## APPENDIX I To CHAPTER 3

## PROFILES OF PROPOSED PROJECTS/PROGRAMS

Project No. EP1

| | |
|---|---|
| 1. PROJECT TITLE | Cooking Stove Dissemination |
| 2. LOCATIONS | The Western Seaboard Region. |
| 3. AGENCY | Population and Community Development Association (PDA, an NGO) |
| 4. OBJECTIVES | (1) Promote environment-friendly technology, especially in rural areas where farmers have to rely on primary energy supply in their daily life<br>(2) Introduce sustainable development in the WSB region. |
| 5. PHASING | Phase I (1997-2001) |

6. DESCRIPTION

Around 60-70 per cent of the 770,468 households in the WSB region use old model stoves, which can be replaced by the new energy saving stoves, consuming less than 40 per cent of energy per unit; it means a saving of 139 million Baht for the 0.7 MMCM of trees saved per year, a figure provided by the Ratchaburi Regional Energy Center.

The new energy cooking stoves were developed under assistance from USAID about ten years ago but their dissemination has been slow, with only around 3 per cent of the potential beneficiaries are using them. Two approaches for wider dissemination include: stronger government commitment/support and NGO participation. NGOs have long worked with farmers and have established a trustful relationship with them; it is much easier for them to introduce the energy saving cooking stoves.

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|---|---|
| 7. RELATION WITH OTHER PROJECTS | EV5 (Environmental Research Center). |
| 8. COST (APPROX.) | Phase I: US$ 3 million. |

# EP1 COOKING STOVE DISSEMINATION

## BACKGROUND

Along with the country's rapid economic development, the forest coverage in Thailand has been reduced from 53 per cent of the total area in 1961 to 26 per cent in 1993. The WSB region followed a similar trend. While most of the land in the WSB region was covered by forests in 1961 (82.4 per cent), the forest coverage has been reduced to 39.1 per cent. The cost of deforestation and ecological, social, and economic effects have had negative impacts on sustainable development in the WSB region.

Around 60-70 per cent of the 770,468 households in WSB area are using old model stoves, which can be replaced by the new energy saving stoves, consuming less than 40 per cent of energy per unit; a saving of 139 million Baht is possible for the 0.7 MMCM, a figure provided by the Ratchaburi Regional Energy Center.

The energy cooking stoves were developed under assistance from USAID about ten years ago but their dissemination has been slow, with only around 3 per cent of the potential beneficiaries are using them. Two approaches for wider dissemination include: stronger government commitment/support and NGO participation. NGOs have long worked with farmers and have established a trustful relationship with them, and therefore it will be easier for them to introduce the energy saving cooking stoves in rural areas.

## PROJECT CONCEPT/RATIONALE

Since there are existing technologies which are easy to use, the focal point will be the dissemination of technologies. This program intends to reduce the consumption of fuelwood, improve the environment, and conserve soil quality to eventually benefit the farmers in the WSB through a reduction in their fuel expenditures or time required for purchasing or collecting fuelwood.

One of the WSB regional development objectives is to enhance the quality of life of the people in the WSB region, including improving the quality of the environment by pursuing a policy of sustainable development. This program involves only a little effort, but a great step, towards that direction.

Constraints on the promotion of energy saving cooking stoves are: (i) farmers' lack of appropriate knowledge about the new cooking stoves; (ii) the higher price of the new cooking stoves if compared with the old ones, and (iii) the lack of a marketing mechanism to promote the energy saving cooking stoves.

## PROJECT DESCRIPTION

It is proposed that the Royal Forestry Department (RFD), Ratchaburi Regional Energy Center (RREC), and Population and Community Development Association (PDA) jointly form a program team to prepare the program budget, source the program funds, and set up a schedule for implementation.

RFD will undertake the prevention of illegal logging and assist PDA in marketing the new cooking stoves. At the same time, RREC under DEDP will continue to improve cooking stoves and provide technical training for the farmers. On the other hand, PDA, with its wide network in rural areas and its long experience in working with farmers, will train the farmers and help them market their products.

The program will, in the initial stage, select several villages to start the marketing of the new stoves. New promotional activities and exhibits will be held in these villages.

A budget of US$3 million will be utilized to subsidize the adoption of new cooking stoves to cover the initial cost difference between the old cooking stoves and the new ones.

## PROJECT ASSESSMENT

The benefits of this program will be substantial. In addition to the 139 million Baht saved from avoiding replanting trees each year, the program will help farmers plant more trees around their communities. The environmental benefits of the program will include the preservation of biodiversity and the conservation of soil. The program will also indirectly improve farmers productivity.

The budget for the program (around US$3 million) will represent 54 per cent percent of the annual economic benefits in replanting cost in the first year.

The beneficiaries of the program will be farmers who will save money and time though using the new stoves. The people living in rural areas will also be benefited from a better environment.

## RECOMMENDATION(S)

It is recommended that RFD, RREC, and PDA form a team to prepare for program implementation. The team may also explore the possibility of international assistance.

Project No. EP2

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|---|---|
| 1. PROJECT TITLE | Energy Substitution (Ceramic/Lime) |
| 2. LOCATIONS | WSB Region, especially Ratchaburi province. |
| 3. AGENCY | Ratchaburi Regional Energy Center (RREC), Department of Energy Development and Promotion. (DEDP) |
| 4. OBJECTIVES | (1) Find the best solution for alternative energy supply to the bulk energy consuming industries.<br>(2) Improve the environment in the WSB region. |
| 5. PHASING | Phase I and Phase II (1997-2006). |

6. DESCRIPTION

In the WSB region, especially in Ratchaburi province, ceramic is a big industry consuming 30 per cent of the fuelwood in the region while the lime industry took about 20 per cent, the remaining 50 per cent consumed by households. Lime is used by sugar factories, shrimp farms, and construction companies. About 50 per cent of the lime factories have now converted their energy source from fuelwood to lignite; the remaining factories continue to use wood or charcoal as fuel, in many cases, illegally. Almost all ceramic factories use charcoal or wood as fuel. Each year, large quantity of trees are cut for fuel, despite government bans on the cutting of trees in public land. Because lignite transportation could be a problem, it is cheaper for local businessmen to bribe than to convert their kilns to lignite.

The project will initiate a study to evaluate the alternative affordable source of fuel, lignite, imported lignite or coal, piped natural gas, LPG, etc. An affordable alternative energy source including transportation availability should be selected, together with recommendations for government actions.

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| 7. RELATION WITH OTHER PROJECTS | |
| 8. COST (APPROX.) | Phase I: US$ 5 million;<br>Phase II: US$ 5 million. |

# EP2 ENERGY SUBSTITUTION (CERAMIC/LIME)

## BACKGROUND

The forest coverage in the WSB region has been reduced from 82.4 per cent of the total area in 1961 to 39.1 per cent in 1993. The cost of deforestation and ecological, social, and economic effects far exceed the benefits from development.

The ceramic industry is one of the largest industries in the WSB region. In 1994, there were about 67 ceramic manufacturing establishments in the region, all of them were in Ratchaburi province. Likewise, there were 47 cement, lime, and plaster industries, scattered in Ratchaburi (83 per cent),Chumphon (8.5 per cent), Petchaburi (4.3 per cent) and Kanchanaburi (4.3 per cent). In terms of employment, the ceramic industry ranked number seven in all the industries in the WSB region, employing 2,430 workers, while the cement, lime, and plaster industry ranked 15, hiring around 1,524. According to a survey conducted by the Study Team, 53 per cent of the surveyed ceramic manufacturers are exporting their products overseas.

In the WSB region, especially in Ratchaburi province, ceramic is a big industry consuming 30 per cent of the fuelwood in the region, while the lime industry took about 20 per cent, with the remaining 50 per cent consumed by households. Lime is used by sugar factories, shrimp farms, and construction companies. About 50 per cent of the lime factories have now converted their energy source from fuelwood to lignite, but the remaining factories continue to use wood or charcoal as fuel, in many cases, illegally. Almost all the ceramic factories use charcoal or wood as fuel. Each year, a large quantity of trees is cut for fuel.

## PROJECT CONCEPT/RATIONALE

Although there are no exact figures available, a preliminary estimate shows that around 1.75 MMCM is consumed by the ceramic and lime industries each year in the WSB region. The replanting value of these trees is about 350 million Baht or US$14 million each year.

The constraints on the conversion from fuelwood to alternative energy are: (i) insufficient information on the cost and supply of the various energy available; (ii) the

expensive cost of lignite due to the transportation cost; (iii) a lack of bargaining power for the small individual manufacturers against larger energy suppliers such as EGAT and PTT; and (iv) the availability of "cheap" illegally acquired firewood.

The project will initiate a study to evaluate alternative affordable sources of fuel, lignite, imported coal, piped natural gas, LPG, etc. An affordable alternative energy source including transportation availability will be selected, and relevant government actions will be recommended.

## PROJECT DESCRIPTION

It is proposed that a project team be formed by the RFD, Ratchaburi Regional Energy Center, and representatives from the private sector.

There will be three major duties for the project team:

(1) Initiating a study of the alternative energy and its cost and long-term reliability by supply source, and conducting an environment study of the alternatives;

(2) Undertaking some pilot projects to demonstrate the benefits of the selected alternative energy and transfer the technologies; and

(3) Recommending measures and policies to achieve the full conversion, if the objectives are realized under the pilot projects.

RFD will be responsible for an enforcement to prevent illegal logging. On the other hand, RREC will provide manufacturers with technical assistance and train the technicians of the ceramic manufacturers to help them keep and improve the quality of their products.

## PROJECT ASSESSMENT

The total project cost is estimated at US$10 million spread over ten years in Phases I and II. The budget will be used to help about 100 manufacturers to convert their fuel consumption pattern.

Compared with the possible savings from avoiding the replanting of trees at an annual cost of US$14 million, the project could save government budget. It is suggested that

part of the project budget be earmarked from a levy on the manufacturers that continue to use fuelwood.

## RECOMMENDATION(S)

It is recommended that RFD and RREC convene a joint committee to map out the benchmarks of the project and possible funding for its implementation.

The government should attach importance to this project, and if natural gas imported from Myanmar is a viable choice, the government should assist the consumers in negotiating with PTT to secure a supply of natural gas at an affordable price.

Project No. EP3

| | |
|---|---|
| 1. PROJECT TITLE | Demand Side Management |
| 2. LOCATIONS | The WSB Region. |
| 3. AGENCY | EGAT/DSMO |
| 4. OBJECTIVES | To promote demand side management (DSM) in the new industries coming to the area. |
| 5. PHASING | Phase I |

6. DESCRIPTION

Demand side management is an integral part of power development. EGAT's DSMO has planned a pilot program to help four large manufacturers in Bangkok to improve their energy consumption process. As more new industries will be located in the WSB region and as it is cheaper to install energy efficient equipment for the new factories and buildings than to retrofit the old ones, it is recommended that a DSM project be initiated in the WSB region. New large investors, in Bang Saphan or other industrial estates, should be informed of the DSM program when they apply for power connections.

The project will establish a revolving fund under the Demand Side Management Office of EGAT specifically for new factories to be located in the WSB region. DSMO will contract energy saving companies (ESCOs) to do a cost-benefit study for the new manufacturers in the WSB region and, upon their consent, undertake energy saving measures.

| | |
|---|---|
| 7. RELATION WITH OTHER PROJECTS | ID1 (Free Trade Areas).<br>ID2 (Strategic Industrial Estates).<br>ID5 (Industrial R&D Promotion. |
| 8. COST (APPROX.) | Phase I: US$ 1.5 million. |

# EP3 DEMAND SIDE MANAGEMENT

## BACKGROUND

Over the past several years, the growing demand for electricity has created many problems on the supply side. In order to generate an adequate quantity of electricity to meet the demand, EGAT had to build or contract new additional power plants, involving a large capital investment and quantity of fuel, especially imported fuel. The demand also results in adverse impact on the environment. Believing that Demand Side Management (DSM) is a resource of the power system, Thailand became the first country in the Asian region to adopt a DSM program. The first pilot DSM master plan was approved by the Government in December 1991. EGAT was designated the implementing agency. The DSM master plan has a projected annual saving of 311 MW in peak demand and 1,826 GWh in energy by the end of 1997 at a cost of US$189 million. If an avoided cost of $1,000 per kW is applied, the program will save US$122 million, plus additional benefits in environmental protection

EGAT is also the first institute in Southeast Asia to have experimented with an Energy Saving Company (ESCO) system. With Thailand's own version of ESCO operations, EGAT's DSM office is expected to recover part of the DSM program cost through reimbursement from savings by the beneficiaries. The current DSM program involves four approaches: (i) focusing on the provision of economic incentives for consumers to adopt energy saving practices; (ii) development of standards and testing facilities; (iii) introduction of new building and appliance codes; and (iv) pursuit of best available technologies.

## PROJECT CONCEPT/RATIONALE

EGAT's DSMO is about to start a pilot program to help four manufacturers improve their energy consumption process. All are located in the BMA; there is no specific DSM program yet in the WSB region. According to DSMO's projection of 6.3 per cent savings from the total projected load demand in the WSB region, the DSM program might reduce regional power demand from 3,388 MW to 3,171 MW. The possible 217 MW saved (or rather, the lower generation demand) in the WSB implies a major reduction in environmental impacts in the region.

Among EGAT's commercial DSM program, energy saving in commercial buildings has been a major component in which cooling and lighting show the highest potential for energy savings. In the industrial program, the DSM program focuses on the promotion of high-efficiency motors (HEM) including energy reducing devices such as variable speed drive (VSD).

As more new industries are located in the WSB region and as it is cheaper to install energy efficient equipment for the new factories and buildings than to retrofit the old ones, it is recommended that a DSM project be initiated in the WSB region. New large investors, in Bang Saphan or other industrial estates, should be informed of the DSM program when they apply for power connections.

## PROJECT DESCRIPTION

It is proposed that the WSB DSM project be initiated under EGAT's DSM office. The project will disseminate information on DSM to the new investors in the WSB region and provide estimates of economic and financial benefits on the DSM programs for the new investors. With the initial funding from the DSM program, EGAT could introduce ESCO service to new investors in the WSB region.

A project officer, part time or full time, in charge of the WSB should be appointed in the DSM office. He will travel to the Free Trade Areas and industrial estates. The project will implement the DSM programs throughout the region, including the following:

(1) Select possible candidates for the DSM program;

(2) Discuss with new investors in the region the benefits of DSM and make a preliminary estimate and accounting of possible savings in energy and monetary terms. The possible clients could be business offices and hotels, and manufacturers in the region;

(3) Help investors choose an ESCO company and contractor; and

(4) Provide appropriate loans to the program.

## PROJECT ASSESSMENT

The beneficiaries of this project are the residents of the WSB region and the industries in the region, through the saving of energy and money, and ultimately reducing the need for additional power generation.

The implementing agency, EGAT, has adequate experience in this field and is fully budgeted to initiate the project. ESCO companies have already been active in the country. The possible savings of about 6.4 per cent of power demand in the next 15 years is a huge amount, if 217 MW in generation capacity to be installed by 2011 could be avoided. The estimated saving of US$217million in energy consumption could be used in more productive industries while contributing to the preservation of a better environment.

The budget for this project is US$1.5 million, and the project will be executed in Phase I.

## RECOMMENDATION(S)

It is recommended that EGAT appoint an officer working specifically for the WSB region. The Officer will coordinate with IEAT, Ministry of Commerce, and other ministries to implement the project.

Project No. EP4

| | |
|---|---|
| 1. PROJECT TITLE | Partially Insulated Cable Promotion |
| 2. LOCATIONS | The WSB Region. |
| 3. AGENCY | Provincial Electricity Authority. |
| 4. OBJECTIVES | (1) Improve stability and reliability in power supply in the WSB<br>(2) Support economic development in the WSB region |
| 5. PHASING | Phase I and Phase II |

6. DESCRIPTION

The unstable power supply in the WSB region is caused by the special characteristics of the region. PEA uses bare wires for transmission lines, passing through orchards. It is difficult to trim the fruit trees, and the overgrown tree branches sometimes cut the transmission lines, causing power supply disruptions. PEA intends to gradually replace bare wires with partially insulated cables (PICs).

The project will be implemented in two stages. During the first stage, PICs will be installed on the main transmission lines from PEA's substations. Distribution lines to the main customers will be installed with PICs during the second stage. PEA is seeking an external loan to finance the foreign currency portion of the project.

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| 7. RELATION WITH OTHER PROJECTS | ID2 (Agro-industrial Community Model).<br>TO4 (Tourism Related Infrastructure). |
| 8. COST (APPROX.) | Phase I: US$ 5 million, and<br>Phase II: US$ 55 million. |

# EP4 PARTIALLY INSULATED CABLE PROMOTION

## BACKGROUND

Power demand in the WSB region is increasing at a rate of 11 per cent per cent per year, and the power supply in the region will grow at a much higher rate. EGAT is building a 500 kV line to the Bang Saphan area. However, power supply reliability has become a bottleneck in the region. Industrial consumers, surveyed by the Study Team, complained about the disruption of power. The manager of a hotel in Hua Hin expressed regrets that air conditioners stop working during the hottest hours of the days when the tourists need them most.

The unstable power supply in the WSB region is mainly caused by the special characteristics of the region. PEA uses bare wires for transmission lines, passing through orchards. It is difficult to trim the fruit trees, and the overgrown tree branches sometimes cut the transmission lines, causing power supply disruption. The lightening and the erosion of electric poles are also causing the disruption of power supply. PEA intends to gradually replace bare wires with partially insulated cables (PICs).

The disruption of power supply not only hurts business in the region, especially the tourist industry, but also results in inconvenience to the people in urban and rural areas. The replacement of bare wire is an urgent task in the WSB region.

## PROJECT CONCEPT/RATIONALE

A reliable power supply is vital to the industrial and tourism development in the region. Since there is sufficient capacity in power generation, high voltage transmission and substation capacity, the only bottleneck is the power transmission from main substations to load centers.

A Science City and Free Trade Areas (FTAs) are proposed in the WSB region. For those institutions, a reliable power supply is essential.

The implementation agency, PEA is a government enterprise, under the Ministry of Interior. PEA's major functions are: (i) to improve the services, (ii) to develop activities

in all areas in order to achieve sufficient revenues; and (iii) to operate with high efficiency and effectiveness.

**PEA's Power System in Western Seaboard Region**

As of February, 1996

| No. | Description | Total |
|---|---|---|
| 1 | Length of transmission Lines (circuit-km) | 823.75 |
| 2 | Substations<br>- Number (Sets)<br>- Size of transformer (MVA) | <br>30<br>23*50<br>7*25 |
| 3 | Length of distribution system (circuit-km) | 18,122 |
| 4 | Peak Load Demand (megawatt) | 573.1 |

## PROJECT DESCRIPTION

This project intends to replace the bare wires with PICs. The project will be implemented in two stages; during the first stage, PICs will be installed on the main transmission lines from PEA's substations. Distribution lines to the main customers will be installed with PICs during the second stage. PEA is seeking an external loan to finance the foreign currency portion of the project.

PEA and PEA's regional office in Petchaburi will be responsible for implementation of the project. PEA's responsibilities include:

(i) Budgeting, scheduling, and sourcing of the funds; and

(ii) Implementation of the project.

The project will be first implemented in those areas where the development initiatives are recommended under the Master Plan, namely Bang Saphan, Hua Hin-Cha Am, and the Free Trade Area in Samut Songkhram.

