries.

[20] The gross enrolment ratio (GER) is the number of students enrolled in the level of education, regardless of age, as a percentage of the population of official school age for that level. The net enrolment ratio (NER) is the enrolment of the official age group for a given level of education expressed as a percentage of the corresponding population.

[21] Private sector shares about 1.2% of education expenses.



Note: GER: Gross Enrolment Rate as measured by percentage of students in age group in education
Source: Ministry of Education

Figure 7.1 Total Enrolment by Education Level in 2005

In the increasing education budget, government of Thailand needs to accelerate decentralization of education and shifted authority of primary and secondary education to regional government. This paradigm shift affects not only for primary and secondary education but also influence tertiary or higher education sector because HEI has to be involved directly or indirectly of this shift. Especially, mission rendered to HEI becomes important. HEI will be involved in policy and planning issues. Furthermore, HEI has to supply teachers, to improve curricula for quality education and to support public services for healthy school life for primary and secondary schools. Therefore, HEI has to acknowledge issues and preparation for paradigm shift.

7.1.1 Higher Education Institute (HEI)

Tertiary or Higher Education system in Thailand involves both of public and private. All of 78 public universities were categorized into three groups, which is Limited Admission University, needs to pass the national standard test to enroll, Open University and Autonomous University, which provide more flexible admission system. 19 community colleges have been

established since 2001 to generate opportunities for local people to improve their quality of life and develop their communities in social and economic aspects.

Table 7.1 Number of Higher Education Institution (HEI) by Category in 2005

Type of Institution	Number
1. Public University	78
1.1 Limited Admission University	72
1.2 Open University	2
1.3 Autonomous University	4
1.4 Community Collage	19
2. Private University	67
Total	164

Source: Ministry of Education

7.1.2 Number of Enrolment to the Higher Education Institution

(1) New Enrolment

Supply of new enrolment to the Higher Education Institution (HEI) is stable in later 1990's. Total of 550,000 – 600,000 students newly enroll to HEI. In the academic year of 2005, total of 602,302 students newly enrolled to HEI (Table 7.2). Among this, 521,612 or 87% of students engage into the public institutes. Out of this number, 358,410 or 69% of students registered to Limited Admission University.

Table 7.2 New Enrolments to Higher Education Institution (Academic Year of 2005)

Type of Institution	Level of Education					Total	
	Lower than Bachelor	Bachelor	Graduate Diploma	Master's	Ph.D.	Number	Ratio (%)
1. Public University	**36,707**	**431,433**	**4,570**	**45,997**	**2,905**	**521,612**	**100%**
1.1 Limited Admission University	28,987	289,437	4,417	32,964	2,605	358,410	69%
1.2 Open University	1,232	133,540	121	11,358	164	146,415	28%
1.3 Autonomous University	0	8,456	32	1,675	136	10,299	2%
1.4 Community College	6,488	-	-	-	-	6,488	1%
2. Private University	**-**	**74,621**	**140**	**5,736**	**193**	**80,690**	
3. Public : Private Ratio	100:0	85:15	97:3	89:11	94:6	87:13	
Grand Total (Students Number)	**36,707**	**506,054**	**4,710**	**51,733**	**3,098**	**602,302**	
Ratio (%)	6.1	84.0	0.8	8.6	0.5		

Source: Commission of Higher Education (CHE), Ministry of Education

Total number of Master and Doctoral Degree students is to the sum of 173,000 or 9% against total enrolment (Table 7.4). Increase number of enrolment to Post-graduate program must be promoted.

Table 7.3 New Enrolments by University (Academic Year of 2005)

Institution	Level of Education					Total
	Lower than Bachelor	Bachelor's	Graduate Diploma	Master's	Ph.D.	
Total New enrollment	36,707	506,054	4,710	51,733	3,098	602,302
1. Public Institute (Total)	**36,707**	**431,433**	**4,570**	**45,997**	**2,905**	**521,612**
1.1 Limited Admission Universities	**28,987**	**289,437**	**4,417**	**32,964**	**2,605**	**358,410**
1) Chulalongkorn University	0	5,686	313	3,786	525	10,310
2) Kasetsart University	0	7,019	36	3,057	177	10,289
3) Khon Kaen University	0	6,223	129	1,423	92	7,867
4) Chiang Mai University	0	5,426	238	2,308	98	8,070
5) Thammasat University	0	1,955	116	1,873	38	6,982
6) Naresuan University	0	6,944	42	2,029	96	9,111
7) Burapha University	0	5,404	37	1,289	117	6,847
8) Mahasarakham University	0	11,662	0	1,672	152	13,486
9) Mahidol University	606	4,130	115	1,700	701	7,252
10) Srinakharinwirot University	99	4,083	60	1,057	83	5,382
11) Silpakorn University	0	4,312	33	653	58	5,056
12) Prince of Songkla University	0	10,272	45	1,386	91	11,794
13) Ubon Ratchathani University	0	2,320	0	280	23	2,623
14) King Mongkut's Institute of Technology Ladkrabang	0	5,195	0	805	36	6,036
15) King Mongkut's Institure of Technology North Bangkok	513	5,542	0	617	23	6,695
16) Maejo University	0	3,648	0	179	0	3,827
17) The National Institute of Development Administration	0	0	0	2,494	36	2,530
18) Thaksin University	0	2,565	35	389	17	3,006
19) University Nakhon Phanom	0	593	0	21	0	614
20)-59) Rajabhat University: 41 universities	11,741	136,379	3,082	4,866	212	171,280
60) Rajamangala University of Technology Thanyaburi	170	7,112	136	0	0	7,418
62) Rajamangala University of Technology Tawan-ok	589	3,434	0	0	0	4,023
63) Rajamangala University of Technology Phra Nakhon	1,492	3,201	0	0	0	4,693
64) Rajamangala University of Technology Srivijaya	1,134	2,336	0	0	0	3,470
65) Rajamangala University of Technology Lanna	3,205	5,121	0	0	0	8,326
66) Rajamangala University of Technology Suvarnbhumi	2,417	20,801	0	0	0	5,218
67) Rajamangala University of Technology Rattanakosin	924	2,768	0	0	0	3,692
68) Rajamangala University of Technology Isan	3,844	4,056	0	0	0	7,900

69) Mahachulalongkornrajavidyalaya University	1,076	2,205	0	143	30	3,454
70) Mahamakut Buddhist University	0	2,888	0	937	0	3,825
71) Princess of Narathiwat University (PNU)	976	356	0	0	0	1,332
72) Pathumwan Institute of Technology	0	1,299	0	0	0	1,299
1.2 Open Universities	**1,232**	**133,540**	**121**	**11,358**	**164**	**146,415**
73) Sukhothai Thammathirat Open University	1,232	43,514	55	2,067	0	46,868
74) Ramkhamhaeng University	0	90,026	66	9,291	164	99,547
1.3 Autonomous Universities	**0**	**8,456**	**32**	**1,675**	**136**	**10,299**
75) King Mongkut's University of Technology Thonburi	0	2,952	8	1,176	68	4,204
76) Suranaree University of Technology	0	1,952	0	141	53	2,146
77) Walailuk University	0	1,432	24	201	7	1,664
78) Mae Fah Lunag University	0	2,120	0	157	8	2,285

Source: Commission of Higher Education (CHE), Ministry of Education

(2) Total Enrolment

Total number of enrolment to HEI becomes 1.9 million, which is almost 2.9% of total population of Thailand. This is a higher ratio to Japan, which is for 2.2% (3.3 million students against 127 million of population).

Table 7.4 Total Enrolment to Higher Education Institution (Academic Year of 2005)

Institution	Level of Education					Total
	Lower than Bachelor	Bachelor's	Graduate Diploma	Master's	Ph.D.	
1. Public University	71,414	1,418,029	6,460	145,768	11,294	1,652,965
1.1 Limited Admission University	58,049	828,507	6,260	104,375	9,389	1,006,580
1.2 Open University	-	565,233	156	35,874	1,319	602,582
1.3 Autonomous University	-	24,289	44	5,519	586	30,438
1.4 Community College	13,365	-	-	-	-	13,365
2. Private University	0	239,846	297	15,433	572	256,148
3. Public : Private	100:0	86:14	95:5	90:10	95:5	87:13
Grand Total (Number):	**71,414**	**1,657,875**	**6,757**	**161,201**	**11,866**	**1,909,113**
Ratio (%)	3.7	86.8	0.4	8.4	0.6	

Source: Ministry of Education

(3) Quality of Education

Generally, quality of education must be expressed through various factors. In accordance with the guideline established by Ministry of Education, Japan, curriculum, level of entrance examination, training and treatment of lecturers, public support, organization of research and education, composition of financial, disclosure of academic activities, contents and level of lecture, level of students, lecturers and researchers, quality of education environment, management system, etc must be core factors to evaluate quality of education. Furthermore, continuous effort to evaluate quality by third party accreditation organization is also necessary

factor. Due to lack of such information and data in Thailand, it can not analyze appropriately, however, a ratio between Teacher and Students, qualification of lecturers, and number of graduates may become one of factors to evaluate quality of education.

a. Ratio between Students and Teachers

Following table shows number of Students and Teacher and their ratio. The mission simply picked up number of students and teacher announced by Commission on Higher Education (CHE), which number may be face to face classroom education basis, and calculates the ratio. As the results, the ratio became 43:1 in average. This may be serious to keep education quality. Since HEI is a venue to finish study and accommodates valuable manpower to industry as a quality work force, obliging lectures is indispensable to complete course work. Number of lecturer is a big concern for qualitative aspect of education whether HEI is able to deliver expertise to cover all subjects. For example, S:T ratio in Japan is reported by 17:1 by Ministry of Internal Affairs in 2007. This figure is just a sample, however, this ratio must be decreased at least 35:1, which is almost double of Japan, to increase quality of education.

Table 7.5 Number of Students and Teachers

	Students	Teachers	S/T Ratio	Number of Institutions
Demonstration Schools *	41,840	813	51:1	(41)
Community College	13,365	111	120:1	17
High Education Sector	1,895,687	44,900	42:1	139
Public Universities				78
Private Universities				61
	1,950,892	45,824	43:1	156

Note: *Calculated by the Study Team based on the original data announced by Commission of Higher Education (CHE), Ministry of Education

b. Quality of Lectures

Qualification of lecturers who belong to HEI is indicated in Table 7.6. In the public university 15% of lecturer is identified as Bachelor Degree holders. Lecturers who obtained Master and Doctoral Degree are 59% and 26% respectively. According to discussion with Commission of Higher Education (CHE) on July 15, 2008, it was emphasized that CHE targets to become a ratio of Doctoral Degree holders up to 50% in 5 years.

Table 7.6 Qualification of Lecturers (Academic Year of 2005)

		Bachelor	Master	Doctor	Total
Public School	Number	6,755	26,676	11,805	45,236
	Ratio (%)	15	59	**26**	
Private School	Number	2,731	9,107	2,295	14,133
	Ratio (%)	19	64	16	
Total	Number	9,486	35,783	14,100	59,369
	Ratio (%)	16	60	24	

Source: Commission of Higher Education (CHE), Ministry of Education

c. Number of Graduates

One of the tasks imposed to HEI is to produce Master and Doctoral Degree holders. Number of Master and Ph. D graduates may be typical factors to evaluate quality of education for HEI in the world. Total number of graduates in 2002 is 330,224 as tabulated on Table 7.7. This table somewhat old but trend may not be largely changed from usual year; therefore, 12.1% and 0.4% of annual graduate rates for Master and Doctor Degree may be realistic. If HEI accepts 602,302 students consists of 51,733 and 3,098 of Master and Doctor Degree students as tabulated on the Table 7.2., as their graduates ratio is 12.1% and 0.4%, total number of Master and Ph. D Degree holders becomes 6,259 and 124 according to this ratio. This is so serious. Ratio of graduation is too small. There are a lot of factors for withdrawal from HEI. Individual's economic situation and family problem may be major problem for withdrawal, which HEI may not offer appropriate solutions to students. Attractiveness, quality of education, environment for study, reducing interest, etc may also be other reasons for withdrawal. However, reducing withdrawal from HEI must be focused to increase number of skilled work force.

Table 7.7 Total Graduates from Higher Education Institution (Academic Year of 2002)

Institution	Level of Education					Total
	Lower than Bachelor	Bachelor's	Graduate Diploma	Master's	Ph.D.	
1. Public University	25,406	206,733	5,619	35,765	1,273	274,796
1.1 Limited Admission University	21,016	173,817	5,469	26,776	1,226	228,304
1.2 Open University	1,856	29,203	67	8,234	12	39,372
1.3 Autonomous University	-	3,713	83	755	35	4,586
1.4 Community College	2,534	-	-	-	-	2,534
2. Private University	5	51,148	22	4,243	10	55,428
3. Public-Private Rate	100:0	80:20	100:0	89:11	99:1	83:17
Total	**25,411**	**257,881**	**5,641**	**40,008**	**1,283**	**330,224**
Ratio (%)	7.7	78.1	1.7	12.1	0.4	

Source: Commission of Higher Education (CHE), Ministry of Education

(4) Quality of Teaching and Research

Commission of Higher Education (CHE) announced university ranking in Thailand on August 31, 2006. Evaluation for university ranking was conducted through data and information that CHE reserved, in terms of factors for student ratio, faculty resources, financial resources, internationality, quality of education, etc for teaching. For the research, CHE conducted evaluation through funding, personnel, output, number of graduate etc. CHE selected for 49 out of 137 universities. Selected universities were categorized into 5 groups. Further, CHE also analyzed achievement of universities in 7 specific academic fields. University ranking in general and specific aspects is illustrated in the following tables.

Table 7.8 University Ranking

	Education	Research
Rank 1	Chulalongkorn University,	Chulalongkorn University
	Khon Kaen University,	Chiang Mai University
	Chiang Mai University	Mahidol University
	Mahidol University	Suranaree University of Technology
		King Mongkut's University of Technology Thonburi
Rank 2	Kasetsart University	Kasetsart University
	Rajamangla University of Technology Krungthep	Khon Kaen University
	Suranaree University of Technology	National Institute of Development Administration
	King Mongkut's University of Technology Thonburi	Naresuan University
Rank 3	Walailak University	Prince of Songkla University
	Mae Fah Luang University	Srinakharinwirot University
	Rajamangla University of Technology Srivijaya	Silpakorn University
	Thaksin University	Burapa University
	Ubon Ratchathani University	King Mongkut's Institute of Technology Chaokuntaharn
	Prince of Songkla University	Ladkrabang
	National Institute of Development Administration,	
	Silpakorn University	
Rank 4	Srinakharinwirot University	Mae Fah Luang University
	Rajamangla University of Technology Phranakon	Loei Rajabhat University
	Suan Dusit Rajabhat University	Udon Thani Rajabhat University
	Valaylongkorn Rajabhat University	Nakhon Ratchasima Rajabhat University
	Nakhon Pathom Rajabhat University	Valaylongkorn Rajabhat University
	Rajamangla University of Technology Suvanabhumi	Suan Dusit Rajabhat University,
	Rajamangla University of Technology Thunyaburi	Maejo University
	Maejo University	King Mongkut's Institute of Technology North Bangkok
	King Mongkut's Institute of Technology North Bangkok	Ubon Ratchathani University
	King Mongkut's Institute of Technology	Mahasarakham University

	Chaokuntaharn Ladkrabang	Thaksin University
	Burapha University	
	Naresuan University	
	Mahasarakham University	
Rank 5	Surat Thani Rajabhat University	Rajamangla University of Technology Phranakon
	Chankasem Rajabhat University	Chandrakasem Rajaphat University
	Dhonburi Rajabhat University	Dhonburi Rajaphat University
	Phranakhon Rajabhat University	Phranakhon Rajabhat University
	Nakhon Srithamarat Rajabhat University	Tapee College, Bundit Borihanturakit Colleg
	Tapee College	Rajamangla University of Technology Thunyaburi
	Bandit Borihanturakit College	Rajamangla University of Technology Krungthep
	Yala Rajabhat University	Rajamangla University of Technology Suvanabhumi,
	Uttaradit Rajabhat University	Rajamangla University of Technology Srivijaya
	Nakhon Sawan Rajabhat University	Surat Thani Rajabhat University
	Pibulsongkram Rajabhat University	Nakhon Srithamarat Rajabhat University
	Loei Rajabhat University	Uttaradit Rajabhat University
	Sakon Nakhon Rajabhat University	Nakhon Sawan Rajabhat University
	Udon Thani Rajabhat University	Pibulsongkram Rajabhat University
	Nakhon Ratchasima Rajabhat University	Sakon Nakhon Rajabhat University
	Buriram Rajabhat University	Buriram Rajabhat University
	Thepsatri Rajabhat University	Thepsatri Rajabhat University
	Muban Chom Bung Rajabhat University	Nakhon Pahom Rajabhat University
	Chiang Mai Rajabhat University	Muban Chom Bung Rajabhat University
		Yala Rajabhat University
		Chiang Mai Rajabhat University

Source: Commission of Higher Education (CHE), Ministry of Education

There is no explanation given about differenced from Rank 1 to Rank 5. However, the issue is CHE selected and ranked only 49 universities out of 137 universities. This means that the quality of rest of universities may not reach to pass the selection criteria. This is also serious issue for HEI to review quality of education.

