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THE STUDY ON THE RATIONAL USE OF ENERGY IN THE REPUBLIC OF BULGARIA (I)

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
MINISTRY OF INDUSTRY
THE REPUBLIC OF BULGARIA

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MARCH 1994

THE ENERGY CONSERVATION CENTER, JAPAN

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Preface

In response to a request from the Government of Bulgaria, the Government of Japan decided to conduct a study on the Rational Use of Energy in Bulgaria and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Bulgaria a study team headed by Mr. Mitsuo Iguchi of the Energy Conservation Center, Japan five times between June 1992 to January 1994.

The team held discussions with the officials concerned of the Government of Bulgaria Government, and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

I do hope that this report will contribute to the promotion of the program and enhancement of friendly relations between the two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of Bulgaria for their close cooperation extended to the team.

February 1994

Kensuke Yanagiya

Kensuke Yanagiya
President
Japan International Cooperation Agency

Contents

4. RECOMMENDATION

4.1 Problems Concerning Energy Demand and Supply, and Energy Conservation Policy

4.2 Determination of Energy Policies

4.3 Clarification of the Relevant Organization in Charge of Energy Administration

4.4 Optimization of Energy Prices

4.5 Establishing an Energy Conservation Promotion Agency

4.6 Energy Conservation Promotion Measures in Factories

4.7 Technological Development

5. SURVEY OF ENERGY USE IN THE MODEL FACTORY

5.1 Results of the Study at a Detergent Factory

5.2 Results of the Study at a Food Oil Factory

5.3 Results of the Study at a Pulp and Paper Factory

5.4 Results of the Study at a Textile Factory

5.5 Results of the Study at a Glass Factory

6. Appended Data Materials
(Members, Counterpart, Timetable, S/W and Measuring Instruments)

Description

1. DESCRIPTION OF THE STUDY
   - 1.1 Background of the Study
   - 1.2 Objective of the Study
   - 1.3 Scope of the Study
   - 1.4 Counterpart Governmental Organization and Object to be Studied
   - 1.5 Method of the Study
   - 1.6 Report of Field Study
   - 1.7 Composition of the Study Team and Counterpart, and Schedules of Field Study

2. ENERGY SUPPLY IN THE REPUBLIC OF BULGARIA
   - 2.1 General Conditions
   - 2.2 Energy Resources and Energy Demand/Supply

3. STUDY ON THE PROMOTION OF RATIONAL USE OF ENERGY IN THE INDUSTRY
   - 3.1 Energy Conservation Policies under the Former Institution
   - 3.2 Current Situation of Energy Conservation

4. RECOMMENDATION
   - 4.1 Problems Concerning Energy Demand and Supply, and Energy Conservation Policy
   - 4.2 Determination of Energy Policies
   - 4.3 Clarification of the Relevant Organization in Charge of Energy Administration
   - 4.4 Optimization of Energy Prices
   - 4.5 Establishing an Energy Conservation Promotion Agency
   - 4.6 Energy Conservation Promotion Measures in Factories
   - 4.7 Technological Development

5. SURVEY OF ENERGY USE IN THE MODEL FACTORY
   - 5.1 Results of the Study at a Detergent Factory
   - 5.1.1 Factory outline
   - 5.1.2 Situation of energy management
   - 5.1.3 Problems in the use of energy and countermeasures
     - (1) Production process
     - (2) Synthetic detergent dryer
     - (3) Boiler
     - (4) Steam piping
     - (5) Control of space heating
     - (6) Power receiving, distribution and electric equipment
     - (7) Total effect

(3) Product chemical composition and physical properties for calculation
(4) Economizer
(5) Electric incoming/distribution facilities, and electric equipment
(6) Total of the effects

List of Tables

List of Figures

1. Description of the Study

1. DESCRIPTION OF THE STUDY

1.1 Background of the Study

(1) East European countries, placed under socialist rule as a result of Soviet influence after World War II, have been rapidly moving toward democracy and a market economy since the disappearance of the Berlin Wall at the end of 1989.

In the Republic of Bulgaria, the movement toward democracy was initiated by a political power shift in October 1989, and the first non-communist cabinet was formed in November 1991 through two free elections.

Economic reforms were started in February 1991. The first step of such economic reforms is the liberalization of financing, foreign exchange and commodity prices, as well as economic stabilization by a renovation of land ownership, retrenchment in finance and a high bank-rate policy. It has been completed successfully. Now, the economic reform is in the second step toward the privatization of national enterprise. For this policy, the "Law of Privatization of National Enterprise" was adopted in April 1992 and the Agency of Privatization was set up in August 1992 for positive privatization. Although many of the medium- and small-sized companies have been in the process of privatization, however, most of the national large-sized companies have not been privatized substantially, for the shares of many large-sized stock companies are owned by the state.

Like other East European countries, the Republic of Bulgaria is burdened with a huge foreign debt (13 billion U.S. dollars as of the end of 1990). The dissolution of the COMECON system, which had undertaken about 80 percent of the foreign trade, and the impact of the Yugoslav conflict damaged industrial production, with the unemployment rate hitting about 13 percent at the end of 1992. The GDP in 1992 declined by 20 percent over the previous year level. The country is now facing a business recession in the process of shifting toward market economy.

Under such circumstances, the country signed an association agreement with EC in February 1993 and made a convention with EFTA (European Free Trade Association) come into force in July 1993 to expand trade with the west market.

(2) In the Republic of Bulgaria, as in other East European countries, the businesses were run by the government when the country was under the socialist rule. Energy prices were set at lower values by the national policy, and there was no incentive for energy conservation. The unit energy consumption rate to GNP was reportedly 30 percent poorer than that in the west European countries.

The Republic of Bulgaria imports two thirds of primary energy. The shift from barter transactions under the COMECON system to market transaction based on hard currency will cause the country to encounter higher energy price coming near to international market price, and increased expenditure of foreign currencies.

The domestic energy supply of the country involves such problems as safety of old nuclear power plants, deterioration of thermal power plants, and limitation to the supply sources of natural gas and imported electric power. It is said that there is no supply shortage for the time being because of the reduced demand due to industrial stagnancy. In long view, however, the supply system of the country is very vulnerable.

