A SURVEY REPORT ON THE ENERGY SUPPLY-DEMAND DATA BANK SYSTEM IN REPUBLIC OF INDONESIA

MARCH 1979

JAPAN INTERNATIONAL
COOPERATION AGANCY

PREFACE

The Government of Japan, in response to a request of the Government of the Republic of Indonesia, agreed to conduct a survey on the Energy Supply-Demand Data Bank System Project and entrusted the Japan International Cooperation Agency (JICA) to carry out the survey.

JICA, recognizing the importance of this project for the economic and social development of Indonesia, dispatched to Indonesia an eight-man survey team headed by Mr. Takao Tomitate (The Institute of Energy Economics) for the period from October 15 through November 4, 1978.

The team conducted a field survey on the Energy Supply-Demand Data Bank System Project and has now completed this report.

I hope this report will be useful for formulating a data bank system of energy supply-demand and for the economic and social development of Indonesia, as well as for the promotion of friendly and cooperative relations between our two countries.

I wish to express my sincere thanks to the parties concerned of the Republic of Indonesia for their kind cooperation extended to the team.

March, 1979

Shinsaku HOGEN
President
Japan International Cooperation
Agency

A Survey Report on Energy Supply-Demand Data Bank System
in Republic of Indonesia

CONTENTS

I. General Remarks

1. Development of Energy Supply-Demand Data Bank System and Japanese Cooperation

In May, 1977 Mr. Piet Haryono, President director of Pertamina, The Indonesian State Oil and Gas Mining Enterprise, requested the Japanese government through Japanese Embassy in Indonesia for technical cooperation concerning energy data bank system. Indonesian government was planning to build energy data bank system to effectively collect, process and retreave information about oil and other energy resources which had strategic importance to Indonesian economy and wanted Japan to cooperate. This was the very start of the cooperation project.

Japanese government, in turn, asked Pertamina to disclose more details of the proposed system. Mr. Trisulo, Director of Exploration and Production, indicated the following two points as concrete content of the data bank system in his reply in November, 1977.

(1) To set up data bank system concerning energy supply-demand
   1) Collection, processing and exposition of data concerning supply-demand balance and distribution broken down by oil and other energy resource products.
   2) Preparation of data analysis methods for economic plan, energy supply-demand plan and other plans.

(2) To set up data bank system concerning energy resource exploration and development.

Processing, storing and exposition of Pertamina's existing data concerning energy resource exploration and development included those provided by foreign contractors.

Japanese government, although basically prepared to accept the request, felt it necessary to ascertain the Indonesian policy and detailed requirement since there still were such ambiguous points as to what extent existing data had been processed or collected as well as basic policy and preparation on their side. In order to confirm these points, a team of experts was dispatched to Indonesia to conduct preliminary study from February 28 to March 12 of 1978.

The preliminary study was conducted on the following subjects.

(1) The basic attitude on the side of Indonesia toward the project.
   1) To confirm whether the project had been on the request list of the formal channel (BAPPENAS) for international cooperation or not
   2) To ascertain relating authorities' attitude and policy toward this project
   3) To know the position of Pertamina in the project
   4) To confirm corresponding organization such as counterparts on Indonesian side

(2) To grasp Indonesian needs for the project and present conditions.

(3) To propose corresponding measures on Japanese side based upon present Indonesian needs and situation.

The preliminary study team summed up findings of the study in a report, "Feasibility Study Report for Technical Cooperation on Energy Data Bank System of the Republic of Indonesia". The report was divided into two parts; the former concerning energy supply-demand data bank system and the latter oil exploration and production data bank. As to energy supply-demand data bank system, co-operation on the following points was recommended.

(1) Technical transfer of methods of future demand forecast of oil and coal products and for optimal operation system in oil refinery.

(2) Technical transfer of future energy consumption forecast in individual industry, particularly in the field of small-and-middle-sized industries.

(3) Technical transfer of methods of energy demand forecast and of energy supply plan.

Indonesian side put this project on the list of international cooperation request (IGGI list) of BAPPENAS formally and, at the same time, specified the content of the request by classifying it into two parts, namely, energy supply-demand data bank system and oil exploration and production data bank system. A formal request for cooperation in written form was submitted to Japanese government from Technical Coordination Committee in President's Office.

Japanese government, responding to the formal request from Indonesian government, studied the result of the preliminary study and in the end of August 1978, Japan International Cooperation Agency (JICA) commissioned the Institute for Energy Economics to conduct a full-scale survey for cooperation on the energy supply-demand data bank project. Accordingly, the Institute set up specific projects, survey method, schedule and others and conducted the survey from October 15 to November 3 of 1978.

2. Field Study

2–1 Purposes and Items for Field Study

2–1–1 Purposes of Field Study

Field study was conducted in order to clearly ascertain the situation prevailing in Indonesia in respect of the items for cooperation listed below and required for establishing Energy Supply-Demand Data Bank, i.e. to collect information through the field study on which to base our judgement for determining the best manner in which Japan may extend its cooperation in regard to the various items for cooperation.

Discussion items listed below have been sorted out based on the detailed discussions exchanged between Japan and Indonesia during the preliminary investigations by the Japanese government conducted from February 28 to March 12, 1978.

Items for Cooperation in the Project for Indonesian Energy Supply-Demand Data Bank System

(1) Design for Establishing Energy Supply-Demand Data Bank

a. Survey of Existing Energy Related Statistics in Indonesia

The most fundamental problem in establishing an energy supply-demand data bank in Indonesia is in what scope the energy related data may be utilized. To learn this point, systems for data collection, actual accumulation and classification on the following statistics will be studied, the problems pointed out and guidance given: (i) supply-demand statistics broken down by energy resources such as oil, coal, natural gas, electric power, etc; (ii) supply-demand statistics broken down by sectors such as industry, agriculture, forestry and fishery, transportation, energy, household sector, etc; (iii) import-export statistics broken, energy, household sector, etc; (iii) import-export statistics broken down by energy resources; (iv) price statistics broken down by energy resources.

b: Design for Computerization of Energy Statistics

In order to systematically collect, store, retrieve and utilize the considerable amount of energy supply-demand statistics, it naturally requires computer utilization. Possible technical assistance will be given for (1) method of data input (including preparation of input format), (2) programming for storage and retrieval of data, (3) preparation of output format for computer processing of data.

c: Preparation of Comprehensive Energy Statistics Table (Energy Balance Table) and Design for Computerization

In order to systematically prepare energy supply-demand plan, it is necessary to have energy statistic balance table summarized by and broken down by the energy resources and the supply-demand sectors. Accordingly, the transfer of know-how and technical guidance will be given for (1) designing optimum energy balance table for Indonesia, (2) statistical method of transfer from primary energy to secondary energy, (3) energy calory conversion, (4) statistical method of handling and correcting inventory, etc.

(2) Design for Establishing Energy Demand Forecasting Method

a: Survey and evaluation of existing demand forecasting method in Indonesia

Evaluation of existing demand forecast model techniques, review of various parameters used, analysis of input data precision, suitableness of forecast model and forecast object, and suitable guidance will be carried out.

b: Introduction and evaluation of major forecast techniques used in Japan and other countries of the world

Advantages and problems of forecast techniques used in major countries are pointed out as the examples of applications are introduced.

c: Review and design for demand forecast suited for Indonesia

In preparing the energy plan in Indonesia in the light of the above points a and b, the forecast method considered the most suitable will be reviewed and the guidance will be given for preparing forecast model.

d. Scope of Forecast Model

The demand forecast will be made in respect of (1) energy resources and of (2) sectors. The feasibility in respect of (3) regional forecast will also be studied.

e: Review of Possibilities of Energy Conversion

One of the most critical points to be reviewed in the Energy Plan in Indonesia is to determine what energy resource is to be put to what kind of uses. Energy Balance Table will be utilized and the possibility of using some types of models (optimal conversion, allocation model) will be considered, and if they are found feasible, they will be put to practice.

(3) Survey of Specific Consumption for Energy in the Industrial Sector

In relation to the energy demand forecast mentioned in the above item (2), the importance for further detailing the forecast in the industrial sector is expected to increase, and the fundamental data in this sector is urgently needed. In particular, the methodology and the manners of operation for more precise forecast based on data collection in the medium and small scale industry sector will be reviewed.

For this purpose, the method for preparing specific consumption in Japan will be introduced, and the method of conducting the survey on the actual situation (the survey table format, optimum number of samples, selecting the survey objects, survey period, etc.) which is suitable for Indonesia will be reviewed and guidance will be given.

(4) Cooperation Concerning Systematization of Refinery Related Data and Application of the Data to Optimal Operation Model for Refineries

a: Survey and Evaluation of Existing Models in Indonesia

Among the refinery models, there are (1) macroscopic model for conforming the oil supply-demand of the whole nation and (2) optimal operation model at a refinery or an oil company.

These models will be introduced and the analysis by these models will be taught.

b. Review of Optimal Refinery Operation Model Suitable for Indonesia

(1) National Refinery Network Model

The nation is divided into 8 demand regions, and the optimal operation of refineries will be sought assuming optimal transportation system between the regions.

(2) Individual Refinery Model

Mainly to correspond to short term supply-demand variations, the operation plans for individual refineries will be prepared.

(3) Overall Model for National Refineries

Preparation of production plan on national basis, allotment and adjustment of production plans, based on each refinery will be reviewed.

2–1–2 Items for Survey

Based on the items for cooperation as above outlined, the items for on-the-spot survey were selected as shown in Table 2–1–1.

Table 2-1-1 Survey Items for Indonesian Energy Supply-Demand Data Bank

Items for technical cooperation	Contents of survey		
	Kind	Items surveyed	Remarks
1-1: Survey of existing statistics related to energy in Indonesia	(demand)	1: Actual statistics of energy demand broken down by primary energy resources	oil, coal, natural gas, hydroelectric power, and other non-commercial energy
		2: Actual statistics of demand broken down by sectors and by primary energy resources	mining, agriculture, forestry and fishery, manufacturing, transportation, energy, household sectors
		3: Actual statistics broken down by regions	administrative regions, or economic regions of Indonesia, demand broken down by primary energy resources, and by sectors
		4: Actual statistics broken down by oil products, and by sectors	gasoline, kerosene, diesel oil, heavy fuel, and other products industry, household transportation, conversion sectors
		5: Actual statistics of power demand broken down by sectors	industry, transportation, household, energy sectors
	(supply)	6: Actual statistics of supply in Indonesia broken down by primary energy resources	oil, coal, natural gas, hydroelectric power, others
		7: Actual statistics of supply in Indonesia broken down by region	including those broken down by regions
		8: Actual statistics of domestic supply of electric power	including those broken down by regions
		9: Actual statistics of domestic supply broken down by oil products	including those broken down by regions
	(production)	10: Actual statistics of domestic production broken down by primary energy resources	including those broken down by regions
		11: Actual statistics of domestic production broken down by oil products	including those broken down by regions

	(import & export)	12: Actual statistics of import and export broken down by primary energy resources	broken down by countries of origin and by importing countries
		13: Actual statistics of import and export broken down by oil products	" "
	(prices)	14: Wholesale and retail prices broken down by primary energy resources	excepting hydroelectric power
		15: Wholesale and retail prices broken down by oil products	
		16: Rate of electricity	charge system classified by the types of clients
		17: Import & export prices broken down by primary energy resources	FOB (export) C&F (import)
		18: Import and export prices broken down by oil products	" "
1-2: Design for computerization of energy statistics	(collection)	19: Methodology for collecting energy statistics	structure and system for collection
		20: Methodology for storing energy statistics	filing system
	(retrieval)	21: Retrieval and use of energy statistics	method of retrieval, use system
1-3. Preparation of comprehensive energy statistics table (Energy Balance Table) and design for its computerization	(balance table)	22: Scope and format of Energy Balance Table	optimum format of balance table
	(data processing)	23: Data processing accompanying energy conversion	how to treat energy loss ratio, calory, inventory, correction
2-1: Energy supply-demand forecast technique	(forecast model)	24. Evaluation of existing forecast models in Indonesia	structure of models, parameters, input data, results
	(economic plan)	25: Energy supply-demand forecast and economic plan	GNP/IIP/energy consumption, economic development plan, energy consumption broken down by sectors, etc.

	(computer)	26: Utilization of computers	types of hardwares, capacity, kinds of software, etc.
	(manpower)	27: Level of programmers	numbers and capacity
3. Investigation of energy specific consumption in industrial sectors	(present situation)	28: Survey on actual situation of energy consumption in big scale manufacturing industry	conduct of actual field survey concerning energy demand control
		29: Survey on actual situation of energy consumption in medium & small scale manufacturing industry	" "
		30: Data collection system from end use	mechanism for data collection
4-1: Survey on existing refinery model in Indonesia	(model)	31: Evaluation of existing model in respect of content, utilization method and result	survey on both sides of input and output
	(refinery)	32: Survey of refinery related data broken down by such as capacities, utilities, manpower, cost, production pattern, etc. in existing refineries	
	(present status)	33: On-the-spot survey of refineries.	

However, these items for survey were rearranged in order to facilitate efficient survey when it was actually conducted.

(1) Survey concerning data related to oil and gas.

(2) Survey concerning demand forecast and energy balance table.

(3) Survey concerning computer utilization in refineries.

(4) Overall survey concerning computer utilization system.

(5) Survey concerning data related to electric power and coal, other than oil and gas.

Accordingly, the items (1) to (5) are distributed to sub-items (1) – (33) in Table 2–1–1.

2–2 Composition and Responsibilities of Survey Team

The team comprised of nine experts in energy economics, demand forecast, oil refinery process, computer technology, system design and system analysis and one officer in charge of the present project from JICA.

The survey was conducted for the period of three weeks, various sections of the survey lasting respectively for 1 week, 10 days, 2 weeks and 3 weeks. Table 2–2–1 lists the members of the team and the subjects for which they were responsible.

Table 2-2-1 Composition of Survey Team, Responsibilities, and schedule

Name	Specialist in	Responsibilities	Items of Survey responsible numbers	Survey Schedule 10/15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 11/1 2 3 4
1: Takao Tomitate Head	Energy economics System analysis	Supervision Report explanation on the spot		10/15 – 11/4
2. Kenichi Matsui	Supply-demand forecast, Statistical analysis	Supply-demand forecast, Energy Balance Table	22, 23, 24, 25	10/15 – 10/22
3: Yoshio Hara Secretary	Energy economics System analysis	Oil, gas statistics	1, 2, 3, 4, 6, 7 9, 10, 11, 13, 18	10/15 – 11/4
4: Eizo Takai	Oil supply & demand, System design, Data bank	Oil refining, Computer	31, 32, 33, 26, 27	10/15 – 10/25
5: Shoichi Sakai	System analysis Oil supply-demand	Oil refining industrial statistics	32, 33, 28, 29, 30	10/15 – 11/4
6: Mototada Kikkawa	Economic development, Energy Supply-demand	Oil, gas statistics	12, 13, 14, 15, 17 25	10/15 – 10/22
7: Toru Nishizutsumi	Data bank, Energy supply-demand forecast	Supply-demand forecast, Balance Table	19, 20, 21, 23	10/17 – 10/27
8: Fumio Arakawa	Electricity supply	Electricity, Coal statistics	1, 2, 3, 5, 6, 8, 10, 12, 16	10/22 – 11/4
9: Koichi Osada	System design and analysis	Computer	26, 27, 31	10/22 – 10/29
10: Isao Asai (JICA)	–	–	–	10/15 – 10/25

Note: Number for items of survey responsible by respective members indicate those in Table 2-1-1.

Table 2-3-1 On-the-spot Survey Record (1)

Date	Participants	Discussions with	Discussions on
Oct. 16 (Mon)	Tomitate, Takai Kikkawa, Matsui, Hara, Sakai, Asai	Japanese embassy, JICA office	Briefing on survey objects, Discussion of objects, content of survey
17 (Tue)	" "	Mr. Wijarso (Director-General, MIGAS) Overall conference with Indonesian counterpart (Mr. R. Robot, Mr. Rohali Sani, Mr. Widartomo, Mr. Nyoman Sudibia, Mr. Djoko Widagdo, Mrs. Endang Lestari, Mr. Sumardi, Mrs. Soeparti)	Content of data bank, Content of survey items, Investigation of schedule
18 (Wed)	Tomitate, Takai Kikkawa, Matsui, Hara, Sakai, Asai	Overall conference with Indonesian counterpart (attended by the same members as previous day)	Discussion continued, Five discussion groups formed
19 (Thu)	Group 1, Tomitate, Kikkawa, Hara	Mr. Rohali Sani, Mrs. Soeparti and others	Data related to oil and gas
	Group 2, Matsui, Nishizutsumi	Mr. Hendro, Mrs. Endang Lestari	Demand forecast, Balance table
	Group 3 & 5 Takai, Sakai	Mr. Robot, Mr. Nyoman, Mr. Sumardi, Mr. Maman, Mr. Djoko, Mr. Pramono	
20 (Fri)	All the members	All the members of Indonesian counterpart	General meeting, Schedule for the 2nd week and after.
	Group 2, Matsui, Nishizutsumi	Mr. Nyoman, Mr. Hendro Mrs. Endang	Visits to other governmental offices, Supply forecasting
21 (Sat)	Group 2, Matsui, Sakai	Mrs. Rohali Sani, Mr. Widartomo, Mr. Razif Razak, Mr. Umar Said	Demand forecast techniques, Method of Balance Table preparation
23 (Mon)	Group 1 & 2, Tomitate, Hara Nishizutsumi, Arakawa	Mr. Rohali Sani. Mrs. Soepatti, Mr. Razif Razak, Mr. Chaligir Djufri	Kinds of oil, gas data; scope, method of data collection
	Groups 3 & 5, Takai, Osada, Sakai	Mr. Robot, Mr. Erwin, Mr. Djoko, Mr. Sumardi	Computer system, Utilization of computer in oil refining

24 (Tue)	Groups 1 & 2, Tomitate, Hara, Arakawa, Nishizutsumi	(Industrial Ministry) Mr. Anwar Nawawi (MIGAS) Mr. Razif Razak	Discussion at Industrial Ministry (Agency of investment Control) on collection of industrial statistics and data types
	Groups 3 & 5 Takai, Osada, Sakai	Mr. Singgih Darsono, Mr. Soegihardi, Mr. Djoko, Mr. Sumardi, Mr. Agung Witono	Oil refinery model, etc.
	Group 4, Tomitate, Arakawa, Hara	(PLN: Electric Power Corporation) Mr. Margono, Mr. Sihonbing, (MIGAS) Mrs. Soeparti, Mr. Djoko	Visit to PLN, Hearing on the content of data on electric power
	All the members	Japanese embassy	Explanation of E.D.B. system
25 (Wed)	Groups 1 & 2 Hara, Arakawa, Nishizutsumi	Mr. Rohali Sani, Mrs. Soeparti, Mr. Razif Razak	MIGAS, Plan for establishing Data Base, Hearing

(Record of Field Study)

Date	Participants	Discussions with	Discussions on
Oct. 25 (Wed)	Groups 3 & 5, Sakai	Sumardi	Computer
26 (Thu)	Hara, Nishizutsumi Arakawa, Osada, Sakai	All the members of Indonesian counterparts	Agreements on various points at intermediate time during the survey
	Group 3, Sakai, Osada, Hara	Mr. Tanudjaja	Distribution data for oil products
27 (Fri)	Groups 3, 5, Sakai	Mr. Nyoman	Computer
	Group 2, Hara, Osada	Mr. Budi Sudarsono (MIGAS) Mr. Hendro, Mr. Razak also attended	Energy Balance Table
28 (Sat)	Group 4, Tomitate Osada, Sakai	(Ministry of Industry) Mr. Anwar Nawawi Mr. Razak (MIGAS also attended)	Industrial statistics, Data collection system, computer utilization plan
	Group 4, Arakawa, Hara	(PLN) Mr. Margono, Mr. Sihonbing, Mr. Djoko (Pertamina) Mrs. Soeparti (MIGAS)	Statistics related to electric power
30 (Mon)	Group 4, Tomitate Hara, Arakawa, Sakai	(P.N. Batu Bara) Mr. Adnan Kusama, Mr. Djoko (Pertamina), Mrs. Soeparti (MIGAS), Mr. Pramono	Coal statistics
	Group 4, Tomitate, Arakawa	(Central Bureau of Statistics) Mr. Sugito, Mr. Supranto	Input-output Table, General statistics
	Groups 1 & 3, Hara Sakai	Mr. Sujana D.A.	Product sales statistics, Sales forecast
31 (Tue)	Tomitate, Hara, Arakawa, Sakai	Mr. Samaun Samadikun (Director General of Energy)	Concept of E.D.B. and explanation of Japanese cooperation
	Group 4, Arakawa, Hara	(PLN) Mr. Margono, Mr. Siponbing, (Pertamina & MIGAS) Mr. Djoko, Mrs. Soeparti	Electric power related data

Nov. 1 (Wed)	Tomitate, Hara, Arakawa, Sakai	Mr. Trisulo	Explanation on E.D.B. system. Briefing on the content of survey
Nov. 2	Tomitate, Hara, Arakawa, Sakai	Counterpart: Mr. Robot, Mr. Nyoman, Mrs. Soeparti, Mr. Pramono, Mr. Sumardi	Final conference, adjustment made on the outline of survey results
	Tomitate, Hara, Arakawa, Sakai	(Japanese embassy) Mr. Kanda, Mr. Ohmura, secretary	Report on the findings of survey
		(JICA office) Mr. Miyamoto, president, Mr. Shinoura	" "
	" "	Mr. Wijarso, Mr. Warga Dalem, Mr. Robot, Mr. Qoyum	" "

2–3 Schedule and Objects of Survey

On-the-spot survey was conducted for the total of 3 weeks, and the period was roughly classified into three. The first week was devoted to the general conference attended by the counterpart in Indonesia comprising of 9 members from MIGAS (including staff at LEMIGAS Oil & Gas Institute) and Pertamina. The general conference discussed primarily the concept of energy supply-demand data bank. That is, what scope of data should be fed to the data bank and what types of application system may be prepared by utilizing the data filed in the bank. It was agreed on one hand to give priority to the processing of oil and gas supply-demand data for input, and on the other hand, it was determined to study the details and the scope of data presently available of other energy such as electricity and coal than oil and gas and the industrial statistics. The reason for conducting the survey on the other energy sources than oil and gas has to do with the establishing of data utilization system. It is considered that the utilization of fundamental data other than that of oil is indispensable in a case, for example, of oil products demand forecast which is most fundamental for the application system of the data bank and which has a high priority for Indonesia.

The second point discussed was the concrete method of survey. As discussed above, the survey team was divided into small groups of two or more experts, each group reviewing from time to time the items of survey. The third point discussed was selection of objects of survey other than MIGAS and Pertamina. The discussion concluded that necessary studies could be conducted by PLN for supply-demand of electricity, Coal Corporation (Batu Bara) for coal supply-demand, and the Investment Control Agency of Ministry of Industry and the Central Bureau of Statistics for general industrial statistics.

The surveys other than by Pertamina and MIGAS were conducted attended by the members of counterpart team comprising of MIGAS and Pertamina for facilitating joint understanding of the investigation. The second week of the survey, or the second stage of the survey was conducted by discussing details the individual items by the five small groups and the corresponding groups on the counterpart. At the same time, at the break of surveys, the general conference was held in which the results of the individual surveys conducted by the groups were published, the groups mutually confirmed the facts. In the third week of the survey, or the third stage, the memorandum conclusively prepared by the survey team was studied and the details of the survey confirmed at the general conference.

3. Survey Findings and Evaluation of Present Situation

3–1 Energy Data Situation in Indonesia

3–1–1 Present Situation of Energy Supply-Demand and its Future Plan

When broken down by energy resources, the character of energy demand structure in Indonesia is highly depend upon oil, and this tendency is increasing steadily. The demand for oil in 1970 held 86.5% of the whole primary energy demand and it increased up to 88.9% in 1975. During the same period, the demand for primary energy increased by 14% annually; this accelerated energy demand made to rise oil consumption. The structure of demand for oil (1975) which holds overwhelming share in total energy demand can be broken down by products as follows: gasoline 19.2%, kerosine 39.3%, motor gas oil 23.1%, fuel oil for industrial use (diesel oil and heavy fuel oil) 15.4%. Growth rates of main products during the period from 1970 to 1975 were 8.7% for gasoline, 12.2% for kerosine, 26.4% for motor gas oil and 14.5% for fuel oil for industrial use.

According to MIGAS, the future primary energy demand is predicted to increase by annual rate of 11.4% from 1975 to 1985. When broken down by energy resources, demand for oil is expected to become 2.73 times, natural gas 3.53 times, coal 14.2 times, hydro power 4.68 times as much as the present volume. This means that demand for energy other than oil is expected to increase by relatively high rate in the future plan. Compared to the primary energy demand structure in 1975, planned future demand structure indicates that while oil share of total energy demand will decrease from 88.8% to 82.4%, share of other energy will increase; natural gas from 8.7% to 10.5%, coal from 1.1%, to 5.1%, hydro power 1.2% to 2.0% respectively.

In forecast of primary energy consumption by sectors, high growth rate in industrial sector and transportation sector is predicted. In demand structure in 1985 compared to that of 1975, household sector will show drastic fail from 33.6% to 23.3% while industrial sector will increase from 32.8% to 43.3% and transportation sector will remain on the present level. Reflecting such shift in primary energy demand structure, oil products demand structure will indicate that fuel oil for industrial use will increase its share while the shares of kerosine and gasoline gradually will drop down.

3–1–2 Direction of Energy Policy

The basic problems in forming energy supply-demand policy in Indonesia are as follows.

1: How to adjust energy supply to meet rapid increasing of energy demand as development of national economy.

2. How to reduce the dependency on oil which presently holds about 90% of whole primary energy.

3: How to diversify the sources of energy to meet for domestic consumption.

4: How to improve efficiency in energy utilization (conservation)

As a concrete countermeasure, an energy plan is drafted corresponding to the Third Five-Year Economic Development Plan (April 1979 to March 1984). This plan sets GDP growth rate during the plan period at annual 6.5% and estimates growth rate of energy demand by 10.8% annually.

(Note:) In estimation of energy demand, both Analytical Approach and Econometrical Approach were used. By the former method, whole energy demand in 1979 is estimated as 31.7 million tons (coal equivalent) and that in 1984 is estimated as 52.8 million tons (coal equivalent).

Table 3-1-1 Primary Energy Demand (Actual & estimate)

in 1,000 t (coal equivalent)

	1970	1971	1972	1973	1974	1975	1980	1985
1: oil products	7,938 (86.5)	9,672 (86.3)	10,689 (87.0)	12,696 (90.0)	14,514 (90.7)	15,910 (88.9)	26,836 (80.2)	43,370 (82.4)
2: natural gas	929 (10.1)	1,176 (10.5)	1,242 (10.1)	1,072 (7.6)	1,113 (7.0)	1,558 (8.7)	5,500 (16.4)	5,500 (10.5)
3: coal	158 (1.7)	185 (1.7)	200 (1.6)	149 (1.1)	154 (1.0)	190 (1.1)	664 (2.0)	2,700 (5.1)
4: hydroelectric power	158 (1.7)	176 (1.6)	157 (1.3)	191 (1.4)	222 (1.4)	222 (1.2)	450 (1.3)	1,040 (2.0)
total	9,177	11,209	12,288	14,108	16,003	17,880	33,450	52,610
growth rate		22.1	9.6	14.8	13.4	11.7	13.3	9.5

source: "Perkiraan Konsumsi Energy Di Indonesia" June, 1976, Department of Mine and Energy, Directorate of Oil and Natural Gas.

Table 3-1-2 Primary Energy Demand by sector (Actual & estimate)

coal equivalent 1,000 t

	1970	1971	1972	1973	1974	1975	1980	1985	Growth rate (%)			
									70/75	75/85	75/80	80/85
1: household sector	3,449 % (37.6)	3,810 % (34.0)	3,919 % (31.9)	4,677 % (33.2)	5,396 % (33.7)	6,000 % (33.6)	8,730 % (26.1)	12,240 % (23.3)	11.7	7.4	7.8	7.0
2: transportation sector	2,728 (29.7)	3,004 (26.8)	3,476 (28.3)	4,162 (29.5)	4,820 (30.1)	6,000 (33.6)	9,560 (28.6)	17,570 (33.4)	17.1	11.4	9.8	12.9
3: industrial & electricity sector	3,000 (32.7)	4,395 (39.2)	4,893 (39.8)	5,269 (37.3)	5,787 (36.2)	5,880 (32.8)	15,160 (45.3)	22,800 (43.3)	14.8	14.5	20.9	8.5
total	9,177	11,209	12,289	14,108	16,003	17,880	33,450	52,610	14.3	11.4	13.3	9.5

source: Same to above table.

