SURVEY REPORT ON THE ENERGY SUPPLY-DEMAND PLANNING SYSTEM IN THE REPUBLIC OF INDONESIA

SEPTEMBER 1982

JAPAN INTERNATIONAL
COOPERATION AGENCY

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PREFACE

In response to the request of the Government of the Republic of Indonesia, the Government of Japan has decided to conduct a survey on the Energy Supply-Demand Planning System, and entrusted the survey to the Japan International Cooperation Agency (JICA).

The JICA dispatched to Indonesia a survey team, headed by Mr. Takao TOMITATE, three times during the period from August 17, 1981 to March 18, 1982. The team conducted the survey and had a series of discussions with the officials concerned of the Government of Indonesia.

After the team returned to Japan, further studies were made and the present report has been prepared. I hope that this report will be useful as a basic reference for development of the Energy Supply-Demand Planning System.

I wish to express my deep appreciation to the officials concerned of the Gevernment of Indonesia for their close cooperation extended to the survey team.

September, 1982

Keisuke Arita

President
Japan International Cooperation
Agency (JICA)

Survey Report on the Energy Supply-Demand Planning System in the Republic of Indonesia

CONTENTS

1 OUTLINE OF TECHNICAL COOPERATION AND WORKS IN 1981

1-1 Outline of Technical Cooperation

The commencement of technical cooperation concerning the establishment of the energy supply-demand data bank in the Republic of Indonesia dates back to May 1977. A request for the said technical cooperation was submitted to the Japanese government by Mr. Piet Haryono, the President Director of the Indonesian State Oil and Gas Mining Enterprise (PERTAMINA).

The contents of the cooperation were confirmed between the Republic of Indonesia and Japan after submission of the request. However, there were various unclear points in connection with the Indonesian attitude and preparedness to receive the Japanese, as well as the scope of collection and filing of various data. Thus, the Japanese government dispatched a preliminary survey team to Indonesia from February 28 to March 12, 1978 in order to carry out investigations on technical cooperation concerning the project.

After their return to Japan, the team prepared the "Feasibility Study Report for Technical Cooperation on the Energy Data Bank System of the Republic of Indonesia." Meanwhile, the Indonesian side included the project in the List of Requests for Foreign Assistance (IGGI LIST) of the BAPPENAS, and at the same time submitted a formal request calling for technical cooperation to the Japanese government through the Technical Coordination Committee in the President's Office.

Upon receiving the formal request from the Indonesian government, the Japanese government examined the results obtained from the preliminary survey and studied the request. As a result, in late August 1978, the Japan International Cooperation Agency (JICA) requested the Institute of Energy Economics in Japan to conduct formal investigations on the area of cooperation concerning the establishment of the energy supply-demand data bank. The Institute of Energy Economics performed its field survey from October 15 to November 13.

The objective of the field survey was to determine actual conditions in Indonesia regarding the fields which required Japanese cooperation in establishing the data bank. Thus, it was aimed at obtaining information which would help the Japanese side decide on the forms of cooperation which could be offered to the Indonesian side.

Consequently, the team was to study the situation in Indonesia by conducting the survey primarily on the following items.

1) Data related to petroleum and gas
2) Energy supply-demand forecast, and balance table

3) Utilization of computers at oil refineries
4) Overall computer utilization system
5) Data on energy sources other than petroleum and gas, such as electric power, coal, etc.

After these five survey items had been further broken down into 33 sub-items, the survey was undertaken. The results from the extensive survey, lasting three weeks, were presented in its "Survey Report on the Energy Supply-Demand Data Bank System in the Republic of Indonesia." The basic conditions for the establishment of the Energy Supply-Demand Data Bank (EDB) system as delineated in the report may be summarized as follows.

1) The EDB system shall fall under the control of the MIGAS of the Indonesian Ministry of Mines and Energy, and be utilized by MIGAS and PERTAMINA with the consent of the said Ministry and the Japanese government. The data to be processed at present shall be mainly related to oil and gas, and electronic computers and software at PERTAMINA shall also be employed.

2) The results of the field survey show that MIGAS and PERTAMINA have sufficient data related to petroleum and gas, and in addition, the hardware, software, manpower, etc. to formulate a project to establish EDB system and to execute it.

3) Important factors in establishing the EDB system include: the type of system to be considered, established, maintained, and operated; and ideas and preparations for future improvement.

According to this basic concept, the types of technical cooperation had been classified into two steps: step 1 which was aimed at establishing a comparatively simple EDB system; and step 2, a more complicated large-scacle EDB system. It was noted that technical cooperation should be restricted to step 1 for the present time.

A simple EDB system designed at the first step has the following basic functions: 1) preparation of a basic energy statistical table; 2) preparation of an energy balance table; and 3) midium- and long-term energy supply-demand forecast.

Based on the basic policy described in the survey report, the Japanese government decided to offer and execute technical cooperation required for the establishment of an EDB system in Indonesia in fiscal year 1979, and entrusted the Institute of Energy Economics to undertake the actual activities.

The items for cooperation in 1979 are as described in the following section 1-2. These comprised of the establishment of energy data bases, formulation of the energy balance table, and development of a medium- and long-term energy supply-demand forecast model. For this purpose, JICA dispatched a team of experts three times and one professional to Indonesia, who stayed in the country for 8 months to render technical assistances. On the other hand, Indonesia, too, dispatched a total of twenty personnel including the four, whose expenses were shouldered by JICA, to Japan for training. As the result of such cooperative works based upon the mutual understanding of the two countries, the objectives as planned were achieved.

It is, however, pointed that the Indonesian members were not able to fully assimilate some of the works involved due to the training period being a little short. In the light of the situation, both governments agreed to further conduct the technical cooperation in 1980.

In the technical cooperation of 1980, the follow-up was made on the data bank established in the previous year and the application system of it as well as the setting-up of the energy balance table and a sub-data bank for preparation of an energy balance table and a supply-demand forecast model. The function of the established sub-data bank is to intensify the micro-data obtained from enterprises into the macro-data of the national level. Thus, the establishment of this sub-data bank makes it possible to store the macro-statistics.

Through these 3-year surveys and technical cooperative works, the alignment of energy-related data in Indonesia will be further enhanced to a large degree. It can be said in this context that the cooperation for the energy supply-demand data bank system in Indonesia has completed its first stage.

Based on the achievements in the past, Japan newly offered technical cooperation in fiscal 1981 to help the country prepare medium- and long-term energy supply-demand plans by making the use of the basic data bank system which has been established upon a request made by the Indonesian government. In other words, Japan's technical cooperation related to the energy supply-demand data bank system entered its second stage in fiscal 1981. In the concrete terms, cooperative activities during fiscal 1981 included the preparation of an optimal energy supply model as well as the establishment of a sub-data bank system dealing with energy technological costs required for the said preparation, both of which would be essential when any energy supply-demand plans should be prepared. The activities also included the preparation of an improved energy supply-demand forecast model based on the previous one.

Furthermore, to realize utilization of computers of PERTAMINA in the MIGAS, software required for the establishment of an on-line system was developed. As a result of a series of these technical cooperation, it is expected that Indonesia is allowed to use much improved systems in its preparing various programs involved in the REPELITA IV (Fourth Five-year Economic Development Plan) scheduled to start in 1984.

1-2 Outline of Established Energy Supply-Demand Data Bank

1-2-1 Establishment of Basic Data Bank System

(1) Objective and items of cooperation

Actual cooperative works rendered to Indonesia for the establishment of the EDB system was put into effect from the end of July 1979. The objective was to assist in the establishment of an EDB system which had been necessary for the repletion of an Energy Supply-Demand Scheme, a part of the REPERITA IV set forth by the Indonesian government. Therefore, the scope of the work related to the EDB System Project was agreed upon between the two countries prior to execution of the cooperation. In the resulting Scope of Work, the objective of cooperation is stated as follows:

> "The objective of the project is to enforce Japanese technical cooperation, through her experience and expertise, for the establishment of the data bank for supply-demand of energy, and its utilization system which would enable the formulation of appropriate plans on the supply-demand of energy."

After the results of the field survey of the previous year was studied and necessary adjustment of opinions made, concrete items which required cooperation were narrowed to three:

1) Establishment of an energy data base;
2) Preparation of energy balance tables; and
3) Development of a medium- and long-term energy supply-demand forecast model.

(2) Contents of items which were effected

1) Establishment of an energy data base

The operation for the establishment of an energy data base was roughly separated into two stages of work. The first comprised the design of an overall system which inputs the necessary data by categories under a specified form to create files, perform information retrieval and output. In addition, the development of software required for the system was necessary. The second stage of work was to determine the data to be input into the system, and to input the great bulk of data with a specified form into the computer sequentially, as well as to determine output forms for the necessary data on a monthly or yearly basis. Output was also to be performed sequentially.

2) Preparation of energy balance tables

An energy balance table illustrates in matrix form, using calorific units, the process in which primary energy is transformed into secondary energy in the energy sector, and then consumed by the industry, transportation, and residential and commercial sectors. As a result, in carrying out cooperative activities, the design of a balance table suitable for the conditions in Indonesia was a primary requirement. Next, data which are indispensable for the preparation of the designed balance table had to be collected; and the construction of an equation system for energy balances necessary for the compilation of the designed balance table was required. Finally, software capable of preparing the balance tables by inputting actual data into the equation system had to be developed. As a result, the energy balance tables for Indonesia covering the years from 1969 to 1978 were compiled in this manner.

3) Development of a medium- and long-term energy supply-demand forecast model

Since medium- and long-term, here, refers to a period of five to ten years, process of the works will be: first, to design medium- and long-term forecast model; second and most important, to collect time-series macroeconomic data from the past decade, and collect data related to energy which would not be input to the data bank – indispensable elements for establishing the structural equations of the forecast model, and in deciding the values of exogenous variables; and third, to develop the medium- and long-term model and associated software. With regard to the cooperative operation in this fiscal year, various restrictions were imposed on the development of the model, primarily due to the lack of necessary time-series data. However, sufficient forecast results up to 1990 could be obtained.

The cooperative items were effected in accordance with the above described contents and procedures in Indonesia and Japan respectively, taking the form of a cooperative operation.

Fig. 1-2-1 illustrates the contents and mutual relationship of the cooperative operation and division of labor.

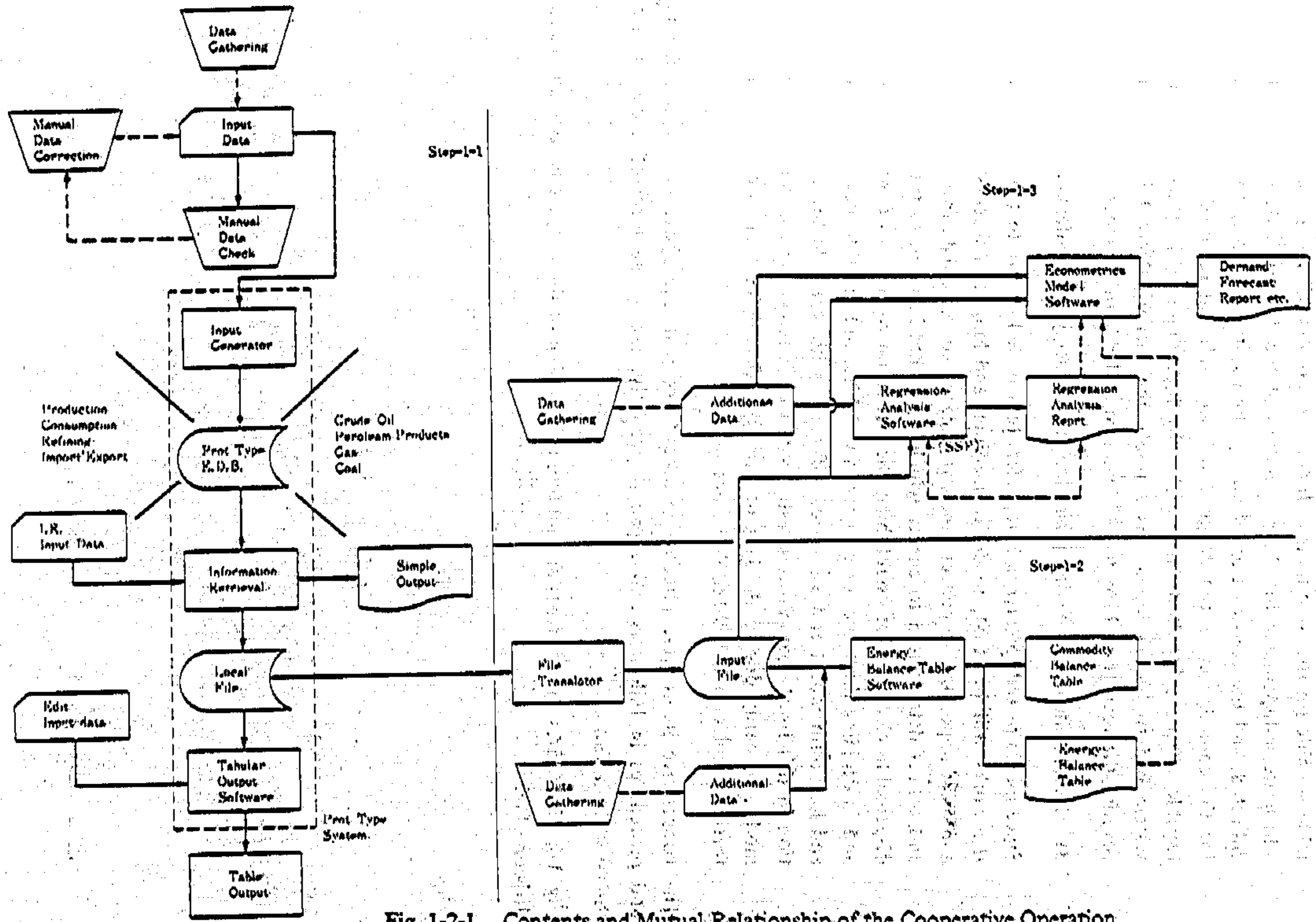

Fig. 1-2-1 Contents and Mutual Relationship of the Cooperative Operation and Division of Labor

1-2-2 Improvement of Data Bank System

As stated in the preceding section, the established data bank system through the 1979 technical cooperation has a capacity of the data input of 200,000. But these are mostly the original micro-data. It is necessary to intensify these data into the macro-data each time that they be used for preparation of an energy balance table or an energy supply-demand forecast. By establishing a sub-data bank system wherein a monthly and a yearly compilation of data are made so that such compiled data for both micro- and macro-bases could be conveniently drawn out depending upon the purpose. Fig. 1-2-2 shows the relationship in this respect. The established data bank system in 1979 shall be used for the production analysis of oils by their oil-classifications and fields and the analysis of conversion process of natural gas. On the other hand, the newly established sub-data bank system (the energy data bank on a macro-scale) shall be used for preparation of an energy balance table and a development of a supply-demand forecast model.

The details of the 1980 works including the follow-up of the 1979 cooperation are as follows:

(1) Energy supply-demand data bank system

1) Accumulation of the energy data excepting those of oil & gas, namely, coal & electric power, and correction of the system so as to be able to make statistical table of other energies.

2) Making of a sub-system for processing data for transfer from the main data bank to the sub-data bank of a macro-data.

3) Making of a sub-system for protection of data from destruction as well as the effective use of the magnetic disks for keeping data, since the main data bank handles a large amount of data.

(2) Energy balance system

1) Improvement of the system for calculating the commodity balance table in original units and the concise energy balance table manually made last year for the purpose of using energy supply-demand forecasting.

2) Development of a system for getting basic energy statistics from the sub-data bank for macro-data, computing the energy balance data, commodity balance data and concise energy balance data for a number of period and storing the results of such computations in the sub-data bank for macro-data.

3) Development of a system for getting energy balance data, commodity balance data and concise energy balance data from the sub-data bank for macro-data and printing out the energy balance table, commodity balance table and concise energy balance table of an arbitrary period and in a desired number.

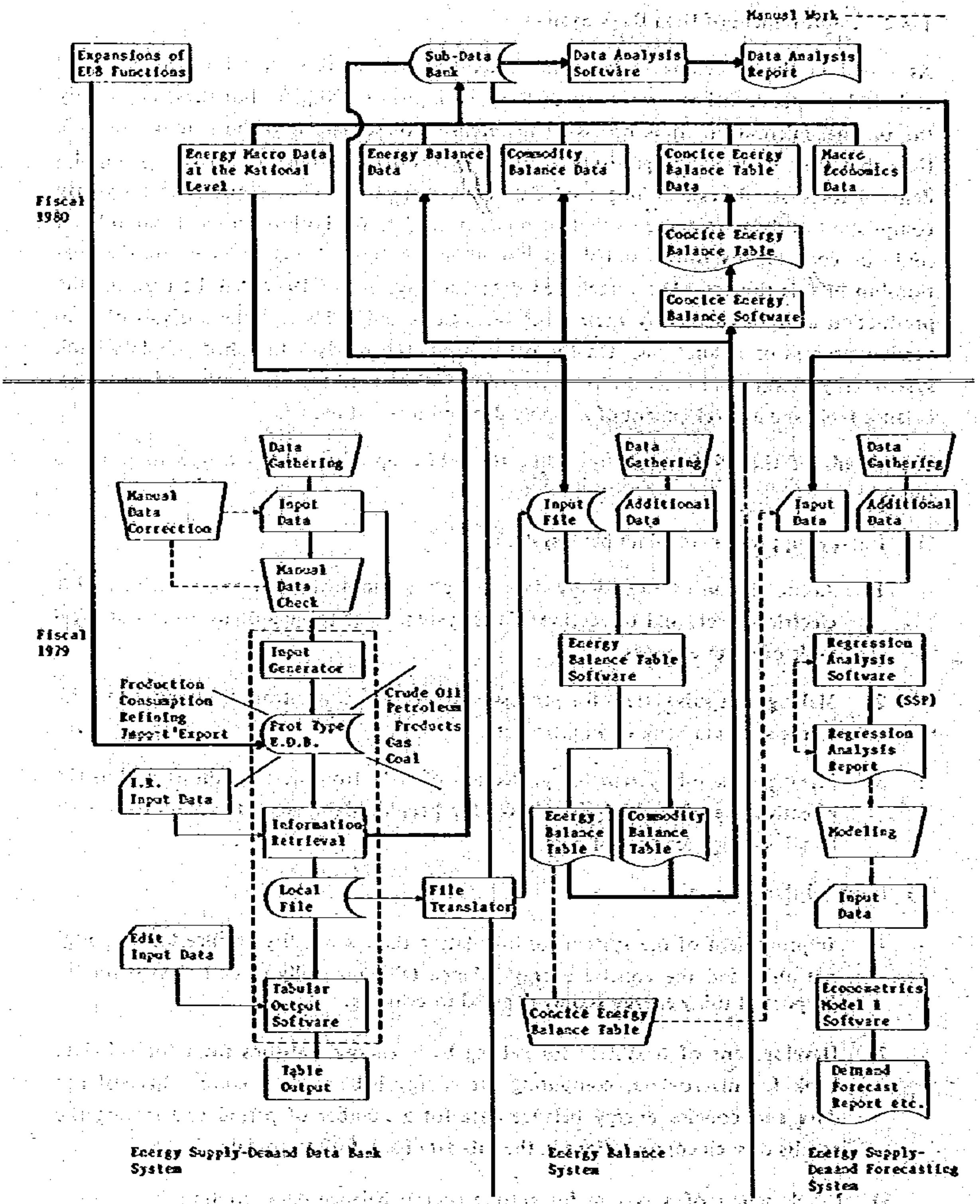

Fig. 1-2-2 Concept of the Final Data Bank System

(3) Energy supply-demand forecast system

1) Since the supply-demand forecast model system developed in 1979 is incapable of coping with the change of models, a simulator shall be developed for application of models constructed by the general econometric method.