For these reasons, a rational use of energy is a major concern of the Republic of Bulgaria.

(3) Against this background, the Japan International Cooperation Agency (JICA) dispatched Project Finding Team to Bulgaria, as a part of the Japanese effort to aid East European countries, and exchanged views on the feasibility of implementation of the Project. The Government of Bulgaria requested JICA in July 1991 to conduct a study of this matter.

In response to this request, JICA dispatched a preliminary study team and a preparatory study team to make the required survey and discussion. Following this survey, an agreement on the Scope of Work was concluded between JICA and the Ministry of Industry and Trade, a counterpart agency of this study in February 1992.

JICA assigned the Energy Conservation Center, Japan to conduct the study.

In May 1992, the Ministry of Industry and Trade was reorganized and separated into the Ministry of Industry and the Ministry of Trade. The responsibility as the counterpart for this study will be succeeded to by the Ministry of Industry.

1.2 Objective of the Study

The objective of the study is to contribute to the promotion and strengthening of the rational use of energy in the field of industries in the Republic of Bulgaria through the study of items (a) - (e).

(a) Recommendation of the energy conservation promotion measures at a national level for the manufacturing industry

(b) Recommendation of the organization for the promotion of energy conservation and its activities

(c) Study of the feasibility of energy conservation by technical and administrative improvements in the model factory

(d) Preparing the reference of the technical guideline for promotion of energy conservation in the manufacturing sector

(e) Transfer of such techniques as a method of diagnostic study to the counterpart

1.3 Scope of the Study

1.3.1 Study on the energy situation in the Republic of Bulgaria

(1) Energy policy of the Government

(2) Current energy situation in Bulgaria

(3) Situation of energy use in the entire industrial sector in Bulgaria

1.3.2 Study on the promotion of rational use of energy in the industry

(1) Related laws and regulations

(2) Current energy conservation promotion program

(3) Situation and evaluation of energy conservation promotion activities in related authorities

a) Current energy conservation promotion activities
b) Achievements of past activities
c) Future program for energy conservation promotion

1.3.3 Study on the situation of energy use in the factory of each industry

a) Outline of the factory
b) Situation of energy management
c) Energy flowchart
d) Situation of major energy consuming equipment
e) Problems in each factory and countermeasures without changing the existing production process
f) Estimated effects of the countermeasures
g) Preparation of the reference of the technical guideline for the promotion of rational use of energy in industries

1.3.4 Recommendation of energy conservation promotion in Bulgaria

a) New organization for energy conservation promotion
b) Activities of the organization
c) Measures for energy conservation promotion in the industrial field

1.4 Counterpart Governmental Organization and Object to be Studied

1.4.1 Counterpart governmental organization: Ministry of Industry

The Ministry of Industry is responsible for managing the production factories other than the building material production factories and for managing petroleum and natural gas supply.

1.4.2 Object of study

(1) Factories

Table 1.1 shows the names of the factories to be studied

Table 1.1 Names of Surveyed Factories

Factory type	Name	Located at:
Synthetic detergent	Verila	Sofia
Vegetable oil	Prima-M	Polski Trambesh
Paper and pulp	Celhart	Stamboliiski
Textile	Nitex-50	Sofia
Glass	Stind	Sofia

(2) Related organizations for energy conservation measures

(a) Governmental organizations in related countries
Ministry of Industry
Committee of Energy
Ministry of Finance
Ministry of Environment
Ministry of Regional Development, Housing and Building
National Statistical Institute
Standardization and Metrology Committee

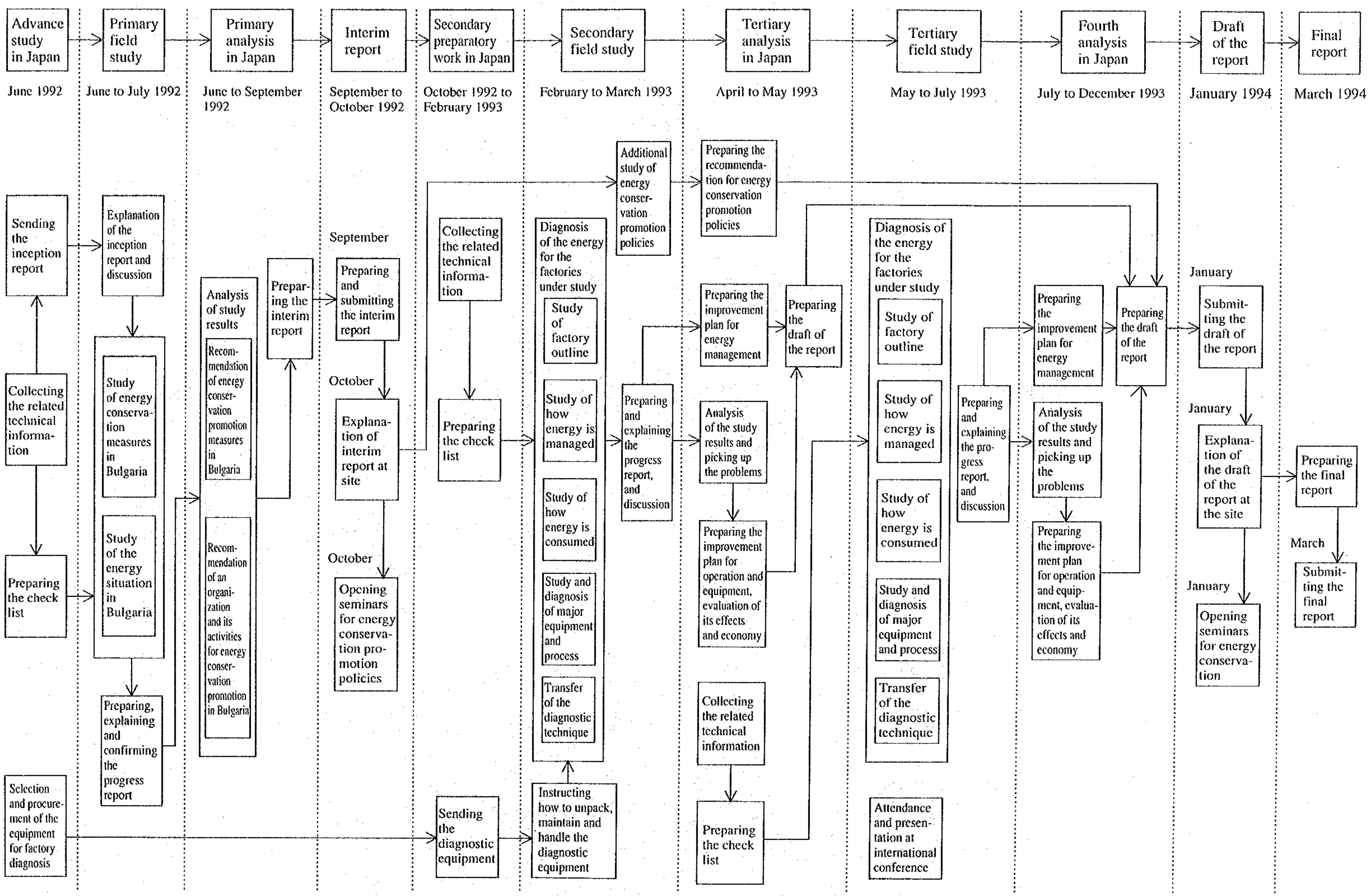
(b) Related organization for energy conservation measures in manufacturing sectors
Industrial Energetics
Scientific and Technical Unions in Bulgaria
National Electric Company
Bulgargas
Petrol

