2.2.3 Socio-economic inputs for Mobile Source Inventory

2.2.3.1 Summary of Socio-Economic Inputs and Their Sources for Inventory

Table 2.2.3.1 shows the data sources and data that were used for the inventory preparation in the future. The details are described in Chapter 5 of the Main Report (Mobile Source Inventory).

Table 2.2.3.1 Summary of Resources and Growth Factors

Sector		Sources	Inputs for inventory
Vehicle	Traffic volume by vehicle type in BMR	URMAP (2001)	PCU, travelling speed by link estimated based on traffic assignment
	Traffic volume by vehicle type in Whole Kingdom	LTP-2 (2001)	Growth rate (Future vehicle kilometer traveled)
	Purchase number of new vehicles	Analysis by JICA Study Team	GDP elasticity model
Railway	BMR Whole Kingdom	TDSRT (2002)	Growth rate (Traffic demand forecast by line)
Ship	Vessels		
	BMR	Data from AAT*	Growth rate (Freight demand forecast)
	Laem Chabang port	Data from Port Authority	Growth rate (Freight demand forecast)
	Phuket port Songrat port	Data from Dept. of Harbor	Growth rate (Freight demand forecast)
	Local ports	Harbor Study (2001)	Growth rate (Freight demand forecast)
	Fishing boat	Analysis by JICA Study Team	no change
	Sea bus	Analysis by JICA Study Team	Growth rate (Tourist forecast in Bangkok)
Aircraft	International airport Chiangmai, Hatyai, Phuket, Chiang Rai	Data from AAT	2011 movement
	2nd International airport	Data from NBIA**	2011 movement
	Local airport	Airport Study (2000)	Growth rate (Movement forecast)
	New airport (Betong, Chantaburi, Mae Sariang, Mukdahan)	Airport Study (2000)	2011 movement

Note: AAT: Airport Authority Thailand
NBIA: New Bangkok International Co., Ltd

2.2.3.2 Vehicle

1) Private Consumption Expenditure for Vehicle Purchase

The Private Consumption Expenditure for Vehicle Purchase is forecasted based upon the GDP projections as mentioned in Section 2.2.1.

(1) Method for Forecast of private consumption expenditure

A GDP elasticity model is employed from high correlation between private consumption expenditure for vehicle purchase and GDP growth being recognized as shown in Figure 2.2.3.1. Formula 2.2.3.1 shows concept of the GDP elasticity model consisting of average GDR growth rate and elasticity coefficient.

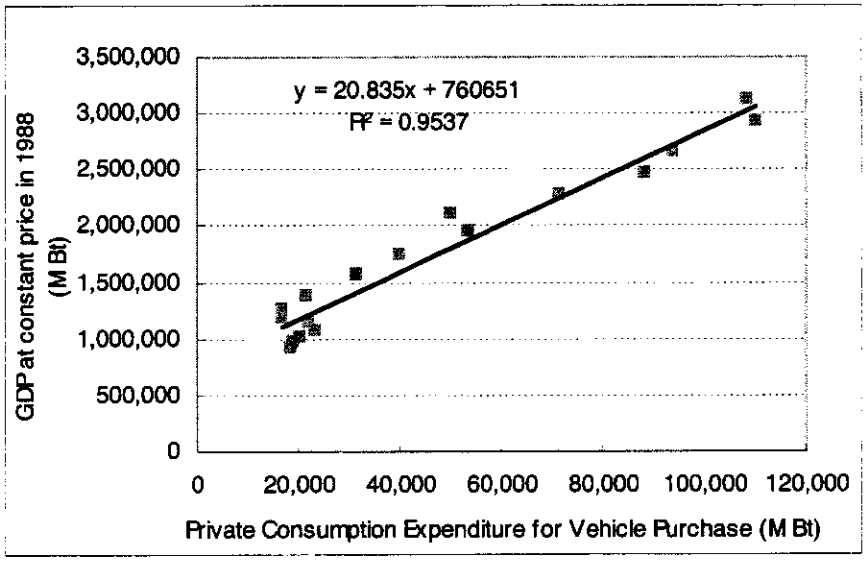


Figure 2.2.3.1 Coefficient Relation between Private Consumption Expenditure for Vehicle Purchase and GDP growth (1980 -1996)

$$V_{t+1} = Egdp \times GDPgr_t \times V_t \qquad (2.2.3.1)$$

t : 2001-2011

V: Private Consumption Expenditure for Vehicle Purchase

Egdp: GDP Elasticity Coefficient

GDPgr: GDP growth rate

(2) Basic Assumption:

- GDP at 1988 constant price: refer to Table 2.2.3.2
- GDP projection scenario up to 2011: refer to table below

Table 2.2.3.2 GDP Projection

GDP growth \ Year	2001	2002*	2003-2006**	2007-2011**
Annual growth rate (%)	2.0	4.0	5.6	5.7

* NESDB forecast
** TDRI forecast

- GDP Elasticity Coefficient: 1.048 (estimated based upon average growth rate of private consumption expenditure for vehicle purchase/average GDP growth rate, refer to Table 2.2.3.3). The average GDP growth and the private consumption expenditure for vehicle purchase are calculated based on the data between 1980 and 1996, because the data after 1997 is strongly influenced by the economic crisis and is not representative

Table 2.2.3.3 Private Consumption Expenditure for Vehicle Purchase and GDP

Year	P.C.E* (M Bt)	Growth rate	GDP (M Bt)	Growth rate
1980	18,518		913,733	
1981	19,263	1.04	967,706	1.06
1982	20,468	1.06	1,019,501	1.05
1983	23,384	1.14	1,076,432	1.06
1984	22,047	0.94	1,138,353	1.06
1985	16,954	0.77	1,191,255	1.05
1986	17,058	1.01	1,257,177	1.06
1987	21,844	1.28	1,376,847	1.10
1988	31,356	1.44	1,559,804	1.13
1989	40,033	1.28	1,749,952	1.12
1990	53,797	1.34	1,945,372	1.11
1991	50,421	0.94	2,111,862	1.09
1992	71,493	1.42	2,282,572	1.08
1993	88,405	1.24	2,473,937	1.08
1994	94,127	1.06	2,659,054	1.07
1995	110,153	1.17	2,933,168	1.10
1996	108,701	0.99	3,109,319	1.06
1997	79,614	0.73	3,054,902	0.98
1998	35,649	0.45	2,746,136	0.90
1999	49,352	1.38	2,871,521	1.05
2000	62,490	1.27	3,004,659	1.05
2001			3,059,000	1.02
2002			3,166,065	1.04
Average Growth Rate**		1.13		1.08

Note:
* Private Consumption Expenditure for Vehicle Purchase
** calculated based upon the data between 1980 and 1996
Source: JICA Study Team analyzed

- Data on the private consumption expenditure for vehicle purchase before 1980: Since the data is not available, the average data between 1976 and 1980 is used considering the little growth during the period.

(3) Estimated Result

Table 2.2.3.4 shows estimated private consumption expenditures for vehicle purchase and their growth rates up to the year 2011. Whilst, Figure 2.2.3.2 shows the growth trend of after 2000.

Table 2.2.3.4 Projection for Future Private Consumption Expenditure for Vehicle Purchase (2000-2011)

Year	P.C.E (M Bt)	Growth rate
2000	62,490	1.27
2001	66,823	1.07
2002	72,857	1.09
2003	80,658	1.11
2004	89,294	1.11
2005	98,856	1.11
2006	109,544	1.11
2007	121,388	1.11
2008	134,513	1.11
2009	149,057	1.11
2010	165,174	1.11
2011	183,033	1.11

Source: JICA Study Team analyzed

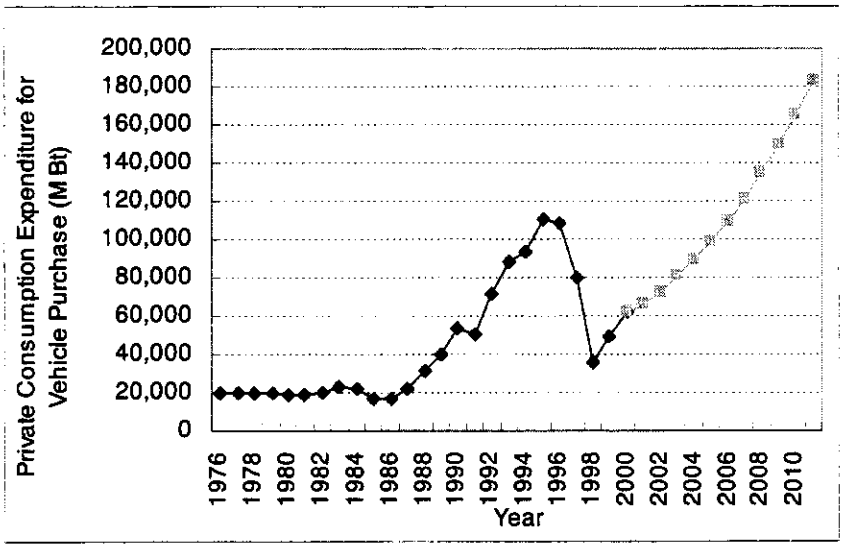


Figure 2.2.3.2 Projection for Future Private Consumption Expenditure for Vehicle Purchase (1980 – 2011)

2) Traffic Volume of Car, Bus and Truck

URMAP estimated the future traffic volume of the BMR by each road considering future extension plan. Therefore, the traffic volume at year 2011 was used for inventory establishment.

On the other hand, as for the other areas, based upon 'vehicle kilometer traveled' estimated in LTP-2, its growth rates between 2011 and 2000 were calculated. Table 2.2.3.5 shows the growth rates in each region except for the BMR.

Table 2.2.3.5 Growth Rate of Traffic Traveled

Vehicle type / Region	Car	Buses	Trucks
Central	2.10	1.70	1.70
Eastern	1.80	1.70	1.70
Western	2.20	1.90	1.70
Notheastern	2.50	1.40	1.40
Northern	2.30	1.60	1.50
Southern	2.40	1.90	1.50

Source: JICA Study Team analyzed

3) Motorcycle

URMAP does not include traffic demand forecasts for motorcycle separately. So that, statistically analyzing the past data (from 1989 to 1996) of registered motorcycle number, the future register numbers were estimated in each region as shown in Table 2.2.3.6.

Table 2.2.3.6 Growth Rate of Registered Number

Region	Growth Rate
Central	1.70
Eastern	1.70
Western	1.90
Notheastern	1.90
Northern	1.70
Southern	1.90

Source: JICA Study Team analyzed

2.2.3.3 Ship

The growth rates of traffic volumes were estimated by ship type: vessel, fishing boat and sea bus for the future inventory. The methodology for the estimation is described by ship type as follow.

1) Vessel

(1) International Port

As for the international ports: Songkhla, Chanthaburi, Krabi and Satun and Trag, traffic demand forecast data were not available. As shown in Table 2.2.3.7, growth rate of future traffic volumes at each port was estimated based upon the GDP growth rate which was used one of key factors for the demand forecast in the Harbor Study as mentioned above.

Table 2.2.3.7 Growth Rate of Traffic Volume for International Ports

Port (region)	Growth Rate	Source
Laem Chabang	1.78	Freight and container demand forecast (up to 2007) from Port Authority + JICA forecast (up to 2011)
Phuket	1.58	Import-export goods forecast (TEU base)
Songkhla	1.58	
Chanthaburi (eastern)	2.18	GDP growth rate (2001:5%, 2002-2006: 7.8%, 2007-2011: 7.4%)
Karabi (southern)	1.75	GDP growth rate (2001:0.2%, 2002-2006: 5.8%, 2007-2011: 5.7%)
Satun (southern)	1.75	ditto
Trag (southern)	1.75	ditto

Source: JICA Study Team analyzed

(2) Local port

The 'Harbor Study' that the JICA carried out in 2002 estimated future freight demand in each local port. Based upon this forecast, the growth rates of traffic volume were estimated.

As for Chonburi (Laem Chabang), Songkrat and Phuket port, growth rate of future traffic volume was calculated, as shown in Table 2.2.3.8, based upon the demand-forecast data that were available from the Department of Harbor.

Table 2.2.3.8 Growth Rate of Freight Demand

Province	Growth Rate (Year 2011/Year 2000)
Bangkok	0.95
Chachoengsao	1.73
Chanthaburi	2.18
Chon Buri (Laem Chabang)	1.77
Chon Buri (others)	1.70
Chumporn	1.72
Krabi	1.75
Nakhon Si Thammarat	1.72
Phetchaburi	2.48
Phuket	1.57
Prachuap Khiri Khan	2.74
Rayong	1.94
Samut Sakhon	2.37
Samut Songkhram	1.72
Satun	1.75
Songkhla	1.58
Surat Thani	1.72
Trang	1.75

Source: JICA Study Team analyzed
Note:
1) Bangkok and Chob Buri (Laem Chabang): based on data of Port Authority and their policies which are freight demand of Bangkok Port will not be increased because of space limitation in Chao Praya River, while, one of Laem Chabang Port will be increased due to new deep sea port.
2) Phuket and Songkhla: based on data of the Harbor Department
3) Other province: based on report of the Harbor Department

2) Fishing boat

Though any jurisdiction agencies do not produce the future departure number of times, the JICA Study Team estimated future traffic volumes analyzing the past data such as the registration numbers and the traffic volumes of fishing boats. As there was no big change with them in the past ten years, no change in the future was set up for growth rate.

3) Sea bus

Because of the reasons data such as the future traffic demand could not be obtained from the jurisdiction agencies, the future growth rate of the number was estimated by statistically projecting future tourist number. As the result, growth rate of the future traffic volume in 2011 is set up with 1.97.

2.2.3.4 Railway

The investigation which the State Railway of Thailand (SRT) conducted in 2002 predicted the traffic and freight demand forecast, so that identified the capacity of the present line and the necessity of double tracking.

This study includes the future traffic demands forecast up to the year 2021 considering extension and double tracking of lines, and presents the future traffic volumes in each section of traffic line. Therefore, the traffic volumes in 2011 were directly applied for inventory development.

2.2.3.5 Aircraft

1) International Airport

The 'Airport Study' that the JICA conducted in 2000 estimated arrival and departure number at the local airports based upon the passenger and demand forecasts of the freight which considered the future development of airports (including new airports) and the increase of tourists, growth rate of traffic volume at each airport was calculated based upon the data. However, as for the planned new airports, the estimated traffic volumes in 2012 in the Airport Study were used for the inventory.

2) Local Airport

The Airport Study does not include future demand estimations of the international airports, the estimations obtained from the Airport Authority Thailand (AAT) were used. Table 2.2.3.9 shows the growth rates of traffic volumes at each airport.

Table 2.2.3.9 Growth Rate of Traffic Volume for Local Airports

	Airport	Growth Rate (Year 2011/Year 2000)	N.B.
1	Betong	-	estimated traffic volume is applied
2	Buri Ram	3.30	
3	Chataburi		
4	Chumphon	1.10	
5	Hua Hin	1.10	
6	Kaen	2.20	
7	Krabi	2.20	
8	Lampang	1.83	
9	Loei	3.30	
10	Mae Hong Son	1.65	
11	Mae Sariang	-	estimated traffic volume is applied
12	Mae Sot	2.20	
13	Nakhon Phanom	2.20	
14	Nakhon Rachasima	2.57	
15	Nakhon Si Thammarat	4.40	
16	Nan	2.20	
17	Narathiwat	1.10	
18	Pattani	1.10	
19	Phetchabun	3.30	
20	Phitsanulok	1.57	
21	Phare	3.30	
22	Ranong	2.20	
23	Roi Et	2.75	
24	Sakhon Nakhon	3.30	
25	Surat Thani	1.38	
26	Trang	3.30	
27	Ubon Ratachathani	1.65	
28	Udon Thani	2.20	
29	Mukdahan	-	estimated traffic volume is applied
30	Sukhotai	1.30	average growth rate of past passenger demand
31	Samui	1.30	ditto
32	Tak	1.00	ditto
33	Utapao	2.00	ditto

Source: JICA Study Team analyzed

3. Stationary Source Inventory

3.1 Questionnaire Survey Sheet

3.2 Estimation of Natural Gas Consumption by Province

3.3 Coal Consumption by Manufacturing Industry

3.4 Estimation of Provincial LPG Consumption by Residential and Commercial Sector

3.5 Estimation of Provincial Kerosene Consumption by Residential and Commercial Sector

3.6 Estimation of Provincial Consumption of Non-Fossil Fuel by Residential and Commercial Sector

3.7 Review of Airviro 1997 and Preliminary Analysis to Develop Airviro 2000

3.8 Estimation of SOx Emission from Cement Plants with Fuel Conversion in 2011

STATIONARY SOURCE INVENTORY SURVEY
on
The Acid Deposition Control Strategy in Thailand
Emission Data Collection Form

1. General Information

Facility/Plant Name:

Location:

Plant Geographical Coordinates:

Latitude/UTM Northing :_____Longitude/UTM Easting:_____

Elevation above MSL (m):_____

Contact Name:

Title :

Telephone Number: Fax Number:

E-mail address:

Permit Number:

Type of Industry:

Main Product:

Plant Layout

SECOT CO.,LTD.
129-131 Rimklongprapa Rd. Bangsue Bangkok 10800
Tel. (66) 0-29105021-6 Fax. (66) 0-29105020

2. Simplify flow diagram of manufacturing process

3. Emission Inventory Data Collection

SOURCE INFORMATION	COMMENTS
Unit ID:	
Manufacturer:	
Date Installed:	
Rated Capacity (units):	
Maximum Heat Input (units) :	
Fuel Type:	
Operating Schedule:	
Hours/Day:	
Days/Week:	
Weeks/Year:	
Days/Year:	

FUEL USE [a]:

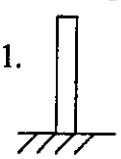
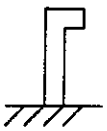
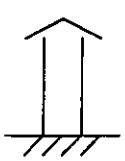
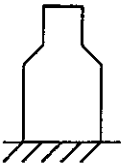
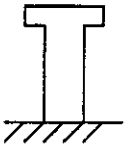
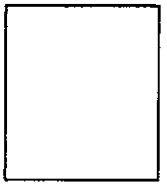
Year:2000	Fuel Use (units)	Raw Material (units)	Production (Units)
Maximum Hourly			
Monthly			
January:			
February:			
March:			
April:			
May:			
June:			
July:			
August:			
September:			
October:			
November:			
December:			
Total Annual			

[a] This form should be completed for each fuel type used.

3. Emission Source Data (For each source)

Description	Design	Actual (Monitoring)
1. Source Type (Process/Combustion)		
2. Fuel used		
2.1 Type		
2.2 Sulfur Content (%):		
2.3 Nitrogen Content (%):		
2.4 Higher Heating Value (HHV in Btu/lb):		
2.5 Lower Heating Value (HHV in Btu/lb):		
2.6 Consumption Rate (l/hr, t/hr)		
2.7 Analysis Data Sheet (if Available):		
3. Stack Information 3.1 Stack ID:		
3.2 Location (UTM x,y)		
3.3 Stack (Release) Height (m):		
3.4 Stack Diameter (m):		
3.5 Stack Gas Temperature (^{O}C):		
3.6 Stack Gas Velocity (m/sec):		
3.7 Stack Gas Flow Rate (Nm^3/min):		
3.8 Moisture Content		
3.9 Excess O_2 (%)		
3.10 Do Other Sources Share This Stack (Y/N)? : (If yes, include Unit IDs for each).		
4. Emission Data 4.1 SO_2 (ppm) (g/sec)		**Result of Monitoring** (Past for 3 years)
4.2 NO_X (ppm) (g/sec)		
5. Control System (Attach Detail if Available) 5.1 Type		
5.2 Efficiency (%)		

Stack Shape

1. 
2. 
3. 
4. 
5. 
6. 

แบบสอบถามข้อมูลด้านมลพิษทางอากาศจากแหล่งกำเนิด

โครงการศึกษาการควบคุมการเกิดฝนกรดในประเทศไทย

1. ข้อมูลทั่วไป

ชื่อโรงงาน:

สถานที่ตั้ง:

ตำแหน่งโรงงาน:

Latitude/UTM Northing :_____Longitude/UTM Easting:_____

Elevation above MSL (m): _____

เจ้าหน้าที่ประสานงาน:

ชื่อ :

โทรศัพท์: โทรสาร:

E-mail address:

ใบอนุญาตโรงงาน:

ประเภทอุตสาหกรรม:

ผลิตภัณฑ์หลัก:

แผนผังโรงงาน

บริษัท ซีคอท จำกัด
129-131 ถนนริมคลองประปา แขวงบางซื่อ เขตบางซื่อ กรุงเทพ 10800
โทร. (66) 0-29105021-6 โทรสาร. (66) 0-29105020
E-mail : RNDmail @ secot.co.th

2. แผนภูมิแสดงกระบวนการผลิต

3. ข้อมูลด้านมลพิษทางอากาศจากแหล่งกำเนิดจากการใช้เชื้อเพลิง

ข้อมูลแหล่งกำเนิด	รายละเอียดเพิ่มเติม
Unit ID:	
ผู้ติดตั้ง:	
วันที่ติดตั้ง:	
กำลังการผลิต (ระบุหน่วย):	
พลังงานความร้อนที่ใช้ (ระบุหน่วย) :	
ประเภทเชื้อเพลิง:	
ตารางการทำงาน:	
ชม./วัน:	
วัน/สัปดาห์:	
สัปดาห์/ปี:	
วัน/ปี:	

ปริมาณการใช้เชื้อเพลิง :

ปี:2000	การใช้เชื้อเพลิง (ระบุหน่วย)	วัตถุดิบหลัก (ระบุหน่วย)	ผลิตภัณฑ์ (ระบุหน่วย)
ข้อมูลรายชั่วโมงสูงสุด			
เดือน			
มกราคม:			
กุมภาพันธ์:			
มีนาคม:			
เมษายน:			
พฤษภาคม:			
มิถุนายน:			
กรกฎาคม:			
สิงหาคม:			
กันยายน:			
ตุลาคม:			
พฤศจิกายน:			
ธันวาคม:			
รวมทั้งหมด			

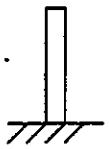
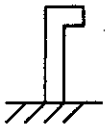
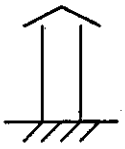
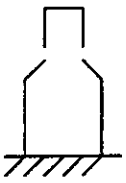
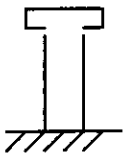
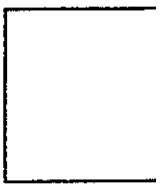
4. ข้อมูลปล่องระบายอากาศ (ในแต่ละปล่อง)

รายละเอียดปล่อง	ค่าที่ออกแบบ	ค่าที่ตรวจวัด *
1. ประเภทของแหล่งกำเนิด (จากกระบวนการผลิต/จากการเผาไหม้)		
2. เชื้อเพลิง		
2.1 ประเภทเชื้อเพลิง		
2.2 องค์ประกอบของกำมะถัน(%):		
2.3 องค์ประกอบของไนโตรเจน (%):		
2.4 ค่าความร้อน (High Heating Value) (HHV in Btu/lb):		
2.5 ค่าความร้อน (Low Heating Value) (LHV in Btu/lb):		
2.6 ปริมาณเชื้อเพลิงที่ใช้ (l/hr, t/hr)		
2.7 เอกสารผลการวิเคราะห์ (ถ้ามี):		
3. ข้อมูลปล่อง 3.1 หมายเลขปล่อง		
3.2 ตำแหน่งปล่อง (UTM x,y)		
3.3 ความสูงปล่องจากพื้นดิน (m)		
3.4 เส้นผ่าศูนย์กลางปล่อง (m)		
3.5 อุณหภูมิภายในปล่อง (^{O}C)		
3.6 ความเร็วอากาศเสียในปล่อง (m/sec)		
3.7 อัตราการไหลของอากาศเสียในปล่อง (Nm^3/min) , dry basis		
3.8 ความชื้น (%)		
3.9 ปริมาณออกซิเจนส่วนเกิน (%)		
3.10 มีการปล่อยมลพิษจากแหล่งอื่นร่วมกับปล่องนี้หรือไม่ (ถ้ามี กรุณาระบุรายละเอียด)		

รายละเอียดปล่อง	ค่าที่ออกแบบ	ค่าที่ตรวจวัด *
4. ข้อมูลการปลดปล่อยสารมลพิษ 4.1 ซัลเฟอร์ไดออกไซด์ (ppm) (g/sec)	_____ _____	_____ _____
4.2 ออกไซด์ของไนโตรเจน (ppm) (g/sec)	_____ _____	_____ _____
5. ระบบการควบคุม (กรอกรายละเอียดเพิ่มเติมถ้ามี) 5.1 ประเภท		
5.2 ประสิทธิภาพ (%)		

* ผลการตรวจวัดย้อนหลัง 3 ปี กรุณาส่งเป็นเอกสารแนบ (ถ้ามี)

<u>รูปร่างปล่อง</u>

1. 
2. 
3. 
4. 
5. 
6. 

Appendix 3.2

Estimation of Natural Gas Consumption by Province

Natural is supplied by pipeline. Table 1 gives Horse Power of gas-supplied provinces by industrial estate. Total national natural gas consumption by manufacturing sector was allocated to each gas-supplied province according to its share of Horse Power of manufacturing industry in the gas-supplied provinces.