## PROJECT ASSESSMENT

The project is an indispensable part of the WSB regional development program, because without a reliable power supply, it will be difficult to realize the stable expansion of the tourist industry and the establishment of a Science City and Free Trade Areas, where electric instruments and equipment will be concentrated. An unstable power supply will also dampen the enthusiasm for people to relocate from the BMA.

This project will greatly improve power supply reliability and contribute to the economic development, as well as the welfare of the local residents.

The project budget is estimated to be $60 million in two phases. The major part of the budget is required for the purchase of some imported equipment.

## RECOMMENDATION(S)

It is recommended that PEA and PEA's regional offices in Petchaburi work together to implement the project at the earliest. It is desirable that an external concessional loan be extended to implement the project.

Project No. EP5

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|---|---|
| 1. PROJECT TITLE | Kra River Hydropower Project |
| 2. LOCATIONS | Ranong and Chumphon (on the border with Myanmar). |
| 3. AGENCY | EGAT |
| 4. OBJECTIVES | (1) Promote subregional cooperation to induce economic development in the region, benefiting both nations |
| | (2) Diversify energy supply source for the whole Kingdom |
| 5. PHASING | Phase I and Phase II. |

6. DESCRIPTION

The power station is located on the Kra river, an international river on the border line between Myanmar and Thailand. Power generation capacity is estimated at 2x65 MW. EGAT undertook a pre-feasibility study in 1990 and is seeking financial support for feasibility study and subsequent implementation. Further geological, construction material investigation and environmental and ecological investigations should be undertaken for the final recommendation.

During the first phase, a feasibility study will be undertaken, possibly financed by an international cooperation/financing agency. The construction of the project, if feasibility is proved, will be scheduled for 2002-2006.

7. RELATION WITH OTHER PROJECTS

8. COST (APPROX.) Phase II: US$ 200 million.

# EP5 KRA RIVER HYDROPOWER PROJECT

## BACKGROUND

Both Thailand and Myanmar have been interested in development of water resources in their international rivers. Since 1988, both governments have been exploring the possibility to jointly develop hydropower potential on these border rivers. The Kra river hydropower project is one of the seven projects identified by the two governments, and EGAT has conducted a pre-feasibility study of this project.

Energy demand in Thailand has been increased rapidly in the last several years, following the high growth in the economy. To meet the demand, Thailand has been cooperating with neighboring countries in energy development. Thailand is importing power from Lao PDR, and will soon import natural gas from Myanmar.

The Kra river hydropower project is a possible subregional cooperation program to be jointly promoted by Thailand and Myanmar. A Thailand-Myanmar Bordering Hydropower Project Committee has been organized to undertake the study of hydropower development on the border rivers.

## PROJECT CONCEPT/RATIONALE

The objective of the project is to help meet the increasing power demand in the WSB region and to bring economic benefits to both countries. The Kra river hydropower project could reduce the need for thermal power plants using imported coal in the WSB.

The direct objective of this project is to carry out further study at the project site on the natural and social environment, as well as to assess technical soundness and economic feasibility. In the event that the project is proved to be viable, it is planned to be implemented during the period from 2002 to 2006.

The project is under the Thailand-Myanmar Bordering Hydropower Project Committee, which is composed, on the Thai side, of the secretary-general of NEA, RID, EGAT, provincial representatives and NEA representatives. A working group was established in EGAT.

The project is planned to be implemented during Phase II, but preparatory work for economic and environment analysis, and project design should be started during the Phase I.

## PROJECT DESCRIPTION

According to the study by EGAT, the Kra hydropower project has the following features:

| | |
|---|---|
| Catchment area: | 756 $km^2$ |
| Average annual runoff | 1,894 MCM |
| High water level: | 65 m |
| Lower water level: | 45 m |
| Gross storage capacity: | 1527 MCM |
| Effective storage capacity: | 1076 MCM |
| Dam type: | Rockfill |
| Height: | 66 m |
| Crest length: | 528 m |
| Rated head: | 50 m |
| Max. discharge: | 304 $m^3/s$ |
| Installed capacity: | 130 MW |
| Annual energy output: | 238 GWh |
| Transmission voltage: | 115 kV |
| Transmission length: | 43 Km |
| Project cost: | $113 million |
| Power cost: | $ 0.064/kWh |

## PROJECT ASSESSMENT

The initial finding of the pre-feasibility study shows that the project is economically feasible against the alternative gas-turbine power plant and other modes of power generation.

The Ranong and Chumphon areas will be major consuming centers of the Kra hydropower. In these areas, no power generating facility is available, and the Kra hydropower will serve as a major power source.

The project will contribute to the enhancement of subregional cooperation between Thailand and Myanmar. The project will also contribute to diversifying energy sources in the WSB region.

The project is estimated to cost about US$200 million (indicative), with economic and financial justifications will be further reviewed under the project.

## RECOMMENDATION(S)

It is recommended that the Thailand-Myanmar Bordering Hydropower Project Committee convene to discuss the execution of a feasibility level study on the Kra hydropower project. It is desirable that the feasibility study be conducted by an international consulting firm under technical/financial cooperation from an international cooperating agency

## (REFERENCE FOR SUBREGIONAL COOPERATION)

1. PROJECT TITLE: Tenasserim Hydropower Project

2. LOCATION: Myanmar

3. AGENCY: Myanmar Electric Power Enterprise (MEPE)

4. OBJECTIVES:
   (1) To harness water of the Tenasserim river for power generation and transmission to the southern region in Myanmar and the WSB region in Thailand
   (2) To promote subregional cooperation in the energy/power sector

5. PHASING:
   Phase I: Pre-feasibility study
   Phase II: Feasibility study
   Phase III: Implementation

6. DESCRIPTION:

The Tenasserim river, running on the Myanmar side of the Isthmus to the west of the WSB region, has a catchment area of over 18,000 $km^2$. With more rainfall than the WSB region, the Tenasserim river basin has a large hydropower potential.

In 1997, Myanmar Electric Power Enterprise (MEPE) conducted a preliminary study to identify possible alternative sites for power generation. The preliminary study mapped out several alternative sites (See attached location map), and suggested that the Tenasserim T4 site is the most attractive site. At this site, the catchment area is 9,870 $km^2$ and the annual mean runoff is estimated to be about 470 $m^3/s$. By constructing a dam/reservoir at this site, it will be possible to generate about 3,240 GWh of energy a year with an installed capacity of 700 MW.

Since a detailed field investigation has not be conducted yet, it is desirable that a pre-feasibility level study be carried out first at the proposed alternative site.

In the event that hydropower generation of such a magnitude is technically, financially, and environmentally viable, a large part of the generated energy will be transmitted to the WSB region.

7. RELATION WITH OTHER PROJECTS

8. COST (APPROX): Phase I : $2 million

# (REFERENCE) TENASSERIM HYDROPOWER PROJECT

## BACKGROUND

The Tenasserim river, having a catchment area of more than 18,000 km$^2$, runs on the Myanmar side of the Thai-Myanmar border to the west of the WSB region. This river has large potential for hydropower; however, no study has been conducted previously of power development in this river basin.

In early 1997, Myanmar Electric Power Enterprise (MEPE) carried out a preliminary study to evaluate hydropower potential in the Tenasserim river basin. According to the MEPE study, several alternative sites have been mapped out, and it has been evaluated that the T4 site located about 190 km from the estuary would be the most attractive scheme. The T4 site is about 120 km from Prachuap Khirikhan in the WSB.

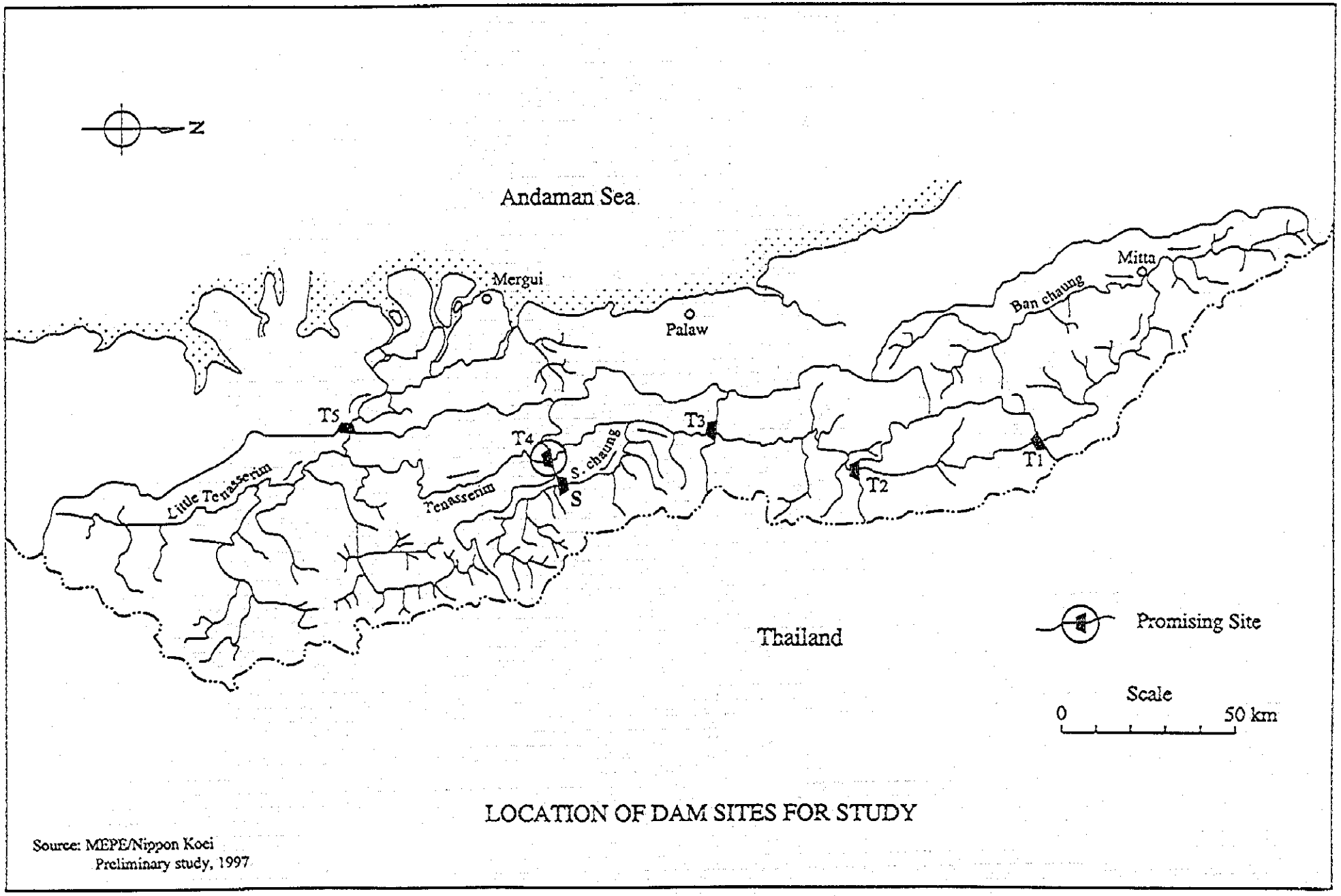
## PROJECT DESCRIPTION

According to the MEPE study, the hydropower scheme at the proposed T4 site has the following features:

| | |
|---|---|
| Catchment area: | 9,870 km$^2$ |
| Annual basin inflow: | 14,805 MCM |
| Annual mean runoff: | 469.5 m$^3$/s |
| Riverbed elevation: | EL. 20 m |
| Full supply level: | EL.150 m |
| Rated head: | 115 m |
| Installed capacity: | 682 MW |
| Annual energy output: | 3,242 GWh |
| Construction cost: | $942 million |
| Power cost: | $0.039/kWh |

## RECOMMENDATIONS

It would be desirable if Thailand could benefit from electric power generated in the Tenasserim river basin in Myanmar, and that a step be taken for the execution of a pre-feasibility level study on the proposed hydropower scheme.




LOCATION OF DAM SITES FOR STUDY

Source: MEPE/Nippon Koei
Preliminary study, 1997

HYDROPOWER POTENTIAL IN TENASSARIM RIVER BASIN

| Particular | Unit | Site | | | | | |
|---|---|---|---|---|---|---|---|
| | | T1 | T2 | T3 | T4 | T5 | S |
| Annual average rainfall | mm | 3,000 | 3,000 | 3,000 | 3,000 | 3,000 | 3,000 |
| Catchment area | $km^2$ | 4,140 | 5,490 | 7,425 | 9,870 | 17,720 | 820 |
| Run-off coefficient | - | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 |
| Annual basin inflow | mill. $m^3$ | 6,210 | 8,235 | 11,138 | 14,805 | 26,580 | 1,230 |
| Specific run-off | $m^3/km^2$ | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 |
| Annual mean runoff | $m^3/sec$ | 196.9 | 261.1 | 353.2 | 469.5 | 842.8 | 39.0 |
| River bed EL at dam site | EL. m | 90 | 40 | 33 | 20 | 3 | 75 |
| Full supply level, FSL | EL. m | 183 | 183 | 120 | 150 | 70 | 150 |
| Ultimate sediment level | EL. m | 110 | 70 | 65 | 60 | 25 | 110 |
| Dead water depth, dwd | m | 60 | 98 | 40 | 70 | 37 | 20 |
| Head variation ratio | - | 0.85 | 0.89 | 0.82 | 0.84 | 0.88 | 0.85 |
| Min. oper. level, MOL | EL. m | 170 | 168 | 105 | 130 | 62 | 130 |
| Drawdown, d | m | 13 | 15 | 15 | 20 | 8 | 20 |
| Drawdown ratio, d / Hg | % | 16 | 11 | 19 | 17 | 13 | 16 |
| Rated pond level | EL. m | 179 | 178 | 115 | 143 | 67 | 143 |
| Pond area at FSL | $km^2$ | 122.5 | 244.0 | 145.6 | 289.0 | 1,480.0 | 2.3 |
| Pond area at MOL | $km^2$ | 93.8 | 172.0 | 111.3 | 232.0 | 845.0 | 1.5 |
| Net storage capacity, Ve | mil. $m^3$ | 1,406 | 3,120 | 1,927 | 5,210 | 9,300 | 37 |
| Regulation ratio, Ve / R | % | 23 | 38 | 17 | 35 | 35 | 3 |
| Maintenance flow | $m^3/sec$ | 9.8 | 13.1 | 17.7 | 23.5 | 42.1 | 2.0 |
| Target discharge, Qtgt | $m^3/sec$ | 87.0 | 196.0 | 138.0 | 325.0 | 585.0 | 4.0 |
| Rated tail water level | EL. m | 95 | 45 | 38 | 25 | 5 | 20 |
| Min. tailwater level | EL. m | 90 | 40 | 33 | 20 | 3 | 15 |
| Gross head, Hg | m | 84 | 133 | 77 | 118 | 62 | 123 |
| Power waterway length | m | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 7,000 |
| Loss head | m | 3.8 | 3.5 | 3.3 | 3.2 | 3.1 | 35.0 |
| Rated head, He | m | 80 | 130 | 74 | 115 | 59 | 88 |
| Combined unit efficiency | m | 0.86 | 0.86 | 0.86 | 0.86 | 0.86 | 0.86 |
| Max. discharge, Qmax | $m^3/sec$ | 222.0 | 339.0 | 418.5 | 702.9 | 1,349.3 | 46.6 |
| Supply ratio, Qmax/R | % | 113 | 130 | 118 | 150 | 160 | 119 |
| Ve/Qmax | day | 73 | 107 | 53 | 86 | 80 | 9 |
| Installed capacity | MW | 149 | 370 | 260 | 682 | 674 | 35 |
| Annual total energy | GWh | 724 | 2,020 | 1,162 | 3,242 | 3,072 | 145 |
| Annual plant factor | % | 55.3 | 62.3 | 51.0 | 54.3 | 52.0 | 47.7 |
| Number of unit | no. | 2 | 2 | 2 | 3 | 4 | 2 |
| Unit turbine capacity | MW | 80 | 190 | 140 | 230 | 170 | 20 |
| Specific speed, Ns | m-kW | 190 | 140 | 190 | 150 | 220 | 180 |
| Rated speed, N | rpm | 160 | 140 | 110 | 110 | 80 | 370 |
| Unit rated output, P | MVA | 91 | 224 | 158 | 276 | 204 | 21 |

**Summary of Base Cost**

Price unit: mil. US$

| Particular | Unit | Unit price | Site | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | T1 | T2 | T3 | T4 | T5 | S |
| Construction Cost | - | - | 245.6 | 499.7 | 334.0 | 717.7 | 630.0 | 138.6 |
| L. Compensation: pond | $km^2$ | 50,000 | 6.1 | 12.2 | 7.3 | 14.5 | 74.0 | 0.1 |
| L.Compensation: other | $m^2$ | 50 | 13.6 | 24.2 | 37.0 | 30.1 | 60.2 | 21.9 |
| Temporary works | ls | 2.0% | 4.9 | 10.0 | 6.7 | 14.4 | 12.6 | 2.8 |
| Engineering Service | ls | 5.0% | 13.5 | 27.3 | 19.2 | 38.8 | 38.8 | 8.2 |
| Administration Cost | ls | 5.0% | 14.2 | 28.7 | 20.2 | 40.8 | 40.8 | 8.6 |
| Physical contingency | ls | 10.0% | 29.8 | 60.2 | 42.4 | 85.6 | 85.6 | 18.0 |
| Direct Cost, Total | - | - | 327.7 | 662.3 | 466.8 | 941.8 | 942.1 | 198.2 |
| Constuction Period | year | - | 4 | 5 | 4 | 7 | 7 | 3 |
| Interest During Const. | - | 3.0% | 41.1 | 105.5 | 58.6 | 216.5 | 216.6 | 18.4 |
| Cost, Grand Total | - | - | 368.9 | 767.8 | 525.4 | 1,158.3 | 1,158.6 | 216.6 |
| Const. Cost / kW | US$ | - | 2,468 | 2,075 | 2,021 | 1,698 | 1,719 | 6,242 |
| Const. Cost / kWh | US$ | - | 0.51 | 0.38 | 0.45 | 0.36 | 0.38 | 1.49 |
| Power Cost / kWh | US$ | - | 0.056 | 0.042 | 0.050 | 0.039 | 0.041 | 0.164 |

Source: MEPE/Nippon Koei Preliminary study, 1997

# Chapter 4 TELECOMMUNICATIONS

## *4.1 Thai Telecommunications*

### 4.1.1 Overview

Telecommunication services in Thailand are provided by two state enterprises: the Telephone Organization of Thailand (TOT) mainly dealing with domestic communications services, and the Communications Authority of Thailand (CAT) mostly providing international communication services. TOT has responsibility to provide domestic telephone and related services, as well as international services limited to the neighboring countries. Currently TOT only provides long distance service to Lao PDR and Malaysia. Its network includes over 1,156 exchanges, many of which are store program control (SPC) digital systems, serving more than 2 million subscribers nationwide. TOT also serves business communities with telebanking services, televideotext, and other advanced services. On the other hand, CAT provides domestic and international postal and telecommunication services including postal banking, telegraphy, mobile telephone, telex, VHF radio, facsimile, and paging services. It is also responsible for international telephone links via satellite and submarine cables, and marine radio telegraphy services.