Electro Impex
Bulgarian Chamber of Commerce and Industry
Ecotech Products

1.5 Method of the Study

The overview of the study is diagraphically shown in Figure 1.1.

Figure 1.1 Overview of the Study on the Rational Use of Energy in the Republic of Bulgaria



1.5.1 Primary field study (from June 15, 1992 to July 10)

Within the scope of the study of paragraph 1.3, energy situation in the Republic of Bulgaria, policy on energy conservation, and situation of energy conservation promotion activities are studied in the field of the production industry. It is based on data collection and on interviewing the Ministry of Industry, energy-related organizations and related factories.

For smooth study, a prepared inception report is provided for the primary field study, with its contents explained to the counterpart prior to the start of the study.

1.5.2 Primary analysis in Japan (from July 11, 1992 to October 19)

On the basis of results of the primary field study and by referring to governmental energy conservation measures in Japan and foreign countries, draft proposals are prepared which are well adapted to the current state in the Republic of Bulgaria.

1.5.3 Interim report (from October 20, 1992 to October 30)

The draft recommendation that has been sent to Bulgaria is subjected to discussion in the country with the counterpart and the policy-related party. Comments from the Bulgarian side are absorbed for reflection in the final report.

1.5.4 Secondary preparatory work in Japan (from October 31, 1992 to February 14, 1993)

Energy consumption characteristics on the business to be studied are identified, and check list is prepared to assure no omission during the field study.

1.5.5 Secondary field study (from February 15, 1993 to March 28)

a) The team leader and two team members are sent prior to the start of the secondary field study. The team leader engages himself in following up energy conservation policy and the two members undertake, unpack and adjust measuring equipment for factory audit. On the completion of setting up the equipment, the remaining team members enter the country to study synthetic detergent and vegetable oil factories.

b) Before study of the factories, the counterpart is told the method of handling the measuring equipment for training.

The process of the study is explained to the counterpart and persons in charge of the factories to be studied on the basis of the check list. They are asked for the preparation of data materials and the arrangement of an equipment installation site.

c) Outlines of the factories and the status quo of energy management are studied through interviews based on the check list, data collection, book examination and site survey to understand current condition, problems and the future plan. Energy consuming facilities are examined and performance or problems with energy usage are identified through the observation of actual operation procedure and measurement by the diagnostic equipment, drawing survey and past data inspection. Factories are studied in the light of the transfer to the counterpart of the audit and analytical procedure.

d) On the end of the study of the factory, results of the measurement and comments based on the observation are reported to the factory management for opinion exchange.

e) On the end of the site survey, the contents of the study are filed with the Bulgarian side, and a progress report is prepared subject to Bulgarian consent for submittal to the Ministry of Industry.

1.5.6 Tertiary analysis in Japan (from March 29, 1993 to May 28)

a) Like the secondary field study covered in Paragraph 1.5.4, preparatory steps of the tertiary field study are carried out.

b) The results of study of the synthetic detergent and vegetable oil factories are analyzed for problem identification. Measures for improvement are prepared on the basis of the analysis and the identification.

Problems with and measures for improving the energy management are examined in the light of country circumstances and the measures successfully adopted by the same kinds of Japanese factories. This study is focused on the energy conservation promotion system including energy management organization, target setup, the record and utilization of actual energy consumption data and employee training. Measures for improvement are proposed which are possibly applicable to the factory.

The isolation of problems with and the identification of measures for energy usage target minor modification of existing facilities without any change in the current process or more efficient energy conservation by facilities addition. These measures are evaluated economically to propose measures for improvement seemingly adapted to the factory.

1.5.7 Tertiary field study (from May 29, 1993 to July 10)

a) As in the secondary field study, glass, paper & pulp and textile factories are studied.

b) During this period, the "Energy Forum" held by Scientific and Technical Unions in Bulgaria is attended to present Japanese energy conservation policies and industrial activities.

1.5.8 Fourth analysis in Japan (from July 11, 1993 to December 1994)

a) Following the tertiary analysis in Japan covered in Paragraph 1.5.6, the results of the secondary field study defined in Paragraph 1.5.5 and of the tertiary field study set out in Paragraph 1.5.7 are analyzed, with problems isolated. Measures for improvement are prepared and proposed on the basis of the analysis.

b) From the results of the factory survey, key points of energy management and usage are extracted per business type, with major energy conservation technologies and their examples presented. This presentation is aimed at preparing and providing such data materials as help the counterpart create particular guidelines of energy conservation technologies.

c) Recommendation for more effective energy use in the production industry in the Republic of Bulgaria incorporates in the interim report the data and information covered in Paragraph 1.5.3 "Interim report".

d) The above results are summarized to create a draft final report to be sent to Bulgaria.