Table 1 Provincial Horse Power and Natural Gas Consumption

Province		Horse Power	Natural Gas (MMscf)
	Total All Province	12,662,427	56,805
Rayong	Total	5,471,570	24,546
	Padaeng IE	30,419	
	Eastern IE	562,960	
	Map Ta Phut IE	4,546,020	
	Asia IE	0	
	Amata City IE	81,715	
	Eastern Seaboard IE	250,456	
	Rayong Industrial Park		
	SSP Rayong Industrial Park		
	Rayong Industrial Land		
	Siam Eastern Industrial Park		
Chonburi	Total	2,090,448	9,378
	Amata Nakorn IE	1,033,890	
	Bowin IE	420,191	
	Leam Chabang IE	636,367	
	Sahapat Group Industrial Park		
Cha-choeng-soa	Total	148,494	666
	Welgrow IE	148,494	
Samuth Prakarn	Total	4,370,075	19,605
	Bang Poo IE	4,370,075	
Bangkok	Total	83,159	373
	Bang Chan IE	83,159	
Phatumthani	Total	153,441	688
	Bang Kradee Industrial Park		
	Nava Nakorn IE	153,441	
Ayudhya	Total	326,679	1,466
	Bang Pa In IE	158,135	
	Hitech IE	168,544	
Saraburi	Total	18,561	83
	Nong Khae IE	18,561	

Appendix 3.3

Coal Consumption by Manufacturing Industry

1. Cement Industry

(1) Characteristics of Cement Industry

Cement industry is one of the major industries in Thailand. Cement plants in Thailand produced 55,472,547 ton of cement in 2000 (Industrial Statistics, Monthly Report, February 1999 – April 2002, Office of Industrial Economics). Many cement plants use a lot of fuel with high sulfur content. At the same time, most of the sulfur in the fuel is not emitted in to the air as SOx. So, estimation of fuel consumption and SOx emission by cement plants is important in calculating SOx emission in an area.

(2) SOx Emission from Cement Plants.

In this Study, we selected 16 big cements plants (including 3 plants which answered to the questionnaire survey). We assigned remaining annual cement production (total national production – production by above 3 plants) to 13 cement plans according to their production capacity.
Annual SOx emission from each cement plant can be calculated by multiplying its cement production (ton /Y) by Emission Factor (0.30 kg/Ton Cement).

(3) Fuel Consumption of Cement Plants

Lignite and imported coal is the major fuels for cement production in Thailand. Lignite consumption by cement industry is 2,512, 000 tons in 2000 (Table 1.1). Table 1.2 shows consumption of coal and its product by manufacturing sector. After allocation of Lignite consumption by others in Table 1.1 into the industry type in Table 1.2, is obtained consumption of coal and lignite (Table 1.3).

Table 1.1 Lignite Consumption for Manufacturing Sector in 2000

(thousand tons)

Industry	Lignite Consumption
Tobacco curing	31
Cement	2,512
Others	869
Total	3,412

DEDP/Thailand Energy Situation 2000

Table 1.2 Consumption of Coal and Its Products for Manufacturing Sector in 2000

(ktoe)

Industry	Consumption
Food and Beverages	50
Textiles	78
Wood and furniture	-
Pulp and Paper	323
Chemical	646
Non-Metal	2,252
Basic Metal	207
Fabricated Metal	-
Other (unclassified)	71
Total	3,627

DEDP/Thailand Energy Situation 2000

Table 1.3 Coal and Lignite Consumption for Manufacturing Sector in 2000

(thousand tons)

Industry	Coal	Lignite
Food and Beverages	75	19
Textiles	117	30
Wood and furniture	-	-
Pulp and Paper	484	123
Chemical	967	247
Non-Metal	1371	350(1)
Basic Metal	310	79
Fabricated Metal	-	-
Other (unclassified)	82	21
Total	3406	869

Note (1): Exclude Cement industry

It is said most of imported coal is used in cement production. However, we have no exact information on it. As a result, we assumed coal of Non-Metal (1371 thousand tons) is consumed by cement plants. Using the same method adopted in Section 1.2,

were allocated coal and lignite to the remaining cement plants according to their production capacity (Table 1.4).

Table 1.4 Cement Plant

Name	Province	Capacity Prod (T/Y)	Actual (T/Y)	Fuel Consumption			SO2 (T/Y)
				Coal (T/Y)	Lignite (T/Y)	BunkerC (L/Y)	
Cement Plant 01	Saraburi	**9,000,000**	**6,118,000**	1,032,000	-	-	**1,835**
Cement Plant 02	Saraburi	**4,290,000**	**3,382,921**	35,356	436,921	5,464,633	**1,015**
Cement Plant Group A		**20,000,000**	24,949,080	**164,830**	**1,126,438**	-	**7,485**
Cement Plant 03	Lampang	4,200,000	5,239,307	34,614	236,552	-	1,572
Cement Plant 04	Nakhon Sritummarat	4,200,000	5,239,307	34,614	236,552	-	1,572
Cement Plant 05	Saraburi	3,600,000	4,490,834	29,669	202,759	-	1,347
Cement Plant 06	Saraburi	4,000,000	4,989,816	32,966	225,288	-	1,497
Cement Plant 07	Saraburi	4,000,000	4,989,816	32,966	225,288	-	1,497
Cement Plant Group B		**13,600,000**	16,965,375	**112,085**	**765,978**	-	**5,090**
Cement Plant 08	Saraburi	11,600,000	14,470,467	95,602	653,334	-	4,341
Cement Plant 09	Lampang	2,000,000	2,494,908	16,483	112,644	-	748
Cement Plant Group C		**2,452,000**	3,058,757	**20,208**	**138,101**	-	**918**
Cement Plant 10	Nakhon Sawan	1,702,000	2,123,167	14,027	95,860	-	637
Cement Plant 11	Petchaburi	750,000	935,591	6,181	42,241	-	281
Cement Plant 12	Saraburi	**210,000**	261,965	1,731	11,828	-	**79**
Cement Plant 13	Saraburi	**165,000**	205,830	1,360	9,293	-	**62**
Cement Plant 14	Ratchaburi	**360,000**	449,083	2,967	20,276	-	**135**
Cement Plant 15	Saraburi	**66,000**	11,428	-	-	**2,684,870**	**3**
Cement Plant 16	Saraburi	**56,200**	70,107	463	3,165	-	**21**
Total		**50,199,200**	**55,472,547**	**1,371,000**	**2,512,000**	**8,149,503**	**16,642**

1.2 Area Source

Coal consumption by area sources is summarized in Table 1.5. In this Study, coal (and lignite) consumption by each sub-sector was allocated to each province by the method shown in Figure 1. Total Boiler capacity (T/h) and total Horse Power is summarized in Table 1.6.

Table 1.5 Coal and Lignite Consumption by Area Source

(thousand tons)

Industry	Coal	Lignite
Food and Beverages	75	19
Textiles	117	30
Wood and furniture	-	-
Pulp and Paper	484	-
Chemical	967	247
Non-Metal(1)	-	350)
Basic Metal	310	79
Fabricated Metal	-	-
Other (unclassified)	82	21
Total	2034	746

Note (1): Exclude Cement industry

Table 1.6 Boiler Capacity and Horse Power by Sub-sector

Industry	Boiler Capacity (T/h)	Horse Power
Food and Beverages	242	
Pulp and Paper	741	
Chemical		133,718
Non-Metal(1)		720,044
Basic Metal		492,665
Other (unclassified)(1)	75	

(1) Other includes textiles and wood and furniture

1.3 Tobacco Curing

Number of tobacco curing industry by province is shown in Table 1.7. Total lignite consumption is allocated to province according to its number of the industries. Then, each provincial consumption was assigned to each area according to its area share of the province.

Table 1.7 Tobacco Curing Industry

Province	NO. Fac	Ratio	Lignite 1000 T
Chiang Mai	31	0.123	3.80
Chiang Rai	66	0.261	8.09
Lampang	63	0.249	7.72
Phayao	18	0.071	2.21
Nan	38	0.150	4.66
Phrae	23	0.091	2.82
Sukhothai	1	0.004	0.12
Lamphun	12	0.047	1.47
Utaradit	1	0.004	0.12
Total	253	1.000	31.00

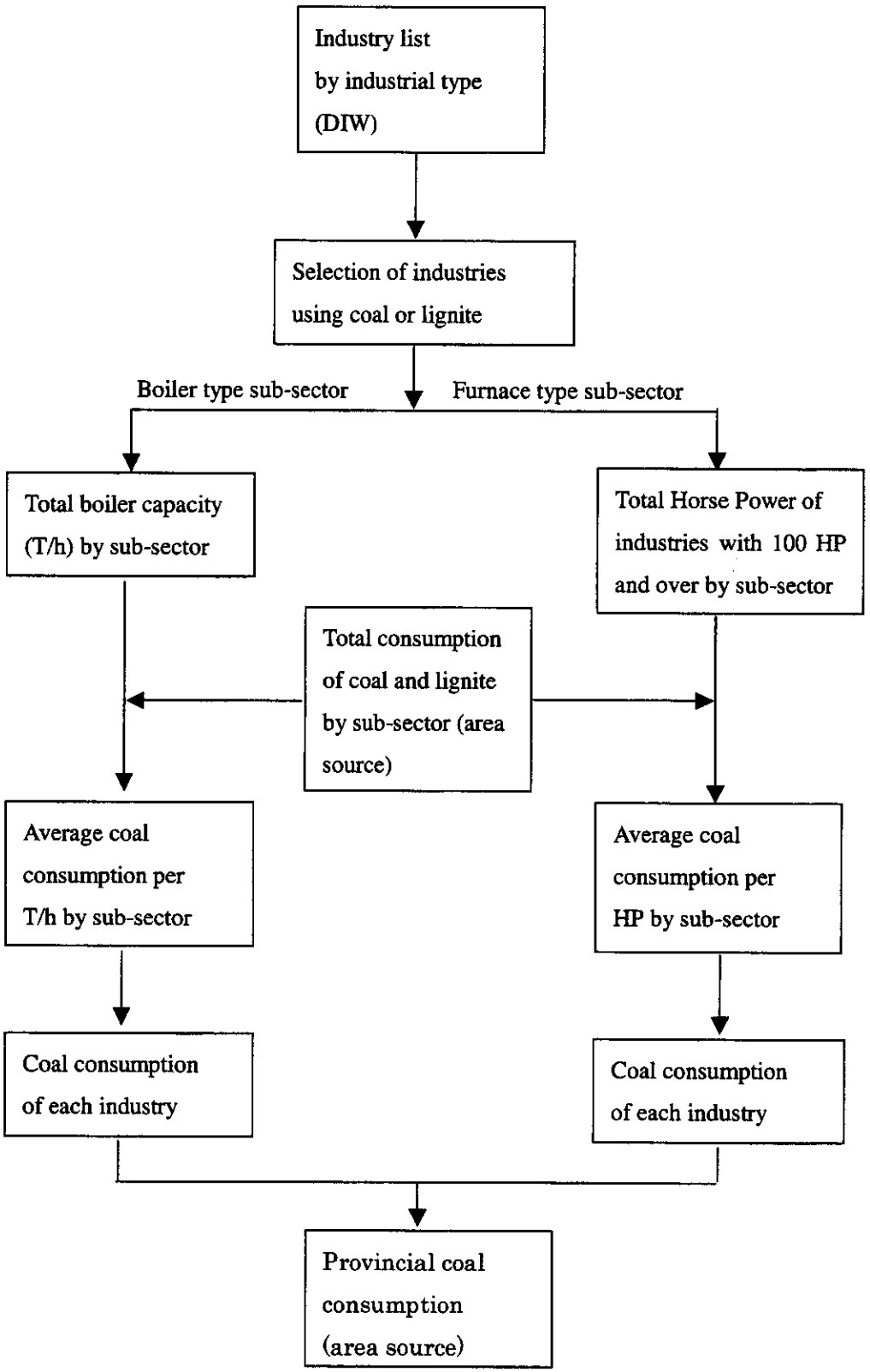


Figure 1.1 Flowchart for Estimating Provincial Consumption of Coal and Lignite by Area Source in 2000

Food and Beverages, Pulp and Paper and Others

Province No.	Province	Group	Airviro Number/Sheet/Excel File Name	Capacity (Cal))	Total Cap	Coal (T)	Lignite (T)	SO2 Coal (T/Y)	SO2 Lignite (T/Y)	X	Y
1	Bangkok	1		11.0		3407	869	32.36	26.08	686275	1527000
4	Samut Prakan	1		12.0		3716	948	35.31	28.45	697500	1505670
4	Samut Prakan	1		5.0		1548	395	14.71	11.86	638300	1504875
4	Samut Prakan	1		10.0		3097	790	29.42	23.71	671180	1501900
5	Samut Sakhon	1		10.0		3097	790	29.42	23.71	641600	1500750
5	Samut Sakhon	1		10.0		3097	790	29.42	23.71	638700	1499655
5	Samut Sakhon	1		10.0		3097	790	29.42	23.71	638700	1499655
20	Chiang Mai	1		1.0		310	79	2.94	2.37		
26	Lamphun	1		5.0		1548	395	14.71	11.86		
3	Pathum Thani	1		16.0		4955	1265	47.07	37.94	654150	1554000
5	Samut Sakhon	1		10.0		3097	790	29.42	23.71	638700	1499655
5	Samut Sakhon	1		10.0		3097	790	29.42	23.71	638700	1499655
6	Nakhon Pathom	1		10.0		3097	790	29.42	23.71	635780	1517300
6	Nakhon Pathom	1		10.0		3097	790	29.42	23.71	635780	1517300
6	Nakhon Pathom	1		8.0		2478	632	23.54	18.97	635780	1517300
6	Nakhon Pathom	1		8.0		2478	632	23.54	18.97	635780	1517300
6	Nakhon Pathom	1		8.0		2478	632	23.54	18.97	635780	1517300
6	Nakhon Pathom	1		8.0		2478	632	23.54	18.97	635780	1517300
6	Nakhon Pathom	1		8.0		2478	632	23.54	18.97	635780	1517300
6	Nakhon Pathom	1		5.0		1548	395	14.71	11.86	633750	1516200
11	Ratchaburi	1		5.0		1548	395	14.71	11.86		
11	Ratchaburi	1		40.0		12388	3162	117.68	94.85		
14	Saraburi	1		10.5		3252	830	30.89	24.90		
19	Chiang Rai	1		0.3		90	23	0.85	0.69		
20	Chiang Mai	1		5.4		1663	424	15.80	12.73		
26	Lamphun	1		5.6	241.7	1731	442	16.44	13.25		
5	Samut Sakhon	4	5147 / 7000 /AirViroEmiss3_020919	149.0		97252	87	923.89	2.62		
11	Ratchaburi	4		80.0		52216	47	496.05	1.40		
11	Ratchaburi	4		110.0		71797	64	682.07	1.93		
11	Ratchaburi	4		110.0		71797	64	682.07	1.93		
4	Samut Prakan	4	2076 / 30FACT / Airviro3_020919			0	0	0.00	0.00		
7	Kanchanaburi	4		141.0		92030	83	874.29	2.48		
7	Kanchanaburi	4		141.0		92030	83	874.29	2.48		
7	Kanchanaburi	4		10.0	741.0	6527	6	62.01	0.18		
18	Ang Thong	9		4.0		10631	2714	101.00	81.43		
18	Ang Thong	9		2.0		5316	1357	50.50	40.72		
37	Khon Kaen	9		12.0		31894	8143	302.99	244.29		
1	Bangkok	9	1360 / 7000 /AirViroEmiss3_020919	8.0		21263	5429	202.00	162.86		
37	Khon Kaen	9		12.0		31894	8143	302.99	244.29		
37	Khon Kaen	9		12.8		34020	8686	323.19	260.58		
37	Khon Kaen	9		12.5		33223	8482	315.62	254.47		
20	Chiang Mai	9		3.6		9644	2462	91.62	73.87		
26	Lamphun	9		0.9		2515	642	23.89	19.26		
26	Lamphun	9		0.9		2516	642	23.90	19.27		
71	Chonburi	9		3.1		8240	2104	78.28	63.11		
71	Chonburi	9		2.7	74.6	7175	1832	68.16	54.96		
	Total			1057.4		756849	70178	7190.06	2105.34		

Group	1	Food and Beverages
	4	Pulp and Paper

Chemical

No.	CategoryNo	Register No	Province No.	HP	Coal	Lignite	SO2 Coal	SO2 Lig
1	48	04807300232□□	7	155.00	1121.25	286.16	10.65	8.58
2	42	04201300237□□	37	860.50	6224.73	1588.63	59.13	47.66
3	42	04201300238□□	70	396.89	2871.04	732.73	27.27	21.98
4	48	04807300114□□	70	334.00	2416.11	616.62	22.95	18.50
5	48	04804300120□□	70	160.60	1161.76	296.50	11.04	8.89
6	48	□04804300239□□	70	103.75	750.51	191.54	7.13	5.75
7	42	04201300138□□	71	6227.06	45045.64	11496.23	427.93	344.89
8	42	04202300139□□	71	3155.74	22828.16	5826.04	216.87	174.78
9	42	□04201300134□□	71	1172.00	8478.08	2163.71	80.54	64.91
10	42	04201300131□□	71	736.45	5327.37	1359.61	50.61	40.79
11	48	04813300140□□	71	496.36	3590.60	916.37	34.11	27.49
12	48	04807300143□□	71	451.79	3268.18	834.08	31.05	25.02
13	42	04201300141□□	71	442.19	3198.74	816.36	30.39	24.49
14	42	□04201300140□□	71	170.00	1229.76	313.85	11.68	9.42
15	48	04803300138□□	71	159.70	1155.25	294.83	10.97	8.85
16	42	□04200300129□□	20	210.50	1522.73	388.62	14.47	11.66
17	48	04804300120□□	20	148.43	1073.72	274.03	10.20	8.22
18	42	04201300135□□	48	8968.33	64875.59	16557.09	616.32	496.71
19	42	04201300138□□	48	1961.80	14191.37	3621.82	134.82	108.65
20	42	04200300131□□	48	1910.62	13821.15	3527.33	131.30	105.82
21	42	□04201300127□□	48	251.71	1820.83	464.70	17.30	13.94
22	42	□04201300138□□	57	1802.00	13035.40	3326.80	123.84	99.80
23	42	□04201300137□□	74	3131.15	22650.28	5780.64	215.18	173.42
24	42	04201300134□□	74	2147.90	15537.59	3965.39	147.61	118.96
25	42	04201300139□□	74	636.94	4607.53	1175.90	43.77	35.28
26	42	04201300133□□	17	13233.50	95729.20	24431.33	909.43	732.94
27	42	04201300140□□	17	730.00	5280.71	1347.71	50.17	40.43
28	42	04201300137□□	17	288.60	2087.69	532.81	19.83	15.98
29	48	□04811300239□□	10	143.00	1034.44	264.00	9.83	7.92
30	48	04813300137□□	11	4584.00	33159.98	8462.86	315.02	253.89
31	42	04201300139□□	11	1725.15	12479.48	3184.93	118.56	95.55
32	42	04201300137□□	11	1533.60	11093.84	2831.29	105.39	84.94
33	42	04201300140□□	11	1173.00	8485.31	2165.56	80.61	64.97
34	42	□04201300136□□	12	11126.17	80485.09	20540.83	764.61	616.23
35	42	□04200300233□□	12	6066.91	43887.14	11200.56	416.93	336.02
36	42	□04201301835□□	12	1425.89	10314.68	2632.44	97.99	78.97
37	42	□04201300136□□	12	1415.70	10240.97	2613.63	97.29	78.41
38	48	□04806300140□□	12	124.00	897.00	228.93	8.52	6.87
39	48	04811300141□□	67	280.00	2025.48	516.93	19.24	15.51
40	48	04806300123□□	14	25126.69	181762.80	46388.21	1726.75	1391.65
41	42	04201300141□□	14	15637.35	113118.30	28869.25	1074.62	866.08
42	42	□04201300139□□	14	8229.10	59528.10	15192.34	565.52	455.77
43	48	04813300135□□	14	1626.80	11768.03	3003.35	111.80	90.10
44	48	04805300141□□	14	360.52	2607.95	665.58	24.78	19.97
45	48	04807300131□□	14	165.00	1193.59	304.62	11.34	9.14
46	48	04805300134□□	14	162.00	1171.88	299.08	11.13	8.97
47	48	□04807300439□□	14	131.16	948.79	242.14	9.01	7.26
48	42	□04201300137□□	14	108.92	787.91	201.09	7.49	6.03
49	42	04201300138□□	61	1025.92	7421.36	1894.03	70.50	56.82
50	42	04201300137□□	18	1104.00	7986.17	2038.17	75.87	61.15
				133718	**967299**	**246867**	**9189**	**7406**

Non-Metal

No.	CategoryNo	Register No	Province No.	HP	Lignite	Coal	SO2 Lig	SO2 Coa
1	56	□05600300138□□	55	148.80	72.30	0.00	2.17	0.0
2	58	05801300121□□	7	395.00	191.92	0.00	5.76	0.0
3	58	□05803300237□□	7	197.00	95.72	0.00	2.87	0.0
4	58	□05801300339□□	7	138.00	67.05	0.00	2.01	0.0
5	58	□05803300138□□	27	195.80	95.13	0.00	2.85	0.0
6	55	05500300135□□	37	209.44	101.76	0.00	3.05	0.0
7	55	□05500300137□□	37	123.80	60.15	0.00	1.80	0.0
8	56	05600300123□□	69	1434.73	697.10	0.00	20.91	0.0
9	55	05500300121□□	69	310.05	150.65	0.00	4.52	0.0
10	55	□05500300139□□	69	202.35	98.32	0.00	2.95	0.0
11	55	□05500300239□□	69	136.25	66.20	0.00	1.99	0.0
12	54	05400300134□□	70	3629.50	1763.48	0.00	52.90	0.0
13	58	□05801300338□□	70	131.00	63.65	0.00	1.91	0.0
14	58	□05801300235□□	71	3589.47	1744.03	0.00	52.32	0.0
15	55	□05500300134□□	71	3432.31	1667.67	0.00	50.03	0.0
16	55	05500300135□□	71	387.51	188.28	0.00	5.65	0.0
17	58	05801300633□□	71	367.61	178.61	0.00	5.36	0.0
18	55	05500300229□□	71	333.00	161.80	0.00	4.85	0.0
19	55	05500300133□□	71	267.23	129.84	0.00	3.90	0.0
20	55	05500300235□□	71	266.45	129.46	0.00	3.88	0.0
21	55	□05500300142□□	71	250.22	121.58	0.00	3.65	0.0
22	55	05500300139□□	71	222.11	107.92	0.00	3.24	0.0
23	55	05500300128□□	71	213.19	103.58	0.00	3.11	0.0
24	55	05500300329□□	71	211.66	102.84	0.00	3.09	0.0
25	55	05500300329□□	71	211.66	102.84	0.00	3.09	0.0
26	54	□05400300141□□	71	197.70	96.06	0.00	2.88	0.0
27	55	□05500300138□□	71	194.13	94.32	0.00	2.83	0.0
28	55	□05500300238□□	71	186.46	90.60	0.00	2.72	0.0
29	54	05400300117□□	71	184.50	89.64	0.00	2.69	0.0
30	55	05500300225□□	71	177.58	86.28	0.00	2.59	0.0
31	55	□05500300137□□	71	160.20	77.84	0.00	2.34	0.0
32	54	□05400300142□□	71	153.94	74.80	0.00	2.24	0.0
33	56	□05600300437□□	71	134.90	65.54	0.00	1.97	0.0
34	55	□05500300135□□	71	120.75	58.67	0.00	1.76	0.0
35	55	□05500300142□□	8	145.20	70.55	0.00	2.12	0.0
36	56	□05600300240□□	56	188.64	91.66	0.00	2.75	0.0
37	58	□05801300739□□	19	150.00	72.88	0.00	2.19	0.0
38	55	□05500300235□□	20	1659.08	806.10	0.00	24.18	0.0
39	55	□05500300236□□	20	684.00	332.34	0.00	9.97	0.0
40	55	05500300233□□	20	318.50	154.75	0.00	4.64	0.0
41	56	05600300128□□	20	201.50	97.90	0.00	2.94	0.0
42	58	□05801300739□□	20	197.50	95.96	0.00	2.88	0.0
43	55	05500300115□□	20	188.55	91.61	0.00	2.75	0.0
44	58	05801300233□□	20	179.27	87.10	0.00	2.61	0.0
45	55	05500300133□□	20	161.91	78.67	0.00	2.36	0.0
46	55	□05500300240□□	20	139.08	67.58	0.00	2.03	0.0
47	55	□05500300338□□	20	117.26	56.97	0.00	1.71	0.0