2) Connection of the simulator and the sub-data bank for drawing from such energy data bank the data necessary for the model application.

3) Improvement and test-simulation of the equation system of the energy supply-demand forecast model including the 1979 data.

4) Expansion of reporting functions for obtaining the result of energy supply-demand forecasts in an output form of a concise energy balance table.

(4) Sub-data bank system for macro-data

1) Development of a system capable of accumulating the macroeconomic and macro-energy data by applying concept of the energy supply-demand data bank and of maintaining such data bank simultaneously.

2) Since it seems likely that a great deal of time is still necessary to be able to transfer basic energy statistics from the energy supply-demand bank to the sub-data bank for macro-data, manual inputs shall be made of basic energy statistics on annual basis into the data bank for obtaining the energy balance table and supply-demand forecast.

3) Manual input of macroeconomic data into the data bank for obtaining the energy supply-demand forecast.

1-3 System to Decide Energy Supply-Demand Plans

1-3-1 Purposes of Cooperation

As outlined in the preceding sections, technical cooperation has been offered in fiscal 1979 and fiscal 1980 in the fields of the establishment of a basic energy supply-demand data bank, the preparation of a demand forecast model with the use of the data bank and the development of software required for the preparation of an energy balance table. In the meantime, the Indonesian government entertains a great expectation for an effective use of the EDB system in its preparing medium- and long-term energy supply-demand plans involved in the REPELITA IV scheduled to be initiated in fiscal 1984. In this light, technical cooperation in fiscal 1981, thereby it entered the second stage, focused on the establishment of a sub-data bank and the development of an improved model required for mapping out energy plans.

Fig. 1-3-1 shows the flow of the whole technical cooperation. Those enclosed by a dotted line represent the basic energy supply-demand data bank which has already been established through technical cooperation implemented in fiscal 1979 and 1980, while

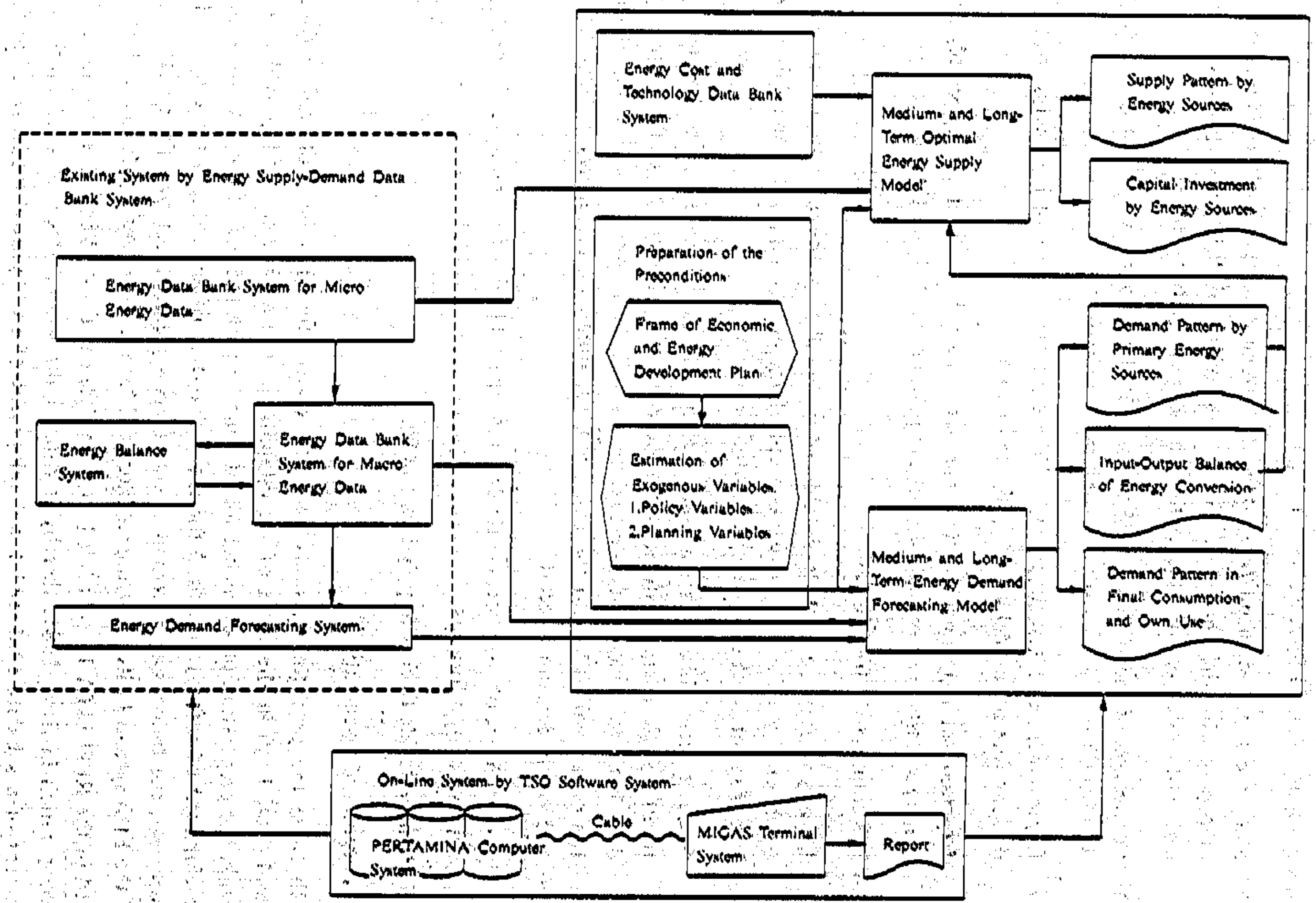

Fig. I-3-1 Block Diagram of Technical Cooperation for "Energy Supply-Demand Planning System" those enclosed by a solid line as well as the TSO Software System represent the contents of technical cooperation provided in fiscal 1981.

1-3-2 Contents of Cooperation

(1) Improvement of medium- and long-term demand forecast models

Existing energy demand forecasting system includes model construction methods and energy demand forecast models, which have been tentatively prepared to help concerned people acquire the manner of system operation. The models have been prepared based on Japan's experience and need to be improved in several points when they are applied for making medium- and long-term demand forecasts in Indonesia, where energy consumption structure is different from that in Japan. Because a priority has been given to the system development, estimated values employed as preconditions are also considered to be unsatisfactory. Accordingly, with the planned cooperation for fiscal 1981, more exact preconditions to be employed in economic plans and energy development plans were set up based on detailed examinations made jointly with the Indonesian side and the formula system of the models was changed and/or improved to the extent where an energy demand forecast required for mapping out the REPELITA IV could be obtained. At the same time, to enable simulation of a variety of policies, case studies which accorded with various political targets were conducted.

(2) Preparation of optimal medium- and long-term energy supply models

It is critically important for Indonesia to establish an energy supply in accordance with medium- and long-term energy demand. In other words, any future plans, including an alternative energy development plan and oil/LNG export plans, should be prepared based on an appropriate plan of domestic energy supply. To this end, by making the best use of information of the demand side obtained through the medium- and long-term energy demand models as well as information of such political factors as domestic supply of crude oil and natural gas and supply of alternative energies and technological costs, a model was prepared, which enabled in-depth analysis with the use of a method to optimize medium- and long-term energy supply.

(3) Preparation or a sub-data bank system dealing with cost and technology

As basic data permitting formation of optimal medium- and long-term energy supply models, cost data, including costs of individual types of energy and costs of various types of plant, and data on energy technologies, such as various technological factors related to energy transformation plants, are essential. In this light, to realize accumulation and effective use of these data, a data bank system specifically dealing with data on cost and technologies was developed.

Favorable effects expected from a series of technical cooperation discussed above are:

1) Medium- and long-term demand forecasts by type of energy sources, which are based on different scenarios.

2) Future directions to be taken to establish an optimal domestic energy supply system to cope with growing energy consumption (including a shift from oil to non-oil energies).

(4) Technical cooperation to promote the establishment of an on-line system between PERTAMINA and MIGAS

The energy supply-demand data bank and peripheral utilization systems, which have been developed in the past, were installed within the head office of PERTAMINA. They are also characterized by a batch-job system. To realize even more effective utilization of the data bank system in the coming years, the establishment of an on-line system is required, thereby the head office is connected with the Ministry of Mines and Energy as well as major local offices of PERTAMINA.

To this end, technical cooperation was extended in fiscal 1981 to the development of the TSO system, which would allow installation of terminal units in the MIGAS, which would be connected through an on-line system with the main computer installed in the head office of PERTAMINA.

(5) Preparation of an operating manual

In addition to the preparation of a report on activities of technical cooperation in fiscal 1981, an operating manual containing various subjects related to the "system to decide energy supply and demand plans," such as contents, management methods, instructions of the management and points to be improved in the future, was prepared in Japan. An operating manual of this type has been longed for by concerned staff in Indonesia and, moreover, can be served as an indispensable reference material in the future when any staff responsible for the system alternates with others.

1-3-3 Composition of Members Involved in the Cooperative Operation

(1) Composition of the JICA expert team

The JICA expert team consists of 13 members including two taken part in the cooperative operation in Japan. A total of 19 members participated in the field survey taken three times.

(2) Composition of the Indonesian counterpart

In undertaking the project, the Indonesian side formed a team consisting of experts in the related fields at MIGAS, LEMIGAS and PERTAMINA in order to participate in the cooperative operation. The number of members in the team reached 23, while the number of members who were dispatched to Japan as trainees exceeded 12, 6 of whom were received by the JICA.

Table 1-3-1 Members of the JICA Expert Team

Name	Distribution of Work
Shizuo Kishida	JICA
Takao Tomitate	Coodinator
Yoshio Hara	Assistant Coordinator, Optimal Energy Supply Model
Hitoshi Shozawa	Data Bank System
Junji Mashige	Interactive On-Line System
Shoji Yoshikoshi	Optimal Energy Supply Model
Shigeru Kimura	Energy Supply-Demand Forecast
Yoshiki Ogawa	Data Bank System
Naoto Sagawa	Energy Supply-Demand Forecast
Masayuki Ochi	Interactive On-Line System
Isao Asai	JICA, Coordinator
(Domestic operation)	
Koichi Osada	Optimal Energy Supply Model
Tsutomu Toichi	Energy Supply-Demand Forecast

Table 1-3-2 Members of the Indonesian Counterpart

Name	Bureau	Distribution of Work
Rohali Sani	MIGAS	Coordinator
Erwin Kasim	PERTAMINA	Deputy Coordinator
Mrs. Soeparti Soediro	MIGAS	Cost/Technology Data Bank System, Optimal Supply Model
Widartomo	MIGAS	Supply-Demand Forecast Model Optimal Supply Model
Mulyanto	MIGAS	"
Pramono	PERTAMINA	"
Hendro Prawoto	LEMIGAS	"
Umar Said	LEMIGAS	Optimal Supply Model
Sumardi C. D.	PERTAMINA	Cost/Technology Data Bank System
C. Doefri	MIGAS	"
Razif Razak	MIGAS	"
Rivai Hamzah	MIGAS	"
Winaryanto	MIGAS	"
Amril K.	MIGAS	"
Ikuten G.	MIGAS	"
Toras P.	MIGAS	Software
Maman Widjaja	PERTAMINA	"
Santoso Koerdi	PERTAMINA	"
Paido H.	PERTAMINA	"
Anton H.	PERTAMINA	"
Djoko Widagdo	PERTAMINA	"
Mrs. Ratna	MIGAS	"
Miss Dame Tobing	MIGAS	"

1-3-4 Operational Schedule and its Contents

(1) Operational schedule and its contents in Indonesia

The Japanese expert team was dispatched to Indonesia three times.

The first expert team was dispatched from August 24 to September 6, 1981. Immediately after determining the scope of the project for fiscal 1981, they moved onto the execution of the operation. The first cooperative works included as follows:

1) Improvement of Energy Demand Model
   - Subtilization of macro economic model
   - Price effect on energy demand
   - Handling of energy conversion in energy demand
   - Regional separation

2) Development of Energy Supply Model
   - Concepts of energy supply model
   - Analitical method
   - Interaction with energy demand model
   - Regional separation

3) Development of Cost/Technology Data Bank System
   - Data item
   - Data classification
   - Basic design of data bank

The second expert team was dispatched from November 16 to November 29, 1981 and the second cooperative works included as follows:

1) Development of Energy Supply Model
   - Model building
   - Data preparation
   - Relation to energy demand model

2) Energy Demand Model
   - Data preparation
   - Model improvement

3) Development of TSO System
   - Basic design
   - Program conversion

The third expert team was dispatched from February 19 to March 18, 1982 and the third cooperative works included as follows:

1) Development of Energy Supply Model

Model building
Data input
Test-run

2) Energy Demand Model
Data input
Test-run

3) Development of Cost/Technology Data Bank System
Programming

4) Development of TSO System
Programming

Table 1-3-3 Contents of Technical Cooperation

Project Items	Work Items
I. Preparation of the Preconditions for Energy Supply-Demand Forecasting	Technical cooperation for 1) Improving the frame of the macro economic model 2) Analysis of actual data 3) Set-up of exogenous variables 4) Reevaluation of precondition
II. Improvement of Energy Demand Model	Technical cooperation for 5) Conceptual design 6) Model building 7) Gathering of macroeconomic data.
III. Simulation by Energy Demand Model	Technical cooperation for 8) Simulation by energy demand model
IV. Development of Optimal Energy Supply Model	Technical cooperation for 9) Basic design of supply model 10) Making software for supply model 11) Test-run of supply model 12) Case study of supply model
V. Establishment of Cost/ Technology Data Bank System	Technical cooperation for 13) Conceptual design of data bank 14) Data preparation
VI. Development of TSO System	Technical cooperation for 16) Basic design 17) Program conversion to TSO system
VII. Making of Operation Manual	18) Making of operation manual

(2) Operational schedule in Japan and its contents

The first domestic operation was undertaken from January 6 to February 3, 1981 and the second was undertaken from January 18 to February 15. The number of countermembers who had visited Japan during this period totalled 12, including 6 trainees received by the JICA.

The first joint works in Japan included as follows:

1) Optimal Energy Supply Model
   Development of matrix generator
   Test-run

2) Cost/Technology Data Bank System
   Development of software for establishment of the data bank
   Development of software for retrieving and edition

3) Development of TSO System

The second included as follows:

1) Energy Demand Model
   Improvement of the model
   Preparation for the case study

2) Optimal Energy Supply Model
   Detailed design of report generator
   Development of report generator

Table 1-3-4 Work Schedule and Assigned Persons & Items

Member Name	Work Item	'81 Aug.	Sept.	Oct.	Nov.	Dec.	'82 Jan.	Feb.	Mar.
Sizuo Kishida	(JICA)	(17) (21)							
Takao Tomitate	Coordinate ⑱	(17) (23)						----	
Yoshio Hara	Coordinate ①④⑨⑪⑱	(24) (30)	----		(23) (29)			----	
Hitoshi Shozawa	Coordinate ⑧⑲		----						(9) (18)
Junji Mashige	⑯⑰⑱		----	----	(16) (29)	----	----	----	(12) (18)
Shigeru Kimura	①②③⑤⑥⑯	(24)	(6)	----	(16) (29)		----	---- (26)	(4) ----
Shoji Yoshikoshi	①④⑨⑩⑪⑫⑭ ⑲	(17) (30)	----	----	(16) (29)	----	----	---- (13)	(4) ----
Yoshiki Ogawa	①②③④⑬⑭⑮ ⑲	(24)	(6) ----		(16) (29)		----	----	----
Naoto Sagawa	⑤⑥⑧⑲			----			----	---- (26)	(11) ----
Masayuki Ochi	⑩⑫⑬⑭⑰⑱	(24)	(6)	----		----	----	---- (26)	(18) ----
Isao Asai	Coordinate (JICA)	(17) (23)							
Koichi Osada	⑩⑪⑱		----			----			----
Tsutomu Toichi	⑤⑥⑱			----					----
Rohali Sani	Coordinate ⑨⑫						(25) ----	---- (13)	

Member Name	Work Item	'81 Aug.	Sept.	Oct.	Nov.	Dec.	'82 Jan.	Feb.	Mar.
Erwin Kasim	Coordinate ⑨⑫						(18) ├┄┄	┄┄┤ (15)	
Mrs. Soeparti Soediro *	⑨⑩⑪⑫						(6) ├┄┄	┄┤ (3)	
Widartomo *	①②③④⑤⑥⑦						(18) ├┄┄	┄┄┤ (17)	
Mulyanto *	⑤⑥⑦⑨⑩⑪⑫⑯⑰						(6) ├┄┄	┄┄┤ (17)	
Pramono	①②③④⑤⑥⑦						(18) ├┄┄	┄┄┤ (15)	
Hendro Prawoto	⑨⑫⑬⑭						(11) ├┄┄	┄┤ (3)	
Umar Said	⑨⑫						(29) ├┄	┄┄┤ (13)	
Sumardi C. D. *	⑨⑫						(22) ├┄┄	┄┄┤ (17)	
C. Djoefri	⑬⑮								
Razif Razak	⑬⑪								
Rivai Hamzah	⑬⑮								
Winaryanto	⑬⑯								
Amril K.	⑯								
Ilunten G.	⑯								
Toras P.	⑮								

Member Name	Work Item	'81 Aug.	Sept.	Oct.	Nov.	'82 Dec.	Jan.	Feb.	Mar.
Maman Widjaja	⑯⑰								
Santoso Koordi *	⑨⑩⑪⑫						(4) ┄┄┄┄	(3)	
Paido H.	⑬⑭								
Antonious Hariyanto*	⑬⑭						(4) ┄┄┄┄	(3)	
Djoko Widagdo	⑮⑯						(4) ┄┄┄┄	(3)	
Mrs. Ratna	⑮⑯								
Miss Dame Tobing	⑮⑯								

Note: ├──┤ Work in Jakarta ( ) Date
├┄┄┤ Work in Tokyo * Trainees accepted by JICA

Numbers for items indicate these in Table 1-3-3.