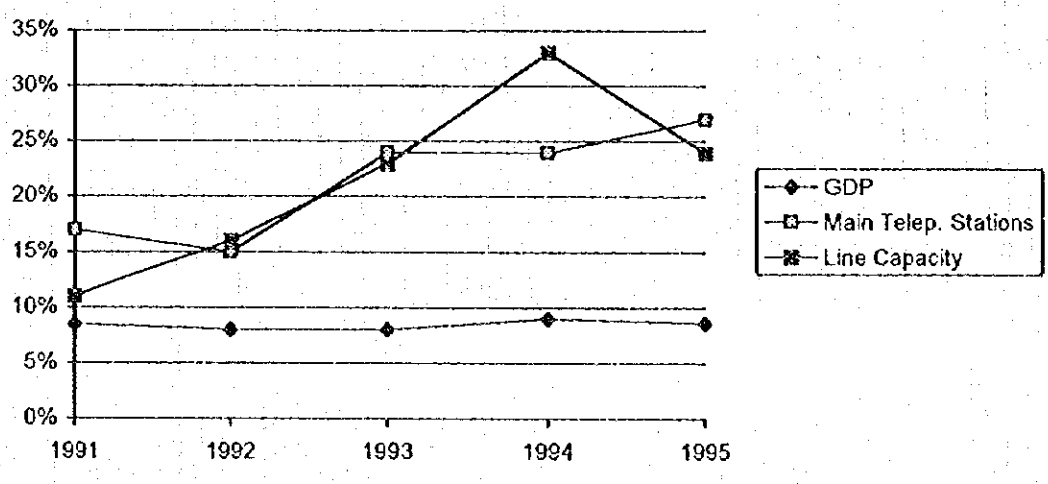
Government involvement in the telecommunications sector is through the Ministry of Transport and Communications (MOTC) and the Post and Telegraph Department (PTD) of MOTC, which manages and coordinates national postal and telecommunication administration, plans, and policies. The Government's development strategy includes the expansion of telephone services, installation of an integrated services digital network (ISDN), and enhancement of the ratio of phone numbers to reach the target of 10 telephones in line capacity per 100 persons by the end of the 7th Plan period and 18 telephones in line capacity per 100 persons by the end of the 8th Plan period.

The role of private sector has become increasingly important. In 1995, two private companies, Telecom Asia (TA) and Thai Telephone and Telecommunication (TT&T) together, have constructed and operated 1.8 million telephone lines which account for 40 per cent of the total installed line capacity in Thailand. The combined cellular phone sets serviced by two other private companies outnumbered those by TOT and CAT by a

ratio of two to one.

In general, the telecommunications sector has developed rapidly since 1991, with main telephone stations growing at 17.2 per cent in 1991, 15.3 per cent in 1992, 23.7 per cent in 1993, 24.2 per cent in 1994, and 26.5 per cent in 1995, much higher than the growth rate of national GDP. However, TOT's share in the sector has experienced a sharp decline since 1993 when the Government gradually opened the sector to private competition. TOT granted a contract to TA in 1992 and TT&T in 1993 to install a total of three million fixed lines. As a result, TOT's share of main telephone stations dropped from 100 per cent in 1992 to 59.2 per cent in 1995 and 52.0 per cent as of June 1996. TOT's annual investment data also showed a downward trend in project investment. Whereas, TOT allocated 10,664 million Baht for project investments in 1991, in 1994 the amount of investments shrank to 4,714 million Baht, or 44 per cent of the 1991 level. But this decline in investment has been more than compensated for by the infusion of private funds. (Refer to Table 9.4.1) The competition introduced through the reform program has boosted the development of the sector.

**Relation Between GDP and Telecommunications Development**




Source: TOT and Telephone in Thailand.

### 4.1.2 Recent Development Under TOT

In 1994, there were 2,441,461 main telephone stations, with a line capacity of 2,583,946 under TOT. Among the total main telephone stations by subscriber in 1994, TOT

accounted for fewer than 1 per cent, while public telephones accounted for 1.7 per cent, government for 4.2 per cent, residences for 68 per cent, and businesses for 25 per cent. The share of residences and businesses of the total remained stable compared with their shares of 67 per cent and 26 per cent in 1990, while the share of government dropped slightly from 5 per cent in 1990. In 1995, the number of main telephone stations under TOT increased by a mere 1.6 per cent over the previous year to 2,479,994, and the line capacity increased by a negligible 0.4 per cent to 2,593,963. (Refer to Table 9.4.2)

In 1990, the telephone line capacity to population ratio was 3 per 100 persons. It increased to 7.4 in 1995. In the Bangkok Metropolitan Area (BMA), the ratio increased from 14.8 per 100 persons in 1990 to 34.5 in 1995. The average ratio in provincial areas was much lower, 1.2 in 1990 and 3.3 in 1995. Although the average annual growth rate showed a slightly faster increase in provincial areas during the five-year period, the difference between the BMA and the rest of the country is huge, reflecting uneven development between Bangkok and the rest of the Kingdom.

### 4.1.3 Mobile Telephone and Other Services

Three types of "cellular" mobile telephones are in the service: i.e., cellular 470 and 900 opened by TOT, and cellular 800 operated by CAT. The mobile telephone network covers most of the WSB area. This subsector has experienced a huge increase; the number of 470 Mhz sets increased from 31,981 in 1990 to 52,171 in 1995, implying an average annual growth rate of 10.3 per cent, while 900 Mhz sets increased at an average annual rate of 106 per cent. The total mobile phone line capacity under TOT and Advanced Information Systems (AIS), a private company with a license from TOT, increased from 43,752 in 1990 to 896,686 in 1995, i.e., at an average annual growth rate of 83 per cent per annum. While figures from CAT and Telecom Asia Corp. (TAC) are not available, TDRI experts have estimated that they are similar to TOT's figures. As part of telecommunications reform, negotiations are being carried out with two private operators in the mobile phone subsector, AIS and TAC, to turn their concessions into joint ventures by converting their revenues into shares. The goal is to introduce more competition into this subsector. TOT has recently ruled that fixed line operators like TA and TT&T could operate hand phone systems, or PHS, as a value-added service (Refer to Table 9.4.3). In 1994, TOT and CAT initiated provision of an Integrated Services Digital Network (ISDN).

### 4.1.4 Telecommunications Master Plan

The Ministry of Transport and Communications has worked out a new draft master plan to liberalize the telecommunications sector. The master plan proposed to divide the country into six telephone zones for the installation of six million lines, bringing the nationwide total up to almost 10 million. Under the plan, TOT will be allowed to operate in all zones on the condition that its total number of connections is capped at one million. For the other five million lines, TOT will form joint ventures with private companies, each of which can operate in only one zone. Initially, three years' protection will be provided for TOT's domestic long distance services and CAT's international call operations. An independent regulatory body, composed of representatives from the public and private sectors, will be established to regulate the sector. A liberalized sector will help boost telecommunications development in the WSB region as well.

### 4.1.5 Rural Telecommunications

Rural pubic long distance telephone sets increased at an average annual rate of 13 per cent between 1990 and 1994. Between 1990 and 1995 local calls increased from 700 million to 3,236 million pulses with an average annual growth rate of 36 per cent; domestic long distance calls increased from 124 million to 327 million (i.e., at an annual growth rate of 21 per cent), and international calls to Malaysia and Lao PDR increased from 0.8 million to 1.432 million (i.e., at an annual growth rate of 12 per cent).

TOT's rural public long distance telephone project is closely related to development in the Study Area. According to the plan, TOT expects to install 1.5 million lines in provincial areas in 1996.

| Year of Construction | Accumulated Lines |
|---|---|
| Year 1 (1994) | 222,032 |
| Year 2 (1995) | 542,464 |
| Year 3 (1996) | 800,384 |
| Year 4 (1996) | 1,000,000 (Add 500,000) |
| | 1,500,000 |

As a part of the one million line expansion of telephone service in provincial areas, TOT had installed an additional 47,104 lines and 24,456 main telephone stations in the WSB as of September 30, 1995. (Refer to Table 9.4.4)

### 4.1.6 Projects and Services by TOT and CAT

TOT's main focus is on telephone line expansion both in rural and urban areas. Relevant to the WSB is the installation of a rural long distance public telephone in all 45,000 mubans nationwide. CAT is working on the laying of fiber optic submarine cable to the neighboring countries, a satellite communication system for air, marine and ground transportation, and expansion of existing international telephone services.

### 4.1.7 The WSB Region

The WSB region had a telephone intensity ratio of 3.4 phones per 100 persons in 1995 (lower than the national average of 5.9 stations per 100 persons), which correlated to its GDP development level in the Kingdom. (Refer to Table 9.4.5)

| | Kachana-buri | Ratcha-buri | Samut Songkhrn | Petcha-buri | Prachuap KhiriKhan | Chum-phon | WSB Region | Nation |
|---|---|---|---|---|---|---|---|---|
| Telephone Line Capacity | 19,072 | 31,144 | 8,960 | 19,512 | 25,616 | 17,616 | 121,920 | 4,380,378 |
| Main Telephone Station | 16,030 | 26,227 | 8,458 | 17,584 | 17,697 | 12,196 | 98,192 | 3,481,997 |
| Population ('000) 1994 figures | 668 | 767 | 199 | 419 | 428 | 415 | 2896 | 59,370 |
| Telephone Lines Per 100 persons | 2.9 | 4.1 | 4,5 | 4.7 | 6.0 | 4.2 | 4.2 | 7.4 |
| Telephone Stations per 100 persons | 2.4 | 3.4 | 4.3 | 4.2 | 4.1 | 2.9 | 3.4 | 5.9 |

Source: TOT (as of Sept. 30, 1995).

### 4.1.8 Information Technology (IT)

Thai Government has recognized the importance of IT and has initiated measures to develop IT within the country, especially telecommunications infrastructure. One of the major steps taken by the Government was establishment of the National Information Technology Committee or NITC in March 1992, with the mandate to prepare, facilitate, and monitor the implementation of IT development plan. The committee comprises 22 members from leading public and private agencies, and is chaired by the Deputy Prime Minister in charge of economic and social development. With its complementary role to that of the NITC, the National Electronics and Computer Technology Center (NECTEC), a government agency under the Ministry of Science, Technology and

Environment, was appointed to be the NITC's Secretariat.

A national IT policy was prepared with the objective to develop Thailand into a modern regional hub in Southeast Asia for: (i) financial services; (ii) manufacturing and commerce; (iii) transportation and tourism; and (iv) human resources development. In order to achieve this objective, information superhighways and access roads for information exchange are required, and National Information Infrastructure (NII) is under rapid expansion. Thailand is in a front-line position in voice, data and TV transmission. It has reached a high 71 per cent in digital switches, over 90 per cent in digital transmission, and 100 per cent for international telecommunications, leapfrogging such countries as the US, UK, Australia, and Japan. Several thousand kilometers of optical fiber cables link major cities across the nation, complemented by two national satellites operating in both the C and Ku bands. The country is laying several submarine optical fiber network that will link the Kingdom to the rest of the world.

In the WSB region, information infrastructure should be expanded under the national IT policies, together with the expansion of telephone lines in urban and rural areas. The Science City and university campuses proposed in the WSB should be linked by IT to facilitate access to global and regional information exchange. They will serve as a center for the development of regional IT, including information network for education, medical services, agricultural marketing, tourism development, and so forth.

## *4.2 Constraints and Development Potentials*

### 4.2.1 Constraints

The Thai telecommunications sector has various constraints to be addressed at the national level. Such constraints are generally applicable to the WSB region, however. Major constraints are:

(i) Outdated laws, rules, and regulations for telecommunications services. The basic laws governing the telecommunications sector are 50 years old and seriously restrict participation by the private sector. TOT and CAT basically enjoy a natural monopoly in fixed line services which results in high telephone rates, and in areas where they give concessions there has been overlapping authority and confusion, which has hindered the development of the sector.

(ii) Lack of an independent regulatory body. There is no independent regulatory body monitoring the sector. Many decisions are not made through competition or through transparent processes.

(iii) Shortage of personnel in the sector. The demand for engineers and technicians with a telecommunications background far surpassed the supply due to the lack of higher education and training institutes. Moreover, most engineers and technicians tend to move to Bangkok in pursuit of better careers and monetary rewards. Because of the outflow of talented young people, rural areas have benefited less from the modern telecommunications technology than they would have otherwise.

(iv) Continued investment in the sector is needed to sustain a long-lasting high growth rate of 15.3 per cent in the total number of main telephone stations, if Thailand is to reach Singapore's telephone intensity level in 1995.

### 4.2.2 Potentials

Despite various constraints that the Thai telecommunications sector is facing, there are potentials for further development in this sector:

(i) Reform: The government is resolved to liberalize the sector through the implementation of a telecommunications master plan. The plan calls for the privatization of TOT and CAT, and makes it easy for new entries into the market by the private sector. According to the telecommunications master plan, by 1999 free competition will be introduced in the telecommunications sector.

(ii) New technology development: Thailand has benefited from recent developments in telecommunications technology. In many ways, it is easy for a country like Thailand to leapfrog over industrialized nations. The fast development of cellular phones is a good example. Computer networking can also benefit the country substantially.

(iii) Economic Growth: Because many new businesses are expected to move into the WSB region, coupled by the fact that part of the region has been designated as the nation's future science/research center, the demand for telecommunications services will greatly increase. Liberalization of the sector

around 1999 will certainly pave the way for faster growth in the telecommunications sector.

## *4.3 Direction of Telecommunications Development*

### 4.3.1 National Development Targets

According to the International Telecommunications Union, a country with a per capita income of US$5,000 should have three phones per 10 persons. NESDB has estimated that by the end of 2001, the per capita income in Thailand will reach that level. Consequently, an additional 12 million lines will be needed, presenting a major challenge to the telecommunications sector in Thailand.

The Thai Government has planned to increase the ratio of telephone line capacity to population to 10 per 100 persons by the end of 1996, which requires an increase of 5 million lines. Under the 8th Plan, the Thai government plans to add 6 million lines to make the ratio to 18.5 lines per 100 persons. In the meantime, the ratio between Bangkok's phone line capacity per 100 people and that of all other provinces is expected to narrow from 11.3:1 to 4.8:1.

**Country Comparison**

| Country | Telephones per 100 persons | GNP per Capita in US$ |
|---|---|---|
| Singapore | 50 | 26,400 |
| Taiwan | 43 | 12,265 |
| South Korea | 43 | 10076 |
| Thailand | 5.9 | 2680 |
| *Bangkok Metropolitan Area in 1996* | *50.95* | *8600* |
| **Average Growth Rate Needed for Thailand to Reach (1995-2011)** | | |
| Singapore's level | 14.3 per cent | 15.4 per cent |
| Taiwan's level | 13.2 per cent | 10.0 per cent |
| South Korea's level | 13.2 per cent | 8.6 per cent |

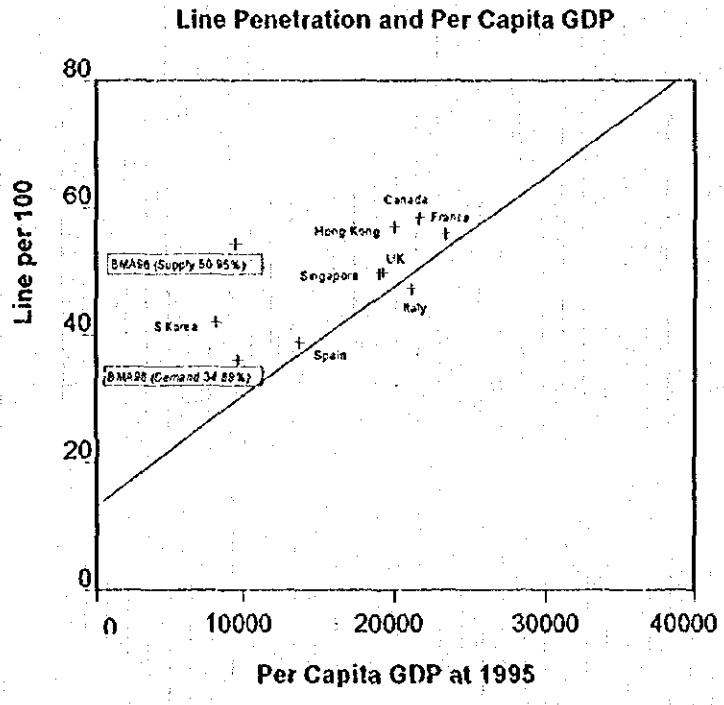
Remark*: ITU Telephone data and GNP per capita data and TOT

Based on Thailand Vision 2020, the GNP per capita in Thailand is expected to be at the same level as New Zealand by the year 2020. That means the telephone intensity would have to be increased at a rate of about 10 per cent per annum in the next 25 years. In

terms of telephone line capacity, based on TOT's own projections, the total number of telephones will grow at an annual rate of 16 per cent to the year 2001, and the ratio of telephone line capacity per 100 persons will grow at an annual rate of 14.5 per cent to reach 18.5 per 100 by 2001.

Between 1990 and 1994, the Thai economy increased by 8 per cent annually, and the total number of telephone lines increased by 20.1 per cent; the demand elasticity was 2.5. If Thailand's economy is expected to grow by 7.5 per cent per year up to the year 2011, the total number of telephone stations should grow by at least 18.75 per cent per year.

However, the demand and supply of telephone services should be decided by the market mechanism as the sector embarks on its liberalization course. The targets used here are just for comparison and reference purposes for the public and private institutions in telecommunications sector to create an environment conducive to rapid changes in the sector.




## 4.3.2 WSB Development Targets

High Growth Case: Using a GNP demand elasticity for telephones of 2.5, the total number of telephone stations should grow at around 23 per cent for the next 16 years

when the economy grows at 9.2 per cent per year[1], a growth rate that will ensure that the GDP per capita in the WSB region will reach the national average. With a growth rate of 23 per cent per annum, by 2011 the number of main telephone stations per 100 persons in Thailand will reach 81.4 per 100, or a level higher than that of the United States in 1995 (i.e., 77 phones per 100 persons).

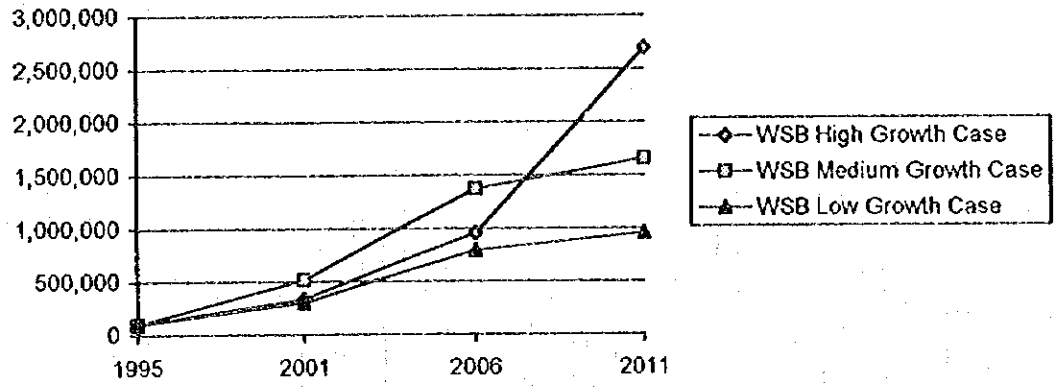
Low Growth Case: By 2006, if the Kingdom's telephone intensity is to reach Singapore's present level and the WSB (with a low base of 3.4 telephones per 100 persons), follows the national trend, the total number of telephone stations in the WSB should grow at a rate of 15.3 per cent per year. But, with this growth rate, the telephone intensity will be only at a low level of 29 telephones per 100 persons while GDP per capita in the WSB region is expected to reach around US$7,300.