No.	CategoryNo	Register No	Province No.	HP	Lignite	Coal	SO2 Lig	SO2 Coal
48	58	05803300334□□	28	4596.72	2233.42	0.00	67.00	0.00
49	58	05803300235□□	28	1192.79	579.54	0.00	17.39	0.00
50	55	□05500300238□□	28	173.75	84.42	0.00	2.53	0.00
51	58	05803300136□□	48	3475.00	1688.41	0.00	50.65	0.00
52	58	05805300140□□	48	3402.28	1653.08	0.00	49.59	0.00
53	58	05803300240□□	48	804.00	390.64	0.00	11.72	0.00
54	58	□05801300738□□	48	197.50	95.96	0.00	2.88	0.00
55	58	□05801301238□□	48	171.20	83.18	0.00	2.50	0.00
56	55	□05500300138□□	48	125.96	61.20	0.00	1.84	0.00
57	58	05805300112□□	57	5743.68	2790.70	0.00	83.72	0.00
58	56	05600300140□□	57	5399.25	2623.35	0.00	78.70	0.00
59	58	□05801300239□□	57	251.08	121.99	0.00	3.66	0.00
60	55	□05500300238□□	57	176.60	85.81	0.00	2.57	0.00
61	55	05500300129□□	57	105.64	51.33	0.00	1.54	0.00
62	58	05803300134□□	29	3526.66	1713.51	0.00	51.41	0.00
63	55	05500300113□□	29	2494.19	1211.86	0.00	36.36	0.00
64	58	05803300226□□	29	1160.22	563.72	0.00	16.91	0.00
65	55	05500300139□□	74	15482.73	7522.65	0.00	225.68	0.00
66	58	05801300133□□	17	3929.38	1909.18	0.00	57.28	0.00
67	58	05805300139□□	17	3606.70	1752.40	0.00	52.57	0.00
68	55	05500300234□□	17	1474.00	716.18	0.00	21.49	0.00
69	55	□05500300138□□	17	186.13	90.44	0.00	2.71	0.00
70	55	□05500300140□□	17	144.89	70.40	0.00	2.11	0.00
71	58	05801300335□□	17	130.50	63.41	0.00	1.90	0.00
72	55	05500300122□□	17	124.80	60.64	0.00	1.82	0.00
73	58	05801300241□□	58	1917.23	931.53	0.00	27.95	0.00
74	58	05801300341□□	58	1495.90	726.82	0.00	21.80	0.00
75	58	05801300142□□	58	1371.71	666.48	0.00	19.99	0.00
76	58	□05801300239□□	31	195.10	94.79	0.00	2.84	0.00
77	55	05500300135□□	31	163.00	79.20	0.00	2.38	0.00
78	58	□05801300138□□	32	160.00	77.74	0.00	2.33	0.00
79	55	05500300133□□	59	113.66	55.22	0.00	1.66	0.00
80	55	05500300121□□	66	1788.98	869.22	0.00	26.08	0.00
81	58	05805300137□□	11	1782.09	865.87	0.00	25.98	0.00
82	55	05500300134□□	11	892.88	433.83	0.00	13.01	0.00
83	58	05801300140□□	11	660.62	320.98	0.00	9.63	0.00
84	55	05500300231□□	11	531.27	258.13	0.00	7.74	0.00
85	55	05500300319□□	11	347.50	168.84	0.00	5.07	0.00
86	55	05500300141□□	11	309.20	150.23	0.00	4.51	0.00
87	55	05500301815□□	11	284.00	137.99	0.00	4.14	0.00
88	55	05500300515□□	11	273.81	133.04	0.00	3.99	0.00
89	55	05500300124□□	11	246.00	119.52	0.00	3.59	0.00
90	55	05500300126□□	11	232.76	113.09	0.00	3.39	0.00
91	55	05500300130□□	11	228.00	110.78	0.00	3.32	0.00
92	55	05500300112□□	11	217.00	105.43	0.00	3.16	0.00
93	58	□05801300139□□	11	195.25	94.87	0.00	2.85	0.00
94	55	□05500300238□□	11	187.60	91.15	0.00	2.73	0.00
95	56	05600300139□□	11	186.55	90.64	0.00	2.72	0.00
96	55	05500300114□□	11	183.50	89.16	0.00	2.67	0.00

No.	CategoryNo	Register No	Province No.	HP	Lignite	Coal	SO2 Lig	SO2 Co
97	55	05500300615□□	11	183.50	89.16	0.00	2.67	0.(
98	55	05500300334□□	11	177.75	86.36	0.00	2.59	0.(
99	55	05500300212□□	11	177.00	86.00	0.00	2.58	0.(
100	55	05500300315□□	11	174.50	84.78	0.00	2.54	0.(
101	55	05500300215□□	11	170.50	82.84	0.00	2.49	0.(
102	55	05500301615□□	11	166.75	81.02	0.00	2.43	0.(
103	55	05500300321□□	11	166.00	80.65	0.00	2.42	0.(
104	55	05500301315□□	11	165.55	80.44	0.00	2.41	0.(
105	55	05500301015□□	11	164.00	79.68	0.00	2.39	0.(
106	55	05500301115□□	11	164.00	79.68	0.00	2.39	0.(
107	55	□05500300140□□	11	162.31	78.86	0.00	2.37	0.(
108	55	05500300116□□	11	162.00	78.71	0.00	2.36	0.(
109	55	05500300216□□	11	162.00	78.71	0.00	2.36	0.(
110	55	05500300216□□	11	162.00	78.71	0.00	2.36	0.(
111	55	05500300316□□	11	162.00	78.71	0.00	2.36	0.(
112	54	□05400300115□□	11	161.50	78.47	0.00	2.35	0.(
113	58	□05803300139□□	11	160.14	77.81	0.00	2.33	0.(
114	55	05500301215□□	11	159.00	77.25	0.00	2.32	0.(
115	55	05500300121□□	11	158.50	77.01	0.00	2.31	0.(
116	55	05500302315□□	11	158.50	77.01	0.00	2.31	0.(
117	55	05500300419□□	11	157.33	76.44	0.00	2.29	0.(
118	55	05500300219□□	11	157.00	76.28	0.00	2.29	0.(
119	55	05500300415□□	11	156.50	76.04	0.00	2.28	0.(
120	55	05500301515□□	11	156.50	76.04	0.00	2.28	0.(
121	55	05500300131□□	11	156.18	75.88	0.00	2.28	0.(
122	55	□05500300239□□	11	136.50	66.32	0.00	1.99	0.(
123	55	□05500300236□□	11	132.42	64.34	0.00	1.93	0.(
124	55	□05500300138□□	11	130.42	63.37	0.00	1.90	0.(
125	55	05500300221□□	11	112.50	54.66	0.00	1.64	0.(
126	55	□05500300134□□	11	106.75	51.87	0.00	1.56	0.(
127	56	05600300138□□	12	9184.34	4462.43	0.00	133.87	0.(
128	58	□05803300137□□	12	196.50	95.47	0.00	2.86	0.(
129	55	05500300139□□	25	18389.64	8935.04	0.00	268.05	0.(
130	55	05500300334□□	25	3267.31	1587.50	0.00	47.62	0.(
131	58	05805300140□□	25	2058.90	1000.36	0.00	30.01	0.(
132	58	05801300142□□	25	1837.46	892.77	0.00	26.78	0.(
133	55	05500300533□□	25	938.89	456.18	0.00	13.69	0.(
134	55	□05500300136□□	25	803.10	390.20	0.00	11.71	0.(
135	55	05500300324□□	25	572.69	278.25	0.00	8.35	0.(
136	55	05500300137□□	25	485.37	235.83	0.00	7.07	0.(
137	55	05500300121□□	25	466.35	226.59	0.00	6.80	0.(
138	55	05500300135□□	25	463.50	225.20	0.00	6.76	0.(
139	55	05500300126□□	25	431.50	209.65	0.00	6.29	0.(
140	55	05500300534□□	25	387.83	188.44	0.00	5.65	0.(
141	55	□05500300641□□	25	387.37	188.21	0.00	5.65	0.(
142	55	05500300124□□	25	376.80	183.08	0.00	5.49	0.(
143	55	05500300237□□	25	364.05	176.88	0.00	5.31	0.(
144	55	05500300115□□	25	346.24	168.23	0.00	5.05	0.(
145	55	05500300529□□	25	336.99	163.73	0.00	4.91	0.(

No.	CategoryNo	Register No	Province No.	HP	Lignite	Coal	SO2 Lig	SO2 Coal
146	55	05500301735□□	25	332.40	161.50	0.00	4.85	0.00
147	55	05500300330□□	25	280.64	136.36	0.00	4.09	0.00
148	55	□05500300339□□	25	276.48	134.33	0.00	4.03	0.00
149	55	05500300618□□	25	259.18	125.93	0.00	3.78	0.00
150	55	05500300515□□	25	254.61	123.71	0.00	3.71	0.00
151	55	05500300525□□	25	254.01	123.42	0.00	3.70	0.00
152	55	05500300120□□	25	253.11	122.98	0.00	3.69	0.00
153	55	□05500300836□□	25	240.87	117.03	0.00	3.51	0.00
154	54	05400300426□□	25	230.31	111.90	0.00	3.36	0.00
155	55	05500302235□□	25	218.02	105.93	0.00	3.18	0.00
156	55	□05500301138□□	25	199.80	97.08	0.00	2.91	0.00
157	55	□05500301237□□	25	199.50	96.93	0.00	2.91	0.00
158	55	□05500300738□□	25	199.20	96.79	0.00	2.90	0.00
159	55	05500300735□□	25	197.52	95.97	0.00	2.88	0.00
160	55	□05500301537□□	25	195.02	94.76	0.00	2.84	0.00
161	55	□05500300838□□	25	192.13	93.35	0.00	2.80	0.00
162	55	□05500300938□□	25	191.30	92.95	0.00	2.79	0.00
163	55	□05500300937□□	25	189.25	91.95	0.00	2.76	0.00
164	55	05500300332□□	25	186.53	90.63	0.00	2.72	0.00
165	55	□05500300539□□	25	174.05	84.57	0.00	2.54	0.00
166	55	05500300632□□	25	171.52	83.34	0.00	2.50	0.00
167	55	□05500300839□□	25	170.90	83.04	0.00	2.49	0.00
168	55	05500300215□□	25	166.08	80.69	0.00	2.42	0.00
169	55	05500300225□□	25	165.08	80.21	0.00	2.41	0.00
170	55	□05500300142□□	25	163.50	79.44	0.00	2.38	0.00
171	58	□05801300438□□	25	160.70	78.08	0.00	2.34	0.00
172	55	05500300228□□	25	159.12	77.31	0.00	2.32	0.00
173	55	05500300132□□	25	158.76	77.14	0.00	2.31	0.00
174	55	□05500301038□□	25	156.50	76.04	0.00	2.28	0.00
175	55	05500300224□□	25	153.80	74.73	0.00	2.24	0.00
176	55	□05500301736□□	25	151.40	73.56	0.00	2.21	0.00
177	55	□05500300741□□	25	139.25	67.66	0.00	2.03	0.00
178	55	05500300221□□	25	139.12	67.59	0.00	2.03	0.00
179	55	05500300230□□	25	127.53	61.96	0.00	1.86	0.00
180	55	05500300118□□	25	127.30	61.85	0.00	1.86	0.00
181	55	05500300435□□	25	124.40	60.44	0.00	1.81	0.00
182	55	05500300222□□	25	122.33	59.44	0.00	1.78	0.00
183	55	05500300425□□	25	121.53	59.05	0.00	1.77	0.00
184	55	05500300718□□	25	120.72	58.65	0.00	1.76	0.00
185	55	05500300134□□	25	119.00	57.82	0.00	1.73	0.00
186	55	05500303434□□	25	114.70	55.73	0.00	1.67	0.00
187	55	□05500301337□□	25	112.56	54.69	0.00	1.64	0.00
188	58	□05801300137□□	26	198.50	96.45	0.00	2.89	0.00
189	58	□05801300139□□	51	181.32	88.10	0.00	2.64	0.00
190	58	□05801300238□□	67	148.75	72.27	0.00	2.17	0.00
191	55	05500300128□□	14	112784.70	54799.08	0.00	1643.97	0.00
192	55	05500300139□□	14	70579.07	34292.49	0.00	1028.77	0.00
193	55	05500300142□□	14	39882.56	19377.87	0.00	581.34	0.00
194	55	05500300118□□	14	35332.91	17167.32	0.00	515.02	0.00

No.	CategoryNo	Register No	Province No.	HP	Lignite	Coal	SO2 Lig	SO2 Coa
195	55	05500300235□□	14	34437.50	16732.26	0.00	501.97	0.0
196	54	□05400300129□□	14	32312.34	15699.70	0.00	470.99	0.0
197	55	05500300233□□	14	31403.56	15258.15	0.00	457.74	0.0
198	55	05500300232□□	14	24931.99	12113.79	0.00	363.41	0.0
199	55	05500300117□□	14	23931.61	11627.73	0.00	348.83	0.0
200	58	05805300113□□	14	19521.71	9485.08	0.00	284.55	0.0
201	55	□05500300131□□	14	18867.35	9167.14	0.00	275.01	0.0
202	55	05500300133□□	14	15736.09	7645.75	0.00	229.37	0.0
203	54	□05400300128□□	14	13953.22	6779.50	0.00	203.38	0.0
204	58	05805300131□□	14	11293.12	5487.03	0.00	164.61	0.0
205	58	05801300136□□	14	8382.00	4072.59	0.00	122.18	0.0
206	55	05500300635□□	14	8000.79	3887.37	0.00	116.62	0.0
207	55	05500300138□□	14	7691.10	3736.90	0.00	112.11	0.0
208	55	05500300137□□	14	5727.70	2782.94	0.00	83.49	0.0
209	56	05600300123□□	14	5690.00	2764.62	0.00	82.94	0.0
210	55	05500300335□□	14	5384.50	2616.18	0.00	78.49	0.0
211	55	05500300132□□	14	5077.14	2466.85	0.00	74.01	0.0
212	55	05500300535□□	14	4592.35	2231.30	0.00	66.94	0.0
213	58	05803300234□□	14	4590.00	2230.16	0.00	66.90	0.0
214	58	05801300238□□	14	4195.28	2038.37	0.00	61.15	0.0
215	58	05801300233□□	14	3943.91	1916.24	0.00	57.49	0.0
216	55	05500300115□□	14	3858.07	1874.53	0.00	56.24	0.0
217	55	05500300136□□	14	3079.66	1496.32	0.00	44.89	0.0
218	54	05400300127□□	14	2268.49	1102.20	0.00	33.07	0.0
219	54	05400300132□□	14	1804.42	876.72	0.00	26.30	0.0
220	58	05801301334□□	14	1515.27	736.23	0.00	22.09	0.0
221	58	05801300428□□	14	545.01	264.81	0.00	7.94	0.0
222	58	05803300135□□	14	507.50	246.58	0.00	7.40	0.0
223	56	05600300227□□	14	445.03	216.23	0.00	6.49	0.0
224	55	□05500300142□□	14	386.15	187.62	0.00	5.63	0.0
225	58	05801300332□□	14	371.90	180.70	0.00	5.42	0.0
226	58	□05801300239□□	14	196.00	95.23	0.00	2.86	0.0
227	55	□05500300136□□	14	195.00	94.75	0.00	2.84	0.0
228	55	05500300135□□	14	164.50	79.93	0.00	2.40	0.0
229	58	05803300338□□	15	3688.00	1791.90	0.00	53.76	0.0
230	55	05500300138□□	15	1998.43	970.98	0.00	29.13	0.0
231	55	05500300132□□	16	187.75	91.22	0.00	2.74	0.0
232	58	05801300139□□	61	574.77	279.27	0.00	8.38	0.0
233	56	05600300139□□	61	340.00	165.20	0.00	4.96	0.0
234	55	05500300133□□	61	282.00	137.02	0.00	4.11	0.0
235	55	05500300134□□	61	190.21	92.42	0.00	2.77	0.0
236	55	□05500300136□□	54	106.65	51.82	0.00	1.55	0.0
				720,044	**349,850**	**-**	**10,496**	**-**

Basic Metal

No.	CategoryNo	Register No	Province No.	HP	Coal	Lignite	SO2 Coal	SO2 Lig
1	59	05900300129□□	7	1,633	1,027	262	9.8	7.9
2	64	□06409300242□□	7	191	120	31	1.1	0.9
3	59	05900300136□□	37	927	583	149	5.5	4.5
4	64	06402300122□□	37	239	150	38	1.4	1.2
5	64	□06412300143□□	37	199	125	32	1.2	1.0
6	64	06409300129□□	37	167	105	27	1.0	0.8
7	59	05900300113□□	70	19,133	12,038	3,072	114.4	92.2
8	59	05900300139□□	70	14,090	8,864	2,262	84.2	67.9
9	60	06000300241□□	70	6,183	3,890	993	37.0	29.8
10	59	05900300240□□	70	5,886	3,703	945	35.2	28.4
11	64	06410300132□□	70	5,885	3,702	945	35.2	28.3
12	60	□06000300335□□	70	5,206	3,275	836	31.1	25.1
13	59	05900300138□□	70	4,482	2,820	720	26.8	21.6
14	59	05900300132□□	70	2,670	1,680	429	16.0	12.9
15	59	05900300235□□	70	2,489	1,566	400	14.9	12.0
16	64	06412300142□□	70	1,385	871	222	8.3	6.7
17	59	05900300121□□	70	940	591	151	5.6	4.5
18	64	06405300139□□	70	810	510	130	4.8	3.9
19	64	□06401300134□□	70	316	199	51	1.9	1.5
20	64	06409300136□□	70	307	193	49	1.8	1.5
21	64	□06402300342□□	70	289	182	46	1.7	1.4
22	64	06413300140□□	70	274	173	44	1.6	1.3
23	59	05900300122□□	70	235	148	38	1.4	1.1
24	64	06406300134□□	70	199	125	32	1.2	1.0
25	64	06413300139□□	70	198	125	32	1.2	1.0
26	59	05900300122□□	70	194	122	31	1.2	0.9
27	64	06409300129□□	70	193	121	31	1.2	0.9
28	60	06000300131□□	70	191	120	31	1.1	0.9
29	64	□06411300140□□	70	188	119	30	1.1	0.9
30	59	05900300138□□	70	173	109	28	1.0	0.8
31	64	□06412300143□□	70	169	106	27	1.0	0.8
32	64	06413301127□□	70	163	103	26	1.0	0.8
33	64	□06412300537□□	70	144	91	23	0.9	0.7
34	59	05900300135□□	71	26,809	16,867	4,305	160.2	129.1
35	59	05900300138□□	71	15,444	9,716	2,480	92.3	74.4
36	59	05900300238□□	71	8,327	5,239	1,337	49.8	40.1
37	64	06405300339□□	71	5,979	3,761	960	35.7	28.8
38	59	05900300141□□	71	3,036	1,910	487	18.1	14.6
39	59	05900300237□□	71	2,404	1,513	386	14.4	11.6
40	59	05900300235□□	71	2,119	1,333	340	12.7	10.2
41	59	05900300139□□	71	1,925	1,211	309	11.5	9.3
42	64	06405300139□□	71	1,753	1,103	281	10.5	8.4
43	60	06000300137□□	71	1,448	911	232	8.7	7.0
44	59	05900300237□□	71	1,283	807	206	7.7	6.2
45	64	06410300133□□	71	1,251	787	201	7.5	6.0
46	64	06401300141□□	71	1,175	739	189	7.0	5.7
47	64	06410300140□□	71	1,129	710	181	6.7	5.4

No.	CategoryNo	Register No	Province No.	HP	Coal	Lignite	SO2 Coal	SO2 Lig
48	60	□06000300130□□	71	969	610	156	5.8	4
49	64	06413300142□□	71	917	577	147	5.5	4
50	64	06401300139□□	71	648	407	104	3.9	3
51	64	□06401300133□□	71	498	313	80	3.0	2
52	60	06000300138□□	71	476	300	76	2.8	2
53	64	06412300139□□	71	429	270	69	2.6	2
54	64	06401300140□□	71	429	270	69	2.6	2
55	60	06000300139□□	71	409	257	66	2.4	2
56	59	05900300138□□	71	326	205	52	1.9	1
57	64	06402300135□□	71	288	181	46	1.7	1
58	64	□06413300342□□	71	265	167	43	1.6	1
59	64	06402300139□□	71	253	159	41	1.5	1
60	64	□06402300242□□	71	211	133	34	1.3	1
61	64	06401300138□□	71	191	120	31	1.1	0
62	60	06000300130□□	71	190	120	31	1.1	0
63	59	05900300133□□	71	160	101	26	1.0	0
64	59	05900300137□□	71	156	98	25	0.9	0
65	64	06413300115□□	71	155	98	25	0.9	0
66	64	□06413300439□□	71	151	95	24	0.9	0
67	64	□06413301035□□	71	148	93	24	0.9	0
68	64	□06413300239□□	71	133	84	21	0.8	0
69	64	□06402300139□□	71	132	83	21	0.8	0
70	64	□06401300139□□	71	128	81	21	0.8	0
71	59	05900300129□□	71	127	80	20	0.8	0
72	64	□06413300140□□	19	132	83	21	0.8	0
73	64	□06402300138□□	20	754	474	121	4.5	3
74	64	□06401300139□□	28	442	278	71	2.6	2
75	64	□06408300139□□	28	293	184	47	1.7	1
76	64	□06405300138□□	48	69,820	43,926	11,211	417.3	336
77	60	06000300140□□	48	19,489	12,261	3,129	116.5	93
78	59	05900300140□□	48	899	566	144	5.4	4
79	59	05900300137□□	48	457	287	73	2.7	2
80	60	□06000300131□□	48	411	259	66	2.5	2
81	64	06408300136□□	48	407	256	65	2.4	2
82	59	05900300138□□	48	271	170	44	1.6	1
83	64	06413300140□□	48	189	119	30	1.1	0
84	64	06410300137□□	48	188	118	30	1.1	0
85	64	06413300136□□	48	166	104	27	1.0	0
86	59	□05900300138□□	29	288	181	46	1.7	1
87	64	06411300122□□	49	119	75	19	0.7	0
88	64	□06410300241□□	74	13,396	8,428	2,151	80.1	64
89	64	06413300127□□	74	11,067	6,962	1,777	66.1	53
90	59	05900300137□□	74	3,883	2,443	623	23.2	18
91	64	06405300239□□	74	820	516	132	4.9	4
92	59	05900300138□□	17	6,187	3,892	993	37.0	29
93	59	05900300140□□	17	4,177	2,628	671	25.0	20
94	59	05900300135□□	17	2,224	1,399	357	13.3	10
95	60	06000300239□□	17	1,452	914	233	8.7	7
96	59	05900300137□□	17	1,207	759	194	7.2	5

No.	CategoryNo	Register No	Province No.	HP	Coal	Lignite	SO2 Coal	SO2 Lig
97	60	06000300138□□	17	817	514	131	4.9	3.9
98	59	05900300135□□	17	753	474	121	4.5	3.6
99	59	05900300140□□	17	495	311	79	3.0	2.4
100	60	06000300134□□	17	469	295	75	2.8	2.3
101	59	05900300140□□	17	445	280	72	2.7	2.1
102	60	06000300140□□	17	385	242	62	2.3	1.9
103	60	06000300138□□	17	363	228	58	2.2	1.7
104	64	□06413300236□□	17	350	220	56	2.1	1.7
105	64	06408300143□□	17	347	219	56	2.1	1.7
106	64	□06412300136□□	17	309	194	50	1.8	1.5
107	59	05900300121□□	17	281	177	45	1.7	1.4
108	64	06410300136□□	17	195	123	31	1.2	0.9
109	64	06413300128□□	17	175	110	28	1.0	0.8
110	64	□06413300343□□	17	158	99	25	0.9	0.8
111	64	06413300135□□	17	156	98	25	0.9	0.8
112	64	□06402300139□□	17	133	83	21	0.8	0.6
113	59	□05900300137□□	30	298	187	48	1.8	1.4
114	64	□06412300142□□	10	14,177	8,919	2,276	84.7	68.3
115	59	05900300121□□	10	2,815	1,771	452	16.8	13.6
116	60	06000300127□□	10	394	248	63	2.4	1.9
117	60	06000300115□□	10	285	179	46	1.7	1.4
118	64	06402300132□□	10	269	169	43	1.6	1.3
119	60	06000300236□□	59	14,453	9,093	2,321	86.4	69.6
120	64	06401300335□□	66	470	296	75	2.8	2.3
121	64	06401300141□□	11	16,674	10,491	2,677	99.7	80.3
122	59	05900300139□□	11	4,702	2,958	755	28.1	22.6
123	64	06401300233□□	11	1,611	1,013	259	9.6	7.8
124	59	05900300140□□	11	1,127	709	181	6.7	5.4
125	64	06410300136□□	11	636	400	102	3.8	3.1
126	64	□06401300135□□	11	299	188	48	1.8	1.4
127	60	06000300141□□	11	229	144	37	1.4	1.1
128	59	05900300142□□	11	195	123	31	1.2	0.9
129	64	06410300135□□	11	132	83	21	0.8	0.6
130	64	06405300133□□	11	112	70	18	0.7	0.5
131	64	06401300140□□	12	99,161	62,386	15,922	592.7	477.7
132	64	□06413300140□□	12	258	162	41	1.5	1.2
133	64	□06405300139□□	12	191	120	31	1.1	0.9
134	59	05900300139□□	12	163	103	26	1.0	0.8
135	64	□06413300742□□	25	1,606	1,010	258	9.6	7.7
136	64	06409300233□□	25	408	256	65	2.4	2.0
137	64	06401300131□□	26	7,993	5,029	1,283	47.8	38.5
138	64	□06412300138□□	26	192	121	31	1.1	0.9
139	64	06409300136□□	67	670	421	108	4.0	3.2
140	59	05900300138□□	67	479	301	77	2.9	2.3
141	64	□06402300235□□	67	333	210	54	2.0	1.6
142	64	06401300137□□	67	249	156	40	1.5	1.2
143	64	06412300139□□	67	171	108	28	1.0	0.8
144	64	06402300143□□	67	157	99	25	0.9	0.8
145	64	□06402300132□□	67	147	92	24	0.9	0.7

No.	CategoryNo	Register No	Province No.	HP	Coal	Lignite	SO2 Coal	SO2 Lig
146	59	□05900300138□□	14	5,230	3,290	840	31.3	25
147	64	□06413300137□□	14	2,007	1,263	322	12.0	9
148	64	□06413300141□□	14	812	511	130	4.9	3
149	64	06410300139□□	14	495	312	80	3.0	2
150	59	05900300136□□	14	304	191	49	1.8	1
151	59	05900300137□□	14	195	123	31	1.2	0
152	64	06405300138□□	14	193	122	31	1.2	0
153	59	05900300233□□	14	190	120	31	1.1	0
154	59	05900300136□□	14	149	93	24	0.9	0
155	64	06401300134□□	14	108	68	17	0.6	0
156	64	06412300240□□	16	1,935	1,217	311	11.6	9
157	64	06406300134□□	16	167	105	27	1.0	0
158	64	□06412300240□□	16	155	98	25	0.9	0
159	64	06413300120□□	61	650	409	104	3.9	3
160	64	06410300138□□	61	175	110	28	1.0	0
161	64	□06413300935□□	52	2,494	1,569	400	14.9	12
162	64	□06413300142□□	18	197	124	32	1.2	0
163	64	□06401300133□□	46	3,569	2,246	573	21.3	17
164	64	06414300135□□	34	212	133	34	1.3	1
165	59	05900300241□□	34	190	120	31	1.1	0
				492,665	**309,955**	**79,105**	**2,944.6**	**2,373**

Appendix 3.4

Estimation of Provincial LPG Consumption by Residential and Commercial Sector

1. LPG Consumption by Residential and Commercial Sector

Figure 1.1 shows flowchart for estimating provincial LPG consumption by residential and commercial sector.