1.5.9 Explanation of draft final report at the site (January 1993)

a) The contents of the draft final report are explained to the counterpart for its understanding.

b) A seminar for spreading energy conservation is held which reflects the results of the study.

1.6 Report of Field Study

1.6.1 Study of energy situation and energy conservation measures

Appropriate arrangement by the counterpart has allowed successful study, leading to the acquisition of the targeted objectives.

1.6.2 Factory study

a) The time of the arrival of the equipment for field study was changed from January 1993 to the middle of February. The study team had to leave Bulgaria in March, the end of the fiscal year. Thus, the initial schedule that five factories should be studied had to be changed, so that only two synthetic detergent and vegetable oil factories were surveyed in March. The updated schedule was such that the remaining three factories would be examined in the period from June to July.

b) The initially chosen glass and paper & pulp factories to be surveyed were changed to other ones.

Factory type	The factories to be studied were changed		Reason for the change
	from	to	
Glass	Interior	Stind	Suspension of factory operation by reduced sales
Paper & pulp	Rulon Iskar	Celhart	Stop of the thermal source by periodic repair by the heat supplier

Both new factories cooperated well in the survey. No trouble was caused during the survey in spite of the sudden change.

1.6.3 Counterpart

The counterpart has a high skill level and became familiar with handling the diagnostic equipment soon. During the second half period of the survey, the counterpart could measure data by itself. Further, its staff members have high morals, much cooperating in the survey.

1.6.4 Diagnostic equipment

Part of the diagnostic equipment had been out of order. But it was repaired successfully and operated normally, with the survey carried out without trouble.

After the end of the survey, the equipment was donated to the Bulgarian side.

1.7 Composition of the Study Team and Counterpart, and Schedules of Field Study

See appended materials (1) thru (5).

2. Energy Supply in the Republic of Bulgaria

2. ENERGY SUPPLY IN THE REPUBLIC OF BULGARIA

2.1 General Conditions

(1) Disorganization of COMECON

For the economic revival and development of the communist countries after World War II, the former Soviet Union and East European countries established COMECON (Council for Mutual Economic Assistance) in 1949 in an effort to compete with the Marshall plan of the United States.

To achieve the purpose, COMECON determined to implement adjustment of the economic programs among countries, specialization of and cooperation in production and mutual supply of products. It registered a considerable success in expansion of mutual trades, large-scale cooperative development of resources, joint participation in large-scale projects and improvement of transport system. Among them, COMECON marked a remarkable success in common development of the resources. The former Soviet Union established its position as a raw material and fuel supplier. The former Soviet Union is the world's largest holder of the resources, and could export a great amount of resources. On the other hand, East European countries were not favored with natural resources. So joint development of the resources among these countries was comparatively easy. The percentage of the trade within the COMECON block (Soviet Union and East European countries) reached 50 to 80 percent of the total trade.

Meanwhile, specialization of production resulted in monopolization, making it difficult for the principle of free competition to work properly.

Bulgaria was deeply involved in the system of specialization of COMECON under the old political system, so its trade with COMECON countries accounted for 70 to 80 percent of the total trade volume, as illustrated in Table 2.1, and, in particular, the trade with the former Soviet Union registered over 50 percent of the entire trade volume. Bulgaria depended exclusively on the former Soviet Union for imports of the resources — almost 100 percent for coal, natural gas and cokes, and 80 to 90 percent for the petroleum, timbers and pig iron.

Table 2.1 Exports and Imports in Bulgaria by Economic Zones

(unit: 1 million Leva)

	Economic zones	1889	Composition ratio	From January to September, 1990	Percentage over previous year's level
Exports	Socialist countries	11,664.9	86.3	6,078.9	-26.5
	Former Soviet Union	8,882.1	65.8	4,794.9	-25.2
	East European countries	2,336.2	17.3	1,163.1	
	Others	446.6		120.9	
	Advanced industrial countries	981.5	7.3	560.1	-17.0
	Former West Germany	150.7	1.1	99.1	21.4
	Greece	175.6		61.8	-50.7
	Others	655.2		399.2	
	Developing countries	859.9	6.4	591.5	- 5.2
	Iraq	135.4	1.0	22.2	-79.3
	Libya	174.8	1.3	223.9	61.1
	Others	549.7		345.4	
	Total	13,506.3	100.0	7,349.8	-24.3
Imports	Socialist countries	9,530.9	76.0	5,730.3	-16.1
	Former Soviet Union	6,731.3	53.6	4,075.4	-15.9
	East European countries	2,375.8	18.9	1,163.1	
	Others	423.8	3.5	120.9	
	Advanced industrial countries	2,139.4	17.0	1,101.6	-26.3
	Former West Germany	617.9	8.8	278.8	-30.4
	Greece	207.2	1.7	109.3	-23.7
	Others	1,317.3	10.5	713.5	
	Developing countries	881.4	7.0	620.3	-11.6
	Iraq	370.8	3.0	218.3	-11.4
	Libya	72.1	0.6	125.4	28.9
	Others	438.5	3.4	276.6	
	Total	12,551.7	100.0	7,565.9	-17.1

Communist powers of East European countries fell one after another in the storm of revolution for democratization blowing through the East Europe, and the former Soviet Union was crumbled from within. After that, partly due to economic depression in the former Soviet Union, East European countries started to go away from the Soviet Union, putting an end to the COMECON system which continued over forty years. In only two years thereafter, the trade within the COMECON countries diminished to about one third.

As a result, the East European countries have come to shift from the centrally planned economy to the market economy and the international economic system through trade among enterprises using hard currencies.