The high-growth case seems too demanding for the economy and the region while the low growth case may not be able to support fast economic growth in the WSB region. Therefore, a medium growth case is put forward.

Medium Growth Case: The moderate growth scenario shows that the economy of the WSB region will grow at an annual rate of 9.2 per cent. If the WSB is to reach the level of Singapore's current telephone intensity by 2011, an annual growth rate of 19.3 per cent is needed to arrive at 50 telephones per 100 person level. With this growth rate, an additional 1.5 million main telephone stations will be added. (Refer to Table 9.4.6) A closer comparison can be made between the WSB region and BMA. In 1996, the estimated telephone penetration rate in BMA, with its GDP per capita at around US$8600, is 50 lines per 100 person. By the year 2011, the GDP per capita in the WSB region will almost reach the same level as that of BMA today. With the introduction of modern technologies, the telecommunications sector will witness an even faster development trend in the decades to come.

[1] The medium growth rate of 9.2 per cent, instead of 10.7 per cent in the high growth case, is used here. The demand elasticity is 2.5.

WSB Telecommunications Development Trend




## 4.4 *Development Objectives and Strategies for WSB Telecommunications*

In the 8th Plan the Government of Thailand stresses the importance of the following policies:

"Implement the policy of opening up free development of telecommunications and information technology systems in Thailand to correspond with the rapidly changing situation of technology to allow sufficient service in terms of quantity and quality as well as competitive rates with the consumer being given justice. "

"Develop the telecommunications and information technology system in important economic areas and in regional centers to link in with the national telecommunications network following the policy of job creation and income distribution to open up new opportunities and create equality in education and build up the performance of a public information system which is opened wide and provides equal opportunities. "

"Coordinate cooperation between the state and private sectors in the development of the telecommunications industry by promoting research and development and the production of telecommunications personnel, both in the quantity and quality which will fulfill the country's needs as well as supporting the development of the skill of telecommunications personnel at all levels. "

"Establish an independent, flexible national mechanism to regulate and monitor telecommunications businesses to ensure efficiency, good quality of service, of a

standard conforming with technological advances as well as setting fair service charges for users and suppliers by emphasizing the opening up of the opportunity for the private sector to participate in investment in the development of activities in this area to its full capability combined with the allowing of regional citizens to use modern telecommunications systems as well as urban citizens. "

"Amend the law related to telecommunications business to allow the private sector to invest and compete freely in providing services by considering the benefits to the user in terms of the quality and cost of service rather than the benefits given to the state by the private sector combined with organization for laws which facilitate the use of information technology in economic and social development."

### 4.4.1 Development Objectives

Based on the above policies, the major objectives for development of the telecommunications sector in the WSB region are defined to include the following:

(i) **To support** economic and social development in the WSB region, both in rural and urban areas;

(ii) **To provide linkages** within the region and within zones, as well as with other regions and subregions, and to facilitate national and international linkages in the process of globalization;

(iii) **To improve** the living standards and quality of life in the region through expanded telecommunications service in the field of education, health, agricultural, cultural preservation, and other economic activities; and

(iv) **To promote** local participation in decision-making process through increased information exchange via telecommunications activities.

### 4.4.2 Development Strategies

To attain the objectives outlined above, it is proposed that social and economic development in the WSB region will be promoted using the following strategies in the telecommunications subsector:

(i) Since facilities for telecommunications in the WSB region are currently limited, the number of facilities should be substantially increased to attain the objectives enumerated above (for reference, the average number of telephones per 100 population at present is 35 (demand) to 50 (supply) lines in the BMA, 43 lines in the Republic of Korea and Taiwan, and 50 in Singapore).

(ii) Telecommunications development should support promotion of information technology (IT) in the WSB region as basic infrastructure for social and economic development.

(iii) IT should be more widely applied to education, medical services, agricultural services, and industrialization in the WSB region, as well as to environmental advocacy and the broad-based participation of the inhabitants in the regional development.

## *4.5 Development Plan and Program*

### 4.5.1 CAT and TOT Projects

CAT and TOT have a range of projects under implementation or for future realization. Most directly relevant to the WSB region are the following:

(i) Facsimile Service Development Project. This project involves installation of facsimile switching equipment and subscriber-end equipment for 110 circuits, covering Bangkok and other eight major cities. The project is scheduled for completion in 1996. Although none of the cities in the WSB is included in this project, it has been recommended to install the same service in the Bang Saphan area.

(ii) CAT also plans to lay a fiber optic system linking the Bang Saphan area to the BMA to boost private investment in the WSB region. The installation of the system will make it possible for large data transmission.

(iii) Rural Long Distance Public Telephone Project (1992-1996). The project intends to install 3,500 rural long distance public telephones in every tambon that has no telephone service, as well as 1,000 lines in other important places. (So far 750 base stations have been installed and 318 lines are in service.)

(iv) Rural Long Distance Public Telephone Project (Additional Part I). The project intends to install an additional 25,000 lines, 23,300 coin box lines and 1,800 attended lines.

(v) Rural Long Distance Public Telephone Project (Muban Level) (1996-1998). This proposal involves the installation of rural long distance public telephones in every muban, of which there are 45,000 nationwide.

(vi) The 800,000 Lines Project. This project is to install 800,000 more lines by 1998 (200,000 lines in the BMA and 600,000 in provincial areas).

(vii) One Million Lines Expansion Project. This project is to install an additional 200,000 lines in the BMA and 800,000 lines in provincial areas.

### 4.5.2 Proposed Projects/Program in the WSB Region

As an integrated part of the development of the WSB region, it is proposed to realize the following projects/programs by the target year of 2011:

1) Establishment of a teleport or a communications center to support economic activities in the region so that users will be able to communicate more effectively with foreign countries without intermediate connection through the long-distance telephone exchange in Bangkok. With the expansion of fiber optic networks across the Kingdom, it may not be necessary to build a teleport in the WSB. However, due to the high domestic telephone rates, it may be too expensive for information-intensive industries like research centers to effectively use Internet and other information technologies. For the purpose of regional development, a comparative study should be initiated to examine, from the perspective regional customers, the economic feasibility of building a teleport versus using existing fiber optic lines and paying the long distance charges. The teleport will have an international transit switching center with an initial capacity of 1,000 to 3,000 international circuits, which will provide cheap and high-quality service for the enterprises and research centers in the region. The teleport will also provide a variety of other services, including international TV conferences, a financing network, and database access. To support these services, a satellite earth station is recommended to be installed and linked by Intelsat/Asiasat. Location proposed for Free Trade Areas

(FTAs) and the Science City would be possible sites for such teleports or communications centers.

2) Installation of 420,000 main telephone stations in the WSB by the year 2001, and 850,000 phone stations by 2006, and 290,000 telephone lines by 2011.

3) Demonstration Agricultural Information System: This system will provide farmers with useful information such as domestic and international agricultural market prices, diagnostic results of farm soils, and changing weather conditions. This information will be available through the Internet. The demonstration project will be launched in villages or local libraries in the model tambons selected for rural development in the WSB region.

4) Demonstration Medical Treatment Information System: Taking advantage of Internet and ISDN networks, the medical staff in the remote clinics can confer with their colleagues in major urban areas to support diagnoses, treatment, and rehabilitation. In the meantime, hospitals at the regional centers can receive the most updated medical information from Bangkok and overseas through the Internet.

5) Tourism Information System: Several tourist spots in the WSB region should be equipped with a tourism information network that will provide tourism business persons with the most updated information on domestic and international tourist arrivals, hotel reservations, in-bound and out-bound destinations, and so on. The tourism community should be able to support this project by itself. However, some government incentives such as tax deductions for investment cost may accelerate the arrival of the information age in this sector.

6) Information Highway for Education: The project, to launched at two levels at selected high schools and colleges, will provide the schools and colleges with computers and Internet services. One group will be linked to colleges and high schools in the United States, Japan, and/or the European Union to form sister schools and colleges through the information highway to facilitate (a) foreign language learning, (b) mutual understanding of the other side of the world, and (c) exchange of curriculum and courses to improve educational quality. Another group will be linked to schools, colleges, and universities in other ASEAN countries to further strengthen bonds and understanding among the ASEAN peoples. The goals are similar to those for the first group. This project is one of the IT programs to be promoted at the regional level.

## Table 9.4.1 Telephone Line Capacity and Station Development

| Year | | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | May-96 |
|---|---|---|---|---|---|---|---|---|
| Line capacity | | | | | | | | |
| | TOT | 1,684,960 | 1,869,269 | 2,166,001 | 2,546,081 | 2,583,946 | 2,593,963 | 2,601,157 |
| | TA | | | | 111,000 | 585,000 | 1,081,135 | 1,422,991 |
| | TT&T | | | | | 364,544 | 705,280 | 978,176 |
| Sub-total | | 1,684,960 | 1,869,269 | 2,166,001 | 2,657,081 | 3,533,490 | 4,380,378 | 5,002,324 |
| Main telephone | | | | | | | | |
| | TOT | 1,324,522 | 1,553,160 | 1,790,029 | 2,184,892 | 2,441,461 | 2,479,994 | 2,487,408 |
| | TA | | | | 29,627 | 242,106 | 615,770 | 833,155 |
| | TT&T | | | | | 68,209 | 386,233 | 563,714 |
| Sub-total | | 1,324,522 | 1,553,160 | 1,790,029 | 2,214,519 | 2,751,776 | 3,481,997 | 3,884,277 |
| Population (NESDB)'1000 | | 56,200 | 56,800 | 57,580 | 58,200 | 58,910 | 59,370 | 59,640 |
| Line capacity per 100 | | 3.0 | 3.3 | 3.8 | 4.6 | 6.0 | 7.4 | 8.4 |
| Main telephone per 100 | | 2.4 | 2.7 | 3.1 | 3.8 | 4.7 | 5.9 | 6.5 |

Source: TOT

### Line Capacity & Main Telephone Station under TOT

| | 1990 | 1991 | 1992 | 1993 | 1994 |
|---|---|---|---|---|---|
| **Line Capacity** | | | | | |
| Metro. Tel. Area | | | | | |
| - X-Bar | 344,574 | 344,574 | 344,574 | 344,774 | 344,774 |
| - SPC | 781,028 | 859,532 | 1,009,836 | 1,243,861 | 1,255,071 |
| Total | 1,125,602 | 1,204,106 | 1,354,410 | 1,588,635 | 1,599,845 |
| Prov. Tel. Area | | | | | |
| - X-Bar | 135,730 | 135,030 | 131,230 | 138,010 | 136,110 |
| - SPC | 423,628 | 530,133 | 680,361 | 819,436 | 874,991 |
| Total | 559,358 | 665,163 | 811,591 | 957,446 | 984,101 |
| Metro. & Prov. Tel. Area | | | | | |
| - X-Bar | 480,304 | 479,604 | 475,804 | 482,784 | 480,884 |
| - SPC | 1,204,656 | 1,389,665 | 1,690,197 | 2,063,297 | 2,103,062 |
| Total | 1,684,960 | 1,869,269 | 2,166,001 | 2,546,081 | 2,583,946 |
| **Main Tel. Station** | | | | | |
| Metro. Tel. Area | | | | | |
| - X-Bar | 327,136 | 334,623 | 338,480 | 341,947 | 343,337 |
| - SPC | 573,805 | 709,672 | 820,747 | 1,041,322 | 1,168,183 |
| Total | 900,941 | 1,044,295 | 1,159,227 | 1,383,269 | 1,511,520 |
| Prov. Tel. Area | | | | | |
| - X-Bar | 115,556 | 117,761 | 115,056 | 122,652 | 131,124 |
| - SPC | 308,025 | 391,104 | 515,746 | 678,971 | 798,817 |
| Total | 423,581 | 508,865 | 630,802 | 801,623 | 929,941 |
| Metro. & Prov. Tel. Area | | | | | |
| - X-Bar | 442,692 | 452,384 | 453,536 | 464,599 | 474,461 |
| - SPC | 881,830 | 1,100,776 | 1,336,493 | 1,720,293 | 1,967,000 |
| Total | 1,324,522 | 1,553,160 | 1,790,029 | 2,184,892 | 2,441,461 |

## Table 9.4.2 Number of Main Telephone Stations by Type of Subscriber

| | 1990 | 1991 | 1992 | 1993 | 1994 |
|---|---|---|---|---|---|
| BMA & Prov. Tel. Area | | | | | |
| Business | 343,242 | 414,406 | 472,605 | 546,571 | 606,750 |
| Residence | 881,061 | 1,023,337 | 1,187,499 | 1,487,985 | 1,666,949 |
| Government | 66,129 | 74,221 | 81,366 | 92,740 | 102,090 |
| Public | 22,284 | 26,085 | 30,999 | 36,730 | 42,119 |
| TOT | 11,806 | 15,111 | 17,560 | 20,866 | 23,553 |
| Total | 1,324,522 | 1,553,160 | 1,790,029 | 2,184,892 | 2,441,461 |
| BMA Tel. Area | | | | | |
| Business | 219,255 | 271,819 | 309,987 | 360,542 | 404,661 |
| Residence | 618,531 | 701,964 | 774,781 | 942,127 | 1,020,723 |
| Government | 41,849 | 45,673 | 47,071 | 50,566 | 53,410 |
| Public | 14,665 | 16,286 | 17,911 | 19,849 | 21,555 |
| TOT | 6,641 | 8,553 | 9,477 | 10,185 | 11,171 |
| Total | 900,941 | 1,044,295 | 1,159,227 | 1,383,269 | 1,511,520 |
| Prov. Tel. Area | | | | | |
| Business | 123,987 | 142,587 | 162,618 | 186,029 | 202,089 |
| Residence | 262,530 | 321,373 | 412,718 | 545,858 | 646,226 |
| Government | 24,280 | 28,548 | 34,295 | 42,174 | 48,680 |
| Public | 7,619 | 9,799 | 13,088 | 16,881 | 20,564 |
| TOT | 5,156 | 6,558 | 8,083 | 10,681 | 12,382 |
| Total | 423,581 | 508,865 | 630,802 | 801,623 | 929,941 |

Note: Included Cardphones (Beginning on May 22, 1991)

**Table 9.4.3 Mobile Phone Service in Thailand**

Unit : Line

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 |
|---|---|---|---|---|---|---|
| 470 MHz | 31,981 | 42,712 | 47,289 | 49,526 | 50,966 | 52,171 |
| 900 MHz | | 36,486 | 95,133 | 205,311 | 371,102 | 654,719 |
| Total | 31,981 | 79,198 | 142,422 | 254,837 | 422,068 | 706,890 |

**Table 9.4.4 Line Capacity & Main Telephone Station in WSB Region Under One Million Line Expansion Project**

| Province | Line Capacity | Main Tel. Station |
|---|---|---|
| Kanchanaburi | 5,760 | 3,061 |
| Ratchaburi | 10,368 | 5,558 |
| S. Songkhram | 1,792 | 1,310 |
| Petchaburi | 9,344 | 7,585 |
| P. Khirikhan | 11,136 | 3,534 |
| Chumphon | 8,704 | 3,408 |
| National | 723,072 | 386,233 |

**Table 9.4.5 TOT Status of Telephone Lines in Study Area**
**As at Sept. 30,1995**

| | Kanchanaburi | Ratchaburi | S. Songkhram | Petchaburi | P. Khirikhan | Chumphon |
|---|---|---|---|---|---|---|
| Line Capacity | 13,312 | 20,776 | 7,168 | 10,168 | 14,480 | 8,912 |
| Main Tel. Stat. (Line Used) | 12,969 | 20,669 | 7,148 | 9,999 | 14,163 | 8,788 |
| Waiting List | 8,414 | 9,656 | 3,524 | 7,896 | 2,933 | 1,520 |
| Available Cable Pairs | 17,900 | 28,200 | 9,950 | 17,800 | 21,300 | 14,200 |
| Used Cable | 12,785 | 20,732 | 7,151 | 10,315 | 13,838 | 8,735 |
| Remaining Cable | 5,115 | 7,468 | 2,799 | 7,485 | 7,462 | 5,465 |
| Line Capacity add in 92-95 | 2,304 | 6,080 | 0 | 2,368 | 1,640 | 512 |
| Total Lines (including no | 19,072 | 31,144 | 8,960 | 19,512 | 25,616 | 17,616 |
| Total Main Stations | 16,030 | 26,227 | 8,458 | 17,584 | 17,697 | 12,196 |

## Table 9.4.6 WSB Telecommunications Development Forecast

| | | 1995 | 2001 | Growth Rate | 2006 | Growth Rate | 2011 | Growth Rate | 95 - 2011 | | GNP/GRP Growth | Elast. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WSB Case 1 | Population '000, | 2,896 | 3,071 | 1.0% | 3,183 | 0.7% | 3,312 | 0.8% | 0.8% | Population | 0.8% | 1.1 |
| Follow | (NESDB) Per 1000 | 2.5 | 11.2 | 28.0% | 26.1 | 18.4% | 30.3 | 3.1% | 16.7% | Per Capita | 8.1% | 2.1 |
| National Trend | Total telephone | 73,736 | 343,671 | 29.2% | 829,730 | 19.3% | 1,003,904 | 3.9% | 17.7% | Total GRP | 9.2% | 1.9 |
| WSB Case 2 | Population '000, | 2,896 | 3,071 | 1.0% | 3,183 | 0.7% | 3,312 | 0.8% | 0.8% | Population | 0.8% | 1.1 |
| Follow | (NESDB) Per 1000 | 2.5 | 18.5 | 39.1% | 43 | 18.4% | 50 | 3.1% | 20.5% | Per Capita | 9.8% | 2.1 |
| NIEs Trend | Total telephone | 73,736 | 566,907 | 40.5% | 1,368,690 | 19.3% | 1,656,000 | 3.9% | 21.5% | Total GRP | 10.7% | 2.0 |
| WSB Case 3 | Population '000, | 2,896 | 3,071 | 1.0% | 3,183 | 0.7% | 3,312 | 0.8% | 0.8% | Population | 0.8% | 1.0 |
| Based on Past | (NESDB) Per 1000 | 2.5 | 6.2 | 16.1% | 13.2 | 16.1% | 27.7 | 16.1% | 16.1% | Per Capita | 9.8% | 1.6 |
| National Trend | Total telephone | 73,736 | 191,494 | 17.2% | 418,670 | 16.9% | 918,939 | 17.0% | 17.1% | Total GRP | 10.7% | 1.6 |
| National | Population '000, | 59,401 | 62,914 | 1.0% | 65,470 | 0.8% | 67712 | 0.7% | 0.8% | Population | 0.8% | 1.0 |
| Follow | (NESDB) Per 1000 | 4.2 | 18.5 | 28.0% | 43 | 18.4% | 50 | 3.1% | 16.7% | Per Capita | 6.7% | 2.2 |
| NIEs Trend | Total telephone | 2,479,994 | 11,613,924 | 29.3% | 28,152,100 | 19.4% | 33,856,000 | 3.8% | 17.7% | Total GRP | 7.6% | 2.6 |

## APPENDIX I To CHAPTER 4

## PROFILES OF PROPOSED PROJECTS/PROGRAMS

Project No. TL1

| | |
|---|---|
| 1. PROJECT TITLE | Telecommunications Expansion |
| 2. LOCATIONS | The WSB Region |
| 3. AGENCY | TOT |
| 4. OBJECTIVES | Support economic and social development in the WSB region through expansion of telecommunications service. |
| 5. PHASING | Phase I, Phase II, and Phase III. |

6. DESCRIPTION

The WSB region had a telephone intensity ratio 3.4 phones per 100 persons in 1995, lower than the national average of 5.9 lines per 100 persons. If Thailand's GNP per capita level is to reach that of present New Zealand by the year 2020, its telephone intensity level should reach above 60 lines per 100 persons. Our target for the WSB region, 50 phones per 100 persons, is Singapore's telephone intensity level in 1995. It is an ambitious target, but not impossible. In the last five years Thailand has experienced above 20 per cent annual growth in the telecommunications sector. With the further liberalization of the sector and introduction of rapidly changing new technologies, the WSB should be able to leapfrog in the sector and the availability of high-quality telecommunications service will pave the way for science and technology oriented economic development planned for the region.