Table 3-1-3 Oil Products Demand in Indonesia

10³ kl

	1970	1971	1972	1973	1974	1975	1980	1985	growth rate (%) 70/75	75/80	80/85	75/85
aviation gasoline	140.5 (2.2)	175.7 (2.5)	209.4 (2.6)	283.1 (3.1)	364.0 (3.4)	368.0 (3.0)	1,050.0 (4.5)	1,880.0 (5.0)	21.2	23.3	12.3	20.6
motor gasoline	1,564.8 (24.9)	1,670.7 (23.9)	1,745.6 (21.9)	1,926.3 (20.9)	2,111.8 (19.7)	2,376.1 (19.2)	3,710.0 (16.0)	5,430.0 (14.4)	8.7	9.3	7.9	8.6
kerosine	2,731.5 (43.5)	3,009.1 (43.1)	3,290.6 (41.3)	3,679.9 (40.0)	4,260.0 (39.8)	4,868.6 (39.3)	6,910.0 (29.7)	9,690.0 (25.7)	12.2	7.3	7.0	7.1
diesel oil	886.0 (14.1)	1,096.3 (15.7)	1,435.2 (18.0)	1,874.4 (20.4)	2,302.9 (21.5)	2,863.2 (23.1)						
diesel oil for industrial use	351.3 (5.6)	375.9 (5.4)	425.5 (5.3)	502.3 (5.5)	591.7 (5.5)	724.2 (5.9)	11,680.0 (50.2)	20,740.0 (55.0)	20.9	19.6	12.2	16.0
heavy fuel oil	611.6 (9.7) (29.4)	650.9 (9.3) (30.4)	855.2 (10.7) (34.0)	930.4 (10.1) (36.0)	1,085.7 (10.1) (37.1)	1,173.3 (9.5) (38.5)						
total	6,285.7	6.978.6	7,961.5	9,196.4	10,716.1	12,373.4	23,350.0	37.740.0	14.5	13.4	10.2	11.8

Source: Same to above table.

As to supply, on the other hand, development of coal and keeping the oil export at present level are the major tasks. Therefore, in the Third Five-Year Plan, domestic oil consumption is considered to maintain at minimal level, promotion of the oil export, in the same time, is expected by putting emphasis on development of hydro power, coal, natural gas and geothermal energy.

However, in near future, since substitutional energy will not be very dependable, oil will have to fulfill adjustment function for energy supply-demand. By the time of the Fourth Five-Year Plan (April 1984 to March 1989) coal is expected to develop sufficiently and conducted adjustment function of energy supply-demand along with oil. Further, in the Fifth Five-Year Plan, oil will be expected to supply mainly for household use and transportation, while coal will function as energy to adjust supply and demand so that oil export will be kept at present level.

3–1–3 Needs for Energy Supply-Demand Data Bank

Present situation and future plan of energy supply-demand in Indonesia is above mentioned. In order to increase reliability of future supply-demand plan, the accuracy of actual figures in energy supply-demand data should be improved first. Secondly, establishing of suitable methodology for energy demand forecast adapted for Indonesian present situation is an important factor.

As to the first point, there lie several problems in the process from data collecting to its utilization. More specifically, (1) Presently data concerning energy such as oil, coal, gas and electricity are collected through state owned corporation. But, the system to unify those data and to offer them is not yet established suficiently (2) Collected data are production and distribution data viewed from suppliers' side, moreover data concerning on energy demand are not collected systematically so far. That causes of rather low accuracy in actual data concerning energy demand. (3) It takes fairly long time (about 3 months) from collection of data to use or exposition of them.

As to analysis methods, appropriate method has to be developed by gradually improving it from simple regression analysis to more sophisticated econometric model in order to make convincing forecast. To achieve abovementioned improvement, establishing data bank would be extremely effective means because in the process of setting up the data bank, collection of data, its input to computer, filing, retrieve, utilization could be systematized and improvement of data accuracy, expansion of available data, reduction of operation time, diversified use of statistics are realized.

By using those organized data, various application systems in turn can be developed and it will greatly contribute to making projects or plans such as five-year plan.

In this context, setting up energy data bank system in Indonesia is an important project since it would lay a foundation for future energy policy in the country.

3–2 Survey Findings Broken Down by Major Survey Items

3–2–1 Data Concerning Oil and Gas

a: Data collecting structure and system

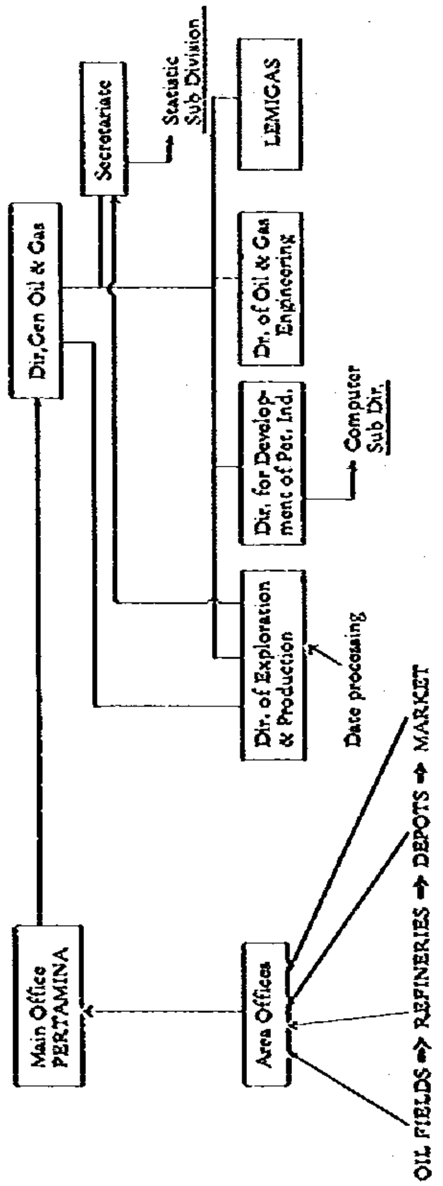
Data concerning oil and gas in Indonesia are collected through Pertamina. The Indonesian State Oil and Gas, Mining Enterprise, and necessary data are secured by Directorate of Oil & Gas of the Department of Mine and Energy. Fig. 3–2–1 indicates actual data flow. Unprocessed data relating to oil and gas production are directly sent to Department of Oil & Gas Exploration & Production of Pertamina while those relating to oil refining to Department of Processing and those relating to products manufacturing and storage to Department of Domestic Supply.

These data are sent to Directorate General Oil and Gas in Ministry of Mine and Energy, then these are transferred to Directorate of Exploration & Production in order to process of these raw data. Moreover, these processed data are sent to Computer Sub-Division, and then, they are conducted final procession and are utilized as the energy statistics at each directorate in MIGAS.

It usually takes 3 to 4 months to process various supply-demand data so that they are usable as statistical data.

b: Variety and Scope of Data

Varieties and scope of data being collected through Pertamina is outlined below. Besides this, MIGAS publishes monthly "Petroleum & Natural Gas Industry of Indonesia" and Pertamina publishes "Indonesian Oil Statistics" (Quarterly).



Fug. 3-2-1 Summary of Oil and Gas Data Flow

(1) Oil Gas Production Data

Oil Gas production data are totalled on monthly base, in the same time. Data are classified by operating companies, and then by oil fields (partly by oil-wells). Data of oil and gas production ratio and underground water production volume as well as crude oil and gas production volumes (daily and monthly volumes) are recorded.

(2) Products Distribution Data

Distribution statistics are totalled monthly by products, sales sectors and areas. Products are classified by aviation gasoline, jet fuel, automobile gasoline, kerosine, diesel oil and heavy fuel oil respectively. Sectors are classified by those directly sold to consumers, those sold to dealers and those for export. Out of them, direct sale consumers are further sub-divided by aviation industry, agriculture, mining, government and munitions.

(3) Data Concerning Oil Refining

Operation data at six oil refineries operated by Pertamina are directly sent to Jakarta. Data mainly consist of type and volume of crude oil through-put, type and volume of refined oil products, stock broken down by type of oil at the beginning and end of period, various technical data and those of cost and budget, all of which are out of monthly operation record.

(4) Inventory, Distribution Data

Presently, number of oil depots including oil refineries in Indonesia is about 60, regardless of size. Data concerning the shipping and inventory are collected regularly from these depots on monthly base. However, data concerning products flow or distribution data from dealer to consumer is not properly collected. This is attributed to the fact that since all wholesale prices and a part of retail prices of products are regulated by the government and, thus, shipping cost is dealt with uniformly, it is extremely difficult to collect actual data in distribution side.

c: Problems in Data Collection

All oil and gas data collected by Pertamina are the ones grasped from suppliers' side, and, as far as it concerns, they are fairly well classified and processed. However, there are some points which might require fundamental improvement in the process of setting up data bank system.

In summation, the following are presented.

(1) Necessity of Data Collection Concerning Products Distribution

Although actual data concerning domestic products distribution has not yet collected so far, distribution statistics including shipping cost should be systematically collected. This is critical, because firstly distribution data is indispensable to determine refinery site and its capacity when a new refinery is built or an existing one is expanded and, secondly it is needed to achieve rational products supply.

(2) Necessity of Demand Data Collection

Regarding the nature of domestic sale data which are presently collected by Pertamina as the supplier, the data is not considered the demand data. Since there exists fairly long time-lag between demand and supply, when a certain period is taken up, demand does not usually identify with supply. Further, because sales routes for gasoline and kerosine are very complicatedly intertangled respectively, demand hardly coincides with supply in a given period. Therefore, direct investigation of consumers such as sampling investigation should be conducted regularly. With these data, supply can be adjusted resiliently to demand even if demand pattern fluctuates at middle of a period, achieving the most effective coordination between demand and supply.

(3) Shortening of time required for data processing

Thirdly, it is important to shorten the time required during from data collection to processing of data as usable statistics. At present, it takes about 3 – 4 months, but it preferably can be reduced to about 2 months by modernizing data collecting work.

With speed-up of the data processing, it is expected that strategical or political countermeasures could be more easily adjusted to change in short-term supply and demand. Establishment of effective collection and retrieval methods by systematic processing on the data base has already been studied inside MIGAS, and it, as OARS (Oil Activities and Revenue System), will be materialized in the near future. But this system seems to be data system for business management, judging from the type of data and its detailed content, and to be different from supply-demand data bank base upon broader concept. Therefore, OARS system and Energy Supply-Demand Data Bank should be regarded separately.

3–2–2 Energy Balance Table & Demand Forecast

Basic data concerning energy are collected by factors such as production, sales (or consumption), export, import and inventory, subdivided by individual energy source such as oil, gas, coal, electricity and others. Those are the original data. By organizing data on individual energy source, balance table by energy source is obtained, and by tabulating those into one single table, comprehensive energy supply-demand table expressed by units particular to energy sources is made. This table is generally called as Basic Energy Statistics or Energy Commodity Balance Table.

Since oil data is indicated by kilo litters, barrels, kilograms, and coal by kilograms and tons, gas by cubic feet or cubic meters, electricity by kilowatt hours at this stage, addition and substraction of those data as they are impossible and figures expressing total energy production and consumption for one country are unobtainable.

The table which indicates figures of each energy source by common unit according to a certain form and which makes addition and substraction possible is the one known by the name of Energy Balance Table.

Actual process to make this table is indicated below.

Basic Data ——→ Basic Energy Statistics ————→ Energy Balance Table
(Commodity Balance Table)

In order to have a complete picture of energy economy in a country, Basic Energy Statistics and Energy Balance Table are indispensable. With those tables, production, export and import, conversion, final consumption of energy could be grasped at a glance.

In the case of Indonesia, although statistics on individual energy source are fairly well-organized, Basic Energy Statistics and Energy Balance Table which would give a general picture are not yet prepared except for simple forms on trial basis.

This is partly attributable to the fact that in Indonesia dependency on oil has been predominantly high, and it has not been always required politically to understand the overall situation convering other energy sources. However, in recent years, it is necessary to understand energy economy much more comprehensively than before in order to utilize coal, to accelerate electrification and to convert non-commercial energy into commercial energy.

This poses an important challenge to set up global energy strategy in Indonesia. To achieve this aim, a whole picture of energy economic situation in the area has to be understood and organization of energy statistics and tabulation of energy balance table would be the first step.

Commodity Balance Table and Energy Balance Table are indispensable base to make energy supply-demand forecast, because these tables would afford better understanding of consumption data broken down by the consumption sectors and by energy sources which are required for energy demand forecast within a framework of energy economics. If these tables were computerized, they would be immediately usable for regression-analysis.

There might be some difficulties in tabulating detailed energy balance table at the present stage in Indonesia considering the quality of statistical data; however, simpler table could be prepared out of the presently available data, if assumptions to a certain extent were allowed. It would also be profitable if, in the process of tabulating detailed balance table, necessary supplementary energy data are identified.

By combining energy balance table with macro-economic data, more complicated and detailed analysis than simple GNP correlation and time series-correlation methods presently used in Indonesia would become applicable.

3–2–3 Computer Utilization in Oil Refinery and Shipment Plan

Pertamina is in charge of making and enforcing oil refinery and transportation plans in Indonesia. Since the demand for middle distillate products holds extremely large share compared to other products, it is a basic rule in making oil refining plan to maximize middle distillate products production and to minimize their import.

A manager of every marketing area sends data regarding sales forecast to head office of Pertamina based on information made by inspectors of his area. The head office makes demand forecast finally, taking into accounts actual statistical data and other economic plans. Oil refining plan is drafted in accordance with the abovementioned basic rule and on the base of computed supply-demand plan, transportation plan, in turn, is made.

Directorate Domestic Supply and Distribution is in charge of making demand forecast and land-transportation plan. Directorate Manufacturing is assigned to make oil refining plan while Directorate Shipping and Telecommunication in responsible to make the sea-transportation plans.

Presently, there are 8 refineries in Indonesia and they are grouped into the following 5 refinery-units.

Unit I : Pangkalan Brandan
Unit II : Sungei Pakning and Dumai
Unit III : Music (Plaju and Sungei Gerong)
Unit IV : Cilacap and Wonokromo
Unit V : Balikpapan

Manufacturing plan is made not for each refinery but for each refinery unit. Based on refining equipments, their capacity and demand in sales areas, crude oil throughput, products mix, specification of products and production volume are alotted to each unit.

LP model is used in making manufacturing plan. Pertamina owns LP models at head office, Musi and Cilacap refineries now, and is developing one at Pangkalan Brandan refinery. LP model at the head office is in a form of combined model covering each refinery unit and sales area.

Data concerning operation at each refinery unit is reported to Pertamina head office regularly once in every 10 days or 3 months. The report includes crude oil throughput, oil products volume, inventory, change in refining equipment and system, cost and others. It is understood that data concerning refinery operation are filed at both each refinery and at the head office. The daily record such as crude oil throughput, oil products volume and inventory are computerized at refinery units where computers are installed.

Utilization of computer for data collection and planning in the field of transportation is being developed. Data collection in sea-transportation is still in the stage of tabulating distance-table and of collecting data concerning tanker performance.

In regard to transportation cost, tariff broken down by the sea route and the ship type are not prepared yet, and only the average cost broken down by clean and black is available. Computer is not utilized in making transportation plan either.

Use of computer in oil refining and transportation at Pertamina still remains at abovementioned stage, and there seems to be ample room for Japanese technical cooperation. Technical transfer on the following 4 points could be recommended taking into account of relation to energy data bank system and making more improving plan by better tools.

a: Short-term demand forecast with the use of data bank.
b: Establishment of data bank concerning sea-transportation data.
c: Building transportation-cost into LP model.
d: Development of installment planning model in the long run.

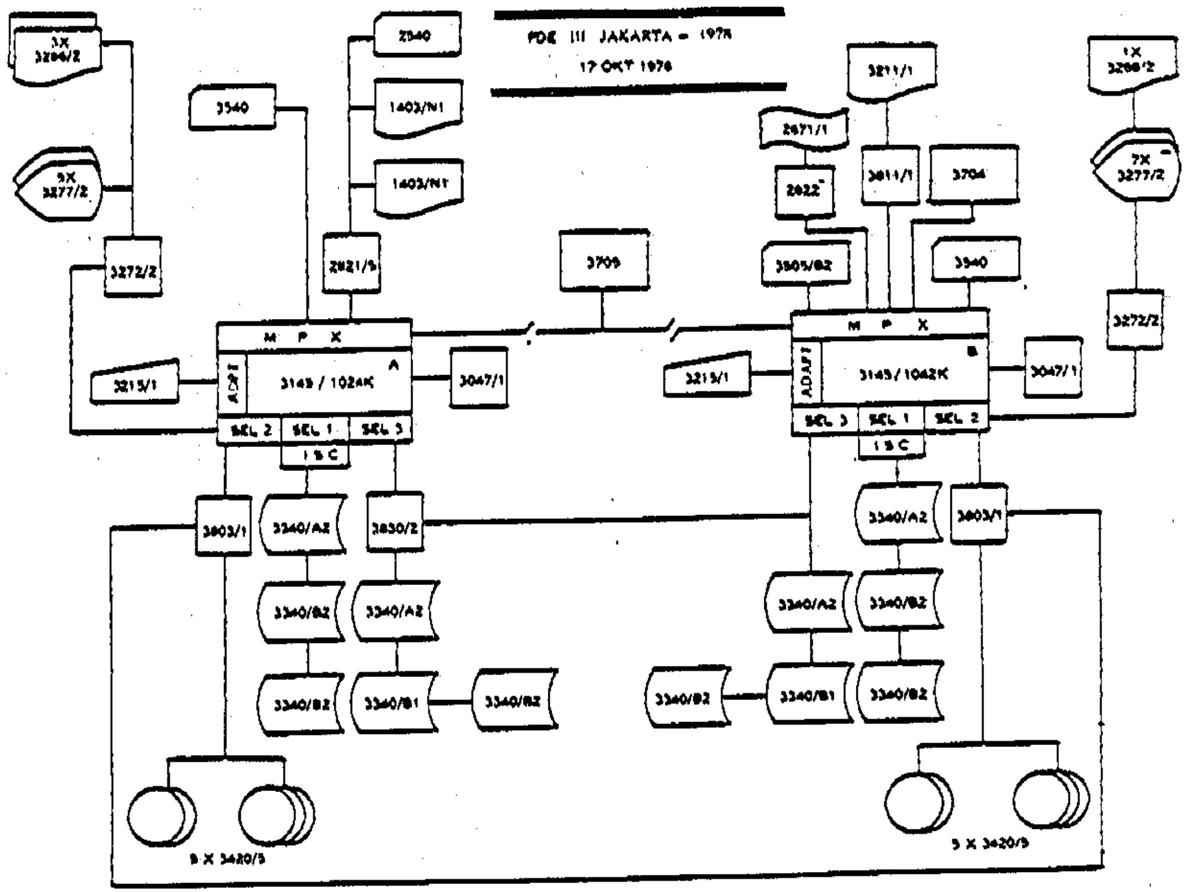
3–2–4 Computer System

As a result of our investigation into the present state of Hardware, Software and Man Power at the computer division in the Jakarta head office of Pertamina, our conclusion is that there is no special problem to be discussed here, so far as the establishment of Energy Supply-Demand Data Bank is concerned.

a: Hardware
Pertamina uses two sets of IBM 370/145 in duplex system, making one set solely as a back-up machine. IBM 370/145 is a typical medium-size machine, equivalent to M–140 in FACOM M series of Fujitsu, the Japanese computer maker. As the said duplex system is provided with a memory of 1,024 K bytes respectively, there is almost no need of worrying about the memory size when an ordinary program of usual size is processed

The quantity of data for the Energy Data Bank will necessitate a disk file in the order of 1 megabytes in the decade from now on. Even if there are some other computations (e.g. crude oil production data, medical information, shipping information, etc.) which must be regularly stationed

Fig. 3-2-2 Configuration of Pertamina's Computer



3145··········Arithmetic Unit
Integral Memory
3340··········Magnetic Disk memory
3540··········Disket Reader
3420/5·······Magnetic Tape Unit
1403/N1 ···Line Printer
3505/B2 ···Card Reader
2671··········Paper Tape Reader
3830··········Magnetic Disk Controller
3272··········Input/Output Controller
3277··········CRT
3803··········Magnetic Tape Controller
3286 }
3211 } ·······Line Printer
3811 }
2821··········Line Printer Controller
2822··········Paper Tape Controller
3215··········Key Board Printer

in the data file, the problem of shortage in the disk file will not probably occur in the near future.

The figure 3–2–2 shows the configuration of hardware system at the head office of Pertamina.

b. Software

In addition to those supplied from IBM, Pertamina owns a lot of software of its own.

FORTRAN and COBOL are the languages mainly used at Pertamina, while PL/I has been used to some extent. Furthermore, Pertamina has CMS (Conversational Monitor System) which services time sharing in conversational type as a control program. System control program and language processor are well prepared, but LCM is not utilized yet.

For an IBM user, Pertamina owns a rather rich library of application programs, but not all of them is utilized.

SSP (Scientific Subroutine Package), i.e. a program for statistical purpose is, of course, well used.

There are also IMS (Information Management System) and DMSII, both being packages for Data Base. While the former is going to be used for medical and shipping information management, the latter remains still untouched.

In respect of linear programming, MPSX is held by Pertamina. Especialy regarding oil refinery model, engineers have been dispatched to Bonner and Moor Corporation (Houston, U.S.A.) in order to prepare for the introduction of RPMS., which is a software rearranged Matrix Generator and Report Writer exclusively used for oil refinery LP model. In short, LP models are considerably well utilized here.

As simulation language, GPSSV and CPPS are used. While GPSS is utilized for LNG export model, refinery process simulator (a considerably large-scale software) is now used at the refineries of Music and Cilacap.

From the result of our investigation it is surmised that various softwares seem to be available at a fairly high level, but the degree of their utilization is likely to be still insufficient.

The Table 3–2–1 shows the list of softwares owned by Pertamina.

Table 3–2–1 Softwares list in Pertamina

System Control Program
1 OS/VS1, DOS/VS
2 Virtual memory (VM/370)
3 CMS

Language Processor (language translator, basic software)
1 ANS COBOL, FORTRAN IV
2 PL/I
3 APLSV

Application Software (service program)

1 Data Management System (General Purpose Software)
IMS (Information Management System)
CICS
DMS II (Data Management System)
SORT/MERGE
RPG (Report Program Generator)

2 Simulation Language (General Purpose Software)
MPSX (Mathematical Programming System Extend)
GPSSV (General Purpose Simulation System V)
CPPS (Continuous Process Plant Scheduling System)

3 Application Software of Scientific Technique
SSP (Scientific Subroutine Package)

4 User Application (Special Purpose Software)
APPLY
RESSTM
MMS' – GENERAL LEADER
UCC – ONE, TEN, FIFTEEN
PANVALET
NOVEL
EASY TRIEVE
FILETAB
HCS (Health Care Support)

c. Man Power

As seen in the Table 3-2-2, computer personnel at the Pertamina head office numbers 180 in all, consisting of 12 administrators, 3 EDP related staff, 11 system designers engaged in simulation, 21 system designers related to Data base, 47 programmers, 21 operators and 40 key punchers.

Several of these people have the experience of study in U.S.A. 4–7 years are the average years of experience of the whole personnel.

d. Conclusion

As above, we have observed the present state of Hardware, Software and Man power at Pertamina and the limited availability of energy related data in Indonesia. In the meantime, it is urgently required to establish Energy Supply-Demand Data Bank, so as to utilize it for practical purpose. Taking these factors into consideration, our conclusion is summed up as follows.

Firstly, to establish Energy Supply-Demand Data Bank centering particularly on oil and natural gas, and said Data Bank must be provided with such macroeconomic indicators that are indispensable for the forecast of energy supply-demand.

Then, as a second step of the application, what is pressingly needed is computerization for the below-mentioned three items:

Table 3-2-2 Member table of Pertamina Computer Division

EXPERIENCE FUNCTION	Over 10	9	8	7	6	5	4	3	2	1	Total
1. Management.	3	1									4
2. Administration.	2		2	2	4		2				12
3. Procedure.	2			1							3
4. System Development.											
4.1. Scientific.	2	1		2		6					11
4.2. Commercial.	3	2	3	6		4	2		1		21
5. Programmer.			2	3		6	4		18		33
6. System Programmer.		1	1	2	2	2	3		3		14
7. Data Base Adm.	1			1		1			4		7
8. Data Controller.	9		3	1	1						14
9. Computer Operator.	2		2	1	2	1	5	3	5		21
10. Key Puncher.	3		8	4	7	7	9	1	1		40
*TOTAL.	27	5	21	23	16	27	25	4	32		180

(a) Tabulation of statistical data related to energy.

(b) Tabulation of Commodity Energy balance.

(c) Drafting of middle term forecast model.

After these projects are completed and mastered by the personnel concerned, the next step to be adopted is to utilize DMS in to reach the higher stage of systematization, pursuant to the higher application corresponded to the increased quantity of data and more accurate data processing.

The above is, we suppose, the best way to approach the final goal for Indonesia. Through the course of the limited computerization at the initial stage, it is possible to accumulate the knowledge necessary for the elevation to the next higher stage. Although such a step by step method looks slow, but it is a steady and surest way, since enormous difficulty might ensue, if sophisticated DMS is put into practice at a stroke without a full preparedness and preliminary term.

In short, what is recommended by us as our technical cooperation in the first year is to establish, as soon as possible, the Data Bank in the limited range as mentioned before and to promote computerization related to the practical application of the Data Bank. Higher systematization and its further application shall be left behind as a question to be taken up in the future, although preliminary study for the problem must be done.

3–2–5 Data Other Than Oil and Gas

1) Electricity

Survey on electricity was conducted to PLN, public electricity corporation, which holds *about 54% (1,500 MW) of about 2,800 MW power in the whole generating capacity of the Republic of Indonesia. Surveyed items consist of availability of electric supply-demand data, method of statistical research, method of demand estimate and other related matters such as rural electrification and electric rates.

It was found out that reliable figures of various factors such as generated electricity sold electricity (final demand), plant capacity, plant operation rate (plant load factor) and primary energy consumption used for generation can be obtained from each PLN supply district. However, data on transmission loss and efficiency of power stations or substations which are critically important for setting up data bank, are not quite satisfactory in the meaning of accuracy. Major items of above factors are mentioned on PLN Year Book and more detailed records are filed at PLN.

About 20% of electricity is supplied by enterprises other than PLN and independent power plants. Statistics about those are not only hard to obtain but their accuracy about their bases, even if obtainable, is not quite satisfactory. Part of electricity supply-demand data concerning districts except supply areas of PLN could be obtained by picking up necessary ones out of statistics prepared by MIGAS, Pertamina, Ministry of Industry, Central Bureau of Statistics, Batubara, and others..

Coordination between these agencies and PLN should be promoted so that electricity supply-demand data could be collected systematically. PLN's plan to introduce a computer (IBM 370/138) for data processing should be evaluated as an effective measure to set up data bank which deals with the whole country. It is useful for PLN too, since it extends the scope of data application.

* PLN Year Book/end of 1977

2) Coal

The survey on coal was conducted for P.N. Batubara which controls almost all mining, shipping and sale of coal in Indonesia. Survey items consist of mine development plan, demand development plan, availability of demand statistics and finding Batubara's views toward the data bank. The survey reveals that statistics on coal output, shipment volume, sales volume, supply-demand estimates are available from Batubara. Although the survey this time did not include grasping of concrete data nor detailed points, the data generally possesses uniformity as well as continuity and would be useful for the data bank to grasp the whole energy picture in Indonesia. Batubara's views toward the data bank establishment is very positive. It shows keen interests in the data bank because the general energy data to be stored in the bank will be very effective in drafting coal supply-demand plan or sales plan for the near future, in making coal policy decisions or carrying out the policies. On its part, the corporation expects the data it provides for the data bank to play important roles.

Since the future Indonesian energy policy will be centered around oil consumption curtailment and development of coal, as a substitutional energy for oil, this keen interest and positive attitude of Batubara has to be highly appreciated and materialized in order to help establish the nationwide data bank. Joint operation, unifying statistic factors, harmonization of communication will facilitate this aim.

Development plan and estimate will be described later separately.

3) Industrial Statistics

As to the industrial statistics, the survey was conducted separately on the Ministry of Industry, which controls various industries, and on the Central Bureau of Statistics, which controls various statistics. Survey items consisted of statistic survey methods, types of available statistics and data processing methods.

The Ministry of Industry is presently making and promoting plans to conduct statistical researches, to collect, to manage and to use of data in order to improve the out-dated industrial statistics, aiming at large and middle sized enterprises. A computer (WANG 2,200) as a central data processing unit was installed in February, 1978.

As the result of this survey, it is secured that records of purchase and consumption of oil, gas, coal, electricity and others in each industry will be stored: they are expected to be available as effective input data for energy data bank in the future. The Ministry of Industry presently considers setting up a data processing system including four terminal equipments installed at the four bureaus of chemical, metal, others and small scale industries, and introducing a larger sized computer. The Ministry of Industry strongly hopes to have technical assistance from Japanese government for this plan and that should be studied separately from this survey in question.

In preparation of energy statistics, Central Bureau of Statistics is collecting data independently, although Pertamina provides statistical materials an oil and the Mine & Energy Ministry, PLN or Batubara offers other statistical materials. Besides General Industrial Census, which is used as the base for the above, and which has been conducted on a nationwide scale once in every five years since 1971, the statistic research is conducted annually on about 9,000 large and middle scale enterprises. In regard to small sized and family industries, sampling was conducted once every five years along with the abovementioned Industrial Census. The collected data are processed by computer ICL-1903. It is expected to install a bigger type of computer by the credit from Japanese government, while, the input-output table (I/O table) is revising based on the statistics taken in 1975, and is going to be published in February of 1979.