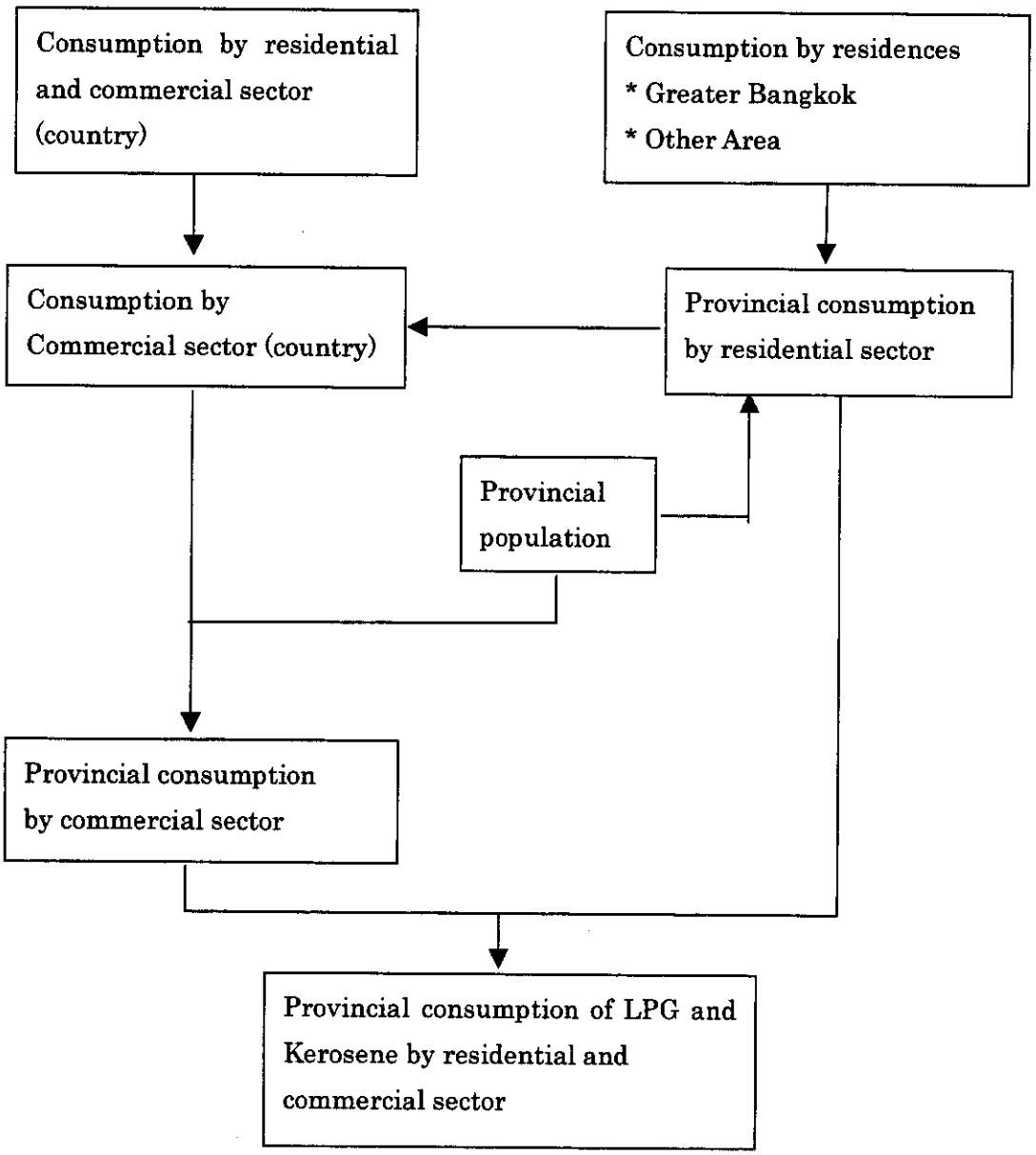


Figure 1.1 Consumption of LPG and Kerosene by Residential and Commercial Sector

LPG consumption by Residential and Commercial Sector in 2000 is 2,540,750 KL (about 1601 ktoe) (DEDP/Oil and Thailand 2000).

2 LPG Consumption by Residential Sector

Residential and Commercial Sector consists of Residential Sector and Commercial Sector. LPG Consumption by Residential Sector is divided into 2 areas: Greater Bangkok and Other Area as shown in Table 2.1.

Table 2.1 LPG Consumption by Residential Sector in 2000

(ktoe)

Area	LPG
Greater Bangkok	188
Other Area	704
Total	892

Source: DEDP/Thailand Energy Situation 2000

So, LPG is consumed both by Residential Sector and Commercial Sector.

3 LPG Consumption by Residential Sector and Commercial Sector

LPG consumption by Residential Sector and Commercial Sector is shown in Table 3.1.

Table 3.1 LPG Consumption by Residential and Commercial Sector in 2000

(KL)

Area	Residential Sector	Commercial Sector
Greater Bangkok	298,381	1,125,027
Other Area	1,117,342	
Total	1,415,723	1,125,027

4 Provincial LPG Consumption by Residential Sector

Provincial LPG consumption by Residential Sector is calculated separately in Greater Bangkok and Other Area. Provincial LPG consumption is calculated by assigning total LPG consumption of the sector in the area where it locates according to its population share in the region.

Provincial LPG consumption by Commercial Sector is calculated by assigning total national LPG consumption in the sector according to its population share in the country.

Provincial LPG consumption by Residential and Commercial Sector is sum of above both values.

Appendix 3.5

Estimation of Provincial Kerosene Consumption by Residential and Commercial Sector

1. Kerosene Consumption by Residential and Commercial Sector

Kerosen consumption by Residential and Commercial Sector in 2000 is 14,486 KL (about 12 ktoe) (DEDP/Oil and Thailand 2000).

2. Kerosene Consumption by Residential Sector

Residential and Commercial Sector consists of Residential Sector and Commercial Sector. Kerosene Consumption by Residential Sector is divided into 2 areas: Greater Bangkok and Other Area as shown in Table 2.1.

Table 2.1 Kerosene Consumption by Residential Sector in 2000

(ktoe)

Area	Kerosene
Greater Bangkok	
Other Area	8
Total	8

Source: DEDP/Thailand Energy Situation 2000

So, Kerosene of Residential and Commercial Sector is consumed both by Residential Sector and Commercial Sector.

3. Kerosene Consumption by Residential Sector and Commercial Sector

Kerosene consumption by Residential Sector and Commercial Sector is shown in Table 3.1.

Table 3.1 Kerosene Consumption by Residential and Commercial Sector (2000)

(KL)

Area	Residential Sector	Commercial Sector
Greater Bangkok		4,829
Other Area	9,657	
Total	9,657	4,829

4. Provincial Kerosene Consumption by Residential Sector

Provincial Kerosene consumption by Residential Sector is calculated separately in Greater Bangkok and Other Area. Provincial Kerosene consumption is calculated by assigning total Kerosene consumption of the sector in the area where it locates according to its population share in the region.

Provincial Kerosene consumption by Commercial Sector is calculated by assigning total national Kerosene consumption in the sector according to its population share in the country.

Provincial Kerosene consumption by Residential and Commercial Sector is sum of above both values.

Appendix 3.6

Estimation of Provincial Consumption of Non-Fossil Fuel by Residential and Commercial Sector

1. Non-Fossil Fuel Consumption by Residential and Commercial Sector

Table 1.1 shows consumption of Non-fossil fuel by residential and commercial sector.

Table 1.1 Non-fossil fuel Consumption by Residential and Commercial Sector

(thousand tons)

Fuel wood	Charcoal	Paddy husk	Bagasse
6,748	3,330	126	

Source: DEDP/Thailand Energy Situation 2000

2, Non-fossil fuel Consumption by Residential Sector

Residential and Commercial Sector consists of Residential Sector and Commercial Sector. Consumption of Non-fossil fuel by Residential Sector is divided into 2 areas: Greater Bangkok and Other Area as shown in Table 2.1.

Table 2.1 Non-fossil fuel Consumption by Residential Sector

(thousand tons)

Area	Fuel wood	Charcoal	Paddy husk
Greater Bangkok	5	10	
Other Area	6,743	3,320	126
Total	6,748	3,330	126

Source: DEDP/Thailand Energy Situation 2000

So, from Tables 1.1 and 2.1, all Non-fossil fuel of Residential and Commercial Sector is consumed by Residential Sector.

Provincial Consumption of Non-fossil fuel is calculated by the same method as shown in Appendix 3-5.

Appendix 3.7

Review of Airviro 1997 and Preliminary Analysis to Develop Airviro 2000

1 Review of Airviro 1997 and Preliminary Analysis to Develop Airviro 2000

Airviro 1997 inventory for BMR was constructed in 2000. It is the base for 2000 inventory. Therefore, Airviro inventory 1997 is reviewed to develop the inventory of 2000.

1.1 Source Type

Stationary sources are classified into point and area sources.

(1) Point source includes

Industry of category 3 of Factory Act (equipped with 50 HP machines and above, or having 50 employees and more)(7014)

Crematory (843)

Municipal incinerator (1)

(2) Area source

Residential area

1.2 Emission Estimation Method

1.2.1 Industries

Flowchart for emission estimation of SO2 and NOx is shown in Figure 1.2.1.1.

1.2.1.1 Stack gas sampling

Thirty (30) stack gas sampling were conducted. From these data, emission rate at maximum loading and ratio between fuel consumption at maximum loading and Horse Power (ratio A) were calculated.

1.2.1.2 Questionnaire survey

Questionnaire survey was conducted for 7014 industries and 452 industries answered the survey (surveyed industries). From the data of these industries other than stack gas sampling industries, also, ratio between fuel consumption at maximum loading and Horse Power (ratio B) were calculated.

(1) Calculation of average ratio between fuel consumption and at maximum loading and Horse Power

Average ratio of ratio A and ratio B was calculated.

(2) Emission estimation

Emission of SO2 and NOx was estimated as shown in Table 1.2.1.1. The emission factors used are shown in Table 1.2.1.2.

Table 1.2.1.1 Emission Estimation Method

Industry	Emission estimation method
Stack gas sampling industries	Use stack gas sampling data
Surveyed industries	Emission = Fuel consumption x Emission Factor
Unsurveyed industries	Fuel consumption = Average ratio x Horse Power Emission = Fuel consumption x Emission Factor

Note: Surveyed industries means those which answered the questionnaire sheet (exclude stack gas sampling industries).

Table 1.2.1.2 Emission Factor for Industries

	Fuel Oil kg/1,000 L	HSD/ULR/Kerosense Kg/1,000 L	NG Lb/MMscf	Lignite kg/1,000 kg	LPG kg/1,000 L	Wood kg/1,000 kg
NOx	8	2.4	190	5.55	2.28	0.19
SO2	19S	17S	0.6	15S	0.012S	0.0375

Source: US EPA AP42 (1996)

1.2.1.3 Method for emission estimation from crematory and municipal incinerator

Emission of SO2 and NOx was calculated by the same method as the Surveyed industry.

1.2.1.4 Area source

Fuel consumption of residential area was calculated by subtracting total fuel consumption by point sources from total fuel consumption in BMR. Then emission from residential area was calculated by using the emission factor shown in Table 1.2.1.3.

Table 1.2.1.3 Emission Factor for Residential Area

	LPG[1] kg/1,000 L	Kerosene[2] Kg/1,000 L	Firewood kg/1,000 kg	Charcoal kg/1,000 kg	Glass/paddy husk kg/1,000 kg
NOx	1.68	2.4	1.4	1.4	1.4
SO2	0.012S	0.17S	0.2	0.2	0.2

(1) Sulfur in LPG (S) = 0.343 gram/m3 (DCR-MOC, 1980)
(2) Sulfur content in Kerosene (S) = 0.15% by Wt (MOI, 1994)
Source: DCR (1980), MOI (1994) and US EPA AP-42 (1996)

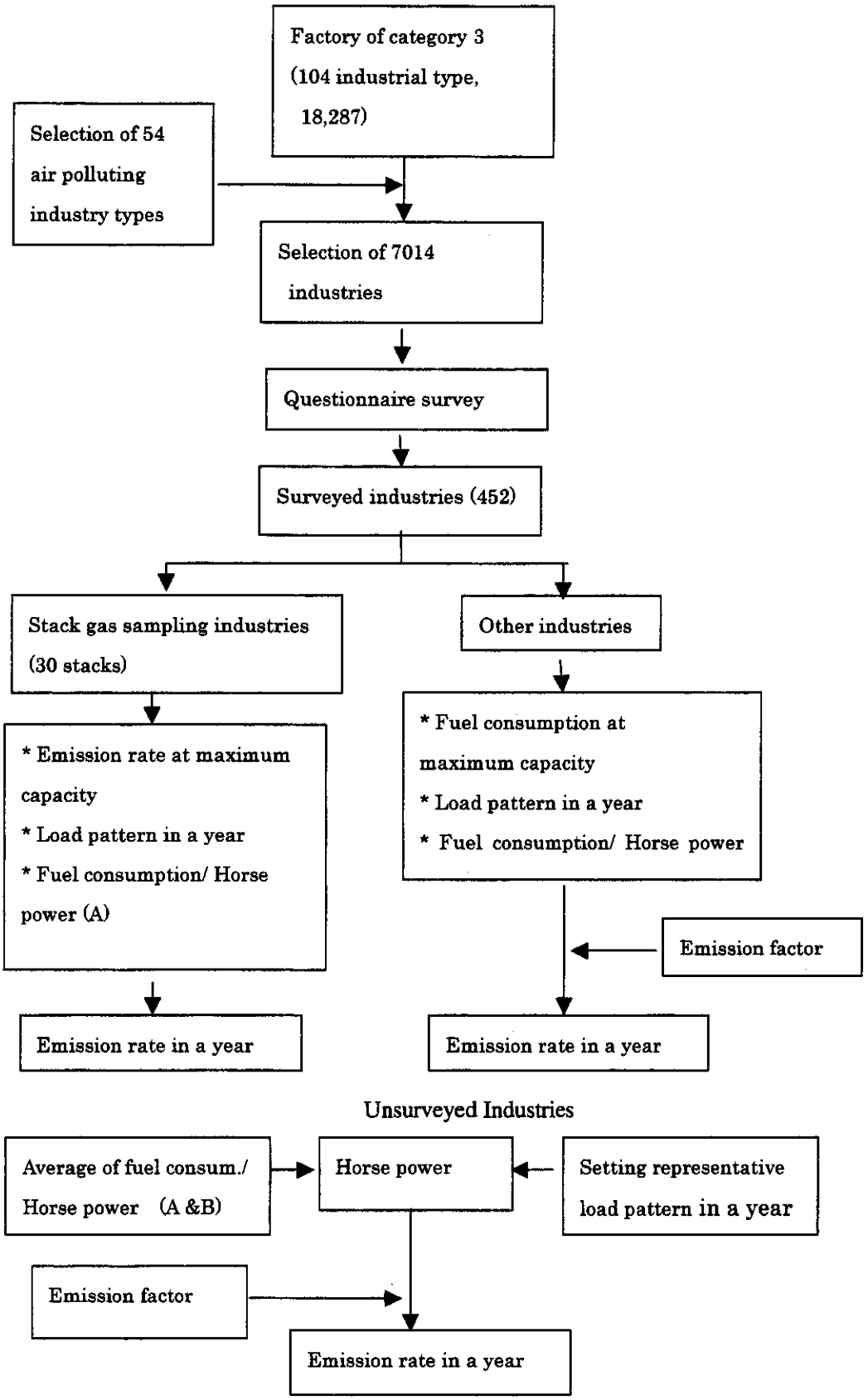


Figure 1.2.1.1. Flowchart of Point Source Emission Estimation (Industries)

1.3 Estimated Emission

SO2 and NOx emission from point and area stationary sources by province are shown in Table 1.2.1.4. Annual total emission of SOx and NOx in BMR is 230,000 tons and 58,600 respectively. For both pollutants, industries account for more than 95% of the total emission.

Table 4.2.1.4 SO2 and NOx Emission in BMR in 1997

SO2 (ton/Y)

Province	Industry	Cremator	Residential area	Waste incinerator	Total
Bangkok	24,410.2	1.4	3.2		24,414.8
Samut Prakan	118,301.8	0.3	1.8		118,303.9
Nonthaburi	27,464.0	0.3	0.8		27,465.0
Pathun Thani	16,376.0	0.2	0.8		16,377.0
Nakon Pathom	16,200.2	0.1	112.3		16,312.6
Samut Sakhon	17,634.9	0.2	65.2		17,700.3
Industrial estates	9,465.9				9,465.9
Total	229,852.9	2.7	184.0	3.6	230,043.2

NOx (ton/Y)

Province	Industry	Cremator	Residential area	Waste incinerator	Total
Bangkok	6,544.7	2.3	569.8		7,116.9
Samut Prakan	28,203.5	0.5	331.0		28,535.1
Nonthaburi	5,816.7	0.5	140.8		5,958.0
Pathun Thani	3,657.9	0.4	146.6		3,804.9
Nakon Pathom	3,885.3	0.2	922.4		4,807.9
Samut Sakhon	5,849.6	0.4	536.7		6,386.7
Industrial estates	2,033.7				2,033.7
Total	55,991.4	4.4	2,647.3	5.8	58,648.9

1.4 Preliminary Analysis for Developing AirViro Inventory for the Year 2000

1.4.1 Preliminary Analysis of Fuel Consumption in BMR

1.4.1.1 National energy consumption structure in manufacturing sector

Table 1.4.1.1 gives comparison of energy consumption structure of the manufacturing sector in the country between 1997 and 2000. This Table shows in the country, total energy consumption of manufacturing sector is almost equal between 1997 and 2000. This is because Thailand economy recovered to the level of 1997 in 2000 (Gross National Product of the manufacturing sector is 1,362,681 million Baht in 1997 and 1,435,369 million Baht (provisional estimate) in 1999). However, energy conversion can be seen : contribution of Natural Gas and Electricity has increased from 1997 to 2000.

Table 1.4.1 1 Comparison of Energy Consumption Structure of Manufacturing Sector in the Whole Country between 1997 and 2000

(ktoe)

Fuel	1997	2000	2000/1997
Coal and its products	3,970	3,627	0.914
Petroleum products	4,215	4,136	0.981
Natural gas	946	1,374	1.452
Electricity	2,870	3,346	1.166
Renewable energy	4,658	4,258	0.914
Total	16,659	16,741	1.005

Source: DEDP/Thailand Energy Situation 2000

1.4.1.2 Consumption of petroleum fuel in manufacturing sector in the country

One of the main energy source in manufacturing sector is petroleum products. Table 1.4.1.3 shows petroleum fuel consumption in the country in 1997 and 2000. This Table shows Fuel Oil is the most dominant petroleum fuel in the manufacturing sector between 1997 and 2000. From Tables 1.4.1.2 and 1.4.1.3, Fuel Oil is a basic index to estimate air pollutant emission in the manufacturing sector.

Table 1.4.1.3 Petroleum Fuel Consumption in Manufacturing Sector in the Whole Country

(KL)

Year	Gasoline	Kerosene	HSD	LSD	Fuel Oil	LPG
1997	68,028	51,231	582,721	23,294	3,059,379	517,887
2000	34,040	33,556	793,832	15,832	3,200,603	590,497
2000/1997	0.500	0.655	1.362	0.680	1.046	1.140

Source: DEDP/Oil and Thailand 2000

1.4.1.3 Petroleum fuel consumption in BMR

Table 1.4.1.4 shows petroleum fuel sale in BMR in 1997 and 2000. As shown above, the main fuel of manufacturing industry is Fuel Oil. The Fuel Oil sale decreased between 1997 and 2000. However, Samut Sakhon doubled its fuel sale in the same period.

Table 1.4.1.4 Petroleum Fuel Sale in BMR in 1997 and 2000

(1000KL)

Year	Province	Gasoline	Kerosene	Jet Fuel	High Speed Deasel	Low Speed Diesel	Fuel Oil	LPG 1000 ton
1997	Bangkok	2,584.743	26.724	3,000.209	3,641.076	115.789	3,587.278	293.511
	Nonthaburi	222.367	0.027		246.278	0.625	58.525	72.616
	Pathun Thani	169.462	2.538	297.514	614.156	1.201	318.769	75.579
	Sumut Prakan	270.131	7.666		829.441	0.988	616.813	170.627
	Nakhon Patom	93.505	0.859	0.390	325.100		148.378	41.234
	Samut Sakhon	67.437	3.880		185.738	3.476	379.351	69.329
	Total	3,407.645	41.694	3,298.113	5,841.789	122.079	5,109.114	722.896
2000	Bangkok	2,443.867	29.280	3,278.443	3,531.022	72.971	2,534.776	329.079
	Nonthaburi	203.923	0.226		205.363	0.071	35.199	65.866
	Pathun Thani	171.470	0.427	0.003	385.749	0.435	215.512	86.653
	Sumut Prakan	175.796	6.976		423.726	2.791	537.459	179.695
	Nakhon Patom	101.153	0.329	0.000	309.395		109.377	57.905
	Samut Sakhon	82.373	1.546		296.433	2.615	815.759	76.794
	Total	3,178.582	38.784	3,278.446	5,151.688	78.883	4,248.082	795.992
2000/1997	Bangkok	0.945	1.096	1.093	0.970	0.630	0.707	1.121
	Nonthaburi	0.917	8.370		0.834	0.114	0.601	0.907
	Pathun Thani	1.012	0.168	0.000	0.628	0.362	0.676	1.147
	Sumut Prakan	0.651	0.910		0.511	2.825	0.871	1.053
	Nakhon Patom	1.082	0.383	0.000	0.952		0.737	1.404
	Samut Sakhon	1.221	0.398		1.596	0.752	2.150	1.108
	Total	0.933	0.930	0.994	0.882	0.646	0.831	1.101

Source: Department of Commercial Registration

Appendix 3.8

Estimation of SOx Emission from Cement Plants with Fuel Conversion in 2011

1. There are 3 EIA reports of cement plants at which fuel conversion and energy saving are intended.
In this study SOx emission from cement plants with fuel conversion was estimated by the following equation (see following example of 3 cement plants and Figure 1).

SOxAf = SOxBf x (FuelSOxAf / Fuel SOx Bf)

Here

SOxAf: SOx emission after fuel conversion
SOxBf: SOx emission before fuel conversion
FuelSOxAf: SOx amount from fuel after fuel conversion
FuelSOxBf: Sox amount from fuel before fuel conversion

Example of 3 cement plants with fuel conversion

Plant A

After fuel conversion coal consumption decreased by 20% compared to before.