2 ENERGY DEMAND FORECAST MODEL AND FORECASTING SIMULATION

2-1 Improvement of Energy Demand Forecast Model and Decision of Exogenous Variables

The model discussed here forms a system based on a total of 203 simultaneous equations, including 38 structural equations and 165 definition equations, and consists of two major sections, macro-economic model and demand forecast model (the former employs 17 structural equations and 10 definition equations, while the latter does 11 structural equations and 165 definition equations). Mathematically it is solved simultaneously using the Gauss-Seidel method.

Preparation of an improved model was required because the 1980 data (latest data) were supplied concerning individual variables of the macro model and the demand model, thereby it was needed to estimate new individual structural equations to cover the 10 years from 1971 to 1980. At the same time, it was thought that the macro and the demand models were to be improved so that the former could permit a good grasp of the mechanism of effects of crude oil exports on the macro-economy and the latter could allow a good grasp of effects of energy prices on energy demand (price effects). In this light, improvements were made first of the macro model and then the demand model. This was because an energy demand forecast greatly depended on variables incorporated with the macro-economy. Listed in Table 2-1-1 are major improvements and changes made in relation to the macro model.

The concept of price effects, introduced to improve the demand forecast model, enables a grasp of changes in demands for different alternative energies resulting from their different prices. Two basic forms of demand functions, logarithmic linear form and linear programming, were planned to be newly introduced, which are presented below.

$$\text{Log } X = f(\log Y, \log(Px/Pz)) \quad \text{(logarithmic linear form)} \; \ldots\ldots \; (1)$$

$$X = f(Y, Px/Pz) \quad \text{(linear form)} \; \ldots\ldots \; (2)$$

X : demand for energy X, Y: income,
Px : price of energy X,
P_Z : price of energy Z which can substitute for energy X, or an average price.

Based on the above, regression analyses were made on all the 11 structural equations. However, the concept of price effects was after all accepted by only 5 equations, including those of residential/commercial use kerosene, transportation sector ADO, industrial use HFO, residential/commercial use LPG and electric power. The remaining 6 equations therefore were explained in a combination of macro-economic variables and energy demand variables. Table 2-1-2 contains major improvements of the demand forecast model.

Results of regression analyses on 28 structural equations employed in the macro and the demand models are presented in pages 25~38 , and all the equation employed in the energy demand model are shown in pages 39~42 .

Table 2-1-1 Major Improvents

Factor	Old structural equation	New structural equation
Export function (EXP73&)	EXP73&=f ($\overline{\text{WIM75\&}}$) $\overline{\text{WIM75\&}}$: World imports (— represents exogenous variables.)	EXP73&=($\overline{\text{WIM75\&}}$, $\overline{\text{PETROP\&}}$) PETROP&: Crude oil output Crude oil exports are so significant in the Indonesian economy that crude oil output was newly introduced to incorporate clearly with the equation the mechanism of effects of crude oil exports on the macro-economy.
Import price deflator (PIMP&)	PIMP&=f ($\overline{\text{PWE75\&}}$ x $\overline{\text{REXCR\&}}$, $\overline{\text{PIMP\&}^{-1}}$) $\overline{\text{PWE75\&}}$: World export price index $\overline{\text{REXCR\&}}$: Exchange rate to the dollar	PIMP&=f (PWE75& x REXCR&) The employment of import deflator of the previous period results in a greater trend effect, thereby errors are gradually accumulated. For this reason, import deflator of the previous period was deleted from the equation.
Wholesale price index (WPI73&)	WPI73&=f (PIMP&, NI&) NI&: Nominal national income	WPI73&=f (PIMP&) Nominal national income was deleted from the equation because it was on a different level from wholesale price index.
Private consumption price deflator (PCP&)	PCP&=f (PIMP&, NI73&) NI73&: Real national income	PCP&=f (PIMP&, NI73&/$\overline{\text{POP\&}}$) $\overline{\text{POP\&}}$: Population Real national income per capita was introduced as an alternate variable for real wage per capita.
Export price deflator (PEXP&)	PEXP&=f ($\overline{\text{PCROIL\&}}$, $\overline{\text{IAGRPE73\&}}$) $\overline{\text{PCROIL\&}}$: Crude oil export price $\overline{\text{IAGRPE73\&}}$: Farm-product export price deflator	log (PEXP&)=f (log ($\overline{\text{PCROIL\&}}$), log ($\overline{\text{IAGRPE73\&}}$)) The equation was changed into of logarithmic linear programming type.
Real private consumption (CP73&)	CP73&=f (NI73&, CP73& -1)	CP73&=f (GDP73&/POP&, CG73&) Government consumption was introduced to grasp its impacts on private consumption.
Index of Industrial production (IIP73&)	IIP73&=f (IIP73&, EXP73&)	IIP73&=f (CG73&, CP73&) To grasp impacts of consumption on industries, government consumption and private consumption were introduced.

Table 2-1-2 Major Improvements of Demand Model (I)

Energy	Old structural equation	New structural equation
Transportation sector gasoline (CTC05R18)	CTC05R18=f (TRPSG&) TRPSG&: Number of autos possessed	Same
Transpotation sector jet fuel oil (CTC06R18)	CTC06R18=f (GDP73&) GDP73&: Real gross domestic product	log (CTC06R18)=f (log (CTC06R18$_{-1}$), log (GDP73&)) The equation was changed into of logarithmic linear programming type, whereby jet fuel oil of the previous period was introduced.
Residential/Commercial use kerosene (CTC07R17)	CTC07R17=f (CP73&, CTC07R17$_{-1}$) CP73&: Real private consumption	log (CTC07R17)=f (log (CP73&), log (PKER&/PLPG&) PKER&: Kerosene price PLPG&: LPG price (— represents exogenous variables.) The concept of price effect was introduced.
Industrial use ADO (CTC08R16)	CTC08R16=f (IIP73&, PETROP&) IIP73&: Index of industrial production PETROP&: Crude oil output	Same
Transportation sector ADO (CTC08R18)	CTC08R18=f (GDP73&, PADO&/PGNP&) PADO&: ADO price PGNP&: GNP deflator	log (CTC08R18)=f (log (GDP73&), log (PADO&/PCNI&) PCNI&: National income deflator The concept of price effect was introduced.
Industrial use IDO (CTC09R16)	CTC09R16=f (IIP73&)	Same
Industrial use HFO (CTC10R16)	CTC10R16=f (IIP73&)	log (CTC10R16)=f (log (IIP73&), log (PHFO&/WPI73&) PHFO&: HFO price WPI73&: Wholesale price index The concept of price effect was introduced.

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Table 2-1-2 Major Improvements of Demand Model (2)

Energy	Old structural equation	New structural equation
Residential/Commercial use LPG (CTC12R17)	CTC12R17=f (CP73&)	log (CTC12R17)=f (log (CP73&), log ($\overline{PLPG\&/PKER\&}$) The concept of price effect was introduced.
Industrial use electric power (CTC24R16)	CTC24R16=f (IIP73&)	log (CTC24R16)=f (log (IIP73&), log (ITP73&$_{-1}$)) ITP73&: Real capital formation The equation was changed into of logarithmic linear programming type, thereby real capital formation of the previous period was introduced.
Residential/Commercial use electric power (CTC24R17)	CTC24R17=f (log (CP73&))	log (CTC24R17)=f (log (C073&), log ($\overline{PELECREC\&}$/CPI73&)) $\overline{PELECREC\&}$: Residential/Commercial use power rate CPI73&: Consumer price index The concept of price effect was introduced.
Residential/Commercial sector non-commercial energy demand (CTC26R17)		CTC26R17=f (POP&) POP&: Population Demand for non-commercial energies in the residential/commercial sector was tried to be explained by introducing the factor of population.

REGRESSION ANALYSIS REPORT

--- DEFINITIONS ---

DPV =CERPTSE
IDV1=CVINTSE
IDV2=CPITRDPE

YEAR	ESTIMATED	OBSERVED	RESIDUAL	
1971	893.9725	890.8000	-3.1725	O=OBSERVED
1972	1079.4356	1123.3559	43.9203	*=ESTIMATED
1973	1338.9421	1354.3000	15.3579	X=COINCID
1974	1389.2982	1403.3999	14.1017	
1975	1306.1195	1266.9000	-39.2195	
1976	1535.5555	1425.2000	-119.7945	
1977	1705.2596	1744.0000	38.7404	
1978	1715.8727	1776.3000	60.4273	
1979	1730.2037	1758.7000	28.4963	
1980	1724.5765	1684.1599	-39.4766	

DPV = -331.260251 + 0.86435*IDV1 + 0.00153*IDV2
T = 2.4391 T = 5.9333
ES2= 0.3621 ES= 0.0311

R**2= 0.871355 SE= 57.7525 DW= 1.6723

----- INPUT DATA -----

YEAR	DPV	IDV1	IDV2
1971	893.650	676.500	375842.500
1972	1123.450	734.500	395560.312
1973	1354.300	825.200	415536.250
1974	1403.650	853.200	501837.812
1975	1268.930	813.500	475854.931
1976	1425.200	563.500	550318.625
1977	1744.000	953.700	615122.750
1978	1776.300	1016.000	556852.437
1979	1758.760	1076.900	580444.682
1980	1684.930	1068.700	573015.875

----- SIMPLE CORRELATION -----

	DPV	IDV1	IDV2
DPV	1.00000		
IDV1	0.95739	1.00000	
IDV2	0.97293	0.96150	1.00000

--- DEFINITIONS ---

DPV =CPIWPB
IDV1=CPWETSE*CRETCRA

YEAR	ESTIMATED	OBSERVED	RESIDUAL	
1971	99.1495	83.7479	-15.4026	O=OBSERVED
1972	103.2335	93.2920	-10.4365	*=ESTIMATED
1973	113.6519	100.0000	-13.6519	X=COINCID
1974	134.3142	137.4300	3.1154	
1975	143.6565	154.3350	13.4735	
1976	142.4921	165.5420	23.0499	
1977	149.6521	160.5040	10.6559	
1978	165.0386	165.0290	-0.0096	
1979	232.3657	235.7190	-3.6471	
1980	287.3370	272.1899	-0.1471	

DPV = 59.078150 + 0.831780*IDV1
T = 13.2541
ES= 0.0621

R**2= 0.955455 SE= 13.3421 DW= 0.5411

----- INPUT DATA -----

YEAR	DPV	IDV1
1971	83.747	49.000
1972	93.292	54.000
1973	100.000	65.000
1974	137.430	92.000
1975	154.335	109.000
1976	165.542	132.000
1977	160.504	111.000
1978	165.029	134.545
1979	235.719	229.560
1980	272.190	270.560

----- SIMPLE CORRELATION -----

	DPV	IDV1
DPV	1.00000	
IDV1	0.97790	1.00000

R E G R E S S I O N   A N A L Y S E S   R E P O R T

--- DEFINITIONS ---

GPY =C81735
IDVI=CGOP734

YEAR	ESTIMATED	OBSERVED	RESIDUAL
1971	4421.1886	4432.6004	11.4122
1972	5218.7033	5207.5000	-11.2033
1973	5765.8034	5760.6992	-5.1041
1974	6141.6598	6075.6008	-66.0590
1975	6419.8750	6403.8984	-15.9766
1976	6823.4349	6859.8984	36.4636
1977	7372.3490	7440.8008	68.4518
1978	7842.7624	7892.5000	49.7376
1979	8231.7875	8223.3564	-8.4291
1980	8972.3937	8912.8008	-59.5929

GPY = 558.218524 + 0.769149129
T = 87.4753
ESD = 0.0093

R**2= 0.998956   SE= 48.2183   DW= 0.9934

---- INPUT DATA ----

YEAR	GPY	IDVI
1971	4432.601	5549.659
1972	5207.500	6047.199
1973	5760.699	6753.398
1974	6075.601	7249.000
1975	6403.898	7630.601
1976	6859.898	8156.301
1977	7440.801	8870.898
1978	7892.500	9483.301
1979	8223.398	9989.801
1980	8912.801	10953.898

---- SIMPLE CORRELATION ----

	GPY	IDVI
GPY	1.00000	
IDVI	0.99948	1.00000

R E G R E S S I O N   A N A L Y S I S   R E P O R T

--- DEFINITIONS ---

GPY =C87134
IDVI=[illegible]

YEAR	ESTIMATED	OBSERVED	RESIDUAL
1971	69.1420	83.6540	14.5120
1972	67.7710	74.5110	6.7400
1973	81.4944	100.0000	18.5056
1974	155.5547	147.7710	-8.1837
1975	189.5742	157.3250	-32.2492
1976	218.1165	187.2550	-31.8235
1977	201.5842	205.7350	3.5058
1978	212.4375	225.4700	13.0365
1979	351.4530	343.3100	-8.1730
1980	524.2355	549.6755	25.4445

GPY = -111.457558 + 1.55532015
T = 16.5758
ESD = 0.1173

R**2= 0.971692   SE= 21.1265   DW= 2.2503

---- INPUT DATA ----

YEAR	GPY	IDVI
1971	83.654	83.747
1972	74.511	93.402
1973	100.000	100.000
1974	147.771	137.430
1975	157.325	154.320
1976	187.255	165.542
1977	205.735	190.504
1978	225.470	205.023
1979	343.310	255.715
1980	549.882	272.450

---- SIMPLE CORRELATION ----

	GPY	IDVI
GPY	1.00000	
IDVI	0.98641	1.00000

R E G R E S S I O N   A N A L Y S I S   R E P O R T

--- DEFINITIONS ---

DPY =ECPI736
IDV1=CWPI736
IDV2=LAG1(ECPI736)

YEAR	ESTIMATED	OBSERVED	RESIDUAL
1972	87.2504	76.3820	-10.8764
1973	100.3312	100.0000	-0.3312
1974	133.5812	149.7040	7.1928
1975	164.3365	167.5040	3.1675
1976	190.5398	200.6100	10.0912
1977	222.1837	222.7655	0.5815
1978	244.1865	240.8370	-3.3515
1979	299.0154	289.9121	-9.1033
1980	370.5334	373.2428	2.7095

DPY = 12.762520 + 0.352184*IDV1 + 0.672249*IDV2
(T = 5.0341) (T = 8.4951)
(SD= 0.0671) (SD= 0.1831)

R**2= 0.994550 SE= 7.9811 DW= 1.3285

----- INPUT DATA -----

YEAR	DPY	IDV1	IDV2
1972	76.382	72.611	71.692
1973	100.000	100.000	76.382
1974	149.704	147.771	100.000
1975	167.504	151.325	149.704
1976	200.610	180.255	167.504
1977	222.765	205.733	200.610
1978	240.837	225.476	222.765
1979	289.912	343.319	240.837
1980	373.243	549.980	289.912

----- SIMPLE CORRELATION -----

	DPY	IDV1	IDV2
DPY	1.00000		
IDV1	0.97786	1.00000	
IDV2	0.98373	0.95498	1.00000

R E G R E S S I O N   A N A L Y S I S   R E P O R T

--- DEFINITIONS ---

DPY =CPCPA
IDV1=CPIWPA
IDV2=CAIT36/CPOPE

YEAR	ESTIMATED	OBSERVED	RESIDUAL
1971	60.5077	72.8430	12.3353
1972	84.4258	79.5970	-4.8828
1973	110.0399	100.0000	-10.0399
1974	133.9345	133.0970	-0.7375
1975	152.5860	153.9820	1.3960
1976	173.8590	173.4830	-0.4160
1977	191.2925	193.6580	2.3655
1978	207.2727	213.6550	6.3823
1979	253.1320	244.0850	-9.0470
1980	297.6920	302.1270	4.4350

DPY = -255.273190 + 0.557644*ICT1 + 8.638604*IDV2
(T = 5.0270) (T = 6.2591)
(SD= 0.1110) (SD= 1.0611)

R**2= 0.992283 SE= 7.4335 DW= 2.0912

----- INPUT DATA -----

YEAR	DPY	IDV1	IDV2
1971	72.843	63.767	40.533
1972	79.597	53.202	43.342
1973	100.000	100.000	46.529
1974	133.097	137.430	47.069
1975	153.982	154.330	48.474
1976	173.483	165.562	50.763
1977	193.658	180.500	53.786
1978	213.655	185.823	55.746
1979	244.085	235.719	56.783
1980	302.127	272.199	60.430

----- SIMPLE CORRELATION -----

	DPY	IDV1	IDV2
DPY	1.00000		
IDV1	0.97642	1.00000	
IDV2	0.98285	0.92922	1.00000

REGRESSION ANALYSIS REPORT

--- DEFINITIONS ---

DPY =CPCGA
IDV1=CPCPB
IDV2=CWPI736

YEAR	ESTIMATED	OBSERVED	RESIDUAL
1971	64.0193	65.1920	1.1727
1972	73.5659	73.8100	0.2450
1973	97.0032	100.0000	2.9968
1974	135.3342	131.0370	-4.2972
1975	156.7280	150.6540	-6.0740
1976	178.6050	177.3730	-1.2320
1977	201.4764	198.8990	-2.5774
1978	223.5907	229.9850	6.3936
1979	269.5691	277.5759	8.0062
1980	338.9563	333.3589	-5.5976

*=OBSERVED +=ESTIMATED X=COMMON

DPY = -22.154270 + 0.962280*IDV1 + 0.135650*IDV2
(T = 8.5403) (T = 1.9672)
(SE= 0.1136) (SE= 0.0690)