Also, they are planning to form the trade I/O table connecting the domestic tables of Japan and Indonesia as a new experiment.

4. Basic Concept Concerning Establishment of Energy Supply-Demand Data Bank System

4–1 Concept of Energy Supply-Demand Data Bank and Conditions for Its Establishment

The energy supply-demand data bank system (to be called hereafter as EDB) referred here is a comprehensive electronic information system on energy that 1) employes electronic computers, 2) systematically collects and stores groups of information concerning energy supply-demand as a whole, 3) retrieves wide-ranging and precise information from various fields to meet specific needs, 4) compiles various statistical data in accordance with different objectives, and 5) has capacity for applied uses such as statistical analysis, supply-demand projection, system analysis and policy simulation analysis by making use of various software incorporated in the computers. Needless to say that this system will be of great value not only for drawing up and enforcing government energy policy but also for managing enterprises and for the energy industry as a whole.

For establishing and utilizing such an EDB system, the following elements must be on hand:

a) Energy-related data (statistics and other digital and literal information) and data processing system for storing in the computer (setting up of input form and maintenance)

b) Hardware (high-speed, large-capacity memory, larger-than-medium main computing system and operation system capable of taking terminals)

c) Software (control program, language program, application software)

d) Manpower (statisticians, energy information analysts (energy economists), system analysts and computer-related system design programmers, operators, key punchers)

In actual cases, the above four elements are at various stages of development depending on country or point of time. For instance, it can be easily imagined that the presence of sufficient data is not enough to establish a sufficiently functional EDB system if computer-related capacity is limited. Conversely, the presence of highly-efficient large-capacity computers and highly sophisticated software packages alone is not enough if dependable data were not available or the manpower to design a system to process these data, store them in the computer, retreave and use them, and to maintain the system was not at hand.

Therefore, an EDB system which could be established by incorporating these requisites at different stages of development may be launched by adjusting other conditions to the least advanced one and gradually improving it from a simple one to more advanced, complex and comprehensive one. For instance, setting up a system comprising highly sophisticated software when statistical data are available only in limited number and fields is like using a steam hammer to crack a nut. When such an imbalanced system is put to use to make a precise supply-demand projection, no meanigful replies or computed results will come out. On the other hand, a system established on the basis of limited statistical data can expand its capacity and fields of application as the number of dependable data and the variety of their fields grow.

In recent years, the advanced computer technology has made it possible to develop for practical use a data managment system (DMS) that can operate and process at will a general purpose data base comprising a huge volume of data. Since the 1973 oil crisis, advanced nations have moved to set up computer-based data banks in the field of energy too. However, only relatively simple systems have been put to practical use so far and those few that are worth being called DMS are still in the research stage (preparations for designing and operation).

4–2 Basic Proposal Concerning Establishment of Energy Data Bank System in Indonesia

Based on our current research, we would like to propose that the establishment of EDB system in Indonesia should base on the following basic concept.

First, the EDB system referred to here means, in concrete terms, one that, based on the under standing between the Japanese Government and the Ministry of Mine and Energy of Indonesia, 1) to be placed under the juristidiction of MIGAS, Ministry of Mine and Energy, 2) to be utilized by MIGAS and Pertamina, 3) to center on oil and gas for the time being, and 4) to use the electronic computers and software owned by Pertamina.

After conducting a research on the present state of availability of data related to oil, gas and other energies, hardware, software and manpower in MIGAS and Pertamina, we have reached a conclusion that it is quite possible to draw up a program for the establishment of an EDB system referred to in the preceding paragraph and put it to practical use. The most important questions are 1) what kind of EDB system should be designed, 2) how to draw up a program for building and maintaining it, 3) how to carry it out, and 4) what kind of future improvement program should be drafted and how preparations should be made for it. Out conclusion is as follows.

The establishment of an EDB in Indonesia is desired to go through two steps. In Step 1, a simple electronic energy data file is to be made by processing existing basic data centered on oil, and basic retrievals and applications are to be conducted. In Step 2, well-arranged and expanded energy-related data are to be processed to make a comprehensive electronic energy data base and sophisticated application on the basis of it is to be conducted.

a) Step 1 (Setting up of a simple EDB system and training of personnel to acquire technical skill)

In Step 1, existing data centering on oil are collected to compile input data card under a regular format. As key to disk system is being used at Pertamina, input disk (diskets) will have to be made. In this case, data checking and compiling are to be conducted manually in Step 1. Then input data (cards or diskets) are to be stored in EDB disks. Using data on these disks, a number of special purpose input data files are to be made in accordance with retrieval and application purposes. In view of the current energy data and policy needs in Indonesia, we consider that the simple EDB system to be set up in Step 1 is best started with the following three functions:

1) Compilation of basic energy statistic table centering on oil, 2) compilation of energy balance table, and 3) medium-range oil-energy supply-demand projection.

In Step 1, at least three data files (special purpose input data files) in accordance with these objectives will have to be made. Also needed are development of conversion software to transfer necessary data from among input data to data file, and software to draw up statistical tables and balance tables to conduct supply-demand projections by using these data. Special know-how will be needed for designing EDB system including the development of these software, its construction, operation and maintenance. However, we believe that with hardware, basic software and manpower currently available in Indonesia, it is possible to start designing and construction of the Step 1 EDB system provided that the above-mentioned technical transfer of special know-how and personnel training for acquiring technical skill can be secured.

Admittedly Step 1 is relatively simple as an EDB system but if the three above mentioned functions -- compilation of energy statistic tables, of energy balance tables and computation of medium-range supply-demand projection as their application – are workable, it can be considered as having attained sufficiently useful level as an EDB system. Further, by having an experience of building, maintaining and operating an EDB system of this level, you can acquire various know-how which in turn enable you to make improvements such as supplementing insufficient data and preparing for moving on to a higher level of sophistication.

b) Oil-Energy Supply-Demand Projection Method and Required Data Level

The three basic functions in the above-mentioned Step 1 are closely related to each other. As regards the compilation of statistical table, MIGAS and Pertamina already possess quite detailed statistics on oil production, refining, sales and trade. There are some insufficiencies concerning transport and consumption data. As regards energies other than oil, considerable data can be obtained on coal and electricity. However, generally speaking, data on energy consumption in each sector with any coordination are hard to come by.

In conclusion, we consider it possible to obtain from the Step 1 EDB various useful statistic tables in monthly, quarterly and annually arranged time series centering on oil, gas with officially announced data on other energies added. The energy balance table will be indispensable for analyzing the total situation of energy of a nation for it will enable one to grasp relations between consumption, import and export, conversion and ultimate consumption of energy arranged according sector and kind of energy. An analysis of supply-demand structure under such matrix is basic for supply-demand projection.

If energy balance tables arranged in time series are stored in EDB system, supply-demand projections employing various statistical methods such as regression analysis can be conducted immediately. The system can be ordered to present results of supply-demand projection in the form of a future energy balance table. Energy balance tables come in various degrees of precision from rough to high precision, with each serving special purpose. In the case of Indonesia, it will not be easy to complie detailed energy balance tables in view of restrictions in acquisition of statistics and the present energy supply-demand structure. However, we consider it possible to obtain an energy balance table of sufficient usefulness on the basis of available data by incorporating certain degree of estimates on those unavailable ones. By compiling such a balance table and making it more precise, compiling and expanding Indonesia's energy statistics will progress in the right direction.

In Indonesia, there is a very strong desire to improve energy supply-demand projection centering on oil. In making a projection, it is important to properly recognize that 1) the energy supply-demand structure and future elements of changes, 2) the accuracy and range of statistical data, and 3) projection method and computing system, are closely interrelated. The Indonesian social economy is in the dinamic process of development from a simple structure to a complex one. In accordance with the development, the growth rate of energy consumption is high and its supply-demand structure is rapidly changing. The Indonesian government is rightly promoting a policy of switching its energy supply from the present heavy dependence on oil, especially kerosine, and gas oil, to coal, natural gas and such renewable energy sources as lumber. Under such circumstances, a much better results on supply-demand projection can be obtained by projecting changes in supply-demand structure on economic development, sector and energy source by a combination of macro-economic data and energy balance table than by conducting projection on each oil product under different method or formula.

And it will open way for developing policy simulation models such as best energy switch programs in the future.

c) Step 2 (Shift to a sophisticated EDB system employing DBS)

While bettering skill in obtaining statistical table, balance table and supply-demand projection from a simple EDB system under Step 1, it will become easier, if wider range of energy data become available, to start preparations for a shift to a more sophisticated EDB system employing DMS (data management system). DMS may be considered as a general designation of a software package for operating energy data of far greater volume than involved in Step 1.

Pertamina already posseses IMS (information management system), an IBM-developed software for DMS. As a similar software, there is TOTAL to be used for IMP hardware. Also, DMS software for various types of EDB are being developed in Japan and other countries. There is a need for careful study on what type of DMS software should be introduced into Indonesia for its EDB system. We have received an impression that IMS was too large in scale and too complex to be adopted for EDB.

When the EDB system in Step 2 is established, it will greatly contribute, by using a wide range of data including those on international relations, to run energy switch policy simulations, oil refining or transport model, and world or ASEAN oil-energy trade models. These will be of great help in drafting and enforcing Indonesian economic programs and energy programs. This sophisticated EDB system can be expected to link with numerous terminals and developed into on-line system in the future.

II. Detailed Exposition

1. Data and Statistics on Oil and Gas

1–1 Data Collecting Organizations and Data Flow

1–1–1 Main Organizations in Pertamina and MIGAS

There are two organizations in charge of collecting and managing various data and statistics concerning oil and gas; one is Pertamina. The Indonesian State Oil and Gas Enterprise and the other is MIGAS in the Ministry of Mine and Energy which supervises Pertamina. The structure of Pertamina, as shown in the Fig. 1–1–1, basically consists of the six directorates, Exploration and Production, Processing and manufacturing, Domestic Supply, Shipping and Telecommunication, Finance, and General Affairs. The five domestic area cordinater offices in Medan, Plaju, Surabaya, Balikpapan, Ujung Pandang are also playing an important role in collecting data. In addition, Pertamina has divided the domestic market into eight supply regions for the purpose of controlling supply-and-demand of oil and gas products. The eight supply regions are roughly as follows: No. 1 Supply Region covers the northern half of Sumatra and has Dumai Refinery in its region. No. 2 Supply Region covers the southern half of Sumatra and has Musi Refinery in its region. No. 3 Supply Region covers the western Java where Jakarta is located, and also West Kalimantan. No. 4 Supply Region covers the central Java and has Cilacap Refinery which stands first throughout the nation. No. 5 Supply Region covers the eastern Java and also eastern area of Kalimantan and has Balikpapan Refinery in its region. No. 6 Supply Region covers the further eastern side beyond Kalimantan, No. 7 Manado Supply Region covers north Surawesi, and No. 8 Supply Region covers the area where Irian-Java is located as the central figure.

Therefore, the statistics and data on the production and sales of the products in these Supply Regions are collected periodically by the Main Office of Pertamina through Regional Offices. In addition, there are a comparatively large-scale seafed depot and a smale-scale inland depot in inland area in each Supply Region, and statistics and data on inventory and others are directly forwarded to Jakarta.

Now, as to the Ministry of Mines and Energy, the former Ministry of Mines was renamed the Ministry of Mines and Energy in 1978 as a result of a reorganization, and is expected to become a more effective organization now that it is equipped with the two functions of mines and energy. The structure of the Ministry of Mines and Energy is as shown in the Fig. 1–1–2 and it consists of Directorate of Finance, Directorate of General Affairs, Directorate of Mines Directorate of Oil and Gas, and Directorate of Power. Of these, the newly established Directorate of Power is to be further expanded in future and so far it has been sufficiently developed to function effectively.

Of these directorates, the one which will play the chief role in establishing the Data Bank is Directorate of Oil and Gas (MIGAS). Internal structure of MIGAS consists of Exploration and Production Department, Planning Department, Mineral Technology Department, Oil and Gas Technology Development Centre (LEMIGAS), and General Affairs Department.

Fig. 1-1-1 Organization Chart of Pertamina

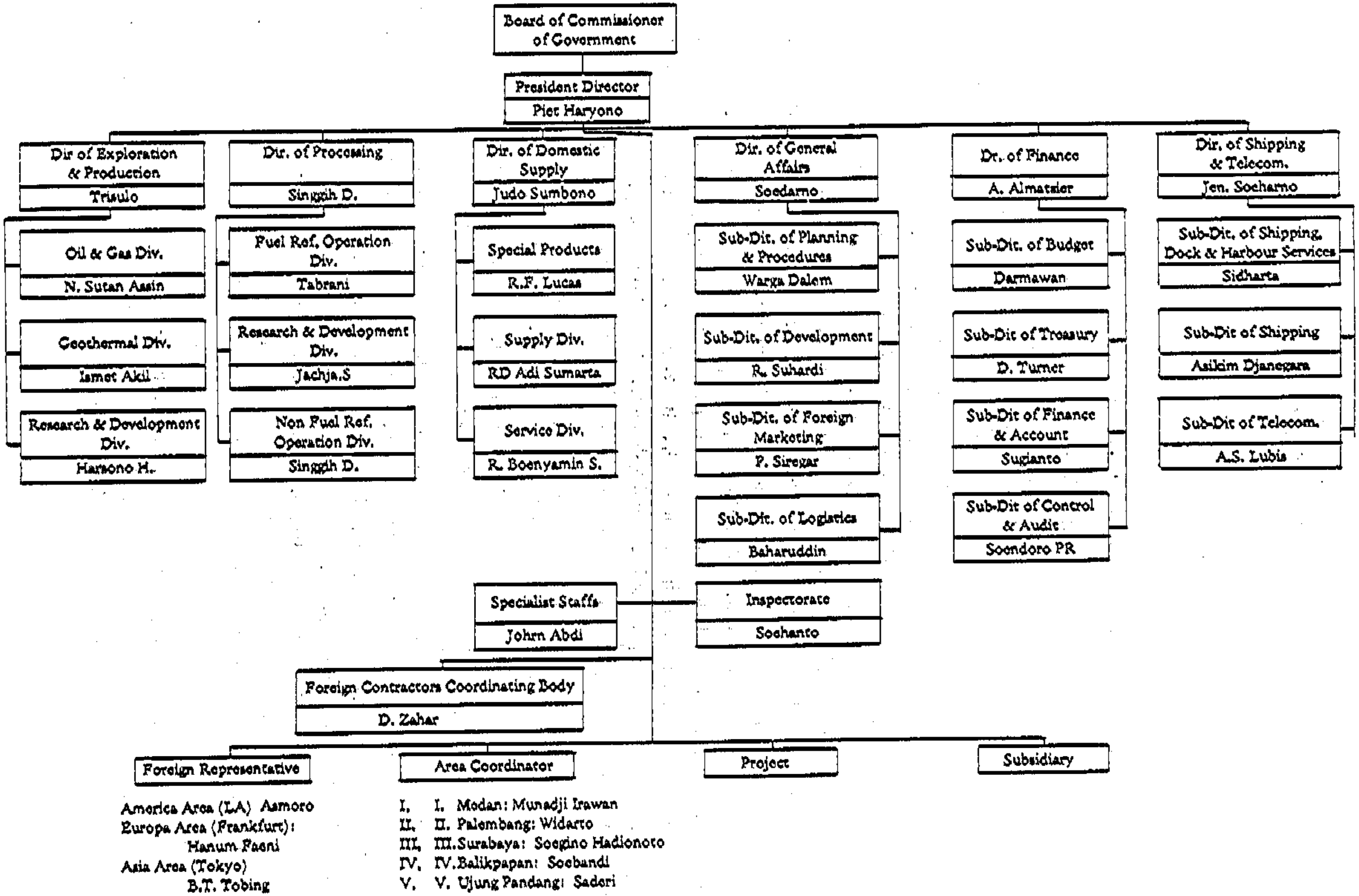


Table 1-1-1 Unit alloted to each directorate of Pertamina

(1) Units alloted to Directorate of Exploration & Production

Name of Unit	Location of Headquarters	Jurisdiction
I	P. Brandan	N. Sumatra, Ajeh
II	Plaju	E. & S. Sumatra, Riau, Jambi, Bengkulu, Lampung
III	Jakarta	Java, Madura, W. & E. Nusatenggara, W. Kalimantan
IV	Balikpapan	C. Kalimanta, S. Kalimanta, E. Kalimantan
V	Sorong	Sulawesi, Maluku, Irian Jaya

(2) Unit alloted to Directorate of Processing and Manufacturing

Name of Unit	Refinery and Plant under jurisdiction of the Directorate
I	P. Brandang Refinery, Rantau Carbon Black Plant, P. Susu Asphalt Plant, P. Susu Lub Plant
II	Refineries at Dumai and S. Pakning
III	Plaju Refinery, Polypropylene Plant, Asphalt Plant, S. Gerong Refinery
IV	Jatibarang LPG Plant, Cilacap and Wonokromo Refinery, Drum Plant. Asphalt Plant.
V	Balikpapan Refinery

(3) Unit alloted to Directorate of Domestic Supply

Name of Unit	Location of Headquarters	Jurisdiction
I	Medan	N. Sumatra, Ajeh
II	Palembang	Jambi, S. & C. Sumatra, Lampung, Benjkulu, Lahat, L. Linggau, Bangka–Baliton
III	Jakarta	DKI Jakarta, W. Java, W. Kalimantan
IV	Semarang	C. Java, Yogyakarta
V	Surabaya	E. Java, S.E. & C. Kalimantan, Madura, Bali W. Nusatenggara
VI	Ujung Pandang	S. & S.E. Sulawesi, Nusatenggara, Timor
VII	Menado	N. Central Sulawesi, Maluku
VIII	Jayapula	Irian-Jaya

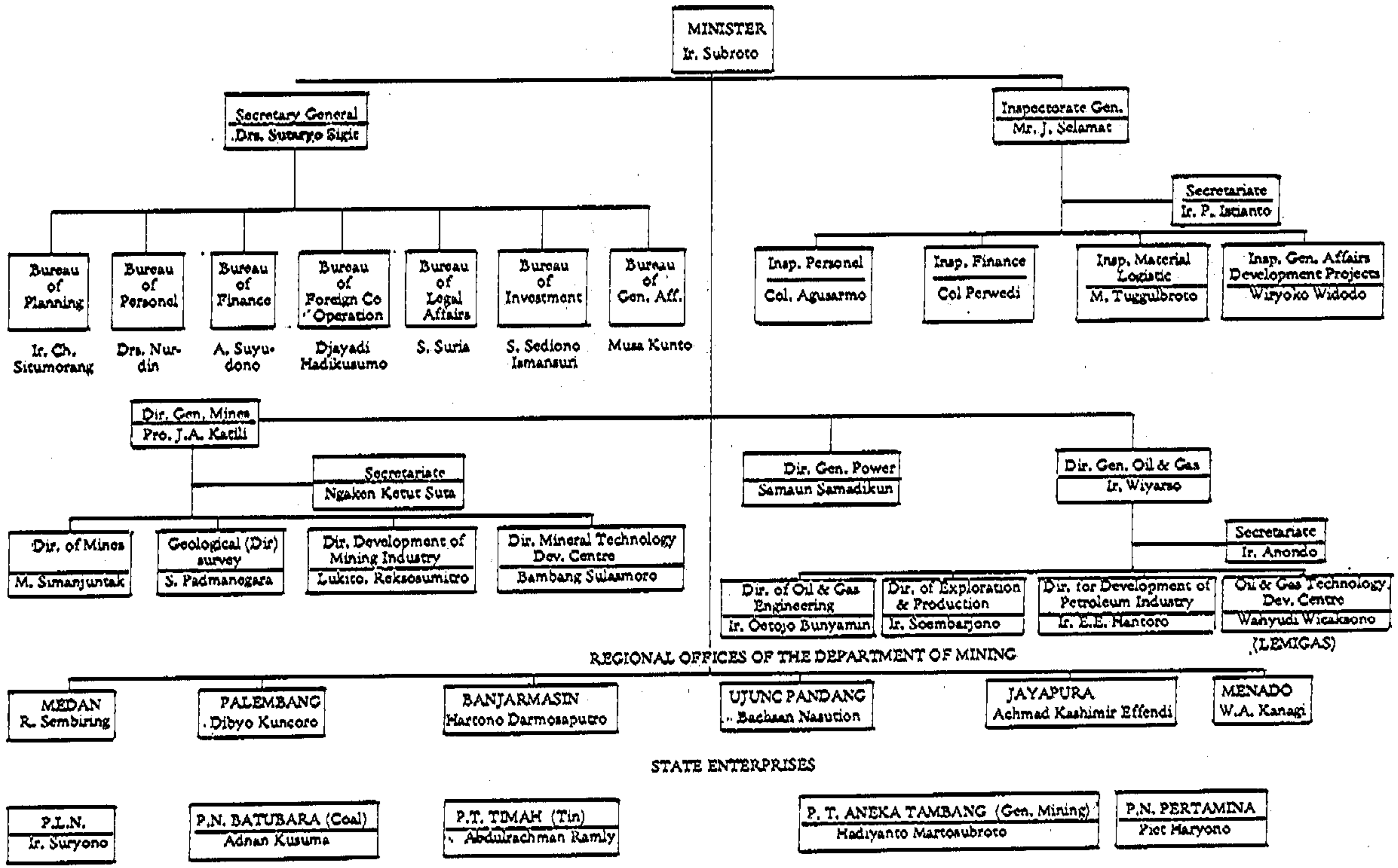
(4) Unit alloted to Directorate of Shipping & Telecom.

Name of Unit	Jurisdiction	Area of Activity
I	N. Sumatra	P. Susu, Belawan
II	Riau	Dumai, S. Pakning
III	S. Sumatra	Plaju./S. Gerong
IV	Jakarta	Tanjung Periok
V	Cilacap	Cilacap
VI	Kalimantan	Tarakan, Bunyu, Balikpapan

(5) Area Adjustment Unit

Name of Unit	Location of Headquarters	Jurisdiction
I	Medan	N. Sumatra, Aceh
II	Palembang	W. Sumatra, Riau, Jambi, Bengkulu, S. Sumatra, Lampung
III	Surabaya	Java, Madura, W. & E. Nusatenggara, W. Kalimantan
IV	Balikpapan	C. Kalimantan, S. Kalimantan, E. Kalimantan
V	Ujung Pandang	Sulawesi, Maluku: Irian Jaya

Fig. 1-1-2 Organization Chart of the Department of Mines & Energy

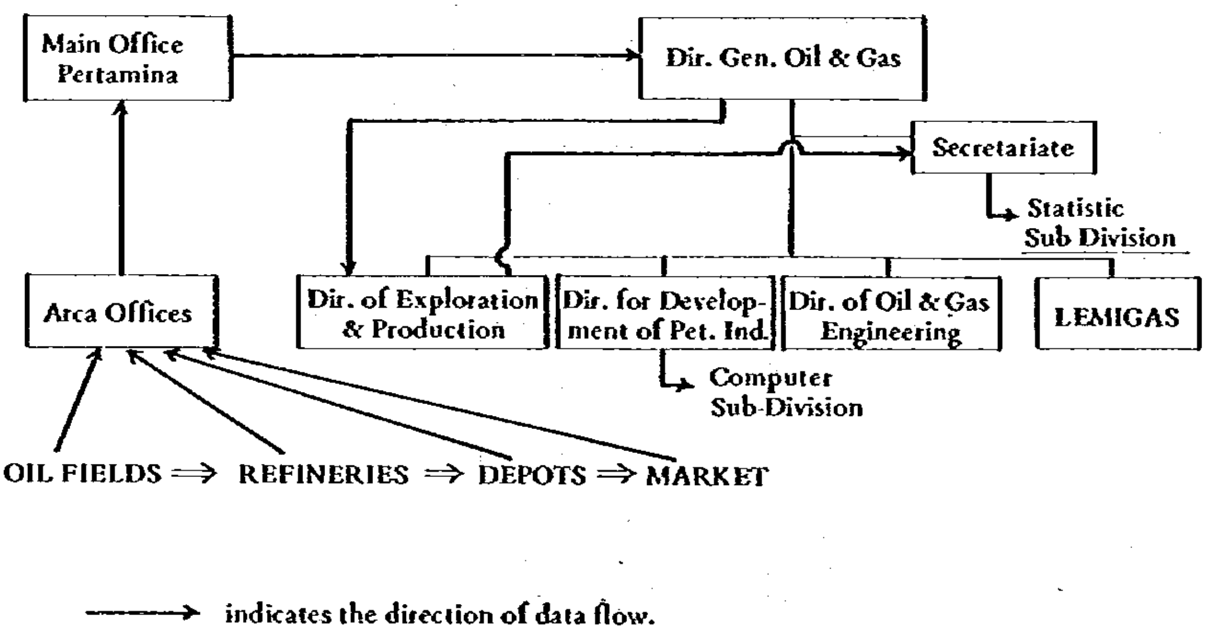


1–1–2 Data Collecting System

Basically all statistics and data on oil and gas are primarily collected through each organization of Pertamina. Namely, data and statistics on exploration and production of crude oil and natural gas are collected by Exploration and Production Department of Pertamina; Similarly all data and statistics on refinery are controlled by Processing Department. Data and statistics on domestic sales of products and supply are collected by Domestic Supply Department. Data and statistics collected in this manner are further prepared as statistical data on the basis of by month, by quarter, by half a year and by year, so that they can be utilized efficiently. At the same time, Pertamina is supplying these data and statistics to Directorate of Oil and Gas (MIGAS). These data are sent to Directorate General Oil and Gas in Ministry of Mine and Energy, then these are transferred to Directorate of Exploration & Production in order to process of these raw data. Moreover, these processed data are sent to Computer Sub-division, and then, they are conducted final procession and are utilized as the energy statistics at each directorate in MIGAS.

The summary of the above explanation concerning the data flow will be as shown in the Fig. 1-1-3.

Fig. 1-1-3 Summary of Oil and Gas Data Flow



The present situation is that it takes at least three or four months before raw data collected through the above mentioned route can be utilized in the form of issued statistics. Also, with regard to data processing in MIGAS, the computer is scarcely utilized.

As for statistical data on oil and gas currently made public, there are only two of them; one is "Indonesian Oil Statistics" issued quarterly by Pertamina, and the other is "Petroleum & Natural Gas Industry of Indonesia" issued monthly by MIGAS.

1–2 Kinds of Data and its Scope

1–2–1 Oil and Gas Production Data

Data on oil and natural gas production are collected on the basis of "by producing company, by oil field, by month," and as to some oil fields, "by well", too. However, data concerning oil fields of Pertamina itself are separately collected by each office of five Management and Administration Areas; Medan, Palembang, Surabaya, Balikpapan, and Ujung Pandang. As the breakdowns of the production data collected by each producing company, there are such items as (1) crude oil production by oil field, by month (barrel, ton), (2) natural gas production by oil field, by month (ton, f^3), (3) output of underground water by oil field, by month (barrel), (4) average daily output of crude oil by month, (barrel/day), (5) average specific gravity of crude oil by oil field (API degree), (6) average production ratio of crude oil vs. gas by oil field (f^3/barrel), (7) accumulated production of crude oil, gas and underground water by oil field (barrel/f^3/ton) and so on.

1–2–2 Sales Statistics of Oil Products

Sales statistics of oil products are collected monthly on the basis of (1) by product, (2) by sales sector, (3) by sales region. The "by product" sector is broken down into aviation gasoline, jet fuel, premium gasoline, regular gasoline, kerosene, motor gas oil, diesel oil and heavy fuel oil. Statistics by sales sector are classified into four items according to respective sales method; (1) direct sales to users, (2) sales to dealers, (3) own use, (4) for export. Aviation gasoline, jet fuel, diesel oil and heavy fuel oil are mostly sold directly to users. These users of directly sold products are roughly divided into such groups as aviation industry, agricultural sector, mining sector, governmental demand, munition sector and others. The kinds of oil products mostly handled by dealers are automobile gasoline, kerosene, and motor gas oil. The Sales Region is divided into eight regions; No. 1 Medan, No. 2 Palembang, No. 3 Jakarta, No. 4 Senarang, No. 5 Surabaya, No. 6 Ujung Pangang, No. 7 Manado, No. 8 Jayapura.

Table 1-2-1 and 1-2-2 are the data collecting formats currently used for showing marketing results of refined products by product and by sales region, and marketing result of gas oil sector and by sales region, respectively. These statistics have been prepared by Domestic Supply Department of MIGAS based on raw data submitted by Pertamina, and therefore not made public at present.

1–2–3 Various Statistics Concerning Refinery, Inventory and Distribution

(1) Statistics and data on oil refinery

The variety and scope of data on oil refining processes at the refineries are roughly as mentioned below.
(Refer to Chapter 3, Computer Utilization System at Refineries, for further details.) The oil refineries currently owned by Pertamina are Brandan (4,000 B/D) in North Sumatra, Plaju (110,000 B/D)

and Sungei Gerong (75,000 B/D) in South Sumatra (Plaju and Sungei Gerong are called Musi Refinery as one unit), Cilacap (110,000 B/D) in South Java, Wonokromo in East Java and Balik Papan Refinery Kalimantan. The operation of each refinery is conducted under the supervision of Processing Department of Pertamina Main Office, and various data are directly sent to the Main Office by each refinery. The kinds of data which can be utilized are as follows; The volume and kind of crude oil through put by month, the volume and kind of profuct by month, both of them are prepared as monthly operation records, inventory at the beginning and at the end of a period by oil type, technical data, data on cost and budget, and statistics concerning products shipping.