To achieve the above goal, 423,878 main telephone stations should be installed in the WSB by 2001, 846,620 stations by 2006, and 287,310 stations by 2011. Most of the telephone lines will be installed in the free trade zone, science city, industrial estates.

| | |
|---|---|
| 7. RELATION WITH OTHER PROJECTS | RD1 (Rural Development Model).<br>UD3 (Urban Infrastructure Improvement). |
| 8. COST (APPROX.) | Phase I: $20 million.<br>Phase II: $20 million.<br>Phase III: $5 million. |

Project No. TL2

| | |
|---|---|
| 1. PROJECT TITLE | Teleport/Communication Center Promotion |
| 2. LOCATIONS | The WSB Region |
| 3. AGENCY | TOT/CAT |
| 4. OBJECTIVES | Support economic and social development in the WSB region through expansion of telecommunications linkage. |
| 5. PHASING | Phase I and Phase II. |

6. DESCRIPTION

It is proposed to initiate a study of the feasibility of establishing a teleport or a communications center to support economic activities in the region so that users will be able to communicate more effectively with foreign countries without intermediate connection through the long-distance telephone exchange in Bangkok. With the expansion of fiber optic networks across the Kingdom, it may not be necessary to build a teleport. However, due to high domestic long distance telephone rates, it may be too expensive for information-intensive industries like research centers to effectively use Internet and other information technologies. For the purpose of regional development, a comparative study should be initiate to examine, from perspective of regional consumers, the economics of building a teleport versus using existing fiber optic lines and paying the long distance change. The teleport will have an international transit switching center with an initial capacity of 1,000 to 3,000 international circuits, which will provide cheap and high-quality service for the investors and enterprises in the region. The teleport will also provide a variety of other services, including international TV conferences, a financing network, and database access. To support these services, a satellite earth station is recommended to be installed and linked by Intelsat/Asiasat. The sites proposed for free trade areas (FTAs) would be possible locations for such a teleport or a communications center.

| | |
|---|---|
| 7. RELATION WITH OTHER PROJECTS | UD2 (Science City and Industrial City).<br>ID1 (Free Trade Areas). |
| 8. COST (APPROX.) | Phase I: US$ 0.5 million for feasibility study. |

Project No. TL3

| | |
|---|---|
| 1. PROJECT TITLE | Agricultural Information System |
| 2. LOCATIONS | The WSB Region |
| 3. AGENCY | TOT/Private Sector |
| 4. OBJECTIVES | (1) Supporting one of the most important sectors in the WSB region.<br>(2) Enhancing farmers' ability to compete in the market place. |
| 5. PHASING | Phase I, Phase II and Phase III. |

6. DESCRIPTION

The Demonstration Agricultural Information System will provide farmers with useful information such as domestic and international agricultural market prices, diagnostic results of farm soils, and changing weather conditions. This information will be available through the Internet. The demonstration project will be launched in the model tambons selected for rural development in the WSB region.

Eventually, the pilot project will result in: (i) the establishment of an institution to collect and disseminate market information; (ii) improvement of the marketing system through introduction of grading system; and (iii) improvement of data collection, analysis and dissemination.

| | |
|---|---|
| 7. RELATION WITH OTHER PROJECTS | AG11 (Agricultural Marketing Information) |
| 8. COST (APPROX.) | Phase I: US$ 0.5 million. |

Project No. TL4

| | |
|---|---|
| 1. PROJECT TITLE | Medical Information System |
| 2. LOCATIONS | The WSB Region |
| 3. AGENCY | Selected Local Hospitals, MOPH |
| 4. OBJECTIVES | Improving health condition in the WSB region and facilitating training of local health workers. |
| 5. PHASING | Phase I and Phase II. |

6. DESCRIPTION

The Demonstration Medical Treatment Information System will take advantage of the Internet and ISDN networks so that the medical staff in remote clinics can confer with their colleagues in major urban areas to support diagnoses, treatment, and rehabilitation. In turn, hospitals at the regional centers will be able to receive the most updated medical information from Bangkok and overseas through the Internet.

| | |
|---|---|
| 7. RELATION WITH OTHER PROJECTS | PH1 (Medical Research Laboratory with Hospital)<br>PH3 (Emergency Medical Service Upgrading)<br>PH5 (Health Promotion Upgrading) |
| 8. COST (APPROX.). | Phase I: US$ 0.5 million.<br>Phase II: US$ 1 million. |

Project No. TL5

| | |
|---|---|
| 1. PROJECT TITLE | Tourism Information System |
| 2. LOCATIONS | The WSB Region |
| 3. AGENCY | TAT |
| 4. OBJECTIVES | (1) Stimulating tourism activities in the WSB region. |
| | (2) Strengthening local competitiveness in the world market. |
| 5. PHASING | Phase I |

6. DESCRIPTION

Several tourist centers and spots in the WSB region will be equipped with a tourism information network that will provide tourism business persons with the most updated information on domestic and international tourist arrivals, hotel reservations, in-bound and out-bound destinations, and so on. The tourism community will be able to support this project by itself. However, some government incentives such as tax deductions for investment cost may accelerate the arrival of the information age in this section.

| | |
|---|---|
| 7. RELATION WITH OTHER PROJECTS | TO5 (Tourism Information Service Promotion) |
| 8. COST (APPROX.) | Phase I: US$ 0.5 million. |

Project No. TL6

| | |
|---|---|
| 1. PROJECT TITLE | Information Highway for Education |
| 2. LOCATIONS | The WSB Region |
| 3. AGENCY | Rajabhat Institute and other colleges |
| 4. OBJECTIVES | (1) Improving local education level and facilitate human resources development.<br>(2) Creating mutual understanding between young people of Thailand and those of the rest of the world. |
| 5. PHASING | Phase I |

6. DESCRIPTION

The project will be launched at two levels at selected high schools and colleges. The project will provide the schools and colleges with computers and Internet services. One group will be linked to colleges and high schools in the United States, Japan, and/or the European Union to form sister schools and colleges through the information highway to facilitate (a) foreign language learning, (b) mutual understanding of the other side of the world, and (c) exchange of curriculum and courses to improve educational quality. Another group will be linked to schools, colleges, and universities in other ASEAN countries to further strengthen the bonds and understanding among the ASEAN peoples.

| | |
|---|---|
| 7. RELATION WITH OTHER PROJECTS | UD2 (Petchaburi Science City)<br>ED2 (High-technology University)<br>ED4 (Computer Availability Expansion) |
| 8. COST (APPROX.) | Phase I: US$ 0.5 million |

# Chapter 5 TRANSPORT

## *5.1 Existing Conditions, Development Constraints/Problems, and Plans*

### 5.1.1 Introduction

For each subsector under consideration (i.e., roads and road transport, water transport, railways, and air transport), this section reviews existing conditions, constraints and problems, as well as ongoing projects and plans for future development. The work was undertaken based on an analysis of previous studies and in-depth interviews with officers of the National Economic and Social Development Board, the Ministry of Transport and Communications, the Department of Highways, the Harbour Department, the Department of Aviation, the State Railway of Thailand, the Land Transport Department, and the Public Works Department, as well as with officers of the governments of the six Western Seaboard (WSB) provinces.[1] In addition, representatives of private-sector concerns with transport development plans in the region (e.g., the Sahaviriya Group, the Federation of Thai Industries) were interviewed. The work undertaken included, to the maximum extent possible, a review of the policies of the Eighth Five-Year Plan, (ii) a review of the investment plan prepared for each province in the region, (iii) analysis and review of the existing infrastructure and plans for development/improvement, and (iv) review of progress of development in other regions (e.g., Central, Eastern, and Southern regions) linked to the WSB.

[1]Including representatives of the Public Works Department and the Office of Accelerated Rural Development.

### 5.1.2 Roads and Road Transport

#### (1) Introduction

Road is the dominant mode for freight and passenger transport in the WSB, as it is generally in Thailand.[1] Also, along with port investments, road projects will be the major infrastructural investments that will shape the future development of the region.

#### (2) Network and Infrastructure

The road network in the WSB (Figure 9.5.1) under the jurisdiction of the Department of Highways (DOH) has been estimated at 2,595 km, of which about 96 per cent is paved, compared to the national average of 92 per cent. The greatest portion of paved road is found within Samut Songkhram province, Thonburi Division of DOH (100 per cent), the lowest in DOH's Prachuap Khirikhan Division (88.7 per cent).[2] The density of DOH roads in the WSB has been estimated at 0.06 km per $km^2$, compared to the national average of 0.10 km per $km^2$, and 0.86 km per 1,000 inhabitants, which is almost the same as the national average. However, available data indicates that rural road densities in much of the WSB are below the national average, especially in Kanchanaburi.

Generally, the road network in the WSB serves most of the region and links most urban centers. However, there are only indirect connections (i) between Bangkok and Ratchaburi, (ii) between Kanchanaburi and the other provincial capitals, (iii) between Samut Songkhram and Ratchaburi, and (iv) between Samut Songkhram and Petchaburi, which suggests that the road network is still immature in much of the region, resulting in a concentration of traffic along the major arteries. In some cases, however, indirect routings may be explained by topographical conditions, e.g., mountains in the western part of the region and a mangrove swamp that intervenes between Samut Songkhram and Petchaburi. Road links between the WSB and regions other than BMA (e.g., the Northern region, the Northeastern region, Ranong) are indirect. Also worth noting, although there are two Asian Highway routes traversing the region, (i) A2, a primary route that crosses Thailand from the Myanmar border in the north to the Malaysian border in the south, and (ii) A18, a secondary route running south of Chumphon, there are no significant road links between the region and Myanmar.

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[1] In 1991, the latest year for which fully comparable data are available, road transport accounted for 90 per cent of both freight and passenger movements in the Kingdom. Data for 1994 available from the Ministry of Transport and Communications suggest that the modal share for road within the WSB was about 96 per cent in that year.

[2] This division includes part of Petchaburi province.

Table 9.5.1 presents a detailed inventory of geometrics for roads in the WSB, as selected from databases available at DOH.

### (3) Institutions

The Department of Highways, under the Ministry of Transport and Communications, is responsible for the administration, planning, construction, and maintenance of all national and provincial roads in Thailand. Its responsibilities overlapping to some extent with those of DOH, the Expressway and Rapid Transit Authority (ETA) has been concerned with the provision of tolled expressways, mainly within Bangkok, but has recently proposed 772 km of intercity motorways. The provinces, under the Ministry of Interior, are generally responsible for rural roads, assisted by other agencies of the central government. Agencies involved include the Public Works Department, the Office of Accelerated Rural Development, the Community Development Department, and local governments, under the Ministry of Interior; the Royal Irrigation Department and the Agricultural Reform Office, under the Ministry of Agriculture and Cooperatives; and the National Security Command, under the Ministry of Defense. DOH's activities, however, account for the largest share of all investment in the road subsector in Thailand, although this share has been declining in recent years.

DOH is a well-organized, well-operated agency that functions with considerable autonomy. The Department has 19 central administrative divisions, 15 regional divisions, and 85 district offices. The largest department within MOTC, DOH has a staff of about 8,000. DOH's institutional competence is manifested in its continuing quest to improve maintenance performance; international transport experts generally acknowledge that Thailand's highway system is among the best maintained in Asia.

### (4) Vehicle Fleet

As shown in Table 9.5.2 and in the text table below, a total of 792,097 vehicles were registered in the WSB in 1994[1] (about 6.2 per cent of the national total), 255,329 in Ratchaburi, 164,549 in Kanchanaburi, 129,130 in Prachuap Khirikhan, 109,784 in Petchaburi, 98,809 in Chumphon, and 34,496 in Samut Songkhram. Motorcycles account for 74 per cent of the vehicles in the region.

[1] Data for 1994 is utilized here due to some anomalies in the 1995 data (e.g., a reported 132 per cent increase in vans and pickups in one province in 1995).

Motorization rates, calculated as the number of cars and light vehicles (excluding motorcycles) per 1,000 population, averaged 59 in the Western Seaboard, ranging from 42 in Prachuap Khirikhan and 43 in Chumphon, to 75 in Ratchaburi, as shown in Table 9.5.3 and below. Growth in vehicle registrations averaged 17.8 per cent in the WSB from 1990-94, ranging from 11.6 per cent in Kanchanaburi to 24.5 in Samut Songkhram and 25.5 per cent in Ratchaburi, also as shown in Table 9.5.3 and below.

**Vehicle Registration in the WSB (1994)**

| Province | Total No. of Vehicles | Motorization Rate[1] | Growth Rate in Number of Vehicles[2] |
|---|---|---|---|
| Kanchanaburi | 164,549 | 47 | 11.6 |
| Ratchaburi | 255,329 | 75 | 25.5 |
| Samut Songkhram | 34,496 | 48 | 24.5 |
| Petchaburi | 109,784 | 52 | 12.6 |
| Prachuap Khirikhan | 129,130 | 42 | 14.1 |
| Chumphon | 98,809 | 43 | 17.6 |

Note: (1) Number of cars and light vehicles (excluding motorcycles) per 1,000 population.
(2) Growth in cars and light vehicles (excluding motorcycles).

### (5) Traffic

Table 9.5.4 presents data on traffic on DOH highways in the WSB in terms of annual average daily traffic (AADT) or motor vehicles per day (MVPD), while Table 9.5.5 presents the same traffic data in terms of passenger car units (PCU).[1] Figure 9.5.2 presents the traffic data in terms of AADT (MVPD) graphically on a map of the WSB. Traffic (1994) on Route 4, the main north-south artery in the WSB, generally varies from 12,000 vehicles per day in Chumphon to over 31,000 in Ban Pong District, Ratchaburi. Traffic on Route 35, the second most important road in the WSB, connecting Route 4 from a point just north of the Ratchaburi/Petchaburi provincial border to Bangkok, is around 20,000 MVPD in the vicinity of Samut Songkhram. Traffic volumes at ten representative locations in the WSB are listed on the next page.

[1]DOH's current standards for widening (from two to four lanes) are stated in terms of AADT (MVPD), but a July 1992 Asian Development Bank sponsored study recommended that thresholds for widening be stated in PCU per day rather than AADT/MVPD since traffic mix and terrain, both of which control the relationship between AADT/MVPD and PCU, can vary widely.

**Traffic Volumes at Representative Locations (1994)**

| Route | Location | MVPD | PCU |
|---|---|---|---|
| 4 | Km 79+845 (Ban Pong District) | 31,436 | 51,455 |
| 4 | Junction Cha Am - Junction to Nong Kae | 15,139 | 21,709 |
| 4 | Junction Thap Sakae, Km 364+486 (Chumphon District) | 11,777 | 16,155 |
| 35 | Samut Songkhram-Route 4 (Pak Tho), Km 62+150 | 21,546 | 36,100 |
| 323 | Km 116+00 - Municipality of Kanchanaburi | 18,463 | 24,247 |
| 346 | Route 340 - Km 52+112 (Ban Pong District) | 11,638 | 21,065 |
| 3088 | Ratchaburi - Route 3093 | 8,304 | 11,124 |
| 3167 | Prachuap Khirikhan - Nong Hin | 2,137 | 3,229 |
| 3291 | Junction Route 4 (Chedi Hat) - Route 3087 (Khao Ngu) | 10,683 | 14,660 |
| 4098 | Pak Nam Chumphon - Hat Si Ri | 1,964 | 2,952 |

Region-wide traffic growth rates region between 1990 and 1994 averaged 12.9 per cent in terms of MVPD and 12.3 per cent in terms of PCU. However, the greatest rate of growth was found on three- and four-digit roads, 15.5 per cent both in terms of MVPD and PCU on three-digit roads and 12.3 per cent in terms of PCU and 14.3 per cent in terms of MVPD on four-digit roads.[1] Lower growth rates were found on the one- and two-digit roads, 10.5-11.4 per cent and 4.4-10.7 per cent, respectively.

Detailed road freight origin-destination data for 1994 are presented in Table 9.5.6, with major movements to and from the WSB highlighted in Figure 9.5.3; Tables 9.5.6A to 9.5.6F present the movements by six aggregated commodity groupings: agricultural commodities, minerals, construction materials, fertilizer and chemicals, equipment and other manufactured articles, and miscellaneous and containers. The underlying source of the tables and figures is a province-by-province database disaggregated by 22 commodities, compiled by the Ministry of Transport and Communications based on an annual (although limited) survey by the Land Transport Department.

Key findings follow:

[1]These rates are somewhat less than the region-wide rates for DOH's Central region (15.4 per cent in 1988-93), of which the WSB forms a part.

(i) Province-to-province flows within the WSB are very small at present, with the largest such annual flows only 71,170 tons, from Kanchanaburi to Samut Songkhram. While the data may understate such flows in certain cases, the general finding concerning the relative insignificance of intraregional flows may be accepted as accurate.

(ii) By far, the greatest flows affecting the Study Area are outflows to Bangkok and vicinity,[1] with 34.5 million tons from Ratchaburi province (88 per cent construction materials), 7.0 million tons from Kanchanaburi province (76 per cent construction materials), 2.5 million tons from Petchaburi province (71 per cent construction materials), and 1.4 million tons from Samut Songkhram province (59 per cent construction materials).

(iii) In addition, flows from Kanchanaburi to the Northeastern region (2.3 million tons, nearly 100 per cent agricultural products), the Northern region (2.0 million tons, nearly 100 per cent agricultural products), and Suphan Buri (1.2 million tons, 90 per cent agricultural products) are significant.

(iv) Also significant are certain inflows from Bangkok and vicinity, including 2.5 million tons to Ratchaburi, 1.3 million tons to Kanchanaburi, 1.2 million tons to Petchaburi, and 1.1 million tons to Prachuap Khirikhan. These flows include a mix of agricultural commodities, minerals, equipment and manufactured goods, among others.

(v) Flows from the WSB to Ranong and the Southern region are insignificant.

### (6) Road Transport Industry

The road passenger transport industry is regulated under the overall supervision of MOTC, through its Land Transport Department (LTD). The WSB, as are all of Thailand's regions, is well served by intercity and rural bus systems. Long-distance bus passenger demand has been increasing at 10-15 per cent per year while train usage has been static. Major issues, at both the national and regional levels, relate to terminals, regulation and route administration,

[1]Defined as Bangkok, Pathum Thani, Nonthaburi, Samut Prakan, Samut Sakhon, and Nakhon Pathom.

vehicle design and technology, management information, driver training, safety, and enforcement.