It must be appended a note that due to questions about responsibility of evaluation body and evaluation criteria, some universities rejected evaluation.

Table 7.9 University Ranking in 7 Specific Fields

	Education	Research
Science	Faculty of Science, Mahidol University	The Petroleum and Petrochemical College, Chulalongkorn University
Technology	Faculty of Engineering, Chulalongkorn University	The Joint Graduate School of Energy and Environment, King Mongkut's University of Technology Thonburi
Biomedical	Faculty of Medicine, Ramathibodi Hospital, Mahidol University	Research Institute for Health Sciences, Chiang Mai University
Humanities & Arts	Faculty of Decorative Arts, Silpakorn University	Faculty of Fine Arts, Chiang Mai University
Social Science	SASIN Graduate Institute of Business Administration, Chulalongkorn University	Institute for Population and Social Research, Mahidol University
Agriculture	Faculty of Agriculture (Kamphaensan Campus), Kasetsart University	Faculty of Agro-Industry, Prince of Songkla University
Education	Faculty of Education, Chulalongkorn University	Faculty of Education, Chulalongkorn University

Source: Commission of Higher Education (CHE), Ministry of Education

7.1.3 Education Reform

(1) Strategy and Policy of Education Reforms

After currency crisis in 1997, education was acknowledged as the urgent needs to enhance people's ability to maintain globalization and to increase competitiveness of Thailand. In order to realize such national agenda, education sector in Thailand identified to ensure flexibility of education in terms of curricula content, modes of delivery and education management. This means that **government accepted decentralization** in education and committed implementing, reviewing and revising program of education reform to keep the up with social change.

The New Constitution also confirm the right of all Thai people to receive quality, basic education for at least 12 years (6 years for primary and 6 years for secondary education – 3 year each of lower and upper secondary education). In order to meet the above requirements, the first National Education Act was promulgated in August 1999. Amendments were made in 2002 to accommodate changes in the cope of the Ministry of Education. Major areas identified needs of reform are as follows;

- Ensuring access to basic education for all
- Reform of education system
- Reorganization of administrative structure
- Reform of teachers, faculty staff and educational personnel
- Educational standards and quality assurance

- Educational finance reform
- Utilization of technologies for education
- Others

Reform of Education System and Reform of Education Administration and Management are focused in the following section.

(2) Reform of Education System

Under the National Education Act, education in Thailand is classified into three types, which are 1) formal education, 2) non-formal education and 3) informal education.

Table 7.10 Type of Education and Characteristics

Type of Education	Characteristics
1. Formal Education	Formal education provides clear target, method, curricula, duration, assessment and evaluation to complete both for public and private bodies. **a) Basic Education:** 12 years of Education - 6 years of pre-primary, 3 years of lower secondary and 3 years of upper secondary. **b) Higher Education:** To be provided at universities, institutes, colleges and other types of specialized institution. Lower-than Degree or Diploma Level: To be offered by colleges and institutes, public and private vocational colleges, as well as colleges of physical education, dramatic arts and fine arts for 2 years of study. Degree Level Programs: To be provided for two years of study for students who have completed diploma courses, and four to six years of study in upper secondary education or equivalent. First professional qualification is Bachelor Degree. **c) Special Needs Education:** [Special Needs of Education] Provided for the hearing impaired, mentally handicapped, visually impaired, physically impaired or health impaired including children with learning disabilities, autistic children, emotionally or behaviorally disordered children. To be placed in special and inclusive schools. Special curriculum is adopted. [Welfare Education] To be provided for students who are socially and/or culturally disadvantaged. Students are not only receive their education for free but also accommodation, food, clothing, equipment, textbooks and other necessities. Students are given special vocational training relevant to the locality of particular school to secure future employment. **b) Vocational Education:** This forms part of the general stream of basic education. Carrier and technology related to education is offered to schoolchildren at both primary and secondary level to provide them with work experience and assist them in carrier preparation and application of technology. There are three classifications. Upper-secondary: Leading to the lower certificate of vocational education Post-secondary: Leading to a diploma or other higher certificate University Level: Leading to a degree **c) Special Vocational Education:** This includes sports schools providing full scholarship to

	particularly talented students. This also includes dramatic arts and fine arts colleges offering certificated equivalent to lower and upper secondary education. **d) Education for Ecclesiastics:** To be provided for novices and monks in general ecclesiastic schools in various Buddhist temples. The schools offer lower and upper secondary education equivalent to curricula of the Basic Education Commission. For higher level studies, there are two Buddhist universities available both for undergraduate and graduate level. **e) Specialized Education:** To be provided for basic and higher education level by ministries, bureaus, departments, state enterprises and other public agencies according to the needs and expertise. All responsible units have developed their own curricula for specific education and training, for instance; professional soldiers, police, specific technicians, medical sciences and other specific purposes.
2. Non-Formal Education	The contents and curricula can be adjusted to meet the needs of individual groups of learners. **a) Pre-School (2 – 6 years):** Established by local communities. Family-based or of the private sector and organized by NGOs. **b) Education for Literacy:** To promote literacy for adults aged 14 years and over. c) General Non-Formal Education: To be provided continuing education programs for the person who have no chance to study in the formal system. This covers primary to higher education level through classroom learning, distance learning and self-learning. **c) Vocational Non-Formal Education:** To be provided for polytechnics, industrial and community colleges. Training Courses for Vocational Certificate: Designated for primary graduates who have no chance to study at higher level. Short Courses in Vocational Training: 3 hours up to one year training depend on objectives and contents. Pre-employment training and training to upgrade skills are offered. Interest Group Programs: To be provided to the individuals needs and interest of general public. Certificate in Vocational Education: To be provided for lower secondary graduates through distance learning for unemployment, public organization and private enterprises are targeted. Requires at least 3 years study. **d) Quality of Life Improvement Activities:** to be provided to general public by the Ministry of Education and other agencies responsible for education services, welfare and public services.
3. Informal Education	Learners learn by themselves according to their individual interests, potential, readiness and opportunities available through individuals, society, environment, media, and other sources of knowledge.

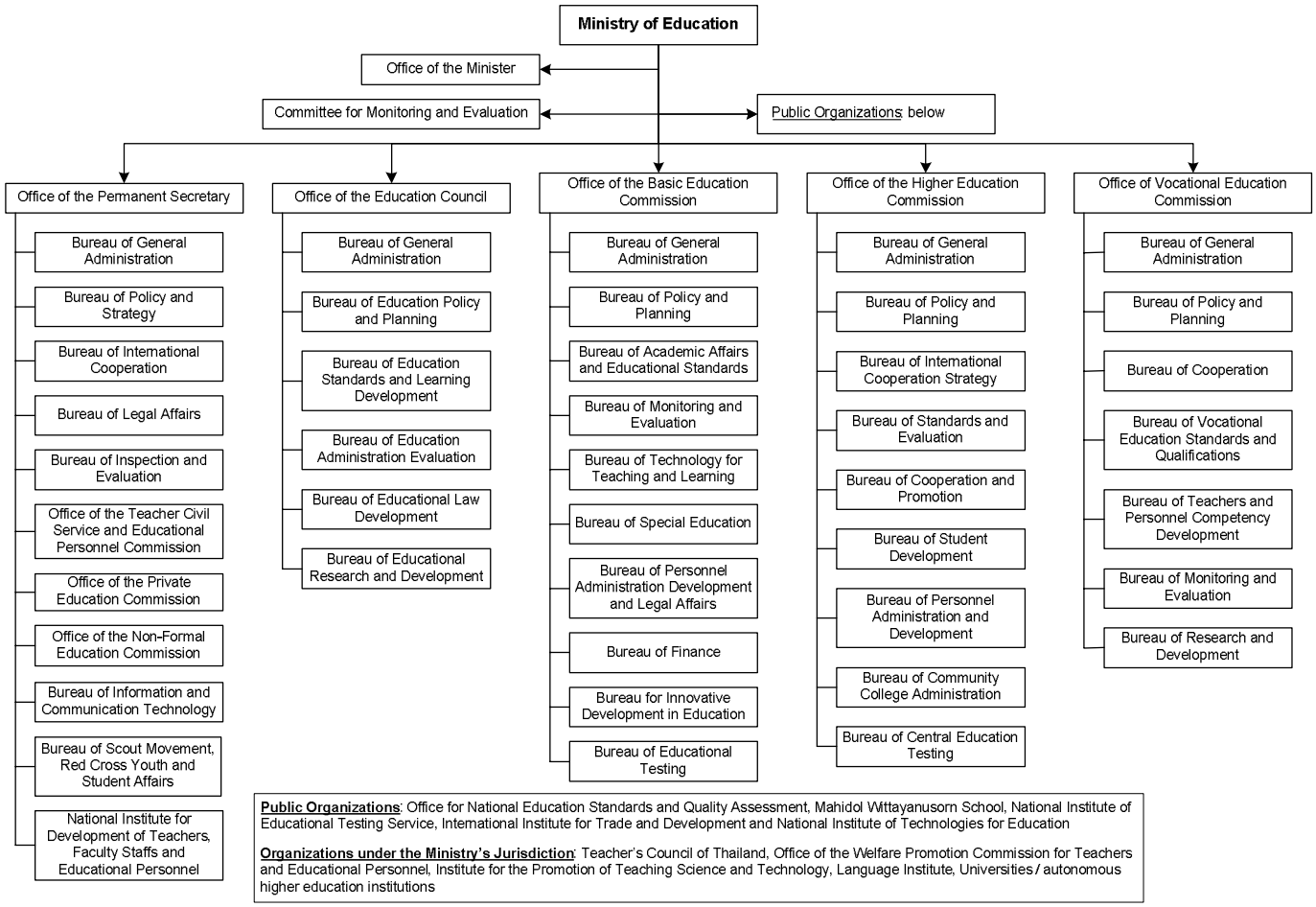
(3) Reform of Education Administration and Management

In order to improve quality of services, the Committee of Education Reform reviewed roles and duties of concerned bodies and worked out restructuring plan. The new Ministry of Education (MOE) is made up of three bodies, which are Ministry of Education (MOE), Ministry of University Affair (MUA) and the Office of National Education Commission (ONEC).

Table 7.11 Education Administration Organization and its Tasks

Organization	Tasks Rendered
Office of the Permanent Secretary	- Managing general administrative work, which is not directly accountable to any other agencies. - Coordinating activities within MOE. - Performing official functions mandated by the law. - Preparing the MOE budget and work plan as well as monitoring, inspection and evaluation of outcomes according to MOE's policy guideline and work plan.
Office of the Education Council (OEC)	- Establishing national education scheme including religion, art, culture, and sports into all levels of education. - Proposing educational policies, plans and standards for implementation in line with the National Scheme of education. - Undertaking, coordinating and promoting networks for educational policy and planning. - Proposing policies and plans for the mobilization of education resources. - Evaluation of education provision as stipulated in the National Scheme of education. - Providing opinion and advice on relevant laws and ministerial regulations as stipulated in the National Education Act.
Office of the Basic Education Commission (OBEC)	- Propose policies, plans, and standards for basic education. - Develop curricula for basic education. - Mobilize education resources. - Develop administration systems. - Promote and coordinate information networks for teaching and learning. - Develop education innovation. - Supervise, monitoring inspection and evaluation of basic education provision. - Conduct secretarial works of the Commission *Approximately 33,000 schools in 175 areas.
Commission on Higher Education	- Propose policies, plans, and standards for higher education. - Mobilize education resources. - Ensuring education quality and standards both for public and private higher education institution. - Encouraging more participation of private sector to take part in higher education. - Coordinating and promoting development of human resource and building capacity of students. - Proposing the establishment, dissolution, amalgamation, discontinuity and improvement of higher education institutes. - Monitoring, inspection and evaluation of education provision of higher education. - Secretarial work of the commission. * Covering 78 public universities, 59 private university and 12 community college.
Office of Vocational Education Commission (OVEC)	- Administrate and manage vocational education at 2 levels. - National Level – comprised of representatives from the private sector and concerned agencies to formulate long-term planning and other major policies - Institutional Level – Reorganize 412 colleges into 28 multi-campus to develop strong partnership with the private sector, remobilizing resources, developing demand-driven programs in line with local needs and identifying and strengthening areas of excellence in each institute, developing multi-disciplinary programs.

In the original framework, MOE mainly took care of secondary education, MUA was responsible for tertiary education and ONEC was responsible for policy making and planning for education at all levels and of all types. These bodies were merged into one ministry. According to this merging, MOE is the main organization to be responsible for education in Thailand. MOE formulates education policies, plans, and standards and mobilizes the necessary resources to achieve its goals and monitors and evaluates education provision. Furthermore, MOE is also responsible for promotion and coordination of religious affairs, art, culture and sports in relation to education. In order to manage above tasks rendered, responsibilities are divided into five offices, which are 1) Office of the Permanent Secretary, 2) Office of the Education Council (OEC), 3) Office the Basic Education (OBEC), 4) Commission of Higher Education (CHE), and 5) Office of Vocational Education.



Source: CHE

Figure 7.2 Organization of Ministry of Education

7.2 Issues on the Higher Education

7.2.1 Background

In 2007, Thailand had a population of 63 million. Labor force became 36.9 million, which is almost 60% of population. Table 7.12 indicates share of GDP and Labor Force by sector and the largest three subsectors in Non-Agriculture, Forestry and Fishing Sector in 2007. Of this, labors from Agriculture, Forestry and Fishing sectors shares large part of employment, which became almost 36 % of the overall labor force but this sector contributed almost 10 % of Gross Domestic Product (GDP). Contrary, manufacturing sector is occupied by only 16 % of labors and contributed to GDP for 39 % in 2007. Other industry such as wholesale and hotels contribute almost same proportion between GDP and labor force. Therefore, manufacturing subsector must be important industry to Thailand.

Table 7.12 GDP and Labor Force Share by Agriculture and Non-Agriculture Sector and their Largest Labor Force Sharing Industry in 2007

Unit: Percent

	GDP Sharing[1)]	Labor Force[2)]
Agriculture, Forestry and Fishing Sectors	10.2	35.7
Non- Agriculture, Forestry and Fishing Sectors	89.8	64.3
Manufacturing	38.4	16.2
Wholesale and Retail Trade, Repair of Vehicles and Personal and Household goods	16.8	16.3
Hotels and Restaurants	5.8	6.7

Note: GDP and Labor Force Sharing by subsectors are ratio against overall GDP and Labor Force.

Source: 1) NESDB, 2) Report of the Labor Force Survey, National Statistical Office, Ministry of Information and Communication Technology.

In the past, Thailand was acknowledged by cheap and unskilled labor supplier but this was realized by rapid economic development during 1980's because labor market supplied sufficient number of labor. However, Thailand's population growth rate was dropped from 3.0% in 1950's to 0.82% in 2005 due to the successful family planning program. Due to this change, Thailand can not expand economic scale to 9% as it was in 1980's. This means that substance of economic structure was changes, according to diffusion of ICT since 1998, from labor-oriented or traditional economy to more value-added of manufacturing of knowledge based economy. Thai Research Development Institute (TRDI) pointed out that insufficient education and limited skilled laborers prevent to follow rapid changes of industry and obstruct increasing productivity. In this situation, quality of education and researches to support Thai industry has to be reviewed to fit to new generation of labor market. Thai government engaged in about 9 years of compulsory education and 12 years of free education in 2000 to widen education opportunity. Further, the government reformed higher education system and administration in 2002 to function education system properly. Thai government exactly

targets to increase number of educated work force. In order to support this policy, approaches for economic development must be designed from three different directions, which are1) increase quality and opportunity of education, 2) improve productivity 3) human security to ensure quality of manufacturing.

As it is understood, there is a large regional divide between Bangkok and other regions in Thailand in terms of economics, social infrastructure, education and other areas. Therefore, strengthening of education sector must be carried out on the nation-wide level. Increase quality of education and opportunity must be considered both for primary/secondary education and higher education sectors. If the purpose of primary and secondary education is to improve humanity, task rendered to higher education is to sharpen economic development. In this context, strengthening higher education sector is getting important.

7.3 Current Issues in the Higher Education Sector and Candidates of Future Collaboration Project

7.3.1 Current Issue

As it is discussed in the section before, mission rendered to the higher education sector is seriously important. Higher education sector has to support primary and secondary education to incubate future manpower, to deliver social services on behalf of government, to prepare advice for government as the third party body, to develop quality of education, etc. However, most of current HEI seems on the way to complete preparation to respond to such expectations. Issues apparently recognized are;

(1) Lack of Lecturers

Importance of increase number of lecturers is acknowledged in three areas, which are 1) to improve Student-Teacher ratio, 2) to cover all academic subject and areas and 3) to support primary and secondary education. Acknowledged Student–Teacher Ratio is 43:1 in average as indicated in Table 7.5. There is no standard ratio between Student and Teacher because situation is different from by programs and by countries. But this S:T ratio for HEI in Thailand is deemed too high. Considering average ratio in Japan[22], 17:1 for undergraduate, 3:1 for Master and Doctoral Course, recommendable ratio for under graduate for Thailand may be set utmost for 35:1, which ratio is almost double compare to Japan.

Increase number of lecturer is also important to cover all academic subject and areas of the program and to deliver expertise. This is sample calculation for Public University. As explained in Table 7.5, If total number of 1,895,687 students, may not change in the next decade, number of lecturers must become 54,162 persons to fit to 35:1 policy, which is increase of 20% of lecturers or 9,262 of additional persons.