These various data and statistics are collected by month, by quarter, by year, and sent to the Main Office.

(2) Inventory Statistics and Product Distribution Statistics

There are nearly 60 oil depots in Indonesia including refineries, seafed depots and comparatively small-scale inland depots all owned by Pertamina, and statistics and data on the shipping and inventory by product are sent to the Main Office periodically every month. However, there is approximately a three-months time lag before raw data can be utilized as statistical data.

On the other hand, statistics on product distribution are extremely insufficient at the present stage. Namely, statistics and data concerning 1) distribution volume by product and by transportation medium and 2) distribution cost by product and by transportation medium, between each refinery and depot and from a refinery/depot to an user/dealer are scarcely collected. The biggest reason for this is that all whole-sale prices of the products sold on domestic markets are regulated by the government and even some of retail prices are standardized throughout the nation in case of the same oil type. The price structure being as above, the market price cannot precisely reflect the distribution cost. Accordingly, distribution costs of the products are unified making it difficult to collect actual data concerning products distribution.

1–3 Various Problems Involved in the Process of from Collecting Data through Data Utilization

Oil and gas data collected through Pertamina are production/marketing data all taken from the supply side, and they are considerably well prepared in so far as they are to be. However, as mentioned in the above 1–2–3, among various data concerning product supply, the one concerning product distribution is scarcely collected at present, and improvement of this particular aspect will be needed first.

Distribution statistics including transportation cost are needed firstly in order to decide a refinery capacity and the site location when a new refinery is to be built or when an expansion plan is to be implemented. Distribution statistics are also necessary for efficiently supply from a refinery to depots in each supply area with products, to directly sell products to users, and to distribute products among several depots. The second problem is that various statistics concerning demand are currently made based on sales statistics prepared by Pertamina, and therefore the demand is treated as approximately equal to the supply on the assumption that the inventory is fixed at a certain level. In case of heavy fuel oil for generation of electric power and the manufacturing industry, buyers are rather restricted in number, and most of the products are directly sold by refineries or depots to users. In such a case, it can be assumed that the supply roughly equals to the demand. However, in case of such products as automobile gasoline, motor gas oil, and kerosene for household usage, it is usual that considerable

Table 1-2-1 Data Collecting Format of Oil Products Marketing by Region

OIL Products		UP I MEDAN	UP II PALEMBANG	UP III JAKARTA	UP IV SEMARANG	UP V SURABAYA	UP VI+UP VII U. PAN DANG + MANADO	UP VIII JAYAPURA	TOTAL	%
Domestic fuel oil	Avgas									
	Avtur									
	Supur 98									
	Premium									
	Kerosene									
	HSD									
	Diesel Oil									
	Fuel Oil									
	Sub Total									
INTERNATIONAL 1. UPLIFT	Avgas									
	Avtur									
	Sub Total									
2. BUNKER	HSD									
	Diesel Oil									
	Fuel Oil									
	Sub Total									
Total (A)										
Domestic Lubricating Oil	Aviation, Lubs									
	Auto Lubs									
International Aviation Lubs	Industrial Lubs									
Total (B)										
LPG / METHANOL MIXTURE DOMESTIC	LPG/ Propane Gas									
	Metha Mix									
INTERNATIONAL	Metha Mix									
Total (C)										
PETRO CHEMICAL	Asphalt									
	Waxes									
	Solvent									
	Chemical for Industry									
	Chemical for Agricultural									
	Plastic									
Total										

Table 1-2-2 Data Collecting Format of Diesel Oil Marketing by Region by Demand Sector (1)

	Group of Consumers	UP I MEDAN	UP II PALEMBANG	UP III JAKARTA	UP IV SEMARANG	UP V SURABAYA	UP VI+UP VII U. PAN DANG + MANADO	UP VIII JAYAPURA	TOTAL	%
	A. Domestic									
	End users									
101	Air Lines									
102	Transportation									
	a. Railway									
	b. Others									
103	Shipping Lines									
104	City Gas Company									
105	Electric Company									
	a. PLN (State Co.)									
	b. Non PLN									
106	Agricultural Company									
	a. Agriculture									
	b. Plantation									
	c. Forestry									
	d. Others									
107	Food & Beverage Co.									
	a. Suger Factory									
	b. YS Factory									
	c. Others									
108	Textile Company									
109	Rubber Company									
	a. Material Product									
	b. Finished Product									
110	Paper Company									
111	Chemical Company									
	a. Fertilizer Factory									
	b. Paints Factory									
	c. Others									
112	Mining Co.									
	a. Oil									
	b. Tin									
	c. Bauxit									
	d. Iron Sands									
	3. Others									

Table 1-2-2 Data Collecting Format of Diesel Oil Marketing by Region by Demand Sector (2)

	Group of Consumers	UP I MEDAN	UP II PALEMBANG	UP III JAKARTA	UP IV SEMARANG	UP V SURABAYA	UP VI+UP VII U. PAN DANG + MANADO	UP VIII JAYAPURA	TOTAL	%
113	Mining Finished Product Co.									
	a. Cement									
	b. Iron & Steel									
	c. Lime & Rooftile									
	d. Others									
114	Project & Construction Corp.									
	a. Highways & Bridges									
	Building Construction									
115	Work Shop Co.									
116	Equipment Industries									
	a. Heavy / Car									
	b. Telecomunication Equipment									
	c. Electric Equipment									
	d. Others									
117	Small Wares Co.									
118	Government Authority									
119	Non Government									
120	Indonesian Forces									
	a. Army Forces									
	b. Navy Forces									
	c. Air Forces									
	d. Police									
	Total (I)									
II	Agents									
	Motor Gasoline									
	a. Service Station for Public Affairs									
	b. Non Public Affairs									
	Total (II)									
III	Own Use									
301	Pertamina Domestic Supply									
302	Non Pertamina Domestic Supply									
	Total (I+II−III)									
	B. INTERNATIONAL									
	End User									
402	Shipping Co.									
	Total (B)									

time lag will occur between the supply volume and the demand volume. In this case, a sales volume of a particular month cannot be considered as the demand volume of the same month. In addition, the sales routes of the products which are sold to a great number of unspecified clients are very complicated in Indonesia; i.e., from refineries to seafed depots, from seafed depots to inland depots, then from inland depots to a certain number of sales agents. For example, in case of kerosene, the sales volume in each stage of sales routes (sales made by each dealer) cannot be immediately regarded as final demand volume. Thus, it will be necessary to prepare data on demand itself independently of the marketing data. But collection of any data concerning demand usually involves considerable difficulties, and therefore it is important to establish a data collecting system with a long-term prospect. As a concrete method of the demand survey the most popular one is survey of actual condition about individual users who will be selected from many users through the sampling method. Of the information obtainable from this survey, even only very general ones can be considered as followed:

Automobile gasoline:

description, type, total exhaust gas, business of private, monthly mileage, frequency of use by month, gasoline consumption by month, frequency of filling by month, name of gas station (other items in case of a private car will be 1) income level, 2) family structure and ages, 3) occupation of householder, 4) number of drivers and 5) others.

Kerosene for household use.

Kerosene consumption by month, by usage (for cooking, for lighting, for hot-water supply, for others), presence of other competitive energy sources (electric light, municipal gas, LPG, firewood and charcoal, others), the amount of money paid for kerosene by month, main place of purchasing of kerosene, the amount of money spent for the purchase of energy sources other than kerosene, family structure, house structure, occupation of householder, income level, others.

A comprehensive marketing strategy including a depots construction plan will be established by periodically collecting above mentioned information based on a certain number of samples and by analyzing them.

Through the survey of the demand trend, it will also be possible to read changes in short and medium term demand patterns, and therefore an excellent result can be expected in filling the gap between the demand and supply of kerosene, which has always been a problem in Indonesia.

The third problem concerns with the time needed for data processing. Though it varies depending on the kinds of data, it takes approximately 3–4 months before raw data collected become statistical data after processing, and can be utilized. However, in view of efficient utilization of statistics, more speedy data processing is necessary; it is desired that monthly data be processed within 2 months at the latest. It goes without saying that statistical data may have significance only when they are actually used. For example, in order to grasp the demand-supply trend quickly so that a short term operational strategy of either production increase or production decrease can be decided, more speedy preparation of statistical data and offering them to the people concerned will be very important. Systematization of the process from data collection to preparation of processed statistical data is the problem to be tackled in future, and it is expected that as the Data Bank System currently being planned develops, most of the problems pointed out as above can be solved.

1–4 Measures for the Establishment of the Data Bank

1–4–1 Outlines of OARS System in MIGAS

Current conditions of oil and gas data from data collection through to utilization, which are mainly carried by MIGAS and Pertamina, and various problems involved in this matter are as mentioned above. On the other hand, MIGAS has been trying to improve a system which deals with collection, filing and finally utilization of oil and gas data since the beginning of 1978. This data collecting system is called OARS (Oil Activities and Revenue System – a data collecting system which deals with activities and finance of the oil industry) System, and a preparation program is set forward with the anticipated opening in 1979. However, this OARS System is a data collecting system which is required by MIGAS itself for its business administration, and accordingly the content of input is a detailed one in line with the system's purpose. Therefore, the nature of the system should be distinguished from the concept of the Energy Supply-Demand Data Bank System. However, this OARS System is a considerably improved system when compared to former data collecting methods employed by MIGAS and Pertamina in that it presupposes computerization of data file. Thus, it can be fully expected that such an approach method like OARS System will be helpful in establishing Energy Data Bank in future. Now, the outlines of the OARS System are as follows: The OARS System was originally planned with the aims that firstly MIGAS may effectively control and make plans about its activities in such fields as exploration, exploitation, production of crude oil, refinery, transportation, and sales, and secondly MIGAS may collect data from the oil industry in order to make various kinds of records. Accordingly, the system is expected to make timely offer of correct information to each organization in MIGAS in a certain form. For this, in the course of the development of OARS System, an investigation was made as to what kinds of data service are required within MIGAS.

Table 1-4-1. OARS IMPUT FORMS

I. EXPLORATION, EXPLOITATION AND COST.

No.	:	Form No.	:	Form Name
1.	:	D O A	:	Annual/Monthly Budget and Work Program.
2.	:	D 1 A	:	Monthly Crude Production Forecast.
3.	:	D 2 A	:	Quarterly/Yearly Crude Production Forecast.
4.	:	D 3 A	:	Annual Crude Lifting Program.
5.	:	D 3 B		
6.	:	D 4 A - D 4 B	:	Survey Activity.
7.	:	D 5 A	:	Exploration/Development Drilling Activity.
8.	:	D 5 B		
9.	:	D 5 C		
10.	:	D 6 A - D 6 B	:	Well Completion Report.
11.	:	D 6 C - D 6 F		
12.	:	D 6 G - D 6 H		
13.	:	D 7 A - D 7 B	:	Monthly Crude Delivery Log.
14.	:	D 8 A - D 8 B	:	Production, Distribution, Own Use And Inventory.
15.	:	D 9 A	:	Monthly Well Report.
16.	:	D 9 B		
17.	:	D 9 C		
18.	:	D10A - D10B	:	Monthly Gas Production and Utilization.
19.	:	D11A - D11B	:	Monthly Expenses and Operating Cost.

II. REFINERY

No.	:	Form No.	:	Form Name
1.	:	P 0 A	:	Annual Refinery Forecast Crude Allocation.
2.	:	P 0 B		
3.	:	P 1 A	:	Monthly Refinery Receipt Log.
4.	:	P 2 A	:	Monthly Refinery Delivery Forecast.
5.	:	P 3 A - P 3 D	:	Monthly Refinery Intake Summary.
6.	:	P 3 B - P 3 G	:	Monthly Refinery Output Summary.

III. MARKETING

No.	:	Form No.	:	Form Name
1.	:	S 0 A	:	Monthly Domestic Marketing Requirement Forecast.
2.	:	S 0 B		
3.	:	S 1 A	:	Monthly Domestic Marketing Receipt Log.
4.	:	S 2 A	:	Monthly Domestic Marketing Delivery Log.
5.	:	S 3 A	:	Monthly Domestic Marketing Sales.
6.	:	S 4 A	:	Monthly Export Realization.
7.	:	S 5 A	:	Monthly Import Realization.

Table 1-4-2 ANNUAL/MONTHLY BUDGET AND WORK PROGRAM

(IN THOUSANDS US$)

FORM NUMBER	(1-3)	D A	FOR YEAR/MONTH (4-7)	YEAR	MONTH	COMPANY NAME
COMPANY CODE	(8-11)					AUTHORIZED SIGNATURE COMPANY / DATE
CONTRACT AREA CODE	(12-15)					AUTHORIZED SIGNATURE D M G B / DATE

LINE CODE (16-17)	ACTIVITY	(18-19)	VOLUME OF ACTIVITY (20-24)	CAPITAL: MOVABLES (25-29)	CAPITAL: NON MOVABLES: DRILLING EQUIP-MENT (30-34)	CAPITAL: NON MOVABLES: FACILITIES (35-38)	CAPITAL: NON MOVABLES: HOUSING (39-42)	CAPITAL: NON MOVABLES: ALL OTHER (43-46)	CAPITAL: TOTAL (47-51)	NON CAPITAL: WAGES SALARIES (52-56)	NON CAPITAL: EQUIP-MENT MATERIAL SUPPLIES (57-61)	NON CAPITAL: SUB CONTRACT (62-66)	NON CAPITAL: ALL OTHERS (67-70)	NON CAPITAL: TOTAL (71-75)	TOTAL COST (76-80)
	EXPLORATION														
01	SURVEY: AIR BORN (KM²)	01													
02	GEOLOGIC (KM²)	02													
03	SEISMIC (KM)	03													
04	GRAVITY (KM)	04													
05	MAGNETIC (KM)	05													
06	OTHERS	06													
07	WELLS: PREPARATION	07													
08	DRILLING	08													
09	COMPLETION	09													
10	OTHER	10													
11	OTHER	11													
12	TOTAL EXPLORATION	12													
	EXPLOITATION														
13	DEVELOPMENT: PREPARATION	13													
14	DRILLING	14													
15	COMPLETION	15													
16	OTHER	16													
17	PRODUCTION: SUPORTING PROJ	17													
18	PROD FACILITIES	18													
19	WORK OVER	19													
20	WELL SERVICE	20													
21	OTHER	21													
22	SECONDARY RECVERY FACILITIES	22													
23	OTHER	23													
24	OTHER	24													
25	TOTAL EXPLOITATION	25													
26	OFFICE SERVICE/ADM	26													
27	DEPRECIATION	27													
28	TOTAL COST	28													

Table 1-4-3 ANNUAL CRUDE OIL PRODUCTION FORECAST
(BY MONTH)

PAGE OF

FORM NUMBER	(1-3)	D 1 A
COMPANY CODE	(6-9)	
CONTRACT CODE	(10-13)	

FOR YEAR OF (4-5)

COMPANY NAME	
AUTHORIZED SIGNATURE COMPANY	DATE
AUTHORIZED SIGNATURE D M G B	DATE

LINE CODE (14-15)	FIELD NAME	FIELD CODE (16-19)	PRODUCTION FORECAST (MBOPCD) JAN (20-24)	FEB (25-29)	MARCH (30-34)	APRIL (35-39)	MAY (40-44)	JUNE (45-49)	JULY (50-54)	AUGST (55-59)	SEP (60-64)	OCT (65-69)	NOV (70-74)	DEC (75-79)
01														
02														
03														
04														
05														
06														
07														
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09														
10														
11														
12														
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25														
26														
27														
28														
29														
30														

Table 1-4-4 MONTHLY CRUDE DELIVERY LOG.

1 FORM NUMBER	(1-3)	D 7 A	2 FOR YEAR MONTH (4-7)	YEAR	MONT	3 COMPANY NAME
4 COMPANY CODE	(8-11)					5 AUTHORIZED SIGNATURE COMPANY / 6 DATE
7 CONTRACT CODE	(12-15)					8 AUTHORIZED SIGNATURE D.M.C.B. / 9 DATE

		NAME	CODE	NAME	CODE	NAME	CODE	NAME	CODE	NAME	CODE	NAME	CODE
10 LINE	(16-17)		0 1		0 2		0 3		0 4		0 5		0 6
11 DATE DAY/MO/YEAR	(18-23)												
12 CRUDE	(24-27)												
13 GRAVITY (API)	(28-31)												
14 SHIPPED TO REFINERY	(32-35)												
15 VOLUME SHIPPED (BBL)	(36-44)												
16 PRORATE	(45-53)												
17 INKIND TO PERTAMINA	(54-62)												
18 LOCAL SALES	(63-71)												
19 OTHER SALES	(72-80)												
20 FORM NUMBER (CUBLICATE PUNCHER COLUMN)	(1-3) (4-17)	D 7 B		D 7 B		D 7 B		D 7 B		D 7 B		D 7 B	
21 VOLUME EXPORT	(18-26)												
22 EXPORT DESTINATION	(27-30)												
23 TRANSPORTATION METHOD	(31-34)												
24 VESEL	(35-38)												
25 PORT LOADING	(39-42)												
26 ARRIVAL TIME DATE/HOUR/MINUTE	(43-48)												
27 SAILED DATE/HOUR/MINUTE	(49-54)												
28 NAME NO OF PIER/MOORING POST	(55-60)												
29 ARRIVAL TIME AT MOORING POST DATE/HOUR/MINUTE	(61-66)												
30 DURATION AT MOORING POST (HOUR/MINUTE)													

Table 1-4-5 MONTHLY GAS PRODUCTION AND UTILIZATION

1 FORM NUMBER (1-4) D 1 0 A	2 FOR YEAR/MONTH (5-8)	YEAR MO.	3 COMPANY NAME
4 COMPANY CODE (9-12)	5 AUTHORIZED SIGNATURE DMGB	6 DATE	7 AUTHORIZED SIGNATURE-COMPANY / 8 DATE

NAME OF EACH FIELD	9 FIELD NAME	9 FIELD NAME	9 FIELD NAME	9 FIELD NAME	9 FIELD NAME
10 LINE CODE (13-14)	0 1	0 2	0 3	0 4	0 5
11 FIELD CODE (15-18)					
12 TOTAL GAS PRODUCED MCF/MO (19-28)					
13 FUEL GAS MFC/MO (29-38)					
14 GAS AS GASOLINE MFC/MO (39-48)					
15 GAS LIFT GAS MFC/MO (49-58)					
16 GAS INJECTION MFC/MO (59-68)					
17 TOTAL GAS OWN USE MFC/MO (69-78)					
18 FORM NUMBER (1-4) (KEYPUCH: DUP. COLS (5-18)	D 1 0 B	D 1 0 B	D 1 0 B	D 1 0 B	D 1 0 B
19 GAS SALES TO PUSR MFC/MO (19-28)					
20 GAS SALES TO KRAKATAU STEEL MFC/MO (29-38)					
21 GAS SALES TO KUJANG MFC/MO (39-48)					
22 GAS SALES TO LPG MFC/MO (49-58)					
23 GAS SALES TO LNG MFC/MO (59-68)					
24 FORM NUMBER (1-4) (KEYPUCH DUP.COLS (5-18)	D 1 0 C	D 1 0 C	D 1 0 C	D 1 0 C	D 1 0 C
25 GAS SALES TO PGN MFC/MO (19-28)					
26 GAS SALES TO CARBON BLACK MFC/MO (29-38)					
27 GAS SALES TO REFINERY MFC/MO (39-48)					
28 GAS SALES TO OTHERS MFC/MO (49-58)					
29 TOTAL GAS LOSSES AND FLARE MFC/MO (59-68)					

Table 1-4-6 MONTHLY REFINERY OUTPUT SUMMARY

1 FORM NUMBER (1-3) P S E	2 FOR YEAR/MONTH (4-7) YEAR MONTH	3 REFINERY NAME		
4 REFINERY CODE (8-11)		5 AUTHORIZED NAME REFINERY	6 DATE	
		7 AUTHORIZED NAME DMGB	8 DATE	

			AVGAS	AVTUR	MOGAS	KEROSINE	ADO	IDO	FUEL OIL	POD	WAX
9	PRODUCT NAME →		AVGAS	AVTUR	MOGAS	KEROSINE	ADO	IDO	FUEL OIL	POD	WAX
10	LINE CODE	(12-13)	1 9	2 0	2 1	2 2	2 3	2 4	2 5	2 6	2 7
11	STOCK CODE	(14-17)									
12	OPENING STOCK	(18-26)									
13	TOTAL RECEIPTS. No.	(27~30)									
14	TOTAL RECEIPTS VOLUME	(31-39)									
15	USED IN PRODUCTION	(40-48)									
16	LOSSES/OWN USE	(49-58)									
17	REF PRODUCT	(59-66)									
18	FORM NUMBER		P S F	P S F	P S F	P S F	P S F	P S F	P S F	P S F	P S F
19	TOTAL DELIVERIES NO.										
20	TOTAL DELIVERIES VOLUME										
21	CLOSING STOCK										

		LSWR	WHITE SPIRITE	SOLVENT	ASPHALT	NAPHTA				
22	PRODUCT NAME →	L S W R	WHITE SPIRITE	SOLVENT	ASPHALT	NAPHTA				
23	FORM NUMBER	P S G	P S G	P S G	P S G	P S G	P S G	P S G	P S G	P S G
24	LINE CODE	2 8	2 9	3 0	3 1	3 2	3 3	3 4	3 5	3 6
25	STOCK CODE									
26	OPENING STOCK									
27	TOTAL RECEIPTS NO									
28	TOTAL RECEIPTS VOLUME									
29	USED IN PRODUCTION									
30	LOSSES/OWN USE									
31	REF PRODUCT									
32	FORM NUMBER	P S H	P S H	P S H	P S H	P S H	P S H	P S H	P S H	P S H
33	TOTAL DELIVERIES NO.									
34	TOTAL DELIVERIES VOLUME									
35	CLOSING STOCK									

Table 1-4-7 MONTHLY DOMESTIC MARKETING DELIVERY LOG

PAGE 1 OF 1

FORM NUMBER (1-3)	S I A	FOR YEAR/MONTH (4-7)	YEAR	MONTH	INSTALLATION/DEPOT NAME
MARKETING REGION (8-11)	U P				AUTHORIZED SIGNATURE-UP / DATE
DEPOT CODE (12-15)					AUTHORIZED SIGNATURE-DMGB / DATE

LINE (16-17)	DATE (18-23) DAY MO YEAR	NAME OF STOCK	STOCK CODE (24-27)	NET VOLUME (28-36)	UNIT OF MEAS (37-39)	SUPPLIER NAME	SUPPLIER CODE (40-43)	TRANS METHOD (44-47)	VESSEL NAME	VESSEL CODE (48-51)	FLAG	FLAG CODE (52-55)	LOADING PORT	PORT CODE (56-59)
01														
02														
03														
04														
05														
06														
07														
08														
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25														
26														
27														
28														

Table 1-4-8 MONTHLY DOMESTIC MARKETING DELIVERY LOG

FORM NUMBER (1-3)	S 2 A	FOR YEAR/MONTH (4-7)	YEAR / MONTH	INSTALLATION/DEPOT NAME
MARKETING REGION (8-11)	U P		AUTHORIZED SIGNATURE-UP	DATE
DEPOT CODE (12-15)			AUTHORIZED SIGNATURE-DMGB	DATE

LINE 16-17	DATE (18-23) DAY MO YEAR	NAME OF STOCK	STOCK CODE (24-27)	NET VOLUME (28-36)	UNIT OF MEAS (37-39)	BUYER NAME/ DESTINATION	BUYER CODE (40-43)	TRANS METHOD (44-47)	VESSEL NAME (FOR SEA ONLY)	VESSEL CODE (48-51) (FOR SEA ONLY)	FLAG (FOR SEA ONLY)	FLAG CODE (52-55)
01												
02												
03												
04												
05												
06												
07												
08												
09												
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Table 1-4-9 MONTHLY EXPORT REALIZATION OF CRUDE OIL/PRODUCT

FORM NUMBER (1-3)	S 4 A	FOR YEAR/MONTH (4-7)	YEAR	MONTH	COMPANY NAME	
COMPANY CODE (8-11)					AUTHORIZED SIGNATURE-COMPANY	DATE
U.O CONTRACT CODE (12-15)					AUTHORIZED SIGNATURE-DMGB	DATE

	NAME	CODE	NAME	CODE	NAME	CODE	NAME	CODE	NAME	CODE	NAME	CODE
LINE (16-17)		0 1		0 2		0 3		0 4		0 5		0 6
CRUDE/PRODUCT (18-21)												
VOLUME (BARRELS)												
PERT. SHARE (22-30)												
CONTR. SHARE (31-39)												
UNIT OF MEAS (40-42)												
LOADING PORT (43-44)												
B/L DATE DAY/MO/YEAR (47-52)												
BUYER (53-56)												
DESTINATION (57-60)												
VESSEL (61-64)												
FLAG (65-68)												
UNIT PRICE US$ (69-73)												

Table 1-4-10 MONTHLY IMPORT REALIZATION OF CRUDE OIL / PRODUCT

FORM NUMBER	(1-3)	S 4 A	FOR YEAR/MONTH (4-7)	YEAR | MONTH	COMPANY NAME
COMPANY CODE	(8-11)				AUTHORIZED SIGNATURE-COMPANY | DATE
U.O CONTRACT CODE	(12-15)				AUTHORIZED SIGNATURE-DMGB | DATE

		NAME	CODE	NAME	CODE	NAME	CODE	NAME	CODE	NAME	CODE	NAME	CODE
LINE	(16-17)		0 1		0 2		0 3		0 4		0 5		0 6
CRUDE/PRODUCT	(18-21)												
VOLUME (BBLS)	(22-30)												
UNIT OF MEAS	(31-33)												
RECEIPT DATE DAY/MO/YEAR	(34-39)												
UNLOADING PORT	(40-43)												
LOADING PORT	(44-47)												
VESSEL	(48-51)												
FLAG	(52-55)												
UNIT PRICE US $	(56-60)												
FREIGHT US $	(61-65)												
INSURANCE US $	(66-70)												
C.I.F. US $	(71-75)												

The first thing which has been done as a result of this investigation was the standization of the requests made by various sections to this new information system. Also discussed was the possibility of centralization of the data processing system so that economy and efficiency may be attained by using the new method.

The role of the information system planned under such circumstances will be first to centralize the process and operation in recording, storing, processing, retrieving, and transmitting data, corresponding to legal and/or transactional requests. At the same time, the system will be expected to offer supporting information at the time of establishing a management plan, administration, and decision-making, and also to offer information in order to materialize the requests made by outside organizations.

The second item to be examined is to decide the forms of input and output data, and process of data collection under this system has been decided as follows: Namely, (1) the form of data input format, (2) the content of the format, (3) schedule, (4) confirmation of what will be required of legally and by transaction, (5) technical and administrative problems concerning the records obtainable from the system. The third item will be to decide the content of input and output data in this system, method of data filing, and the process which will be required to support the computer program and the system.

The concept of the data processing cycle currently being planned consists of four categories: (1) the updating cycle of input data table, (2) the updating cycle of master file, (3) editing and its updating cycle, and (4) the cycle of data report.

1–4–2 The Data Input Form to be Used in the QARS System

The table No. 1–4–1 (I, II, III) shows the items to be put on the data input format currently discussed by the QARS System in MIGAS. Of these items, from No. 1 to No. 19 under the I deal with oil exploitation, production and transportation except No. 18 which deals with gas production and utilization, from No. 1 to No. 6 under the II deal with oil refinery, and from No. 1 to No. 7 under the III are the input items concerning the marketing data of the products.

The table Nos. from 1–4–2 to 1–4–10 are some of the input formats shows as samples. These formats are directly distributed to individual enterprises by MIGAS and the enterprises are to put down various data requested. The collected data lists will be re-written on the punch cards in order to install them in the computer. Therefore, this format serves both as an investigating form and a cording sheet. For this reason, each format is divided into the maximum 80 columns which is equivalent to the number of columns on the punch card so that a case of data can be punched on a sheet of card.

When raw data are collected in accordance with these forms in future, the time required for the total process of from data input to data utilization will be shortened remarkably.

1–4–3 Problems to be Solved for the Establishment of the Oil and Gas Data Utilization System

As mentioned above, the scheme of the OARS System aims at a remarkable improvement in the data collecting method compared with the previous methods taken in Indonesia. However, it is considered almost impossible to use in their original condition the data which will be collected by this system as data for the Data Bank because of the character of collected data. Now, the summary of the bais items in the oil and gas statistical data, especially those of supply-demand situation, which will be required for the establishment of the Energy Supply-Demand Data Bank System will be as follows:

First, the basic items in the "oil products data by product" will be sales by oil type by sector, export, import, production, inventory, whole sale and retail prices, and so on. Similar items will be applied for the gas data, and for the data on crude oil, the item will be production, processed volume, export volume, export/import prices, inventory, and so on.