The road freight industry in Thailand consists mostly of owner-operators, although a few firms have several hundred trucks, including the Government-owned Express Transport Organization. The industry, as far as domestic transport is concerned, is essentially free of economic regulation. The overloading of trucks is fairly common and has implications for road safety, maintenance, and the enforcement of traffic laws. Truck overloading, however, is essentially limited to the major bulk commodities, which are carried on ten-wheel trucks largely on the major trunk corridors, such as Route 4 in the WSB.

### (7) Road Safety

Road safety is a significant transport (and public health) problem in the region, with an average of 630 fatalities per year from 1992 to 1994 according to DOH data (Table 9.5.7), or about 5.8 per cent of the Kingdom's total during that period; Chumphon had the highest number of road traffic fatalities in the WSB, an average of 187 per year. The rate of traffic-related deaths per 10,000 vehicles in the WSB from 1992 to 1994, 8.8, was somewhat lower than the Kingdom-wide average during the period (about 12.0), but still was many times higher than rates in developed countries (e.g., 1.8 in Japan, 2.3 in Australia).[1]

### (8) Summary of Constraints/Problems

Constraints/problems in the road and road transport subsectors in the Western Seaboard include the following:

(i) the immaturity of the primary road network in places, e.g., reflected by poor links between Bangkok and Ratchaburi, between Kanchanaburi and the other provincial capitals, between Samut Songkhram and Ratchaburi, and between Samut Songkhram and Petchaburi, resulting in a concentration of traffic along the major arteries;

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[1]Moreover, the numbers are believed to be higher in Thailand because accident records are neither accurate nor complete. Data (1995) from the public health authorities, presented in the chapter on public health (Chapter 3) of Volume 2 on the Social Environment, show higher levels of road fatalities, with 336 in Kanchanaburi, 137 in Ratchaburi, 19 in Samut Songkhram, 178 in Petchaburi, 384 in Prachuap Khirikhan, and 254 in Chumphon. Road accidents were the single leading cause of death in Chumphon, the second-leading cause of death in Kanchanaburi, Petchaburi, and Prachuap Khirikhan, the fifth-leading cause of death in Samut Songkhram, and the seventh-leading cause of death in Ratchaburi.

(ii) the need to improve secondary and rural routes, including the provision of feeder roads, such as between Route 4 and the Bang Saphan industrial complex, between the Bang Saphan industrial complex and the new Chumphon (Pathiu) Airport, and between Route 4 and the new Chumphon (Pathiu) Airport;

(iii) the need to improve road connections between the WSB and regions of Thailand other than the BMA (e.g., the Northern region, the Northeastern region, Ranong);

(iv) the lack of proper road links between the WSB and Myanmar;

(v) the need for adequate maintenance of existing facilities, to avoid expensive road reconstruction and rehabilitation; and

(vi) other sector issues, such as road safety.

**(9) Development Potentials and Plans**

Development potentials in the road and road transport subsectors in the WSB include:

(i) feeder routes to Route 4 or motorways that may be developed;

(ii) better connections within the WSB (e.g., improvement of secondary roads); and

(iii) better links with other regions, including improvement of Route 4 and development of parallel motorways (as required), such as between Ban Pong and Cha Am, and including the development of an outer-outer orbital route for Bangkok; and

(iv) a link or links with Myanmar to provide an outlet to western-situated countries (e.g., through development of a road connection between Kanchanaburi and a deep-sea port in Myanmar, most likely at Tavoy/Dawei).[1]

[1] In this chapter old Burmese names are listed along with new Myanmar names, separated by a slash. Thus, for example Tavoy is the old spelling, while Dawei is the new spelling.

Partly in response to these development potentials and constraints summarized previously, there are a number of planned improvements in the road system in the WSB and surrounding regions. Some highlights are set out below:

(i) The Final Report of the *Long-Term Strategic Study of Highway Planning and Investment*, completed in May 1995 by consultants to DOH, developed a new long-term (i.e., 20-year) plan for expansion and improvement of the national strategic highway network. Table 9.5.8A sets out project proposals in the plan affecting the Western Seaboard from 1996 to 2011, the time horizon of the WSB study. One motorway proposal, from Ban Pong to Cha Am (feasibility study completed by JICA in March 1995, now under detailed design) is included in this time period, although others were put forward for the period from 2011 to 2016. The remainder are primarily widening proposals, to 2-, 3-, and 5-lane dual carriageways in various sections of Routes 4, 323, and 325, and one new construction project (Nakhon Chaisi-Nakhon Pathom-Ratchaburi programmed for 2006-2011).

(ii) A number of motorway plans affecting the study area have been prepared, in addition to that included in the *Long-Term Strategic Study*. The most recent is the 1996 plan prepared by Department of Highways (see Figure 9.5.4), which is an updated and revised version of the plan prepared in the 1990-91 JICA-assisted *Toll Highway Development Study in the Kingdom of Thailand*, with the latest DOH plan including Ban Pong/Cha Am as a priority section, along with a north-south corridor traversing the WSB (so-called Route 8), an outer-outer orbital route for the extended Bangkok Metropolitan region (Route 91), and a Ban Pong-Kanchanaburi motorway section (Route 81); Table 9.5.8B presents the proposed implementation schedule for this plan, which as of this writing is still awaiting Cabinet approval. Another motorway study, prepared by the Expressway and Rapid Transit Authority of Thailand and finalized in October 1992, recommended 772 km of intercity expressway, including an alignment to the south as far as Cha Am, running west of Route 4 (Figure 9.5.5); the DOH and ETA plans represent a clear duplication of effort within the WSB. The overall transport strategy, developed as part of the Bangkok Regional Structure Plan, included development of a network of motorway standard routes, including an initial route in the southern corridor, i.e., along or west of Route 4 toward Prachuap Khirikhan.

(iii) DOH has a number of additional ongoing or proposed projects that affect the WSB. For example, with respect to the outer-outer orbital route, DOH notes that it has been widening Route 321 from Nakhon Pathom to Suphan Buri (from two lanes to a two-lane dual carriageway), and that some sections from Suphan Buri north to Chai Nat have been widened already to a two-lane dual carriageway; east of Suphan Buri, construction has just been finished on Route 329 to Pa Mok (with further extension to Suphan Buri planned), a new two-lane facility, which can be widened further if traffic warrants. There is also a proposal for building a new road from Pa Mok, on Route 329 east of Suphan Buri, to Plaeng Yao in Chachoengsao province. Regarding a short-cut route between Ratchaburi and Bangkok, an eight-month study assessing an extension of Route 338 to a point between Ban Pong and Ratchaburi commenced in October 1996; in addition, there is a proposed new road project linking a point on Route 3091 north of Samut Sakhon (Thumbaen) with Route 325 and then perhaps later to Ratchaburi. Also worth noting, DOH has a secondary road under construction completing the connection between Bang Saphan and Pathiu, by filling in the "missing link" south of Route 3411; and DOH has been constructing a secondary road connecting Routes 4139 and 4091, between Chumphon and Ranong. For reference purposes, Table 9.5.8C presents a preliminary list of road projects affecting the WSB to be included in the Eighth Plan, which reflects DOH's latest thinking for the region.

(iv) Other concerned authorities--e.g., the Public Works Department, the Royal Irrigation Department, and the Office of Accelerated Rural Development--also have plans for smaller rural and municipal roads in the WSB.

(v) Finally, the private sector has put forward at least one proposal, that of the Federation of Thai Industries (Kanchanaburi Branch) for the Kanchanaburi-Tavoy/Dawei Corridor.

### 5.1.3 Water Transport

#### (1) Introduction

As noted, along with roads, ports will be among the major infrastructure projects that will shape the future development of the WSB. The development of the region will require at least one major deep-sea port as well as feeder ports at strategic locations. Also, related to (sea)ports, inland water transport along the Mae Klong River system can play a (limited) role in the regional transport system.

#### (2) Infrastructure

The largest port facilities in Thailand are found in Bangkok and the Eastern Seaboard (Laem Chabang), with smaller deep-sea ports at Songkhla and Phuket in the South. A target of 1.0 million TEUs of containerized throughput at Bangkok Port has been set by the Ministry of Transport and Communications to reduce adverse road traffic congestion impacts in Bangkok. The surplus from Bangkok is to go via Laem Chabang, with expansion planned to adequately serve this additional traffic; indeed, prospects for Laem Chabang are as bright as ever with several shipping companies offering regular services beginning in 1996.

The most significant port in the WSB is now Prachuap, a deep-sea port recently developed by the private-sector Sahaviriya Group at Bang Saphan in Prachuap Khirikhan province. Key features of the facilities at Prachuap Port are outlined briefly below:

(i) The natural water depth in the vicinity—a seabed contour of -15 m below MSL (mean sea level) lies as close as 900 m to the coast line—offers the potential for developing a deep-sea port capable of accommodating cargo vessels ranging from 50,000 to 100,000 dwt (deadweight tons).

(ii) At present, the port consists of a 490 m long main berth 15 m below MSL and a 245 m long secondary berth 10 m below MSL; maximum berthing capacity is 45,000 dwt at the main berth and 7,000 dwt at the secondary berth. Tidal operation is required to receive vessels above 30,000 dwt, however.

(iii) The port configuration is rather tightly spaced for large vessels maneuvering inside the breakwater-protected basin; however, a jetty plan will allow 200,000 dwt vessels to enter.

(iv) Cargo handling is mainly by ship derrick cranes assisted by onshore mobile cranes.

Other existing seaports in the Western Seaboard—including Samut Songkhram, Ban Laem (Petchaburi), Prachuap Khirikhan, and Chumphon—are relatively insignificant at present. These include shallow-draft coastal ports that vary greatly in size and consist in some cases of little more than wooden wharves or jetties for landing fish and small volumes of cargo.

There are also a number of small "outports" (i.e., feeder ports) on Myanmar's Andaman Sea coast, including Moulmein/Mawlamyine, Tavoy/Dawei, Mergui/Myeik, and Victoria Point/Kawthaung. Tavoy/Dawei, the site that has received the most attention to date with respect to the WSB, has at present only three small jetties located at the southern end of Tavoy/Dawei town on the west bank of the Tavoy/Dawei River, some 50 km upstream of the Andaman Sea.

Finally, the region's water transport infrastructure includes the Mae Klong River, which connects with the rest of the Thai waterways system via the Tha Chin and Sappasamit Canals. Generally, the Mae Klong River is navigable and barges can reach upstream as far as Ratchaburi.

### (3) Institutions

The Harbour Department, under the Ministry of Transport and Communications, is responsible for planning, undertaking and controlling maintenance, improvement, and navigation in coastal ports and on inland waterways in Thailand. The Harbour Department is also providing general oversight as well as dredging and pilotage services for the new deep-sea ports at Songkhla and Phuket, which are owned by the Treasury Department of the Ministry of Finance and managed by a private concern under a ten-year operating agreement. The ports of Bangkok and the Laem Chabang are managed by the Port Authority of Thailand.

### (4) Traffic

Traffic data for Prachuap Port, as obtained by the JICA Bang Saphan team, indicates 2.4 million tons of throughput in 1995, about two-thirds of which was export traffic. The number of ship calls in 1995 was 366, about one per day. Most cargo was steel related, but locally based general cargo (mainly cement) totaled perhaps as much as 500,000 tons in 1995, a significant amount considering the port's early development stage.

A total of about 1.358 million tons of traffic was handled at the region's four smaller coastal ports in 1993, the latest year for which comprehensive, non-preliminary data was available (see Table 9.5.9). Samut Songkhram was the busiest of the coastal seaports, with about 780,000 tons of traffic, of which over 90 per cent consisted of petroleum products. The next busiest was Ban Laem, with about 290,000 tons of traffic, of which 64 per cent consisted of cement and 30 per cent of minerals. The third busiest was Chumphon, with about 250,000 tons of throughput, nearly 100 per cent of which consisted of petroleum products. The port at Prachuap Khirikhan handled less than 40,000 tons of traffic in 1993, but according to preliminary data, registered a big increase in traffic in 1994.

Regarding inland waterway traffic, Harbour Department data from 1994 show that about 300,000 tons of minerals and construction goods passed through Ratchaburi province and about 650,000 tons (mainly fuel) passed through Samut Songkhram province. Data obtained from MOTC indicate significantly greater quantities passing through Mae Klong River Canals in 1994 (e.g., over 2 million tons of agricultural products).

### (5) Constraints/Problems

Constraints/problems in the water transport subsector in Thailand in general and the Western Seaboard and vicinity in particular include the following:

(i) congestion and a limit on the traffic that may use Bangkok Port, coupled with emerging capacity constraints at Laem Chabang (the latter to be addressed, at least in the short or intermediate term, by an expansion plan);

(ii) the lack of a feeder service between the WSB and the BMA/ESB regions;

(iii) some constraints on expansion of Prachuap Port at Bang Saphan, a consequence of a tightly spaced port configuration inside the breakwater-protected basin;[1]

(iv) difficulties in using the shallow coastal ports in WSB and in finding suitable new port locations in the Upper WSB; and

(v) constraints on inland water transport along the Mae Klong River system, mainly a result of low water depth.

**(6) Development Potentials and Plans**

Development potentials in the water transport subsector in the WSB and vicinity include:

(i) the development of a large deep-sea port, probably at Bang Saphan, to serve general cargo traffic possibly including some of the transshipment traffic now transiting Singapore;

(ii) the development of a ro-ro truck ferry service between the WSB and the BMA and/or ESB (probably the latter, considering congestion at the former), in order to promote linkages and provide a cost-efficient freight distribution system serving points overseas, the ESB, the WSB, and points south of the WSB (e.g., Ranong, the SSB, the Lower South);[2]

(iii) the development of feeder (i.e., coastal) ports at suitable locations within the WSB; and

(iv) improvement of inland water transport infrastructure in the Mae Klong River system, to efficiently link the Mae Klong with Thailand's other inland rivers and with major ports via the Gulf of Thailand.

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[1]There may also be constraints to having the private Sahaviriya Group, a major user of the port, operate a general cargo port open for use by all shipping lines.

[2]The water transport development strategies included in the 8th Plan include "linking inland water transport with the southern and eastern coasts, to promote water transport as one measure to ease traffic congestion in Bangkok and its perimeters and also to promote water transport as part of multi-modal transport."

Partly in response to these development potentials and constraints summarized previously, a number of planned improvements in the water transport system in the Western Seaboard have been put forward, as set out below:

(i) To accommodate steel cargo and general cargo, the JICA Bang Saphan team has put forward a possible port expansion plan to expand the berths within the existing tightly spaced port configuration. In addition, the steel complex is planning to construct a jetty capable of handling iron ore and coat via 200,000 dwt-class vessels.

(ii) The Khi Dha Group, a Thai private-sector concern, has obtained a license from the Ministry of Transport and Communications to construct feeder port facilities and operate ro-ro cargo ferry services connecting Chumphon with Laem Chabang and Laem Chabang with Samut Sakhon, thereby linking the WSB and the ESB; they were planning to commence their "Siam Sea Link" operation in April 1997, first using Bang Saphan rather than Chumphon, to take advantage of existing facilities at the former location.

(iii) A number of additional feeder port proposals have been put forward by local authorities. For example, Samut Songkhram provincial authorities have proposed construction of a general cargo port at the mouth of the Mae Klong River capable of receiving vessels up to 5,000 dwt. In a competing proposal, Petchaburi authorities have put forward a plan for a feeder port at Ban Laem.

(iv) The Harbour Department commenced a 15-month Study of the Mae Klong and Tha Chin Rivers in June 1996, with the objective of improving the connection between all of Thailand's navigable rivers and its international ports.

### 5.1.4 Railway Transport

#### (1) Introduction

While roads are of great importance in the transport system of the Western Seaboard, railways could potentially play a vital role.[1] Railways can move bulk loads or large numbers of passengers over long distances more efficiently than road transport, and with greater energy efficiency and less severe environmental impacts. While the State Railway of Thailand (SRT, formerly known as Royal State Railways) is beset with deteriorating infrastructure and financial problems, they are seeking to move toward a more market-oriented outlook to improve their ability to compete with road transport. The demand for new rail services, both passenger and freight, is likely to remain constrained, however.

#### (2) Infrastructure and Services

The railway system in the Western Seaboard consists of three lines:

(i) the main Southern Line (1,144 km), which starts at Bangkok/Thonburi and runs westward to Nong Pla Duk junction (80 km west of Bangkok), and then proceeds southward to Chumphon (485 km from Bangkok) and the Southern region, and then on to Malaysia and finally Singapore;

(ii) the Nong Pla Duk-Nam Tok Line (132 km), running westward to Kanchanaburi and then across rugged terrain, terminating at Nam Tok station in Amphoe Sai Yok; and

(iii) the Wong Wien Wai-Mae Klong Line (31 km plus 34 km), which connects Thonburi (Wong Wien Yai) and Samut Songkhram (ending on the east side of the Mae Klong River), is discontinuous as it breaks at the Tha Chin River in Samut Sakhon at a ferry crossing (Mahachai), and is operated as a separate unit since it does not connect with any other SRT lines.

The quality of railway infrastructure within the Western Seaboard region may be characterized as follows:

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[1] This point was stressed at the Seminar in October 1996 by the Director of MOTC's and Transport Communication Policy and Planning Bureau.

(i) Right of way is as wide as 40-80 m, but only 14-20 m on the Mae Klong line.

(ii) The maximum axle load on the network is 15 tons.

(iii) Studies in the mid-1980s concluded that the roadbed is generally stable, and track maintenance and riding quality are good. However, there is more than one rail failure (broken rail) per day (countrywide), pointing to the need for a large track replacement program.

(iv) A number of railway bridges within the WSB require strengthening.

(v) SRT's motive power and rolling stock are relatively old, with the diesel locomotives and passenger cars averaging about 23 years of age and the freight wagons over 30 years. The maximum speed of most wagons is 40 kph, which greatly lowers capacity and operating speeds.

(vi) SRT's signalling and telecommunications systems are now adequate, a result of a recent project financed by the Overseas Economic Cooperation Fund of Japan.

The quality of the railway services in the Western Seaboard region may be described as follows:

(i) Speeds are relatively low, largely a consequence of the condition of the rolling stock, the lack of track fencing, and the need to slow or stop trains for road traffic at grade crossings or to pass other trains on single-track sections. As shown in Figure 9.5.6, which provides the basic technical and operational data of relevant sections of the Southern Line, the average speed varies from only 52 to 71 kph between Bangkok and Chumphon. SRT has difficulty competing with truck delivery times because passenger trains are accorded line priority.

(ii) Schedule reliability is relatively high, at least compared with other developing countries.

(iii) Safety should be improved, with an average of 267 fatalities per year on the nation's railway system from 1990 to 1994.

### (3) Institutions and Financial Performance

The State Railway of Thailand, a state enterprise under the Ministry of Transport and Communications, was established as an independent legal entity under the State Railway of Thailand Act of 1951. The formulation of policies and the supervision of the general affairs of SRT is the responsibility of a Board of Commissioners, comprised of a chairman and four to six members. The Government approves the borrowing of money, tariff revisions, and the abandonment of lines.