[22] Information about the average ratio in Japan comes from the Ministry of Internal Affairs.

Further, number of Ph. D holder lecturers is available for 14,100 persons out of 59,369 lecturers according to Table 7.6. If government targets to 50% of Ph. D holder lecturer, total of 29,685 lecturers must become Ph. D holder. Taking current situation into account, 11,805 Ph. D holder lecturers are available at Public Universities, which employs total of 45,236 lecturers, total number of Ph. D holder lecturer has to become 22,618 according to 50% policy or Public Universities needs to employ 10,813 additional Ph. D holder lecturers. To attain this target, there are two options to increase number of Ph. D holder lecturers, which is to recruit Ph. D graduate and to upgrade Master Degree holder lecturers to Ph.D. For employment of Ph. D holder, annual number of Ph. D enrolment is 11,866 students (see Table 7.4) but graduates number may become 124 as explained in the section 7.1.2(3). Even if HEI employs all Ph. D holders, it will take more than 80 years to attain 50% policy. This means that HEI has to consider upgrades Master Degree holder lecturers to Ph. D holder and reduce the rate of drop off of Ph. D students. Further, HEI immediately has to become attractive institutions to break through this situation.

(2) Quality of Education

Quality of education must be in proportion with academic title and level. For academic title, total of 59% of lecturers are Master Degree holders and 26% is for Ph. D holders in the public school. Overall average of them, including public and private, is 60% and 24% respectively. One of the missions for HEI is to create post-graduate students. As it is discussed in the section before, total number of graduate becomes almost 50% and the rest of 50% students withdrew from HEI. This figure may also be a result of education quality. Ph. D holder lecturers may give higher quality of education than lecturer. In this sense, measures for upgrading of lecturers have to be planned. Furthermore, shortage of Ph. D lecturers also link to lack of Full Professors, Assistant Professors and Associated Professors. There is no specific reference data, however, it is deemed that number of Full Professor is too small compare to Associate Professor and Assistant Professor. In the lack of Ph. D holder lecturer situation, training program for existing lecturers has to be planed by government or individual HEI.

(3) Over-concentration of Academics in Bangkok

Reviewing current situation in Thailand, it is over-concentration in Bangkok. All of 1,015,172 or 52% of students attend school in Bangkok. However, total number of lecturers is only 17,737 persons or 39% against overall number. S:T ratio becomes 57:1. Regardless to examine appropriateness of such proportions, HEI must be distributed to all direction of region in Thailand and create human resources in nation-wide level. Since the concept that education is a repertory for work force, decentralization must be promoted. Supporting regional SME's or OTOP is one of areas to be supported by higher education sector. Of course there are a couple of disadvantages for decentralization in terms of traffic, infrastructure, communication, finance, acquisition, etc. However, nation-wide development in harmony is the most effective approach to contribute to economic development in Thailand.

(4) Increase Quality of the Products:

Research is major mission rendered to HEI. Research activities promote acquisition of knowledge in S&T field, increase quality of human resource and improve quality of products. It is understood that successful research activities are results of joint research between/among university and other R&D institution. According to data provided by Ministry of Education, Japan in 2004, accumulated number of agreement between universities in Japan and universities in China became 2,054 and the one with Korea turn into 1,149. Contrary, accumulation of agreement between universities in Thailand and Japan completed only 371. Both China and Korea increased GDP and quality of products in the last decade. This means that academic agreement may promote research activities both countries and may accelerate technology transfer from universities in Japan to counterpart universities, which largely contribute to economic development.

(5) Secure Timely Access and Sufficient Medical Services

Furnishing compulsory education by government is understood that government is primary responsible organization to take care of students in primary and secondary education. Generally, children easily get illness and injury by nature and elderly people needs emergency, timely and appropriate medical care. In this sense, government has to spread medical network in Thailand. Since hospitals belong to public university have to support "10 Baht Medicine" accepting hundreds of patients a day, accessing timely medical service sometimes does not be secured. Public hospital has to provide sufficient level of facilities, staffs and medical quality to maintain number of work force for sustainable economic development.

7.3.2 Candidates of Future Collaboration Project

Considering above situation, the mission recommends three solutions for future collaboration project, which are suitable for Yen Loan. Tentative project name and contents outlined as follows.

(1) Chulalongkorn University: the Second Thailand-Japan Technology Transfer Project (TJTTP-II)

- Establishment of interdisciplinary research oriented project among faculties of Engineering, Science, Medicine, Pharmaceutical Science, Dentistry, etc at Chulalongkorn University and other universities or R&D institutions in Thailand, supported by universities in Japan.
- Universities in Japan supervise researches as the counterpart universities to pursue state-of-the-art, to transfer technology, to assist promotion of Public-Private Partnership.
- Strengthen collaboration with universities in Japan to widen possibility to register patent right, intellectual copy right, and other right to be officially acknowledged setting up of Technology Licensing Organization to manage such royalty.
- Enhancement of Public-Private Partnership (PPP) involving private sector and transfer incubated technology and human resources from university to industry through Master Degree students as the initiator.

(2) Chiangmai University: Medical Network Development Project at Chiangmai University

- Establishing medical network covering 17 provinces in Northern Thailand setting CMU as a core of medical services in this region in terms humanware, software and hardware.
- Produce medical specialist such as medical doctor, physician and nurse, and building up of database for medical knowledge and technique assisted by universities in Japan to accommodate sufficient medical services in timely manner for all participants.
- To conduct institutional development in terms of curricula, new course and hospital management to improve quality of medical care collaborating with universities in Japan.
- Construction of a hospital building to widen opportunities to access to medical services in timely manner, to improve quality of medical services and to reduce patient's queue time to delay advance of disease.
- Promote joint research activities with universities in Japan in the area of preventive medicine, infection disease and others.

(3) Rajamangala University of Technology: RMTU Capacity Building Project

- Produce number of Doctoral and Master Degree holder lecturers who study in Japan to increase quality of education and produce skilled work force.
- Update curriculum and develop new courses assisted by universities in Japan to respond to social demands.
- Establish credit transfer and credit exchange system among consortium universities.
- Facilitate teaching and research equipment to accelerate acquisition of knowledge in the field of Science and Technology.

7.3.3 Conformity of Candidate Projects to National Policy

All candidate projects for future collaboration explained in the section before completely meet the National Plan, Policy on Long Range Plan on Higher Education.

(1) Chulalongkorn University (CU): The Second Thailand-Japan Technology Transfer Project (TJTTP-II),

This research oriented project sets goals to transfer technology and human resources from academic to industry, pursuing valuable research results with an authorized form such as patent right, intellectual property right, royalty etc, conducting collaboration with counterpart universities in Japan. Such specific project outcome directly support R&D activities at industry in Thailand, and bring economic development to Thailand in terms of quality, stability and equality. Further, development of new technology is one of solutions to prevent environmental damages and secure stabilization of natural resources and environmental quality. All of this perspective completely meets the direction of National Plan. Increasing quality of education and lecturers and producing skilled work force through joint research activities will be brought as bi-products of the Project. This is also fit to the Policy on National Education. With regard to contribution to the Long-Range Education Plan, the Project especially considers development of outsource financing collaboration with private sector with Public-Private Partnership scheme.

(2) Chiangmai University (CMU): Medical Network Development Project at Chiangmai University

In this project, Chiangmai University (CMU) stands on securing human development in terms of quality, morals and knowledge from medical perspectives according to the National Plan. Further, research in preventive medicine and infection disease may contribute to stabilization of natural resources and environment quality, which is also expressed policy on the National Plan indirectly. Outcomes of the Project vary humanware, hardware and software. Increase number of medical specialist such as medical doctor, physician and nurse is outcome of humanware. Hardware includes hospital building and installation of equipment. Software means establishment of medical knowledge database and the latest medical technique, joint researches, operation management scheme of hospital. All of these products encourage life of patients and make healthy person to increase intensive for work, which leads economic development. Workshop, lectures or symposium inviting professors from Japan also contribute to increase quality of and lecturers, which is acknowledged policy on Education. Further, CMU has to support to promote decentralization of academics and economics by establishing medical network in Northern Thailand following the 15 years Long-Range Education Plan.

(3) Rajamangala University of Technology (RMUT): RMTU Capacity Building Project

Substance of RMUT is technical vocational school, therefore, RMUT historically produced engineer for industry sector. In this Project, RMUT will obtain hundreds of Master and Doctoral Degree holders who studied in Japan to deliver quality education to students as a center of professional, improving curricula and facilities. Increase number of Master and Doctoral Degree holder lecturers and to improve quality of education is exactly same direction as the Policy of Education, and educated work force assists to make quality products for development of economy in terms of quality, stability and equality, which is expressed on the National Plan. Another distinctive aspect of the project is to utilize advantage of 9 university consolidation to accelerate decentralization of economics and academics in Thailand. Development of credit exchange system and credit transfer system among consolidation universities or universities in Japan may accelerate decentralization in effective and efficient manner. At the same time, introducing such system strengthen connection with each universities and rush development of university network at the nation-wide level. Further, exchange of credit or exchange of lecturers among consortium may assists to improve quality of education. From this standpoint, the Project is in line with direction of the Policy of Education and Long Range Education Plan.

7.3.4 National Economic and Social Development Plan [NESDP]

Thailand's strategic framework addressing its national development challenges from 2007 to 2011 is manifested as the 10th National Economic and Social Development Plan. Thailand aims at "Green and Happiness Society" and "Sufficient Economy" in this plan. The policy

related to the Higher Education Sector is three points which are;

- Human development in terms of quality, morals and knowledge
- Economic development in terms of quality, stability and equality
- Preservation of biological diversity and stabilization of natural resources and environment quality

Overall structure of the National Plan is illustrated on Figure 7.3.

7.3.5 National Policy on Education

Prime Minister, Mr. Samak Sundaravej, made a speech at parliament on February 18, 2008 regarding task of Thai government and National Policy of Education. The policy related to Higher Education is as follows;

- Raise the quality of education
- Develop teachers' curricula, adjust teacher production and develop teachers of quality
- Support production and development of a work force

7.3.6 15 Years Long Range Plan on Higher Education of Thailand (2008 – 2022)

Under the Ministry of Education Regulatory Act 2003, the Commission on Higher Education (CHE) was established to administrate and supervise Higher Education Institution (HEI). According this policy to Ninth Higher Education Plan (2002-2006), CHE completed the drafting of Thailand Long-Term Development Plan for Higher Education (2008 – 2022), which was approved by the Board in October 2007. Main agenda is discussed as follows;

- Demography: In the next fifteen years, the population of Thailand will be increasing but at a slower rate. With this expansion, universities have to focus on education quality, enhance role in improvement of economic productivity of working population and direct more effort on continuing and life-long education.
- Decentralization of the country and development of local administrative bodies: Supports from universities are needed for system design of administration and management, knowledge management as well as training of personnel.
- Universities are National Prime Movers for Competitiveness: Limited number of quality researchers and research funding necessitate focusing and judicious financing of research. Mechanisms such as Research Assessment Exercise (RAE) should be explored and developed for assessing university research capability and potentiality.
- University Financing System: Need to design a scheme on higher education contribution by different stakeholders, such as the public, students and parents, beneficiaries of universities outputs (graduates, research and services).
- Network of Universities: Sharing and consolidation of academic programs and teaching activities to build up mutual trusts among staff, and investing in common infrastructures must be fostered.
- Higher Education Plan for Southern Thailand: Development of students and youth, development of university staff, capacity strengthening of institutes and building bridges with ASEAN are necessary.

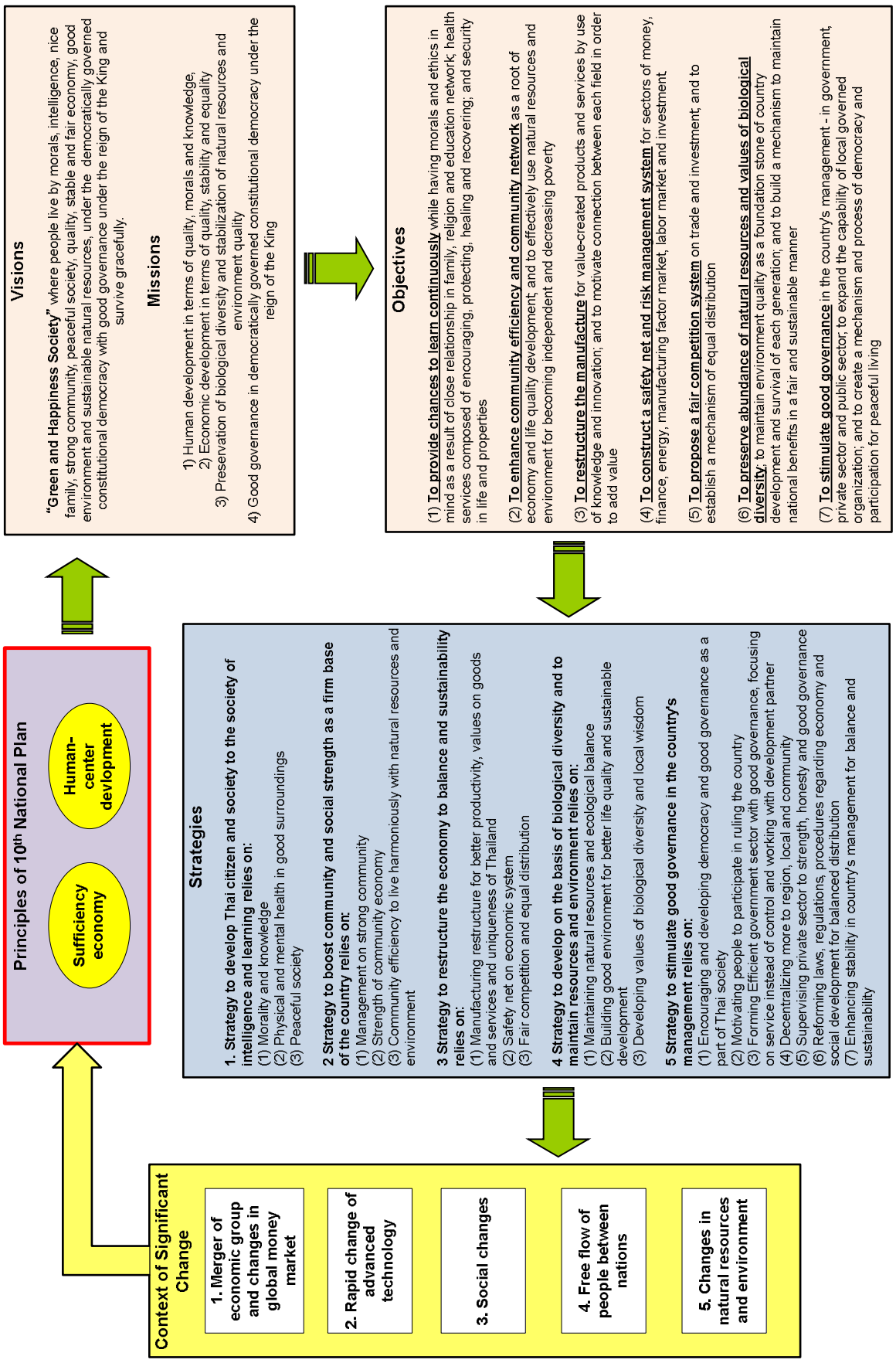


Figure 7.3 10th National Economic and Social Development Plan

7.4 Comments from Commission of Higher Education (CHE), Ministry of Education

The Study Team interviewed with Director of Commission of Higher Education (CHE) on July 15, 2008. The following items are comments from the director.

1. Increase quality of education is national agenda, which is expressed on the Policy of Education, and CHE is a primary responsible organization for policy planning of higher education.
2. Royal Thai Government (RTG) exploring education project, however, no specific projects are proposed to Ministry of Education and CHE this year, therefore, CHE could not submit the project to the cabinet.
3. No official assistance projects have been conducted both on bilateral and international organizations basis. Only World Bank contacted CHE to acknowledge organizing workshop and symposium in Thailand.
4. MOE and Ministry of University Affair (MUA – former organization of CHE) handled following four projects in the past.
   - **World Bank and Australia government**: Thai Australia Science & Engineering Assistance Project – TASEAP (1997 – 2002) – Strengthen tertiary education through facilitating equipment and organizing seminars and workshops.
   - **OECF**: Development of Vocational Education Project – DOVE (1995 – 1999) – Strengthen vocational education sector installing equipment.
   - **JBIC**: Thailand-Japan Technology Transfer Project – TJTTP (1998 – 2007) – Human resource development through joint research activities and acquisition of Master and Doctoral Degrees, updating equipment, IT infrastructure and digital libraries.
   - **ADB**: Human Resource Development Project – HRD (1999 – 2004) – Funding for teaching and research activities.
5. Applying Japanese ODA Loan is one of solutions to accelerate and facilitate large scale development in the higher education sector. Since infrastructure sector already obtained loans from various sources, they may not have options to obtain further loan. However, CHE completed all projects for the moment. CHE may become a candidate to apply Yen Loan.
6. CHE must be a front end to be contacted with universities to initiate projects. General administration flow starts is CHE, MOE and Cabinet. After cabinet approval Ministry of Finance (MOE) and NESDB may become supporting agencies.
7. Due to above discussion, the mission outlined three (3) candidates of Japanese ODA Loan projects to CHE. It was confirmed that concept of all of above projects are in line with the Policy on Education that help to create quality work force, contribute to increase lecturer's quality for further development of Thai economy.
8. Construction of a hospital needs strong support by Ministry of Public Health (MPH) to obtain

permission and approval. If there are discrepancies in policy and direction between MOE and MPH for building of a hospital at CMU, MOE will support CMU. One of the solutions to build a hospital building may be to make agreement between MOE and MPH.