With the fall of the COMECON system, Bulgaria is making a drastic change from the trade heavily dependent on COMECON to the trade open to the West. However, the country is visited by serious economic depression because of economic stagnation in the former Soviet Union with which Bulgaria had a close economic relationship, declining demands in the process of abrupt economic reform, and poor exports to the Western counties due to insufficient competitiveness. In 1992 as well as 1991, the GDP declined by the 20 percent level on a year-on-year basis.

(2) Economic Reform

Bulgaria joined International Monetary Fund (IMF) in September 1990, and started to shift to a market economy according to the economic reform program worked out through consultation with the IMF. The economic reform program by the Government is shown below. The Government announced that the first phase of the economic reform ended in a success in August 1991.

Phase I Stabilization of economy by the following means:

① Measures to avoid inflation by domestic demand-repressing policies and tight budget
② Export promotion by cutting the real wages and currency devaluation
③ Liberalization of prices of commodities, foreign trade and foreign exchange
④ Agricultural reform

Phase II

Privatization of state-run businesses and introduction of foreign capital

From February 1991 to May 1992, product prices were liberalized in order except for some products.

As a result, the consumer prices of about 80 percent of the products were raised, registering an increase of 473 percent up in December 1991 from the level of the corresponding month of the previous year.

Energy prices for petroleum products and imported coal were liberalized in June 1991, and the electric power and heat charges for consumers were fixed. Subsidies are disbursed for covering suppliers' deficit as part of the social policy.

The country is proceeding with privatization of the enterprises by revising the "commercial code", and enacting the "foreign investment law" and "privatization law for state-run enterprises". Privatization of small enterprises such as restaurants, hotels, retail shops is going on smoothly, but there has been a substantial delay in privatization of the state-run enterprises which occupy a great majority of the national economy. Efforts are being made for division of large companies and transfer of them into stock corporations, but 90 percent of the enterprises are still state-run. The reasons for substantial delay in privatization will include lack of private funds, monopolistic industrial structure and economic depression.

(3) Government Finance, Financing, and Tax Positions

a) Government finance

Tables 2.2 and 2.3 illustrate the transition of the national budget and major expenditure items:

Table 2.2 Trend of National Budget

(unit: 1 million Leva)

Year	1987	1988	1989	1990	1991	1992
Revenue	20,673	23,258	24,288	24,894	62,967	74,860
Expenditure	20,663	23,213	24,287	25,851	70,477	102,641

(Source: Government publications)

Table 2.3 Major Expenditures

Item	Amount (unit: 1 million Leva)	Composition rate (%)
Wages for public officials	12,109	11.8%
Allowance for low-income people	14,041	13.7%
Payment of social insurance	7,677	7.5%
Social securities (pensions, etc.)	20,341	19.8%

(Source: Government publications)

The Bulgarian population accounts for about 8.97 million as of 1991, of which about 2.36 million depend on the pension. This is equivalent to about 26 percent of the entire population, and is considerably high according to the world's standards. One third of the national budget is used for the pension and allowance for low-income people, giving pressure to the Government finance. This has resulted in insufficient funds for infrastructures such as roads and communications networks, and investment for economic reconstruction, and no budgets have been earmarked for implementing energy policy including energy conservation measures.

b) Financing

Bulgaria joined International Monetary Fund (IMF) in September 1990, and financial and intellectual aid by IMF has gained in importance for economic reform and shift to a market economy. Since the start of 1991, optimization of the interest rate has been under way, as a part of the program for shifting to a market economy. The National Bank of Bulgaria (central bank) determined the interest rate in an effort to protect the depositors, to restrain inflation due to liberalization of prices and to stabilize foreign exchange rate. The interest was in the level from 45 to 54 percent in the period from January 1991 to May 1993.

The interest rate consisting of the basic interest rate plus 7% (currently 54%) is applied to the short-term loan for the fund to purchase raw materials.

The only preferential treatment of the interest rate is the one provided by the farm loan bank to the farmers. There is no such preferential treatment for energy conservation. In the industrial sector, there is no investment for equipment because of high interest rate.

c) Tax system

The profit tax of 40%, urban tax of 10% and irrigation tax of 2% are imposed on all the enterprises. Furthermore, a sales tax (70% of the sales volume) is imposed on final consumer's goods. The Government is currently reviewing the tax system, and is studying the possibility of introducing the added value tax. No tax incentive measures have been taken for energy conservation.

d) Fund

A development and promotion fund was established in 1991 by pooling all the foreign financial aids. Preferential conditions can be placed on the loan from this fund, and the interest rate is not fixed. However, when the fund is loaned to the enterprise, major consideration is given to the profitability of the enterprise. Furthermore, the Ministry of Industry has a fund for organization and technology development established for small and medium enterprises.

(4) Trend of Environmental Regulation

Promotion of heavy industries and use of the low-quality lignite have contaminated the environment. Many of the industrial technologies were outdated or inadequate, causing an excessive use of the natural resources and fuels, producing excessive wastes, and thereby aggravating environmental pollution.

Most serious environmental pollution problems have occurred in the special local areas ("hot spots"). The pollution in these spots have been caused mostly by heavy industries (iron and steel, non-ferrous, metallurgical, chemical, cement and similar industries). The pollution is as serious as that in the most seriously contaminated areas in central Europe. These hazardous areas are inhabited by about 12 percent of the Bulgarian population (1.1 million), and there is a concern about the impact of the pollution on human health. In many of the large cities in Bulgaria, concentration of SO_2 in the atmosphere has exceeded the standard level, giving rise to a serious problem. The source of pollutants is the factories for heavy industries, thermal power plants, and household heaters using coal and briquette. Bulgaria is one of the countries where the quantity of SO_2 exhaust per GDP is the greatest in the world. The NOx has not yet created serious problems in the suburban area since the automobiles are not much used.

The environmental regulation in Bulgaria has a comparatively long history.

However, hardly any regulations have been observed because:

① Regulations have been too severe, compared with those in the Western Europe, and the existing technology has been unable to keep up with the regulations.

② Fines for violation of the regulation have been too small.

Thus, low priority has been placed on the pollution-control program in the appropriation of the budget.