R**2= 0.975636 SE= 5.7812 DW= 1.6926

----- INPUT DATA -----

YEAR	DPY	IDV1	IDV2
1971	65.192	79.843	63.696
1972	73.810	79.547	72.811
1973	100.000	100.000	100.000
1974	131.037	133.097	147.771
1975	150.654	153.982	157.325
1976	177.373	173.483	160.255
1977	198.899	193.658	265.733
1978	229.985	213.655	225.476
1979	277.576	244.045	343.518
1980	333.359	302.121	449.550

----- SIMPLE CORRELATION -----

	DPY	IDV1	IDV2
DPY	1.00000		
IDV1	0.99734	1.00000	
IDV2	0.95565	0.97324	1.00000

REGRESSION ANALYSIS REPORT

--- DEFINITIONS ---

DPY =CPITPA
IDV1=CPIRPI
IDV2=CNIC

YEAR	ESTIMATED	OBSERVED	RESIDUAL
1972	87.2416	83.0430	-4.1986
1973	99.9135	100.0000	0.0865
1974	138.0789	124.7920	-13.2869
1975	156.4196	155.8420	-0.5776
1976	174.0241	183.2210	9.1969
1977	181.1767	188.7250	7.5483
1978	195.5711	200.2100	4.6389
1979	271.8458	275.2180	3.3722
1980	338.3477	335.6450	-2.6797

*=OBSERVED +=ESTIMATED X=COMMON

DPY = 4.173034 + 0.716314*IDV1 + 0.003650*IDV2
(T = 3.0831) (T = 2.9071)
(SE= 0.2321) (SE= 0.0013)

R**2= 0.991695 SE= 6.4548 DW= 1.4516

----- INPUT DATA -----

YEAR	DPY	IDV1	IDV2
1972	83.043	93.202	3012.500
1973	100.000	100.000	3765.699
1974	124.792	137.629	9057.196
1975	155.842	154.339	10745.031
1976	183.221	169.542	13332.459
1977	188.725	165.508	16250.199
1978	200.210	165.823	18117.530
1979	275.218	235.719	24212.159
1980	335.645	282.190	31154.336

----- SIMPLE CORRELATION -----

	DPY	IDV1	IDV2
DPY	1.00000		
IDV1	0.98955	1.00000	
IDV2	0.99921	0.97656	1.00000

R E G R E S S I O N   A N A L Y S I S   R E P O R T

--- DEFINITIONS ---

GPY =LOG(CPEXPS)
IDY1=LOG(CPCROILS)
IDY2=LOG(CAGRPE734)

YEAR	ESTIMATED	OBSERVED	RESIDUAL
1971	4.0143	4.0869	0.0726
1972	4.2350	4.2062	-0.0288
1973	4.5139	4.6052	0.0913
1974	5.4061	5.3993	-0.0068
1975	5.3237	5.4162	0.0925
1976	5.5549	5.4833	-0.0716
1977	5.6895	5.5454	-0.1441
1978	5.7067	5.5967	-0.1100
1979	6.1206	6.2878	0.1672
1980	6.5193	6.6770	0.0577

*=OBSERVED +=ESTIMATED X=COINCIDE

GPY = 0.803550 + 0.45564*IDY1 + 0.43186*IDY2
(T = 5.3511 (T = 5.2657
(SD= 0.0761 (SD= 0.1561

R**2= 0.965631 SE= 0.1133 DW= 1.9142

----- INPUT DATA -----

YEAR	GPY	IDY1	IDY2
1971	4.087	0.784	4.166
1972	4.226	0.904	4.383
1973	4.605	1.165	4.605
1974	5.399	2.449	4.625
1975	5.416	2.449	4.692
1976	5.483	2.516	4.691
1977	5.545	2.528	4.931
1978	5.597	2.542	4.931
1979	6.288	2.931	5.125
1980	6.677	3.469	5.258

----- SIMPLE CORRELATION -----

	GPY	IDY1	IDY2
GPY	1.00000		
IDY1	0.91179	1.00000	
IDY2	0.90266	0.83624	1.00000

R E G R E S S I O N   A N A L Y S I S   R E P O R T

--- DEFINITIONS ---

GPY =CPA18
IDY1=CPGUPA

YEAR	ESTIMATED	OBSERVED	RESIDUAL
1971	64.0959	64.9230	0.8272
1972	73.5491	74.3520	0.8029
1973	99.5758	100.0000	0.4242
1974	149.2139	149.0226	-0.1919
1975	168.5683	167.8010	-0.7673
1976	193.7239	194.4330	0.7041
1977	219.6458	218.4020	-1.2431
1978	243.3013	242.2240	-1.0773
1979	320.7699	318.7519	-1.9989
1980	414.2343	416.7529	2.5186

*=OBSERVED +=ESTIMATED X=COINCIDE

GPY = -5.472169 + 1.05544*IDY1
(T = 237.5531
(SD= 0.5648

R**2= 0.999854 SE= 1.4009 DW= 3.2929

----- INPUT DATA -----

YEAR	GPY	IDY1
1971	64.923	66.225
1972	74.352	75.224
1973	100.000	100.000
1974	149.042	147.310
1975	167.801	165.077
1976	194.430	189.526
1977	218.426	214.304
1978	242.224	236.119
1979	318.751	310.546
1980	416.753	399.534

----- SIMPLE CORRELATION -----

	GPY	IDY1
GPY	1.00000	
IDY1	0.99993	1.00000

REGRESSION ANALYSIS REPORT

--- DEFINITIONS ---

DPY =CCP734
IDV1=CCGP734/CPOP1
IDV2=CCG734

YEAR	ESTIMATED	OBSERVED	RESIDUAL
1971	3856.1924	3958.3999	102.2075
1972	4420.2625	4276.1592	-144.1033
1973	5098.5458	4790.6992	-307.8466
1974	5258.3732	5453.6016	195.2284
1975	5559.5582	5678.1954	118.6372
1976	5944.4487	6031.6016	87.1529
1977	6541.6522	6433.1992	-108.4530
1978	6592.6296	6555.1016	-37.5280
1979	7366.4756	7394.6992	28.2236
1980	8242.7124	8269.0000	26.2876

*=OBSERVED +=ESTIMATED X=COMMON

DPY = -2791.093916 + 134.896358*IDV1 + 0.531164*IDV2
(T = 4.9631) (T = 0.8297)
(SE= 27.4751) (SE= 0.6403)

R**2= 0.987663 SE= 173.3512 DW= 1.5591

----- INPUT DATA -----

YEAR	DPY	IDV1	IDV2
1971	3958.400	48.545	514.300
1972	4276.159	50.497	561.900
1973	4790.699	54.656	716.000
1974	5453.602	58.313	841.900
1975	5678.198	57.361	835.550
1976	6031.602	60.332	896.700
1977	6433.199	64.923	1044.400
1978	6955.102	66.552	1154.100
1979	7394.699	67.960	1345.000
1980	8269.000	74.269	1669.200

----- SIMPLE CORRELATION -----

	DPY	IDV1	IDV2
DPY	1.00000		
IDV1	0.99321	1.00000	
IDV2	0.97140	0.96549	1.00000

REGRESSION ANALYSIS REPORT

--- DEFINITIONS ---

DPY =CIIP734
IDV1=CCP734
IDV2=CCG734

YEAR	ESTIMATED	OBSERVED	RESIDUAL
1971	870.0292	866.8999	-3.1293
1972	993.9140	1032.0000	38.0860
1973	1241.9429	1208.0000	-33.9429
1974	1692.1153	1640.0000	-52.1153
1975	1632.9931	1650.2000	17.2069
1976	1791.7622	1749.2000	-42.5622
1977	1992.3106	2027.5000	35.1894
1978	2232.6010	2332.8999	100.2989
1979	2459.9253	2436.0000	-23.9253
1980	2904.4253	2868.5000	-35.9253

*=OBSERVED +=ESTIMATED X=COMMON

DPY = -885.378457 + 0.406137*IDV1 + 0.253469*IDV2
(T = 7.3201) (T = 1.2251)
(SE= 0.0551) (SE= 0.2071)

R**2= 0.994634 SE= 54.1556 DW= 2.0069

----- INPUT DATA -----

YEAR	DPY	IDV1	IDV2
1971	866.900	3958.400	518.350
1972	1032.000	4276.159	561.930
1973	1208.000	4790.699	716.000
1974	1640.000	5453.602	841.950
1975	1650.200	5678.198	835.550
1976	1749.200	6031.602	896.250
1977	2027.500	6433.199	1044.400
1978	2332.900	6955.102	1154.100
1979	2436.000	7394.699	1345.000
1980	2868.500	8269.000	1669.200

----- SIMPLE CORRELATION -----

	DPY	IDV1	IDV2
DPY	1.00000		
IDV1	0.99676	1.00000	
IDV2	0.97645	0.97140	1.00000

R E G R E S S I O N   A N A L Y S I S   R E P O R T

--- DEFINITIONS ---

DPV =C1M736
IDV1=CGCP736

YEAR	ESTIMATED	OBSERVED	RESIDUAL
1971	682.1619	729.7000	47.5381
1972	956.6436	925.3000	-31.3435
1973	1320.5044	1315.5001	-5.0043
1974	1594.0800	1669.0000	74.9200
1975	1785.9795	1800.0000	14.0205
1976	2064.6653	1946.3599	-118.3054
1977	2443.7287	2378.2000	-65.5287
1978	2768.5476	2749.2000	-19.3476
1979	3037.1957	3131.1001	93.9044
1980	3548.5541	3557.7000	9.1458

DPV = -2261.40548 + 0.53540*IDV1
(T = 41.3523)
(SD= 0.0133)

RBAR2= 0.995299   SE= 47.6785   DW= 1.0226

--- INPUT DATA ---

YEAR	DPV	IDV1
1971	729.700	5549.699
1972	925.300	6067.199
1973	1315.500	6753.358
1974	1669.000	7269.600
1975	1800.000	7650.603
1976	1946.400	8158.301
1977	2378.200	8879.558
1978	2749.200	9453.301
1979	3132.100	9517.691
1980	3557.700	10953.458

--- SIMPLE CORRELATION ---

	DPV	IDV1
DPV	1.00000	
IDV1	0.99765	1.00000

R E G R E S S I O N   A N A L Y S I S   R E P O R T

--- DEFINITIONS ---

DPV =C01P736
IDV1=CCG736
IDV2=CCP736

YEAR	ESTIMATED	OBSERVED	RESIDUAL
1971	71.5852	69.4300	-2.1552
1972	79.5309	83.8100	4.2791
1973	98.7026	100.0000	1.2974
1974	106.7871	111.1400	4.3529
1975	122.8583	117.4000	-5.4583
1976	133.3415	130.4300	-2.9115
1977	149.9715	146.0750	-3.8965
1978	166.7087	170.8200	4.1113
1979	186.5461	182.5200	-4.0261
1980	223.3129	226.9800	3.6671

DPV = -34.142534 + 0.06075492*IDV1 + 0.01502912*IDV2
(T = 3.5781)   (T = 4.1910)
(SD= 0.0171)   (SD= 0.0035)

RBAR2= 0.993455   SE= 4.4490   DW= 2.4630

--- INPUT DATA ---

YEAR	DPV	IDV1	IDV2
1971	69.430	510.300	3590.600
1972	83.810	561.900	4276.155
1973	100.000	736.900	4790.499
1974	111.140	683.900	5423.502
1975	117.400	835.500	5670.898
1976	130.430	896.700	6031.692
1977	146.075	1044.400	6533.199
1978	170.820	1154.190	6155.182
1979	182.520	1345.000	7394.699
1980	226.980	1449.200	8269.800

--- SIMPLE CORRELATION ---

	DPV	IDV1	IDV2
DPV	1.00000		
IDV1	0.96645	1.00000	
IDV2	0.99078	0.97186	1.00000

REGRESSION ANALYSIS' REPORT

--- DEFINITIONS ---

DPY =CGNP734
IDVI=CGDP734

YEAR	ESTIMATED	OBSERVED	RESIDUAL
1971	5452.0854	5465.0000	12.9146
1972	5968.3247	5956.1992	-12.1255
1973	6513.2929	6507.6592	-5.5931
1974	6967.6585	6920.0000	-47.6585
1975	7286.8360	7270.5000	-16.3360
1976	7750.1223	7789.6006	39.4765
1977	8380.1272	8448.1992	68.0720
1978	8920.0345	8969.5000	49.4655
1979	9366.5760	9358.0000	-8.5760
1980	10218.5455	10158.8984	-59.6471

*=OBSERVED +=ESTIMATED X=COMMON

DPY = 559.349226 + 0.881626*IDVI
(T = 98.8551)
(SD= 0.0091)

R**2= 0.959164 SE= 46.7746 DW= 0.5910

--- INPUT DATA ---

YEAR	DPY	IDVI
1971	5465.000	5519.699
1972	5956.199	6067.199
1973	6507.659	6753.358
1974	6920.000	7269.000
1975	7270.500	7639.901
1976	7789.601	8158.301
1977	8448.199	8973.858
1978	8969.500	9413.301
1979	9358.000	9989.601
1980	10158.898	10553.698

--- SIMPLE CORRELATION ---

	DPY	IDVI
DPY	1.00000	
IDVI	0.99559	1.00000

REGRESSION ANALYSIS' REPORT

--- DEFINITIONS ---

DPY =CGNP6
IDVI=CGDP6

YEAR	ESTIMATED	OBSERVED	RESIDUAL
1971	3632.3546	3605.3000	-27.0543
1972	4479.1333	4404.6016	-74.5334
1973	6557.5460	6507.6952	-49.8468
1974	10319.6702	10200.4984	-119.1717
1975	12148.1023	12086.8008	-61.3015
1976	14829.1310	15034.5000	205.3690
1977	18193.4708	18332.1992	138.7285
1978	21460.2989	21600.1992	139.9003
1979	29596.7211	29533.5500	-63.2211
1980	41692.8721	41595.6016	-97.2705

*=OBSERVED +=ESTIMATED X=COMMON

DPY = 165.593550 + 0.96931*IDVI
(T = 259.5693)
(SD= 0.0033)

R**2= 0.999938 SE= 122.0925 DW= 1.0649

--- INPUT DATA ---

YEAR	DPY	IDVI
1971	3605.300	3672.000
1972	4404.602	4564.000
1973	6507.659	6753.358
1974	10200.498	10520.900
1975	12086.801	12642.500
1976	15034.500	15458.199
1977	18332.199	19010.699
1978	21600.199	22458.301
1979	29533.500	31022.858
1980	41595.602	43765.000

--- SIMPLE CORRELATION ---

	DPY	IDVI
DPY	1.00000	
IDVI	0.99995	1.00000

R E G R E S S I O N   A N A L Y S I S   R E P O R T

--- DEFINITIONS ---

DPV =CGTCOSKLB
IDV1=CTRPSGA

YEAR	ESTIMATED	OBSERVED	RESIDUAL	O=OBSERVED	*=ESTIMATED	X=COMMON
1972	1756.2920	1868.6799	112.3879			
1973	2073.2080	2208.0330	134.8249			
1974	2396.2744	2488.4900	92.2156			
1975	2783.8065	2665.4399	-117.3666			
1976	3135.0958	2962.8301	-172.2657			
1977	3630.8143	3328.3201	-302.4943			
1978	4170.0706	3553.3559	-210.6737			
1979	4626.9299	5095.9257	469.0958			

DPV = 344.39605 + 2.5339347IDV1
(T = 9.9011)
(SD= 0.2561)

R**2= 0.942329   SE= 271.2064   DWL= 1.2324

----- INPUT DATA -----

YEAR	DPV	IDV1
1972	1868.683	557.152
1973	2208.033	692.259
1974	2488.493	858.929
1975	2665.440	952.133
1976	2962.830	1101.347
1977	3328.320	1255.559
1978	3553.400	1509.113
1979	5095.933	1690.073

----- SIMPLE CORRELATION -----

	DPV	IDV1
DPV	1.00000	
IDV1	0.97076	1.00000

R E G R E S S I O N   A N A L Y S I S   R E P O R T

--- DEFINITIONS ---

DPV =CTRPSGA
IDV1=CGDP738
IDV2=LAG1(CTRPSGA)

YEAR	ESTIMATED	OBSERVED	RESIDUAL	O=OBSERVED	*=ESTIMATED	X=COMMON
1972	538.2879	557.1521	18.8642			
1973	662.2396	682.2591	20.0624			
1974	818.5396	808.9790	-9.5512			
1975	949.4498	962.7329	13.2924			
1976	1122.9541	1101.3669	-21.6871			
1977	1320.6445	1296.9590	-23.6455			
1978	1531.3596	1509.0130	-22.3466			
1979	1734.6089	1690.0781	-44.5309			
1980	1997.6822	2068.0325	69.3499			

DPV = -253.61926 + 0.17345*IDV1 + 0.54647*IDV2
(T = 2.7401)   (T = 2.2731)
(SD= 0.0621)   (SD= 0.2451)

R**2= 0.555320   SE= 39.4532   DWL= 1.7241

----- INPUT DATA -----

YEAR	DPV	IDV1	IDV2
1972	557.152	6047.159	546.411
1973	682.259	6753.398	557.152
1974	808.979	7269.000	682.259
1975	962.733	7639.901	858.979
1976	1101.367	8156.301	962.733
1977	1296.959	8879.958	1101.367
1978	1509.013	9465.301	1296.959
1979	1690.078	9929.801	1509.013
1980	2068.032	10553.198	1690.078

----- SIMPLE CORRELATION -----

	DPV	IDV1	IDV2
DPV	1.00000		
IDV1	0.99565	1.00000	
IDV2	0.99472	0.99815	1.00000

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--- DEFINITIONS ---

DPY =LOG(CC(C[illegible])
IDV1=LOG(LAG(CC(C[illegible]))
IDV2=LOG(C[illegible])

DPY = -[illegible] 0.4835*IDV1 0.0578*IDV2
(T = 2.0501) (T = 2.7291)

R**2= 0.9[illegible] DW= 2.56

ESTIMATION PERIOD 1972 - - 1980

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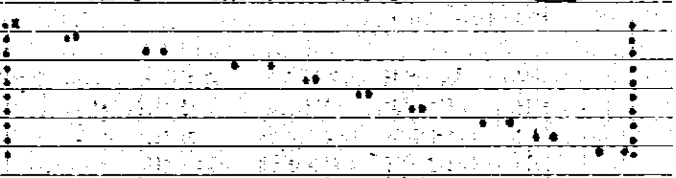
--- DEFINITIONS ---

DPY =LOG(CCT(OTAL))
IDV1=LOG(CCP734)
IDV2=LOG(CPKEA[illegible])-LOG(CPLPGA)