7.5 Chulalongkorn University (CU): The Second Thailand-Japan Technology Transfer Project (TJTTP-II)

7.5.1 Background

During 1980's and 1990's, Thailand enjoyed the highest level of economic development - averaging almost 9% of GDP annually. Increased speculative pressure on Thailand's hit as currency crisis in 1997-1998 that uncovered financial sector weaknesses and forced the government to float the Baht. In this currency crisis, GDP was dropped to minus 10.5% but Thai economy rapidly recovered oneself and kept up to 4.8% of GDP growth rate in 1999. However, Thai economy could not return to 9% of growth rate as before because economic structure was dramatically changed in 1998. Main reason of this change is come from rapid technology development in ICT sector and demand of skilled work force.

In accordance with this change, Thai government acknowledged change of economic structure, as the paradigm shift, which supply of cheap labors is not the mission of Thailand, and changed direction of economic development to produce quality products based on skilled work force. In accordance with this change, government established the New Education Act, in 1999 and its amendment in 2002 and confirmed total of 9 years compulsory education and 12 years of free education officially, reform of education system and reform of education administration management. One of the targets of this principle change is to create skilled work force to industry to increase quality of products for sustainable economic development. In 2007, this policy was clearly declared on the #10 National Development Plan and extended to National Policy on Education that Thai government aims at supporting quality of production to development of work force and to enhance researches to find solutions to increase productivity.

7.5.2 Necessity of the Project

In order to obtain sustainable economic development, the National Plan clearly mentioned restructuring of manufacturing and services sectors (whole sale and retail, hotel, restaurant, transportation, financial, etc) because these sectors share almost 84% of GDP (40% for manufacturing and 44% for service) with 56% of work force (18% for manufacturing and 38% for service) keeping 6.3% of average annual growth in 2005. Restructuring of industry sector means to input skilled work force and to increase quality of products changing approach of production. The task rendered to Higher Education Institution (HEI) is to increase quality of education and lecturers and to increase number of skilled work force and lecturers to increase quality of products. Government acknowledged to strengthen higher education sector is one of options to accelerate economic development.

Chulalongkorn University (CU), acknowledged as a leading university in Thailand, successfully transformed his entity from education oriented university to research oriented university. CU already experienced Thailand-Japan Technology Transfer Project (TJTTP) during 1998 – 2005 financed by JBIC, which assisted much for CU as indicated on Table 7.5.1. Due to the past experience, CU knows guideline and process of Japanese ODA Loan, easily establish Project Implementation Unit (PIU), and understand impact of the Project. Further, CU already established 49 authorized research unit and all of which have a Research Profile and Counterpart University in Japan. However, they could not be complete Public-Private Partnership (PPP) due to limitation of the Project period during Phase-I. Since CU already has fundamentals to start project, which is a basement of the Project usually needs 1-2 years to establish, the most concern in Phase-II project is to create PPP to pursue patent and other official recognized right to contribute to industry for sustainable economic development of Thailand.

Table 7.13 Performance of TJTTP-I

	Target	Outcomes	Achievement
Degree participants	42	40	95%
Non-Degree participants	76	198	260%
Visiting Scholars	256	562	212%
Master Thesis (overall)	-	1,006	-
Doctoral Thesis (overall)	-	135	-
Journal Paper (international journals + international conference proceedings)	-	191 by 35 Ph.D (89 + 102)	-
Co-authorship by Japanese and Thai researchers (international journals + international conference proceedings)	-	391 (222 +169)	-
Researches	-	49	-
Software Development	1,720.00	1,315.95	76%
Hardware Development	4,269.00	3,837.89	89%

7.5.3 Concept of the Project

To enhance research capacities and capabilities through the interdisciplinary based research unit among the S & T related faculties at CU and other institution supported by universities in Japan, pursuing specific research outcomes to improve quality of products, improving quality of education and lecturer, and increasing number of lecturers and work force, to encourage Thai industry for sustainable economic development for Thailand.

In order to attain above project targets, the Project needs three keywords, which is “quality of Research and Outcomes”, “World Class University” and “Institutional Development”. All of these keywords are supported by three programs such as Academic Fellowship, Research Activity Enhancement and Procurement explained in the following section.

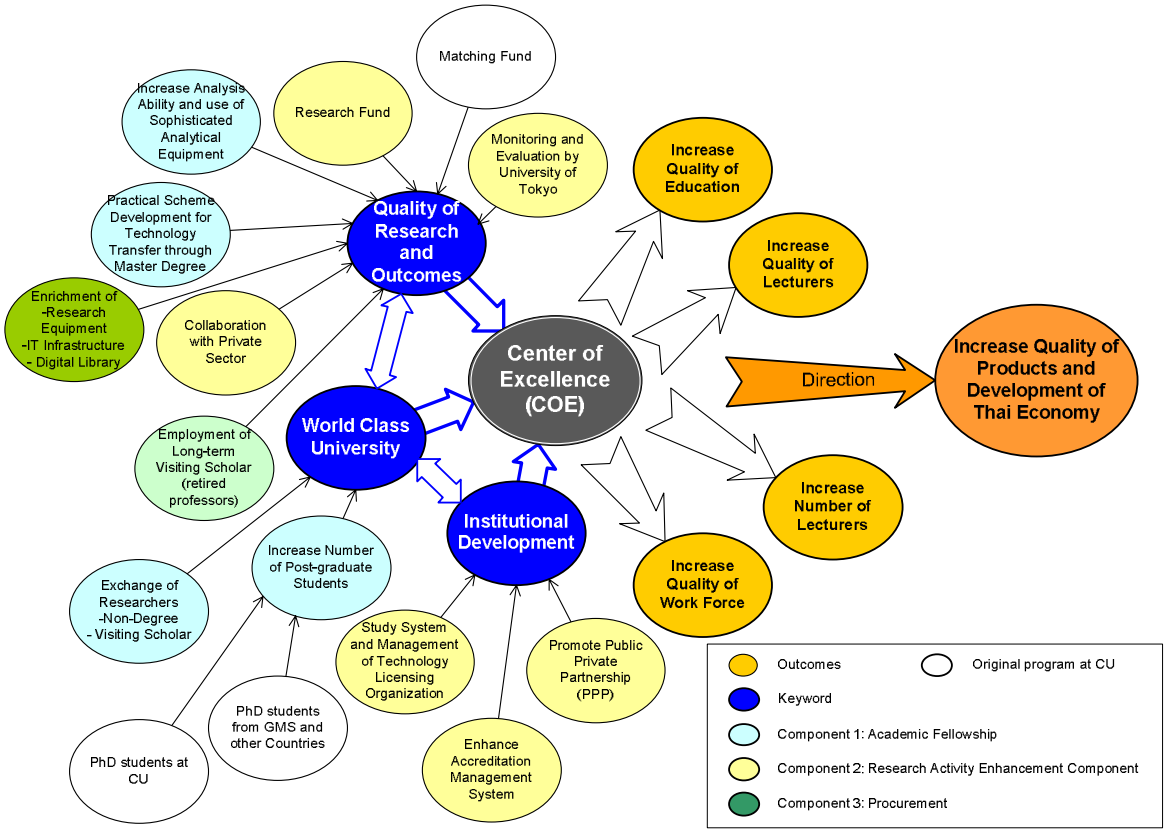


Figure 7.4 Conceptual Relationship among Input, Outcome and Target

Attaining “increase quality of products and development of Thai Economy” as the final goal of the Project will be supported by establishment of Center of Excellence[23].

7.5.4 Project Rational

The Project may find solutions for mainly four issues, which are 1) increase quality of education, 2) increase quality of lecturers, 3) increase quality of work force and 4) increase quality of the products. All of these are focused on the Policy on Education and 15 years Long-Range Higher Education Plan, which directly assists National Plan in terms of economic development.

7.5.5 Outline of the Project

Outline of the project is compiled as following points.

- Setting University of Tokyo who is the counterpart universities in Japan under TJTTP-I, as the third-party body to monitor and evaluate research activities.

[23] A venue inclusive of capacity and capability to impel “quality of research outcomes”, “a world class university” and “institutional development” conducting creative research and human resource development activities toward the mission rendered to the Project.

- Use of the project resources is limited only for interdisciplinary research units in the Science and Technology field, which is established between/among departments/faculties at CU and other institution other than CU supervised by universities in Japan.
- Master and Ph. D Program is provided for the participants only for faculty member of CU to conduct joint researches.
- Master graduates is highly demanded by Japanese manufacturers in Thailand and universities in Japan
- MS graduates must be recognized as the faculty member of CU to conduct lecture at CU and other universities in a framework of research unit.
- Professors in Japan join Ph. D thesis evaluation meeting at CU.
- Create at least 20 Center of Excellence (COE).
- Funding for COE has to be conducted separately from the project component (component 1 and 3).
- Employment of retired professors to supervises research activity, thesis writing and involvement of industry.
- Technology transfer from CU to industry will be done through MS returnee from Japan after completion of Ph.D course at CU.
- Research outcome oriented such as patent right, create Ph.D, thesis, research paper, etc.

7.5.6 Project Component

The project consists of Implementation Component and Consulting Services. Implementation Component consists of three projects such as Academic Fellowship, Research Activity Enhancement and Procurement. Consulting Services also consist of four programs, which are 1) Overall Project Management Services, 2) Academic Fellowship Services, 3) Procurement Management Services and 4) Research Activities Management Services. Outline of the component is illustrated as follow.

[Implementation Component]

Component 1: **Academic Fellowship Component**	1. Degree Program: obtain Master and Doctoral Degree in Japan. 2. Non-Degree Program: dispatch researchers from Thailand to Japan. 3. Visiting Scholar Program: invite professors from Japan to Thailand for exchange of opinion on research, monitor research progress and schedule, direction of researches, etc. Lecture, workshop, symposium, conference, etc.
Component 2 **Research Activity Enhancement Component**	1. Management of Intellectual Property Right Program: study management scheme for intellectual property right, patent right and other right to protect them to third party establishing Technology Licensing Organization (TLO). 2. Public-Private-Partnership Management (PPP) Program: plan collaboration with private sector, technology transfer, research contract, etc through workshop. 3. Funding and Academic System Development Program: establish scheme for evaluation of research and internal accreditation system. Conducting proposal based funding for selected research activities separate from other benefit of the project.
Component 3 **Procurement Component**	1. Enhancement of Research Equipment Program: facilitate research equipment through ICB, Direct Purchase and International Shopping. 2. IT Infrastructure Improvement Program: improvement of existing IT infrastructure to meet to current technology. 3. Library Development Program: enrich library collection not only hardcover but also website journals.

[Consulting Services]

Component 4: **Overall Project Management Services**	1. Supervisory services for overall aspects of the project coordinating implementation schedule and progress. 2. Coordinate CU and government agencies and JICA. 3. Plan project implementation and budget management.
Component 5 **Academic Fellowship Services**	1. Support Degree, Non-Degree and Visiting Scholar program providing necessary information and documentation. 2. Support selection of candidates for Degree and Visiting Scholar Program.
Component 6 **Procurement Management Services**	1. Support cost estimation and tender document development. 2. Support process of ICB, Direct Purchase and International Shopping. 3. Supervise overall procurement work until hand-over of equipment.
Component 7 **Research Activities Management Services**	1. Coordinate University of Tokyo and CU in terms of evaluation of research activities, establishment of accreditation criteria, promote research agreement with private sector, manage and improve TLO at CU. 2. Support selection of research unit for funding and financial management.

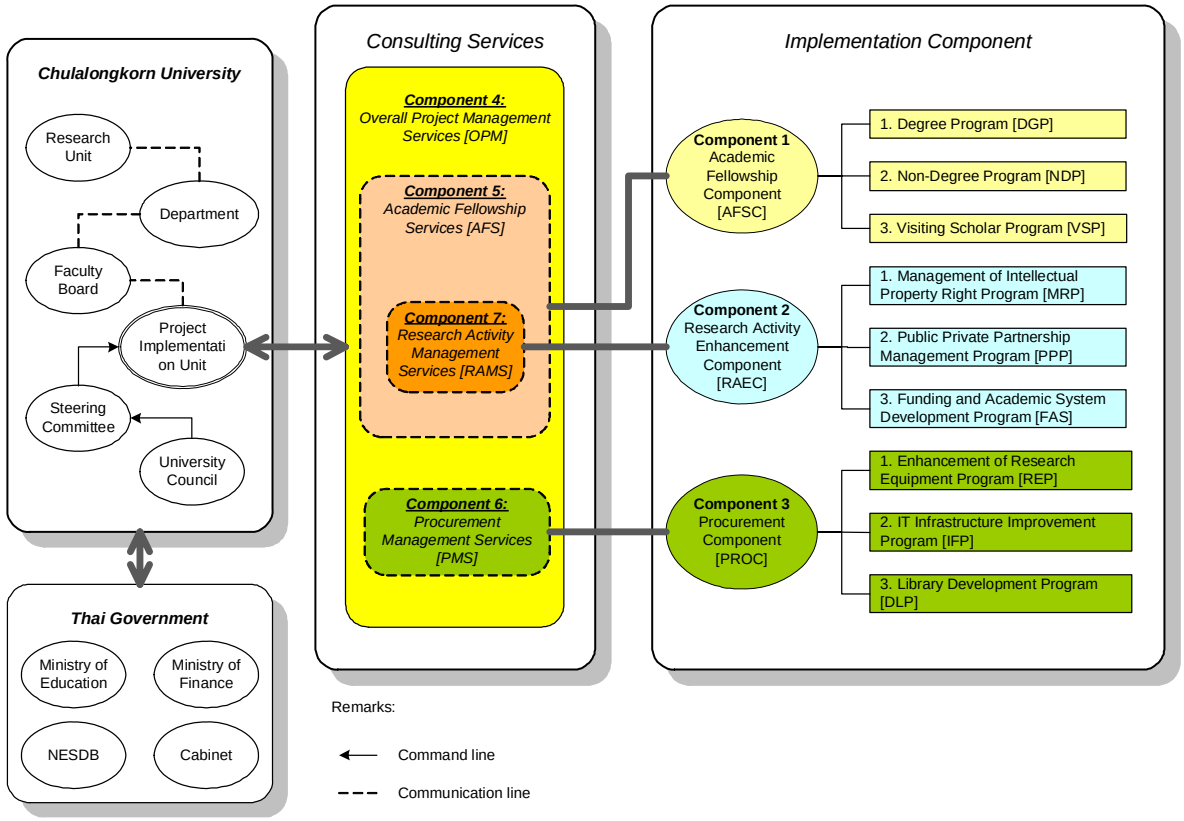


Figure 7.5 Project Component

7.5.7 Target of the Project

(1) Component 1: Academic Fellowship Component

Current problem involved in the higher education sector is lack of lecturers and quality of education. In order to handle this problem, the Project focuses on human resource development through academic fellowship and research activities. Especially, demands for Non-Degree and Visiting Scholars were extremely high in TJTTP-I to support human resource development, target of these components were increased under TJTTP-II.

Program	Target Number	Remarks
Ph. D Program	10 participants	1. 10 Ph. D participants must be a faculty member. 2. Participant's name must be listed in the Research Profile.
Master Program	140 participants	1. 140 MS participants become faculty member and receive instruction on research planning by counterpart professors in Japan to complete MS program in Japan within 2 years. 2. Returnee is highly recommended to enter into Ph. D course at CU during obligation period (4 years). 3. Participants can engage with industry in Thailand after Ph. D course. 4. Participants name must be listed in the Research Profile.
Non-degree Program	400 participants	1. Participant's name must be listed in the Research Profile. 2. Visiting period is provided for 2 types (1 week and 6 months) according to the purpose of visit.
Visiting Scholar (VS) Program	1,030 participants	1. VS will be categorized into two types, which are active professor and retired professor. Total number to be invited becomes 1,000 and 30 VS respectively. 2. Active professor will stay at CU 3-10 days per visit but retired professor will stay longer period than active professor (1-3 years). 3. Main tasks rendered to retired professor are to supervise overall research activities, thesis writing and make closer link with industry. 4. Participant's name must be listed in the Research Profile.

(2) Component 2: Research Activity Enhancement Component

Quality of education and lecturer or skilled work force will be produced through joint research activities. This component is established to guide research activities toward successful results in terms of direction, timeframe, world trend, social impact and value of research, etc supported by professors from University of Tokyo. Further, to bring the policy of "competition" into research activities, proposal based financial assistance was newly introduced to the Project. This is research outcome oriented scheme, which is quite practical and activate research work.