SRT's operations are considered well-managed and its staff competent. In terms of traffic units[1] per employee, SRT ranks second among ten Asian railways reported in a recent World Bank tabulation and eighteenth among 78 railways reporting worldwide.

However, SRT has been operating at a net loss for the last 20 years; financial highlights from 1986 to 1993 are set out in Table 9.5.10. Over the last decade, net losses have averaged about 0.5 billion Baht per year. Labor accounts for about 60 per cent of the direct operating cost of SRT, with fuel and materials accounting for most of the remainder. The poor condition of SRT's assets and the advanced age of its rolling stock result in high maintenance costs, equal to about half of total operating cost.

SRT's consolidated losses require subsidies of about one billion Baht per year for operating losses and debt service. With adequate maintenance standards, the amount of subsides would be 4 billion Baht per year. No line-by-line breakout is available, but is clear that the biggest lossmakers are the branch lines (e.g., the Nong Pla Duk-Nam Tok Line and the Wong Wien Wai-Mae Klong Line).

A recent *SRT Master Plan Development Study* prepared by the Thailand Development Research Institute (TDRI) set out a number of useful recommendations for improving the Railway's operations. The main recommendation was the establishment of a Public Service Obligation (PSO) agreement with the Government, which would contract for the unprofitable services that it requires, paying compensation to SRT for providing them. Additional recommendations included increasing the size and importance of the railway's marketing organization, providing competitive salaries for management staff, and upgrading the organization's personnel function.

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[1] I.e., the sum of passenger-km and ton-km.

### (4) Traffic

An examination of the railway traffic data available from SRT and the Ministry of Transport and Communications (see Tables 9.5.11A and 9.5.11B), shows the following specifically with respect to the Western Seaboard:

(i) Passenger railway transport is most important in Chumphon (1.87 million passenger loadings and unloading in 1994), followed by Kanchanaburi (1.11 million), Prachuap Khirikhan (0.97 million), Ratchaburi (0.96 million), Samut Songkhram (0.48 million), and Petchaburi (0.38 million). In most cases, Bangkok is the most significant origin/destination,[1] but there is also a significant amount of intra-WSB passenger traffic by rail as well as traffic to other destinations. The WSB's share of total national railway passenger traffic was 4.9 per cent in 1994, about the same as the region's share of the Kingdom's population.

(ii) Freight transport by railway is not at present very significant in the WSB. The most significant provinces for railway freight transport within the region are Chumphon (127,319 tons of loading and unloading in 1994), Petchaburi (115,118 tons), and Ratchaburi (100,790 tons), with the other provinces much less significant, especially Samut Songkhram, to/from which there are no rail freight movements. The most significant commodities are "other" agricultural products and cement unloaded at Chumphon. The WSB's share of total railway freight traffic was 2.6 per cent in 1994, much less than the region's share of the Kingdom's population (4.9 per cent).

### (5) Summary of Constraints/Problems

Constraints/problems in the railway subsector in the Western Seaboard may be summarized as follows:

(i) relatively short trip distances and low operating speeds that put the railway at a disadvantage relative to truck and bus transport, and limit the railway to a relatively small share of the total freight transport market;

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[1] According to data presented in the *High Speed Train Study*, in 1989/90 15.8 per cent of the person trips to and from Bangkok in the Southern Corridor were by rail, compared to 49.2 per cent by bus, 33.1 per cent by car, and 1.9 per cent by air.

(ii) deteriorating infrastructure and facilities, as manifested by poor track quality, weakened bridges, and aging rolling stock;

(iii) a single track configuration throughout the study region, which limits capacity and operating speeds;

(iv) missing links in the regional railway network; and

(v) SRT's poor financial condition, which limits the enterprise's ability to invest in needed improvements.

**(6) Development Potentials and Plans**

Development potentials in the railway subsector in the WSB include:

(i) the development of spur or long loop lines, e.g., to Prachuap port in Bang Saphan;

(ii) connecting the Nong Pla-Nam Tok Line with the Northern and Northeastern regions by constructing a new link between the Nong Pla Duk-Suphan Buri Line and the Northern and Northeastern Lines;

(iii) connecting the Wong Wien Yai-Mae Klong Line with the Southern Main Line by constructing a Samut Songkhram-Pak Tho link, and with other lines by constructing a Thonburi-Bangkok link;

(iv) the improvement of freight transport, through a more modernized approach to intermodal transport, and through aggressive responses to specific opportunities (e.g., the transport of wood chips to a new paper mill in Kanchanaburi);

(v) international haulage of freight, particularly if unit movements of trains were permitted across Thailand and Malaysia uninterrupted;

(vi) improved tourist train services between Bangkok and Hua Hin/Cha Am; and

(vii) the development of a quality intercity rail passenger system, to promote interregional integration.

Partly in response to these development potentials and constraints summarized previously, planned short-term improvements in the railway system in the Western Seaboard include 25 km of double tracking in Chumphon province between Wi Sai and Khao Evan Durian; some bridge work at 10 locations on the Southern Line between Km 227 and Km 456; turnout replacement at various locations (Nam Pla Duk, Ratchaburi, Petchaburi, Cha Am, and Hua Hin); preparation of road crossing barriers at over 3,000 locations along the Southern Line; and installation of two-color signaling on the Southern Line between Chumphon and Thung Song.

In the longer term, there are a number of planned improvements in the railway system, both nationally and in the Western Seaboard:

(i) The *SRT Master Plan Development Study*, completed in May 1993, prepared a 20-year investment plan for SRT that reflects new directions recommended for the railway. Major elements of the plan include a nationwide double tracking project, investment in about 10 locomotives per year, continuation of the recent level of investment in wagons and coaches, replacement of rail at a rate of about 3 per cent per year, and replacement of 30 per cent of shops and depots over 20 years. No specific programs for the WSB or other regions were put forward, however.

(ii) The *High Speed Train Study*, completed in March 1994, was a national and regional strategy study, intended to analyze the possible introduction of high-speed rail passenger services. The Southern Corridor, which passes through the WSB, was one of the corridors assessed. The study concluded that there might be an economic rationale for building high speed rail in the Southern Corridor, but only if fares are low; economic rates of return ranged from 17.3 to 18.3 per cent when the rail fare was set at only two times the bus fare.

(iii) Some recent and planned international studies have considered or may consider improvements to the Southern Line, which traverses the WSB onward to Malaysia. One is the *Report on the Development of the Trans-Asian Railway in the Indochina and Asean Subregion*, prepared by the Economic and Social Commission for Asia and the Pacific (ESCAP), which among other considerations, addresses non-physical barriers to cross-border railway transport. Another is a proposed Association of Southeast Asian

Nations (ASEAN) study of a high-speed railway linking Singapore, Malaysia, and Thailand as part of the Trans-Asian Railway.

(iv) Finally, the 1991-92 JICA-assisted *Tourism Development Study on Hua Hin Cha Am Beach Area in Thailand* proposed the introduction of a special tourist train to Cha Am and Hua Hin.

### 5.1.5 Air Transport

#### (1) Introduction

Air transport can play an important role in the development of at least part of the Study Area. For locations farthest from Bangkok (e.g., Chumphon and Prachuap Khirikhan provinces), air services have the potential (i) to allow business and professional persons to link with trading partners and with sources of capital and technology; (ii) to facilitate tourism; and (iii) to open up markets for certain exports with high value/weight ratios and which can be produced advantageously as a consequence of various factors, such as climate and resource availability.

#### (2) Infrastructure

At present, there are two airports in the Western Seaboard serving civil aviation, and a third airport[1] is to open in the first half of 1997:

(i) Hua Hin Airport has a relatively short asphaltic concrete runway, 1200 m x 30 m, suitable only for ATR 72 class aircraft (62-seat capacity) with reduced payloads (40 passengers).[2] Also, there are often turbulent crosswinds to the runway. Aids to navigation at Hua Hin include NDB (non-directional (radio) beacons), DME (distance measuring equipment), PAPI (precision approach path indicator), and runway lighting. Hua Hin Airport is mainly used as by the Flight Training Institute under the Ministry of Transport and Communication, although it also serves one trip per day to and from Bangkok.

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[1] There is also a military aviation facility in Prachuap Khirikhan.

[2] The existing pavement strength of the runway at Hua Hin, PCN 10, is at best only marginally suitable for ATR 72 class aircraft.

(ii) The Thai Aerospace Company (TASCO) recently opened a 600+ million Baht general aviation facility northwest of Ratchaburi city. The aerodrome's asphaltic runway is 1400 m x 30 m. The privately operated facility in Ratchaburi hopes to attract smaller general aviation aircraft with its relatively low aircraft parking charges, 3,000 Baht per month compared with the 600 Baht per day charge assessed in Bangkok by the Airports Authority of Thailand. TASCO is also planning some aviation-related manufacturing and repair activities at Ratchaburi.

(iii) In addition, a 453 million Baht airport will be opening during the first half of 1997 at Pathiu, north of Chumphon; the master plan for the airport is set out in Figure 9.5.7. The 2100 m x 45 m runway will be suitable for B737 class aircraft.

Although not in the WSB, it is worth noting that an airport was opened at Ranong (south and west of Chumphon) in October 1995, with a 2,000 m x 45 m runway, i.e., suitable for B737 class aircraft. Daily service is now provided by Bangkok Airways.

### (3) Institutions

The Royal Thai Government regulates and operates the country's civil aviation system through a number of aviation-related organizations under the Ministry of Transport and Communications (MOTC). The Department of Aviation has the responsibility for operating most of the country's airports, and plays a key role in aviation safety. Other agencies involved in the country's civil aviation subsector include the Airports Authority of Thailand, which is charged with the operation of the Bangkok International Airport and three additional international airports; Aerothai Company, which provides en route air traffic control and communications services within the Bangkok Flight Information Region, and which operates aerodrome and approach control services at three airports; the Department of Meteorology, another MOTC department, which provides aviation weather data; and the Civil Aviation Board, which advises MOTC on aviation policy. While there are several organizations involved in the aviation subsector in Thailand, they tend to take a similar approach to addressing aviation issues because of close interrelationships among the organizations.

### (4) Traffic

Generally, domestic air traffic in the Kingdom of Thailand has been increasing rapidly in recent years. For example, the total number of passengers carried on domestic flights more than doubled between 1990 and 1994, from 3.21 million to 7.44 million, an annual average increase of 23.3 per cent.

Traffic at Hua Hin Airport, the only airport in the region that currently has scheduled services (Bangkok Airways since April 1989), decreased to 589 aircraft movements in 1994, down from 1,280 in 1993 and 1,274 in 1992. The total number of passengers at Hua Hin Airport peaked in 1992 at 19,233, then decreased by 15.3 per cent to 16,283 in 1993, and by 31.2 per cent to 11,209 in 1994. Passengers carried as a percentage of aircraft seating capacity decreased from 43.7 per cent in 1990 to 34.5 per cent in 1993. The modal share of air transport for visitors to Cha Am and Hua Hin was reported as only 0.2 per cent and 0.4 per cent, respectively, in 1991, indicating that air is not an important transport mode for the area. No air freight is handled at Hua Hin at present.

### (5) Summary of Constraints/Problems

The main constraint to developing air transport in the Western Seaboard is limited demand, because of proximity to Bangkok in the case of provinces in the northern part of the region, and because of the small market area in the southern part of the region. Further, the already limited market demand for air transport in the WSB may decrease with the development of improved roads (e.g., motorways) in the region. There are also site-specific constraints, such as at Hua Hin, where expansion of the runway may require (expensive) relocation of Route 4 and perhaps also SRT's Southern Line, both which are very close to the end of the runway; or at Pathiu, where the roads to/from Route 4 and Bang Saphan require upgrading.

### (6) Development Potentials and Plans

Development potentials in the civil aviation subsector in the WSB include:

(i) serving both air passenger and freight transport demand in the southern part of the WSB, i.e., that part most remote from Bangkok;

(ii) increasing the size of the market area for air transport, perhaps by improving communication with areas in Myanmar across the border from the WSB; and

(iii) developing facilities to serve tourists.

Partly in response to these development potentials and constraints summarized previously, the Department of Aviation has been constructing a new Chumphon (Pathiu) Airport, as discussed previously. In addition, the Department has been conducting an in-house study of extending the runway at Hua Hin, but because of the need to relocate the nearby road and possibly also the railway, have preliminarily estimated project costs at more than 1 billion Baht. Another proposal worth noting, because of its proximity to Chumphon, is the project to improve Surat Thani Airport, by extending the runway to 3,000 m to serve B747 class aircraft, to expand the terminal facility, and to widen the access road to four lanes. Also worth noting is the proposal of the Thai Government in 1995 to create an Air Linkages Working Group under the Greater Mekong Subregional Transport Forum, to consider new air routes between countries in the subregion, including between Thailand and Myanmar; the Working Group's first meeting took place in August 1996 at Pattaya.

## *5.2 Transport Forecasts*

### 5.2.1 Methodology and Synopsis of Findings

This section presents an overall framework for the development of the various transport subsectors based on the following:

(i) broad concepts (e.g., globalization and subregional cooperation) on which the overall integrated regional development master plan was based;

(ii) demand forecasts available from existing databases and other studies;

(iii) the spatial and socioeconomic frameworks adopted in other volumes of this WSB study; and

(iv) broad global, national, and regional trends in the transport and related sectors.

The *broad concepts* on which basis the overall regional development master plan was produced, set out in the Main Volume of this Report, include globalization (the WSB as a center for promoting international linkages and as a crossroads of industrial and trade belts), subregional cooperation with Myanmar, and interregional linkages within Thailand.

*Existing databases and other studies* considered include a wealth of materials collected from the Ministry of Transport and Communications, the Department of Highways, the Harbour Department, the State Railway of Thailand, the Department of Aviation, the Land Transport Department, the Public Works Department, as well as from the World Bank and the Asian Development Bank.

The *socioeconomic framework* entailed three development scenarios for the region's economic growth, as set out in the Macroeconomics volume; the medium-growth scenario, the one adopted, forecast an annual average rate of economic growth of 9.4 per cent for the WSB from 1994 to 2001, 9.2 per cent from 2002 to 2006, and 8.7 per cent from 2006 to 2011. In addition, an annual population growth rate of 1.0 per cent was forecast for the region from 1994 to 2011.

The *spatial development framework* (summarized in the Main Volume and Volume 4 entails the following aspects with respect to transport: (i) a multiple access model supported by multiple transport modes to meet a variety of needs,[1] (ii) upgrading of the road system as the prime mode of transport, (iii) establishment of alternative links to Myanmar and alternative outlets to the Andaman Sea, (iv) establishment of sea lanes as an integral part of the multimodal transport system, (v) rehabilitation of the railway to serve a diversity of needs (e.g., bulk cargo transport, tourism), and (v) provision of key infrastructure in the various macro-zones in the WSB (e.g., for the Ratchaburi regional center, establishment of direct road links with other provincial capitals and the BMA; for the Ban Pong domestic market-oriented industrial zone, an improved linkage with the Upper Central region bypassing the BMA).

Finally, general trends taken as part of the *transport development framework* include: (i) the expansion of economic and social activities and resulting growth in transport demand; (ii) the tendency for transport demand to shift from high-value, low-value commodities to higher-value, lower-volume products; (iii) the increased importance of quality of service, including reliability and efficiency, which will cause transport demand to focus on time-efficient services such as door-to-door trucking and air freight; and (iv) rapid growth in the use of containers.

[1]Different points or areas in the region should be accessible from other areas by various modes of transport.

The (domestic) demand forecasts by transport subsector, derived in the following subsections, may be summarized as follows:

**Traffic Demand Forecasts**

| Traffic Indicator | Growth Rate (%) | Period |
|---|---|---|
| Vehicular Road Traffic | 11.1 | 1997-2001 |
| | 10.2 | 2002-2006 |
| | 8.7 | 2007-2011 |
| Road Freight Tonnages | 11.7 | 1997-2001 |
| | 9.1 | 2002-2006 |
| | 8.5 | 2007-2011 |
| Port Traffic-Prachuap | 18.0 | 1995-2001 |
| | 15.3 | 2001-2006 |
| | 12.4 | 2006-2011 |
| | 15.4 | 1995-2011 |
| Port Traffic-Coastal Ports | 21.0 | 1997-2006 |
| | 15.0 | 2007-2011 |
| Rail Traffic | | |
| - tons (freight) | 3.0 | 1997-2011 |
| - ton-km (freight) | 1.0 | 1997-2011 |
| - passengers | 1.0 | 1997-2011 |
| - passenger-km | - | 1997-2011 |
| Air Traffic | | |
| - passengers | 15.0 | 1997-2000 |
| | 10.0 | 2001-2011 |
| - tons (freight) | 30.0 | 1997-2001 |
| | 20.0 | 2002-2011 |

In addition, present and future cross-border demand with Myanmar is addressed, with the broad conclusion reached that the potential for such traffic is considerable. These forecasts will provide the basic background with which to evaluate the development options and projects set out in the final section of this chapter. For the analysis of priority projects, however, it is anticipated that more detailed project-specific information will supplement these broad overall forecasts.

### 5.2.2 Road Transport

#### (1) Vehicular Traffic

An assessment of vehicular road traffic trends, both at the national and the regional levels, shows the following:

(i) Overall annual national average road traffic growth rates were 11.2 per cent from 1983 to 1993 and 15.2 per cent from 1988 to 1993. GDP growth rates

(adjusted for inflation) during this period have been 8.7 per cent and 9.6 per cent, respectively, implying an elasticity of traffic growth with respect to GDP in the range of 1.29 to 1.58 at the national level.

(ii) As reported in Tables 9.5.4 and 9.5.5, region-wide traffic growth rates between 1990 and 1994 averaged 12.9 per cent in terms of motor vehicles per day (MVPD) and 12.3 per cent in terms of passenger car units (PCU). GDP in the WSB, again adjusted for inflation, increased at an annual average rate of 7.7 per cent during this period, implying an elasticity of traffic growth with respect to GDP in the range of 1.60 (in terms of PCU) to 1.68 (in terms of MVPD) at the regional level, somewhat higher than the elasticity at the national level, but lower than the elasticities found in certain other countries in the Greater Mekong Subregion (e.g., about 1.80 in Lao PDR and Vietnam).

(iii) As reported earlier, the greatest rates of traffic growth within the WSB were generally found on three- and four-digit roads, 15.5 per cent both in terms of MVPD and PCU on three-digit roads, and 14.3 per cent in terms of MVPD and 12.3 per cent in terms of PCU per day on four-digit roads. Lower growth rates were found on the one-digit road (i.e., Route 4), 10.5 per cent in terms of MVPD and 11.4 per cent in terms of PCU, and on two-digit roads, 4.4 per cent in terms of PCU and 10.7 per cent in terms of MVPD.

With varying degrees of reference to these trends, a number of studies have prepared traffic forecasts, usually at the national level:

(i) The World Bank-assisted *Long-Term Strategic Study of Highway Planning and Investment* forecast traffic growth rates (in vehicle-km) falling to 9.6 per cent in 2001 and to 6.2 per cent in 2011 under its "decentralized" scenario.

(ii) Somewhat lower traffic growth rates (in vehicle trips) were forecast by the 1990-91 JICA-assisted *Toll Highway Development Study*, i.e., an annual average growth rate of 8.4 per cent from 1990 to 2000 and 4.8 per cent between 2000 and 2010.