Table 1-4-11 Supply Demand Data Items on Oil Products (1)

	Unit	Aviation Gasoline	Automobile Gasoline	Jet Fuel	Kerosene	Motor Gas Oil	Diesel Oil	Heavy Fuel Oil	Total Fuel Oil	Lubricating Oil	Grease	Other Products
Sales	kl (t)	o	o	o	o	o	o	o	o	o	o	o
(Direct Sales by Sector)												
Agriculture & Forestory Sector	kl (t)						o	o	o	o	o	o
Fishery Sector	"						o	o	o	o	o	o
Mining Sector	"						o	o	o	o	o	o
Construction Industry Sector	"						o	o	o	o	o	o
Manufacturing Industry Sector	"						o	o	o	o	o	o
Transportation Industry Sector	"	o	o	o		o	o	o	o	o	o	o
Energy Industry Sector	"						o	o	o	o	o	o
Service Industry Sector	"						o	o	o	o	o	o
Government Sector	"	o		o			o	o	o	o	o	o
Household Sector	"		o		o	o			o	o	o	
(Intermediate Sales to Dealers)	"		o		o	o	o	o	o	o	o	
Supplement Volume	"	o	o	o	o	o	o	o	o	o	o	o
Export	"	o	o	o	o	o	o	o	o	o	o	o
Export Volume	"	o	o	o	o	o	o	o	o	o	o	o
Export Amount	1,000$	o	o	o	o	o	o	o	o	o	o	o
Export Price	$/kl (t)	o	o	o	o	o	o	o	o	o	o	o
" "	Rp/kl (t)											
Production	kl (t)	o	o	o	o	o	o	o	o	o	o	o

Table 1-4-11 Supply Demand Data Items on Oil Products (2)

	Unit	Aviation Gasoline	Automobile Gasoline	Jet Fuel	Kerosene	Motor Gas Oil	Diesel Oil	Heavy Fuel Oil	Total Fuel Oil	Lubricating Oil	Grease	Other Products
Production Yield	%	o	o	o	o	o	o	o	o			
Import	kl (t)	o	o	o	o	o	o	o	o	o	o	o
Import Volume	"	o	o	o	o	o	o	o	o	o	o	o
Import Amount	1,000$	o	o	o	o	o	o	o	o	o	o	o
Import Price	$/kl (t)	o	o	o	o	o	o	o	o	o	o	o
" "	Rp/kl (t)	o	o	o	o	o	o	o	o	o	o	
Inventory	kl (t)	o	o	o	o	o	o	o	o	o	o	o
Inventory Ratio	%	o	o	o	o	o	o	o	o	o	o	o
Refinery	kl (t)	o	o	o	o	o	o	o	o	o	o	o
Depot	"	o	o	o	o	o	o	o	o	o	o	o
Sales Agent	"		o		o	o	o	o	o	o	o	o
Half-finished Product	"	o	o	o	o	o	o	o	o	o	o	o
Statistically Imcomplete	"	o	o	o	o	o	o	o	o	o	o	o
Whole-sale Price	Rp/kl (t)	o	o	o	o	o	o	o	o	o	o	o
Whole-sale Price Index	Standard Year=100	o	o	o	o	o	o	o	o	o	o	o

Remarks: (1) o shows the items considered to be necessary.
(2) Break-down of the sales sector will be made in accordance with the actual situation.

Table 1-4-12 Supply Demand Data Items on Crude Oil and Gas

[Liquified Petroleum Gas]	Unit	[Natural Gas]	Unit	[Crude Oil]	Unit
Demand	t	Demand	$10^3 m^3$	Processed Volume	kl (B/D)
For Chemical Industry Material	"	For Chemical Industry Material	"		
For Industry Fuel	"	For Industry Fuel	"	Production	"
For Automobile	"	For Municipal Gas	"		
For Municipal Gas	"			Export	
For Household Fuel	"	Production	"	Export Volume	"
				Export Amount	$
Production	"	Export (LNG)		Export Price	$/kl
Refinery	"	Export Volume	t	" "	Rp/kl
Natural Gas Field	"	Export Amount	$		
Petrochemical Plant	"	Export Price	$/t	Import	
Municipal Gas Production Volume	"	" "	Rp/t	Import Volume	kl
				Import Amount	$
Import		Inventory	t	Import Price	$/kl
Import Volume	"			" "	Rp/kl
Import Amount	$				
				Inventory	kl
Import Price	$/t			Inventory Ratio	%
" "	Rp/t				
				Statistically Imcomplete	kl
Export					
Export Volume	t			Rate of Operation	
Export Amount	$			of Processing	%
Export Price	$/t				
" "	Rp/t			Equipment Capacity	kl/y (B/D)
Inventory	t				
Statistically Imcomplete	"				
Whole-sale Price	Rp/t				
Whole-sale Price Index	Standard Year=100				
Retail Price	Rp/t				

2. Energy Balance Table and Method of Energy Demand Forecast

2–1 Concept of Energy Balance Table.

For the survey and analysis of energy economics in one country, it is necessary to grasp the extent of indigineous energy production and export, the extent of energy import, the internal supply process of energy sources to the final consumers, and the correlations of various energy sources.

Energy Balance Table contains such energy flow and it offers the most basic data for energy demand forecast and policy analysis.

Energy Balance Table firstly shows what situation the energy supply is in with a due consideration of the indigineous energy, energy import and export as well as stock change; secondly it elucidates the energy transformation of what primary energy is utilized to produce manufactured energy (secondary energy) and the energy demand of energy sectors which arises in energy production and transformation, and; finally, it shows how much of what energy the final consumers consume. It is of course possible to invert the order of this flow by starting from the final consumption stage to primary energy supply. This latter process is generally employed in demand forecasting operation.

In either cases, an energy balance table is vertically broken down into such items as primary energy supply sources, producer and transformer of energy, and final consumer while the horizontal breakdown consists of columns of various energy sources. (Here again, the arrangement of the vertical and horizontal breakdowns is inversible.) Although it is prescribed by the basic statistics precision of each energy sources, it is preferable that an energy balance table is divided into as many items as possible in view of analysis and policy making purposes. In view of the fact that an elaborate table is difficult for people in general to understand it is also necessary to prepare a more simplified table.

Statistics of each energy source form the basis for an energy balance table and these statistics are generally expressed in units specific to each energy source so that an original table of energy balance shall be made up of varying original units. That is, it will be expressed in such units as tons for coal, barrels, kiloliters or kilogrammes for oil, cubic feet or cubic meters for gas, and kilowatt hour for electricity.

It is impossible at this stage, however, to add or subtract the values of various energy sources nor is it possible, it goes without saying, to estimate a total national energy demand. An aim of energy balance table is to express these different energy sources in a common unit of value to enable addition and subtraction of energy sources values for the estimation of overall energy demand and to enable reading of quantative changes among substitutable energies to certain extent from the table.

When different goods are indicated in a common unit, there arises a drawback that properties of each good which are not expressible by the common unit will be abstracted. But a measure of abstraction is unavoidable in an attempt to conduct macroscopic analysis.

Each energy source such as oil, coal, gas, electricity gasoline and the like has its own properties, and to add these up causes similar problem as seen in adding apples and oranges. One way to add apples and oranges is by their respective prices as done in economic analysis, or from the standpoint of dietetics, each caloric value or nutritive elements are perhaps calculated before adding, but the properties of apples and oranges such as color, shape, and flavor are abstracted. A similar problem exists in the field of energy, in which case, however, although the mode of utilization varies, they are mutaully transformable in terms of physical chemistry. Further, a certain given relationship exists between the input heat value and the produced electricity and between the amount of coking coal and the produced cokes and coke oven gas. It is therefore possible as well as convenient to express the relationship in either one of the units of heat value, KWH, horse power, etc.

It is possible to adopt the price as a common unit in energy balance table as is customarily done so in the Input Output Table, but this may also pose a difficulty that such technical relationship as above mentioned can not be directly grasped. Even if either one of heat value, KWH, horse power, etc. is to be adopted, opinions will be divided on which factor to take depending on one's point of view. But since it has been a common practice to utilize energy in the form of heat and because it still has a large weight at present, it is customary to employ the heat value as a common unit. There still remains a problem in this, as we have already pointed out, especially in indicating the amount of energy consumption at the final demand stage, the amount of electricity consumption in particular, by heat value. At present stage, one of the limitations of energy balance table lies on this point.

Secondly, there are minute problems yet to be solved in employing the heat value as a common unit. A relatively familiar unit of heat value is the caloric value, and a common unit of 10^{13} Kcal. (roughly one million tons converted in oil) is employed in the OECD·IEA energy balance table which is deemed as a standard energy balance table worldwidely. It is also frequently employed to use the expression such as n.n. tons of oil equivalent, n.n. tons of coal equivalent, or n.n. KWH electricity equivalent. They are estimated by a conversion factor like 1kg. of oil=10,000 Kcal., 1 kg. of coal =7,000 Kcal., 1KWH of electricity=860 Kcal (or, 2,450 Kcal.), etc. There is an arguement also that joule instead of calorie should be used.

There are other problems in working out an energy balance table like whether to employ gross heat value or netto heat value, how to handle the conversion into heat value of primary electricity production such as hydraulic power, atomic power, etc., how to deal with the autogeneration, and the like, but we will not discuss them here and just point them out.

2–2 Energy Balance Table in Indonesia.

An energy balance table is based on the statistics of individual energy sources. As we have stated in Chapter 1,4, statitics of oil (including natural gas), electricity and coal are rather well prepared in Indonesia. However, statistics with more detailed breakdowns of the consumer sectors are indispensable in preparing an energy balance table, and it seems much remains to be improved in this aspect. As for the energy balance table in Indonesia, there are simple tables for 1969–'74 which are reported in "Hasil-Hasil Lokakarya Energi 1977, Komite Nasional Indonesia, World Energy Conference, 1977". These tables are prepared by the people who organized the said report, and there is no official tables prepared by the government.

The form of these tables is the same for each year as illustrated in Table 2–1 which is for the year 1974. The common unit is 10^{13} Kcal. The table consists of six columns; the five energy sources, i.e. oil, natural gas, coal, electricity and hydraulic power, and a column of the total. The vertical breakdowns consist of eight raws: two raws for the primary energy demand and supply relations, i.e. production and net export; one raw for the energy production and transformation sector, i.e. public utilities; six raws for the final demand sectors, i.e. own use and loss in the energy sectors, industries and electricity transportation, residential, commercial, and others and two raws of the primary energy demand total and the final energy demand total. For a simplified energy balance table, this contains almost all the elements and could be considered as well prepared. If we are to add a few comments, first of all, it would be advisable to delete the raw of own use and loss in the energy sector from the final demand sector and instead place it below the raw of public utilities, because it is more common to include it in the energy production and transformation sector and not in the final demand sector. Secondly, since the non commercial energy has a considerably high share in Indonesia, we wonder if there is any measure to take this factor into the table. There is no theoretical difficulty, in including it in the energy balance table but the problem would be whether the original data which are to be entered are available. Practically speaking, it would probably be almost impossible to obtain reliable data. Perhaps we could work out a way to include it in a table as estimate figures by inserting a column of the non commercial energy to the right hand side of the total in the present energy balance table even if the figures are of bold estimation.

The third point of our comment is, although it is not directly connected with this particular table, that we suggest more details be included even in a simplified table. It is expected in this regard that the column of oil should be divided into crude oil and petroleum product and that the industries of the final demand sector should be broken down into about say five categories.

With due consideration of the view points as stated above, we recommend as a sample of energy balance table which could be prepared in Indonesia the form of energy balance table taken up in the energy statistics and energy balance table of the developing countries* which are prepared by the IEA Secretariat and unofficially presented at the Workshop on Energy Data of Developing Countries. December, 1978, held by the International Energy Agency. According to these data, the basic statistics of energy and the energy balance table of Indonesia in 1974 are as in Table 2–2 and Table 2–3. Table 2–3 is the energy balance table, which covers the points to be improved on the said simplified Indonesian energy balance table that we have pointed out, and we consider it to be a very good simplified energy balance table.

As we compare the figures of the 1974 energy balance table (Table 2–3) by the IEA Secretariate with those by the Indonesian working group, a fairly good similarity in the figures is observed except for those of natural gas. (As for the natural gas, it seems the IEA Secretariat had no sufficient materials.) Although the figures seem to be of bold estimation, there are entries in Table 2–3 of non-commercial energy. We would like to recommend that Indonesia employ this form of Table 2–3 as an official form of simplified energy balance table and try to improve the accuracy of the figures.

At any rate, it requires an accumulation of figures in fairly detailed classifications in order to make such simplified tables, and it may therefore be useful to prepare a detailed table although it may only be a tentative table in the working stage. It is true that even if such a table is designed there may be many colums left blank. Even so, it will be helpful in collecting clues for what improvements to make on which statistics if it has been made. As a sample of detailed energy balance table, a tale which is used by the Institute of Energy Economics, Japan (Table 2–4) is attached. There is no entry of noncommercial energy in this table, and therefore it is desirable to add this in case of Indonesia.

2–3 Method of Energy Demand Forecast in Indonesia and Comments Thereon.

As a representative as well as authoritative energy demand forecast in Indonesia, there is a report of "Perikraan Kabuthan Energi Pelita III, Tahun 1979/80–1983/84." There is another forecast up

* to be published sometime in middle of 1979.

to the year of 2000. The fundamental principles of forecasting method seem to be substantially the same in both reports. Here, we take up the former report to briefly introduce the method of :forecast used in the country at present and make comments on it. The first step of the forecast is to estimate total energy demand by the following regression equation:

$$\ln E/P = a + b \ln GDP/P$$

E: total energy demand

P: population

GDP: Gross Domestic Production

That is, total energy demand per capita and GDP per capita are correlated to estimate energy demand per capita.

It should be noted here that they have utilized pooling data of 22 and more developing countries instead of those of Indonesia alone in getting this equation.

First of all with regard to the estimation method of total energy demand, it is assumed that there exists a strong correlation between energy demand per capita and GDP per catipa. However, it is pointed out by many authors* that this assumption is not necessarily approved as a causal relation. However, there certainly is a correlation

* P. Kral: "Energy and GNP: "Some Thoughts on Inter-Country Comparisons" Paper distributed in the Working Group Meeting on Energy planning and Programming, 15–21 Aug. 1978 ESCAP'

of significancy to certain extent between these two factors, at least statistically, in certain regions, in certain stage of economical development, as is seen in the above equation, and it is considered to be one of the practical methods for the estimation of energy demand forecast, especially a long term forecast, in the developing countries. The reason that they used the data of many developing countries here is, we think, perhaps because it was considered safer to take them into account the forms of development, widely and in good balance, of these countries which have various possibilities in the future in assuming a future picture of Indonesia which also has diversified possibilities in the future. We would think that the method will be approved of as one of the feasible approaches.

In the advanced countries, however, a method of this kind is generally used as one of the materials to check the figures of forecast obtained by other methods except in case of the extra-long term forecasting. In case of short-middle term forecast in the developing countries, it would be more advisable to take a sector wise forcasting method and to use the above mentioned method as a one checking material.

The second step of the forecast is to estimate the demand by sectors in such a manner as to correspond them with the total demand estimated in the first step. In this step, the energy demand is estimated in separate breakdowns of sectors such as industrial sector, residential and commercial sector, transportation sector, electricity sector (public utilities). As for the industrial sector, it is further divided into following sectors:

fertilizers

liquid natural gas

cement

town gas

refineries, etc.

The procedure of the forecast by each sector is that the relevant governmental agencies collect prospective estimate figures intended by resoective enterprises and factories. It reflects the particular situation of the country that the number of enterprises and factories in the said sectors is relatively small and that the projects of these enterprises and factories are seemingly incorporated in the economic planning. Insofar as that, it could be said that the procedure is practical and effective in Indonesia but a question still seems to remain that to what extent the consistency between the projects of the enterprises and the factories and the economic planning is checked. Under the recent circumstances that the economic growth rate is so high and the structural changes develop so rapidly, it may be difficult to employ a method to estimate using macro economic model (including utilization of Input Output Table) the production activities of each industrial sector, and based on this estimates to calculate the energy demand for each sector. And even if it could be done, it might bring result which will be far from the expectation of the planners as well as the enterpreneus.

But we feel that an attempt on such estimation is still necessary and worthwhile.

As for the residential and commercial sector, the main energy source is kerosene. The demand forecast of kerosene is done by a simple time regression equation of $E= a+b\ t$. This is also a practical method, but it may be useful to work out a regression analysis correlateed with private consumption expenditure. Also, non commercial energy such as fuel wood and agrarian waste is an importand energy source in Indonesia and since it has been substituted by commercial energy such as kerosene and LPG, it seems necessary to analyze the problem pertaining to the shift from non commercial energy to commercial energy despite of the problems of availability of statistical data.

As for the transportation sector, the total demand of this sector is first estimated by a regression equation with the value added of the transportation, which is then distributed to each energy source. This method is basically based on the assumption that the transportation activities are reflected on the added value of the transportation sector and that this defines the energy demand of the transportation sector. It is acceptable as one of the methods of forecast, but if possible, it would also be useful to design a future picture of transportation system in order to use it as a basis for checking the necessary amount of energy by each transportation module. That is, we have to see how the automobile transportation module will develop in future (this includes various problems such as how soon the man power energy like rikishas in large cities like Jakarta will be replaced by automobiles; how soon the non commercial energy in the rural areas provided by livestock like cows and horses or man power will be replaced by automibiles or tractors, etc.), what will be the future of the railway network or the navigation system, etc. We have to work out an outlook for the future transportation system from these aspects in order to estimate the energy demand of the transportation sector.

Here, the energy demand of the transportation sector as a total will be divided into gasoline, light oil, aviation gasoline, fuel for jet engine, etc. This is done by using the trend in the past five to ten years as a basis for judgement and adjusted to meet the added amounts with the said total amount with a touch of experience.

As for the electricity sector, PLN (State Owned Electricity Company) has been in charge of estimation, and its procedure seems to be substatially the same as those mentioned above.

It is easily conjectured that the total sum of the forecasted amounts by each sectors thus estimated above will not meet the total amount calculated in the first step. Adjustment is made in each sector to make the summed up figure equal to the said total amount so as to finally obtain the amount of energy demand forecast of each sector.

We have thus introduced, briefly in the above, the methods of energy demand forecast in Indonesia with some comments. It may be given as a conclusion that these are acceptable as realistic methods for demand forecast under the circumstances of rapid economic growth in the past, dynamic change in the industrial structure and diversified possiblities of future development on one hand, and limited statistical materials on the other.

Of course, we have already stated as comments that there are several points which can be improved and that it is necessary to check the figures by other methods. It will be necessary to collect required statistics and data and put them in order for that purpose. And what is needed to be done first of all is to work out an energy balance table.

The reason why the working out of an energy balance table is a pressing need will be evident if you will read the next section in which the method of energy demand forecast in Japan is introduced.

2–4 Introduction of Energy Demand Forecast Method in Japan (Middle-Long Term Energy Forecasting Model of the IEE) and Feasibility of its Application in Indonesia.

There are varieties of methods for energy demand forecasting. In a sophisticated method, macro-economic frame is incorporated and the relative price is used as the main explaining parameter. Linear programming model is another sophisticated forecasting method, in which adding to the cost and or price of energy, those of machinery and tools and obher factors area incorporated. There are relatively simple and experimental methods, in which although a given economic frame is used as a premise and the technical factors are taken into consideration, the economic frame itself does not get any feed-back from the activities of the energy sector. There are number of modifications of these simpler methods which vary in each details.

Various methods of energy demand forecasting are developed and utilized in different agencies and institutes in Japan. Here, we would like to introduce the middle-long term forecasting method which the Institute of Energy Economics, Japan presently employs. This model is, as can be seen hereunder, relatively simple, but it has been serving as a standard for middle-long term forecasting in Japan. The method employed by the government is substantially the same as this one. We introduce this method because we believe this model serves as the most useful one in working out a method of demand forecasting in Indonesia because it fits relatively well in terms of statistics even in a country like Japan where the economic growth has been considerably rapid and the change in the industrial structure is dynamic, and because the factors of policy making can be easily reflected on it, and further, the model building is easily done since it requires relatively small volume of statistical data.

This forecasting model consists of following two items:

1. Forecast of final energy demand.
2. Forecast of activities in the energy transformation sector and primary.
3. Energy demand and supply.

The process of this forecasting is illustrated in Figure 2–1. In the following, the process of forecasting is briefly explained by each item.

(1) Final energy demand.

The first step in energy demand forecast is to forecast the final energy consumer's demand. The final energy consumers are those who consume the energy and do not transfer the energy further to other consumers. This is roughly divided into industries sector, residential and commercial sector and transportation sector. Agriculture, forestry, construction and the like are included in idustries sector in a broad sense in this case, but it is also possible to treat them separately. In the developing countries, agriculture should be divided as an independent sector as it stands as an important sector also in terms of energy.

The energy demand is basically dependent upon the way of living, the scale and structure of the economic activities and the form of energy consumption techniques. It is therefore necessary to forecast on these indices in order to work out the final energy demand forecasting. In this model, however, the feedback from the aspect of energy to the economic activities is not taken into consideration, and the forecast of economic activities is based on the separately developed macro-economic model. That is, GNP and its constituting elements, and production indices of each industrial sectors are estimated from this macro-economic model.

. Energy demand forecast of industries sector including agriculture, forestry, construction.

Industries sector including agriculture and forestry, and construction sector is further broken down into the following 12 sectors:

agriculture and forestry, mining industry, construction, foodstuff, textile, paper and pulp, chemicals, ceramic, clay sands and stones, steel, non-ferrous metals, machinery and metal products, and other manufacturing. These correspond with the breakdowns used in the energy balance table of the Institute of Energy Economics. The forecasted figures of production activities (production indices) in these sectors are obtained from the macro-economic model as mentioned above. In case of Japan, it is often the case that the results seem unrealistic from the standpoint of practical sense if the production index is used as it is because the industrial structure changes so rapidly as compared with the advanced countries of Europe and United States. When this happens, the figures are changed qualitatively by asking opinions and views of the specialist of various industries. Recently in this respect, this kind of thing happened in the forecast of the future activities of energy intensibe material industries such as raw steel, petroleum and chemicals, aluminum ore production, cement.

We suppose that such a case also exists in Indonesia, and we think it practical as well as effective to decide the future figures for the production index by the qualitative judgment. The amount of energy consumption by each sector can be obtained by multiplying estimated production index with the amount of separatedly estimated energy consumption per unit of production index. Here in our model, time series data of specific energy consumption by each energy source in accordance with each industries is made, to which time regression equation, or regression equation with multi parameters of production volume with actual price of energy source and rate of operation and the like are applied to obtain the specific energy consumption by each energy source in future. There has been an active trend since the oil crisis, from the standpoint of what is generally know as energy conservation, to lower the specific energy consumption by energy conservation, to lower the specific energy consumption by eliminating waste and improving technique. Although these efforts seem to have achieved much, it is still difficult to obtain a significant equation which is capable of forecasting even if the recent actual results are incorporated in the above mentioned equation because of the disturbing conditions such as that it is only five years since the oil crisis, the warm winter, and an large drop of rate of operation. The forecast of changes in the specific energy consumption by qualitative judgement is also conducted at present in which technical informations on energy saving or factors to increase the energy demand on account of counter-measures of public nuisance are incorporated.

As for Indonesia, it seems doubtful whether an useful regression equation is obtainable even if a considerable detailed energy balance is made and if time series data of specific energy consumption by each energy source of each sector is collected. If not, there will be no other way but to depend on some kind of qualitative judgement. Whatever the case may be, the amount of energy consumption by each energy souce of each industry is to be estimated by multiplying the production index of each sector with the specific energy consumption by each energy source that are obtained in accordance with the process described above. This is basically the same with the method of demand forecast of the industrial sector in Indonesia. The difference is that a few econometrical techniques are incorporated in forecasting the production index and the specific energy consumption in Japanese case. In this sense, it will therefore be relatively easy to study the feasibility of its introduction to Indonesia.

Energy demand forecast of the residential and commercial sector

There is a variety of kinds in energy used in the residential and commercial sector such as electricity, oil, gas, fuel wood, charcoal, briquette, etc. and these different kinds of energy are competing with one another, especially in the heating uses, by such factors as price, heat efficiency, apparatus, usability, etc. The demand forecast of various kinds of energy involves, all the more, delicate problems, but in the model of ours it is estimated by the following simple regression equation. That is, the demand or residential electricity is correlated with private consumption expenditure and the commercial electricity demand is correlated with GNP. Likewise for the demand of town gas, that of residential is correlated with private consumption expenditure, and with GNP for that of commercial use. The oil demand which consists substantially of heating is forecasted in correlation with private consumption expenditure. Heavy oil for commercial use (mainly used for heating larger buildings, but heavy oil of light quality is more used from the standpoint of public nuisance recently) is forecasted in correlation with GNP, and others such as fuel wood, charcoal, briquette are given as exogenous variables on the assumption that the demand thereof will either level off or come to zero.

These are the basic ideas, but in the last five years there is a tendency that the forecast by such simple regression equations results is somewhat higher figures, and the tendency is more prominent especially since the oil crisis. It is therefore a recent practice to work out a forecast by a statistically significant regressional equation in which the real price of each energy source is included as an explaining parameter other than private consumption expenditure and GNP wherever such an equation is obtainable. Moreover, checking measures are also employed such as analysis of the energy demand according to different uses per household (room air conditioning, cooking, hot water supply, lighting, and other uses), accumulation of data on the dissimination rate of apparatus and on specific energy consumption.

In Indonesia, almost all the energy demand of residential and commercial uses is supplied by kerosene and or non-commercial energy. It will therefore be an important point to forecast the demand of these energies with due consideration of the shift from the non-commercial energy into kerosene or

LPG. And as the uses are limited to cooking and lighting, it can be said that it could be easier to forecast in case of Indonesia. On the other hand, but there is a problem of insufficiency in the statistical data on energy for demand forecasting. As for kerosene, the problem is that it is difficult to decide with what the estimated figures should be correlated since its demand has recently been increasing rapidly. As we have stated before, the demand forecasting in Indonesia is presently done by the time series analysis but it may be worth estimating the figures to see what results come out when the explaining parameters such as the price of kerosene, private consumption expenditure, etc. are added. Further, because the substitution of the non-commercial energy into commercial energy is an important subject in policy examination, it will be necessary to study how much of which non-commercial energy will be shifted into commercial energy by producing the actual results of non-commercial energy consumption and its demand growth estimates even if they are of bold in its nature.

Energy demand forecast of transportation sector.

Energy demand forecast of transportation sector is done by combining three items of forecast. The first item is respective transportation volume of passengers and freights; the second is the rate of share by each transportation module in passengers and freights, and; the third is the specific energy consumption by each transportation module. As for the forecast of transportation volume, that of the passengers is correlated with the private consumption expenditute and that of the freight is correlated with GNP. The transportation volume (ton km, passenger km) thus estimated by the above equation is then divided into different transportation means (railroad, truck, vessel, private car, bus, aircraft) in accordance with the respective rate of share. Since it is necessary to have an outlook for the future transportation system in order to forecast the rate of share of each transportation module, it entails not only quite troublesome processes but indifinite elements if a detailed forecast is attempted. Presently we do it on the assumption and the qualitative process that the distribution ratios of shipping in the freight transportation and bus and vessels in the passengers transportation will level off; that the share of railroad in terms of both freight and passenger transportations will be extrapolated by the trend in the past (it will gradually decrease) that the distribution ratio of air-transport sector in the passengers transportation will be extraneously given; and that the rest will be the automobiles.

The third item is the forecasted figures of energy consumption efficiency in each transportation module.

We resort to a method to select reasonable figures from the estimated figures obtained by extrapolating the trend in the past, plotting the recent results as future figures, or qualitatively forecasting while incorporating the evalution from the technical view point.

These methods are the basic approach in this sector, but when we look at the recent situations the degree of fitting between the figures got from the equation of forecasting and the actual results are lowering and it seems we can not simply depend on these methods in some sectors, especially in gasoline and light oil for automobiles which have a large share in this sector. Hence, for these two energy sources, a correlation equation with the number of passenger cars, the number of trucks and the real price of gasoline and diesel oil as the explaining parameters is now applied to forecast in order to get apparently more reasonable figures.

In Indonesia, the transportation sector is mainly consisted of automibiles, vessels and railroad, and therefore the energy demand forecast puts emphasis on gasoline and diesel oil. In both cases, extrapolation in accordance with the empirical law is utilized as the forecasting method, as stated above. It will be an effective checking measure to carry out an analysis in which is incorporated the forecast of the number of automobiles including the evaluation of shift from such energies as cows, horses and man power to automobiles. It is also preferable to carry out the energy demand forecast of the transportation sector by making a blue-print of future transportation system as a whole.

(2) Forecast of activities in the energy transformation sector and primary energy demand and supply.

The amount of demand by each energy source in the final consumption stage is obtained by these methods. The problem to be studied at the next step is which energy sector will provide these energy by what activities.