At present, the country is studying the method of imposing less strict regulations in the beginning, which will be gradually made more and more strict.

① Less strict regulation standards
② Increase of the fines
③ Tax imposed on the generation of pollutants even within the standards
④ Waste regulation
⑤ Regulation on the use of farmland

2.2 Energy Resources and Energy Demand/Supply

(1) Supply of Primary Energy

Bulgaria is poor in natural resources, producing a very small amount of coal and natural gas. Relatively much coal is produced in this country, but is mostly low-quality brown coal (including lignite). Among the East European countries, Bulgaria is particularly weak in energy supply.

In the supply of the primary energy, the rate of the domestic energy is not more than 34 percent in 1990, and the country depends on imports for about 66 percent of the energy. Furthermore, the country depends heavily on the former Soviet Union for the supply.

Table 2.4 Trend of Energy Supply

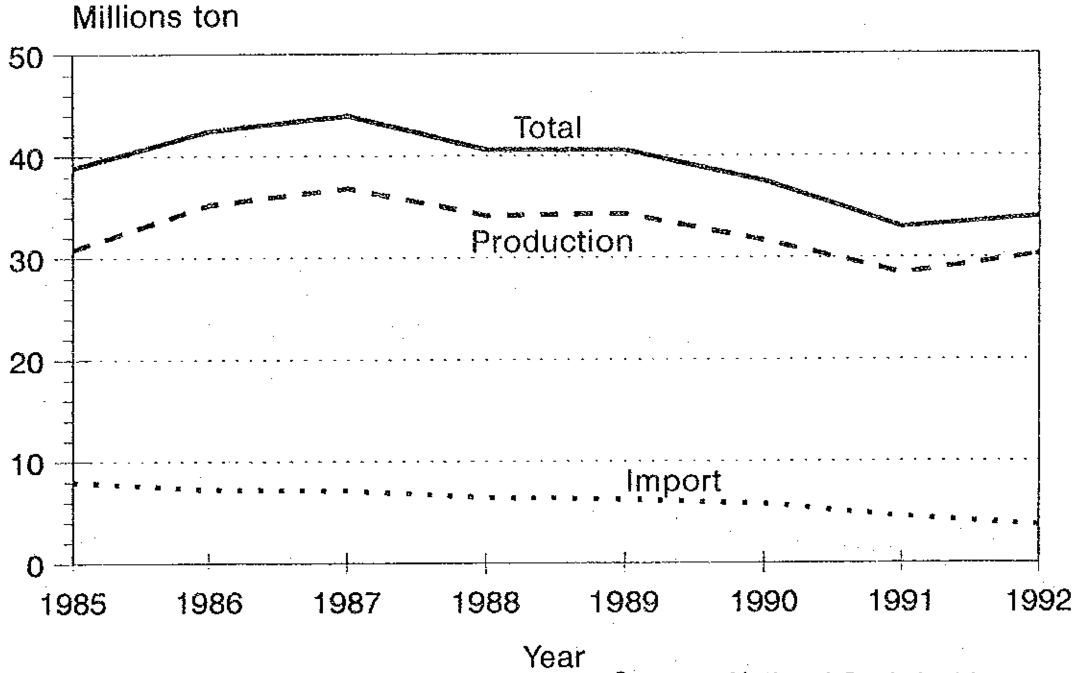
Year		1989		1990		1991		1992	
		TJ	%	TJ	%	TJ	%	TJ	%
Domestic	Solid fuel	254,661	17.7	232,542	18.8	203,105	20.3	226,309	25.3
	Liquid fuel	2,989	0.2	2,544	0.2	2,454	0.2	2,244	0.3
	Others(Note)	193,526	13.5	205,585	16.6	189,296	19.0	167,781	18.8
	Total	451,176	31.4	440,671	35.7	394,855	39.5	396,334	44.3
Imported	Liquid fuel	591,430	41.2	412,733	33.4	292,318	29.3	232,766	26.0
	Gas	232,424	16.2	227,353	18.4	188,305	18.9	170,038	19.0
	Others	159,831	11.2	154,915	12.5	123,108	12.3	95,641	10.7
	Total	983,685	68.6	795,001	64.3	603,731	60.5	498,445	55.7
	Grand total	1,434,861	100.0	1,235,672	100.0	998,586	100.0	894,779	100.0

(Source: National Statistical Institute)

Note: The primary energy produced in hydroelectric power plants and nuclear power plants are included.

a) Coal

Figure 2.1 Trend of Coal Supply



Source : National Statistical Institute

Table 2.5 Trend of Coal Supply

(unit: 1,000 t)

Year	1985	1986	1987	1988	1989	1990	1991	1992
Production	30,852	35,205	36,819	34,147	34,298	31,675	28,451	30,336
Import	8,015	7,242	7,122	6,451	6,240	5,790	4,528	3,674
Total	38,867	42,447	43,941	40,598	40,538	37,465	32,979	34,010

(Source: National Statistical Institute)