YEAR	ESTIMATED	OBSERVED	RESIDUAL
1971	0.2751	0.2834	0.0082
1972	0.3679	0.3826	0.0256
1973	0.5221	0.4998	-0.0222
1974	0.5919	0.6326	-0.0[illegible]
1975	0.7535	0.7645	0.0110
1976	0.8354	0.8655	0.0091
1977	0.9245	0.9414	0.0169
1978	0.9312	0.9785	0.0473
1979	1.1152	1.1502	0.0350
1980	1.2769	1.2163	-0.0546

*=OBSERVED +=ESTIMATED X=COMMON



DPY = -3.0[illegible] 1.3681*IDV1- 0.00346*IDV2
(T = 11.0[illegible]) (T = -0.0211)
(SD= 0.1241) (SD= 0.1[illegible])

R**2= 0.987256 SE= 0.0[illegible] DW= 1.5506

----- INPUT DATA -----

YEAR	DPY	IDV1	IDV2
1971	0.283	0.276	-2.510
1972	0.383	0.361	-2.550
1973	0.500	0.476	-2.403
1974	0.633	0.606	-2.207
1975	0.765	0.545	-2.0[illegible]
1976	0.865	0.735	-2.200
1977	0.941	0.769	-2.172
1978	0.978	0.8[illegible]	-2.172
1979	1.150	0.909	-2.196
1980	1.216	1.0[illegible]	-2.609

----- SIMPLE CORRELATION -----

	DPY	IDV1	IDV2
DPY	1.00000		
IDV1	0.99360	1.00000	
IDV2	0.[illegible]	0.[illegible]	1.00000

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R E G R E S S I O N   A N A L Y S I S   R E P O R T

--- DEFINITIONS ---

DPY =CCTCOAL16
IDV1=CS1P734
IDV2=CPETROP6

YEAR	ESTIMATED	OBSERVED	RESIDUAL
1971	367.9610	419.6459	51.6419
1972	535.5654	531.3301	-4.0353
1973	729.6521	640.2300	-89.4221
1974	842.6922	729.0550	-113.6421
1975	892.9993	954.5550	61.5557
1976	1048.7896	1074.4650	25.6604
1977	1234.0725	1274.1201	40.0476
1978	1457.8934	1512.6399	54.7465
1979	1564.3032	1596.8601	32.5569
1980	1992.8303	1933.6699	-59.1604

DPY = -435.456926 + 9.66376*IDV1+ 0.00043*IDV2
(T = 11.1511) (T = 0.9551)
(SD= 0.8661) (SD= 0.0001)

R**2= 0.953741 SE= 72.9068 DW= 1.4655

---- INPUT DATA ----

YEAR	DPY	IDV1	IDV2
1971	419.650	69.430	325456.500
1972	531.330	83.119	355580.312
1973	640.230	160.000	486536.250
1974	729.050	111.160	501837.812
1975	954.550	117.400	476854.937
1976	1074.660	130.432	550311.625
1977	1274.120	145.075	635122.750
1978	1512.640	173.620	596658.437
1979	1596.860	182.520	590456.687
1980	1933.670	226.560	578015.975

---- SIMPLE CORRELATION ----

	DPY	IDV1	IDV2
DPY	1.00000		
IDV1	0.97308	1.00000	
IDV2	0.83362	0.81502	1.00000

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R E G R E S S I O N   A N A L Y S I S   R E P O R T

--- DEFINITIONS ---

DPY =LOG(CCICOAL16)
IDV1=LOG(CGDP734)
IDV2=LOG(CPADC8)-LOG(CPAI16)

YEAR	ESTIMATED	OBSERVED	RESIDUAL
1971	6.3503	6.1100	-0.2403
1972	6.5919	6.7106	0.1187
1973	6.9790	7.0642	0.0852
1974	7.3646	7.3436	-0.0210
1975	7.4299	7.5415	0.1116
1976	7.5911	7.7254	0.1343
1977	7.8539	7.8543	0.0004
1978	8.0941	8.0229	-0.0712
1979	8.2434	8.1458	-0.0976
1980	8.3411	8.3212	-0.0200

DPY = -14.237530 + 2.211784*IDV1- 0.190731*IDV2
(T = 4.2471) (T = -1.1191)
(SD= 0.5221) (SD= 0.5011)

R**2= 0.970973 SE= 0.1337 DW= 1.5133

---- INPUT DATA ----

YEAR	DPY	IDV1	IDV2
1971	6.110	8.621	-1.647
1972	6.711	8.711	-1.692
1973	7.064	8.918	-1.864
1974	7.344	8.891	-2.116
1975	7.541	8.960	-2.046
1976	7.725	9.007	-2.012
1977	7.856	9.091	-2.167
1978	8.023	9.153	-2.273
1979	8.146	9.229	-2.369
1980	8.321	9.301	-2.189

---- SIMPLE CORRELATION ----

	DPY	IDV1	IDV2
DPY	1.00000		
IDV1	0.97873	1.00000	
IDV2	-0.94546	-0.92192	1.00000

R E G R E S S I O N   A N A L Y S I S   R E P O R T

--- DEFINITIONS ---

GPY =GCICOP116
ICV1=CSSP734

YEAR	ESTIMATED	OBSERVED	RESIDUAL
1971	262.6765	270.0601	7.3851
1972	347.4120	297.7400	-49.6720
1973	442.8154	378.3799	-64.4356
1974	509.6506	453.0501	-56.6005
1975	545.3491	574.6399	29.2908
1976	622.1315	668.1659	46.0344
1977	719.0377	809.4299	90.3923
1978	869.1394	889.3735	20.2301
1979	929.0866	1020.5701	91.4835
1980	1191.0756	1066.9600	-124.1156

O=OBSERVED *=ESTIMATED C=COMMON

GPY = -148.459650+ 5.89214*ICV1
(T = 11.2463)
(SE= 0.5241)

RSQ= 0.940526   SE= 36.2512   DW= 1.5921

---- INPUT DATA ----

YEAR	GPY	ICV1
1971	270.060	69.630
1972	297.740	83.830
1973	378.380	100.900
1974	453.050	111.165
1975	574.640	117.400
1976	668.170	133.430
1977	809.430	146.475
1978	889.370	172.820
1979	1020.570	182.520
1980	1066.960	226.550

---- SIMPLE CORRELATION ----

	GPY	ICV1
GPY	1.00000	
ICV1	0.96982	1.00000

R E G R E S S I O N   A N A L Y S I S   R E P O R T

--- DEFINITIONS ---

GPY =LOG(GCIC)0161)
ICV1=LOG(CII/7348)
ICV2=LOG(CP=FC48)-LOG(CIP1734)

YEAR	ESTIMATED	OBSERVED	RESIDUAL
1971	6.1955	6.0618	-0.1337
1972	6.4236	6.4650	0.0413
1973	6.6567	6.6202	-0.0365
1974	6.7018	6.8920	0.1158
1975	6.7606	6.8610	0.1005
1976	6.8983	6.9276	0.0293
1977	7.0433	7.0492	0.0059
1978	7.2317	7.2265	-0.0052
1979	7.3987	7.3295	-0.0692
1980	7.5720	7.4693	-0.1027

O=OBSERVED *=ESTIMATED C=COMMON

GPY = 0.942356+ 1.15076*ICV1- 0.14935*ICV2
(T = 15.2621) (T = -0.9333)
(SE= 0.0761) (SE= 0.1601)

RSQ= 0.970582   SE= 0.0823   DW= 1.4567

---- INPUT DATA ----

YEAR	GPY	ICV1	ICV2
1971	6.062	4.240	-2.302
1972	6.465	4.429	-2.432
1973	6.620	4.665	-2.424
1974	6.894	4.711	-2.444
1975	6.861	4.766	-2.213
1976	6.928	4.871	-2.138
1977	7.049	4.990	-2.235
1978	7.226	5.141	-2.323
1979	7.330	5.207	-2.531
1980	7.469	5.425	-2.494

---- SIMPLE CORRELATION ----

	GPY	ICV1	ICV2
GPY	1.00000		
ICV1	0.98356	1.00000	
ICV2	0.05311	0.11524	1.00000

R E G R E S S I O N   A N A L Y S I S   R E P O R T

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--- DEFINITIONS ---

[illegible]
[illegible]
[illegible]

OPV = -15.256(1)+ 2.48143*IOV1 - 0.77856*IOV2
(T = 5.2489) (T = -0.7843)

R**2= 0.9595 DW= 1.292

ESTIMATION PERIOD [illegible]

R E G R E S S I O N   A N A L Y S I S   R E P O R T

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--- DEFINITIONS ---

OPV =LOG(CCIC2MAI6)
IOV1=LOG(CIIP73I)
IOV2=LOG(LAG1(CIIP73C))

YEAR	ESTIMATED	OBSERVED	RESIDUAL	O=OBSERVED	*=ESTIMATED	X=COMMON
1972	4.9234	4.9185	-0.0049	X		
1973	5.2180	5.2283	0.0103	*O		
1974	5.4466	5.4287	-0.0179		O*	
1975	5.6577	5.6935	0.0358			* O
1976	5.8651	5.8339	-0.0313			O *
1977	6.0052	6.0096	0.0044			X
1978	6.2555	6.2591	0.0036			X

OPV = -4.820634 + 0.456816*IOV1 + 0.974133*IOV2
(T = 2.9903) (T = 5.2110)
(SD= 0.2410) (SD= 0.1493)

R**2 = 0.997682   SE= 0.0262   DW= 3.5303

---- INPUT DATA ----

YEAR	OPV	IOV1	IOV2
1972	4.919	4.420	6.765
1973	5.228	4.605	6.939
1974	5.420	4.711	7.097
1975	5.693	4.766	7.272
1976	5.834	4.871	7.409
1977	6.010	4.990	7.487
1978	6.259	5.141	7.915

---- SIMPLE CORRELATION ----

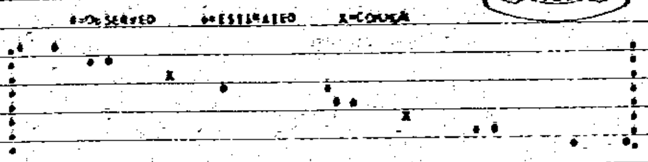
	OPV	IOV1	IOV2
OPV	1.00000		
IOV1	0.95371	1.00000	
IOV2	0.99672	0.98257	1.00000

REGRESSION ANALYSIS REPORT

--- DEFINITIONS ---

DPY =LOG(CCTC2/REI7)
IDV1=LOG(CP/361)
IDV2=LOG(CPELEC/REC(6))-LOG(CCP/1736)

YEAR	ESTIMATED	OBSERVED	RESIDUAL
1971	4.9000	4.9492	0.0492
1972	4.9586	5.0185	0.0195
1973	5.1040	5.1056	0.0044
1974	5.3123	5.1681	-0.1442
1975	5.3428	5.3203	-0.0225
1976	5.4098	5.4112	0.0014
1977	5.5124	5.5268	0.0144
1978	5.5325	5.7104	0.1779



DPY = -6.082470 + 1.229264*IDV1 - 0.198123*IDV2
(T = 8.2403 (T = -0.5641
(SD= 0.1553 (SD= 0.3531

R**2= 0.937343 SE= 0.0780 DW= 1.4645

----- INPUT DATA -----

YEAR	DPY	IDV1	IDV2
1971	4.949	8.296	-1.876
1972	5.018	8.361	-1.938
1973	5.108	8.474	-1.737
1974	5.166	8.604	-1.931
1975	5.320	8.645	-1.844
1976	5.411	8.705	-1.793
1977	5.527	8.769	-1.595
1978	5.710	8.847	-1.597

----- SIMPLE CORRELATION -----

	DPY	IDV1	IDV2
DPY	1.00000		
IDV1	0.95613	1.00000	
IDV2	-0.21967	-0.22584	1.00000

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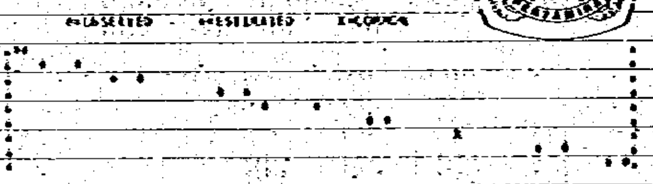
--- DEFINITIONS ---

DPY =CCTC2/REI7
IDV1=CP/PI

YEAR	ESTIMATED	OBSERVED	RESIDUAL
1971	16346.5176	16025.1054	-321.4035
1972	17005.3037	18103.6210	1098.2576
1973	19136.3755	19555.0351	358.6632
1974	23424.2512	22599.8960	-824.3606
1975	25559.6659	23949.0351	-1650.6549
1976	27012.0116	27155.6992	-816.3123
1977	30072.6532	30005.0351	-67.0142
1978	32602.3705	33269.5103	667.1558
1979	34731.6836	35387.3366	655.6430



DPY =-69319.210550 + 716.477830*IDV1
(T = 18.9251
(SD= 37.8651

R**2= 0.950630 SE= 1037.0934 DW= 2.1726

----- INPUT DATA -----

YEAR	DPY	IDV1
1971	16025.104	119.232
1972	18103.621	120.149
1973	19595.039	123.115
1974	22599.893	129.043
1975	23949.039	132.110
1976	27155.695	135.190
1977	30005.039	138.342
1978	33269.573	141.539
1979	35387.359	145.821