The first step is to break down the energy demand in the final consumption stage into substitutable and non substitutable energies. That is, a certain energy demand is covered only by a certain specific energy source unless the future in a very long range is taken into consideration. That is, in case the technical standard of the present stage and of near future is taken as a premise at the final energy consumption stage, there are, as the energy demand which is considered almost non substitutable, electricity for lighting and fixed as well as partially movable motive power, gasoline and diesel oil for automibiles, jet fuel for jet planes and cokes for the production of pig iron. In Japan, naptha for petrochemical raw material is also included here.

The underlying basic ideas here are that the energy production and transformation sector will provide the final consumers with these non substitutable energy sources in required amount in the form of such energies, and that in the process of producing such non substitutable energy sources, the energies inevitably by-produced in the multi-products of energies (products of oil and coal) will be supplied to the market of substitutable energies. The important items as the by-products in the energy multi products are the coke oven gas in the production of cokes, the blast furnace gas produced in the process of pig iron production, the heavy oil and refinery gas from the oil refinery process. Among these, the energies in the form of gas are directly put to own use or utilized as the raw material for the town gas. In either cases, these are domestically used. From the standpoint of the users, these energies or the raw materials may well be other energy sources, but since it is impossible, technically and economically, to use them in other ways they are obliged to use them. That is, some the substitutable energies in the classification of non substitutable and substitutable energies divided from the standpoint of the consumers may be non substitutable in terms of energy supply techniques. That is, the substitutability of the energy has an aspect that it is limited not only from the demand side but also from the supply (production) side. Those energy sources which have substitutability seen from both sides become the objects of competition analysis, such as the energy source for heating purpose in the residential and commercial sector and industrial sector.

It willthen be necessary to analyze which energy source will be selected for heating purpose with due consideration of the price of competing energies, the price of apparatus, usability and the like in respective sector. In Japan, the circumstance is that since crude oil as the primary energy has such a large share, there is little change in the relative price gap among the secondary energies, and therefore even a complicated and sophisticated econometrical method does not produce very effective results. This point is not taken into consideration in our model at present, but it seems more incressant to study into these aspects when the situation after the oil crisis is taken into consideration.

The amount of secondary energy source to be imported or exported (sometimes consumed in the country, uneconomical as it may be, depending on the cases) is calculated from the relation of the energy products production by-produced in the process of the production of non substitutable energy sources with the demand of substitutable energy sources. The amount of primary energy to be imported is obtained by substracting the indigenous primary energy from the necessary amount to produce non substitutable energies in a given or presumed technical system. In the case of Japan, the major indigenous energy includes hydraulic power, coal and a very small amount of crude oil and natural gas as well as atomic power which is classified as quasi indigenous. Except for coal, crude oil and natural gas, these energies include elements which could be determined by policy. It is therefore more realistic to give their future figures exogenously. And also for coal, crude oil and natural gas, especially the latter two, contain so many indefinite elements that they can only be given extraneously as a kind of simulation parameter. As for Indonesia, similar way of thinking is to be applied with respect to the energy transformation sector. But as for the primary energy supply, they will employ a method in which particular production policy as an energy ecporting country is reflected.

Here the important subjects of evaluation are: how and where to stand the economics of oil, gas, coal in the development of Indonesian economy; how to establish the amount of export of each energy source, and; how much of energy can be exported in the world energy economy. There is much to consider in terms of policy because it has abundance of oil, gas and coal resources, and the effects of policy can all the more be reflected in the forecast of energy demand: It inevitably gives rise to a method which incorporates qualitative judgement backboned by policy and not with the results obtained by mere econometrical processes. And therefore the establishment of fundamental energy policy or strategies will have extreme significance. For this, it will be indispensable to have intelligible analysis and insight into the world energy economy as well as a solid outlook for the future of Indonesia. In this sense, the energy demand forecast contains elements not as mere forecasting technique. The model which we have introduced here is simple in its structure and such political considerations can be qualitatively incorporated.

Table 2-1 Energy Balance Table (Indonesia, 1974)

(Unit: 10^{13} Kcal)

	Oil	Gas	Coal	Electricity	Hydropower	Total
Production	70,250	4,813	0,085		0,193	75,341
Net Export	57,242	–	–		–	57,242
Primary Energy Consumption	13,008	4,813	0,085		0,193	18,099
Electricity Generation (Public Utilities)	0,491	–	–	0,279	0,193	0,405
Final Energy Consumption	12,517	4,813	0,085	0,279		17,694
Self Consumption of Energy Sector and Loss	2,650	1,205	0,032	0,075		3,962
Industry (Include Ind. Power Plant)	3,570	0,512	0,027	0,050		4,159
Transportation	2,316	–	0,026	–		2,342
Residential	3,981	–	–	0,098		4,079
Commercial	–	–	–	0,020		0,020
Others	–	3,096	–	0,036		3,132

Source: "Hasil-Hasil Lokakarya Energi 1977"
Komite Nasional Indonesia, World
Energy Conference, 1977

Table 2-2 Basic Energy Statistics (Indonesia 1974)

BASIC ENERGY STATISTICS

INTERNATIONAL ENERGY AGENCY WORKSHOP ON ENERGY DATA OF DEVELOPING COUNTRIES

	1 HARD COAL TH.MT	2 COKE	3 GAS COKE	4 LIGNITE	5 BKB	6 NATURAL GAS M.FT3	7 CITY GAS TCAL.9	8 OVEN GAS TCAL.9	9 REFINERY GAS	10 CRUDE & NGL TH.BBL	11 LPG TH.MT	12 WHITE SPIRIT TH.MT	13 AVIATION GASOLINE TH.BBL
1 PRODUCTION	160	.	.	.	.	14884	140	11	.	501837	12	.	140
2 FROM OTHER SOURCES	.	.	.	.	.	.	.	.	.	.	.	.	.
3 IMPORTS +	10	.	.	.	.	.	.	.	.	.	.	.	.
4 EXPORTS -	.	.	.	.	.	.	.	.	.	-378905	-2	.	.
5 BUNKERS -	.	.	.	.	.	.	.	.	.	.	.	.	.
6 STOCK CHANGES +/-	.	.	.	.	.	.	.	.	.	.	.	.	.
7 DOMESTIC CONSUMPTION	172	.	.	.	.	14884	140	11	.	122932	10	.	140
8 STAT. DIFF.	.	.	.	.	.	.	.	.	.	.	.	.	.
9 TRANSFERS	.	.	.	.	.	.	.	.	.	.	.	.	.
10 TRANSFORMATIONS	.	.	.	.	.	.	.	.	.	122932	.	.	.
11 PATENT FUEL PLANTS	.	.	.	.	.	.	.	.	.	.	.	.	.
12 COKE OVENS	.	.	.	.	.	.	.	.	.	.	.	.	.
13 GAS WORKS	.	.	.	.	.	.	.	.	.	.	.	.	.
14 FOR BLAST FURN. GAS	.	.	.	.	.	.	.	.	.	.	.	.	.
15 FOR GAS AND COKE	.	.	.	.	.	.	.	.	.	.	.	.	.
16 PETROL. REFINERIES	.	.	.	.	.	.	.	.	.	122932	.	.	.
17 THERMO-ELEC. PLANTS	.	.	.	.	.	.	.	.	.	.	.	.	.
18 ENERGY SECTOR	.	.	.	.	.	.	.	.	.	.	.	.	.
19 HARD COAL MINES	.	.	.	.	.	.	.	.	.	.	.	.	.
20 LIGNITE MINES	.	.	.	.	.	.	.	.	.	.	.	.	.
21 NAT. GAS EXTRACTION	.	.	.	.	.	.	.	.	.	.	.	.	.
22 PETROL. EXTRACTION	.	.	.	.	.	.	.	.	.	.	.	.	.
23 PATENT FUEL PLANTS	.	.	.	.	.	.	.	.	.	.	.	.	.
24 COKE OVENS	.	.	.	.	.	.	.	.	.	.	.	.	.
25 GAS WORKS	.	.	.	.	.	.	.	.	.	.	.	.	.
26 FOR GAS AND COKE	.	.	.	.	.	.	.	.	.	.	.	.	.
27 PETROL. REFINERIES	.	.	.	.	.	.	.	.	.	.	.	.	.
28 ELECTRIC PLANTS	.	.	.	.	.	.	.	.	.	.	.	.	.
29 DISTRIB. LOSSES	.	.	.	.	.	.	.	.	.	.	.	.	.
30 PUMPED STORE. ELEC.	.	.	.	.	.	.	.	.	.	.	.	.	.
31 FINAL CONSUMPTION	172	.	.	.	.	14884	140	11	.	.	10	.	140
32 TRANSPORTATION	34	.	.	.	.	.	.	.	.	.	.	.	140
33 AIR TRANSPORT	.	.	.	.	.	.	.	.	.	.	.	.	140
34 ROAD TRANSPORT	.	.	.	.	.	.	.	.	.	.	.	.	.
35 RAILWAYS	34	.	.	.	.	.	.	.	.	.	.	.	.
36 INTERNAL NAVIGATION	.	.	.	.	.	.	.	.	.	.	.	.	.
37 INDUSTRY SECTOR	59	.	.	.	.	10117	.	.	.	.	.	.	.
38 IRON & STEEL IND.	40	.	.	.	.	.	.	.	.	.	.	.	.
39 CHEM. & P.CHEM IND.	.	.	.	.	.	10117	.	.	.	.	.	.	.
40 OTHER INDUSTRY	.	.	.	.	.	.	.	.	.	.	.	.	.
41 NON-ENERGY USES	.	.	.	.	.	.	.	.	.	.	.	.	.
42 OTHER SECTORS	.	.	.	.	.	.	140	.	.	.	10	.	.
43 AGRICULTURE	.	.	.	.	.	.	.	.	.	.	.	.	.
44 COMMERCIAL	.	.	.	.	.	.	.	.	.	.	.	.	.
45 PUBLIC SERVICE	.	.	.	.	.	.	.	.	.	.	.	.	.
46 RESIDENTIAL	.	.	.	.	.	.	.	.	.	.	.	.	.
47 LOST & NOT ACCTD FOR	79	.	.	.	.	4867	.	11	.	.	.	.	.

BASIC ENERGY STATISTICS

INTERNATIONAL ENERGY AGENCY WORKSHOP ON ENERGY DATA OF DEVELOPING COUNTRIES

	14 MOTOR GASOLINE TH.BBL	15 JET FUEL TH.BBL	16 KEROSENE TH.BBL	17 DISTIL-LATES TH.MT	18 RESIDUAL OIL TH.KL	19 LUBRI-CANTS TH.MT	20 BITUMEN TH.MT	21 NAPH-THAS	22 GAS TH.BBL	23 PETROLEUM COKE TH.MT	24 UNFIN. OILS	25 PETROCHEM FEEDSTKS	26 OILS NES	27 ELEC-TRICITY GWH	28 BAGASSE ETC TH.MTOE	29 WOOD & CHARCOAL TH.MTOE
1 PRODUCTION	12292	1359	22036	2621	8431	4	108	.	787	29	.	.	.	3246	309	27780
2 FROM OTHER SOURCES	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
3 IMPORTS +	43	1011	5582	77	788	92	24	.	.	.	.	.	.	.	.	.
4 EXPORTS -	-264	-70	-70	-76	-5748	.	.	.	-723	.	.	.	.	.	.	.
5 BUNKERS -	.	.	.	-20	-260	.	.	.	.	.	.	.	.	.	.	.
6 STOCK CHANGES +/-	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
7 DOMESTIC CONSUMPTION	12071	2300	27548	2597	3211	96	132	.	64	29	.	.	.	3246	309	27780
8 STAT. DIFF.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
9 TRANSFERS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
10 TRANSFORMATIONS	.	.	.	246	521	.	.	.	.	.	.	.	.	.	.	.
11 PATENT FUEL PLANTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
12 COKE OVENS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
13 GAS WORKS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
14 FOR BLAST FURN. GAS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
15 FOR GAS AND COKE	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
16 PETROL. REFINERIES	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
17 THERMO-ELEC. PLANTS	.	.	.	246	521	.	.	.	.	.	.	.	.	.	.	.
18 ENERGY SECTOR	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
19 HARD COAL MINES	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
20 LIGNITE MINES	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
21 NAT. GAS EXTRACTION	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
22 PETROL. EXTRACTION	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
23 PATENT FUEL PLANTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
24 COKE OVENS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
25 GAS WORKS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
26 FOR GAS AND COKE	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
27 PETROL. REFINERIES	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
28 ELECTRIC PLANTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
29 DISTRIB. LOSSES	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
30 PUMPED STORE. ELEC.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
31 FINAL CONSUMPTION	12071	2300	27548	2348	2690	96	132	.	64	29	.	.	.	3246	309	27780
32 TRANSPORTATION	12071	2300	.	1426	.	.	.	.	.	.	.	.	.	.	.	.
33 AIR TRANSPORT	.	2300	.	.	.	.	.	.	.	.	.	.	.	.	.	.
34 ROAD TRANSPORT	12071	.	.	1426	.	.	.	.	.	.	.	.	.	.	.	.
35 RAILWAYS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
36 INTERNAL NAVIGATION	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
37 INDUSTRY SECTOR	.	.	.	.	400	96	132	.	64	.	.	.	.	.	309	.
38 IRON & STEEL IND.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
39 CHEM. & P.CHEM IND.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
40 OTHER INDUSTRY	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
41 NON-ENERGY USES	.	.	.	.	.	96	132	.	64	.	.	.	.	.	.	.
42 OTHER SECTORS	.	.	27548	.	.	.	.	.	.	.	.	.	.	.	.	27780
43 AGRICULTURE	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
44 COMMERCIAL	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
45 PUBLIC SERVICE	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
46 RESIDENTIAL	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
47 LOST & NOT ACCTD FOR	.	.	.	920	2290	.	.	.	.	29	.	.	.	3246	.	.

BREAKDOWN OF ELECTRICITY GENERATION

PUBLIC (GWH)		AUTOPRODUCERS	
CONV. THERMAL:	1467	INDUSTRIAL:	600
HYDRO:	1179		
NUCLEAR:	NONE		

Table 2-3 Energy Balance Table, Indonesia 1979

1973 INDONESIA

ENERGY BALANCE

INTERNATIONAL ENERGY AGENCY WORKSHOP ON ENERGY DATA OF DEVELOPING COUNTRIES

IN THOUSANDS OF METRIC TONS OF OIL EQUIVALENT /A

	1	2	3	4	5	6	7	8	9	10	11
	PRIMARY SOLID FUELS	SECONDARY SOLID FUELS	CRUDE & NGL	PETROLEUM PRODUCTS	GAS	NUCLEAR POWER	HYDRO & GEOTHRM	ELEC-TRICITY	TOTAL COLUMNS 1 TO 8	NON-COM-MERCIAL ENERGY	TOTAL COLUMNS 9 & 10
1 INDIGENOUS PROD.	97	.	67907	.	388	. /B	475/B	.	68842	27039	95881
2 IMPORTS +	2	.	.	1264	.	.	.	.	1267	.	1267
3 EXPORTS -	.	.	-61288	-7547	.	.	.	.	-68808	.	-68808
4 MARINE BUNKERS -	.	.	.	-20	.	.	.	.	-20	.	-20
5 STOCK DRAWDOWN +/-	.	.	.	.	.	.	.	.	.	.	.
6 TOTAL ENERGY REQUIREMENTS	94	.	10640	-6296	388	.	475	.	11180	27039	38219
7 STAT. DIFFERENCE	.	.	.	.	.	.	.	.	.	.	.
8 TRANSFERS	.	.	.	.	.	.	.	.	.	.	.
9 ELEC. GENERATION	.	.	.	-688	.	.	-475	262	-912	.	-912
10 GAS MANUFACTURE	.	.	.	.	13	.	.	.	13	.	13
11 REFINERIES	.	.	-10640	14618	.	.	.	.	-1722	.	-1722
12 OWN USE, LOSSES & OTHER TRANSFORMATIONS	.	2	.	.	.	.	.	.	2	.	2
13 TOTAL FINAL CONSUMPTION	94	2		7632	382	.	.	262	8801	27039	35400
14 INDUSTRY	38	.	.	864	281	.	.	.	1183	280	1442
15 IRON AND STEEL	29	.	.	.	.	.	.	.	25	.	25
16 CHEMICAL & P CHEM	.	.	.	.	261	.	.	.	261	.	261
17 OTHER INDUSTRY	.	.	.	.	.	.	.	.	.	.	.
18 TRANSPORTATION	24	.	.	2897	.	.	.	.	2921	.	2921
19 ROAD	.	.	.	2704	.	.	.	.	2704	.	2704
20 RAIL	24	.	.	.	.	.	.	.	24	.	24
21 AIR	.	.	.	193	.	.	.	.	193	.	193
22 INLAND WATERWAY	.	.	.	.	.	.	.	.	.	.	.
23 OTHER SECTORS	.	.	.	3222	13	.	.	.	3235	26750	29985
24 AGRICULTURE	.	.	.	.	.	.	.	.	.	.	.
25 COMMERCIAL	.	.	.	.	.	.	.	.	.	.	.
26 PUBLIC SERVICE	.	.	.	.	.	.	.	.	.	.	.
27 RESIDENTIAL	.	.	.	.	.	.	.	.	.	.	.
28 NON-ENERGY USES	.	.	.	196	.	.	.	.	196	.	196
29 NOT INCLUDED ELSEWHERE	32	2	.	643	108	.	.	262	1047	.	1047

NOTE A: ONE METRIC TON OF OIL EQUIVALENT IS DEFINED AS TEN MILLION KCAL
NOTE B: CALCULATED EQUIVALENT OF POWER PLANT INPUT ASSUMING 29% EFFICIENCY

Table 2-4 1974 F.Y. Energy Balance

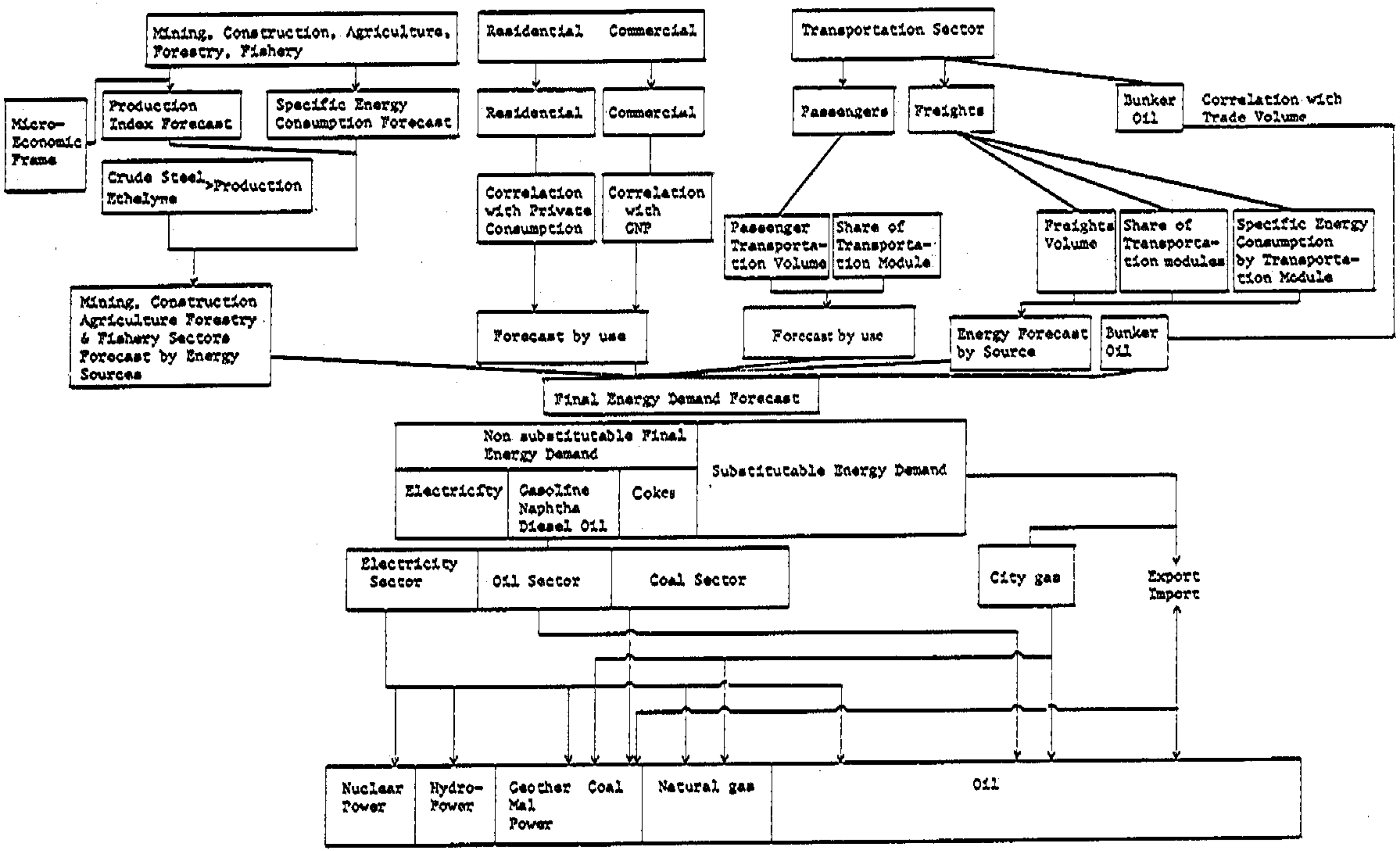
(Unit: 10^{10} Kcal)

No.	Code	Item	1 COAL	2 COKING COAL DOMESTIC	3 COKING COAL IMPORT	4 STEAM COAL DOMESTIC	5 STEAM COAL IMPORT	6 ANTHRACITE	7 LIGNITE	8 CRUDE OIL	9 PETROLEUM PRODUCTS	10 FUEL OIL TOTAL	11 GASOLINE	12 NAPHTHA	13 JET FUEL	14 KEROSENE	15 DIESEL OIL	16 HEAVY FUEL OIL	17 A	18 B	19 C	20 LUBRICANTS	21 OTHERS	22 REFINERY GAS	23 LPG	24 NATURAL GAS
1	PA	PRIMARY ENERGY DOMESTIC	[illegible]	7,4[illegible]		5,[illegible]		[illegible]	[illegible]	[illegible]																
2	PB	IMPORT	[illegible]		[illegible]		[illegible]	[illegible]		255,7[illegible]	24,3[illegible]	13,2[illegible]	[illegible]	5,[illegible]			[illegible]	11,[illegible]	2,5[illegible]	1,3[illegible]	7,7[illegible]	[illegible]	15		[illegible]	2,[illegible]
3	PC	EXPORT	▲ [illegible]	▲ 15		▲ [illegible]					▲ 22,2[illegible]	▲ 21,[illegible]	▲ [illegible]	▲ 65	▲ 1,[illegible]	▲ [illegible]	▲ [illegible]	▲ 20,[illegible]	▲ [illegible]	▲ [illegible]	▲ 10,[illegible]	▲ [illegible]	▲ 66	[illegible]	▲ [illegible]	
4	PD	BUNKERS																								
5	PE	STOCK CHANGE	▲ [illegible]	[illegible]	▲ 1,3[illegible]	[illegible]	▲ [illegible]	▲ [illegible]		▲ 5,[illegible]	[illegible]	[illegible]	▲ [illegible]	▲ [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	▲ [illegible]	[illegible]		▲ [illegible]	▲ [illegible]
6	P	DOMESTIC PRIMARY ENERGY	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	▲ [illegible]	▲ [illegible]	[illegible]	▲ 1,[illegible]	▲ [illegible]	[illegible]	▲ [illegible]	[illegible]	[illegible]	▲ 12,[illegible]	▲ [illegible]	▲ [illegible]		[illegible]	[illegible]
7	IA	PUBLIC UTILITIES	▲ [illegible]			▲ [illegible]	▲ [illegible]			▲ 22,5[illegible]	▲ [illegible]	▲ [illegible]		▲ [illegible]				▲ [illegible]			▲ [illegible]				▲	▲ [illegible]
8	IB	PUMP UP HYDRO																								
9	IC	(JOINT UTILITIES)	(▲ [illegible])			(▲ [illegible])				[illegible]	(▲ 7,5[illegible])	(▲ 7,5[illegible])						(▲ 7,5[illegible])			(▲ 7,5[illegible])					
10	ID	AUTO GENERATION									▲ [illegible]	▲ [illegible]						▲ [illegible]			▲ [illegible]			▲ [illegible]		
11	IE	TOWN GAS								▲ [illegible]	▲ 2,[illegible]	▲ [illegible]		▲ 1,[illegible]			▲ [illegible]								▲ [illegible]	▲ [illegible]
12	IF	GAS COKE	▲ 4,[illegible]	▲ [illegible]	▲ [illegible]																					
13	IG	IRON AND STEEL COKE	▲ [illegible]	▲ 5,[illegible]	▲ 34,[illegible]			▲ [illegible]																		
14	IH	COKE PRODUCER	▲ [illegible]	▲ 1,[illegible]	▲ [illegible]	▲ [illegible]		▲ [illegible]																		
15	II	BLAST FURNACE GAS						▲ [illegible]																		
16	IJ	BRIQUET	▲ [illegible]	▲ [illegible]		▲ [illegible]	▲ [illegible]	▲ [illegible]																		
17	IK	REFINERY								▲ [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
18	IL	PETROCHEM LPG																								
19	CA	PUBLIC UTILITIES									[illegible]	▲ [illegible]		▲ [illegible]											[illegible]	
20	CB	TOWN GAS																								
21	CC	REFINERY																								
22	CD	BRIQUET									▲ [illegible]	▲ [illegible]	▲ [illegible]	▲ [illegible]		▲ [illegible]	▲ [illegible]	▲ [illegible]	▲ [illegible]	▲ [illegible]	▲ [illegible]	▲ [illegible]	▲ [illegible]	▲ [illegible]	▲ [illegible]	
23	CE	COKE PRODUCER	▲ [illegible]			▲ [illegible]																				
24	CF	COAL MINE	▲ [illegible]	▲ [illegible]		▲ [illegible]																				
25	CG	CRUDE OIL,GAS PRODUCER							▲ [illegible]																	
26	CH	LOSS																								▲ [illegible]
27	CI	STATISTICAL DIFFERENCE	▲ [illegible]	[illegible]	▲ 1,[illegible]	[illegible]	▲ [illegible]	▲ [illegible]	[illegible]	▲ [illegible]	[illegible]	▲ [illegible]	[illegible]	▲ [illegible]	▲ [illegible]	▲ [illegible]	▲ [illegible]	[illegible]	▲ [illegible]	▲ [illegible]	[illegible]	[illegible]		[illegible]	▲ [illegible]	[illegible]
28	F	FINAL ENERGY																								
29	FA	INDUSTRY(TOTAL)	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]
30	FB	AGRICULT.FORESTRY									[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				[illegible]	[illegible]
31	FC	FISHERY									[illegible]	[illegible]				[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]					
32	FD	MINING(EXCEPT ENERGY)									[illegible]	[illegible]				[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]					
33	FE	CONSTRUCTION									[illegible]	[illegible]				[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]					
34	FF	MANUFACTURING(TOTAL)	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				[illegible]	[illegible]
35	FG	FOODS	[illegible]			[illegible]					[illegible]	[illegible]	[illegible]					[illegible]	[illegible]	[illegible]	[illegible]					
36	FH	TEXTILE									[illegible]	[illegible]	[illegible]					[illegible]	[illegible]	[illegible]	[illegible]					
37	FI	PAPER,PULP	[illegible]			[illegible]					[illegible]	[illegible]						[illegible]	[illegible]	[illegible]	[illegible]					
38	FJ	CHEMICALS	[illegible]	[illegible]		[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]				[illegible]	[illegible]	[illegible]	[illegible]				[illegible]	[illegible]
39	FK	(PETRO CHEMICALS)																								
40	FL	NON METALLIC MINERAL PRODUCTS	[illegible]			[illegible]	[illegible]	[illegible]			[illegible]	[illegible]						[illegible]	[illegible]	[illegible]	[illegible]					
41	FM	(CEMENT)																								
42	FN	IRON AND STEEL	[illegible]			[illegible]					[illegible]	[illegible]						[illegible]	[illegible]	[illegible]	[illegible]					
43	FO	(BLAST FURNACE)																								
44	FP	NON FERROUS METALS									[illegible]	[illegible]						[illegible]	[illegible]	[illegible]						
45	FQ	(ALUMINUM)																								
46	FR	METAL PRODUCTS,MACHINERY									[illegible]	[illegible]						[illegible]	[illegible]	[illegible]	[illegible]					
47	FS	OTHERS	[illegible]	[illegible]		[illegible]					[illegible]	[illegible]				[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				[illegible]	[illegible]
48	SA	RESIDENTIAL AND COMMERCIAL(TOTAL)	▲ [illegible]			▲ [illegible]			▲ [illegible]		[illegible]	[illegible]				[illegible]		[illegible]	[illegible]	[illegible]	[illegible]				[illegible]	
49	SB	RESIDENTIAL(TOTAL)																								
50	SC	COOLING,HEATING																								
51	SD	COOKING																								
52	SE	OTHERS																								
53	SF	COMMERCIAL(TOTAL)	▲ [illegible]			▲ [illegible]			▲ [illegible]																	
54	SG	COOLING,HEATING																								
55	SH	OTHERS																								
56	TA	TRANSPORTATION(TOTAL)	[illegible]			[illegible]					[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				[illegible]	
57	TB	RAILWAY	[illegible]			[illegible]					[illegible]	[illegible]				[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
58	TC	OTHERS									[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				[illegible]	
59	KJ	PASSENGERS(TOTAL)																								
60	KE	RAILWAY																								
61	KF	CAR																								
62	KG	BUS																								
63	KH	SHIP									[illegible]	[illegible]	[illegible]			▲ [illegible]	▲ [illegible]	▲ [illegible]	▲ [illegible]	▲ [illegible]	▲ [illegible]					
64	KI	AVIATION									▲ [illegible]	▲ [illegible]				▲ [illegible]	▲ [illegible]	▲ [illegible]	▲ [illegible]	▲ [illegible]	▲ [illegible]					
65	KJ	CARGO(TOTAL)									▲ [illegible]	▲ [illegible]	▲ [illegible]													
66	KK	RAILWAY																								
67	KL	TRUCK																								
68	KM	SHIP																								
69	KN	AVIATION																								
70	N	NON-ENERGY									[illegible]											[illegible]	[illegible]			