	Coal	Lignite	Fuel SOx (ton/Y)
2000	1,032,000		9,804
2000Af	825,600		7,843

SOx rate 0.800

Plant B

	Lignite consumption		
before	1,163,942	decrease rate of Lignite consumption	
after	642,800		0.448

	Coal	Lignite	Fuel SOx
2000	32,966	225,288	7,072
2000Af	32,966	124,418	4,046

SOx rate 0.572

Plant C

	Coal consumption		
before	1,380,000	decrease rate of Coal consumption	
after	1,149,000		0.167

	Coal	Lignite	Fuel SOx
2000	95,602	653,334	20,508
2000Af	79,599	653,334	20,356

SOx rate 0.993

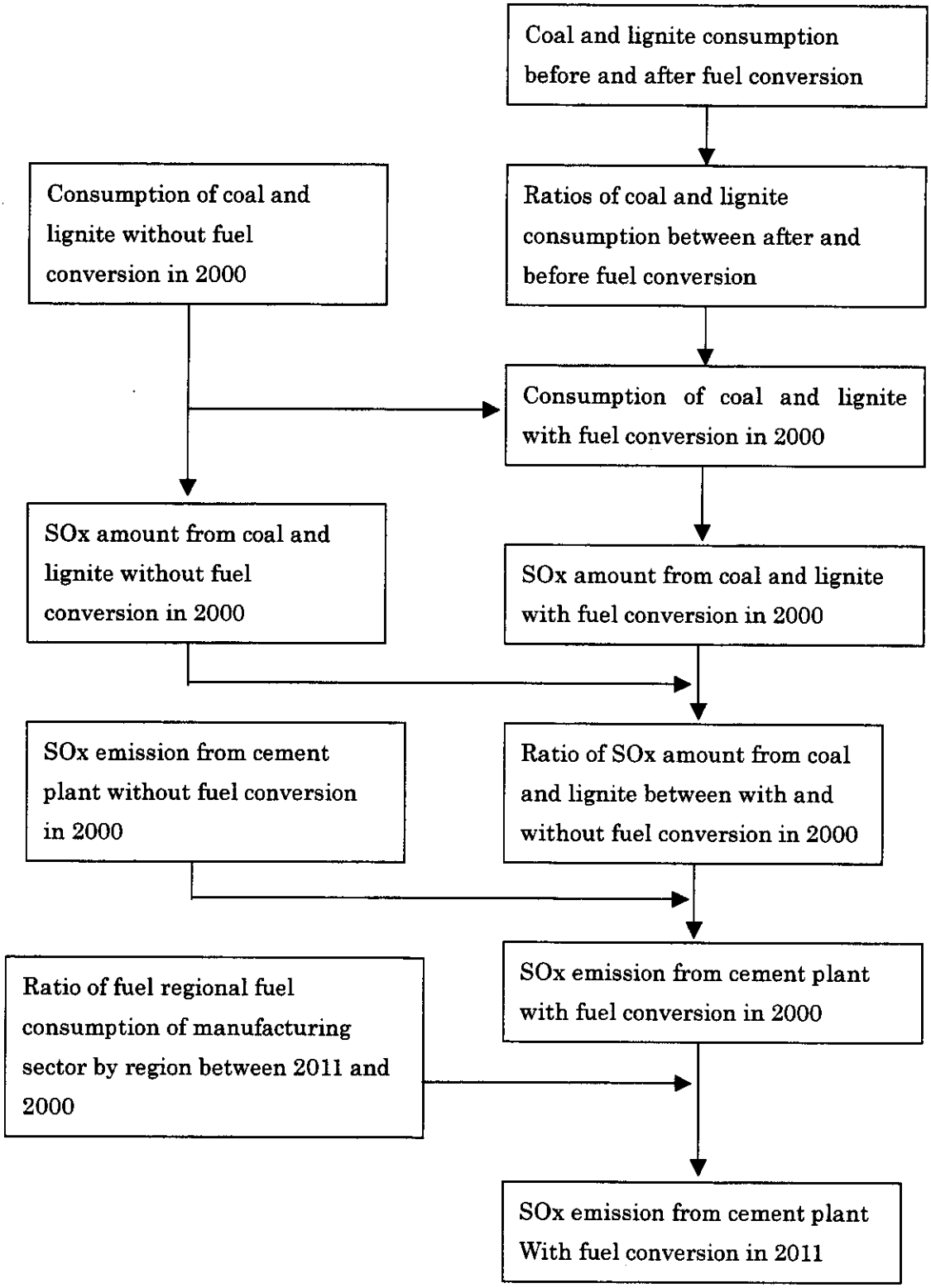


Figure 1. Method for Calculation of SOx Emission from Cement Plants with Fuel Conversion

4. Mobile Source Inventory

4.1 Mobile Source Inventory of the Year 2000

4.1.1 Mobile Source Inventory of the Year 2000 in Whole Thailand

4.1.1.1 Vehicle

1) Traffic Data

The vehicle kilometers of the Year 2000 by province in BMR are shown in Table 4.1.1.1, which are estimated using Airviro database updated based on the traffic assignment data in "Urban Rail Transportation Master Plan (URMAP,2001) " report of OCMLT.

The vehicle kilometers by province in the area except BMR in Thailand are shown in Table 4.1.1.2, which are based on "Highway Traffic Data by Province (2000, DOH)" report of DOH.

The location of province in which the vehicle kilometers are provided is shown in Figure 4.1.1.1.

Table 4.1.1.1 Vehicle Kilometers in BMR in Year 2000

Province	ID	Vehicle Kilometers by vehicle type (Million Vehicle-Kilometers/year)							
		PS(G)	Taxi (G)	PS(D)	Light Truck	Bus	Heavy Truck	MC	total
Bangkok	32	10,724	301	1,407	3,112	1,454	2,106	3,368	22,472
Nonthaburi	24	1,427	40	258	477	265	370	435	3,272
Pathum Thani	28	2,958	83	581	844	547	719	818	6,550
Samut Prakan	57	2,177	61	322	689	352	515	744	4,860
Nakhon Pathom	19	1,746	49	370	1,432	408	784	1,238	6,027
Samut Sakhon	59	1,100	31	224	503	202	301	484	2,845
Total		20,132	565	3,162	7,058	3,228	4,794	7,086	46,025

Note: Estimated based on traffic assignment data of URMAP report in OCMLT

Table 4.1.1.2 Vehicle Kilometers in the area except BMR in Thailand in Year 2000

Province	ID	Vehicle Kilometers by vehicle type (Million Vehicle-Kilometers/year)							
		Car, taxi	light bus	heavy bus	light truck	medium truc	heavy truck	motorcycle	total
Central		4,048	506	423	2,430	764	1,249	1,342	10,761
Chai Nat	9	542	42	34	332	81	163	207	1,400
Lop Buri	49	719	64	57	420	125	114	359	1,857
Saraburi	60	1,015	152	76	760	205	363	240	2,811
Sing Buri	61	163	11	6	38	20	14	131	383
Ayutthaya	33	1,282	192	214	587	277	505	300	3,356
Ang Thong	67	327	46	36	293	56	90	105	953
Northern Region		7,986	945	480	8,234	1,407	1,359	7,386	27,796
upper part		4,449	575	224	4,721	744	540	4,309	15,562
Chiang Rai	12	604	104	50	944	134	89	771	2,696
Chiang Mai	13	1,608	209	70	1,674	215	107	1,381	5,265
Nan	26	587	28	11	185	81	53	497	1,442
Phayao	72	284	43	24	469	69	43	475	1,409
Phrae	40	316	42	14	279	52	50	210	964
Mae Hong Son	43	128	25	5	57	24	14	144	397
Lampang	50	642	81	35	584	93	126	455	2,016
Lamphun	51	281	43	14	528	75	58	375	1,374
lower part		3,537	369	257	3,513	664	818	3,076	12,233
Kamphaeng Phet	4	455	50	22	541	90	142	495	1,796
Tak	16	374	46	18	312	70	96	246	1,163
Nakhon Sawan	23	647	58	50	726	119	201	385	2,186
Phichit	36	318	18	26	423	65	87	296	1,231
Phitsanulok	37	473	40	35	330	70	65	322	1,334
Phetchabun	39	433	75	43	497	99	85	453	1,685
Sukhothai	62	427	30	27	261	59	55	375	1,235
Uttaradit	69	241	40	26	284	53	58	311	1,014
Uthai Thani	70	170	12	9	138	39	29	193	589
Northeastern Region		8,930	1,074	998	7,606	1,980	1,607	7,594	29,788
upper part		4,521	621	528	3,573	956	723	4,020	14,943
Kalasin	3	385	44	34	271	83	51	306	1,173
Khon Kaen	5	996	143	149	700	217	187	608	2,999
Nakhon Phanom	20	138	31	19	270	43	25	249	776
Maha Sarakham	42	593	79	68	337	121	76	502	1,776
Mukdahan	73	207	42	26	138	44	34	231	721
Roi Et	45	562	59	48	183	108	80	296	1,336
Loei	52	335	45	32	307	77	45	402	1,243
Sakon Nakhon	54	280	53	46	443	79	51	409	1,360
Nong Khai	66	214	19	20	287	44	36	416	1,036
Nong Bua Lam Phu	75	120	26	20	166	32	33	141	539
Udon Thani	68	690	81	66	471	110	105	460	1,984
lower part		4,409	453	470	4,033	1,023	884	3,574	14,845
Chaiyaphum	10	203	22	32	441	90	62	282	1,132
Nakhon Ratchasima	21	1,742	161	202	1,428	407	445	786	5,172
Buri Ram	27	333	51	53	582	120	95	460	1,694
Yasothon	17	347	35	28	194	53	34	271	963
Si Sa Ket	53	387	33	31	198	76	52	353	1,129
Surin	65	329	42	32	319	95	82	397	1,297
Amnat Charoen	76	103	10	11	160	26	16	133	460
Ubon Ratchathani	71	965	98	82	710	156	99	890	3,000
Southern Region		5,960	1,027	325	4,441	1,160	1,386	5,434	19,734
upper part		3,509	617	212	2,735	774	937	2,740	11,525
Krabi	1	267	84	32	438	103	91	415	1,430
Chumphon	11	412	33	22	489	105	190	243	1,495
Nakhon Si Thammarat	22	1,181	234	55	555	264	276	836	3,400
Phangnga	34	161	38	22	217	38	50	219	744
Phuket	41	283	89	24	244	26	24	260	950
Ranong	46	124	22	7	195	28	20	137	533
Surat Thani	64	1,082	118	51	597	211	285	629	2,973
lower part		2,451	411	113	1,705	386	449	2,695	8,209
Trang	14	326	74	24	264	69	67	489	1,313
Narathiwat	25	267	27	5	100	28	30	433	891
Pattani	31	350	45	13	193	40	53	372	1,066
Phathalung	35	252	37	15	229	65	83	270	950
Yala	44	186	30	6	90	21	16	293	641
Songkhla	55	929	167	46	709	141	186	589	2,767
Satun	56	141	31	5	120	21	13	249	581
Eastern Region		5,322	667	429	4,265	1,019	1,268	2,281	15,251
Chanthaburi	6	345	53	16	752	51	44	309	1,571
Chachoengsao	7	1,327	155	116	772	277	346	190	3,183
Chon Buri	8	1,587	189	140	1,062	318	478	400	4,174
Trat	15	136	33	4	228	18	13	200	633
Nakhon Nayok	18	198	13	9	52	32	52	57	414
Prachin Buri	30	520	66	46	467	127	127	327	1,682
Rayong	47	820	134	76	731	125	153	472	2,512
Sa Kaeo	74	388	25	22	199	71	54	324	1,084
Western Region		3,280	249	224	3,323	676	964	2,102	10,819
Kanchanaburi	2	656	51	37	794	79	147	582	2,346
Prachuap Khiri Khan	29	595	31	38	490	189	192	284	1,818
Phetchaburi	38	626	53	46	382	129	174	257	1,666
Ratchaburi	48	472	39	34	870	102	209	451	2,176
Samut Songkhram	58	179	14	18	103	36	81	44	476
Suphan Buri	63	751	61	51	685	140	162	485	2,336
Total		35,525	4,468	2,880	30,298	7,006	7,833	26,139	114,149

Source: "Highway Traffic Data by Province (2000), DOH"

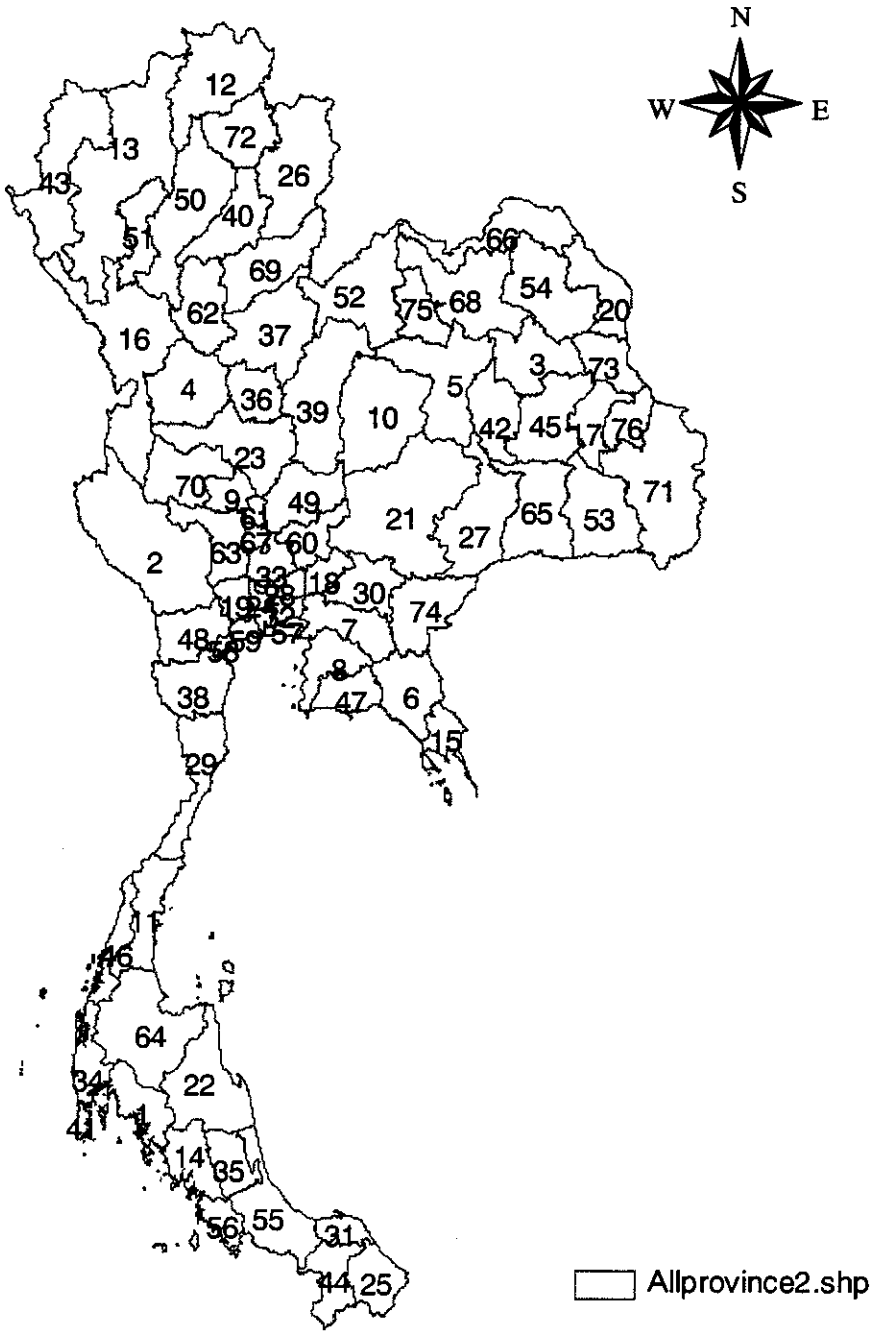


Figure 4.1.1.1 Location of Province

2) Emission Factor

(1) Age Distribution

Age distributions at 2000 were calculated on the number of vehicles for new registration, which lacks the data before 1993, as shown in Table 4.1.1.3. It was confirmed that Private consumption expenditure for vehicle purchase in the domestic market had close correlation with the data by high correlations, as shown in Figure 4.1.1.2, so that the lacking data were estimated from them.

Table 4.1.1.3 Key Factors and Calculation Result of Age Distribution at 2000

Private Consumption Expenditure for Vehicle Purchase in the Domestic Market (mil.B)

unit: Thousand

2000	1999	1998	1997	1996	1995	1994	1993	1992	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	1979	1978	1977	1976
62,490	49,352	35,649	79,614	108,701	110,153	94,127	88,405	71,493	50,421	53,797	40,033	31,356	21,844	17,058	16,954	22,047	23,384	20,468	19,263	18,518	19,670	19,670	19,670	19,670

Number of Vehicle for New Registration by Type

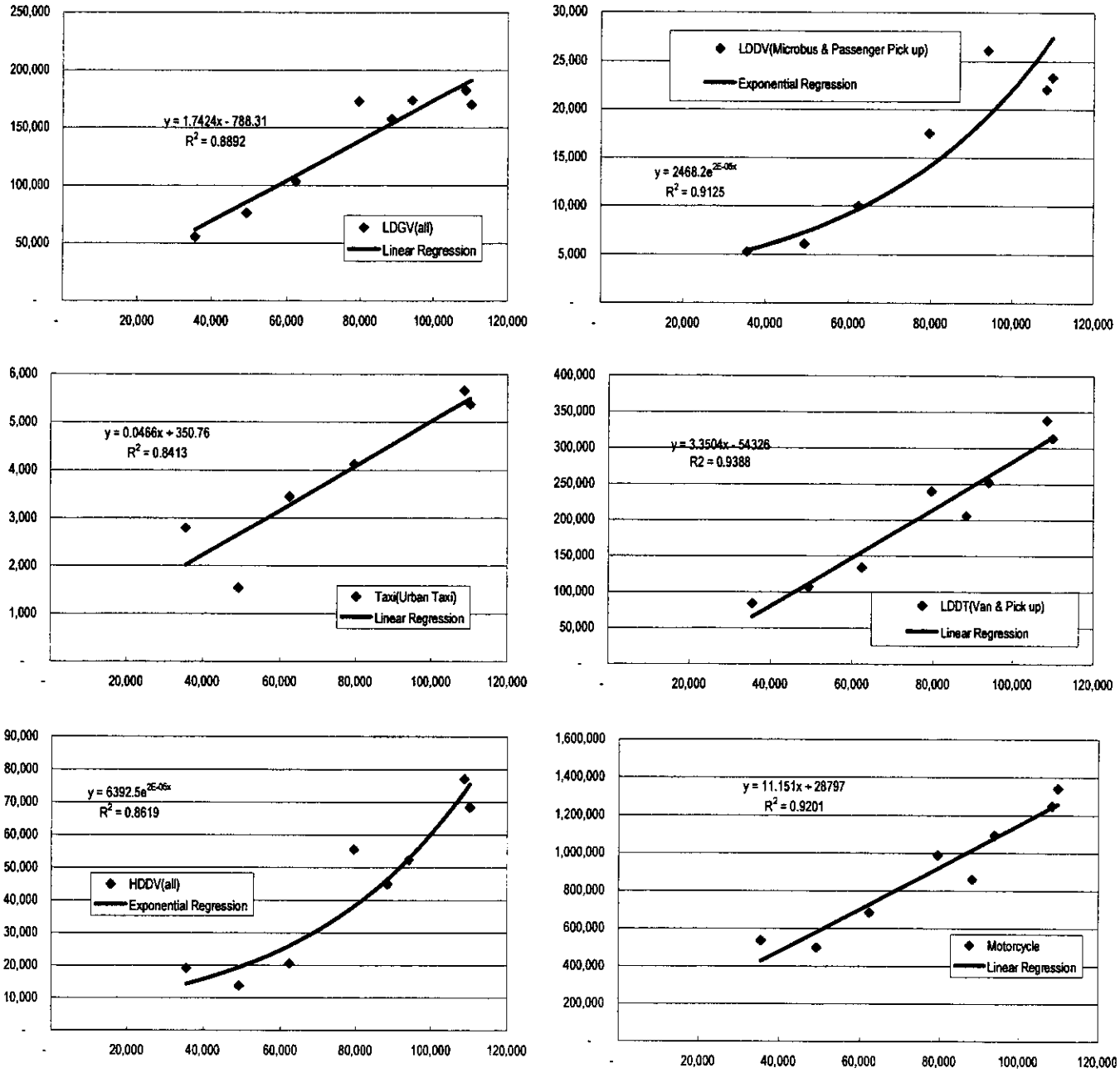
	2000	1999	1998	1997	1996	1995	1994	1993	1992	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	1979	1978	1977	1976
LDGV	103.0	75.7	55.0	172.5	182.1	169.9	173.5	157.2	123.8	87.1	92.9	69.0	53.8	37.3	28.9	28.8	37.6	40.0	34.9	32.8	31.5	33.5	33.5	33.5	33.5
Taxi	3.4	1.5	2.8	4.1	5.7	5.4	7.7	22.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LDDV	10.0	6.1	5.3	17.5	22.0	23.3	26.1	35.9	10.3	6.8	7.2	5.5	4.6	3.8	3.5	3.5	3.8	3.9	3.7	3.6	3.6	3.7	3.7	3.7	3.7
LDDT	133.3	106.6	83.6	239.7	338.1	312.9	251.7	205.3	185.2	114.6	125.9	79.8	50.7	18.9	2.8	2.5	19.5	24.0	14.2	10.2	7.7	11.6	11.6	11.6	11.6
HDDV	20.5	13.6	19.0	55.5	77.0	68.4	52.3	44.8	25.9	17.2	18.4	13.9	11.5	9.2	8.2	8.2	9.3	9.6	8.9	8.7	8.5	8.8	8.8	8.8	8.8
MC	682.9	497.4	533.8	987.3	1,247.9	1,339.1	1,091.2	859.2	826.0	591.0	628.7	475.2	378.4	272.4	219.0	217.9	274.6	289.6	257.0	243.6	235.3	248.1	248.1	248.1	248.1

Source: LTD

Note: The values from 1976 to 1992, except Taxi, were estimated by the correlation between Private Consumption Expenditure for Vehicle Purchase in the Domestic Market and Number of Vehicle for New Registration from 1993 to 2000.

Age Distribution by Vehicle Type

	2000	1999	1998	1997	1996	1995	1994	1993	1992	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	1979	1978	1977	1976	Total
LDGV	5.4%	3.9%	2.9%	9.0%	9.5%	8.8%	9.0%	8.2%	6.4%	4.5%	4.8%	3.6%	2.8%	1.9%	1.5%	1.5%	2.0%	2.1%	1.8%	1.7%	1.6%	1.7%	1.7%	1.7%	1.7%	100%
Taxi	6.4%	2.9%	5.2%	7.7%	10.6%	10.0%	14.4%	42.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100%
LDDV	4.4%	2.7%	2.3%	7.8%	9.8%	10.4%	11.6%	16.0%	4.6%	3.0%	3.2%	2.4%	2.1%	1.7%	1.5%	1.5%	1.7%	1.8%	1.7%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	100%
LDDT	5.6%	4.5%	3.5%	10.1%	14.2%	13.2%	10.6%	8.6%	7.8%	4.8%	5.3%	3.4%	2.1%	0.8%	0.1%	0.1%	0.8%	1.0%	0.6%	0.4%	0.3%	0.5%	0.5%	0.5%	0.5%	100%
HDDV	3.8%	2.5%	3.5%	10.2%	14.2%	12.6%	9.6%	8.2%	4.8%	3.2%	3.4%	2.6%	2.1%	1.7%	1.5%	1.5%	1.7%	1.8%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	100%
MC	3.7%	2.5%	3.4%	10.0%	13.9%	12.3%	9.4%	8.1%	4.8%	3.2%	3.4%	2.6%	2.2%	1.8%	1.6%	1.6%	1.8%	1.8%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	100%



unit: Million Bahts & vehicle population

Regression Models

Vehicle Type	Regression Equation	Correlation Coefficient (R2)
LDGV	y = 1.7424x - 788.31	0.89
Taxi	y = 0.0466x + 350.76	0.84
LDDV	y = 2468.2*exp(2E-05x)	0.91
LDDT	y = 3.3504x - 54326	0.94
HDDV	y = 6392.5*exp(2E-05x)	0.86
MC	y = 11.151x + 28797	0.92

Note: y: Number of new-registered vehicle

x: Private Consumption Expenditure for Purchase of Vehicles in the Domestic Market

Figure 4.1.1.2 Correlation between No. of new-registered vehicle and Private Consumption Expenditure for Purchase of Vehicles in the Domestic Market

(2) Emission Factor

The SOx emission factors were calculated from the fuel consumption rates as shown in Table 4.1.1.4. The graphs of SOx emission factors are shown in Figure 4.1.1.3.