(iii) DOH has prepared traffic growth forecasts until 2011 by region and province for seven vehicle types, with the forecast growth rates for the WSB shown in Table 9.5.12. These vehicle- and province-specific growth rates

imply overall regional annual growth rates of 9.2 per cent from 1997 to 2001, 8.5 per cent from 2002 to 2006, and 7.2 per cent from 2007 to 2011 when weighted by vehicle composition in the 1994 traffic flow,[1] and by total motor vehicle registrations in the provinces in 1994 (see Table 9.5.2); these growth rates are broadly comparable to the national growth rates forecast in the other two studies (particularly the World Bank-assisted one), but tend to be lower than expected from recent traffic trends, or by forecasts based on applying past elasticities of traffic growth with respect to GDP to the GDP growth rates forecast in this study.

In light of the above, the road traffic growth rates for the WSB Study region that have been forecast by DOH, increased by 20 per cent (e.g., from 10.0 per cent to 12.0 per cent) to account for the greater regional development induced by the WSB program, have been taken as the basic traffic growth rates in this study (see Table 9.5.13). This forecast implies overall annual growth rates of 11.1 per cent from 1997 to 2001, 10.2 per cent from 2002 to 2006, and 8.7 per cent from 2007 to 2011 (when weighted by 1994 vehicle composition and motor vehicle registration data), and implies elasticities with respect to GDP growth of 1.18 from 1997 to 2001, 1.11 from 2002 to 2006, and 0.96 from 2007 to 2011, which are significantly lower than the range of observed elasticities in the past years, indicating that the forecast growth rates, while seemingly high, may be considered reasonable (indeed conservative), particularly in view of the strategic development of the WSB through interregional linkages envisaged in the present study.

Forecasts of traffic growth rates by road type are shown in Table 9.5.14 and summarized below. Traffic growth rates on three-digit roads have been assumed to be three percentage points higher than the regional average (they were 4.6 percentage points higher in terms of MVPD and 3.2 percentage points higher in terms of PCU), while traffic on four-digit roads have been assumed to be equal to the regional average (from 1990 to 1994 they were 0.5 percentage points higher in terms of MVPD, although equal in terms of PCU). Traffic growth rates on the region's one one-digit road (i.e., Route 4) have been assumed to be one percentage point less than the regional average (they were 3.3 per cent lower in terms of MVPD and 0.9 percentage points lower in terms of PCU), while traffic on the region's two two-digit roads have been assumed to be five percentage points less than the regional average (they were 3.1 percentage points lower in terms of MVPD but 7.9 percentage points lower in terms of PCU).

[1] 17 per cent car and taxi, 3 per cent light bus, 3 per cent heavy bus, 32 per cent light truck, 8 per cent medium truck, 18 per cent heavy truck, and 19 per cent motorcycle.

**WSB Road Traffic Growth Rates**

| Province | 1997-2001 | 2002-2006 | 2007-2011 |
|---|---|---|---|
| Kanchanaburi | 11.4 | 10.4 | 8.8 |
| Ratchaburi | 11.6 | 10.6 | 8.9 |
| Samut Songkhram | 11.9 | 10.9 | 9.0 |
| Petchaburi | 11.2 | 10.4 | 8.9 |
| Prachuap Khirikhan | 10.7 | 9.9 | 8.5 |
| Chumphon | 10.3 | 9.6 | 8.3 |
| Total | 11.1 | 10.2 | 8.7 |

### (2) Road Freight Tonnages

Data on growth rates in road freight tonnages over any significant period of time are only available for the country as a whole and are considerably less reliable than for vehicular traffic. For example, data from MOTC's Transport Management Information System Subdivision indicate a 5.7 per cent annual growth rate in road freight tonnages from 1990 to 1994, with annual growth rates varying from 1.8 per cent for agricultural commodities to 14.5 per cent for equipment and other manufactured articles. However, the World Bank-assisted *Long-Term Strategic Study of Highway Planning and Investment* reported an annual growth rate in road freight tonnages of 16.4 per cent from 1993 to 1996, ranging from 11.3 per cent for agricultural commodities to 17.4 per cent for general cargo; this World Bank study also forecast annual growth rates in road freight tonnages of 15.1 per cent from 1993 to 1996, 12.2 per cent from 2001 to 2006, and 9.9 per cent from 2006 to 2011.

Considering the wide variation in data on road freight tonnages, the present WSB study has forecast future road freight tonnages equal to 10.7 per cent in 1997 to 2001, 9.1 per cent from 2002 to 2006, and 8.5 per cent from 2007 to 2011 (i.e., in the range of growth forecast for heavy trucks for the region; see Table 9.5.13). Based on available data from MOTC and the World Bank study, this overall annual growth rate has been disaggregated by commodity type as presented in Table 9.5.15.

### 5.2.3 Water Transport Demand

Generally, port traffic has been expanding rapidly in Thailand, by about 16-17 per cent per annum between 1986 and 1993, with the relationship between the rate of growth of port throughput and GDP nearly constant in the period (see Figure 9.5.8); this trend reflects the double-digit growth in port traffic in most Asian developing economies. However, recently port traffic growth in Bangkok has been constrained by congestion and Government policy, with traffic now moving to other ports, mainly Laem Chabang on the Eastern Seaboard, for which the Port Authority of Thailand has (very conservatively) forecast an annual traffic growth of about 12 per cent between 1995 and 2001.

Within the WSB, forecasts prepared by the JICA-assisted *Feasibility Study on Bang Saphan Industrial Estate* show the potential for substantial traffic growth rates at the new Prachuap Port, i.e., 18.0 per cent between 1995 and 2001, 15.3 per cent between 2001 and 2006, and 12.4 per cent between 2006 and 2011, or about 15.4 per cent per annum between 1995 and 2011. The collective year-on-year growth rate (1993 compared to 1992) for the smaller coastal ports in the WSB was 21.3 per cent, with the growth rate about 30 per cent for Samut Songkhram.

The present study has assumed the following as a first proposition regarding port traffic demand growth rates:

(i) continued rapid growth in the Kingdom's seaborne trade, consistent with recent trends and in view of the movement toward globalization and subregional cooperation;

(ii) for Bang Saphan, the same rates as assumed in the ongoing JICA industrial estate study; and

(iii) a continuation of past annual growth rates for coastal ports to 2006, falling to 15 per cent until the end of the study period (i.e., 2011).

These broad assumptions may be revised slightly during the course of more detailed assessments of specific projects, however.

### 5.2.4 Railway Transport Demand

Traffic growth in Thailand's railway subsector has been low compared with other transport subsectors. From 1985 to 1994, rail freight traffic increased at an average annual rate of 3.9 per cent in tons and 1.6 per cent in ton-km; however, from 1990 to 1993, rail freight transport decreased by 2.7 per cent per cent in tons and 3.9 per cent in ton-km, before recovering slightly in 1994. From 1987 to 1993, rail passenger traffic decreased by 0.7 per cent in terms of passengers and by 3.7 per cent in terms of passenger-km, with particularly sharp declines in some recent years. However, the *SRT Master Development Plan Study* outlines a strategy for the Railway to maintain its share of future traffic growth in future years. In view of this strategy and the proposed industrial development program in the present regional planning study, rail freight traffic on existing lines in the WSB has broadly been assumed to increase by 3.0 per cent per year in tons and 1.0 per cent per year in ton-km, while passenger traffic has been assumed to increase by 1.0 per cent in terms of passengers and remain constant in terms of passenger-km, reflecting the likelihood of shorter average trip distances in the future. Once again, these are broad assumptions that should be reevaluated when assessing specific projects.

### 5.2.5 Air Transport Demand

Generally, domestic air traffic in the Kingdom of Thailand has been increasing rapidly in recent years. For example, the total number of passengers carried on domestic flights more than doubled between 1990 and 1994, from 3.21 million to 7.44 million, an annual average increase of 23.3 per cent. Also, the total tonnage of domestic freight hauled by air almost tripled during the same four-year period, increasing from 13,670 to 38,474, an annual average increase of 42.5 per cent.

But as noted previously, traffic at Hua Hin Airport, the only airport in the region that currently has scheduled services (Bangkok Airways since April 1989), decreased to 589 aircraft movements in 1994, down from 1,280 in 1993 and 1,274 in 1992. Also, the total number of passengers at Hua Hin Airport peaked in 1992 at 19,233, then decreased by 15.3 per cent to 16,283 in 1993, and by 31.2 per cent to 11,209 in 1994.

The *Airport System Master Plan Study* forecast growth rates in passenger traffic of 8.0-8.1 per cent annually at Level 2 airports (the lowest considered) from 1995 to 2010, although this is likely to be a gross underestimate in view of recent traffic trends and the movement toward globalization and subregional cooperation; annual air traffic growth rates of 15 per

cent until 2000 and 10 per cent thereafter, as adopted for Thailand by the Asian Development Bank's Greater Mekong *Subregional Transport Sector Study*, appear more accurate. The *Airport System Master Plan Study* forecast growth rates in domestic freight traffic at Level 2 airports of 4.8 per cent per year until 2010, but this too seems to be a gross underestimate, particularly considering the potential demand for perishable and high-value air freight; in this study, national annual growth rates in air freight have conservatively been assumed to be 30 per cent until 2001 and the 20 per cent until 2011.

With respect to specific airports, Hua Hin is unlikely to attain traffic growth rates much greater than zero without extension of the runway. Traffic at the new Chumphon (Pathiu) Airport is likely to follow that of Ranong, where Bangkok Airways recently increased flights from three to seven times per week, with traffic at Chumphon (Pathiu) likely to be further enhanced by development of industrial estates at Bang Saphan and Pathiu; data on air traffic generation rates of industrial estates in Thailand is unavailable, however. For reference purposes, data on mode split by air freight for exports by commodity type in Thailand is set out in Table 9.5.16; however, as Thailand's economy moves more toward the production and export of higher-value, lower-volume products, this mode split (2.0 per cent in tonnage terms and 25.8 per cent in terms of monetary value in 1994) is likely to increase.

### 5.2.6 Cross-Border Transport Demand

Demand for transport between Thailand and Myanmar has been sporadic, as borders open and close, but has remained at relatively low levels. Customs Department data[1] for 1993 and 1994 (the latest available) indicate that cross-border transport demand between Thailand and Myanmar was (i) about 150,000 tons per year at Ranong, 61 per cent exports (mainly forest products) and 39 per cent imports (mainly cement); and (ii) about 40,000 tons per year each at Mae Sot in Tak province, just north of Kanchanaburi, and at Mae Sai in Chiang Rai province. However, the recorded trade reported greatly understates actual trade (i.e., recorded plus unrecorded trade),[2] and more importantly greatly understates the potential trade between the two countries as a result of comparative advantages and

[1]Other sources present somewhat different data. For example, data from the Harbour Department show that the two ports in Ranong province (Kraburi and Ranong) had a total of 911,771 tons of imports and 59,595 tons of exports in 1994.

[2]The Asian Development Bank has (conservatively) estimated that unrecorded trade in the Greater Mekong Subregion accounts for 50 per cent or more of total trade (i.e., unrecorded trade equals 100 per cent or more of recorded trade). Other estimates of the ratio of unrecorded to recorded trade in the subregion are much higher, however (e.g., unrecorded timber exports from Cambodia in 1993 were estimated at 960,000 tons compared to only 90,000 tons of recorded exports).

complementarities,[1] which are likely to become increasingly important after Myanmar joins the Association of Southeast Asian Nations (ASEAN). In this context, a proposed Thai-Myanmar Industrial Complex at Tavoy/Dawei is important, with a preliminary study finding that it could generate 5-10 million tons per year of port traffic, the largest portion representing industrial materials or products coming from Thailand's Upper WSB and the Bangkok Metropolitan Region.

In addition to the Thailand-Myanmar cross-border trade (and domestic traffic in the corridors),[2] potential traffic in the corridor includes "global" trade, particularly to western-situated countries. Table 9.5.17 presents data on the proportion of value of Thailand's foreign trade attributable to western-situated countries in 1988 to 1994. One finding is that 19.1 per cent of the value of Thailand's trade in 1994 was with western-situated countries; 19.1 per cent of the tonnage of Thailand's sea trade in 1994 (60.56 million tons) was equal to 11.57 million tons, suggesting the possibility of substantial cross-border traffic between Thailand and Myanmar if a suitable deep-sea port could be constructed on Myanmar's Andaman Sea coast, particularly if it were a free port. Indeed, prospects for growth with western-situated counties are deemed excellent between now and 2011; consider, for example, that in 1995 Thai investors were reportedly ranked third in foreign investment in India (after the United States and Israel) compared to their ranking of 13th in 1991.

In summary, while any forecast of future cross-border traffic would be highly speculative, the potential of such traffic in the future is considerable. The preliminary study forecast port demand of the order of 7.0-13.0 million tons per year,[3] with most of this demand involving cross-border traffic of industrial goods or products from the Upper WSB and Bangkok; assuming 80 per cent of this tonnage moves on the new cross-border road, and assuming 8.4 tons per truck (consistent with current loads in Thailand and Myanmar, including some empty or reduced-load backhauls), the

[1]For reference purposes, recorded two-way trade between Thailand and Cambodia increased by a factor of 16.8 between 1991 and 1992 (from 59,026 tons to 991,964 tons), a time when prior constraints on trade were eased substantially (data from Ministry of Transport and Communications).

[2]Note, however, that the relatively low population density in the corridors between Thailand and Myanmar may mean that domestic traffic will be relatively light, at least in the foreseeable future. Consider, for example, that the population of the Tenasserim/Tanintharyi Division of Myanmar was only 1.187 million in 1994. Growth rates in domestic traffic may be substantial, however; as indicated in a previous section, growth rates in road traffic in Kanchanaburi province (reflecting socioeconomic factors), for example, are forecast to be 11.4 per cent from 1997 to 2001, 10.4 per cent from 2002 to 2006, and 8.8 per cent from 2007 to 2011.

[3]In addition to the 5.0-10.0 million tons of throughput estimated for the Tavoy/Dawei Industrial Complex and the 1.0 million tons estimated for traffic diversion from the existing Bangkok Port, 1.0-2.0 million tons of throughput is estimated to be locally generated in Myanmar's Tanintharyi Division.

estimated port tonnage implies daily truck traffic on the cross-border road of 1,826 to 3,392 per day. However, in order to achieve maximum cross-border traffic, construction of any proposed cross-border links between Thailand and Myanmar (i.e., the hardware) should be accompanied by measures to address the non-physical barriers that currently impede the free movement of goods and persons across borders in the Greater Mekong Subregion (i.e., the software).

## *5.3 Transport Development Plan*

### 5.3.1 Strategies

Transport is a derived demand and the development of transport must be viewed as an integral part of a region's development, with transport proposals formulated to meet the demand for passenger and goods transport as efficiently as possible. At the same time, certain transport facilities, especially roads and ports, can be expected to play a key role in shaping a region's development. Therefore, the transport strategies identified below involve both demand-serving and demand-leading elements, with the *overarching strategy to promote linkages* between subregions, between regions and between sectors. Specific strategies include the following:

(i) *Reducing total distribution costs*: Reduced distribution costs will make Thailand's exports cheaper and more competitive on world markets, while also assisting in the stimulation of regional development by reducing the costs of bringing in inputs for production as well as reducing transport costs for moving out the final product. Total distribution costs include not only transport tariffs paid to operators, but include other factors such as transport time, reliability, and probability of loss and damage. In many instances distribution costs other than strictly transport costs are of greatest importance and can be determining factors driving modal and route choice.

(ii) *Maximizing route choice for regional exports and imports*: If transport users have the choice of only one route, flexibility in negotiating freight rates becomes limited. The situation usually results in a higher level of transport costs and a reduced quality of services compared with a more competitive transport environment. Such route choice should be available both for imports and exports and for domestic shipments between the Western Seaboard region and other regions in Thailand.

(iii) *Increasing accessibility within the region*: There are presently many subareas within the WSB that are poorly served by the existing transport network. Increased accessibility will serve to expand the scope of regional producers and strengthen GDP growth potential. This strategy involves addressing communication needs through provision of linkages between and among urban centers, provinces, and regions as well as the improvement of rural transport to increase the access of rural communities to the services provided in urban areas and allow their effective participation in economic development.

(iv) *Assisting development projects in other sectors and subsectors*: Intersectoral synergies/linkages are important in any regional development master plan. One such synergy/linkage is transport infrastructure serving the needs of other sectors (e.g., industry, agriculture), which in turn justifies the development of the transport infrastructure. Other complementarities occur within the transport sector itself, e.g., with the construction or improvement of a road and a linked port.[1]

(v) *Promoting the regional spatial development plan*: This last strategy emphasizes the demand-leading aspect of transport in regional development. The proposed spatial framework for regional spatial development, put forward in the Main Volume and summarized above, is based on a multiple access model in which spatial development is supported by multiple transport modes to meet a variety of needs by promoting linkages between regions and subregions.

Thirty-eight projects are put forward in the next section to achieve these strategies. It should be noted, however, application of these strategies in many cases requires tradeoffs if optimal overall benefits are to be achieved (e.g., between accessibility and efficiency in terms of costs).

### 5.3.2 Development Options

With reference to the strategies set out in the previous section, and based on (i) in-depth discussions with the various concerned ministries, departments, and agencies (including NESDB), (ii) exploratory discussions with representatives of the private sector, (iii) a review of previous studies (e.g., the Sahaviriya Group, the Federation of Thai Industries), and (iv)

[1] Competition between and among modes, e.g., when road and rail are in the same corridor, must also be considered, although often each hauls different types of freight as appropriate to the mode.

the Study Team's own assessments, a long list of 38 transport sector projects has been formulated for the Western Seaboard, as shown in Tables 9.5.18 and 9.5.19.[1] The former table presents projects by subsector (e.g., road, water transport), and within subsectors, by geographic impact (e.g., intraregional, interregional, subregional); the latter presents projects by area of geographic impact, and within areas of geographic impact, by subsector. An effort was made to keep the length of the list manageable, with small projects in certain cases, combined into larger projects (e.g., secondary/feeder road improvements). Nevertheless, the list is intended as a long rather than a short list of projects, with certain projects only feasible in the long run or perhaps not feasible at all (e.g., Project AT2, Expansion of Hua Hin Airport; RW3, Samut Songkhram-Pak Tho Link).

Figure 9.5.9 sets out the locations of all transport projects. Table 9.5.20 summarizes the major land, water, and air corridors proposed for transport development by geographic impact (i.e., interregional, subregional/global) implied by these projects, while Figures 9.5.10 and 9.5.11 present maps of these corridors, showing the interregional and global/subregional corridors separately.

The following section presents summaries of the proposed projects, while the final section assesses project priorities.[2] Additional details on specific projects are presented in the Project Profiles annexed to this Section as Appendix I; more detailed profiles have been prepared for selected of the highest priority projects as presented in Appendix II.

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[1]The emphasis here on projects, sometimes described as "the cutting edge of development," provides a systematic approach to analyzing options for development of the regional transport sector, and permits the reader to easily focus on subsectors and geographic areas of interest.

[2]Since the priority of a corridor is a function of very specific supply/demand characteristics of the modes in the corridor, a more microscopic (i.e., project-based) approach was adopted in assigning priorities. The results are also more useful as they relate to specific investments that the Royal Thai Government may undertake to improve the transport system of the WSB, not only in terms of interregional and subregional/global aspects, but also in terms of vitally important intraregional elements as well.