----- SIMPLE CORRELATION -----

	DPY	IDV1
DPY	1.00000	
IDV1	0.99337	1.00000

EQUATIONS

```
NO.   ----1---------2---------3---------4---------5---------6---------7---------8
 1.    CEXP738=CON(-331.26030)+CON(0.EE230)*CWIN758+CON(0.00193)*CPETROP8;
 2.    CPIMP8=CON(59.07815)+CON(0.E1770)*CFWE758*CREXCR8;
 3.    CNI738=CON(558.21852)+CON(C.76E14)*CGDP738;
 4.    CWP1738=CON(-117.43769)+CON(1.5E932)*CPIMP8;
 5.    CCP1738=CON(12.762 2)+CON(C.36218)*CWP1738+CON(0.67225)
   C          *LAG1(CCP1738);
 6.    CPCP8=CON(-255.27319)+CON(C.55764)*CPIMP8+CON(6.63860)*
   C          (CNI738/CPOP8);
 7.    CFCG8=CON(-12.19497)+CON(?.96225)*CPCP8+CON(0.13569)*CWP1738;
 8.    CPIIP8=CON(-7.53182)+CON(G.E5241)*CPIMP8+CON(0.00313)*CNI8;
 9.    CPEXP8=CON(2.71828)**(CON(0.64965)+CON(0.69191)*LOG(CFCPOIL8)+
   C          CON(0.67626)*LOG(CIALRPE738));
10.    CPNI8=CON(-5.47214)+CON(1.55(48)*CPGCP8;
11.    CCP738=CON(-2791.69301)+CON(136.E9638)*CGDP738/CPOP8+
   C          CON(0.53116)*CCG738;
12.    CITP738=CON(-885.37864)+CON(0.4C618)*CCP738+CON(0.25240)*CCG738;
13.    CIMP738=CON(-2261.4054E)+CON(0.53040)*CGDP738;
14.    CITP738=CON(-36.14253)+CON(0.C6375)*CCG738+CON(0.21507)*CCP738;
15.    CGNP738=CON(559.34922)+CON(0.EE162)*CGDP738;
16.    CGNP8=CON(146.5E366)+CON(0.94931)*CGDP8;
17.    CCG738=CCG8/(CPCG8/CON(100.));
18.    CGDP738=CCP738+CCG738+CITP738+CEXP738-CIMP738;
19.    CCP8=CCP738*(CPCP8/CON(100.));
20.    CITP8=CITP738*(CPIIP8/CON(1CC.));
21.    CEXP8=CEXP738*(CPEXP8/CON(100.));
22.    CIMP8=CIMP738*(CPIMP8/CON(1C0.));
23.    CGDP8=CCP8+CCG8+CITP8+CEXP8-CIMP8;
24.    CPGDP8=CON(1C0.)*CGDP8/CGDP738;
25.    CPGNP8=CON(100.)*CGNP8/CGNP738;
26.    CNI8=CNI738*(CPNI8/CON(100.));
27.    CCTC05R18=CON(344.30606)+CON(2.53393)*CTRPSG8;
28.    CTRPSG8=CON(-793.61928)+CON(0.17649)*CGDP738+CON(0.54647)*
   C          LAG1(CTRPSG8);
29.    CCTC06R18=CON(2.71828)**(CON(-4.41157)+CON(0.48309)*
   C          LOG(LAG1(CCTC06R18))+CON(0.35703)*LOG(CGDP738));
30.    CCTC07R17=CON(2.71828)**(CON(-3.08178)+CON(1.36818)*LOG(CCP738)+
   C          CON(-0.00316)*(LOG(CPKER8)-LOG(CPLPG8)));
31.    CCTC08R16=CON(-435.45690)+CON(9.66076)*CITP738+
   C          CON(0.00041)*CPETROP8;
32.    CCTC08R18=CON(2.71828)**(CON(-14.23759)+CON(2.21778)*
   C          LOG(CGDP738)+CON(-0.E9073)*(LOG(CPADO8)-LOG(CPNI8)));
33.    CCTC09R16=CON(-146.45869)+CON(5.89274)*CIIP738;
34.    CCTC10R16=CON(2.71828)**(CON(0.970982)+CON(1.15676)*LOG(CIIP738)
   C          +CON(-0.14939)*(LOG(CPHFO8)-LOG(CWP1738)));
35.    CCTC24R16=CON(2.71828)**(CON(-4.72063)+CON(0.69694)*LOG(CIIP738)
   C          +CON(0.98413)*LOG(LAG1(CIIP738)));
36.    CCTC26R17=CON(-69319.21056)+CON(718.47922)*CPOP8;
37.    CCTC12R17=CON(2.71828)**(CON(-15.25664)+CON(2.49143)*
   C          LOG(CCP738)-CON(0.77850)*(LOG(CPLPG8)-LOG(CPKER8)));
38.    CCTC24R17=CON(2.71828)**(CON(-6.C8247)+CON(1.27926)*LOG(CCP738)+
   C          CON(-0.15887)*(LOG(CPELECRE(8)-LOG(CCP1738)));
39.    CCTC01R15=CCTC01R16+CCTC01R17+CCTC01R18;
40.    CCTC01R14=CCTC01R15+CCTC01R20;

41.    CCTC01R06=CCTC01R14-(CCTC01R12+CCTC01R11+CCTC01R13+
   C      CCTC01R09+CCTC01R13);
42.    CCTC01R01=CCTC01R06-CCTC01R05-CCTC01R03-CCTC01R02;
       CCTC02R06=CON(-1.0)*(CCTC02R07+CCTC02R11+CCTC02R12+CCTC02R13);
       CCTC02R03=CCTC02R06-CCTC02R01-CCTC02R02-CCTC02R05;
       CCTC05R15=CCTC05R18+CCTC05R19;
       CCTC05R14=CON(1.C)*CCTC05R15;
47.    CCTC05R07=CON(-1.0)*(CCTC02R07+CCTC05R07);
48.    CCTC05R06=CCTC05R14-CCTC05R07-CCTC05R12-CCTC05R13;
49.    CCTC05R02=CCTC05R06-CCTC05R03-CCTC05R05;
50.    CCTC06R19=((CCG738/LAG1(CCG738)-CON(1.0))*CELC06R19+CON(1.0))
   C      *LAG1(CCTC06R19);
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EQUATIONS

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NO.------1---------2---------3---------4---------5---------6---------7---------8

 51.      CCTC06R15=CCTC06R16+CCTC06R19;
 52.      CCTC06R14=CON(1.0)*CCTC06R15;
 53.      CCTC06R07=CON(-1.0)*(CCTC02R07*CYC06R07);
 54.      CCTC06R06=CCTC06R14-CCTC06R07-CCTC06R12-CCTC06R13;
 55.      CCTC06R02=CCTC06R06-CCTC06R03-CCTC06R05;
 56.      CCTC07R15=CON(1.0)*CCTC07R17;
 57.      CCTC07R14=CON(1.0)*CCTC07R15;
 58.      CCTC07R07=CON(-1.0)*(CCTC02R07*CYC07R07);
 59.      CCTC07R06=CCTC07R14-CCTC07R12-CCTC07R10-CCTC07R07-CCTC07R13;
 60.      CCTC07R02=CCTC07R06-CCTC07R05;
 61.      CCTC08R19=((CCG738/LAG1(CCG738)-CON(1.0))*CELC08R19+CON(1.0))
    C        *LAG1(CCTC08R19));
 62.      CCTC08R15=CCTC08R16+CCTC08R18+CCTC08R19;
 63.      CCTC08R14=CON(1.0)*CCTC08R15;
 64.      CCTC08R07=CON(-1.0)*(CCTC02R07*CYC08R07);
 65.      CCTC09R19=((CCG738/LAG1(CCG738)-CON(1.0))*CELC09R19+CON(1.0))
    C        *LAG1(CCTC09R19));
 66.      CCTC09R15=CCTC09R16+CCTC09R18+CCTC09R19;
 67.      CCTC09R14=CON(1.0)*CCTC09R15;
 68.      CCTC09R07=CON(-1.0)*(CCTC02R07*CYC09R07);
 69.      CCTC09R06=CCTC09R14-CCTC09R07-CCTC09R10-CCTC09R09-
    C        CCTC09R11-CCTC09R12-CCTC09R13;
 70.      CCTC09R02=CCTC09R06-CCTC09R03-CCTC09R05;
 71.      CCTC10R15=CCTC10R16+CCTC10R18+CCTC10R19;
 72.      CCTC10R14=CON(1.0)*CCTC10R15;
 73.      CCTC10R07=CON(-1.0)*(CCTC02R07*CYC10R07);
 74.      CCTC10R06=CCTC10R14-CCTC10R07-CCTC10R09-CCTC10R10-
    C        CCTC10R11-CCTC10R12;
 75.      CCTC10R02=CCTC10R06-CCTC10R03-CCTC10R05;
 76.      CCTC11R15=CON(1.0)*CCTC11R16;
 77.      CCTC11R14=CCTC11R15+CCTC11R20;
 78.      CCTC11R07=CON(-1.0)*(CCTC02R07*CYC11R07);
 79.      CCTC11R06=CCTC11R14-CCTC11R07-CCTC11R08-CCTC11R11-CCTC11R12-CCTC11R13;
 80.      CCTC11R03=CCTC11R06-CCTC11R05-CCTC11R02;
 81.      CCTC12R15=CCTC12R16+CCTC12R17+CCTC12R19;
 82.      CCTC12R14=CCTC12R15+CCTC12R20;
 83.      CCTC12R07=CON(-1.0)*(CCTC02R07*CYC12R07);
 84.      CCTC12R06=CCTC12R14-CCTC12R07-CCTC12R08-CCTC12R12-CCTC12R13;
 85.      CCTC12R02=CCTC12R06-CCTC12R03-CCTC12R05;
 86.      CCTC13R15=CON(1.0)*CCTC13R16;
 87.      CCTC13R14=CCTC13R15+CCTC13R20;
 88.      CCTC13R07=CON(-1.0)*(CCTC02R07*CYC13R07);
 89.      CCTC13R06=CCTC13R14-CCTC13R07-CCTC13R11-CCTC13R12-CCTC13R13;
 90.      CCTC13R02=CCTC13R06-CCTC13R05-CCTC13R03;
 91.      CCTC04R07=CCTC05R07+CCTC06R07+CCTC07R07+CCTC08R07+
    C        CCTC09R07+CCTC10R07;
 92.      CCTC04R10=CCTC07R10+CCTC08R10+CCTC09R10+CCTC10R10;
 93.      CCTC04R11=CCTC08R11+CCTC09R11+CCTC10R11;
 94.      CCTC04R12=CCTC05R12+CCTC06R12+CCTC07R12+CCTC08R12+
    C        CCTC09R12+CCTC10R12;
 95.      CCTC04R13=CCTC05R13+CCTC06R13+CCTC07R13+CCTC08R13+
    C        CCTC09R13+CCTC10R13;
 96.      CCTC04R16=CCTC08R16+CCTC09R16+CCTC10R16;

 97.      CCTC04R17=CON(1.0)*CCTC07R17;
          CCTC04R18=CCTC05R18+CCTC06R18+CCTC08R18+CCTC09R18+CCTC10R18;
          CCTC04R19=CCTC05R19+CCTC06R19+CCTC08R19+CCTC09R19+CCTC10R19;
          CCTC04R15=CCTC04R16+CCTC04R17+CCTC04R18+CCTC04R19;
```

EQUATIONS

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NO.--------1---------2---------3---------4---------5---------6---------7---------8

101.     CCTC04R14=CON(1.0)*CCTC04R15;
102.     CCTC03R07=CCTC04R07+CCTC11R07+CCTC12R07+CCTC13R07;
103.     CCTC03R08=CCTC11R08+CCTC12R08;
104.     CCTC03R10=CON(1.0)*CCTC04R10;
105.     CCTC03R11=CCTC04R11+CCTC11R11+CCTC13R11;
106.     CCTC03R12=CCTC04R12+CCTC11R12+CCTC12R12+CCTC13R12;
107.     CCTC03R13=CCTC04R13+CCTC11R13+CCTC12R13+CCTC13R13;
108.     CCTC03R14=CCTC04R14+CCTC11R14+CCTC12R14+CCTC13R14;
109.     CCTC03R15=CCTC04R15+CCTC11R15+CCTC12R15+CCTC13R15;
110.     CCTC03R16=CCTC04R16+CCTC11R16+CCTC12R16+CCTC13R16;
111.     CCTC03R17=CCTC04R17+CCTC12R17;
112.     CCTC03R18=CCTC04R18+CCTC12R18;
113.     CCTC03R19=CON(1.0)*CCTC04R19;
114.     CCTC03R20=CCTC11R20+CCTC12R20+CCTC13R20;
115.     CCTC14R15=CCTC14R16+CCTC14R17;
116.     CCTC14R14=CCTC14R15+CCTC14R20;
117.     CCTC14R17=CON(-1.0)*(CCTC10R10-CCTC11R10-CCTC03R10);
118.     CCTC14R11=CCTC14R01*ZC14R11;
119.     CCTC14R06=CCTC14R14-CCTC14R08-CCTC14R09-CCTC14R10-
     C      CCTC14R11-CCTC14R12-CCTC14R13;
120.     CCTC14R01=CON(1.0)*CCTC14R06;
121.     CCTC15R06=CON(-1.0)*(CCTC15R08+CCTC15R13);
122.     CCTC15R03=CON(1.0)*CCTC15R06;
123.     CCTC16R06=CON(-1.0)*(CCTC16R08+CCTC16R13);
124.     CCTC16R03=CON(1.0)*CCTC16R06;
125.     CCTC17R15=CON(1.0)*CCTC17R16;
126.     CCTC17R14=CCTC17R15+CCTC17R20;
127.     CCTC17R06=CCTC17R14-CCTC17R08-CCTC17R13;
128.     CCTC17R03=CON(1.0)*CCTC17R06;
129.     CCTC18R15=CCTC18R16+CCTC18R17;
130.     CCTC18R14=CON(1.0)*CCTC18R15;
131.     CCTC18R10=CCTC18R14-CCTC18R11-CCTC18R12-CCTC18R13;
132.     CCTC19R10=CON(-1.0)*(CCTC19R11+CCTC19R13);
133.     CCTC20R06=CON(-1.0)*(CCTC20R09);
134.     CCTC20R01=CON(1.0)*CCTC20R06;
135.     CCTC21R06=CON(-1.0)*(CCTC21R09);
136.     CCTC21R01=CON(1.0)*CCTC21R06;
137.     CCTC22R06=CON(-1.0)*(CCTC22R09);
138.     CCTC22R01=CON(1.0)*CCTC22R06;
139.     CCTC23R06=CON(-1.0)*(CCTC23R09);
140.     CCTC23R01=CON(1.0)*CCTC23R06;
141.     CCTC24R15=CCTC24R16+CCTC24R17+CCTC24R18+CCTC24R19;
142.     CCTC24R14=CON(1.0)*CCTC24R15;
143.     CCTC24R09=CCTC24R14/(CON(1.0)-ZC24R12)-CCTC24R11;
144.     CCTC24R12=CON(-1.0)*(ZC24R12/(CON(1.0)-ZC24R12))*CCTC24R14;
145.     CCTC08R09=CON(-1.0)*(CCTC24R09)/ZC24R09-CCTC01R09-CCTC09R09-
     C      CCTC10R09-CCTC14R09-CCTC20R09-CCTC21R09-CCTC22R09-CCTC23R09;
146.     CCTC08R06=CCTC08R14-CCTC08R07-CCTC08R05-CCTC08R10-
     C      CCTC08R11-CCTC08R12-CCTC08R13;
147.     CCTC08R02=CCTC08R06-CCTC03R03-CCTC08R05;
148.     CCTC04R02=CCTC05R02+CCTC06R02+CCTC07R02+CCTC08R02+
     C      CCTC09R02+CCTC10R02;
149.     CCTC04R03=CCTC05R03+CCTC06R03+CCTC08R03+CCTC09R03+CCTC10R03;

150.     CCTC04R04=CCTC05R04+CCTC06R04+CCTC08R04+CCTC09R04+CCTC10R04;
```

EQUATIONS

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NO.---------1---------2---------3---------4---------5---------6---------7---------8

151.      CCTC04R05=CCTC05R05+CCTC06R05+CCTC07R05+CCTC08R05+
   C         CCTC09R05+CCTC10R05;
152.      CCTC04R06=CCTC05R06+CCTC06R06+CCTC07R06+CCTC08R06+
   C         CCTC09R06+CCTC10R06;
153.      CCTC04R09=CCTC08R09+CCTC09R09+CCTC10R09;
154.      CCTC03R02=CCTC04R02+CCTC11R02+CCTC12R02+CCTC13R02;
155.      CCTC03R03=CCTC04R03+CCTC11R03+CCTC12R03+CCTC13R03;
156.      CCTC03R04=CON(1.0)*CCTC04R04;
157.      CCTC03R05=CCTC04R05+CCTC11R05+CCTC12R05+CCTC13R05;
158.      CCTC03R06=CCTC04R06+CCTC11R06+CCTC12R06+CCTC13R06;
159.      CCTC03R09=CON(1.0)*CCTC04R09;
160.      CCTC25R01=CCTC01R01+CCTC02R01+CCTC14R01+CCTC20R01+CCTC21R01+
   C         CCTC22R01+CCTC23R01;
161.      CCTC25R02=CCTC01R02+CCTC02R02+CCTC03R02;
162.      CCTC25R03=CCTC01R03+CCTC02R03+CCTC03R03+CCTC15R03+
   C         CCTC16R03+CCTC17R03;
163.      CCTC25R04=CON(1.0)*CCTC03R04;
164.      CCTC25R05=CCTC01R05+CCTC02R05+CCTC03R05;
165.      CCTC25R06=CCTC25R01+CCTC25R02+CCTC25R03+CCTC25R05;
166.      CCTC25R07=CCTC02R07+CCTC03R07;
167.      CCTC25R08=CCTC03R08+CCTC14R08+CCTC15R08+CCTC16R08+CCTC17R08;
168.      CCTC25R09=CCTC01R09+CCTC03R09+CCTC14R09+CCTC20R09+
   C         CCTC21R09+CCTC22R09+CCTC23R09+CCTC24R09;
169.      CCTC25R10=CCTC01R10+CCTC03R10+CCTC14R10+CCTC18R10+CCTC19R10;
170.      CCTC25R11=CCTC01R11+CCTC02R11+CCTC03R11+CCTC14R11+
   C         CCTC18R11+CCTC19R11+CCTC24R11;
171.      CCTC25R12=CCTC01R12+CCTC02R12+CCTC03R12+CCTC14R12+
   C         CCTC18R12+CCTC24R12;
172.      CCTC25R13=CCTC01R13+CCTC02R13+CCTC03R13+CCTC14R13+CCTC15R13+
   C         CCTC16R13+CCTC17R13+CCTC18R13+CCTC19R13;
173.      CCTC25R16=CCTC01R16+CCTC03R16+CCTC14R16+CCTC18R16+CCTC24R16;
174.      CCTC25R17=CCTC01R17+CCTC03R17+CCTC14R17+CCTC18R17+CCTC24R17;
175.      CCTC25R18=CCTC01R18+CCTC03R18+CCTC17R18+CCTC24R18;
176.      CCTC25R19=CCTC03R19+CCTC24R19;
177.      CCTC25R20=CCTC01R20+CCTC03R20+CCTC14R20+CCTC17R20;
178.      CCTC25R15=CCTC25R16+CCTC25R17+CCTC25R18+CCTC25R19;
179.      CCTC25R14=CCTC25R15+CCTC25R20;
180.      CCTC26R15=CCTC26R16+CCTC26R17+CCTC26R18;
181.      CCTC26R14=CCTC26R15+CCTC26R20;
182.      CCTC26R06=CON(1.0)*CCTC26R14;
183.      CCTC26R01=CCTC26R06-CCTC26R05-CCTC26R03;
184.      CCTC27R01=CCTC25R01+CCTC26R01;
185.      CCTC27R02=CON(1.0)*CCTC25R02;
186.      CCTC27R03=CCTC25R03+CCTC26R03;
187.      CCTC27R04=CON(1.0)*CCTC25R04;
188.      CCTC27R05=CCTC25R05+CCTC26R05;
189.      CCTC27R06=CCTC25R06+CCTC26R06;
190.      CCTC27R07=CON(1.0)*CCTC25R07;
191.      CCTC27R08=CON(1.0)*CCTC25R08;
192.      CCTC27R09=CON(1.0)*CCTC25R09;
193.      CCTC27R10=CON(1.0)*CCTC25R10;
194.      CCTC27R11=CON(1.0)*CCTC25R11;
195.      CCTC27R12=CON(1.0)*CCTC25R12;

196.      CCTC27R13=CCTC25R13+CCTC26R13;
197.      CCTC27R14=CCTC25R14+CCTC26R14;
198.      CCTC27R15=CCTC25R15+CCTC26R15;
199.      CCTC27R16=CCTC25R16+CCTC26R16;
200.      CCTC27R17=CCTC25R17+CCTC26R17;
```

2-2 Results and Evaluation of Forecasting Simulation

Using the energy demand forecast model discussed in the preceding section, three different cases (base case, high economic growth case and high energy price case) were simulated. The simulation was made to examine the relation between economic growth and energy consumption as well as the relation between energy prices and energy consumption.

In this section, the results of the simulation are summarized under the following titles in that order.

1) Forecasting results of the base case
2) Comparative analysis on the simulation results
3) Evaluation on the 1981 model and future subject
4) Appendix – list of variables employed in the base case

2-2-1 Forecasting Results of the Base Case

The forecast of the base case was made by employing such exogenous variables as summarized in Table 2-2-1. Major exogenous variables related to the macro-economy included nominal government final consumption, world imports and domestic crude oil output. Energy-related exogenous variables included prices of individual types of energy and coal demand, the latter with no other alternative.

These exogenous variables were selected based on deliberate discussions made among Indonesian counterparts about such subjects as future plans of the Indonesian government and past trends of individual variables.

Discussed here are the grounds for the exogenous value setting in detail. As shown in Table 2-2-1, the macro-economic model employs eight major exogenous variables. The growth of nominal government consumption CG had stayed at around 35% on the average between 1975 and 1980. However, giving special consideration to the lower growth rates marked in 1981 and 1982, it was set at 20% for the 1981–85 period, 17.5% for the 1986–90 period and 15% for 1991 and afterwards. The values of crude oil output and population were set based on government policies, while the value of world imports was deduced from the trends in the past (the average annual growth rate had been 5.2% between 1971 and 1980). The values of the remaining variables were set based on government policies and recent economic trends.

As indicated in Table 2-2-1 (2), the demand forecast model employs 13 major exogenous variables, which can be roughly divided into two groups, those related to energy prices (5 variables) and others related to energy demand by sector (8 variables).