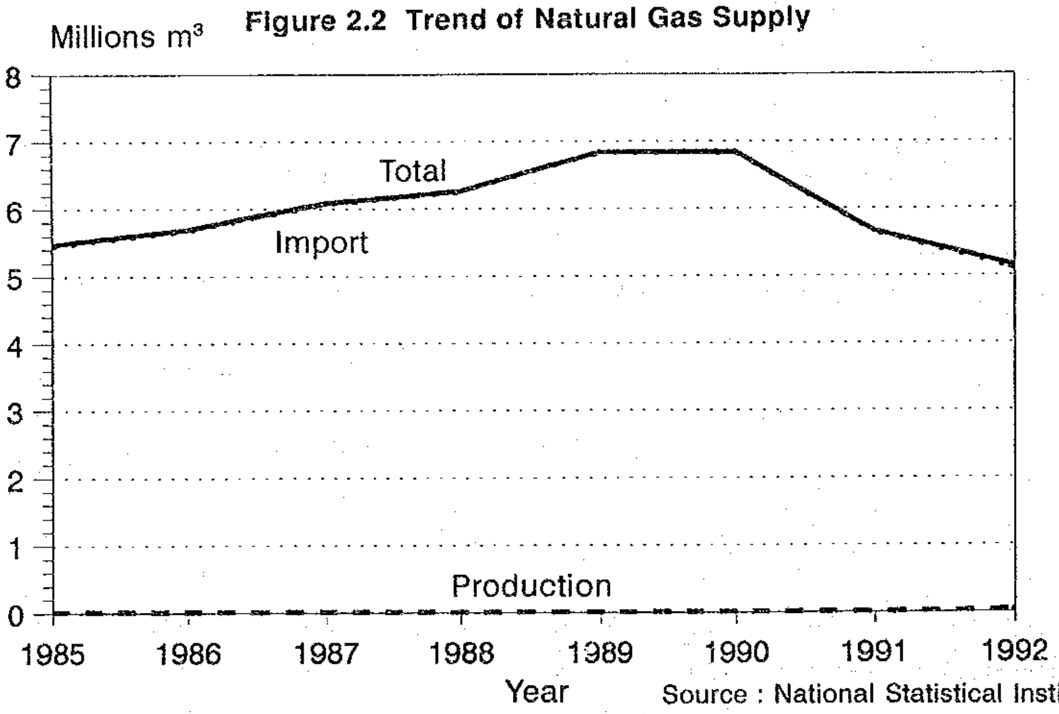
A very small amount of bituminous coal is produced in the country, with the production registering only 500,000 tons. On the other hand, brown coal is comparatively abundant, with reserves posting 4.1 billion tons; it occupies more than 99 percent of the production. However, the quality is low as shown below:

For five years from 1985 to 1989, the amount of both domestically produced and imported coal was almost unchanged, but in 1991 the production fell 10 percent and imports declined 45 percent due to the reduced demand. Coal had mainly been imported from the former Soviet Union until 1990.

Heating value: 1,200 to 1,300 kcal/kg
Water content: 33 to 35 percent
Ash content: 24 percent

b) Natural gas

Figure 2.2 Trend of Natural Gas Supply



Source : National Statistical Institute

Table 2.6 Trend of Natural Gas Supply

(unit: $10^6 m^3$)

Year	1985	1986	1987	1988	1989	1990	1991	1992
Production	20.5	17.1	13.3	10.2	9.3	13.6	10.2	38.0
Import	5,455.5	5,679.8	6,072.3	6,251.4	6,832.4	6,831.7	5,658.4	5,109.5
Total	5,476.0	5,696.9	6,085.6	6,261.6	6,841.7	6,845.3	5,668.5	5,147.5

(Source: National Statistical Institute)

The natural gas deposit and the production amount are very small; therefore the country depends on the former Soviet Union for almost all the supply. Imports increased at an annual average of 5 to 6 percent for the period from 1985 to 1989, but in and after 1991 both production and imports declined due to the reduced demand.

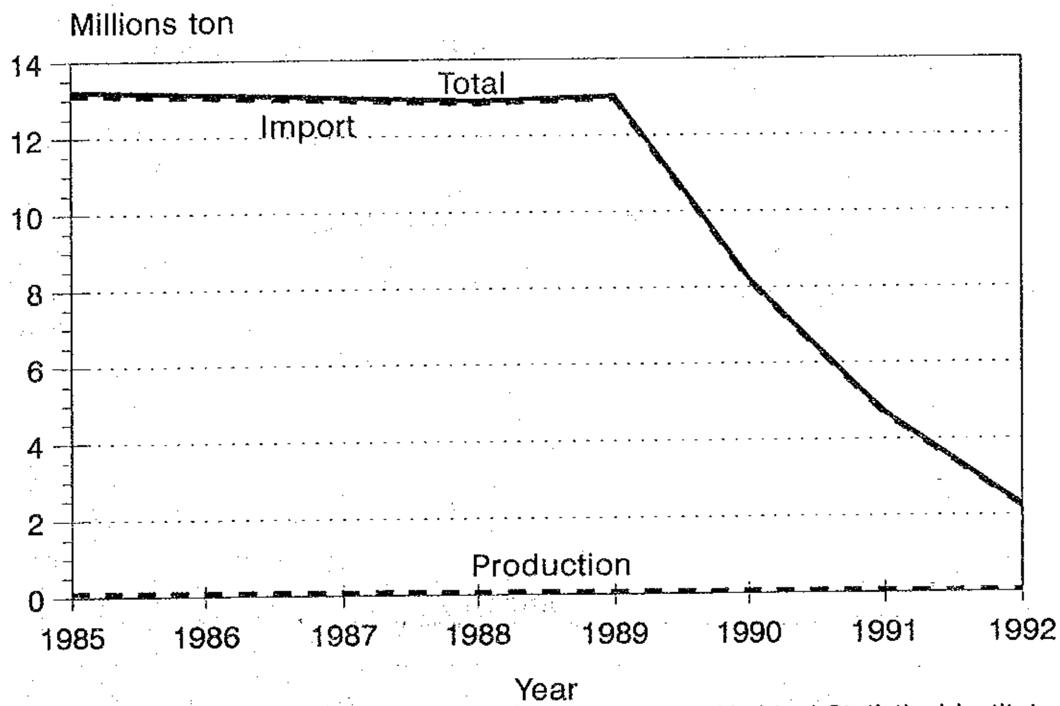
The country receives stable supply of natural gas through the pipeline (2,000 km long in the country) according to the long-term agreement with Russia. The outline of the Agreement is as follows:

Agreement according to payment by foreign exchange
  6.35 Gm^3/year (1992)
  This Agreement can be extended until 1996.
Yamburg Agreement
  3.5 Gm^3/year
  This Agreement is valid until 1996.
Transit gas agreement
  0.3 to 0.35 Gm^3/year
  This Agreement is valid for 20 years.