(GROSS CALORIE)　　　　NETTO TABLE 2

No.	Code	Item	25 LNG	26 Natural gas f. coal mine	27 Town gas	28 Coke	29 Coke oven gas	30 Blast furnace gas	31 [illegible]	32 Wood	33 Char coal	34 Electricity	35 Public utilities	36 Thermal	37 Hydro	38 Pump up	39 Nuclear	40 Geothe-rmal, others	41 Auto generation	42 Thermal	43 Hydro	44 Others	45 Total
			10^9Kcal	10^9Kcal	10^9Kcal	10^9Kcal	10^9Kcal	10^9Kcal	10^9Kcal	10^9Kcal	10^9Kcal	10^9Kcal	10^9Kcal	10^9Kcal	10^9Kcal	10^9Kcal	10^9Kcal	10^9Kcal	10^9Kcal	10^9Kcal	10^9Kcal	10^9Kcal	10^9Kcal
1	PA	PRIMARY ENERGY DOMESTIC		22[illegible]						963	51				18,54[illegible]		4,555				1,5[illegible]		42,6[illegible]
2	PB	IMPORT	4,999			153																	332,2[illegible]
3	PC	EXPORT				▲ 512																	▲ 22,8[illegible]
4	PD	BUNKER																					
5	PE	STOCK CHANGE				▲ 22																	▲ 8,2[illegible]
6	P	DOMESTIC PRIMARY ENERGY	4,999	224		▲ 367				963	51				18,54[illegible]		4,555				1,5[illegible]		345,5[illegible]
7	TA	PUBLIC UTILITIES	▲ 3,28[illegible]				▲ 853	▲ 2,6[illegible]				34,05[illegible]	34,35[illegible]		▲ 18,54[illegible]		▲ 4,555						▲ [illegible]
8	TB	PUMP UP HYDRO										29	29										29
9	TC	(JOINT UTILITIES)					▲ 563	▲ 2,65[illegible]															
10	TD	AUTO GENERATION					▲ 28	▲ 1,557				5,274									▲ 1,55[illegible]		▲ 5,53[illegible]
11	TE	TOWN GAS	▲ 1,30[illegible]		2,423	▲ 57	▲ 1,866	▲ 167															224
12	TF	GAS COKE				2,619	1,254																63
13	TG	IRON AND STEEL COKE				20,873	7,938																▲ 3,55[illegible]
14	TH	COKE PRODUCER				5,321	1,354																▲ 66
15	TI	BLAST FURNACE GAS				▲ 11,653		11,174															▲ 558
16	TJ	BRIQUET							[illegible]														▲ [illegible]
17	TK	REFINERY																					▲ 55[illegible]
18	TL	PETROCHEM LPG																					▲ 69
19	EA	PUBLIC UTILITIES										▲ 1,300	▲ 1,300										▲ 1,300
20	EB	TOWN GAS			▲ 563							▲ 12[illegible]	▲ 12[illegible]										▲ 668
21	EC	REFINERY										▲ 521	▲ 308						▲ 213				▲ 19,3[illegible]
22	ED	BRIQUET																					
23	EE	COKE PRODUCER				▲ 73	▲ 867	▲ 567															▲ 1,50[illegible]
24	EF	COAL MINE		▲ 165								▲ 143	▲ 74						▲ 66				▲ 39[illegible]
25	EG	CRUDE OIL,GAS PRODUCER																					▲ 35[illegible]
26	EH	LOSS										▲ 2,315	▲ 1,863						▲ 353				▲ 2,2[illegible]
27	EI	STATISTICAL DIFFERENCE	▲ [illegible]	▲ 53	▲ 73	1,621	▲ 258	▲ 353															1,33[illegible]
28	F	FINAL ENERGY		18	8,605	26,063	5,363	5,162	679	963	51	36,052	30,63[illegible]						4,85[illegible]				253,[illegible]
29	IA	INDUSTRY(TOTAL)		18	832	25,752	5,292	5,252				23,336	19,87[illegible]						4,65[illegible]				159,3[illegible]
30	IB	AGRICULT.FORESTRY										62	62										2,65[illegible]
31	IC	FISHERY																					4,5[illegible]
32	ID	MINING(EXC.ENERGY)										151	123						32				6[illegible]
33	IE	CONSTRUCTION										22	22										1,0[illegible]
34	IF	MANUFACTURING(TOTAL)		18	832	25,752	5,292	5,152				23,124	19,733						4,33[illegible]				145,1[illegible]
35	IG	FOODS										845	832						14				4,7[illegible]
36	IH	TEXTILE										985	961						2				6,5[illegible]
37	II	PAPER,PULP										1,833	862						567				6,5[illegible]
38	IJ	CHEMICALS				251						4,563	2,25[illegible]						1,863				38,3[illegible]
39	IK	(PETRO CHEMICALS)										▲ 1,461	▲ 461						▲ 557				
40	IL	NON METALLIC MINERAL PRODUCTS				233						1,556	1,402						155				12,5[illegible]
41	IM	(CEMENT)										▲ 601	▲ 523						▲ 164				
42	IN	IRON AND STEEL				25,622	5,292	5,152				8,443	5,575						377				55,1[illegible]
43	IO	(BLAST FURNACE)				▲ 21,432	▲ 1,435	▲ 5,263				▲ 3,341	▲ 2,680						▲ 662				
44	IP	NON FERROUS METALS				304						2,616	2,25[illegible]						513				4,8[illegible]
45	IQ	(ALUMINUM)										▲ 1,654	▲ 1,241						▲ 454				
46	IR	METAL PRODUCTS,MACHINERY				119						2,421	2,405						1				6,5[illegible]
47	IS	OTHERS		18	830	38						1,543	1,485						66				19,5[illegible]
48	RA	RESIDENTIAL AND COMMERCIAL(TOTAL)			5,874	58			597	963	51	12,658	12,65[illegible]						[illegible]				45,7[illegible]
49	RB	RESIDENTIAL(TOTAL)			4,341																		
50	RC	COOLING,HEATING																					
51	RD	COOKING																					
52	RE	OTHERS																					
53	RF	COMMERCIAL(TOTAL)			1,533																		
54	RG	COOLING,HEATING																					
55	RH	OTHERS																					
56	TA	TRANSPORTATION(TOTAL)							82			1,157	956						151				46,2[illegible]
57	TB	RAILWAY							82			1,157	956						131				2,5[illegible]
58	TC	OTHERS																					43,6[illegible]
59	TD	PASSENGERS(TOTAL)																					
60	TE	RAILWAY																					
61	TF	CAR																					
62	TG	BUS																					
63	TH	SHIP																					
64	TI	AVIATION																					
65	TJ	CARGO(TOTAL)																					
66	TK	RAILWAY																					
67	TL	TRUCK																					
68	TM	SHIP																					
69	TN	AVIATION																					
70	N	NON ENERGY																					6,5[illegible]

Fig. 2-1 Chart of Demand-Forecast Method Concept



3. Use of Computerized System for Refinery Operation and Transportation Planning

3-1 Present Status in Pertamina

From the view-point of oil product marketing and distribution, whole country of Indonesia is divided into 8 sales areas. Sales managers are assigned for each sales area and the estimation of area demand forecast are made by them and are reported to Pertamina's Head Office. The accumulated total of each area's demand figures are checked at the Directorate Domestic Supply & Transportation against historical records, economic indices, etc., and revisions are made if necessary to derive the final annual demand forecast.

The supply of oil products in Indonesia relies on domestic refineries' production and importation. The basic philosophy of refinery operation planning in Indonesia is to maximize domestic middle distillate production while minimizing import volume, under the specific demand pattern of oil products with high requirement in middle distillate products. Heavy fuel oil is normally in excess, and the surplus volume is exported. Along with those supply-demand plannings, the plannings on product transportation are also required. Such periodical plans on demand, refinery operation, import, export, and transportation are compiled and submitted to the Board of Directors for approval after which the total annual operation plan is turned for implementation.

The above routine is shown in the schematic chart on the Figure 3.1.1. Besides the abovementioned annual plans, the 5-year plans, the quarterly plans, and the monthly plans are made at Pertamina and a periodic review of each plan is made as shown in the Figure 3.1.2.

Production plannings of the refineries are handled by the Directorate Manufacturing of the Head Office of Pertamina. At present there are eight refineries in Indonesia which are grouped into the five units, as shown in the Table 3.1.1. Production planning is made on the basis of each unit, and not on each of the eight refineries. Product volume by kinds of oil are allocated to the each refining unit, considering the capacities of the respective refining units and the demand of each sales area, kinds and volume of crude oil, product quality level and plant throughout. Mathematical methods are used for this production planning. There are three linear programmings (LP) models presently used at Pertamina as shown in the Table 3.1.2. Among these, the LP model used in the head office is an integrated LP model incorporating the eight sales areas and the five refinery units. The refinery LP models used at Pertamina have been succeeded from Shell Oil and Stanvac and have been modified to meet the present requirements of Pertamina. Besides the above three LP models, a refinery LP model is now under development at Pangkalan Brandan. For this development a specialist from the head office is working as an advisor and the actual model construction is done by the refinery staff.

Block Flow Diagrams of the Refineries are as shown in the Tables 3.1.3 to 3.1.7. The operational records of the refining plants are reported periodically to the Head Office on a 10 days and 3 months basis. These reports include volume of crude oil processed, oil products manufactured, inventory volume, change of process plants and facilities, refining costs, etc.

The data on refinery operations are available at both the refineries and the head office. At the Refinery Units where computers are installed, the daily records of crude oil processed, plant operations, inventory, etc. are computerized, however, the on-line system to send these records to the head office has not been implemented yet.

Fig. 3-1-1 Supply Demand Transportation Program

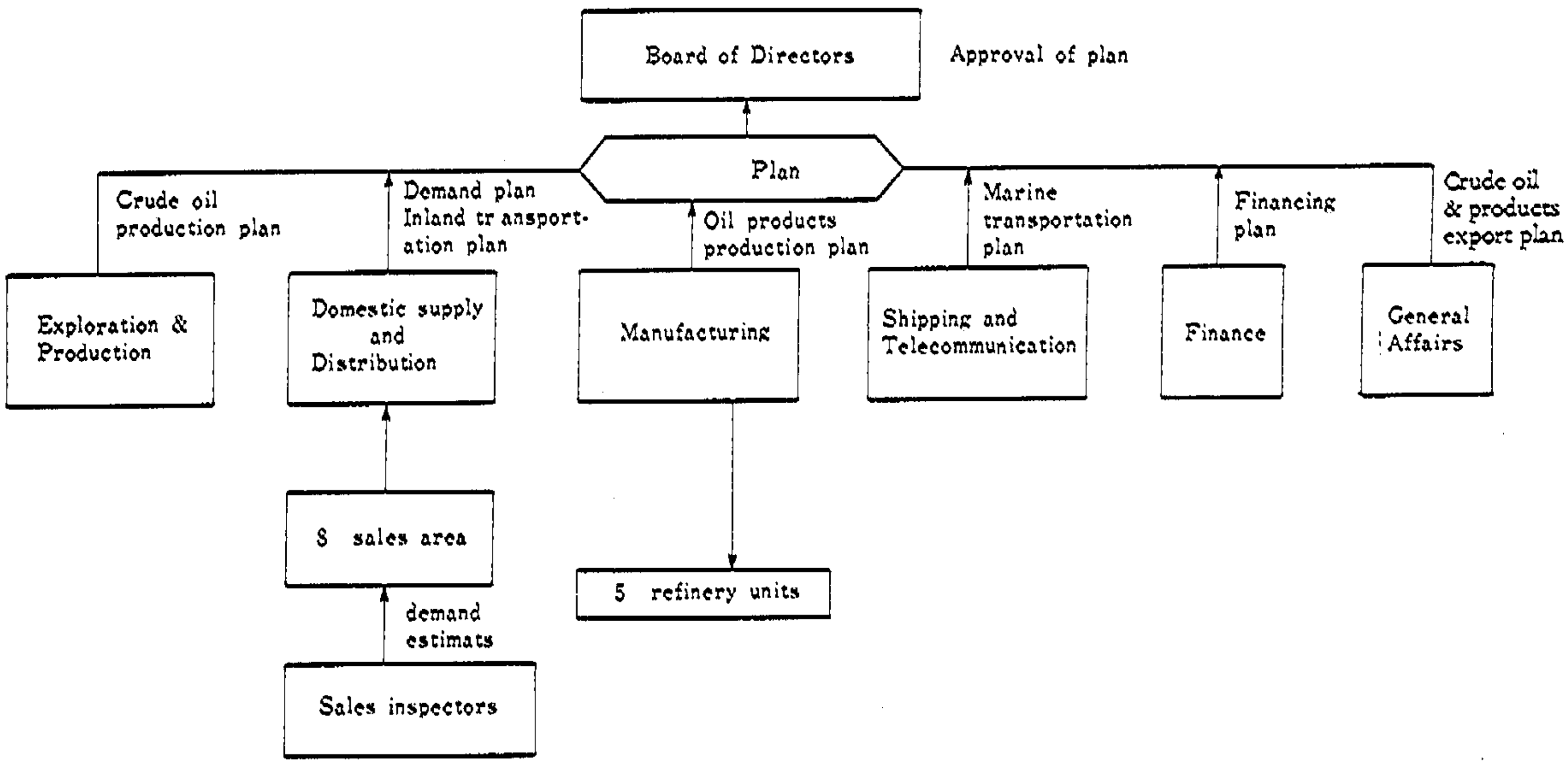


Fig. 3-1-2 Periodic review of Plan

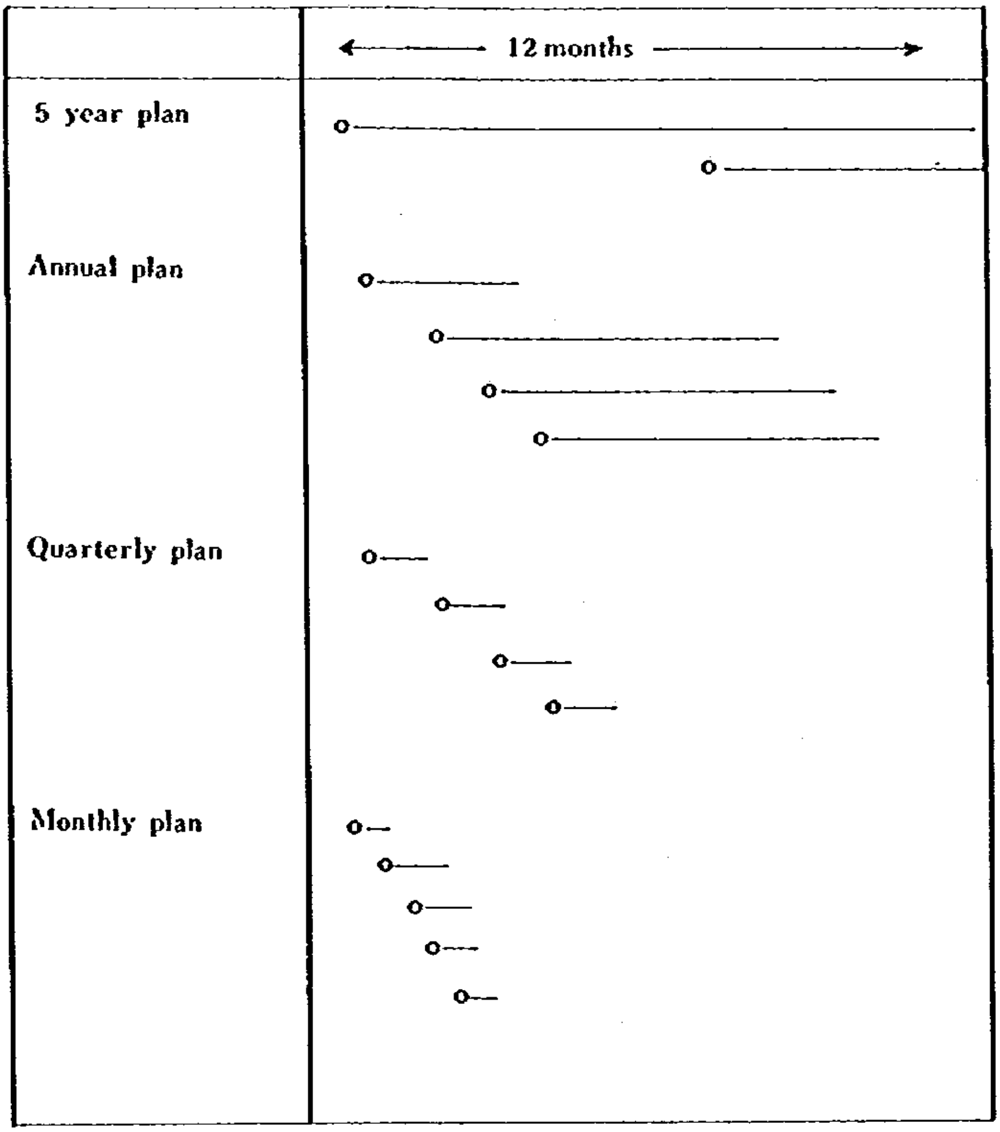


Fig. 3-1-3 Unit 1 Pangkalan Brandan Refinery

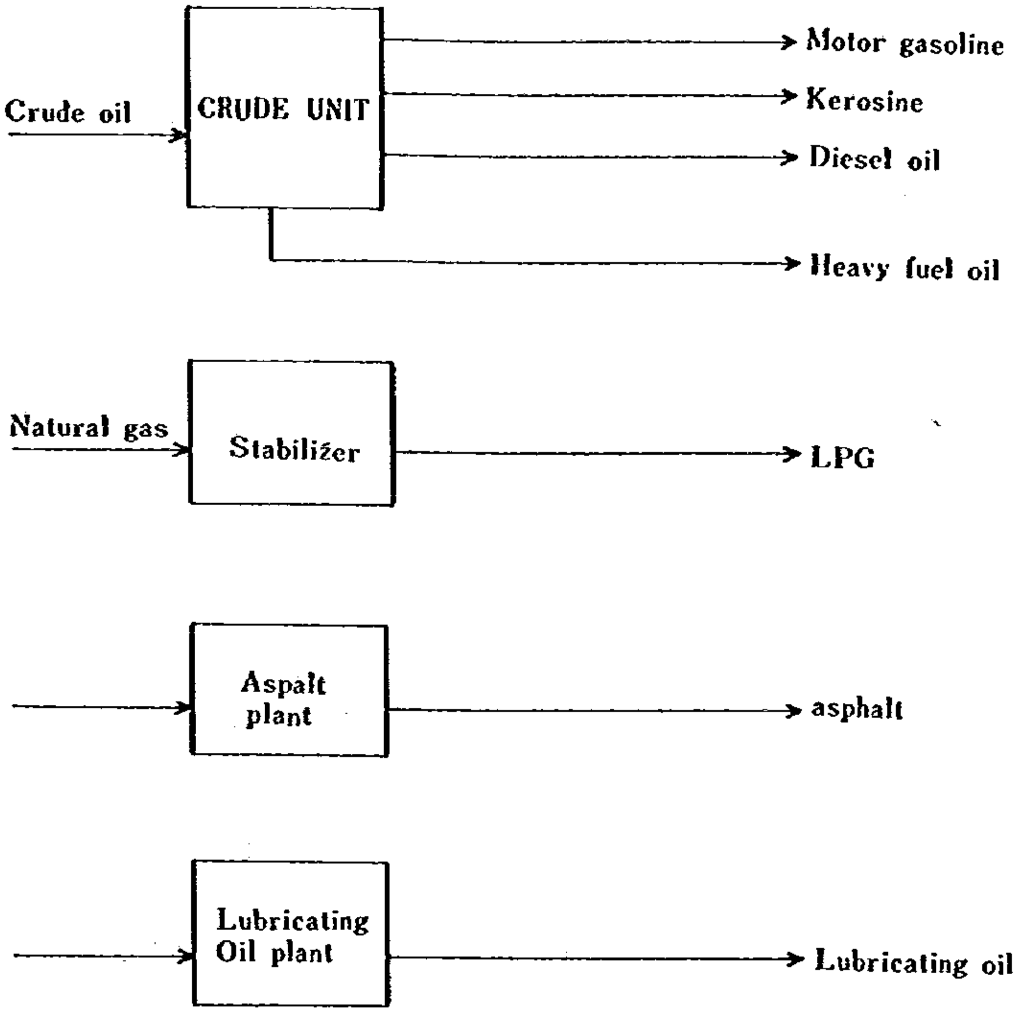
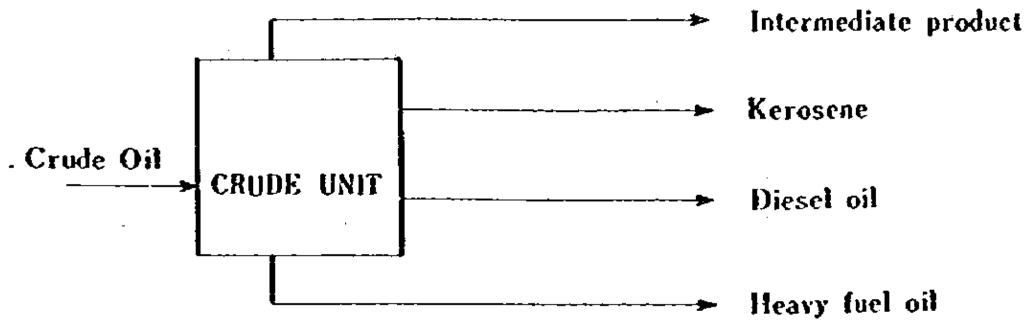


Fig. 3-1-4 Unit II Sungai Pakuning and Dumai Refinery



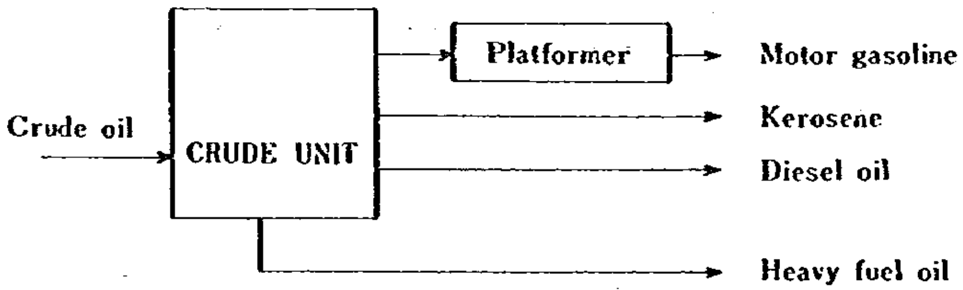
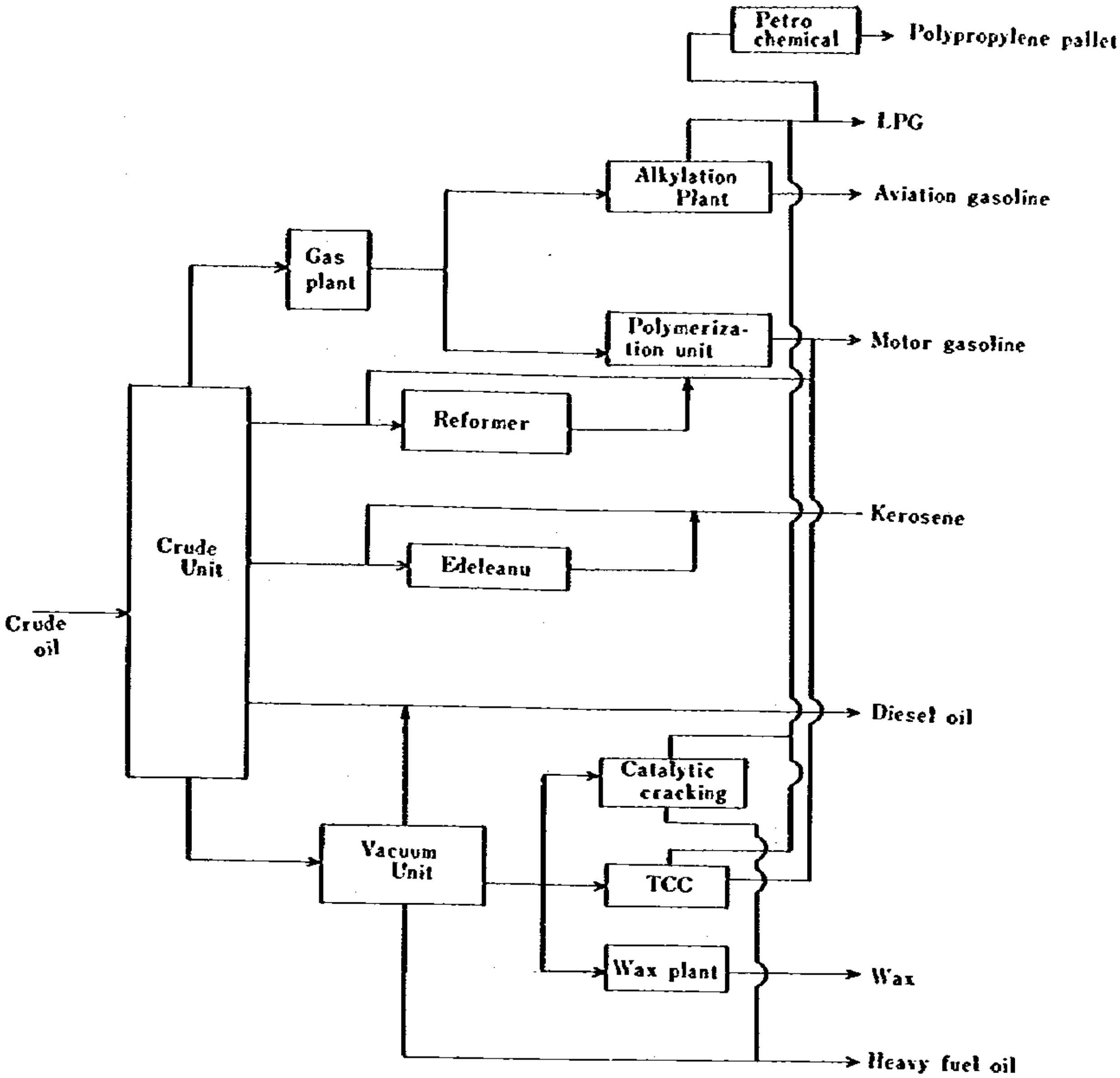


Fig. 3-1-5 Unit III Musi Refinery



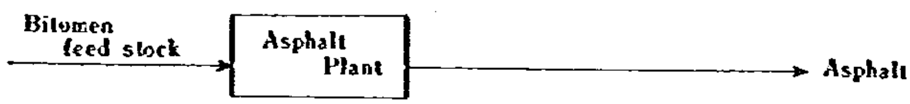


Fig. 3-1-6 Unit IV Cilacap Refinery

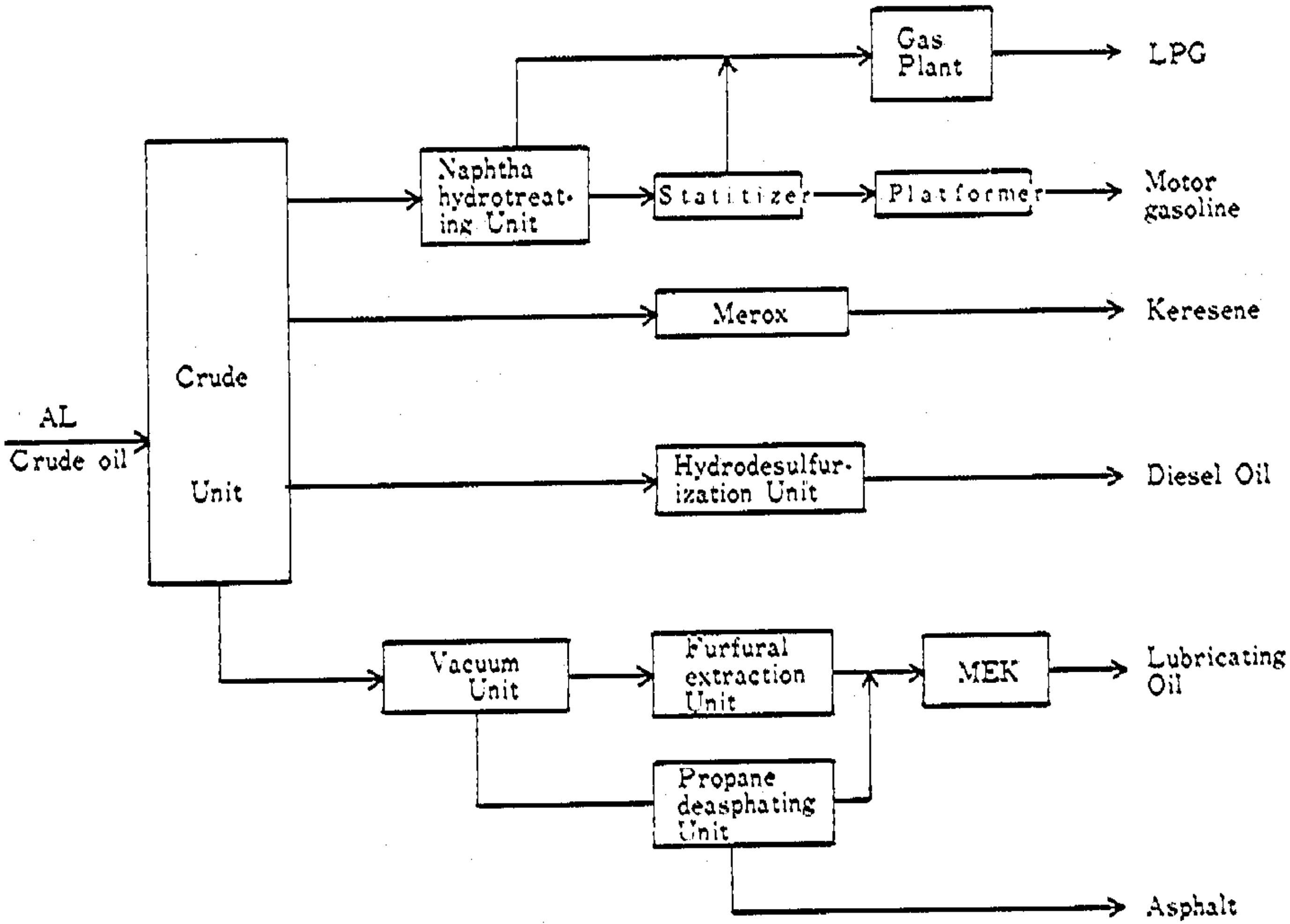
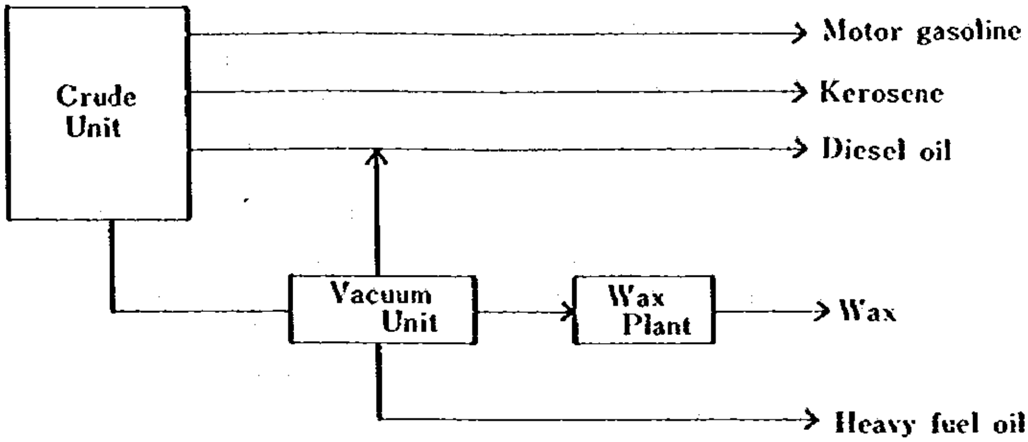


Fig. 3-1-7 Unit V Balikpapan Refinery



Oil products are transported by the marine and the land transportations. The marine transportation is handled by the Directorate of Shipping and Telecommunications, and inland transportation by Directrate Domestic Supply & Distribution, and from the refinery to the shipping pier by Directorate Manufacturing.