Program	Target Number / Budget	Remarks
Management of Intellectual Property Right Program (MRP)	20 participants	- Discussion and study about management of intellectual property right with universities or TLO in Japan. - 4 person x 5 trips = 20 trips
Public Private Partnership Management Program (PPP)	20 participants	- Discussion and study about linkage between university and industry in Japan. - 4 person x 5 trips = 20 trips
Funding and Academic System Development Program (FAS)	JPY 365 million	- Financial assistance will be conducted only for selected Center of Excellence (COE). 20 COE x 5 years x JPY 3 million = JPY 300 million - University of Tokyo (UT) assists CU to evaluate COE. Monitoring/Evaluation: 5 persons x 5 trips = 25 trips Mid-term Evaluation: 5 persons x 1 trip = 5 trips End of the Project Evaluation: 5 persons x 1 trip = 5 trips - Mission from CU to Japan is planed to exchange academic opinion. 5 persons x 7 times = 35 trips.

(3) Component 3: Procurement Component

Procurement component is a back-up component to support research activities, at the same time, the component accelerate acquisition of S&T knowledge.

Program	Target Number / Budget	Remarks
Enhancement of Research Equipment Program (REP)	JPY 2,000million	1. Procurement of Equipment through International Competitive Bidding (ICB), Direct Purchase and International Shopping. 2. Procurement Manual, contract and tender documents were already provided at Phase-I project.
IT Infrastructure Improvement Program (IFP)	JPY 1,000million	1. Improvement of internet accessibility. 2. Diffusion of mobile computing 3. Procurement has to be completed through ICB
Library Development Program (LDP)	JPY 500 million	1. Procurement will be done through Direct Appointment method as provided at Phase-I project. 2. Payment must be done by re-imbursement method as same as Phase-I project. 3. Enrichment of library is not limited to develop digital library but also applicable to buy hardcover books.

7.5.8 Project Cost

Project cost of TJTTP-II is estimated as Table 7.14.

7.5.9 Implementation Schedule

Implementation schedule of TJTTP-II is illustrated as Figure 7.6.

Table 7.14 Project Cost

unit: Million JPY

		Quantity	Unit Cost	Amount	Remarks
Component 1: Academic Fellowship Component (AFSC)					
1. Degree	Ph. D Program	10	11.0	110.0	49.5 month in Japan in aver.
	Master Program	140	7.0	980.0	2 years stay in Japan
2. Non-Degree		400	1.5	600.0	3 months stay in JPN
3. Visiting Scholars	Active professors from Japan	1,000	0.6	600.0	15 days stay in BKK
	Retired professors	30	6.0	180.0	1 – 3 years stay in BKK
			Sub-Total:	**2,470.0**	
Component 2: Research Activity Enhancement Component (RAEC)					
1. Management of Intellectual Property Right Program		20	0.4	8.0	4 persons x 5 times to JPN
2. Public Private Partnership Management Program		20	0.4	8.0	4 persons x 5 times to JPN
3. Funding and Academic System Development Program					
- Research Fund		100	3.0	300.0	20 research x 5 times
- Monitoring/Evaluation by UT		25	0.8	20.0	5 persons x 5 years
- Mid Term Evaluation by UT		5	0.8	4.0	5 person x 1 time
- End of the Project Evaluation by UT		5	0.8	4.0	5 person x 1 time
- Mission from CU to Japan		35	0.6	21.0	5 persons x 7 times
			Sub-Total:	**365.0**	
Component 3: Procurement Component (PROC)					
1. Enhancement of Research Equipment Program				2,000.0	
2. IT Infrastructure Improvement Program				1,000.0	
3. Library Development Program				500.0	
			Sub-Total:	**3,500.0**	
			Project Cost Total:	**6,335.0**	
Price Escalation (5%)				**316.8**	
Contingency (5%)				**316.8**	
Consulting Services					
Component 4: Overall Project Management Services (OPM)					
Component 5: Academic Fellowship Services (AFS)				**1,267.0**	20% of the Project Cost*
Component 6: Procurement Management Services (PMS)					
Component 7: Research Activity Management Services (RAMS)					
			Grand Total of the Project Cost:	**8,235.5**	

Note: Based on the unit cost applied at TJTTP Phase-I
* Due to the characteristics of the project, which is research or software oriented project, the Project needs continuous assistance by the Consultants in terms of matching of research topics, searching of candidate professors in Japan, coordination between CU and universities in Japan, etc. In this circumstance, 20% of consulting services against overall project cost would be appropriate. TJTTP-I consumed 23% of the Project cost.

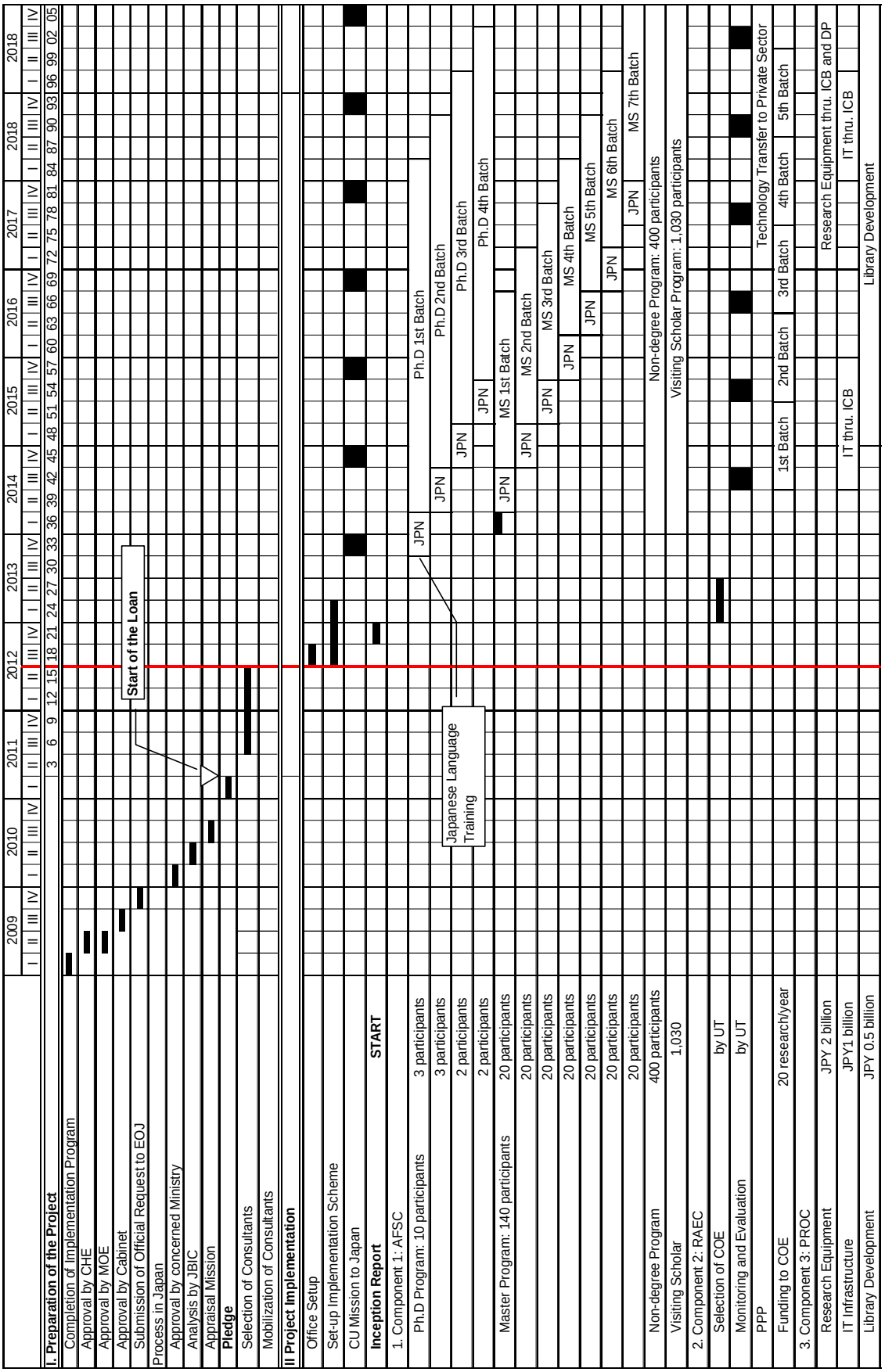


Figure 7.6 Implementation Schedule

7.5.10 Lessons Learned from Previous Project

From experience of TJPP-I, the following points should be considered in implementation of TJTTP-II.

Research unit oriented implementation	State-of-the-art is based on collaborative work from different areas to find solutions. Therefore, it is desirable to support projects like TJTTP from research oriented standpoints such as a multidisciplinary departmental orientation or actively foster cooperation among departments.
Reward and incentive structure system for Technology Transfer	Researches conducted at Faculty of Engineering focuses on application development and have collaborative relationship with private sector. But researchers in Faculty of Science stand on basic research contract with Thai government and agencies. From this standpoint, a new and improved reward and incentive structure has to be considered to encourage researchers to implement their work for the benefit to the Thai society and economy.
Reduction of teaching assignment from researchers	Substantial research work to make technology transfer or to obtain research fund are difficult due to high teaching load.
Improvement of organization structure for research unit	In order to realize both teaching and technology transfer activities, CU has to consider the organization structure to make researcher concentrate research activities as in Japan. At CU all professors, associated professors, assistant professors and lecturer have a task of teaching and administration affair. In Japan, professors, associated professors and assistant professors are responsible for teaching, however, lecturer mainly dedicates to researches, and technician and researcher (post-doctor) assists research activities. Further, a secretary in research unit completely assists administration work.
Budget for Equipment and Facilities	It is quite difficult for CU researchers to obtain continuous budget to maintain for necessary consumables, spare parts and maintenance. CU has to plan use and management of equipment and establish a plan for reduction of maintenance cost at first. Establishing equipment maintenance organization; concentrating operation of highly sophisticated equipment in the certain organization; avoiding duplication of purchase; planning purchasing equipment sharing common consumables and spare parts; bulk purchase of chemicals, materials and agents; managing use of equipment; training equipment operator, etc have to be considered simultaneously with purchasing equipment.
Flexible use for resources of Exchange of Researchers	In the research oriented project, exchange of researchers such as Non-degree Program and Visiting Scholar Program are the key for successful results. Therefore, TJTTP reached to 282% and 212% against the target figure. However, participation in Non-Degree Program provided a couple of limitations or conditions. Establishing flexible scheme may enhance further more activities and bring successful results.

From above experience, TJPP-II is characterized to support interdisciplinary based research activities through proposal based funding, which will increase flexibility for use of the Project resources and expenses and support forming organization within research unit.

7.5.11 Implementation Organization

Implementation organization is available. Former Project Director was assigned to coordinate work force by Dean, Faculty of Engineering.

7.6 Chiangmai University (CMU): Medical Network Development Project at Chiangmai University

7.6.1 Background

The latest daily minimum wage announced by government in June 2008 is THB 203 for Bangkok area and THB 168 for Chiang Mai. Even if the government established "30 Bahts treatment" most of labor and people who belongs to poverty group may miss the chance to access to proper level of medical care.

Chiangmai University (CMU) has Maharaj Nakorn Chianmai Hospital, attached to Faculty of Medicine, on the Suan Dok campus, where is the Health Sciences complex with the faculties of Medicine, Associated Medical Sciences, and Nursing, Dentistry and Pharmacy. Faculty of Medicine is the core of medical service in this region covering 15 million of population in 17 provinces. The faculty keeps 400 of faculty staff, 1,000 of medical students, 1,200 of nurse and 5,000 of hospital employee. The hospital consists of four buildings: an old 7-story building (constructed more than 50 years before), the 15-story Sujinno Building in 1983, and the 15-story Sripat Building is in 1996 and another one. These hospitals facilitated a total of 1,800 beds and 400 auxiliary beds, accumulated number served patient is 896,721 out-patients and 45,793 in-patients until 2006. Total number of patient served becomes one million patients in 2008. However, due to decrepit of hospital building, lack of functionality and insufficient floor space made longer queue time for out-patient longer, which became 1-1.5 days. At the same time, CMU supports "30 Bahts treatment" according to the government policy, number of patients visiting this hospital are getting bigger. They wait for their turn laying down on the outer space of building because most of patients belong to poverty group in Northern Thailand and no budget to stay in hotel. In this situation, absorbing congestion and reducing queue time for out-patients are urgent needs to delay advancement of disease and to secure timely access to medical services. At the same time, CMU has to support "30 Bahts treatment" as a public university. Furthermore, CMU dispatches medical doctors to most of provincial and secondary hospitals in this region. However, existing resources in terms of humanware, software and hardware at CMU is not enough to resolve the issues. In order to keep a level of medical service, create number of medial specialist and update medical knowledge database are urgent needs. Special assistance is necessary to break through the situation.

7.6.2 Necessity of the Project

Human development and economic development is acknowledged as the priority areas for Thailand according to the National Plan. Both agenda must be realized based on human

security. Economic development is based on increase of productivity both in quality- and quantity-wise. Since production operation is responsibility of labor, human security such as preparing sufficient level of and timely access to medical care, and quality of medical services must be placed the highest priority. Especially, lower income labors do not have options to visit private hospital to get sufficient level of medical care. They have to visit public hospital to access to medical care with 30 Bahts. There is a lot of discussion on this scheme, however, CMU has to support this scheme as the public university to secure economic development of Thailand and to contribute social welfare in this region. In order to realize this strong policy of CMU, mobilize satisfactory level of medical humanware, software and hardware are dispensable.

7.6.3 Project Rational

It must be acknowledged that the concept and planed outcomes of the Project contributes human development and economic development as expressed on the National Policy. Establishment of database for medical knowledge and technique apparently support to increase quality of education and lecturers. Further, the Project aims at increase number of human resources, which completely meet the Policy of Higher Education.

7.6.4 Concept of the Project

As the center of medical services in Northern Thailand, Chiangmai University (CMU) produces sufficient number of medical specialist, provides database for medical knowledge and technique and establishes medical network in this region facilitating medical hardware to secure timely access to medical services in this region to increase quality of social welfare and economic development of Thailand.

7.6.5 Outline of the Project

Outline of the project is compiled as the following points.

- Setting a host university / hospital to improve Faculty of Medicine and a hospital at CMU in terms of conducting Academic Fellowship Program, improvement of hospital management, conducting joint research activities, and obtaining appropriate advice for hospital construction and equipment procurement.
- CMU dispatches Master and Doctoral Degree participants to Japan, who has to become faculty member.
- CMU dispatches medical specialist to Japan, who must be a faculty member, to study up-to-date technique and other training and researches.
- Visiting scholars from Japan will give lectures, workshop, symposium, etc and conducting joint researches, exchange of opinion, etc.
- Knowledge database has to be created based on lecture by visiting scholars, exchange of opinion with professors in Japan, trainee, etc, which must be released other hospitals in this region.
- In order to strengthen medical network in Northern Thailand, CMU has to grasp current

situation of medical services and give necessary support.

7.6.6 Project Component

The project consists of Implementation Component and Consulting Services. Implementation Component consists of four projects such as Academic Fellowship, Institutional Development, Procurement and Construction. Consulting Services also consist of five programs, which are 1) Overall Project Management Services, 2) Academic Fellowship Services, 3) Institutional Development Services, 4) Procurement Management Services and 5) Construction of Hospital Building Services. Outline of the component is illustrated as the following tables and figures.

[Implementation Component]

Component 1: **Academic Fellowship Component**	1. Degree Program: obtain Master and Doctoral Degree in Japan. 2. Non-Degree Program: dispatch researchers and medical specialist such as doctor, physician and nurse from Thailand to Japan for training. 3. Visiting Scholar Program: invite professors and medical specialist from Japan to Thailand for exchange of opinion, monitor research progress and schedule, direction of researches, etc to support research activities, and lecture, workshop, symposium, conference, etc to improve knowledge database and medical technique for medical specialists at CMU.
Component 2 **Institutional Development Component**	1. Improvement of Hospital Management Program: study hospital management for effective medical administration, improvement of facility lay-out, waste management, medical extension, establishment of regional medical network etc to improve quality of medical care and to contribute public health. 2. Curriculum Development Program: study current status and analysis, and develop curriculum that meets to social demands. 3. Enhancement of International Collaboration and Joint Researches: increase number of international collaboration, review and realign joint research topics, etc.
Component 3 **Procurement Component**	1. Enhancement of Research Equipment Program: facilitate research equipment through ICB, Direct Purchase and International Shopping. 2. IT Infrastructure Improvement Program: improvement of existing IT infrastructure to meet to make telediagnosis possible. 3. Library Development Program: enrich library collection not only hardcover but also website journals.
Component 4 **Construction Component**	1. Building Design: design hospital building in terms of function and atmosphere. 2. Construction Supervising: supervise building construction in terms of conformity to the contract and design and approve variation order. 3. Operation and Maintenance: secures proper hospital operation and management considering medical waste, energy saving, patient friendly, emergency measures, etc.

[Consulting Services]

Component 5: **Overall Project Management Services**	1. Supervisory services for overall aspects of the project such as coordinating implementation schedule and progress, CMU and government agencies and JICA. 2. Plan project implementation and budget management.
Component 6 **Academic Fellowship Services**	1. Support Degree, Non-Degree and Visiting Scholar program providing necessary information and documentation.