Table 4.1.1.4 Fuel Consumption Rate and SOx Emission Factor at 2000

$FCR = a V^2 + b V + c$

FCR :Fuel Consumption Rate (g/km) V :Vehicle Speed (km/h)

Vehicle Speed		PS(G)	Taxi(G)	PS(D)	L-Truck	Bus	H-Truck	MC
<40km/h	a	0.0908	0.09	0.0125	0.0207	0.253	0.2317	0.0019
	b	-7.2427	-7.1814	-1.8595	-2.5988	-19.947	-18.606	-0.1241
	c	217.28	215.71	110.57	139.82	582.48	600.11	26.262
>40km/h	a	0.0129	0.0129	0.0125	0.0207	0.0308	0.0433	0.0002
	b	-1.9323	-1.9329	-1.8595	-2.5988	-4.5138	-5.8203	0.0599
	c	127.67	127.4	110.57	139.82	316.19	385.81	21.475

$EF = a V^2 + b V + c$

EF :SOx Emission Factor (g/km) V :Vehicle Speed (km/h)

Vehicle Speed		PS(G)	Taxi(G)	PS(D)	L-Truck	Bus	H-Truck	MC
<40km/h	a	0.173428	0.1719	0.02175	0.036018	0.44022	0.403158	0.003629
	b	-13.83356	-13.71647	-3.23553	-4.521912	-34.70778	-32.37444	-0.237031
	c	415.0048	412.0061	192.3918	243.2868	1013.5152	1044.1914	50.16042
>40km/h	a	0.024639	0.024639	0.02175	0.036018	0.053592	0.075342	0.000382
	b	-3.690693	-3.691839	-3.23553	-4.521912	-7.854012	-10.12732	0.114409
	c	243.8497	243.334	192.3918	243.2868	550.1706	671.3094	41.01725

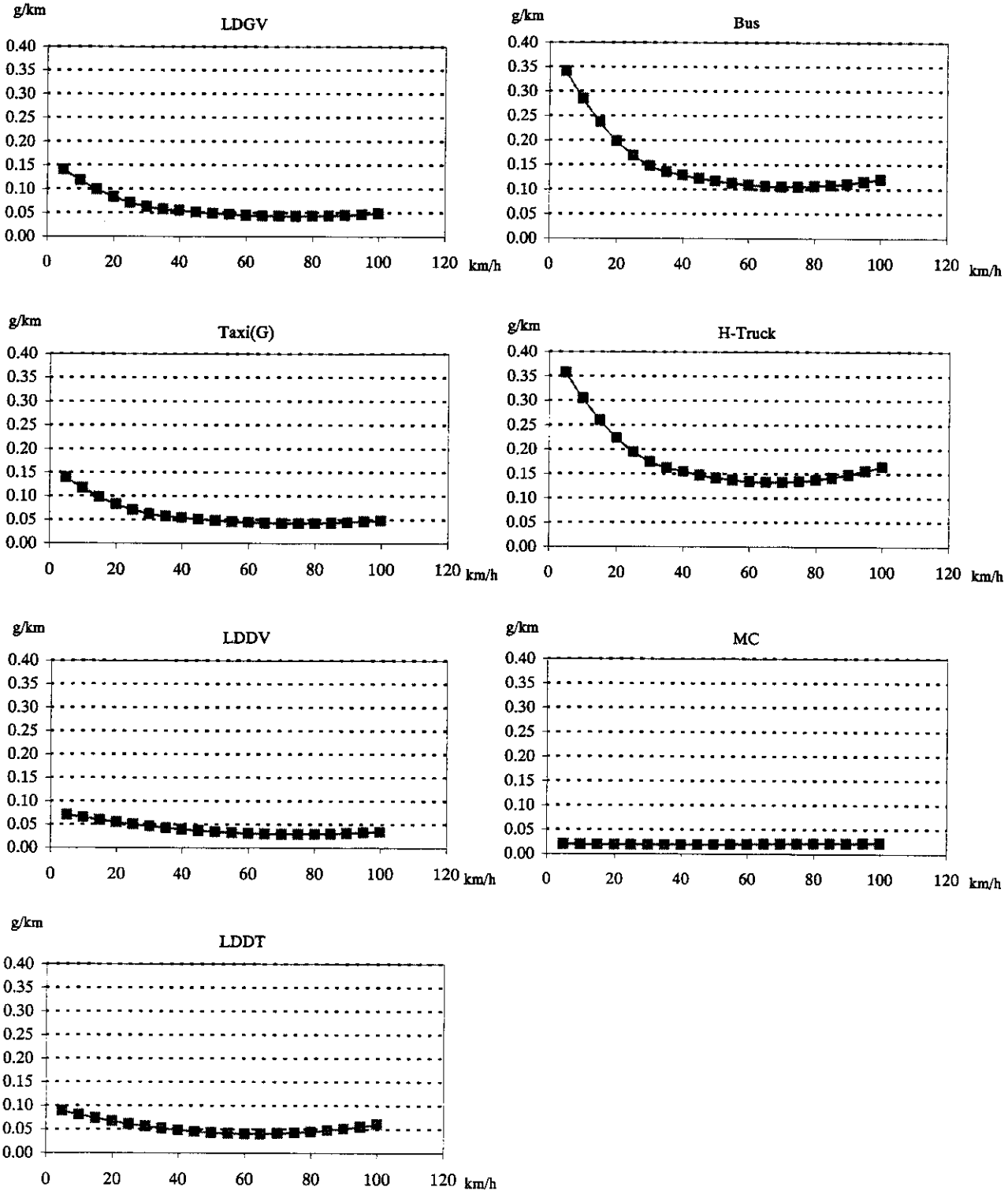


Figure 4.1.1.3 SOx Emission Factor at 2000

3) Estimated Emission

The estimated fuel consumption and SOx emission of vehicle by province of the Year 2000 in BMR are shown in Table 4.1.1.5 - 4.1.1.6.

The estimated fuel consumption and SOx emission of vehicle by province of the Year 2000 in the area except BMR in Thailand are shown in Table 4.1.1.7 - 4.1.1.8.

Table 4.1.1.5 Fuel Consumption of Vehicle in BMR in Year 2000

Province	ID	Fuel Consumption (kton/year)							
		PS(G)	Taxi (G)	PS(D)	Light Truck	Bus	Heavy Truck	MC	total
Bangkok	32	959	27	95	260	335	561	88	2,324
Nonthaburi	24	111	3	15	35	55	90	11	321
Pathum Thani	28	188	5	28	54	92	148	21	536
Samut Prakan	57	160	4	18	50	68	119	19	438
Nakhon Pathom	19	146	4	23	116	99	215	32	634
Samut Sakhon	59	72	2	11	33	35	64	12	229
Total		1,636	46	190	547	684	1,197	184	4,482

Table 4.1.1.6 SOx Emission of Vehicle in BMR in Year 2000

Province	ID	SOx Emission (ton/year)							
		PS(G)	Taxi (G)	PS(D)	Light Truck	Bus	Heavy Truck	MC	total
Bangkok	32	733	20	66	181	233	390	68	1,691
Nonthaburi	24	85	2	10	24	38	63	9	232
Pathum Thani	28	143	4	20	37	64	103	16	388
Samut Prakan	57	122	3	13	35	47	83	15	318
Nakhon Pathom	19	111	3	16	80	69	150	24	454
Samut Sakhon	59	55	2	8	23	24	44	9	165
Total		1,250	35	132	380	476	833	140	3,247

Table 4.1.1.7 Fuel Consumption of Vehicle in the area except BMR in Thailand in Year 2000

Province	ID	Fuel Consumption (ktons/year)							
		Car, taxi	light bus	heavy bus	light truck	medium truc	heavy truck	motorcycle	total
Central		219	62	85	167	125	334	38	1,031
Chai Nat	9	29	5	7	23	13	44	6	127
Lop Buri	49	39	8	11	29	20	31	10	148
Saraburi	60	55	19	15	52	33	97	7	279
Sing Buri	61	9	1	1	3	3	4	4	25
Ayutthaya	33	69	23	43	40	45	135	9	365
Ang Thong	67	18	6	7	20	9	24	3	87
Northern Region		440	116	97	566	230	364	209	2,021
upper part		245	71	45	324	121	145	122	1,073
Chiang Rai	12	33	13	10	65	22	24	22	189
Chiang Mai	13	89	26	14	115	35	29	39	346
Nan	26	32	3	2	13	13	14	14	92
Phayao	72	16	5	5	32	11	12	13	94
Phrae	40	17	5	3	19	8	13	6	72
Mae Hong Son	43	7	3	1	4	4	4	4	27
Lampang	50	35	10	7	40	15	34	13	154
Lamphun	51	15	5	3	36	12	15	11	98
lower part		195	45	52	241	108	219	87	948
Kamphaeng Phet	4	25	6	4	37	15	38	14	140
Tak	16	21	6	4	21	11	26	7	95
Nakhon Sawan	23	36	7	10	50	19	54	11	187
Phichit	36	17	2	5	29	11	23	8	96
Phitsanulok	37	26	5	7	23	11	17	9	99
Phetchabun	39	24	9	9	34	16	23	13	128
Sukhothai	62	24	4	5	18	10	15	11	86
Uttaradit	69	13	5	5	20	9	16	9	76
Uthai Thani	70	9	1	2	9	6	8	5	42
Northeastern Region		472	132	201	522	323	430	215	2,296
upper part		239	76	106	245	156	194	114	1,131
Kalasin	3	20	5	7	19	14	14	9	87
Khon Kaen	5	53	18	30	48	35	50	17	251
Nakhon Phanom	20	7	4	4	19	7	7	7	54
Maha Sarakham	42	31	10	14	23	20	20	14	132
Mukdahan	73	11	5	5	9	7	9	7	53
Roi Et	45	30	7	10	13	18	22	8	107
Loei	52	18	5	6	21	13	12	11	87
Sakon Nakhon	54	15	6	9	30	13	14	12	99
Nong Khai	66	11	2	4	20	7	10	12	66
Nong Bua Lam Phu	75	6	3	4	11	5	9	4	43
Udon Thani	68	36	10	13	32	18	28	13	151
lower part		233	55	94	277	167	237	101	1,165
Chaiyaphum	10	11	3	6	30	15	17	8	89
Nakhon Ratchasima	21	92	20	41	98	66	119	22	459
Buri Ram	27	18	6	11	40	20	25	13	132
Yasothon	17	18	4	6	13	9	9	8	67
Si Sa Ket	53	20	4	6	14	12	14	10	81
Surin	65	17	5	6	22	16	22	11	100
Amnat Charoen	76	5	1	2	11	4	4	4	32
Ubon Ratchathani	71	51	12	16	49	25	26	25	205
Southern Region		332	126	65	305	189	371	154	1,543
upper part		195	76	43	188	126	251	78	956
Krabi	1	15	10	6	30	17	24	12	115
Chumphon	11	23	4	4	34	17	51	7	140
Nakhon Si Thammarat	22	66	29	11	38	43	74	24	284
Phangnga	34	9	5	4	15	6	13	6	59
Phuket	41	16	11	5	17	4	6	7	66
Ranong	46	7	3	1	13	5	5	4	38
Surat Thani	64	60	14	10	41	34	76	18	255
lower part		136	50	23	117	63	120	76	586
Trang	14	18	9	5	18	11	18	14	93
Narathiwat	25	15	3	1	7	5	8	12	51
Pattani	31	19	5	3	13	7	14	11	72
Phathalung	35	14	5	3	16	11	22	8	78
Yala	44	10	4	1	6	3	4	8	37
Songkhla	55	52	21	9	49	23	50	17	220
Satun	56	8	4	1	8	3	3	7	35
Eastern Region		292	82	86	293	166	339	65	1,324
Chanthaburi	6	19	6	3	52	8	12	9	109
Chachoengsao	7	73	19	23	53	45	93	5	311
Chon Buri	8	87	23	28	73	52	128	11	403
Trat	15	7	4	1	16	3	4	6	40
Nakhon Nayok	18	11	2	2	4	5	14	2	39
Prachin Buri	30	29	8	9	32	21	34	9	142
Rayong	47	45	16	15	50	20	41	13	202
Sa Kaeo	74	21	3	4	14	12	14	9	78
Western Region		177	31	45	228	110	258	60	909
Kanchanaburi	2	35	6	7	55	13	39	16	173
Prachuap Khiri Khan	29	32	4	8	34	31	51	8	167
Phetchaburi	38	34	6	9	26	21	46	7	151
Ratchaburi	48	26	5	7	60	17	56	13	182
Samut Songkhram	58	10	2	4	7	6	22	1	51
Suphan Buri	63	41	8	10	47	23	43	14	185
Total		1,933	548	579	2,081	1,144	2,097	741	9,123

Table 4.1.1.8 SOx Emission of Vehicle in the area except BMR in Thailand in Year 2000

Province	ID	SOx Emission (tons/year)							
		Car, taxi	light bus	heavy bus	light truck	medium truck	heavy truck	motorcycle	total
Central		165	43	59	116	87	233	29	732
Chai Nat	9	22	4	5	16	9	30	4	90
Lop Buri	49	29	5	8	20	14	21	8	106
Saraburi	60	41	13	11	36	23	68	5	197
Sing Buri	61	7	1	1	2	2	3	3	18
Ayutthaya	33	52	16	30	28	32	94	6	259
Ang Thong	67	13	4	5	14	6	17	2	62
Northern Region		332	81	67	394	160	253	160	1,447
upper part		185	49	31	226	84	101	93	770
Chiang Rai	12	25	9	7	45	15	17	17	135
Chiang Mai	13	67	18	10	80	24	20	30	249
Nan	26	24	2	2	9	9	10	11	67
Phayao	72	12	4	3	22	8	8	10	68
Phrae	40	13	4	2	13	6	9	5	52
Mae Hong Son	43	5	2	1	3	3	3	3	19
Lampang	50	27	7	5	28	11	23	10	110
Lamphun	51	12	4	2	25	9	11	8	70
lower part		147	31	36	168	75	152	67	677
Kamphaeng Phet	4	19	4	3	26	10	26	11	100
Tak	16	16	4	2	15	8	18	5	68
Nakhon Sawan	23	27	5	7	35	14	38	8	133
Phichit	36	13	2	4	20	7	16	6	69
Phitsanulok	37	20	3	5	16	8	12	7	71
Phetchabun	39	18	6	6	24	11	16	10	91
Sukhothai	62	18	3	4	12	7	10	8	62
Uttaradit	69	10	3	4	14	6	11	7	54
Uthai Thani	70	7	1	1	7	4	5	4	30
Northeastern Region		352	92	140	364	225	299	165	1,636
upper part		178	53	74	171	109	135	87	807
Kalasin	3	15	4	5	13	9	9	7	62
Khon Kaen	5	39	12	21	33	25	35	13	178
Nakhon Phanom	20	5	3	3	13	5	5	5	39
Maha Sarakham	42	23	7	10	16	14	14	11	95
Mukdahan	73	8	4	4	7	5	6	5	38
Roi Et	45	22	5	7	9	12	15	6	76
Loei	52	13	4	4	15	9	8	9	62
Sakon Nakhon	54	11	5	6	21	9	10	9	70
Nong Khai	66	8	2	3	14	5	7	9	47
Nong Bua Lam Phu	75	5	2	3	8	4	6	3	31
Udon Thani	68	27	7	9	23	13	20	10	108
lower part		174	39	66	193	116	165	77	830
Chaiyaphum	10	8	2	4	21	10	12	6	63
Nakhon Ratchasima	21	69	14	28	68	46	83	17	325
Buri Ram	27	13	4	7	28	14	18	10	94
Yasothon	17	14	3	4	9	6	6	6	48
Si Sa Ket	53	15	3	4	9	9	10	8	58
Surin	65	13	4	4	15	11	15	9	71
Amnat Charoen	76	4	1	2	8	3	3	3	23
Ubon Ratchathani	71	38	8	11	34	18	18	19	147
Southern Region		251	88	46	212	132	258	118	1,104
upper part		148	53	30	131	88	175	59	683
Krabi	1	11	7	4	21	12	17	9	82
Chumphon	11	17	3	3	23	12	35	5	99
Nakhon Si Thammarat	22	50	20	8	27	30	51	18	203
Phangnga	34	7	3	3	10	4	9	5	42
Phuket	41	12	8	3	12	3	5	6	48
Ranong	46	5	2	1	9	3	4	3	27
Surat Thani	64	46	10	7	29	24	53	14	182
lower part		103	35	16	82	44	84	58	422
Trang	14	14	6	3	13	8	13	11	67
Narathiwat	25	11	2	1	5	3	6	9	37
Pattani	31	15	4	2	9	5	10	8	52
Phathalung	35	11	3	2	11	7	16	6	55
Yala	44	8	3	1	4	2	3	6	27
Songkhla	55	39	14	6	34	16	35	13	157
Satun	56	6	3	1	6	2	2	5	25
Eastern Region		221	57	60	204	116	236	49	943
Chanthaburi	6	14	4	2	36	6	8	7	78
Chachoengsao	7	55	13	16	37	31	65	4	221
Chon Buri	8	66	16	20	51	36	89	9	286
Trat	15	6	3	1	11	2	2	4	29
Nakhon Nayok	18	8	1	1	3	4	10	1	28
Prachin Buri	30	22	6	6	22	14	24	7	101
Rayong	47	34	11	11	35	14	29	10	144
Sa Kaeo	74	16	2	3	10	8	10	7	56
Western Region		133	21	31	159	77	180	46	647
Kanchanaburi	2	27	4	5	38	9	27	13	123
Prachuap Khiri Khan	29	24	3	5	23	21	36	6	119
Phetchaburi	38	25	5	6	18	15	32	6	107
Ratchaburi	48	19	3	5	42	12	39	10	129
Samut Songkhram	58	7	1	3	5	4	15	1	36
Suphan Buri	63	30	5	7	33	16	30	11	132
Total		1,455	381	403	1,449	796	1,459	566	6,509

4) Sample Calculation

A sample calculation is provided below;

Fuel Consumption and SOx emission in BMR are estimated using fuel efficiency calculated by vehicle speed by each road link. They are not estimated by average vehicle speed.

Central Region : (average vehicle speed : 85km/h)

Fuel Consumption (kton/year) = Fuel Efficiency (g/km/vehicle)
* Vehicle-kilometer(million vehicle, km/year) /1,000

F.C. of Car, taxi = (4,048* 0.77 * 57.6 + 4,048 * 0.23 * 42.9) /1000 = 219 kton/year

F.C. of Light Bus = 506* 122.5 /1000 = 62 kton/year

F.C. of Heavy Bus = 423* 201.0 /1000 = 85 kton/year

F.C. of Light Truck = 2,430* 68.7 /1000 = 167 kton/year

F.C. of Medium Truck = 764* 163.3 /1000 = 125 kton/year

F.C. of Heavy Truck = 1,249* 267.7 /1000 = 334 kton/year

F.C. of Motorcycle = 1,342* 28.4 /1000 = 38 kton/year

SOx Emission(ton/year) = Sulfur Contents(wt%) /100 * 64/32 *
Fuel Consumption (kton/year) * 1000

SOx E. of Car, taxi = 0.0382 / 100 * 2 * 219 * 1000 = 167 ton/year

SOx E. of Light Bus = 0.0348 / 100 * 2 * 62 * 1000 = 43 ton/year

SOx E. of Heavy Bus = 0.0348 / 100 * 2 * 85 * 1000 = 59 ton/year

SOx E. of Light Truck = 0.0348 / 100 * 2 * 167 * 1000 = 116 ton/year

SOx E. of Medium Truck = 0.0348 / 100 * 2 * 125 * 1000 = 87 ton/year

SOx E. of Heavy Truck = 0.0348 / 100 * 2 * 334 * 1000 = 233 ton/year

SOx E. of Motorcycle = 0.0382 / 100 * 2 * 38 * 1000 = 29 ton/year

Table 4.1.1.9 Share of LDGV,Taxi and LDDV in Car,Taxi

Region	LDGV,Taxi(%)	LDDV(%)
Northern Part	0.83	0.17
Northeastern Part	0.68	0.32
Central Part	0.77	0.23
Southern Part	0.87	0.13
Eastern Part	0.82	0.18
Western Part	0.76	0.24

Note: estimated by number of registered vehicle of year 2000 based on data of LTD

Table 4.1.1.10 Fuel Efficiency of Vehicle (velocity:85km) in the area except BMR in Thailand

Unit: g/km/vehicle

Properties	Speed (km/hr)	Car, Taxi		Light Bus	Heavy Bus	Light Truck	Medium Truck	Heavy Truck	Motor Cycle
		LDGV,Taxi	LDDV	BUSES	BUSES	LDDT	MDDT	HDDT	MC
Fuel Efficiency	85	57.6	42.9	122.5	201.0	68.7	163.3	267.7	28.4

Note: estimated by JICA study team

4.1.1.2 Railway

1) Traffic Data

The number of operations of trains in 4 major lines (Northern line, Northeastern line, Southern line, Eastern line) and others of the Year 2000 are shown in Table 4.1.1.11. The location of lines of railway and their sections are shown in Figure 4.1.1.4.

Table 4.1.1.11(1) Number of Operations of Train in Year 2000

Line	Section	Station		Distance (km)	Operation (one-way/day)
Northern Line	N1	Bangkok	Bang Sue Junction	7.47	169
	N2	Bang Sue Junction	Rangsit	22.53	126
	N3	Rangsit	Ban Phachi Junction	59.95	124
	N4	Ban Phachi Junction	Lop Buri	42.86	72
	N5	Lop Buri	Ban Takhli	60.2	68
	N6	Ban Takhli	Nakhon Sawan	52.77	64
	N7	Nakhon Sawan	Taphan Hin	73.22	62
	N8	Taphan Hin	Phitsanulok	70.28	60
	N9	Phitsanulok	Ban Dara Junction	69.03	42
	N10	Ban Dara Junction	Den Chai	75.63	34
	N11	Den Chai	Nakhon Lampang	108.35	30
	N12	Nakhon Lampang	Chiang Mai	109.13	24
	N13	Ban Dara Junction	Sawankalok	28.83	4
			Sub Total	780.25	879
Northeastern Line	NE1	Ban Phachi Junction	Map Kabao	44.35	56
	NE2	Map Kabao	Thanon Chira Junction	131.98	48
	NE3	Thanon Chira Junction	Surin	153.47	36
	NE4	Surin	Ubon Ratchathani	155.35	32
	NE5	Ubon Ratchathani	Bua Yai Junction	79.22	14
	NE6	Bua Yai Junction	Samran	115.21	32
	NE7	Samran	Udon Thani	103.13	24
	NE8	Udon Thani	Nong Khai	57.26	10
	NE9	Kaeng Khoi Junction	Lam Narai	83.7	26
	NE10	Lam Narai	Bua Yai Junction	167.1	24
			Sub Total	1,090.77	302
Eastern Line	E1	Yommarat	Makkasan	3	40
	E2	Makkasan	Hua Mak	10.24	48
	E3	Hua Mak	Hua Takhe	15.5	48
	E4	Hua Takhe	ChachoengsaoJunction	30.08	64
	E5	ChachoengsaoJunction	Khlong Sip Kao Junction	24.61	36
	E6	Khlong Sip Kao Junction	Kaen Khoi Junction	82.83	23
	E7	Kaen Khoi Junction	Si Racha	69.61	46
	E8	Khlong Sip Kao Junction	Kabin Buri	75.66	14
	E9	Kabin Buri	Aranyaprathet	93.24	6
	E10	Chit Lada	Makkasan	3.03	21
	E11	Makkasan	Mae Nam	9.87	8
	E12	Lat Krabang ICD	Hua Takhe	1.5	24
	E13	Si Racha	Laem Chabang	9.25	30
	E14	Si Racha	Sattahip	66.2	22
	E15	Kao Chin Chan Junction	Map Ta Phut	20.48	10
			Sub Total	515.10	440

Source: Investment of Capacity Constraints and Determination of the Need for Track Doubling of SRT Network (SRT, 2002)

Table 4.1.1.11(2) Number of Operations of Train in Year 2000

Line	Section	Station		Distance (km)	Operation (one-way/day)
Southern Line	S1	Bang Sue Junction	Taling Chan Junction	14.66	42
	S2	Taling Chan Junction	Nakhon Pathon	42.04	54
	S3	Nakhon Pathon	Nong Pla Duk Junction	16.07	52
	S4	Nong Pla Duk Junction	Hua Hin	148.8	42
	S5	Hua Hin	Prachuap khiri khan	89.34	38
	S6	Prachuap khiri khan	Chumphon	166.2	36
	S7	Chumphon	Surat Thani	166.49	34
	S8	Surat Thani	Thung Song Junction	122.06	38
	S9	Thung Song Junction	Hat Yai	171.5	34
	S10	Hat Yai	Yala	110.16	22
	S11	Yala	Sungai Kolok	104.25	16
	S12	Thon Buri	Taling Chan Junction	6.08	16
	S13	Nong Pla Duk Junction	Malaiman	78.41	2
	S14	Nong Pla Duk Junction	Nam Tok	130.05	8
	S15	Ban Thung Pho Junction	Khiri Rattanikhom	31	2
	S16	Thung Song Junction	Kantang	93	6
	S17	Khao Chum Thong Junction	Nakhon Si Thammarat	35.01	10
	S18	Hat Yai	Padang Besar	45.26	13
			Sub Total	1,570.38	465
Mae Klong Line	MK1	Wongwian Yai	Maha Chai	31.12	34
	MK2	Ban Laem	Mae Klong	33.54	8
			Sub Total	64.66	42

Source: Investment of Capacity Constraints and Determination of the Need for Track Doubling of SRT Network (SRT, 2002)

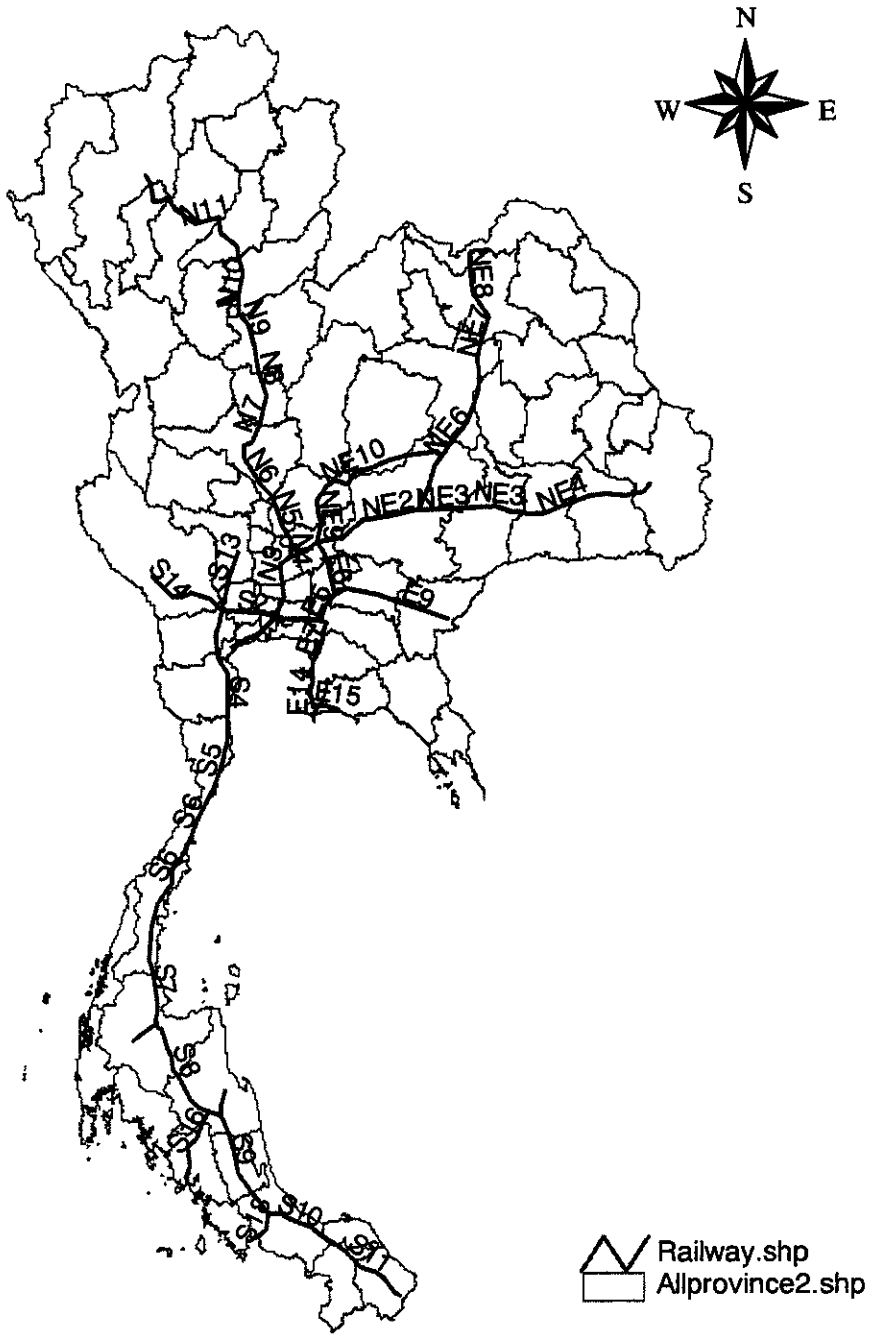


Figure 4.1.1.4 Location of Section in Line of Railway

2) Estimated Emission

The estimated fuel consumption and SOx emission of railway of the Year 2000 in whole Thailand are shown in Table 4.1.1.12.