Between 1975 and 1980, kerosene price had increased by about 19% a year on the average. However, assuming that government subsidies would be deescalated by about 5% by 1995, the rate of increase in kerosene price was set at 25% for the 1981–85 period. In other words, the rates of increase were set at 20% for the 1980–85 period, 15% for the 1986–

Table 2-2-1 Main Exogenous Variables in the Base Case

(1) Macro-economic model

(Unit: Annual growth rate %)

Exogenous Variables	1981–85	1986–90	1991–95	1996–2000
Nominal Government Consumption CCG&	20.0	17.5	15.0	15.0
Crude Oil Production CPETROP&	2.0	2.0	2.0	2.0
Crude Oil Export Prices CPCROIL&	10.0	8.0	6.0	6.0
World Real Import CWIM75&	5.0	5.0	5.0	5.0
Index of World Export Prices CPWE75&	5.0	5.0	5.0	5.0
Agricultural Export Deflator CIAGRPE73&	10.0	7.5	5.0	5.0
Exchange Rate CPEXCR&	2.0	2.0	1.0	1.0
Population CPOP&	2.3	2.25	2.20	2.15

(2) Demand forecast model

Kerosene Price CPKER&	25.0	20.0	15.0	10.0
LPG Price CPLPG&	15.0	15.0	10.0	10.0
ADO Price CPADO&	(81–82) 24.0 (83–85) 20.0	15.0	10.0	10.0
HFO Price CPHFO&	24.0	24.0	24.0	19.0
Electricity Price, Residential/Commercial Sector CPELECREC&	15.0	15.0	10.0	10.0
Coal Demand, Industry, Transportation, Non-Energy Sector CCTC01R16, R18, R20	81–85 estimated	86 – 0%		
Gasoline Demand, Government Sector CCTC05R19	0.0	0.0	0.0	0.0
IDO Demand, Transportation Sector CCTC09R18	1.5	1.0	1.0	1.0

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Table 2-2-1 *(continued)*

(Unit: annual growth rate %)

Exogenous Variables		1981–85	1986–90	1991–95	1996–2000
HFO Demand, Transportation & Government Sector CCTC10R18, R19	T	–5%/year			
	G	0%			
Other Petroleum Products in Non-Commercial Energy Sector CCTC13R20		15.0	15.0	10.0	10.0
Natural Gas Demand, Industry & Residential/Commercial Sector CCTC14R16, R17	I	25.0	2.5	0.0	0.0
	R/C	0.0	0.0	0.0	0.0
Town Gas Demand, Residential/Commercial Sector CCTC18R17		5.0	5.0	5.0	5.0
N.E.* Demand, Industry & Transportation Secotr CCTC26R16, R18	I	–2.5	–2.5	–2.5	–2.5
	R/C	0.0	0.0	0.0	0.0

* N.E.: Non-commercial Energy

90 period and 10% for the 1991–95 period. ADO and HFO prices were also determined in a similar manner, though the former, characterized by a high ratio of consumption in the public transport sector, was set at a relatively lower level. As far as LPG price and power rate for residential/commercial use were concerned, the rates of increase of these prices stayed at about 11% over the 10 years between 1970 and 1980. However, judging from accelerated inflation in Indonesia during the past few years, inflation rates are expected to be slightly higher than the past. Hence, they were set at 15% for the 1981–90 period and 10% for the period between 1991 and 2000.

As for energy demand by sector, the growth rates of demands for individual types of energy in the government sector were assumed to level off. Excluding town gas demand of the residential/commercial sector and demand for other petroleum products of the non-energy sector, the growth of individual types of energy was assumed to decline or level off. The exogenous values of town gas for residential/commercial use and other petroleum products for non-energy use were set based on the government's town gas supply plan and the past trends (with the average annual growth rate of 13% between 1974 and 1979), respectively.

Results of the forecast, made based on these exogenous variables, are shown in Table 2-2-2 ~ 2-2-11.

Of macro-economic variables, GDP growth rates were forecasted at 4.8% in terms of an annual average for the 1980–85 period, 6.3% for the 1985–90 period and 6.4% for the period between 1990 and 2000. Though these represent slight decreases from 7.8%, the average growth rate marked between 1971 and 1980, it is noteworthy that favorable economic growth was forecast despite a slowdown in the growth of crude oil output expected in the next 20 years.

Major factors supporting the expected economic growth are government final consumption expenditure and gross fixed capital formation. On the other hand, even though trade balance is expected to be favorable in the black exports/imports form a negative factor and private final consumption expenditure serves as a neutral factor producing neither favorable nor adverse effects on the economic growth.

Discussed below are expected trends of energy demand corresponding to the economic growth. In terms of domestic primary energy demand, the annual growth rates were estimated at 8.1% for the 1978–85 period, 6.1% for the 1985–90 period and 6.6% for the period between 1990 and 2000. In terms of elasticity to GDP, they are 1.42, 0.97 and 1.03, respectively, thus showing fluctuations of around 1 (see Table 2-2-3). Compared with 0.91, the average elasticity between 1971 and 1978, energy elasticity to GDP in the coming years is expected to show a slightly upward trend.

By each consuming sector, the industrial sector was forecasted to mark a 7.2% increase in energy demand a year on the average between 1978 and 2000, the residential/commercial sector a 5.7% increase, the transportation sector a 10.5% increase, the government sector a 0.6% increase, the non-energy sector a 8.5% increase and the energy transformation sector a 6.4% increase. In other words, the transportation, non-energy and industrial sectors are expected to show higher growth, while the government and residential/commercial sectors lower growth. When the forecasted growth rates are compared with those achieved during the 1971–78 period, a marked growth in the industrial sector is particularly noted. This reflects the expected development of the Indonesian economy in the coming years. On the other hand, it is also noted that the growth in the government and residential/commercial sectors are assumed to slow down sharply.

Energy demand by type of energy source by consuming sector is detailed in Table 2-2-5 ~2-2-9. The most noteworthy points are the growth of solid fuel demand from the industrial and power generation sectors and the declining share of petroleum fuels in the power generation sector.

Summarized in Table 2-2-11 are demand for petroleum products by consuming sector, shares of petroleum products by consuming sector and shares of petroleum product demand in total commercial energy demand. As shown clearly, it is the power generation sector where the share of oil is sharply declining. In comparison, the shares of oil, also declining slightly in the industrial and government sectors, show upward trends in the remaining sectors.

It can be said that the forecast implies that how to curb energy demand from the residential/commercial and transportation sectors and how to promote fuel conversion in the industrial sector are the keys to curbing the growth of oil demand in Indonesia in the coming years.

Table 2-2-2 Major Macro Economic Variables

Item		1971	1975	1978	1980	1985	1990	2000
Nominal Gross Domestic Product CGDP&	1 billion RP	3672.0	12642.5	21788.4	43765.0	99653.1	212595.4	919358.5
Real Gross Domestic Product CGDP73&	1 billion RP	5544.7	7630.8	9392.2	10953.9	13848.0	18797.5	34958.5
Real Private Consumption CCP73&	1 billion RP	3998.4	5678.9	6754.6	8289.0	11280.4	15223.7	27344.2
Real Government Consumption CCG73&	1 billion RP	518.3	835.5	1065.0	1669.2	2983.4	5048.2	12828.1
Gross Capital Formation CITP73&	1 billion RP	866.9	1650.2	2272.2	2868.5	4452.5	6577.4	13471.9
Export, etc. CEXP73&	1 billion RP	890.8	1266.8	1618.6	1684.9	2059.9	2518.8	3807.9
Import, etc. CIMP73&	1 billion RP	729.7	1800.6	2318.2	3557.7	5733.3	8711.0	18433.8
Real National Income CGNP73&	1 billion RP	4832.8	7270.5	7839.2	10156.9	13848.0	18797.5	34958.5
Consumer Price Index CCPI73&	CA1973=100	71.7	167.5	240.9	373.2	630.0	887.6	1594.6
Wholesale Price Index CWPI73&	CA1973=100	63.7	157.3	222.5	449.7	620.3	874.1	1572.6

Item		1978/1971	1980/1975	1985/1978	1990/1985	2000/1990		
Nominal Gross Domestic Product CGDP&	1 billion RP	(%) 29.0	28.2	24.3	16.4	- 15.8		
Real Gross Domestic Product CGDP73&	1 billion RP	(%) 7.8	7.5	5.7	6.3	6.4		
Real Private Consumption CCP73&	1 billion RP	(%) 7.8	7.9	7.6	3.0	6.0		
Real Government Consumption CCG73&	1 billion RP	(%) 10.8	14.8	15.9	5.4	9.8		
Gross Capital Formation CITP73&	1 billion RP	(%) 14.8	11.7	10.1	8.1	7.4		
Export, etc. CEXP73&	1 billion RP	(%) 8.9	5.9	3.7	4.0	4.1		
Import, etc. CIMP73&	1 billion RP	(%) 18.0	14.6	13.8	8.7	7.8		
Real National Income CGNP73&	1 billion RP	(%) 7.2	6.9	8.5	6.3	6.4		
Consumer Price Index CCPI73&	CA1973=100	(%) 18.9	17.4	14.7	7.1	6.0		
Wholesale Price Index CWPI73&	CA1973=100	(%) 19.6	23.4	15.8	7.1	6.0		

Table 2-2-3 Domestic Primary Energy Requirement and GDP Elasticity

Item		1971	1978	1985	1990	2000
Domestic Primary Energy Requirement CCTC27R06	10^3TCE	54599	88037	151497.4	203781.5	385690.4
GDP CGDP73&	1 billion RP	5544.7	9392.7	13848.0	18797.5	34958.5
GDP per unit Energy Requirement	10^3TCE/ 1 billion RP	9.85	9.37	10.94	10.84	11.03
GDP Elasticity	–	–	–	–	–	–

Item		1978/1971	1985/1978	1990/1985	2000/1990	
Domestic Primary Energy Requirement CCTC27R06	10^3TCE	(%) 7.1	8.1	6.1	6.6	
GDP CGDP73&	1 billion RP	(%) 7.8	5.7	6.3	6.4	
GDP per unit Energy Requirement	10^3TCE/ 1 billion RP	(%) Δ0.7	2.2	Δ0.2	0.2	
GDP Elasticity	–	(%)0.91	1.42	0.97	1.03	

Table 2-2-4 Energy Demand by Sector

Item	1971 10^3TCE	Share(%)	1975 10^3TCE	Share(%)	1978 10^3TCE	Share(%)	1985 10^3TCE	Share(%)
Production CCTC27R01	108231		142657		190896		244174.6	
Import CCTC27R02	1898		2923		9883		18955.4	
Export CCTC27R03	−55552		−81602		−111629		−111632.5	
Marine Bunker & Stock Change CCTC27R04 + CCTC27R05	−359		−716		−1712		−669.8	
Domestic Primary Energy Supply CCTC27R06	54599		63605		88037		151497.4	
Energy Sector, etc.	7611		9452		23799		47212.1	
Final Consumption CCTC27R14	46988	100	54153	100	64238	100	104285.3	100
Industry Sector CCTC27R16	22912	48.8	16413	30.3	11624	18.1	17943.9	17.3
Transportation Sector CCTC27R18	3466	7.4	6097	11.3	8007	12.5	16824.2	16.1
Residential/Commercial Sector CCTC27R17	20039	42.7	30438	56.2	42040	65.4	66581.3	63.8
Government Sector CCTC27R19	288	0.6	705	1.3	1020	1.6	776.5	0.7
Non-Energy Consumption CCTC27R20	233	0.5	500	0.9	1547	2.4	2159	2.1

Item	1990 10^3TCE	Share(%)	1995 10^3TCE	Share(%)	2000 10^3TCE	Share(%)
Production CCTC27R01	283309.8		340432.9		399513.4	
Import CCTC27R02	6579.7		−		−	
Export CCTC27R03	−86107.9		−60437.6		−13822.8	
Marine Bunker & Stock Change CCTC27R04 + CCTC27R05	−814.5		−974.8		−1194.5	
Domestic Primary Energy Supply CCTC27R06	203781.5		279995.2		385690.4	
Energy Sector, etc.	57058.3		78933.7		99606.1	
Final Consumption CCTC27R14	146723.2	100	201061.5	100	286084.3	100
Industry Sector CCTC27R16	24638.4	16.8	33760.7	16.8	49309.3	17.2
Transportation Sector CCTC27R18	26218.4	17.9	41796.7	20.8	70983.6	24.8
Residential/Commercial Sector CCTC27R17	89538.4	61.0	117727.8	58.6	155689.5	54.4
Government Sector CCTC27R19	794.1	0.5	816.6	0.4	845.4	0.3
Non-Energy Consumption CCTC27R20	5533.9	3.8	6959.9	3.4	9256.6	3.3

Table 2-2-5 Energy Demand in Industrial Sector by Energy Type

Item	1971 10^3TCE	Share %	1975 10^3TCE	Share %	1978 10^3TCE	Share %	1985 10^3TCE	Share %	1990 10^3TCE	Share %
Solid Fuels C1R16	50	0.2	45	0.3	50	0.4	1142	6.4	1365	5.5
Petroleum Products Total C3R16	1153	5.0	1831	11.2	3667	31.5	8407	46.9	13074	53.1
Diesel Oil (1) C8R16+C9R16	713	3.1	1008	6.1	2307	19.8	5280	29.4	8428	34.2
Heavy Fuel Oil (2) C10R16	441	1.9	823	5.0	1360	11.7	3063	17.1	4581	18.6
Others C3R16 – ((1)+(2))	Δ1	–	0	–	0	–	64	0.3	65	0.3
Gas Total C14R16 + C18R16	79	0.3	294	1.8	1139	9.8	3132	17.4	3582	14.5
Natural Gas C14 R16	79	0.3	294	1.8	1139	9.8	3052	17.0	3453	14.0
Others C18 R16	0	–	0	–	0	–	80	0.4	129	0.5
Electricity C24 R16	119	0.5	220	1.3	480	4.1	1738	9.7	3513	14.3
Non-Commercial Energy C26 R16	21510	93.9	14023	85.4	6288	54.1	3524	19.6	3105	12.6
Total C27 R16	22912	100	16413	100	11624	100	17944	100	24638	100

Item	2000 10^3TCE	Share %	1978/1971	1985/1978	1990/1985	2000/1990
Solid Fueld C1R16	1365	2.8	0	56.4	3.6	0
Petroleum Products Total C3R16	29140	59.1	18.0	12.6	9.2	8.3
Diesel Oil (1) C8R16 + C9R16	19436	39.4	18.3	12.6	9.8	8.7
Heavy Fuel Oil (2) C10R16	9539	19.6	17.5	12.3	8.4	7.7
Others C3R16 – ((1)+(2))	65	0.1	–	–	0.3	0
Gas Total C14R16 + C18R16	3787	7.7	46.4	15.5	2.7	0.6
Natural Gas C14R16	3453	7.0	46.4	15.1	2.5	0
Others C18R16	334	0.7	–	–	10.0	10.0
Electricity C24R16	12607	25.5	22.0	20.2	15.1	13.6
Non-Commercial Energy C26R16	2411	4.9	Δ16.1	Δ7.9	Δ2.5	Δ2.5
Total C27R16	49309	100	Δ9.2	6.4	6.5	7.2

Table 2-2-6 Energy Demand in Residential/Commercial Sector by Energy Type

Item	1971 10^3TCE	Share %	1975 10^3TCE	Share %	1978 10^3TCE	Share %	1985 10^3TCE	Share %	1990 10^3TCE	Share %
Petroleum Products Total C3R17	3908	19.4	6270	20.6	8555	20.3	16548	24.9	25274	28.2
Kerosene C7R17	3905	19.4	6222	20.4	8475	20.1	16161	24.3	24336	27.2
LPG C12R17	3	0.01	48	0.2	80	0.2	387	0.6	939	1.0
Gas Total C14R17+C18R17	15	0.1	14	0.04	16	0.03	53	0.1	67	0.1
Electricity C24R17	141	0.7	204	0.7	302	0.7	572	0.9	817	0.9
Non-Commercial Energy C26R17	16025	79.8	23949	78.7	33168	78.9	49408	74.2	63360	70.8
Total C27R17	20089	100	30438	100	42040	100	66581	100	89538	100

Item	2000 10^3TCE	Share %	1978/1971	1985/1978	1990/1985	2000/1990
Petroleum Products Total C3R17	58738	37.7	11.8	9.9	8.8	8.8
Kerosene C7R17	54182	34.8	11.7	9.7	8.5	8.3
LPG C12R17	4555	2.9	59.8	25.3	19.4	17.1
Gas Total C14R17+C18R17	108	0.1	0.9	18.7	4.8	4.9
Electricity C24R17	1607	1.0	11.5	9.6	7.4	7.0
Non-Commercial Energy C26R17	95237	61.2	11.0	5.9	5.1	4.2
Total C27R17	155690	100	11.1	6.8	6.1	5.7

Table 2-2-7 Energy Demand in Transportation Sector by Energy Type

Item	1971 10^3TCE	Share %	1975 10^3TCE	Share %	1978 10^3TCE	Share %	1985 10^3TCE	Share %	1990 10^3TCE	Share %
Petroleum Products Total C3R18	3380	97.5	6006	98.5	7943	99.2	16751	99.6	26145	99.7
Gasoline C5R18	2062	59.5	2601	42.7	3644	45.5	9215	54.8	14224	54.2
Jet Fuel C6R18	192	5.5	515	8.4	677	8.5	1497	8.9	2541	9.7
Kerosene C8R18+C9R18	578	16.7	2546	41.8	3187	39.8	5768	34.3	9171	35.0
Heavy Fuel Oil C10R18	547	15.8	345	5.6	436	5.4	270	1.6	209	0.8
Solid Fuels Others C27R18 – C3R18	86	2.5	91	1.5	64	0.8	73	0.4	73	0.3
Total C27R18	3466	100	6097	100	8007	100	16824	100	26218	100

Item	2000 10^3TCE	Share %	1978/1971	1985/1978	1990/1985	2000/1990
Petroleum Products Total C3R18	70911	99.9	13.0	11.2	9.3	10.5
Gasoline C5R18	30396	45.8	8.5	14.2	9.1	7.9
Jet Fuel C6R18	7258	10.2	19.7	12.0	11.2	11.1
Kerosene C8R18+C9R18	33131	46.7	27.6	8.8	9.7	13.7
Heavy Fuel Oil C10R18	125	0.2	△3.2	△6.6	△5.0	△5.0
Solid Fuels Others C27R18 – C3R18	73	0.1	△4.1	1.9	0	0
Total C27R18	70984	100	12.7	11.2	9.3	10.5

Table 2-2-8 Energy Demand in Government Sector by Energy Type

Item	1971 10^3TCE	Share %	1975 10^3TCE	Share %	1978 10^3TCE	Share %	1985 10^3TCE	Share %	1990 10^3TCE	Share %
Petroleum Products Total C3R19	247	85.8	673	95.5	973	95.4	713	91.8	713	89.8
Gasoline C5R19	0	0	314	44.5	285	27.9	300	38.6	300	37.8
Jet Fuel C6R19	0	0	27	3.8	54	5.3	42	5.4	42	5.3
Kerosene C8R19 + C9R19	203	70.5	261	37.0	579	56.8	311	40.0	311	39.2
Heavy Fuel Oil C10R19	44	15.3	72	10.2	55	5.4	60	7.7	60	7.5
Electricity C24R19	41	14.2	32	4.5	47	4.6	64	8.2	81	10.2
Total C27R19	288	100	705	100	1020	100	777	100	794	100