	2. Support selection of candidates for Degree and Visiting Scholar Program.
Component 7 **Institutional Development Services**	1. Coordinate universities and hospitals in Japan and CMU in terms of hospital management development, joint research activities, promote international collaboration, curriculum development, etc. 2. Support development of medical network in Northern Thailand, medical extension, etc.
Component 8 **Procurement Management Services**	1. Support cost estimation and tender document development. 2. Support process of ICB, Direct Purchase and International Shopping. 3. Supervise overall procurement work until hand-over of equipment.
Component 9 **Construction of Hospital Building Services**	1. Support hardware design and function design of hospital. 2. Support supervising of building construction. 3. Support establishment of Operation and Maintenance Manual.

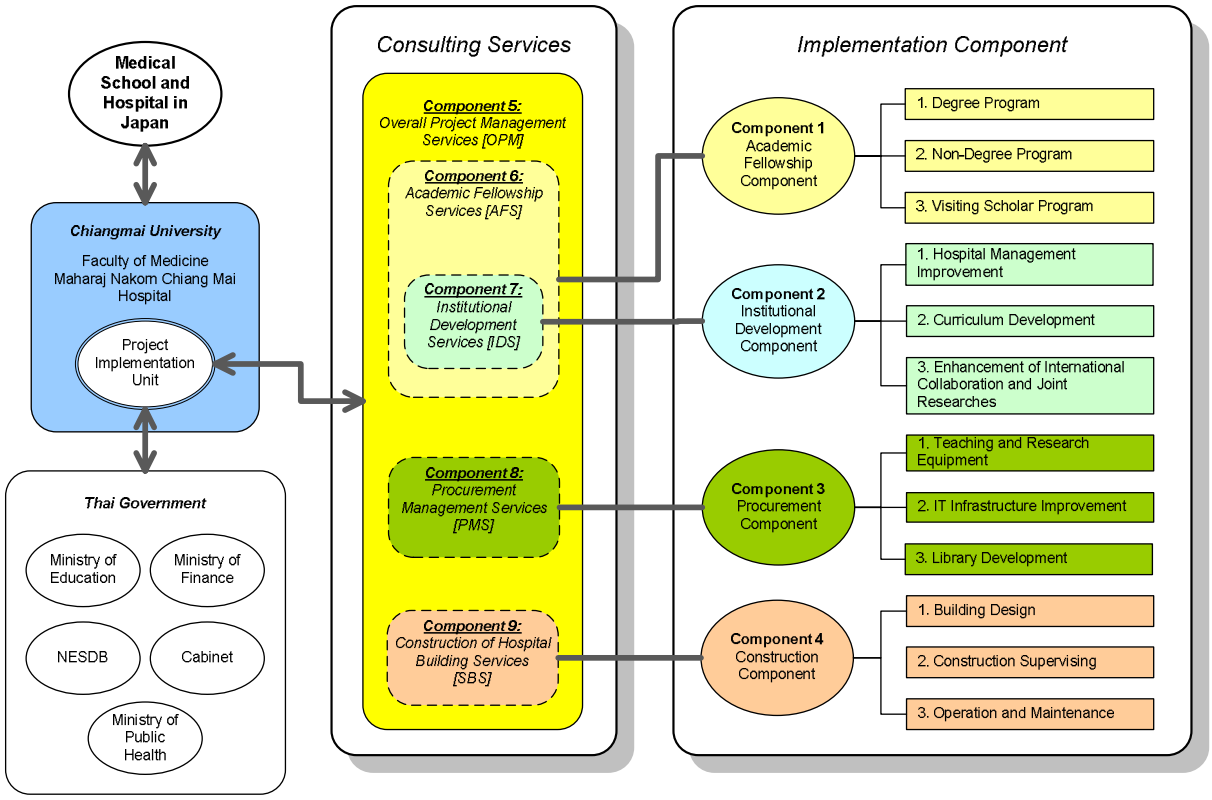


Figure 7.7 Project Component

7.6.7 Implementation Schedule

Implementation schedule of Medical Network Development Project is indicated as Figure 7.8.

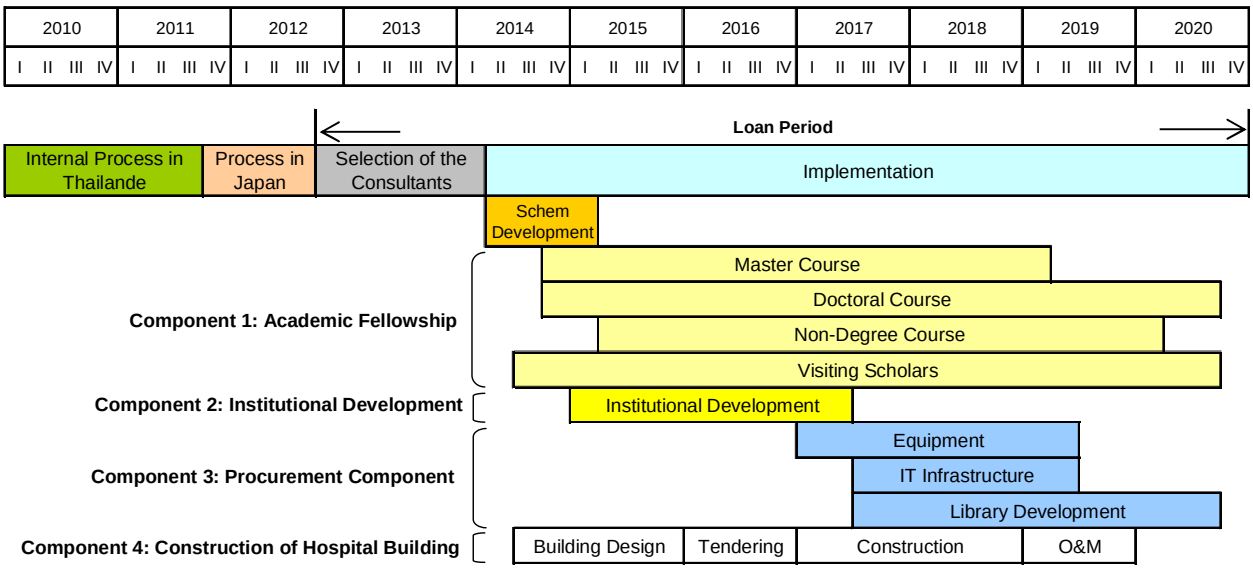


Figure 7.8 Implementation Schedule

7.6.8 Lessons Learned from TJTTP-1

In order to realize effective and efficient project implementation, organization of laboratories has to be improved like the one in universities in Japan. A pyramid style organization placing professor or research leader on the top must be considered. At the same time, classification of job descriptions between administration staffs and medical specialist has to be identified. Furthermore, flexible budgeting and implementation through periodical monitoring and review have to be considered.

7.7 Rajamangala University of Technology Capacity Building Project

7.7.1 Background of the Project

In the past, Thailand was acknowledged as a cheap and unskilled labor supplier in the world. Economic development in 1980's, GDP underwent almost 9% annually, which was supported by sufficient number of labor by high rate of population growth during 1950 – 1970 but it was dropped. During 1950's, population growth was 3.0% but it changed to 1.73% (1980's) and 0.82% in 2005 as the successful results of family planning program from 1967. After currency crisis in 1997-1998, Thai GDP rapidly dropped to -10.5% but it was recovered soon in 1999. However, GDP could not return back to the one in glory period in 1980's because of paradigm shift of manufacturing sector. Utilization of ICT from 1998 rejected use of un-skilled labor. The new production system needs skilled work force. Due to this paradigm shift, Thai government modified direction of economic development and sought for the fundamental solutions in education sector, which is absolutely different approach from the policy taken in 1990's. Thai government announced National Education Act in 1999 and released

amendment in 2002, which confirms 12 years long compulsory education, reform of education system, modify of education administration and management. In accordance with this change Commission of Higher Education (CHE) established the 15 Years Long-Range Plan on Higher Education in 2007 in line with the #10 National Plan during 2007 until 2011, and Prime Minister announced the Policy on Education in February 2008. The Policy on Education requested development of three areas, which are 1) rise the quality of education, 2) develop teacher's curricula, adjust teacher production and develop teachers of quality, and 3) support production and development of a work force. Further, 15 Years Long-Range plan mentions decentralization and network of university, which direction is completely meet the one that Rajamangala University of Technology (RMUT) aims. In response to this policy, RMUT designed project to contribute to national economic development.

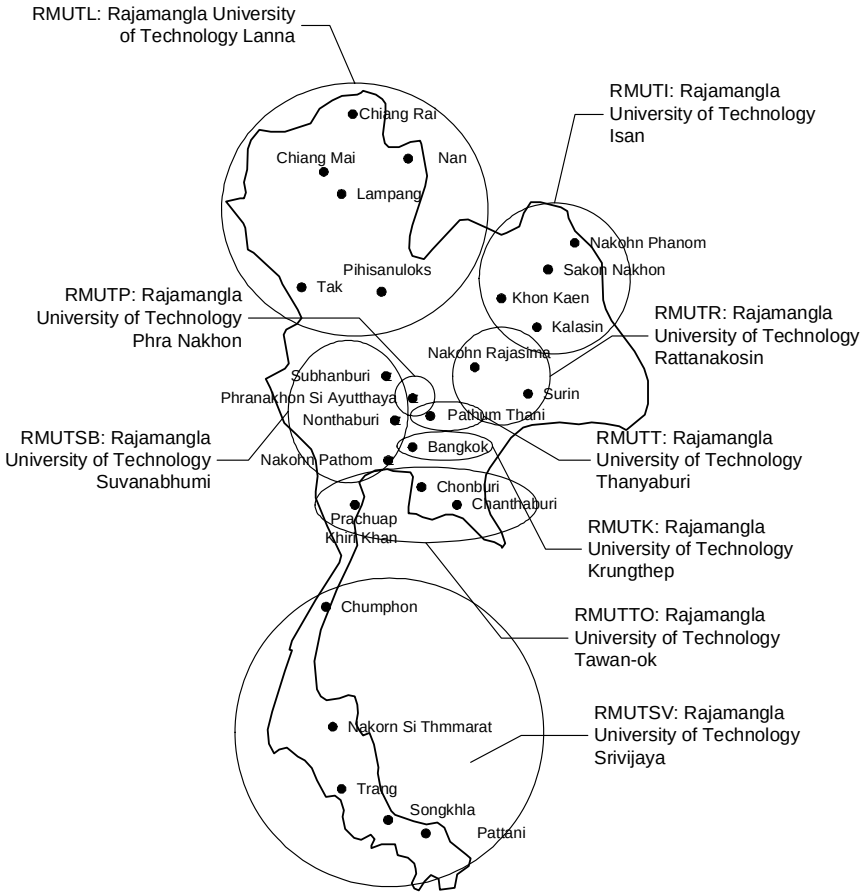


Figure 7.9 Location of RMUT

7.7.2 Necessity of the Project

Rajamangala University of Technology (RMUT) is acknowledged as Rajamangala Institute of Technology, a consolidation of 9 universities spreading out in all area of nation founded as Institute of Technology and Vocational Education (ITVE), which was affiliated to the Commission of Higher Education (CHE) since 2005. Figure 7.9 indicates location of RMUT. Location and name is listed as follows.

- Rajamangala University of Technology Thanyaburi (RMUTT), Thanyaburi, Pathum Thani

province

- Rajamangala University of Technology Krungthep (RMUTK), 2 campuses
- Rajamangala University of Technology Phra Nakhon (RMUTP), 5 campuses
- Rajamangala University of Technology Ratanakosin (RMUTR), 4 campuses
- Rajamangala University of Technology Lanna (RMUTL), 6 campuses
- Rajamangala University of Technology Srivijaya (RMUTSV), 5 campuses
- Rajamangala University of Technology Isan (RMUTI), 6 campuses
- Rajamangala University of Technology Suvanabhumi (RMUTSB), 4 campuses
- Rajamangala University of Technology Tawanok (RMUTTO), 5 campuses

Due to immediate substance change after amendment of the New Education Act in 2002, RMUT and Ministry of Education (MOE) could not provide enough time to accommodate necessary facilities and teaching staffs during transition period. Budget allocated by CHE in fiscal year of 2005 was for THB 3,558 million or 7.87 % against overall national education budget for 9 universities. This means that each university obtain budget only for THB 395 million or 0.874% against overall budget.

Considering capacity of RMUT that produces 6,500-7,000 students annum in Science and Technology field with 1,100 of academic staff, cost per person became extremely low compare to other universities. Table 7.15 presents a sample calculation of budget to produce one graduate and one academic staff.

Table 7.15 Comparison of Budget and Cost Per Person among Higher and Lower Budget Allocated University

Name of University	Budget Provided by CHE		1) Producing One Graduate Students under CHE Budget Allocation		2) Budget for One Academic Staff under CHE Budget Allocation	
	Amount	Ratio (%)	Number	Cost per person (THB)	Number	Cost per person (THB)
Chulalongkorn University	4,227,284,400	9.34	7,348	575,297	2,787	1,516,787
Kasetsart University	2,351,748,000	5.20	9,582	245,434	2,269	1,036,469
Mahidol University	5,429,840,300	12.00	5,535	981,001	2,847	1,907,215
Walailuk University	414,786,100	0.92	713	581,748	209	1,984,622
Mae Fah Luang University	328,476,000	0.73	334	983,461	155	2,119,200
Nakhon Phanom University	71,044,000	0.16	285	249,277	37	1,920,108
Rajamangla University of Technology	3,558,312,900 [395,368,100 per univ.]	7.87 [0.874 per univ.]	32,372	109,919	5,644	630,459

Note: * Funding support for research projects by public institutes and by sources are not considered due to insufficient data.
Source: Commission of Higher Education, Ministry of Education (2005)

Table 7.16 indicates existing capability of RMUT. Seriously, most part of lecturers are MS holder and almost 80% of lecturer are only lecturer. Share of assistance Professor and Associated Professor is only 21%. Further, there is no full Professor exist.

This table also suggests potentiality of RMUT. Of course experience, age, academic field, etc have to be considered selection of Degree Program candidate, however, RMUT so far connote potentiality of 371 Master and 715 Ph. D candidates.

Table 7.16 Academic Title and Level of Teaching Staffs (in 2005)

	BS	MS	Ph.D	Total		Lecturer	Asst. Prof.	Assc. Prof.	Prof.	Total		Student	T:S Ratio
RMUTT	24	144	43	211		148	57	6	0	211		5,546	26:1
RMUTK	17	62	7	86		72	14	0	0	86		3,292	38:1
RMUTTO	12	14	0	26		26	0	0	0	26		1,089	42:1
RMUTP	48	79	0	127		108	19	0	0	127		1,844	16:1
RMUTSV	36	86	7	129		114	14	1	0	129		3,834	30:1
RMUTL	91	112	8	211		144	64	3	0	211		3,628	17:1
RMUSB	17	24	1	42		37	5	0	0	42		4,726	113:1
RMUTR	36	86	7	129		114	14	1	0	129		941	7:1
RMUTI	90	108	6	204		159	42	3	0	204		3,142	15:1
Total	**371**	**715**	**79**	**1,165**		**922**	**229**	**14**	**0**	**1,165**		**28,042**	**24:1**
Ratio	**32%**	**61%**	**7%**	**100%**		**79%**	**20%**	**1%**	**0%**	**100%**			

Note: *T:S ratio: Teacher-Student Ratio. National average is 26:1 under coverage of CHE.
Abbreviations:
RMUTT: Rajamangla University of Technology Thanyaburi
RMUTK: Rajamangla University of Technology Krungthep
RMUTTO: Rajamangla University of Technology Tawan-ok
RMUTP: Rajamangla University of Technology Phranakon
RMUTSV: Rajamangla University of Technology Srivijaya
RMUTL: Rajamangla University of Technology Lanna
RMUTSB: Rajamangla University of Technology Suvanabhumi
RMUTR: Rajamangla University of Technology Rattanakosin
RMUTII: Rajamangla University of Technology Isan

Source: Project Coordination Team, Rajamangala University of Technology Thanyaburi (RMUTT)

Taking the explained problems into account, which are 1) lack of lecturers, 2) insufficient quality of education, 3) over-concentration of academics in Bangkok, and 4) insufficient research fund, matching with RMUT and Japanese ODA Loan may bring sufficient project results.

RMUT provides huge number of academic staffs and students. Thai government asked for improvement of quality of education and lecturers, and increase number of lecturers and skilled work force to all Higher Education Institution (HEI). Matching with Japanese ODA Loan and potentiality that RMUT provides will be one of big solutions to break through existing problems and strongly support economic development in Thailand.

Furthermore, RMUT is distributed nation-wide level, which provides 39 campuses all over the Thailand. Develop quality of education and lecturers, and increase number of lecturers and work force in harmony will accelerate economic development in Thailand.

7.7.3 Concept of the Project

To accelerate human resource development upgrading quality of education and increase number of lecturers in science and technology fields at the nation-wide level developing skilled work force to support quality production for Thai industry.

7.7.4 Project Rational

The concept for increase quality of education and lecturers, and produce number of lecturers and skilled work force completely meet the Policy on Education. Further, decentralization of the country and development of university networking, which is expressed on the 15 Year Long-range Plan on Higher Education, is also fit to the substance of RMUT.

7.7.5 Outline of the Project

Outline of the project is compiled as the following points.