Table 4.1.1.12(1) Fuel Consumption and SOx Emission of Railway in Year 2000

Line	Section	Station		Fuel Consumption (kton/year)	SOx Emission (tons/year)
Northern Line	N1	Bangkok	Bang Sue Junction	2.3	1.6
	N2	Bang Sue Junction	Rangsit	5.2	3.6
	N3	Rangsit	Ban Phachi Junction	13.6	9.5
	N4	Ban Phachi Junction	Lop Buri	5.6	3.9
	N5	Lop Buri	Ban Takhli	7.5	5.2
	N6	Ban Takhli	Nakhon Sawan	6.2	4.3
	N7	Nakhon Sawan	Taphan Hin	8.3	5.8
	N8	Taphan Hin	Phitsanulok	7.7	5.4
	N9	Phitsanulok	Ban Dara Junction	5.3	3.7
	N10	Ban Dara Junction	Den Chai	4.7	3.3
	N11	Den Chai	Nakhon Lampang	5.9	4.1
	N12	Nakhon Lampang	Chiang Mai	4.8	3.3
	N13	Ban Dara Junction	Sawankalok	0.2	0.1
			Sub Total	77	54
Northeastern Line	NE1	Ban Phachi Junction	Map Kabao	4.5	3.2
	NE2	Map Kabao	Thanon Chira Junction	11.6	8.1
	NE3	Thanon Chira Junction	Surin	10.1	7.0
	NE4	Surin	Ubon Ratchathani	9.1	6.3
	NE5	Ubon Ratchathani	Bua Yai Junction	2.0	1.4
	NE6	Bua Yai Junction	Samran	6.7	4.7
	NE7	Samran	Udon Thani	4.5	3.2
	NE8	Udon Thani	Nong Khai	1.0	0.7
	NE9	Kaeng Khoi Junction	Lam Narai	4.0	2.8
	NE10	Lam Narai	Bua Yai Junction	7.3	5.1
			Sub Total	61	42
Eastern Line	E1	Yommarat	Makkasan	0.2	0.2
	E2	Makkasan	Hua Mak	0.9	0.6
	E3	Hua Mak	Hua Takhe	1.4	0.9
	E4	Hua Takhe	ChachoengsaoJunction	3.5	2.5
	E5	ChachoengsaoJunction	Khlong Sip Kao Junction	1.6	1.1
	E6	Khlong Sip Kao Junction	Kaen Khoi Junction	3.5	2.4
	E7	Kaen Khoi Junction	Si Racha	5.9	4.1
	E8	Khlong Sip Kao Junction	Kabin Buri	1.9	1.3
	E9	Kabin Buri	Aranyaprathet	1.0	0.7
	E10	Chit Lada	Makkasan	0.1	0.1
	E11	Makkasan	Mae Nam	0.1	0.1
	E12	Lat Krabang ICD	Hua Takhe	0.1	0.0
	E13	Si Racha	Laem Chabang	0.5	0.4
	E14	Si Racha	Sattahip	2.7	1.9
	E15	Kao Chin Chan Junction	Map Ta Phut	0.4	0.3
			Sub Total	24	17

Table 4.1.1.12(2) Fuel Consumption and SOx Emission of Railway in Year 2000

Line	Section	Station		Fuel Consumption (kton/year)	SOx Emission (tons/year)
Southern Line	S1	Bang Sue Junction	Taling Chan Junction	1.1	0.8
	S2	Taling Chan Junction	Nakhon Pathon	4.2	2.9
	S3	Nakhon Pathon	Nong Pla Duk Junction	1.5	1.1
	S4	Nong Pla Duk Junction	Hua Hin	11.4	8.0
	S5	Hua Hin	Prachuap khiri khan	6.2	4.3
	S6	Prachuap khiri khan	Chumphon	11.0	7.6
	S7	Chumphon	Surat Thani	10.4	7.2
	S8	Surat Thani	Thung Song Junction	8.5	5.9
	S9	Thung Song Junction	Hat Yai	10.7	7.4
	S10	Hat Yai	Yala	4.4	3.1
	S11	Yala	Sungai Kolok	3.1	2.1
	S12	Thon Buri	Taling Chan Junction	0.2	0.1
	S13	Nong Pla Duk Junction	Malaiman	0.3	0.2
	S14	Nong Pla Duk Junction	Nam Tok	1.9	1.3
	S15	Ban Thung Pho Junction	Khiri Rattanikhom	0.1	0.1
	S16	Thung Song Junction	Kantang	1.0	0.7
	S17	Khao Chum Thong Junction	Nakhon Si Thammarat	0.6	0.4
	S18	Hat Yai	Padang Besar	1.1	0.7
			Sub Total	78	54
Mae Klong Line	MK1	Wongwian Yai	Maha Chai	1.9	1.3
	MK2	Ban Laem	Mae Klong	0.5	0.3
			Sub Total	2.4	1.7
Total				242	169

3) Sample Calculation

A sample calculation is provided below;

Section N1: Bangkok-Bang Sue Junction in Northern Line

Fuel Consumption (kg/year) = Fuel consumption rate (liter/km/operation) * distance (km) * operation (operation/year) * Specific gravity(kg/liter)

= 6.0 * 7.47 * 169 (operation/day) * 365 (day) * 0.8358

= 2,304,568 (kg/year)

= 2.3 (kton/year)

SOx Emission (kg/year) = SOx emission factor (kg/km/operation) * distance (km) * operation (operation/year)

= 0.0035 * 7.47 * 169 (operation/day) * 365 (day)

=1,608 (kg/year)

= 1.6 (ton/year)

4.1.1.3 Ship

1) Traffic Data and Estimated Emission

The number of calls and the estimated fuel consumption, NOx and SOx emission of vessel (in mooring) of the Year 2000 are shown in Table 4.1.1.13-4.1.1.14.

The number of calls and the estimated fuel consumption, NOx and SOx emission of vessel (in cruising) of the Year 2000 are shown in Table 4.1.1.15-4.1.1.16.

The number of fishing boats and their estimated fuel consumption, NOx and SOx emission of the Year 2000 by province in whole Thailand are shown in Table 4.1.1.17.

The number of trips of small boat and their estimated fuel consumption, NOx and SOx emission of the Year 2000 in Chao Phraya River are shown in Table 4.1.1.18 - 4.1.1.20.

Table 4.1.1.13(1) Results in Mooring(Arrival) by Ship Type in Year 2000

Port	Liquid Bulk							Solid Bulk						
		Sub Diesel			Sub Boiler				Sub Diesel			Sub Boiler		
	Number of Voyger	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)	Number of Voyger	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)
Bangkok	579	754,444	35,888	25,651	3,237,968	226,658	110,091	635	1,132,970	54,820	38,521	728,504	50,995	24,769
Klong Toey Wharf								21	37,468	1,813	1,274	24,092	1,686	819
Klong Toey Pole								32	57,095	2,763	1,941	36,712	2,570	1,248
Bang Hua Suer Pole								24	42,821	2,072	1,456	27,534	1,927	936
Sathupradit Buoy								136	242,652	11,741	8,250	156,026	10,922	5,305
Tmn Wharf								9	16,058	777	546	10,325	723	351
Private Wharves	571	744,020	35,392	25,297	3,193,229	223,526	108,570	400	713,682	34,532	24,265	458,900	32,123	15,603
Others	8	10,424	496	354	44,739	3,132	1,521	13	23,195	1,122	789	14,914	1,044	507
Provincial Area	3,189	4,155,305	197,665	141,280	17,833,989	1,248,379	606,356	1,253	2,235,608	108,173	76,011	1,437,505	100,625	48,875
Chachoengsao	174	226,724	10,785	7,709	973,068	68,115	33,084	1	1,784	86	61	1,147	80	39
Chanthaburi														
Chon Buri														
Ko Sichang	14	18,242	868	620	78,293	5,480	2,662	308	549,535	26,590	18,684	353,353	24,735	12,014
Laem Chabang	45	58,636	2,789	1,994	251,656	17,616	8,556	59	105,268	5,094	3,579	67,688	4,738	2,301
Sattahip	1	1,303	62	44	5,592	391	190	3	5,353	259	182	3,442	241	117
Sri Rcha	622	810,473	38,554	27,556	3,478,439	243,491	118,267	146	260,494	12,604	8,857	167,499	11,725	5,695
Others														
Chumporn														
Krabi	2	2,606	124	89	11,185	783	380	68	121,326	5,871	4,125	78,013	5,461	2,652
Nakhon Si Thammarat														
Khanom	43	56,030	2,665	1,905	240,471	16,833	8,176	20	35,684	1,727	1,213	22,945	1,606	780
Pakpanang														
Tha Sala								11	19,626	950	667	12,620	883	429
Phetchaburi														
Cha-am														
Others														
Phuket	137	178,513	8,492	6,069	766,151	53,631	26,049	17	30,331	1,468	1,031	19,503	1,365	663
Prachuap Khiri Khan														
Bang Saphan								20	35,684	1,727	1,213	22,945	1,606	780
Thap Sakae														
Others								17	30,331	1,468	1,031	19,503	1,365	663
Rayong														
Maptaphut	1,372	1,787,732	85,041	60,783	7,672,698	537,089	260,872	140	249,789	12,086	8,493	160,615	11,243	5,461
Others	429	558,992	26,591	19,006	2,399,116	167,938	81,570	52	92,779	4,489	3,154	59,657	4,176	2,028
Samut Sakhon														
Mahachai	2	2,606	124	89	11,185	783	380	26	46,389	2,245	1,577	29,829	2,088	1,014
Thachalom														
Thachin														
Others	2	2,606	124	89	11,185	783	380	7	12,489	604	425	8,031	562	273
Samut Songkhram														
Maeklong														
Satun														
Songkhla	346	450,842	21,446	15,329	1,934,951	135,447	65,788	217	387,172	18,734	13,164	248,953	17,427	8,464
Surat Thani														
Trang														
Katang								141	251,573	12,173	8,553	161,762	11,323	5,500
Total	3,768	4,909,748	233,553	166,931	21,071,957	1,475,037	716,447	1,888	3,368,578	162,993	114,532	2,166,010	151,621	73,644

Table 4.1.1.13(2) Results in Mooring(Arrival) by Ship Type in Year 2000

Port	Fully Cellular Container							Semi-Container						
		Sub Diesel			Sub Boiler				Sub Diesel			Sub Boiler		
	Number of Voyger	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)	Number of Voyger	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)
Bangkok	1,801	4,376,035	238,849	148,785	2,032,073	142,245	69,090	203	339,235	16,240	11,534	208,231	14,576	7,080
Klong Toey Wharf	1,225	2,976,481	162,460	101,200	1,382,171	96,752	46,994	133	222,257	10,640	7,557	136,427	9,550	4,639
Klong Toey Pole								1	1,671	80	57	1,026	72	35
Bang Hua Suer Pole								5	8,356	400	284	5,129	359	174
Sathupradit Buoy														
Tmn Wharf														
Private Wharves	568	1,380,115	75,328	46,924	640,876	44,861	21,790	63	105,280	5,040	3,580	64,623	4,524	2,197
Others	8	19,438	1,061	661	9,026	632	307	1	1,671	80	57	1,026	72	35
Provincial Area	1,003	2,437,070	133,018	82,860	1,131,688	79,218	38,477	185	309,155	14,800	10,511	189,767	13,284	6,452
Chachoengsao	5	12,149	663	413	5,642	395	192							
Chanthaburi														
Chon Buri														
Ko Sichang	2	4,860	265	165	2,257	158	77	14	23,396	1,120	795	14,361	1,005	488
Laem Chabang	623	1,513,753	82,622	51,468	702,933	49,205	23,900	86	143,715	6,880	4,886	88,216	6,175	2,999
Sattahip	1	2,430	133	83	1,128	79	38							
Sri Rcha	5	12,149	663	413	5,642	395	192	27	45,120	2,160	1,534	27,696	1,939	942
Others														
Chumporn														
Krabi														
Nakhon Si Thammarat														
Khanom														
Pakpanang														
Tha Sala								1	1,671	80	57	1,026	72	35
Phetchaburi														
Cha-am														
Others														
Phuket	11	26,728	1,459	909	12,411	869	422							
Prachuap Khiri Khan														
Bang Saphan														
Thap Sakae														
Others														
Rayong														
Maptaphut								3	5,013	240	170	3,077	215	105
Others	22	53,455	2,918	1,817	24,823	1,738	844	16	26,738	1,280	909	16,412	1,149	558
Samut Sakhon														
Mahachai														
Thachalom														
Thachin														
Others														
Samut Songkhram														
Maeklong														
Satun														
Songkhla	334	811,547	44,295	27,593	376,853	26,380	12,813	38	63,502	3,040	2,159	38,979	2,729	1,325
Surat Thani														
Trang														
Katang														
Total	2,804	6,813,105	371,867	231,646	3,163,761	221,463	107,568	388	648,390	31,040	22,045	397,998	27,860	13,532

Table 4.1.1.13(3) Results in Mooring(Arrival) by Ship Type in Year 2000

Port	Ro-Ro							Conventional						
		Sub Diesel			Sub Boiler				Sub Diesel			Sub Boiler		
	Number of Voyger	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)	Number of Voyger	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)
Bangkok	61	299,179	15,512	10,172	259,749	18,182	8,831	1,406	5,365,594	262,483	182,430	3,618,345	253,284	123,024
Klong Toey Wharf	48	235,420	12,206	8,004	204,392	14,307	6,949	499	1,904,290	93,157	64,746	1,284,178	89,892	43,662
Klong Toey Pole								94	358,724	17,549	12,197	241,909	16,934	8,225
Bang Hua Suer Pole								82	312,929	15,308	10,640	211,027	14,772	7,175
Sathupradit Buoy								94	358,724	17,549	12,197	241,909	16,934	8,225
Tmn Wharf								11	41,978	2,054	1,427	28,309	1,982	962
Private Wharves	13	63,760	3,306	2,168	55,356	3,875	1,882	615	2,346,970	114,813	79,797	1,582,704	110,789	53,812
Others								11	41,978	2,054	1,427	28,309	1,982	962
Provincial Area	194	951,488	49,334	32,351	826,086	57,826	28,087	2,213	8,445,277	413,140	287,139	5,695,161	398,661	193,635
Chachoengsao								88	335,827	16,429	11,418	226,468	15,853	7,700
Chanthaburi														
Chon Buri														
Ko Sichang	4	19,618	1,017	667	17,033	1,192	579	730	2,785,835	136,282	94,718	1,878,657	131,506	63,874
Laem Chabang	147	720,973	37,382	24,513	625,952	43,817	21,282	379	1,446,344	70,755	49,176	975,357	68,275	33,162
Sattahip								15	57,243	2,800	1,946	38,603	2,702	1,312
Sri Rcha	4	19,618	1,017	667	17,033	1,192	579	161	614,410	30,057	20,890	414,334	29,003	14,087
Others								2	7,632	373	260	5,147	360	175
Chumporn								1	3,816	187	130	2,574	180	87
Krabi	6	29,427	1,526	1,001	25,549	1,788	869	103	393,070	19,229	13,364	265,071	18,555	9,012
Nakhon Si Thammarat														
Khanom								55	209,892	10,268	7,136	141,543	9,908	4,812
Pakpanang														
Tha Sala								4	15,265	747	519	10,294	721	350
Phetchaburi														
Cha-am														
Others								1	3,816	187	130	2,574	180	87
Phuket	20	98,092	5,086	3,335	85,164	5,961	2,896	49	186,994	9,148	6,358	126,102	8,827	4,287
Prachuap Khiri Khan														
Bang Saphan								64	244,238	11,948	8,304	164,704	11,529	5,600
Thap Sakae														
Others								69	263,319	12,881	8,953	177,572	12,430	6,037
Rayong														
Maptaphut	3	14,714	763	500	12,775	894	434	310	1,183,026	57,873	40,223	797,786	55,845	27,125
Others								39	148,832	7,281	5,060	100,367	7,026	3,412
Samut Sakhon														
Mahachai								4	15,265	747	519	10,294	721	350
Thachalom														
Thachin														
Others								5	19,081	933	649	12,868	901	437
Samut Songkhram														
Maeklong														
Satun								8	30,530	1,494	1,038	20,588	1,441	700
Songkhla	10	49,046	2,543	1,668	42,582	2,981	1,448	101	385,437	18,855	13,105	259,924	18,195	8,837
Surat Thani														
Trang														
Katang								25	95,405	4,667	3,244	64,338	4,504	2,187
Total	255	1,250,668	64,847	42,523	1,085,835	76,008	36,918	3,619	13,810,870	675,623	469,570	9,313,506	651,945	316,659

Table 4.1.1.13(4) Results in Mooring(Arrival) by Ship Type in Year 2000

Port	Others							Total									
		Sub Diesel			Sub Boiler				Sub Diesel			Sub Boiler			Total		
	Number of Voyger	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)	Number of Voyger	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)	Fuel Consumption (ton)	NO2 Emission (kg)	SO2 Emission (kg)
Bangkok	188	138,614	6,527	4,713	57,927	4,055	1,970	4,873	12,406,071	630,319	421,806	10,142,797	709,996	344,855	22,549	1,340,315	766,661
Klong Toey Wharf	5	3,687	174	125	1,541	108	52	1,931	5,379,603	280,450	182,906	3,032,801	212,296	103,115	8,412	492,746	286,022
Klong Toey Pole								127	417,490	20,391	14,195	279,647	19,575	9,508	697	39,967	23,703
Bang Hua Suer Pole	2	1,475	69	50	616	43	21	113	365,580	17,850	12,430	244,306	17,101	8,306	610	34,951	20,736
Sathupradit Buoy	6	4,424	208	150	1,849	129	63	236	605,800	29,498	20,597	399,784	27,985	13,593	1,006	57,483	34,190
Tmn Wharf	10	7,373	347	251	3,081	216	105	30	65,409	3,178	2,224	41,715	2,920	1,418	107	6,098	3,642
Private Wharves	159	117,232	5,520	3,986	48,991	3,429	1,666	2,389	5,471,059	273,932	186,016	6,044,681	423,128	205,519	11,516	697,060	391,535
Others	6	4,424	208	150	1,849	129	63	47	101,130	5,021	3,438	99,862	6,990	3,395	201	12,011	6,834
Provincial Area	889	655,470	30,863	22,286	273,920	19,174	9,313	8,926	19,189,372	946,993	652,439	27,388,116	1,917,168	931,196	46,577	2,864,161	1,583,635
Chachoengsao	38	28,018	1,319	953	11,709	820	398	306	604,502	29,282	20,553	1,218,034	85,262	41,413	1,823	114,545	61,966
Chanthaburi																	
Chon Buri																	
Ko Sichang	6	4,424	208	150	1,849	129	63	1,078	3,405,909	166,350	115,801	2,345,802	164,206	79,757	5,752	330,557	195,558
Laem Chabang	40	29,492	1,389	1,003	12,325	863	419	1,379	4,018,182	206,910	136,618	2,724,126	190,689	92,620	6,742	397,599	229,238
Sattahip	11	8,110	382	276	3,389	237	115	31	74,439	3,636	2,531	52,154	3,651	1,773	127	7,287	4,304
Sri Rcha	8	5,898	278	201	2,465	173	84	973	1,768,163	85,333	60,118	4,113,106	287,917	139,846	5,881	373,250	199,963
Others								2	7,632	373	260	5,147	360	175	13	734	435
Chumporn								1	3,816	187	130	2,574	180	87	6	367	217
Krabi	40	29,492	1,389	1,003	12,325	863	419	219	575,922	28,138	19,581	392,142	27,450	13,333	968	55,588	32,914
Nakhon Si Thammarat																	
Khanom	15	11,060	521	376	4,622	324	157	133	312,665	15,180	10,631	409,580	28,671	13,926	722	43,851	24,556
Pakpanang	4	2,949	139	100	1,232	86	42	4	2,949	139	100	1,232	86	42	4	225	142
Tha Sala	2	1,475	69	50	616	43	21	18	38,037	1,846	1,293	24,556	1,719	835	63	3,565	2,128
Phetchaburi																	
Cha-am																	
Others								1	3,816	187	130	2,574	180	87	6	367	217
Phuket	110	81,104	3,819	2,758	33,893	2,373	1,152	344	601,762	29,471	20,460	1,043,224	73,026	35,470	1,645	102,496	55,930
Prachuap Khiri Khan																	
Bang Saphan	3	2,212	104	75	924	65	31	87	282,134	13,779	9,593	188,574	13,200	6,412	471	26,979	16,004
Thap Sakae																	
Others	2	1,475	69	50	616	43	21	88	295,125	14,419	10,034	197,691	13,838	6,722	493	28,257	16,756
Rayong																	
Maptaphut	12	8,848	417	301	3,697	259	126	1,840	3,249,121	156,420	110,470	8,650,648	605,545	294,122	11,900	761,966	404,592
Others	7	5,161	243	175	2,157	151	73	565	885,957	42,802	30,123	2,602,532	182,177	88,486	3,488	224,979	118,609
Samut Sakhon																	
Mahachai	47	34,654	1,632	1,178	14,482	1,014	492	79	98,914	4,747	3,363	65,789	4,605	2,237	165	9,352	5,600
Thachalom																	
Thachin																	
Others	72	53,086	2,500	1,805	22,185	1,553	754	86	87,263	4,161	2,967	54,268	3,799	1,845	142	7,960	4,812
Samut Songkhram																	
Maeklong																	
Satun	34	25,069	1,180	852	10,476	733	356	42	55,598	2,674	1,890	31,064	2,174	1,056	87	4,848	2,947
Songkhla	89	65,621	3,090	2,231	27,423	1,920	932	1,135	2,213,167	112,003	75,248	2,929,666	205,077	99,609	5,143	317,080	174,856
Surat Thani																	
Trang																	
Katang	349	257,322	12,116	8,749	107,534	7,527	3,656	515	604,300	28,956	20,546	333,634	23,354	11,344	938	52,310	31,890
Total	1,077	794,084	37,390	26,999	331,847	23,229	11,283	13,799	31,595,443	1,577,312	1,074,245	37,530,913	2,627,164	1,276,051	69,126	4,204,476	2,350,296

Table 4.1.1.14(1) Results in Mooring(Departure) by Ship Type in Year 2000

Port	Liquid Bulk							Solid Bulk						
		Sub Diesel			Sub Boiler				Sub Diesel			Sub Boiler		
	Number of Voyger	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)	Number of Voyger	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)
Bangkok	394	519,207	24,744	17,653	2,264,500	158,515	76,993	551	983,097	47,568	33,425	632,135	44,249	21,493
Klong Toey Wharf								16	28,547	1,381	971	18,356	1,285	624
Klong Toey Pole								20	35,684	1,727	1,213	22,945	1,606	780
Bang Hua Suer Pole								14	24,979	1,209	849	16,062	1,124	546
Sathupradit Buoy								141	251,573	12,173	8,553	161,762	11,323	5,500
Tmn Wharf								4	7,137	345	243	4,589	321	156
Private Wharves	386	508,665	24,241	17,295	2,218,521	155,296	75,430	350	624,472	30,216	21,232	401,538	28,108	13,652
Others	8	10,542	502	358	45,980	3,219	1,563	6	10,705	518	364	6,884	482	234
Provincial Area	3,213	4,234,041	201,781	143,957	18,466,597	1,292,662	627,864	1,266	2,258,803	109,295	76,799	1,452,420	101,669	49,382
Chachoengsao	176	231,930	11,053	7,886	1,011,553	70,809	34,393							
Chanthaburi														
Chon Buri														
Ko Sichang	17	22,402	1,068	762	97,707	6,839	3,322	309	551,319	26,676	18,745	354,501	24,815	12,053
Laem Chabang	47	61,936	2,952	2,106	270,131	18,909	9,184	59	105,268	5,094	3,579	67,688	4,738	2,301
Sattahip	1	1,318	63	45	5,747	402	195	3	5,353	259	182	3,442	241	117
Sri Rcha	625	823,615	39,251	28,003	3,592,164	251,451	122,134	149	265,846	12,863	9,039	170,940	11,966	5,812
Others														
Chumporn														
Krabi	3	3,953	188	134	17,242	1,207	586	64	114,189	5,525	3,882	73,424	5,140	2,496
Nakhon Si Thammarat														
Khanom	41	54,029	2,575	1,837	235,646	16,495	8,012	10	17,842	863	607	11,473	803	390
Pakpanang														
Tha Sala								18	32,116	1,554	1,092	20,651	1,446	702
Phetchaburi														
Cha-am														
Others														
Phuket	138	181,854	8,667	6,183	793,150	55,520	26,967	16	28,547	1,381	971	18,356	1,285	624
Prachuap Khiri Khan														
Bang Saphan								22	39,252	1,899	1,335	25,240	1,767	858
Thap Sakae														
Others								13	23,195	1,122	789	14,914	1,044	507
Rayong														
Maptaphut	1,390	1,831,720	87,294	62,278	7,988,973	559,228	271,625	142	253,357	12,259	8,614	162,910	11,404	5,539
Others	429	565,329	26,942	19,221	2,465,661	172,596	83,832	45	80,289	3,885	2,730	51,626	3,614	1,755
Samut Sakhon														
Mahachai	1	1,318	63	45	5,747	402	195	35	62,447	3,022	2,123	40,154	2,811	1,365
Thachalom														
Thachin														
Others	7	9,224	440	314	40,232	2,816	1,368	5	8,921	432	303	5,736	402	195
Samut Songkhram														
Maeklong														
Satun														
Songkhla	337	444,093	21,164	15,099	1,936,895	135,583	65,854	232	413,935	20,029	14,074	266,162	18,631	9,050
Surat Thani														
Trang														
Katang	1	1,318	63	45	5,747	402	195	144	256,925	12,432	8,735	165,204	11,564	5,617
Total	3,607	4,753,248	226,525	161,610	20,731,097	1,451,177	704,857	1,817	3,241,899	156,864	110,225	2,084,555	145,919	70,875