Most of the marine transportation is carried by the Pertamina's own tankers, time charter and hired ones. Data collection of marine transportation is on the way and the distance table is already prepared, while the collection tanker performance data is in progress. This tanker performance includes sailing time, demurrage, bunker fuel consumption and sailing distance. It is mentioned that implementation of the computerized data base in this field is being development. Regarding tanker performance, the standardized reports are planned to be collected, however, the data from the receiving port of the ships are collected only in a incomplete condition, unfortunately. Though the generation of the ton-mile tariff table which reflects the transportation distance is planned, at present, only average transportation costs are available for clean and black products respectively. Land transportation is made by pipeline, tank car, and tank lorry. Tank car transportation is made by Pertamina's own tank cars, operation service of which consigned to the National Railway, and the fuel necessary for the operation service is paid in kind. Tank lorry transportation is carried out either by Pertamina's tank lorry, by private transportation companies, or by the respective customers.

The present status of the transportation of oil products is as above, and for the drafting of the transportation plan, the computerized techniques, such as transportation LP models are not yet applied.

3–2 Utilization of the Computers in Japan on Refinery Operation and Transportation Planning

Comparing with the present situation in Indonesia, the utilization of computers in Japan in the fields of refinery operation and transportation planning is considered to be more extensive and experienced. Therefore to introduce the examples of computer applications in Japan for the above fields will surely be meaningful to support further development of the application of computers at Pertamina for its planning works in the future.

The utilization of computers in a refinery covers a broad field such as plant operation, sales, accounting, finance, and personnel. Compared with other industries, the characteristics of the computer application in the refining industry will be (1) computer application for planning works is well established, particularly by the use of linear programming (LP), and (2) refining companies are very positive in the development of Refinery Management Information System which have been started with computer application for automation of some plants and shipments.

By introducing the examples of application of LP techniques for the planning works in Japan, this report intends to serve as a reference for Pertamina to promote the enhanced computer applications in the future.

(1) Use of LP Model

Among the objects of the use of computers in the refining industry, the most utilized one is the LP calculation for the production planning. The LP procedure of the production planning is as follows:

a. Input Data

Cost, properties and availability of crude oils by kind,
Cost, properties and availability of intermediate products,
Cost and availability of imported oil products,
Demand and sales price of oil products by product,
Capacity of processing unit, severity of operation, operating cost, blending capacity, blending cost,
Oil product specification,
Inventory cost,
Transportation cost,
Other restrictions.

b. Construction of LP Model

Objective function

Material balance (numerical equations of the relations between variables that rules the flow of oil)

Constraint (availability of crude oil, intermediate product and imported product, capacity of facilities, blending capacity, product demand, specification of product.)

c. Optimization Calculation

Optimization calculation by LP Code.

d. Optimal Solution

Value of objective function,
Determining the optimal combinations of the kind and volume of crude oil, intermediate product, oil products, imported,
Operation ratio of processing plants and operation severity,
Blending plan,
Inventory adjustment
Shadow price, reduced cost (useful as data for economic evaluation of the solution)

LP model does not display a complete actual situation of the refinery, but more or less simplified schematic refinery structures as a model. A large scale model is not only too complicated to construct and increasing the load of the computer, but also due to its intricacies make the contents difficult to understand, possibly resulting difficulties in interpretation of the solution. Therefore it is desirable to keep the model as small as possible without deviating from the principle of the refinery. The model should be constructed to satisfy both accuracy and flexibility, i.e. sections or factors which greatly affect the profit should be formulated in detail, on the other hand those sections which are not affected should be simplified.

(2) Various types of refinery models in Japan

Refinery models may be classified into model for the purpose of operational or managerial plannings for single enterprise and such models for macroscopic analysis in whole country or the whole world.

For the purpose of managerial plannings in a company, each enterprise has its own model which includes their own refinery, oil depot, types of transportation, and sales activities. These models vary from one unit refinery model, multi-refinery combined model, to consolidated refinery model in which several refineries are regarded as one unit refinery model. Furthermore, there are models incorporating demand by area, oil depot, transportation data, etc. Various kinds of models are constructed according to the requirements of the specific enterprises.

The followings are the examples of application areas of such models:

i. Long term management and long term investment planning

– Study of the selection of crude oil, investment plan, marketing plan under a long term projections.

– Economic evaluation of the expansion plan of a refinery, i.e. optimal structure of their installations, timing of construction, site selection, etc.

ii. Short-term management planning

– Optimization of the selection of crude oils, plant operation planning and sales and distribution planning.

– Study in profits, improvement planning.

iii. Monthly production planning

– Guide to the monthly production planning of a refinery.

The macroscopic model does not have the direct object to be used for the study of operating conditions of the specific enterprise, but its main object is to be used for the evaluation of various alternative plans from the long term strategic point of view.

For example, it is used for the evaluation of the measures to reduce sulfur emission, study of the relation between import volume of oil and economic activities through the use of input-output table, study of the spread effect of the price of oil or various industries and on international balance of payments, etc. As above, it may not always be satisfactory to apply only LP technique, but it is often necessary to incorporate other techniques such as input-output analysis to construct macroscopic model.

Outlines of some examples of the macroscopic model are as follows:

a. Whole Japan model

This model is a large scale comprehensive LP model which intends to find the optional combination of measures at minimum expenses, satisfying the given demand, product price, environmental conditions, within the limitations of the availability of crude oil, import, oil products import, capacity of existing refinery, availability of new installation capacity. This model was used to analyze how the selection of crude oil and product, selection and operation status of refining facilities, investment requirement of new installation, and cost up of the product manufacturing price change, product demands shift to lighter products side and sulfur emission regulation becomes severer.

In this model, due to the limitation of the model size, assumption is made that the oil refining of all Japan is performed in one refinery; the concept of this refinery model is shown in Fig. 3.2.1.

Following items have been considered as a precondition of the model:

i. Availability and prices of crude oils, properties of each kind of crude oil, yield and properties of atmospheric residue

ii. Availability and prices of oil product to be imported

iii. Oil refining capacity, operation ratio of each unit, operating cost, (fixed cost and variable cost, both in yen/KL unit), construction cost of new installation, a modeling technique which allows the new installation over the existing installation if required is applied.

iv. Demand of oil products

– Demand of products by area is classified according to the degree of sulfur emission regulation,

– Demands of large consumers are estimated based on the past records and accumulation of plans. Where such method is not applicable, allocation is made considering the estimated industrial output amount, etc.

– LP model is constructed to optimize the selection from among naphtha, high pour point low sulfur heavy fuel oil, low pour point low sulfur heavy fuel oil, high sulfur heavy fuel oil, crude oil satisfying sulfur emission regulation by area taking costs of fuel gas desulfurization, fuel gas denitrification into account.

v. Refinery fuel

Refinery fuel requirement is calculated by this model. Model allows the refinery to supply LPG and naphtha for hydrogen production separately. With the refinery besides the normal demand.

LP Model is constructed based on the estimated value according to the refinery scheme as shown on Fig. 3.2.1 and precondition mentioned above. Furthermore by making case studied of alternative conditions for selection of units, conditions for volume of burning crude oil, conditions for availability of crude oil, conditions for import products, analyses were made on the selection of crude oil, change of refinery unit, investment, change of refining cost, and countermeasures were studied against the increasing demand of white oil products.

b. World Model

World Oil Trading Simulator (WOTS) is a representative example. This LP model has been developed for the purpose of studying the flow of crude oil, and oil products on a world wide scale, and includes crude oil production, refining and transportation to meet the demand of oil products in the world.

In this model the whole world is divided into several areas or countries (capable to divide up to 25 areas or countries) production of crude oil is allowed in each area or country (capable to handle

50 kinds). By connecting organically areas or countries of their import/export of crude oil and import/export of crude oil and import/export of products, and establishing the necessary factors as as below, the model provides the users with optional solution of the production and movement of crude oil and product for each area or country.

Factor

i. Crude oil

Production, yield (gasoline, swing, middle distillate, residual oil, sulfur content)

ii. Refinery

Refining, desulfurization and cracking capacity, rate of operation, desulfurization ratio, cracking ratio.

iii. Market

Demand by products (gasoline, naphtha, kerosene, diesel oil, high sulfur heavy fuel oil, low sulfur heavy fuel oil, etc.) demand of crude oil burning, sulfur emission regulations.

iv. Cost

FOB price of crude oil, cost of refining, transportation, tariff, desulfurization cost.

v. Pipeline

Pipeline capacity (crude oil, product) transportation cost

Major points of the structure of the model are as follows:

i. Objective function

Cost minimization is the objective function with demand volume as exogenous variable.

ii. Crude oil

In case crude oil is transported to importing countries from producing countries, transportation cost is charged in addition to FOB price of crude oil. The volume allowed for importation is, of course, limited within the production volume of the subject crude oil.

iii. Refining

Crude oil shipped to each country is then shipped to refinery and refined into various products. Refining scheme differs according to area/countries as shown on Fig. 3.2.2–3.2.5.

iv. Oil product

After refined at the refineries, the products will be supplied to the domestic market and then the surplus will be shared for export. Export product, with transportation cost added, will supply the domestic demand of importing area or country.

v. Pipeline

There are pipelines for crude oil and oil product, transportation of each is available within the flow capacity of the pipelines. Pipeline cost is added up.

vi. Crude oil production increase

By using the model it is possible to select a certain crude oil over the production limit. The model assigns penalty for the additional portion of production in such case. The underlying is that the cost of the newly increased production is not the same as the previous production and thereby in the first place to enable the consumption of the presently available crude oil.

On the basis of the above factors and model structure, the total cost will be given according to the following equation:

Total cost = FOB price + refining cost + crude oil transportation cost + oil product transportation cost + tariff + (penalty for crude oil production increased)

Various case studies can be performed by using this model. Studies are conceivable for the selection of the crude oils in each area or country on the leading markets with and without constraints both politically and economically. It is also possible to consider the effect of pollution control on the selection between high priced low sulfur clude oil and desulfurization measures. This model has a weak point in examining the world oil flow on the basis of either complete free market or complete economical rationality to seek the most efficient use of the oil resource of the world as a whole. That is, the factors of political or non-competition can only be treated as exogenous variable. But still this model is considered as a kind of "Policy Model"–being a useful tool that supplies the efficient frame to avaluate the selection of policies of the oil consuming countries or oil exporting countries.

3–3 Points at Issue and Measure to Improve Regarding Use of Computers for the Oil Refinery Operation and Transportation Planning at Pertamina

According to Directorate Manufacturing which is in charge of the planning of the refinery operation of Pertamina, it is said that "There is nothing to request for the cooperation of Japan regarding the operation planning of the refinery – but will welcome any suggestion or recommendation from the Japanese side." They recognize that "At present the operation planning of the refinery is done well without any problems, but the points at issue is the estimate of demand which is the precondition for planning – since if the forecast is wrong the production plan of the oil products estimated by the Directorate Manufacturing will be wrong. It is understood that demand forecast is difficult but it is necessary to solve this problem." As far as the production planning of the refinery is concerned, the above will apply, but possession of a better tool leads to better planning, and in this sense there will be much room to be expected for the technical cooperation of Japan.

From the standpoint of a better planning by better tools, the following are suggested as possible items for technical cooperation by Japan.

a. Middle term demand forecast by utilizing Data Bank
b. Construction of data bank for marine transportation
c. Inclusion of transportation cost in LP Model
d. Development of long term installation planning model.
e. Short term demand forecast by utilizing Data Bank

Normal procedure of demand forecast by the Japanese oil companies is that they total the requirements of the branches of oil companies, while considering the requirements for the direct sales at head office, economic growth, and elasticity etc., they perform the macro check, and arrive at their own demand estimates. Actually, however, the frame is determined by the oil supply plan projected annually by MITI (Ministry of International Trade & Industry). Although competition among oil companies are done, the situation of the market occupancy ratio hardly changes within this frame.

Pertamina is the only integrated oil companies in Indonesia covering oil production, refining, sales, import/export, transportation activities, and cannot be regarded in the same light as the private oil companies of Japan.

Rather, the planning works for the demand supply program at Pertamina corresponds to that of supply plan at MITI. The supply planning program of MITI on the demand estimate of oil products is made on the precondition of Government's economic forecast and economic planning and are performed as is shown in the Table 3.3.1.

As can be seen from this table, various techniques are applied to estimate demands of oil products, i.e. trend analysis, estimated number of cars multiplied by unit consumption to arrive at gasoline for motor cars, accumulating method, production trend by industries and others, depending on the kind of oil products and usage.

Fig. 3-2-1 General Zalea of Oil Refinery Model

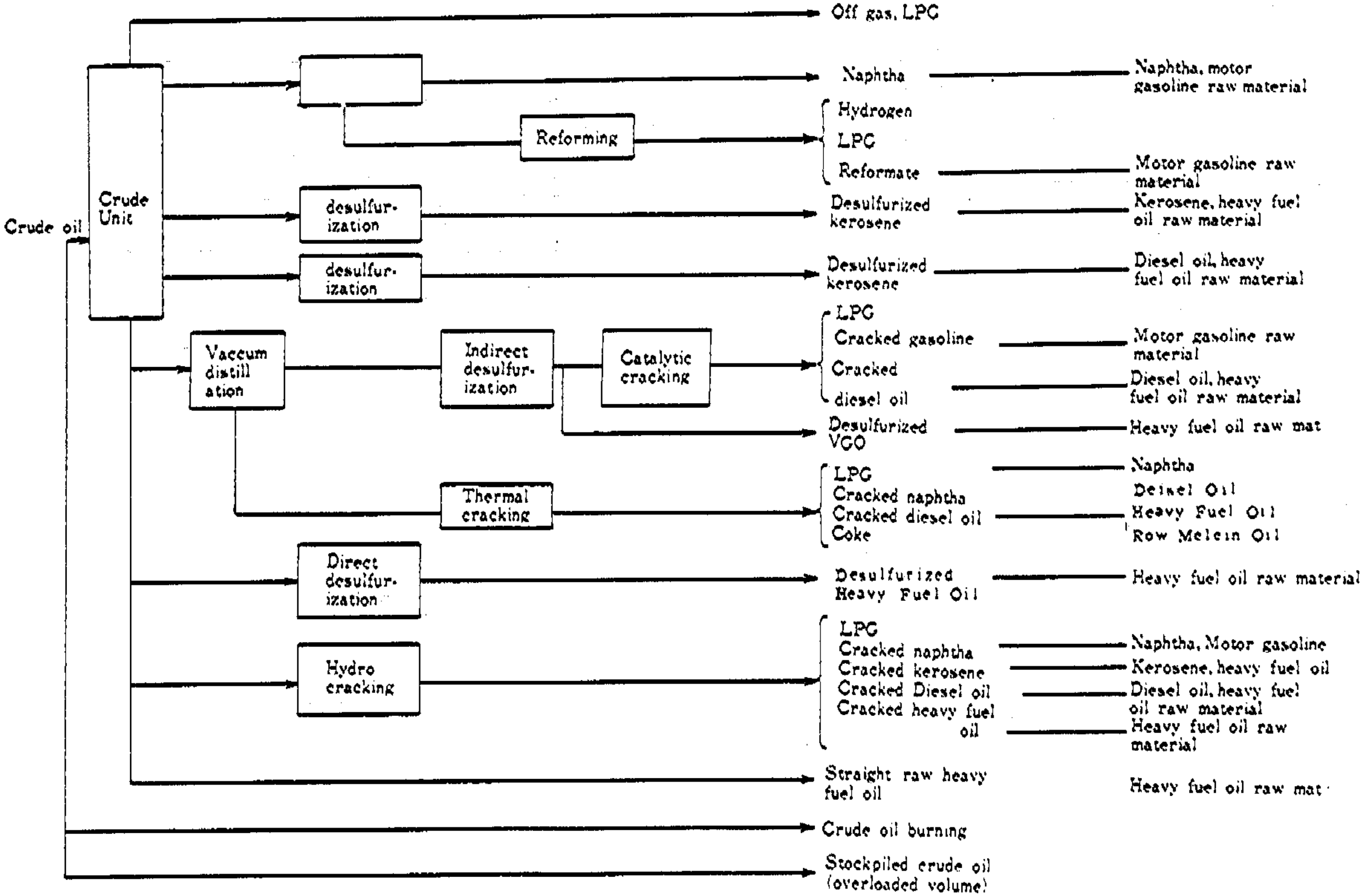


Fig. 3-2-2 Standard Model

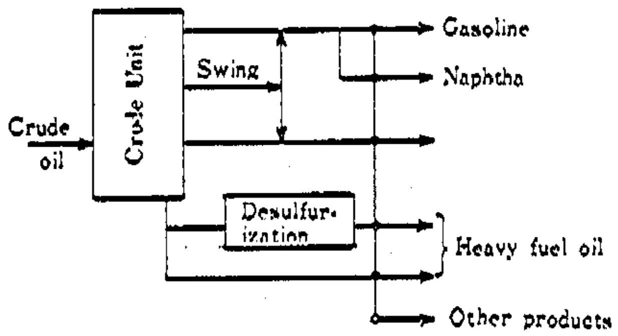


Fig. 3-2-3 Japanese Model

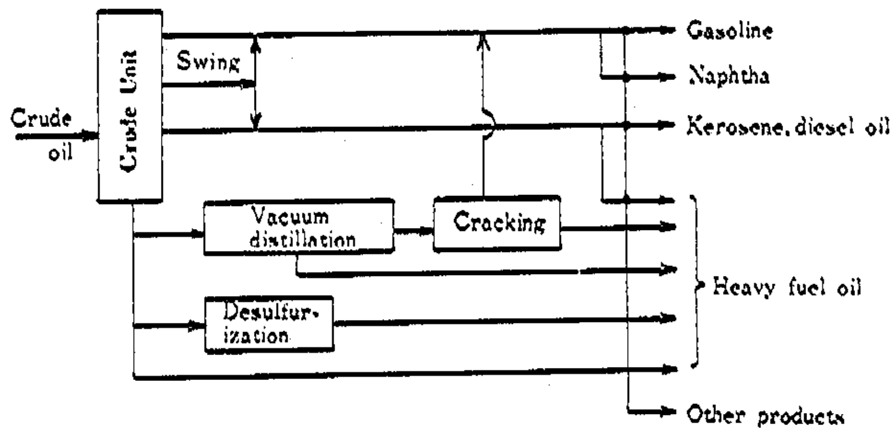


Fig. 3-2-4 European Model

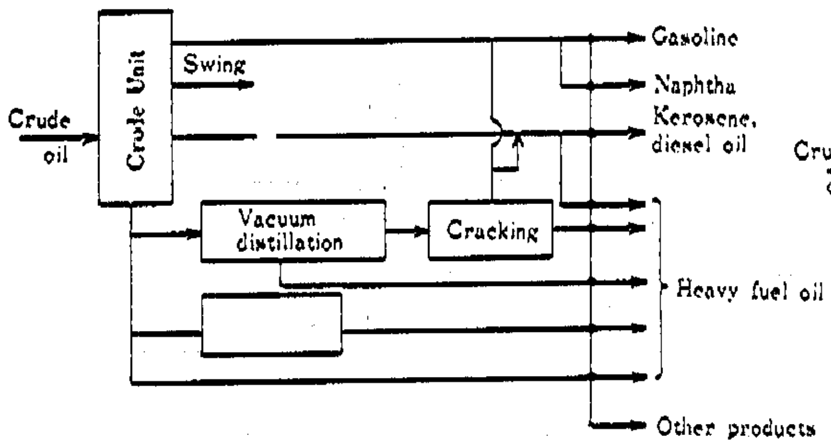


Fig. 3-2-5 American Model

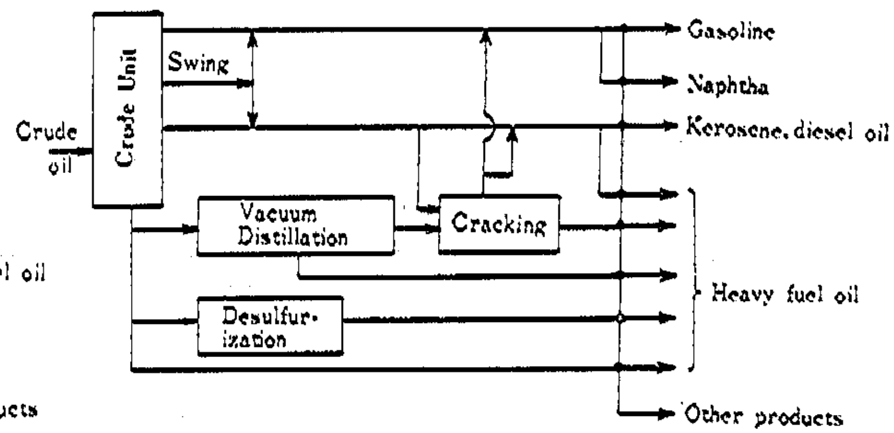


Table 3.3.1 Method to estimate demand of oil products

Kind of oil	Use for	Method to estimate demand
(Domestic demand)		
Gasoline	Motor car use	Estimated by number of gasoline cars. Multipled by gasoline consumption per gasoline car. (Number of cars: Utilize the estimation of related governmental bureaus. Per gasoline car consumption: Estimated by time series.)
	Airplane and Industrial	Estimated by time series.
Naphtha	Petrochemical, Gas and Fertilizer	Forecast of raw material consumption by related governmental bureaus. Accumulating method is used.
Jet fuel	Airplane	Estimated by time series.
Kerosene	Agriculture, Forestry and Fishery, Mining, Manufacturing Industries, Construction and Transportation	Estimated by recent production trend of the respective industries.
	Public welfare and Others	Estimated by the multi regression between number of equipment processed and days heating required.
Diesel oil	Motor car use	Estimated by the number of cars driven by diesel oil and fuel consumption per car.
	Others	Estimated by time series analysis for each of National Railway, electricity and ceramics.
Heavy fuel oil	Electricity	Forecast of fuel consumption based on related governmental bureaus' forecast on electric power.
	Mining and Manufacturing	Estimate fuel consumption by time series based on the forecast production trend by related governmental bureaus.
	Others	Estimated by time series.
LPG	Household	Estimated by macro method based on economic indices, LP gas ratio of dissemination into households, unit consumption accumulation method, and accumulation method of ratio of dissemination of equipment, etc.
	Industrial use	Estimated by the correlation with economic indices.
	City gas use	Estimated by the accumulation method of realted governmental bureaus.
	Motor car use	Estimated by the trend of the LP gas driven motor car population and running rate.
	Chemical raw material	By forecast of consumption based on accumulation method of related bureaus.
(Export demand)	International airplane, Foreign vessels, General export use and Special procurement	Estimated based on each company's plan.

b. Construction of data bank for marine transportation

Data on marine transportation cost at Pertamina cannot be refer to as being in a well established status. At present only available are the total expenses and total volume of the marine transportation for clean and black products, respectively. Therefore only average marine transportation costs of clean and black products are available. The price policy of the oil products in Indonesia to maintain the uniform price throughout the country may be a background of the high transportation cost, resulting from the long distance from the refinery to the sales point cannot be reflected on the product price. But for a better drafting of the transportation plan, the establishment of the transportation cost data is indispensable, and a better transportation plan naturally leads to the reduction of the whole transportation cost. Therefore it is necessary to firstly establish the transportation cost data.

Marine transportation at Pertamina is mainly done by its own vessel, time charter and hire purchase, and very little by spot charter. In view of this fact, the first thing to do is to establish the transportation cost data accumulating the tanker performance data, and, based on this, a tariff by route and by size of vessel should be prepared. Since distance table by route has already been prepared at Pertamina, it is possible to prepare this kind of tariff if a decision is made regarding a conversion method by which expenses of own vessels are converted to time charterage or alike. To prepare a highly reliable tariff of this kind, voluminous data are necessary. Collection of data and improvement of reliability should be continued in the future; however, it is desired to start, as early as possible, to apply the available data to the drafting of transportation plan without awaiting complete set of transportation data.

c. Inclusion of transportation cost in LP Model

When constructing the transportation model, the most necessary items are the transportation cost data and transportation form. In general, transportation form varies depending on the harbor conditions, scale of receiving terminal, refining facilities, etc. and route of product transportation and size of tankers to be used are naturally limited. Therefore, to incorporate all the transportation form into a transportation model is impractical. The unnecessary factors and data should be excluded.

At Pertamina, since transportation cost tariff is not available, it is left as a future theme to utilize a transportation model or a combined model which incorporates a refinery model and a transportation model. However, as these models are considered to be very useful tools for better planning, it is recommended that development of these models should be started as soon as possible.

Since it is reported that Pertamina has been trying to develop a LP model similar to the above combined model, application will be immediately materialized when the transportation cost data becomes available. It is also desirable to prepare better tools for the drafting of a better plan for the future, such as complicated transportation model or a little less complicated transportation model combined with refinery model, etc.

d. Development of long term installation plan

LP model is valuable not only as the total for drafting of the refinery operations plan, but also as the tool for the drafting of long term expansion of new installation plan.