- The project consists of three major components, which are 1) Academic Fellowship, 2) Curricula Development and 3) Procurement of Equipment.
- RMUT already completed international collaboration more than 30 universities with 10 countries. RMUT already started students exchange program and joint researches with Nagaoka University, Osaka University and Kyoto Institute of Technology in Japan. These universities may be a candidate to accept first batch of Master and Doctoral candidate of RMUT.
- Academic Fellowship Component consists of major three activities, which are Degree, Non-degree and Visiting Scholar Program. All of these programs assist to obtain Degree in Japan, to conduct research activities with universities in Japan and transfer knowledge and technology from Japan to Thailand.
- Degree program is to dispatch lecturers from RMUT to Japan, therefore, some affiliation or RMUT may not give lecture to students. In order to avoid such situation, RMUT has to study credit transfer or credit exchange system among consolidation to receive lecture any location in RMUT framework.
- Development of credit exchange among consolidation and credit transfer from consolidation to another university will widen option to select universities in Japan. Curricula Development Component handles such issues. In the future, linkage program (1^{st} year in Thailand and 2^{nd} year in Japan) will be promoted to reduce cost of study.
- RMUT has to establish selection criteria for Degree candidate before start the project. Furthermore, venue for training of Japanese Language is necessary to dispatch candidate to Japan.
- Domestic Degree Program, Non-Degree Program and Visiting Scholar Program has to be considered by RMUT.
- Basically, candidate for Master Degree Program in Japan will be selected from Bachelor Degree holder. Candidate for Ph. D Program in Japan also selected from Master Degree holder at RMUT. All candidates must be a faculty member of RMUT.
- RMUT can invite professors from Japan to conduct lectures, workshops, symposium, discussion, etc not only for the issues on the academic development but also exchange opinion on the curricula development, credit transfer, linkage or sandwich program, etc.

- Professors of RMUT will visit Japan to complete academic agreement with universities in Japan.
- Procurement of equipment will assist research and education from hardware aspects. Selection of equipment will be advised by professors of counterpart universities. Especially, improvement of IT infrastructure and contract with web site publisher and database provide must be recommendable. Such provider furnishes huge number of collection with cheaper price. Of course purchasing ordinary hardcover is acceptable to enrich existing library.
- Due to budgetary constraints, it is possible to divide the project into two phases. First phase will be like a pilot project shares approximately 2/5 of budget and establish credit transfer, linkage and sandwich program, which will be take over to phase II project.

7.7.6 Project Component

The project consists of Implementation Component and Consulting Services. Implementation Component consists of three projects such as Academic Fellowship, Curricula Development, and Procurement. Consulting Services also consist of four programs, which are 1) Overall Project Management Services, 2) Academic Fellowship Services, 3) Curricula Development Services, and 4) Procurement Management Services. Outline of the component is illustrated as follow.

[Implementation Component]

Component 1: **Academic Fellowship Component**	1. Degree Program: obtain Master and Doctoral Degree in Japan. 2. Non-Degree Program: dispatch Master Degree holder lecturers or researchers from Thailand to Japan for short term training. 3. Visiting Scholar Program: invite professors from Japan to Thailand for exchange of opinion on research, lecture, workshop, symposium, conference, etc.
Component 2 **Curricula Development Component**	1. New Course and Curricula Development: curricula improvement and planning of human resource development for the future, study establishment of new course and linkage program for MS, credit exchange system, etc. 2. Enhancement of International Collaboration: exploring opportunities for joint researches with universities in Japan.
Component 3 **Procurement Component**	1. Procurement of Teaching and Research Equipment: facilitate teaching and research equipment through ICB, Direct Purchase and International Shopping. 2. IT Infrastructure Improvement Program: improvement of existing IT infrastructure to meet to current technology. 3. Library Development Program: enrich library collection not only hardcover but also website journals.

[Consulting Services]

Component 4: **Overall Project Management Services**	1. Supervisory services for overall aspects of the project coordinating implementation schedule and progress. 2. Coordinate RMUT and government agencies and JICA. 3. Plan project implementation and budget management.
Component 5	1. Support Degree, Non-Degree and Visiting Scholar program providing

Academic Fellowship Services	necessary information and documentation. 2. Support selection of candidates for Degree and Visiting Scholar Program.
Component 6 **Procurement Management Services**	1. Support cost estimation and tender document development. 2. Support process of ICB, Direct Purchase and International Shopping. 3. Supervise overall procurement work until hand-over of equipment.
Component 7 **Curricula Development Services**	1. Support establishment of credit exchange system among all RMUT as the measure of reducing lecturer in MS or Ph.D program. 2. Support study establishment of MS course at RMU and credit exchange system to conduct linkage program between universities in Japan to reduce degree acquisition cost. 3. Support joint research activities with universities in Japan.

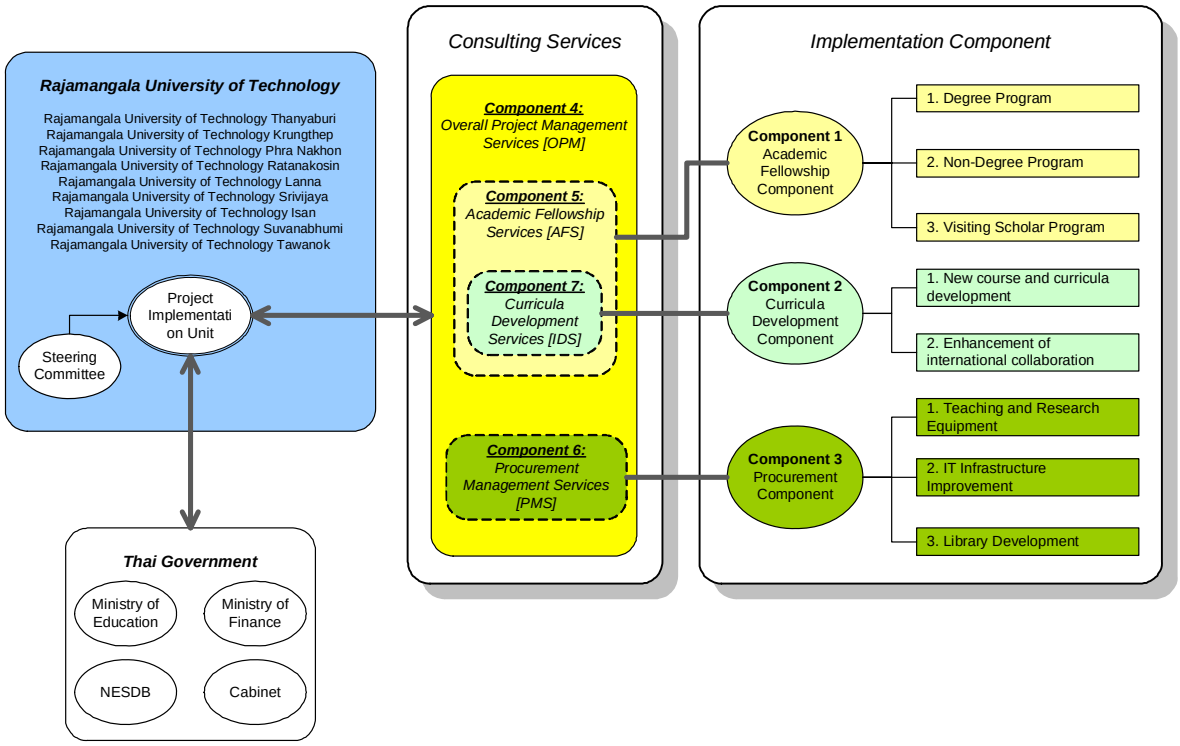


Figure 7.10 Project Component

7.7.7 Target of the Project

(1) Component 1: Academic Fellowship Component

Acknowledged issues in the higher education sector in Thailand are lack of lecturers and quality of education. This component is a core of the Project mainly handles human resource development and finds solutions for above issues obtaining academic title and increase academic level.

Program	Target Number	Remarks
Upgrade quality of lecturers	1) Ratio by Academic Title Ph. D: 50% MS: 30% BS: 20% 2) Acquisition Ratio: 90% 3) Ratio by Level Professor: 0% Assist. Prof.: 5% Assoc. Prof.: 40% Lecturer: 55%	1. Current rate by academic title is explained on the Table 7.16, which is 7%, 61% and 32%. National average for Ph. D holder lecturer is 26% according to data disclosed in 2005. Further detail will be discussed and agreed. 2. Acquisition ratio is applicable only for Ph. D and MS 3. Ph. D means Doctoral Degree including Doctor of Engineer. 4. Current rate for academic level is 0%, 2%, 22%, and 79%. This proportion must be changed to deliver quality of education. Further detail will be discussed and agreed.
Ph.D Program	500 candidates	1. 70% of MS holders try to obtain Doctoral Degree. 2. Program is limited to the academic staff. 3. The course consists of pre-departure Japanese Language Training.
MS Program	350 candidates	1. Program is limited to the academic staff. 2. The course consists of pre-departure Japanese Language Training.
Non-degree Program	90 participants	1. Academic training for lecturer for MS holder. 2. 6 months training in Japan. 3. 10 candidates per university as maximum.
Visiting Scholar Program	117 participants	1. Short term VS less than one month x 10 persons x 9 universities = 90 persons. 2. Long term VS more than 3 month x 3 persons x 9 universities = 27 persons. 3. Above target is only for cost calculation purpose. Implementation must be done under budget ceiling basis. 4. Promote to employ retired professor in Japan for long term VS.

(2) Component 2: Institutional Development Component

This component is also important to strengthen university network formulating credit transfer and exchange among affiliation universities and universities in Japan to realize linkage and sandwich program. This activity enhances decentralization and strengthen university network, which is completely follow the Policy of Education and Long-Range Plan.

Program	Target Number / Budget	Remarks
Invite Professor for Curricula Development from Japan	54 participants	1. Invite 2 professors x 9 universities x 3 times = 54 trips for one week from Japan. 2. Development of new course and improvement of existing curricula to respond to social demand. 3. Study credit exchange system and linkage program.
Dispatch Professors for Academic Exchange Development to Japan	90 participants	1. Promote international collaboration through research activities and academic exchange agreement. 2. Dispatch 2 professors x 9 universities x 5 times = 90 trips for one week to Japan.
Monitoring Activities	126 participants	1. Monitor academic activities in Japan for participants under Degree and Non-Degree Program. 2. Exchange opinion with supervisors and counterpart professors in Japan for future plan. 3. Dispatch 2 professors x 9 universities x 7 times = 126 trips for one week to Japan.

(3) Component 3: Procurement Component

Equipment is inevitable factor to deliver quality education especially in Science and

Technology field. Improvement of IT infrastructure and use of digital library widen area of study, increase opportunity of study and satisfy demand of data acquisition, which is also required in the Policy of Education. Therefore, this component meets the Policy of Education.

Program	Target Number / Budget	Remarks
Enhancement of Research Equipment Program	JPY 2,000million	1. Procurement of Equipment through International Competitive Bidding (ICB), Direct Purchase and International Shopping.
IT Infrastructure Improvement Program	JPY 900million	1. Improvement of internet accessibility. 2. Diffusion of mobile computing 3. Procurement has to be completed through ICB
Library Development Program	JPY 450 million	1. Procurement will be done through Direct Appointment method. 2. Payment must be done by re-imbursement method as. 3. Enrichment of library both hardcover and web access.

7.7.8 Project Cost

Project cost of is indicated in Table 7.17 in the next page.

7.7.9 Implementation Schedule

Implementation schedule of the project is indicated in Figure 7.11.

Table 7.17 Project Cost

(Unit: JPY)

				Unit Cost	Amount
Component 1: Academic Fellowship Component					
1.1 Master Course	9 batches	350 persons	in total	8,000,000	2,800,000,000
1.2 Doctoral Course	5 batches	500 persons	in total	11,000,000	5,500,000,000
Sub-Total of 1.2:		850 persons			5,500,000,000
1.3 Non-degree Course (short term training)	10 batches	9 persons		1,580,000	142,200,000
Sub-Total of 1.3:		90 persons			142,200,000
1.4 Visiting Scholars					
1.4.1 Short Term (less than 1 months)	10 persons	9 universities		880,000	79,200,000
1.4.2 Long Term (more than 3 months)	3 persons	9 universities		1,990,000	53,730,000
Sub-Total of 1.4:			117 persons		132,930,000
Sub-total of 1:					**8,575,130,000**
Component 2: Institutional Development Component					
2.1 Curriculum Development from JPN	2 persons	9 universities	3 times	460,000	24,840,000
2.2 Academic Exchange Development to JPN	2 persons	9 universities	5 times	610,000	54,900,000
2.2 Monitoring Mission (1week in Japan)	2 persons	9 universities	7 times	750,000	94,500,000
Sub-total of 2:			270 persons		**174,240,000**
Component 3: Procurement Component					
3.1 Teaching and Research Equipment		9 universities			2,000,000,000
3.2 IT Infrastructure Development		9 universities		100,000,000	900,000,000
3.3 Library Development		9 universities		50,000,000	450,000,000
Sub-total of 3:					**3,350,000,000**
Total Cost of Implementation Component:					**12,099,370,000**
Price Escalation (5%)					**604,968,500**
Contingency (5%)					**604,968,500**
Consulting Fees (15%)*:					**1,814,905,500**
Grand Total:					**15,124,212,500**

Note: Based on the actual expenses of TJTTP-I
* Dispatch students to Japan are deemed routine work which scheme will be established within 2 years from the commencement. Since nature of the project is different from TJTTP-II, fees for employment of consultants may be lowered than TJTTP-II. In this sense, 15% of consulting service fees would be appropriate.

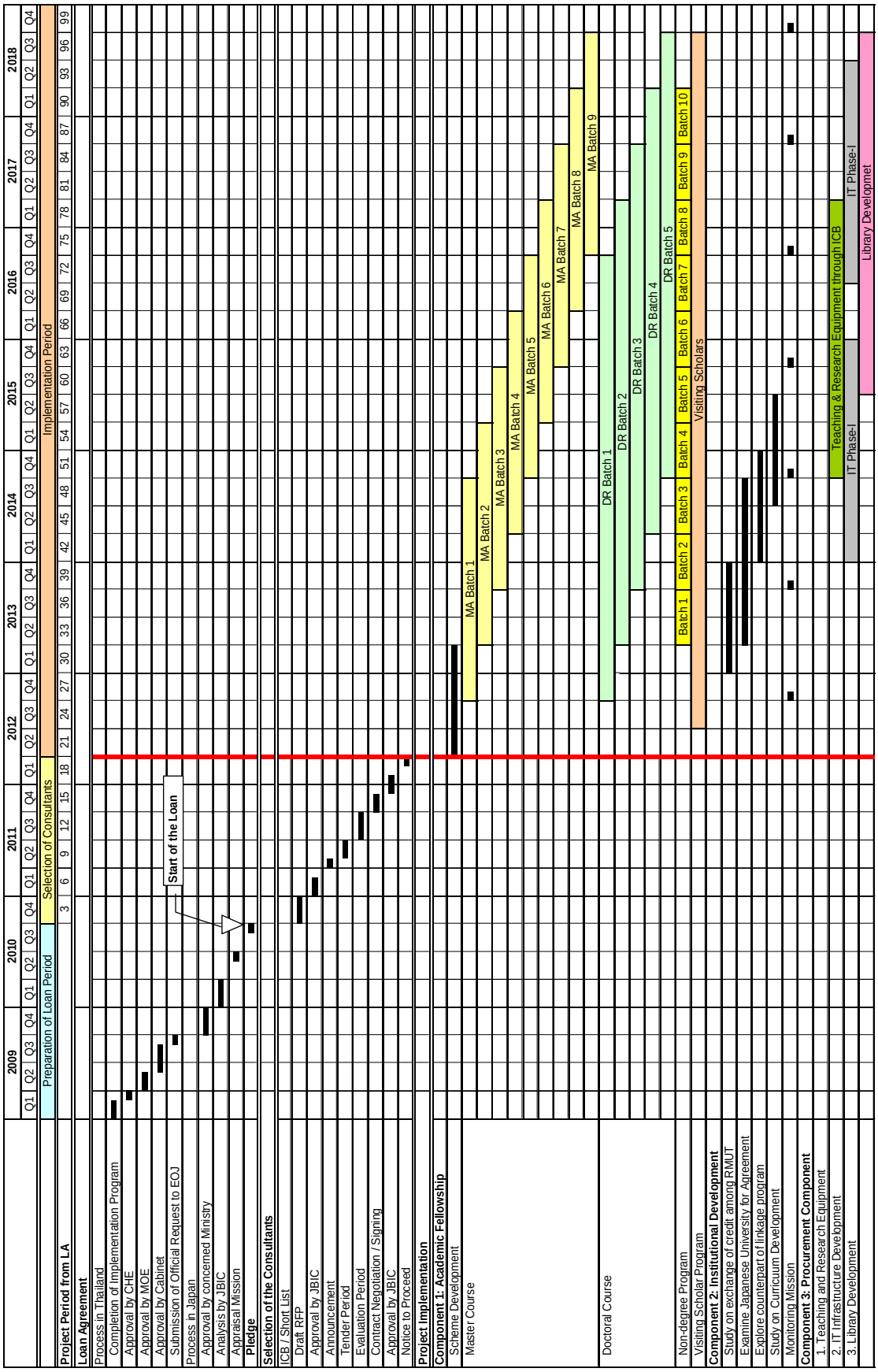


Figure 7.11 Implementation Schedule

7.7.10 Availability of Task Force

Task Force for the Project is available. Rajamangala University of Technology Thanyaburi (RMUTT) was assigned contact person to formulate project that is acknowledged by all of 9 universities.