Table 4.1.1.14(2) Results in Mooring(Departure) by Ship Type in Year 2000

Port	Fully Cellular Container							Semi-Container						
		Sub Diesel			Sub Boiler				Sub Diesel			Sub Boiler		
	Number of Voyger	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)	Number of Voyger	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)
Bangkok	1,769	4,317,545	235,829	146,797	2,006,163	140,431	68,210	173	648,050	31,606	22,034	431,298	30,191	14,664
Klong Toey Wharf	1,222	2,982,498	162,907	101,405	1,385,829	97,008	47,118	113	423,293	20,645	14,392	281,715	19,720	9,578
Klong Toey Pole														
Bang Hua Suer Pole								3	11,238	548	382	7,479	524	254
Sathupradit Buoy														
Tmn Wharf														
Private Wharves	542	1,322,843	72,255	44,977	614,664	43,026	20,899	53	198,536	9,683	6,750	132,132	9,249	4,492
Others	5	12,203	667	415	5,670	397	193	4	14,984	731	509	9,972	698	339
Provincial Area	1,003	2,447,992	133,712	83,232	1,137,468	79,623	38,674	185	693,002	33,799	23,562	461,215	32,285	15,681
Chachoengsao	4	9,763	533	332	4,536	318	154	1	3,746	183	127	2,493	175	85
Chanthaburi														
Chon Buri														
Ko Sichang	6	14,644	800	498	6,804	476	231	14	52,443	2,558	1,783	34,903	2,443	1,187
Laem Chabang	620	1,513,215	82,653	51,449	703,121	49,218	23,906	85	318,406	15,529	10,826	211,910	14,834	7,205
Sattahip	1	2,441	133	83	1,134	79	39							
Sri Rcha	7	17,085	933	581	7,938	556	270	28	104,887	5,115	3,566	69,806	4,886	2,373
Others														
Chumporn														
Krabi														
Nakhon Si Thammarat														
Khanom														
Pakpanang														
Tha Sala								1	3,746	183	127	2,493	175	85
Phetchaburi														
Cha-am														
Others														
Phuket	12	29,288	1,600	996	13,609	953	463							
Prachuap Khiri Khan														
Bang Saphan														
Thap Sakae														
Others														
Rayong														
Maptaphut	2	4,881	267	166	2,268	159	77	2	7,492	365	255	4,986	349	170
Others	19	46,373	2,533	1,577	21,547	1,508	733	17	63,681	3,106	2,165	42,382	2,967	1,441
Samut Sakhon														
Mahachai														
Thachalom														
Thachin														
Others														
Samut Songkhram														
Maeklong														
Satun														
Songkhla	332	810,302	44,260	27,550	376,510	26,356	12,801	37	138,600	6,760	4,712	92,243	6,457	3,136
Surat Thani														
Trang														
Katang														
Total	2,772	6,765,536	369,541	230,028	3,143,632	220,054	106,883	358	1,341,052	65,405	45,596	892,513	62,476	30,345

Table 4.1.1.14(3) Results in Mooring(Departure) by Ship Type in Year 2000

Port	Ro-Ro							Conventional						
		Sub Diesel			Sub Boiler				Sub Diesel			Sub Boiler		
	Number of Voyger	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)	Number of Voyger	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)
Bangkok	57	281,998	14,642	9,588	246,343	17,244	8,376	1,147	4,393,038	215,033	149,363	2,970,092	207,906	100,983
Klong Toey Wharf	44	217,683	11,303	7,401	190,160	13,311	6,465	363	1,390,299	68,053	47,270	939,968	65,798	31,959
Klong Toey Pole								114	436,623	21,372	14,845	295,197	20,664	10,037
Bang Hua Suer Pole								47	180,011	8,811	6,120	121,704	8,519	4,138
Sathupradit Buoy								103	394,493	19,310	13,413	266,713	18,670	9,068
Tmn Wharf								9	34,470	1,687	1,172	23,305	1,631	792
Private Wharves	13	64,315	3,339	2,187	56,184	3,933	1,910	501	1,918,842	93,924	65,241	1,297,311	90,812	44,109
Others								10	38,300	1,875	1,302	25,894	1,813	880
Provincial Area	194	959,782	49,835	32,633	838,432	58,690	28,507	2,206	8,449,034	413,568	287,267	5,712,312	399,862	194,219
Chachoengsao								86	329,382	16,123	11,199	222,692	15,588	7,572
Chanthaburi														
Chon Buri														
Ko Sichang	4	19,789	1,028	673	17,287	1,210	588	717	2,746,128	134,419	93,368	1,856,631	129,964	63,125
Laem Chabang	145	717,363	37,248	24,390	626,663	43,866	21,307	394	1,509,030	73,865	51,307	1,020,241	71,417	34,688
Sattahip	1	4,947	257	168	4,322	303	147	14	53,620	2,625	1,823	36,252	2,538	1,233
Sri Rcha	6	29,684	1,541	1,009	25,931	1,815	882	159	608,974	29,808	20,705	411,722	28,821	13,999
Others								2	7,660	375	260	5,179	363	176
Chumporn								1	3,830	187	130	2,589	181	88
Krabi	6	29,684	1,541	1,009	25,931	1,815	882	103	394,493	19,310	13,413	266,713	18,670	9,068
Nakhon Si Thammarat														
Khanom								39	149,371	7,311	5,079	100,988	7,069	3,434
Pakpanang								2	7,660	375	260	5,179	363	176
Tha Sala								14	53,620	2,625	1,823	36,252	2,538	1,233
Phetchaburi														
Cha-am														
Others														
Phuket	20	98,947	5,138	3,364	86,436	6,051	2,939	49	187,671	9,186	6,381	126,883	8,882	4,314
Prachuap Khiri Khan														
Bang Saphan								65	248,952	12,186	8,464	168,314	11,782	5,723
Thap Sakae														
Others								63	241,292	11,811	8,204	163,135	11,419	5,547
Rayong														
Maptaphut	2	9,895	514	336	8,644	605	294	314	1,202,628	58,867	40,889	813,085	56,916	27,645
Others								32	122,561	5,999	4,167	82,862	5,800	2,817
Samut Sakhon														
Mahachai								5	19,150	937	651	12,947	906	440
Thachalom								1	3,830	187	130	2,589	181	88
Thachin														
Others								7	26,810	1,312	912	18,126	1,269	616
Samut Songkhram														
Maeklong														
Satun								10	38,300	1,875	1,302	25,894	1,813	880
Songkhla	10	49,473	2,569	1,682	43,218	3,025	1,469	102	390,662	19,122	13,283	264,123	18,489	8,980
Surat Thani								1	3,830	187	130	2,589	181	88
Trang														
Katang								26	99,581	4,874	3,386	67,326	4,713	2,289
Total	251	1,241,780	64,477	42,221	1,084,775	75,934	36,882	3,353	12,842,072	628,600	436,630	8,682,404	607,768	295,202

Table 4.1.1.14(4) Results in Mooring(Departure) by Ship Type in Year 2000

Port	Others							Total									
		Sub Diesel			Sub Boiler				Sub Diesel			Sub Boiler			Total		
	Number of Voyger	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)	Number of Voyger	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)	Fuel Consumption (ton)	NO2 Emission (kg)	SO2 Emission (kg)
Bangkok	170	125,343	5,902	4,262	52,381	3,667	1,781	4,261	11,268,277	575,324	383,121	8,602,913	602,204	292,499	19,871	1,177,528	675,620
Klong Toey Wharf	5	3,687	174	125	1,541	108	52	1,763	5,046,006	264,462	171,564	2,817,568	197,230	95,797	7,864	461,692	267,362
Klong Toey Pole								134	472,307	23,099	16,058	318,142	22,270	10,817	790	45,369	26,875
Bang Hua Suer Pole	1	737	35	25	308	22	10	65	216,965	10,603	7,377	145,553	10,189	4,949	363	20,791	12,326
Sathupradit Buoy	12	8,848	417	301	3,697	259	126	256	654,913	31,899	22,267	432,173	30,252	14,694	1,087	62,151	36,961
Tmn Wharf	15	11,060	521	376	4,622	324	157	28	52,667	2,553	1,791	32,516	2,276	1,106	85	4,829	2,896
Private Wharves	131	96,588	4,548	3,284	40,364	2,825	1,372	1,976	4,734,260	238,207	160,965	4,760,713	333,250	161,864	9,495	571,457	322,829
Others	6	4,424	208	150	1,849	129	63	39	91,159	4,501	3,099	96,249	6,737	3,272	187	11,238	6,372
Provincial Area	862	635,562	29,925	21,609	265,601	18,592	9,030	8,929	19,678,216	971,915	669,059	28,334,045	1,983,383	963,358	48,012	2,955,298	1,632,417
Chachoengsao	38	28,018	1,319	953	11,709	820	398	305	602,839	29,211	20,497	1,252,983	87,709	42,601	1,856	116,920	63,098
Chanthaburi	1	737	35	25	308	22	10	1	737	35	25	308	22	10	1	56	36
Chon Buri																	
Ko Sichang	4	2,949	139	100	1,232	86	42	1,071	3,409,675	166,687	115,929	2,369,065	165,835	80,548	5,779	332,521	196,477
Laem Chabang	41	30,230	1,423	1,028	12,633	884	430	1,391	4,255,448	218,763	144,685	2,912,386	203,867	99,021	7,168	422,630	243,706
Sattahip	8	5,898	278	201	2,465	173	84	28	73,577	3,614	2,502	53,362	3,735	1,814	127	7,350	4,316
Sri Rcha	9	6,636	312	226	2,773	194	94	983	1,856,727	89,825	63,129	4,281,274	299,689	145,563	6,138	389,514	208,692
Others								2	7,660	375	260	5,179	363	176	13	737	437
Chumporn								1	3,830	187	130	2,589	181	88	6	369	218
Krabi	48	35,391	1,666	1,203	14,790	1,035	503	224	577,710	28,231	19,642	398,100	27,867	13,535	976	56,098	33,178
Nakhon Si Thammarat																	
Khanom	11	8,110	382	276	3,389	237	115	101	229,353	11,132	7,798	351,496	24,605	11,951	581	35,736	19,749
Pakpanang	2	1,475	69	50	616	43	21	4	9,135	444	311	5,795	406	197	15	850	508
Tha Sala	6	4,424	208	150	1,849	129	63	39	93,906	4,570	3,193	61,245	4,287	2,082	155	8,857	5,275
Phetchaburi																	
Cha-am																	
Others																	
Phuket	111	81,842	3,854	2,783	34,201	2,394	1,163	346	608,149	29,825	20,677	1,072,635	75,084	36,470	1,681	104,909	57,147
Prachuap Khiri Khan																	
Bang Saphan	4	2,949	139	100	1,232	86	42	91	291,153	14,224	9,899	194,786	13,635	6,623	486	27,859	16,522
Thap Sakae																	
Others	2	1,475	69	50	616	43	21	78	265,961	13,003	9,043	178,665	12,507	6,075	445	25,509	15,117
Rayong																	
Maptaphut	13	9,585	451	326	4,006	280	136	1,865	3,319,558	160,017	112,865	8,984,871	628,941	305,486	12,304	788,958	418,351
Others	5	3,687	174	125	1,541	108	52	547	881,920	42,638	29,985	2,665,620	186,593	90,631	3,548	229,232	120,616
Samut Sakhon																	
Mahachai	50	36,866	1,736	1,253	15,406	1,078	524	91	119,781	5,758	4,073	74,255	5,198	2,525	194	10,955	6,597
Thachalom								1	3,830	187	130	2,589	181	88	6	369	218
Thachin																	
Others	65	47,925	2,257	1,629	20,028	1,402	681	84	92,881	4,440	3,158	84,122	5,889	2,860	177	10,329	6,018
Samut Songkhram																	
Maeklong																	
Satun	35	25,806	1,215	877	10,784	755	367	45	64,106	3,090	2,180	36,679	2,568	1,247	101	5,657	3,427
Songkhla	70	51,612	2,430	1,755	21,568	1,510	733	1,120	2,298,679	116,334	78,155	3,000,720	210,050	102,024	5,299	326,384	180,180
Surat Thani								1	3,830	187	130	2,589	181	88	6	369	218
Trang																	
Katang	339	249,948	11,769	8,498	104,453	7,312	3,551	510	607,772	29,138	20,664	342,730	23,991	11,653	951	53,129	32,317
Total	1,032	760,905	35,827	25,871	317,981	22,259	10,811	13,190	30,946,493	1,547,239	1,052,181	36,936,958	2,585,587	1,255,857	67,883	4,132,826	2,308,037

Table 4.1.1.15(1) Results in Cruising(Arrival) by Ship Type in Year 2000

Port	Liquid Bulk										Solid Bulk									
		Main Diesel			Sub Diesel			Sub Boiler				Main Diesel			Sub Diesel			Sub Boiler		
	Number of Voyger	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)	Number of Voyger	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)
Bangkok	579	289,971	18,314	9,859	56,899	1,024	1,935	151,526	10,607	5,152	635	339,845	21,370	11,555	76,801	1,382	2,611	60,539	4,238	2,058
Klong Toey Wharf											21	11,401	717	388	2,575	46	88	2,030	142	69
Klong Toey Pole											32	17,373	1,093	591	3,924	71	133	3,093	216	105
Bang Hua Suer Pole											24	7,179	449	244	1,680	30	57	1,324	93	45
Sathupradit Buoy											136	96,256	6,062	3,273	21,513	387	731	16,958	1,187	577
Tmn Wharf											9	5,517	347	188	1,240	22	42	977	68	33
Private Wharves	571	285,517	18,032	9,708	56,029	1,008	1,905	149,210	10,445	5,073	400	195,062	12,258	6,632	44,276	797	1,505	34,901	2,443	1,187
Others	8	4,453	281	151	870	16	30	2,316	162	79	13	7,058	444	240	1,594	29	54	1,256	88	43
Provincial Area	3,189	375,908	23,187	12,781	85,585	1,540	2,910	227,919	15,954	7,749	1,253	144,043	8,841	4,897	37,933	683	1,290	29,901	2,093	1,017
Chachuengsao	174	20,510	1,265	697	4,670	84	159	12,436	871	423	1	115	7	4	30	1	1	24	2	1
Chanthaburi																				
Chon Buri																				
Ko Sichang	14	1,650	102	56	376	7	13	1,001	70	34	308	35,407	2,173	1,204	9,324	168	317	7,350	515	250
Laem Chabang	45	5,304	327	180	1,208	22	41	3,216	225	109	59	6,783	416	231	1,786	32	61	1,408	99	48
Sattahip	1	118	7	4	27	0	1	71	5	2	3	345	21	12	91	2	3	72	5	2
Sri Racha	622	73,319	4,523	2,493	16,693	300	568	44,455	3,112	1,511	146	16,784	1,030	571	4,420	80	150	3,484	244	118
Others																				
Chumporn																				
Krabi	2	236	15	8	54	1	2	143	10	5	68	7,817	480	266	2,059	37	70	1,623	114	55
Nakhon Si Thammarat																				
Khanom	43	5,069	313	172	1,154	21	39	3,073	215	104	20	2,299	141	78	605	11	21	477	33	16
Pakpanang																				
Tha Sala											11	1,265	78	43	333	6	11	263	18	9
Phetchaburi																				
Cha-am																				
Others																				
Phuket	137	16,149	996	549	3,677	66	125	9,791	685	333	17	1,954	120	66	515	9	17	406	28	14
Prachuap Khiri Khan																				
Bang Saphan											20	2,299	141	78	605	11	21	477	33	16
Thap Sakae																				
Others											17	1,954	120	66	515	9	17	406	28	14
Rayong																				
Maptaphut	1,372	161,726	9,976	5,499	36,821	663	1,252	98,057	6,864	3,334	140	16,094	988	547	4,238	76	144	3,341	234	114
Others	429	50,569	3,119	1,719	11,513	207	391	30,661	2,146	1,042	52	5,978	367	203	1,574	28	54	1,241	87	42
Samut Sakhon																				
Mahachai	2	236	15	8	54	1	2	143	10	5	26	2,989	183	102	787	14	27	620	43	21
Thachaloom																				
Thachin																				
Others	2	236	15	8	54	1	2	143	10	5	7	805	49	27	212	4	7	167	12	6
Samut Songkhram																				
Meeklong																				
Satun																				
Songkhla	346	40,785	2,516	1,387	9,286	167	316	24,729	1,731	841	217	24,946	1,531	848	6,569	118	223	5,178	362	176
Surat Thani																				
Trang																				
Katang											141	16,209	995	551	4,269	77	145	3,365	236	114
Total	3,768	665,879	41,501	22,640	142,484	2,565	4,844	379,445	26,561	12,901	1,888	483,889	30,211	16,452	114,734	2,065	3,901	90,440	6,331	3,075

Table 4.1.1.15(2) Results in Cruising (Arrival) by Ship Type in Year 2000

Port	Fully Cellular Container										Semi-Container									
		Main Diesel			Sub Diesel			Sub Boiler				Main Diesel			Sub Diesel			Sub Boiler		
	Number of Voyger	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)	Number of Voyger	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)
Bangkok	1,801	2,373,694	179,377	80,706	463,810	8,348	15,770	215,377	15,076	7,323	203	95,168	5,861	3,236	22,362	403	760	16,827	1,178	572
Klong Toey Wharf	1,225	1,668,068	126,081	56,714	325,452	5,858	11,065	151,128	10,579	5,138	133	65,129	4,012	2,214	15,273	275	519	11,493	805	391
Klong Toey Pole											1	490	30	17	115	2	4	86	6	3
Bang Hua Suer Pole											5	1,349	83	46	328	6	11	247	17	8
Sethupradit Buoy																				
Tmn Wharf																				
Private Wharves	568	694,732	52,473	23,621	136,232	2,452	4,632	63,261	4,428	2,151	63	27,711	1,706	942	6,531	118	222	4,915	344	167
Others	8	10,894	823	370	2,125	38	72	987	69	34	1	490	30	17	115	2	4	86	6	3
Provincial Area	1,003	289,202	21,334	9,833	65,796	1,184	2,237	30,553	2,139	1,039	185	19,183	1,153	652	5,246	94	178	3,947	276	134
Chachoengsao	5	1,442	106	49	328	6	11	152	11	5										
Chanthaburi																				
Chon Buri																				
Ko Sichang	2	577	43	20	131	2	4	61	4	2	14	1,452	87	49	397	7	13	299	21	10
Laem Chabang	623	179,634	13,251	6,108	40,868	736	1,390	18,978	1,328	645	86	8,917	536	303	2,439	44	83	1,835	128	62
Sattahip	1	288	21	10	66	1	2	30	2	1										
Sri Racha	5	1,442	106	49	328	6	11	152	11	5	27	2,800	168	95	766	14	26	576	40	20
Others																				
Chumporn																				
Krabi																				
Nakhon Si Thammarat																				
Khanom																				
Pakpanang																				
Tha Sala																				
Phetchaburi											1	104	6	4	28	1	1	21	1	1
Cha-am																				
Others																				
Phuket	13	3,172	234	108	722	13	25	335	23	11										
Prachuap Khiri Khan																				
Bang Saphan																				
Thap Sakae																				
Others																				
Rayong																				
Maptaphut																				
Others	22	6,343	468	216	1,443	26	49	670	47	23	3	311	19	11	85	2	3	64	4	2
Samut Sakhon											16	1,659	100	56	454	8	15	341	24	12
Mahachai																				
Thachalom																				
Thachin																				
Others																				
Samut Songkhram																				
Maeklong																				
Satun																				
Songkhla	334	96,304	7,104	3,274	21,910	394	745	10,174	712	346	38	3,940	237	134	1,077	19	37	811	57	28
Surat Thani																				
Trang																				
Kateng																				
Total	2,804	2,662,896	200,711	90,538	529,606	9,532	18,007	245,930	17,215	8,362	388	114,351	7,014	3,888	27,608	497	939	20,775	1,454	706

Table 4.1.1.15(3) Results in Cruising (Arrival) by Ship Type in Year 2000

Port	Ro-Ro										Conventional									
		Main Diesel			Sub Diesel			Sub Boiler				Main Diesel			Sub Diesel			Sub Boiler		
	Number of Voyger	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)	Number of Voyger	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)	Fuel Consumption (kg)	NO2 Emission (kg)	SO2 Emission (kg)
Bangkok	61	63,124	4,536	2,146	11,185	201	380	11,905	833	405	1,406	806,567	51,790	27,423	175,662	3,162	5,973	145,220	10,165	4,937
Klong Toey Wharf	48	50,772	3,649	1,726	8,988	162	306	9,566	670	325	499	301,129	19,342	10,238	65,431	1,178	2,225	54,092	3,786	1,839
Klong Toey Pole											94	56,726	3,644	1,929	12,326	222	419	10,190	713	346
Bang Hua Suor Pole											82	27,264	1,742	927	6,139	111	209	5,075	355	173
Sathupradit Buoy											94	73,952	4,757	2,514	15,902	286	541	13,146	920	447
Tmn Wharf											11	7,496	482	255	1,620	29	55	1,340	94	46
Private Wharves	13	12,352	887	420	2,198	40	75	2,339	164	80	615	333,363	21,397	11,334	72,802	1,310	2,475	60,185	4,213	2,046
Others											11	6,638	426	226	1,442	26	49	1,192	83	41
Provincial Area	194	43,452	3,047	1,477	8,969	161	305	9,546	668	325	2,213	282,784	17,727	9,615	71,649	1,290	2,436	59,232	4,146	2,014
Chachoengsao											88	11,245	705	382	2,849	51	97	2,355	165	80
Chanthaburi																				
Chon Buri																				
Ko Sichang	4	896	63	30	185	3	6	197	14	7	730	93,282	5,848	3,172	23,635	425	804	19,539	1,368	664
Laem Chabang	147	32,925	2,309	1,119	6,796	122	231	7,234	506	246	379	48,430	3,036	1,647	12,271	221	417	10,144	710	345
Sattahip											15	1,917	120	65	486	9	17	401	28	14
Sri Racha	4	896	63	30	185	3	6	197	14	7	161	20,573	1,290	699	5,213	94	177	4,309	302	147
Others											2	256	16	9	65	1	2	54	4	2
Chumporn											1	128	8	4	32	1	1	27	2	1
Krabi	6	1,344	94	46	277	5	9	295	21	10	103	13,162	825	447	3,335	60	113	2,757	193	94
Nakhon Si Thammarat																				
Khanom											55	7,028	441	239	1,781	32	61	1,472	103	50
Pakpanang																				
Tha Sala											4	511	32	17	130	2	4	107	7	4
Phetchaburi																				
Cha-am																				
Others											1	128	8	4	32	1	1	27	2	1
Phuket	20	4,480	314	152	925	17	31	984	69	33	49	6,261	393	213	1,586	29	54	1,312	92	45
Prachuap Khiri Khan																				
Bang Saphan											64	8,178	513	278	2,072	37	70	1,713	120	58
Thap Sakae																				
Others											69	8,817	553	300	2,234	40	76	1,847	129	63
Rayong																				
Maptaphut	3	672	47	23	139	2	5	148	10	5	310	39,613	2,483	1,347	10,037	181	341	8,297	581	282
Others											39	4,984	312	169	1,263	23	43	1,044	73	35
Samut Sakhon																				
Mahachai											4	511	32	17	130	2	4	107	7	4
Thachalom																				
Thachin																				
Others											5	639	40	22	162	3	6	134	9	5
Samut Songkhram																				
Maeklong																				
Satun											8	1,022	64	35	259	5	9	214	15	7
Songkhla	10	2,240	157	76	462	8	16	492	34	17	101	12,906	809	439	3,270	59	111	2,703	189	92
Surat Thani																				
Trang																				
Katang											25	3,195	200	109	809	15	28	669	47	23
Total	255	106,576	7,583	3,624	20,155	363	685	21,451	1,502	729	3,619	1,089,351	69,517	37,038	247,311	4,451	8,409	204,452	14,312	6,951