Item	2000 10^3TCE	Share %	1978/1971	1985/1978	1990/1985	2000/1990
Petroleum Products Total C3R19	713	84.3	21.6	△4.3	0	0
Gasoline C5R19	300	35.5	0	0.7	0	0
Jet Fuel C6R19	42	4.9	0	△3.5	0	0
Kerosene C8R19 + C9R19	311	36.8	16.2	△8.5	0	0
Heavy Fuel Oil C10R19	60	7.1	3.2	1.3	0	0
Electricity C24R19	133	15.7	2.0	4.5	4.8	5.1
Total C27R19	845	100	19.8	△3.8	0.4	0.6

Table 2-2-9 Conposition of Fuels for Electric Power Generation

Item	1971 10^3TCE	Share %	1975 10^3TCE	Share %	1978 10^3TCE	Share %	1985 10^3TCE	Share %	1990 10^3TCE	Share %
Solid Fuels C1R9	66	4.7	77	3.6	76	1.9	2044	21.7	11357	65.2
Petroleum Products Total C3R9	706	50.8	1210	56.0	2754	67.6	5495	58.3	3340	19.2
Kerosene C9R9+C8R9	552	39.7	864	40.0	2116	52.0	3884	41.2	974	5.6
Heavy Fuel Oil C10R9	154	11.1	346	16.0	638	15.6	1611	17.1	2366	13.6
Nuclear Power	0	0	0	0	0	0	0	0	0	0
Hydro & Geothermal C20R9+C21R9	619	44.5	871	40.4	1241	30.5	1888	20.0	2719	15.6
Total	1391	100	2158	100	4071	100	9427	100	17416	100

Item	2000 10^3TCE	Share %	1978/1971	1985/1978	1990/1985	2000/1990
Solid Fuels C1R9	45945	81.5	2.0	59.7	40.9	15.0
Petroleum Products Total C3R9	4899	8.7	21.5	24.1	Δ4.3	3.9
Kerosene C9R9+C8R9	1398	2.5	21.2	24.0	Δ24.2	3.7
Heavy Fuel Oil C10R9	3501	6.2	22.5	24.6	8.0	4.0
Nuclear Power	0	0	0	0	0	0
Hydro & Geothermal C20R9+C21R9	5547	9.8	10.4	11.7	7.6	7.4
Total	56391	100	16.6	23.4	13.1	12.5

Table 2-2-10 Supply and Demand of Petroleum Products

Item	1971 10^3TCE	1975 10^3TCE	1978 10^3TCE	1985 10^3TCE	1990 10^3TCE	1995 10^3TCE
Crude, Domestic Production	62,260	95,562	119578	127136	140368	154978
Crude, Import	570	122	6224	7330	7330	7330
Petroleum Products, Import Total	1329	2795	3659	18387	17490	26020
Gasoline	1	0	3	0	0	0
Jet Fuel	0	467	652	1228	2082	3466
Kerosene	1062	1278	898	0	0	0
Diesel Oil	10	945	2024	1182	0	9972
Heavy Fuel Oil	255	36	0	14538	15408	12582
Naphthas+Condensates (NGL)	0	0	0	0	0	0
LPG	0	0	4	0	0	0
Others	0	70	77	1439	0	0
Petroleum Products, Domestic Demands	9561	16256	24353	49104	73110	109944
Fuel Oil Total	9405	15964	23837	47490	67570	101728
Gasoline	2062	2915	3928	9515	14524	21129
Jet Fuel	192	542	731	1539	2583	4273
Kerosene	3905	6222	8475	16161	24336	35691
Diesel Oil	2059	4698	8214	15262	18902	30851
Heavy Fuel Oil	1186	1585	2489	5014	7226	9784
Naphthas + Condensates (NGL)	0	0	0	0	0	0
LPG	3	48	80	387	939	2189
Others	153	244	436	1227	4601	6027
Crude Oil, Export	570	122	6224	7330	7330	7330
Petroleum Products Export	7539	8843	9575	15563	32277	47251
Heavy Fuel Oil	1185	0	411	0	0	0
Naphthas + Condenseates (NGL)	0	727	2227	6534	5854	8705
LPG	8	6	657	157	119	84
Others	6346	8110	6280	8872	26304	38462
Petroleum Products Bunker	337	417	609	670	814	975

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Table 2-2-10 *(continued)*

Item	2000 10^3TCE	1978/1971	1985/1978	1990/1985	2000/1990
Crude, Domestic Production	171108	9.0 (%)	0.9 (%)	2.5 (%)	1.0 (%)
Crude, Import	7330	40.7	2.4	0	0
Petroleum Products, Import Total	23932	15.6	25.9	Δ1.0	Δ0.8
Gasoline	0	17.0	0	0	0
Jet Fuel	6000	0	9.5	11.1	5.6
Kerosene	0	Δ2.4	0	0	0
Diesel Oil	10470	113.5	Δ7.4	0	0.5
Heavy Fuel Oil	7462	0	0	1.2	Δ0.5
Naphthas + Condensates (NGL)	0	0	0	0	0
LPG	0	0	0	0	0
Others	0	0	51.9	0	0
Petroleum Products, Domestic Demands	172688	14.3	10.5	8.3	9.0
Fuel Oil Total	159809	14.2	10.3	7.3	9.0
Gasoline	30696	9.6	13.5	8.8	7.8
Jet Fuel	7300	21.0	11.2	10.9	10.9
Kerosene	54182	11.7	9.7	8.5	8.3
Diesel Oil	54296	21.9	9.3	4.4	11.1
Heavy Fuel Oil	13335	11.2	10.5	7.6	6.3
Naphthas + Condensates (NGL)	0	0	0	0	0
LPG	4555	59.8	25.3	19.4	17.1
Others	8324	16.1	15.9	30.3	6.1
Crude Oil, Export	7330	40.7	2.4	0	0
Petroleum Products Export	79022	3.5	7.2	15.7	5.3
Heavy Fuel Oil	0	14.0	0	0	0
Naphthas + Condensates (NGL)	12646	0	16.6	Δ2.2	8.0
LPG	29	87.7	Δ18.5	Δ5.4	Δ13.2
Others	66347	Δ0.1	5.1	24.3	5.6
Petroleum Products Bunker	1195	8.8	1.4	4.0	3.9

Table 2-2-11 Petroleum Demand by Sector

10^3TCE

		1978	1985	1990	1995	2000
Demand	Industry Sector	3667	8407	13074	19376	29140
	Residential/Commercial Sector	8555	16548	25274	37880	58738
	Transportation sector	7943	16751	26145	41724	70911
	Government Sector	973	713	713	713	713
	Non-Energy Sector	436	1161	4536	5962	8259
	Power Generation Sector	2754	5495	3340	4260	4899
	Total	24328	49075	73082	109915	172660
Share	Industry Sector	15.1	17.1	17.9	17.6	16.9
	Residential/Commercial Sector	35.2	33.7	34.6	34.5	34.0
	Transportation Sector	32.6	34.1	35.8	38.0	41.1
	Government Sector	4.0	1.5	1.0	0.6	0.4
	Non-Energy Sector	1.8	2.4	6.2	5.4	4.8
	Power Generation Sector	11.3	11.2	4.6	3.9	2.8
	Total	100.0	100.0	100.0	100.0	100.0
Share in Commercial Energy	Industry Sector	68.7	58.3	60.7	62.5	62.1
	Residential/Commercial Sector	96.4	96.4	96.6	96.9	97.2
	Transportation Sector	99.6	99.8	99.9	99.9	100.0
	Government Sector	95.4	91.8	89.8	87.3	84.3
	Non-Energy Sector	28.2	53.8	82.0	85.7	89.2
	Power Generation Sector	67.6	58.3	19.2	13.8	8.7
	Total	84.3	80.8	74.9	73.0	70.5

2-2-2 Conparative Analysis on the Simulation Results

As mentioned before, three different cases were simulated. Table 2-2-12 contains preconditions employed in individual cases. Sim. 1 is the case of high economic growth and Sim. 2 is the case of high energy prices.

Forecasting results based on the preconditions are shown in Table 2-1-13. In the high economic growth case, average annual growth rate of GDP was estimated to be 6.88% between 1978 and 2000. This is higher by 0.24% than the GDP growth rate in the base case. Domestic primary energy demand, forecasted at 7.18%, is also higher than 6.95% in the base case. Meanwhile, in the both cases, long-term energy elasticity to GDP was revealed to be slightly higher than 1.04. It was also forecast in the both cases that energy net exports would decline year by year. The rate of decrease is higher in the high economic growth case, thereby it was predicted that Indonesia would become an energy net importing country in 2000.

In the high energy price case, a slowdown in the growth of energy demand was forecast due to price effect and the average annual growth rate was calculated to be 6.52% between 1978 and 2000. Energy elasticity to GDP was forecasted to be 0.98, falling below 1. It was also forecasted that energy net exports, by 1995, would decline but slightly at an annual rate of 1.6%.

As far as domestic energy production is thought to be a postulate to some extent, it is clear that fluctuations in energy net exports should be sharper than fluctuations in energy demand. Hence, assuming that energy net exports in 2000 should be maintained at the same level as in 1978, energy demand in the same year should be controlled at 297,766 10^3TCE. This means that it would be needed to curb the growth of energy demand at an annual rate of 5.7%.

2-2-3 Evaluation on the 1981 Model and Future Subjects

One of major aims in our improving the model in 1981 was to incorporate the concept of price effect into the model as much as possible so as to enable analyses on effects of energy pricing policies on energy demand. In this light, the simulation of the high energy price case can be evaluated as a successful result.

However, due to such factors as the limit of time and data, even the improved model is not necessary satisfactory. Accordingly, it is needed in the coming years to build up a better model by expanding the 1981 model from several aspects, which are discussed below.

Table 2-2-12 Set-up of Energy Prices and Nominal Government Consumption Expenditure in Simulations

		Energy Price					
		Kerosene	ADO	Heavy Fuel Oil	LPG	Electricity	Nominal Government Consumption Expenditure
BASE	1985	117.2	124.0	119.1	541.5	52.3	14735
	1990	291.6	249.4	349.1	1089.2	84.3	35163
	1995	586.5	401.7	982.2	1754.1	135.8	75460
	2000	944.6	646.9	2343.8	2825.1	218.6	161938
SIM1	1985	117.2	124.0	119.1	541.5	52.3	15041
	1990	291.6	249.4	349.1	1089.2	84.3	36653
	1995	586.5	401.7	982.2	1754.1	135.8	80360
	2000	944.6	646.9	2343.8	2825.1	218.6	176185
SIM2	1985	245.8	327.8	218.5	999.6	120.7	14735
	1990	1321.8	1217.2	1174.9	3711.6	448.0	35163
	1995	4907.6	4519.5	5867.8	9235.5	1663.5	75460
	2000	18221.5	16780.7	21786.6	22980.9	6176.6	161938

Table 2-2-13 Summary Table of Simulation Results

		1978	1985	1990	1995	2000
BASE	GDP	9483	15073	20687	28062	39018
	Domestic Primary Energy Requirement (TCE)	88037	151497	203782	279995	385690
	Net Energy Export (TCE)	101746	92678	79528	60348	13822
SIM1	GDP	9483	15243	21172	29088	40984
	Domestic Primary Energy Requirement (TCE)	88037	152458	206981	288070	405050
	Net Energy Export (TCE)	101746	91712	76324	52356	Δ5544
SIM2	GDP	9483	15073	20687	28062	39018
	Domestic Primary Energy Requirement (TCE)	88037	147688	195535	263197	352989
	Net Energy Export (TCE)	101746	96482	87770	77230	46518

		1985/1978	1990/1985	2000/1990	2000/1978
BASE	GDP	6.8	6.5	6.6	6.64
	Domestic Primary Energy Requirement (TCE)	8.1	6.1	6.6	6.95
	Net Energy Export (TCE)	Δ1.3	Δ3.0	Δ16.1	Δ8.67
SIM1	GDP	7.0	6.8	6.8	6.88
	Domestic Primary Energy Requirement (TCE)	8.2	6.3	6.9	7.18
	Net Energy Export (TCE)	Δ1.5	Δ3.6	–	–
SIM2	GDP	6.8	6.5	6.6	6.64
	Domestic Primary Energy Requirement (TCE)	7.7	5.8	6.1	6.52
	Net Energy Export (TCE)	Δ0.8	Δ1.9	Δ6.2	Δ3.49

Table 2-2-14 Example of the Difference in Forecasted Results by Forecasting Methods

Energy Source	Energy Consumption in 1970	Growth Rate (1970-1980)	1980-2000 Growth Rate		Consumption 2000	
			Case A	Case B	Case A	Case B
1	5	30%	30%	(20.7%)	13113	2958
2	30	10%	10%	(2.1%)	525	118
3	10	15%	15%	(6.8%)	655	148
Total	45	15.3%	24.2%	15.3%	14293	3224

Note: In the Case A, consumption in 2000 was deduced from trends of consumption of individual types of energy source, and the growth rate of total consumption was calculated by summing up of estimated consumption of individual types of energy source.
In the Case B, consumption in 2000 was deduced from trends of total energy demand, from which consumption of individual types of energy source was deduced based on the shares employed in the Case A.

As shown in the table, as of the year 2000, there is a difference of as much as nearly five times between total energy demand calculated by accumulating demands for individual types of energy obtained by extrapolating each fuel, and total energy demand obtained by extrapolating total energy which is grasped first of all. This clearly shows that, in case of a country such as Indonesia where growth rates greatly vary depending on types of energy, the summation of demand forecast by type of energy does not always approximate to total energy demand.

Needless to say, an absolute potentiality of substitution (substitution of energy in terms of equivalent calorific value) does not exist among all the types of energy. In this sense, even the equations of 2) are not perfect to make an exact energy forecast. However, by functionally fractionalizing energy demand and making in-depth analysis on the relations of substitution among individual types of energy, the equations of 2) can be competent for producing more accurate energy forecasts and improvements should be made in this line.

(2) Improvements of the macro-economic model to be made in the coming years

Due to the limit of data and time, the works done in 1981 in relation to the macro-economic model was limited within construction of a model dealing with only the real economy. The breakdown of composing elements of GDP was also left unfinished, thereby GDP was analysed into only five items, including private final consumption, government final consumption, gross fixed capital formation, exports and imports.

However, to construct a macro model of an economy, such as the Indonesian economy, characterized by energy carrying a great weight with the macro economy, it is needed to incorporate a feedback loop of energy and the economy into the model as clearly as possible.

To improve and expand the 1981 model, there are three major directions. They are to improve the energy demand model, to improve the macro-economic model and to prepare an expanded model dealing with energy demand by area. Because these works involve drastic expansion of the scale of the models, they should be done step by step from the most important subjects.

(1) Improvements of the energy demand model to be made in the coming years

The energy demand model should be improved from two aspects.

First, the point that energy prices are treated as exogenous variables in the 1981 model should be improved. In other words, the 1981 model should be expanded so that energy prices can be indigenously determined based on such data as energy cost.

When individual energy prices are exogenously determined, not only the efficiency of operation of the model deteriorates due to an increasing number of exogenous variables but also checking profitability of energy industries becomes difficult.

The second point, which is more essential than the first one, is to improve the method to grasp energy demand. That is, instead of existing method to grasp energy demand by type of energy source, a method capable of grasping total demand first should be established. The basic structure employed in the 1981 model can be described as follows.

1) $$\begin{cases} ED_i = \sum_{j=1}^{n} ED_{ij} \\ ED_{ij} = f(Y_i, P_j/P), \text{ or } f(Y_i, P_j/P_j') \end{cases}$$

ED_{ij}: Demand for "j" energy source in "i" consuming sector
Y_i: An index showing the level of activities in "i" consuming sector
P_j: Price of "j" energy source
P: Level of general commodity prices

These equations fail to show clearly relations of substitution among energy sources. To improve the point then requires following equations.

2) $$\begin{cases} ED_i = f(Y_i, PE/P) \\ PE = (\sum_{j=1}^{n} P_j ED_{ij})/ED_i \\ ED_{ij}/ED_i = g(P_j/PE), \text{ or } ED_{ij} = ED_i - \sum_{\substack{j'=1 \\ j' \neq j}}^{n} ED_{ij'} \end{cases}$$

PE represents nominal average price of energy. With these equations, total energy demand in "i" consuming sector is first explained based on the index showing the level of activities in the consuming sector and real energy prices. Energy demand by each type of energy source is then explained by share functions or as a residual by substructing the amounts of alternative energies introduced as political variables.

The most important point is the idea to grasp total energy demand first. The idea is exemplified in Table 2-2-14.

The only feedback from energy into the economy incorporated into the 1981 macro-economic model was the feedback from crude oil output into exports. To introduce similar linkages between energy and the economy requires expansion of the model through preparation of a detailed trade model and additional models such as those dealing with public finance and the monetary sector.

To detail the trade model, it is needed first to incorporate into the model major energy export items, such as crude oil, petroleum products, NGL and LNG, as explanatory factors of exports. It will be also helpful to convert the exchange rate into an endogenous variable by incorporating individual composing elements of international payments into the model.

As for the public finance model, it is necessary to prepare equations to describe oil revenues, indirect and direct taxes and other composing elements of government revenues and construct a model capable of checking the balance between government revenues and expenditures. This is particularly important for Indonesia where the economy greatly depends on the government sector.

Finally, other sectors involved in the macro-economic models are referred to. To examine impacts of energy pricing policies on the economy, it is necessary to model the monetary sector. Moreover, once equations are prepared to describe the monetary phenomena, it becomes possible to make more accurate forecasts for inflation. Though very difficult for the time being due to the absence of data, construction of a model of the labor market is an important subject to be pursued in the future.

(3) Expansion into a model dealing with energy demand by area

Energy supply and demand in Indonesia is characterized by distinct differences in energy supply-demand structure by area. Because the country consists of a large number of islands, special consideration should be also given to the energy supply networks. In this light, it is essential to construct an energy demand forecast model which deals with energy demand by area reflecting conditions peculiar to individual area. This requires collection of macro-economic data and energy data by area. Because of a great lack of data, construction of the model is impossible for the time being, which is to be tried in the future.