7.7.11 Lessons Learned from TJTTP-I

Since the Project handles more than 850 participants for Master and Doctoral Degree Programs in Japan, matching of academic field is a key for placement of candidates. For smooth dispatch of candidates to Japan, reconfirmation of academic agreement and credit transfer system between all RMUT's and universities in Japan and establishment of database for academic field for universities in Japan must be completed before the Project takes place. At the same time, affirmative contact with universities in Japan to widen possibility of academic agreement is also necessary. Further, study of curricula and syllabus by professors of universities in Japan is necessary for efficient and effective procurement. It is recommendable for RMUT to obtain recommendable equipment list by professors of Japan.

7.8 Implementation Organization

As it is explained in the section before, Chulalongkorn University already has experienced Japanese ODA Project, therefore, they can organize the Project Implementation Unit (PIU) without difficulty. Chiangmai University already has the task force team, who plans whole lot of the Project. Both cases are individual university, which is completely different case from Rajamangala University of Technology (RMUT). RMUT is 9 universities consortium. They are geographically separated and provide different history, background, academic field, administration system etc. Therefore, strong leadership to manage 9 characteristics is necessary. Since RMUT Thanyaburi (RMUTT) functioned as the leading institution of the consortium before affiliation of Committee of Higher Education in 2005, RMUTT is the most preferable institution for RMUT consortium. As the matter of fact, RMUTT organized Presidential Meeting of Consortium University on July 23, 2008, the president of RMUTT chaired the meeting and obtained approval to apply Japanese ODA Loan.

Since the Project consists of three components, which are 1) Academic Fellowship Component, 2) Curricula Development Component and 3) Procurement Component, all affiliation universities have to provide workforce to handle these three components. Especially, RMUTT is a leading university, they have to plan overall implementation scheme and schedule, coordinate and monitor progress, and report status to the Steering Committee, JICA, Ministry of Education and others Thai government agencies. The Steering Committee attached to RMUTT functions as the decision making organization consists of representative of affiliation universities and task force team at RMUTT. The mission statement of the Steering Committee is to decide important issues and evaluate the progress. Schematic organization of the Project Implementation Unit (PIU) is demonstrated as Figure 7.12.

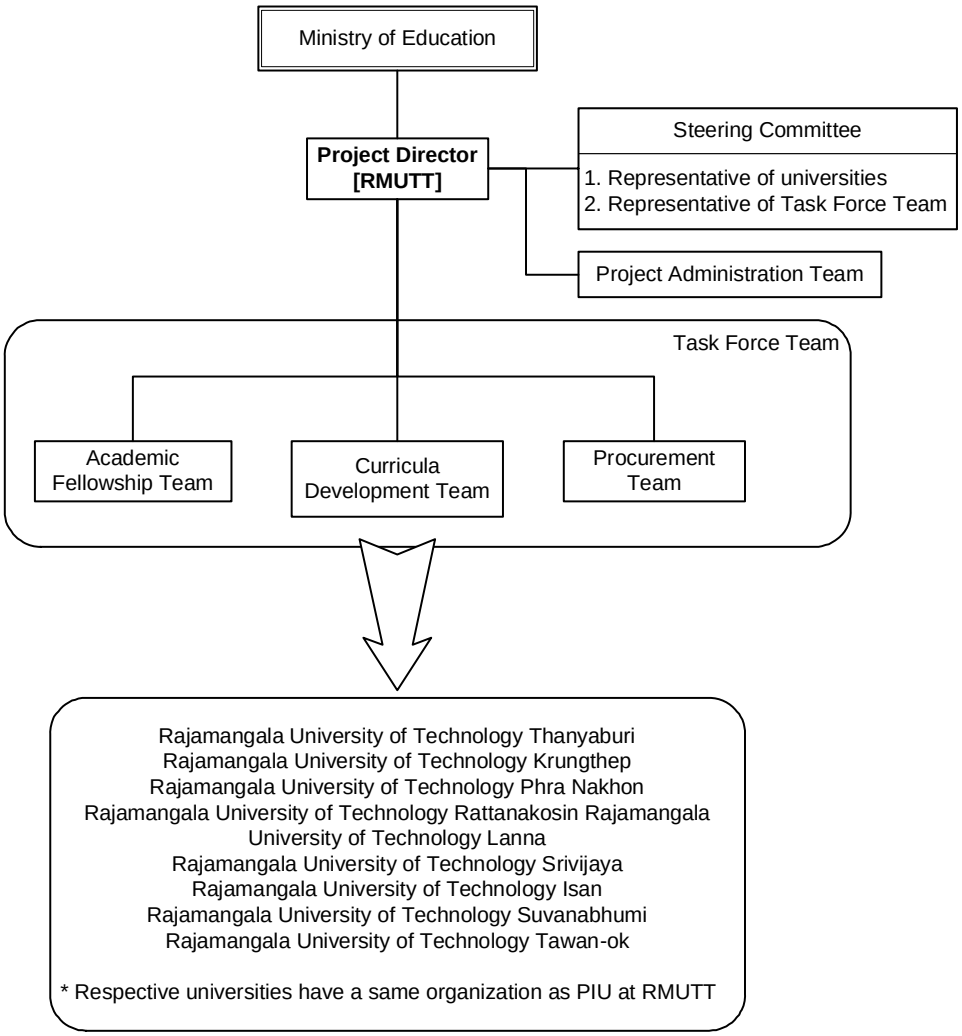


Figure 7.12 Organization of the Project Implementation Unit (PIU)

Chapter 8 CONCLUSION AND RECOMMENDATION

8.1 Renewable Energy Project

The renewable energy project aims at contributing to save energy by utilizing biomass energy as well as generating additional income opportunity for local farmers. The project is sufficiently rationalized in national policies in particular latest 5 year plan and national energy policies.

Through the preliminary study, the JICA Pilot Study Team identifies that the project is technically, environmentally, financially feasible in the desk plan with very high economic internal rate of return. The JICA Pilot Study Team concludes that the project is worth carrying out further actions.

8.1.1 Further Actions

Toward the realization of the project, the JICA Pilot Study Team recommends to take the following two actions: pilot project and assessment of biomass in candidate plantations. The pilot study is strongly recommended to confirm actual performance of gasification plant as well as continuous availability of biomass resource in site. Impact on natural environment and social environment seems to be limited, but it should be reconfirmed through pilot project too.

While, it is necessary to evaluate candidate FIO plantations to investigate availability of wood biomass in each site as well as to set up executing work force team in site.

(1) Pilot Project

FIO should take into account Pilot Study to confirm workability of the project in the filed in prior to carrying out the project by own financial arrangement. As the pilot study, few number of FIO plantations shall be selected. The pilot project consists of the following components.

- Selection of a pilot project site(s)
- Design, manufacturing, installation and commissioning of a gasification and power plant (12 months)
- Operation of gasification and power plant (including collection of biomass and connecting power transmission to PEA network) (one to two years)
- Capacity building of Technical Support Office and Project Unit, and preparation of training

program for the project[24]

The following points should be assessed though the execution of pilot project.

- Collection rate of biomass which depends on site condition of plantations (location of plantations, population density surrounding the plantation, etc)
- Collection of biomass from private plantations around the FIO plantations
- Sustainable production of biomass: constant logging, thinning and improvement cutting
- Disposal of leaves and residual carbide
- Operation of 1 MW power plant with Thai gasification technology
- Environmental impact of gasification power plant.

Since Thai gasification technology has been tested and operated as described in 5.3.5, technical verification of gasification technology is not so important in the pilot project. However, it is preferable to conduct technical verification of 1MW plant though the pilot project.

On the other hand, it is necessary to confirm collection volume of biomass from FIO plantation and the surrounding private plantations and sustainable and stable collection of the biomass though the pilot project.

Cost of the pilot project is estimated as 70 to 80 million Baht (220 to 250 million Yen) including initial investment cost and a consultant team who supports procurement of facilities and organizing local villagers, and monitoring the project. Operation cost of the gasification and power plant and other equipment will be covered by power supply fee to PEA. It is necessary to conduct the pilot project for a few years.

(2) Assessment of Candidate Plantations and Other FIO Plantations

In line with pilot study, it is necessary to evaluate candidate FIO plantations. FIO intends to produce 126.5 MW of electricity from 99 plantations but the expected electric capacity seems to overestimate.

The study team visited FIO plantations at Thong Pha Phum in Kanchanaburi Province and at Klongtakrao in Chachoengsao Province. At the Thong Pha Phum plantation, Teak tree is planted steep slope and it is difficult to collect all of biomass. And more, population density around the plantation is low, and it is difficult to collect local villagers who will collect biomass. It means that each FIO plantation has uniqueness one by one, which should be considered in design stage.

That is why it is necessary to assess candidate plantation sites. At least the following points should be evaluated though questionnaire survey to FIO local offices, site reconnaissance by

[24] Necessity of enhancement of project implementation capacity was described in section 5.9.

consultant team and regular data collection from FIO local offices.

- Analysis of characteristics of plantation (species, topography, population in surrounding areas and employment situation etc.)
- Analysis on organization (location of FIO office, plantation and connection to PEA network, surrounding settlements and private plantation etc.)
- Age structure of Teak trees (whether continuous collection of biomass is possible or not)
- Estimate of collection volume of biomass by candidate plantation
- Conceptual design of facilities and connection to PEA network
- Cost estimate
- Implementation organization and staffing plan
- Economic and financial analysis
- Impact on natural environment and social environment

The assessment of the candidate plantation should be conducted in the course of the pilot project described in the previous section. Monitoring of generated woody biomass in multi-year will possess higher reliability of sustainable and stable biomass volume of the plantations. It is possible to include the assessment of candidate plantations so that experts for the assessment will be needed.

8.2 Public Transport Improvement Project

8.2.1 Conclusion

Mitigation of traffic congestion as well as energy saving through providing efficient and effective public transport system is one of priority policy issues in Thailand. In this regard, the public transport improvement project, consisting of several sub-projects including BRT in Bangkok, CTS in Chiang Mai, other public transport studies in other regional cities, meet the national policy. Through this preliminary study, the JICA Pilot Study Team identifies that the project is technically, environmentally, financially feasible with adequate economic internal rate of return.

8.2.2 Further Actions

(1) Set-up of Effective Implementation Organization

The project has several stakeholders such as OTP, BMA, Chiang Mai PAO and other municipalities. And, project preparation in BRT in Bangkok and CTS in Chiang Mai is well processed up to feasibility study and basic design; however, projects in other regional cities are not yet prepared. Accordingly, the project needs to take care of different status of project in each target cities. Accordingly, it is important to set up efficient and workable project implementation structure. In this sense, the JICA Pilot Study Team proposes that the OTP of the Ministry of Transportation would act as the counterpart agency that will carry out all necessary studies, manage and monitor the project implementation, and BMA, Chiang Mai

PAO and other municipalities will act as implementation agencies, which is an implementation structure similar to previous “Transport Sector Loan” under Japanese ODA loan.

(2) Confirmation of Utilization of Japanese ODA Loan

After the necessity and justification of project as well as project components and scope are confirmed, the project implementation organization (OTP) is required to confirm utilization of Japanese ODA Loan for the project implementation. From this stand point, following action will be required for implementation.

- Report the Project detail to MOT and discuss about policy, direction, target, implementation plan, timeframe, budget, financial source, etc. in order to get approval from the cabinet.
- Organize task force team. The team must be a contact point with the government agencies, prepare the Project Plan, carry out internal coordination of related agencies, and other related issues.

OTP is then required to get approval from NESDB and Public Debt Management Office (PDMO), Ministry of Finance. At the same time, official request has to be issued from Thai government to Embassy of Japan in Thailand and JICA Thailand Office.

(3) Confirmation of Project Scope in details

The Urban Transport Improvement Project consists of the projects/studies for Bangkok, Chiang Mai and other 10 regional cities. The project scope for Bangkok and Chiang Mai is clear, which are construction of BRT and CTS, respectively. However, project scope for the other 10 regional cities is not so matured yet without certain TOR. It is of great necessity to confirm project scope of the project based on the project rationale and justification through analyzing current traffic conditions and issues.

For this purpose, small study to clarify at least the following points should be taken into account:

- Analysis of future development directions
- Analysis of current traffic conditions, transport infrastructure and facilities
- Future demand forecast
- Identification of issues
- Urban transport development strategy and necessary projects
- Project components and scope
- Cost estimate
- Implementation organization and staffing plan
- Economic and financial analysis
- Impact on natural environment and social environment

There is an option to take care of the study above by the follow-up activities of JICA and NESDB for example, by utilizing Special Assistance for Project Formation (SAPROF).

8.3 Human Resource Development Project

8.3.1 Conclusion

The human resource development project consists of three projects. These three projects are justifiable along with National Plan, Policy on Education, Policy on Education and Long-Range Higher Education Plan and identified to contribute social and economic development of next generation of Thai society and economy in the future.

For Chulalongkorn University case, they have already experienced the Project for 9 years. However, due to highly sophisticated Project, survey on joint research activities, grasping capacity and ability of Technology Licensing Organization, use of equipment under Phase-I, etc are necessary to be more carefully elaborated as a draft Implementation Program.

For Chiangmai University project, the university organizes workforce to formulate project with positive and high motivation. However, project target and scope are still unclear at this moment. They have to collect data and analyze it to complete feasible project planning. It is deemed that they may need further discussions.

Concept and scheme for Rajamangala University of Technology will be most matured one comparing to other tow projects. Project rational, target, and outcomes are very clear. All of fundamental aspects meet National Plan and ODA Policy of Japan. It is recommended to continue to further preparation on the implementation scheme, budget, and Project Implementation Organization along the current direction, in particular necessary actions on approval process in the Thai government shall be taken into account accordingly.

8.3.2 Further Actions

(1) Internal Approval Process in Thai Government

In order to assist human resource development and strengthen higher education sector for sustainable economic development in Thailand, all three projects may need modification and alternation according to the situation, policy of higher education and national plan. This discussion has to be done with Commission of Higher Education (CHE), Ministry of Education. During this process, the Project Plan will become operable form. At the same time, confirmation of funding, such as Thai government or Japanese ODA Loan, has to be confirmed. In case CHE needs financial assistance by Japanese government, the request has to be issued through official manner. From this stand point, following action will be required for implementation.

- Report the Project detail to CHE and discuss about policy, direction, target, implementation plan, timeframe, budget, financial source, etc.

- Organize task force team. The team must be a contact point with the government agencies, prepare the Project Plan, settle internal affairs of university, and other related issues.
- Complete and submit details of the Project Plan in the form of Implementation Program (IP) to CHE.

In case CHE needs financial assistance by Japanese ODA Loan, the Project Plan must be submitted to cabinet from Ministry of Education, authorized by NESDB and Public Debt Management Office (PDMO), Ministry of Finance. At the same time, official request has to be issued from Thai government to Embassy of Japan in Thailand and JICA Bangkok Office. JICA appraisal mission examines the Project and JICA concludes funding to the Project. Financial assistance will be authorized exchange of the Loan Agreement.

(2) Issue on Repayment as Autonomous University

Before 2005, all universities under Commission of Higher Education (CHE) were public university, therefore, there are not responsible for repayment of Japanese ODA Loan, but the RTG makes repayment. However, after 2006, all universities requested Ministry of Education to transform their status from public university to autonomous university. In this regard, Chulalongkorn University (CU), Chiangmai University (CMU) and Rajamangala University of Technology (RMUT) may have responsibility of repayment in certain extent. This means whether CU, CMU and RMUT have to make repayment through Thai government, or how much percentage or amount CU, CMU or RMUT have to repay to government of Japan. This issue was not discussed before. This issue must be concluded before submission of official requests to government of Japan.

(3) Recommended draft TOR for Special Assistance for Project Formation (SAPROF)

There is an option to take into account the remaining issues above mentioned under the follow-up activities of this study of JICA and NESDB. As a potential idea, it is recommended to carry out Special Assistance for Project Formation (SAPROF) due to following reasons:

- Form of higher education or human resource development project is intangible and their conditions are in flux, therefore, to review the concept or direction of the Project and to confirm implementation scheme, schedule, outcomes, target etc with Project Implementation Unit (PIU) are necessary to share same understanding of the Project,
- Degree program will start soon after mobilization of Consultants, therefore, preparatory work to dispatch 1st batch of Degree program participants has to be completed before starting up of the Project. Selection of counterpart universities in Japan, conditions of enrolment and timeframe must be determined as well as preparation of a long list of candidate, selection criteria, etc.
- Since the Project covers wide range, establishment of functional organization for Project Implementation Unit (PIU), decision making organization such as the Steering Committee, communication line between PIU and academic, and collaboration with administration section have to be well planed before start the Project.

Taking above situation into account, common draft TOR for three projects is recommended as

follow.

TOR 1 Review the necessity and background of the Project

TOR 2 Examine scope of the Project

TOR 3 Review the project implementation organization and implementation scheme,

TOR 4 Review the operation and monitoring indicator

TOR 5 Review the project cost and schedule

Above draft TOR has to be modified and break into parts by the Project. Study has to be completed within 4-5 months with approximately 8.0 MM.