Heating value: 7,800 to 8,000 $kcal/m^3$

c) Oil

Figure 2.3 Trend of Oil Supply



source : National Statistical Institute

Table 2.7 Trend of Oil Supply

(unit: 1,000 t)

Year	1985	1986	1987	1988	1989	1990	1991	1992
Production	105	93	85	77	73	60	58	53
Import	13,107	13,031	12,929	12,843	12,951	8,169	4,585	2,215
Total	13,212	13,124	13,014	12,920	13,024	8,229	4,643	2,268

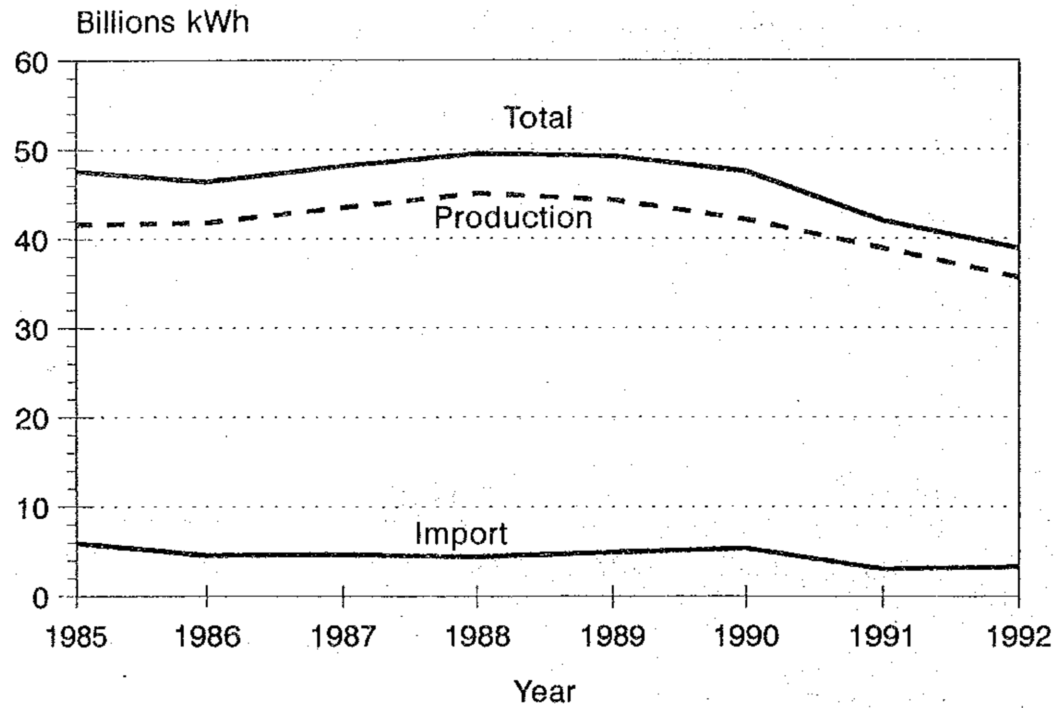
(Source: National Statistical Institute)

The oil reserves in Bulgaria are very small amounting to 15 million barrels (according to "Oil & Gas Journal" 1991). The production is about 100,000 tons, and the country depends mostly on imports.

During the period from 1985 to 1989, the amount of supply was almost unchanged, but in 1991 the figure fell 45 percent from the previous year's level due to the poor economic performance in Bulgaria and reduced production in the former Soviet Union. The adequate requirement in Bulgaria at present is considered to be about 7.5 million tons. Due to the rise of refining costs, crude oil imports have been reduced to zero in 1992, and the country depends entirely on the imported products.

d) Electric power

Figure 2.4 Trend of Electric Power Supply



Source : National Statistical Institute

Table 2.8 Trend of Electric Power Supply

(unit: 1,000 Mwh)

Year	1985	1986	1987	1988	1989	1990	1991	1992
Production	41,632	41,820	43,470	45,039	44,331	42,144	38,917	35,610
Import	5,959	4,571	4,672	4,450	4,937	5,382	3,083	3,289
Total	47,591	46,391	48,142	49,489	49,268	47,526	42,000	38,899

(Source: National Statistical Institute)

For five years from 1985 to 1990, the supply of electric power remained almost unchanged, with approx. 10% imported from the former Soviet Union, but from 1991 onward both the power generation and imported power declined due to the economic depression.

The current power generating capacity is 10,000 megawatts, of which 8,500 megawatts is possessed by the National Electric Company.

The power supply comprises 38.2 percent of nuclear power, 34.7 percent of thermal power by lignite, 18.3 percent of thermal power by imported coal, 4.0 percent of thermal power by petroleum and gas, and 4.8 percent of hydroelectric power. There is no pumped storage hydroelectric plant in this country. Adjustment between demand and supply depends on hydroelectric power generation and imports of the electric power.

The nuclear power plants occupy a great percentage. Those built in the earliest period have been, however, pointed out to have safety problems, and are currently being repaired with the financial aid of PHARE. Success in solving these safety problems will be a major key to a stable supply of the power in future.

Table 2.9 shows records of recent electric power supply and demand, and the future plan of such supply and demand.

Table 2.9 Electric Power Generation

(unit: 1000 Mwh)

	1991	1992
Thermal power	19,662	20,510
(Domestic coal)	(11,900)	(12,135)
(Imported coal)	(6,300)	(6,900)
(Gas and petroleum)	(1,382)	(1,475)
Hydroelectric power	2,435	2,080
Nuclear power	13,184	15,740
Total	35,281	38,330
Private power generation	3,547	3,320
Grand total	38,828	41,650
Imported	4,208	2,000
Consigned	195	130
Exported	1,833	1,520
Total = consumption	41,008	42,000
Against previous year's level	-10.7	+2.4

(2) Energy Consumption in Industrial Sectors

a) General

Bulgaria was an agricultural country favored with fertile land and warm climate. In the early period of the socialistic planned economy, major emphasis was placed on promotion of heavy industries. In the period from 1950s to 1960s, the country achieved a double-digit industrial growth.
As a result, the ratio of the mining and manufacturing industry in the composition of GDP reached nearly 60 percent in 1989, as shown in Table 2.10, whereas in recent years it has declined due to the reduced production.

Table 2.10 Composition of GDP by Industries

(unit: 100 million leva)

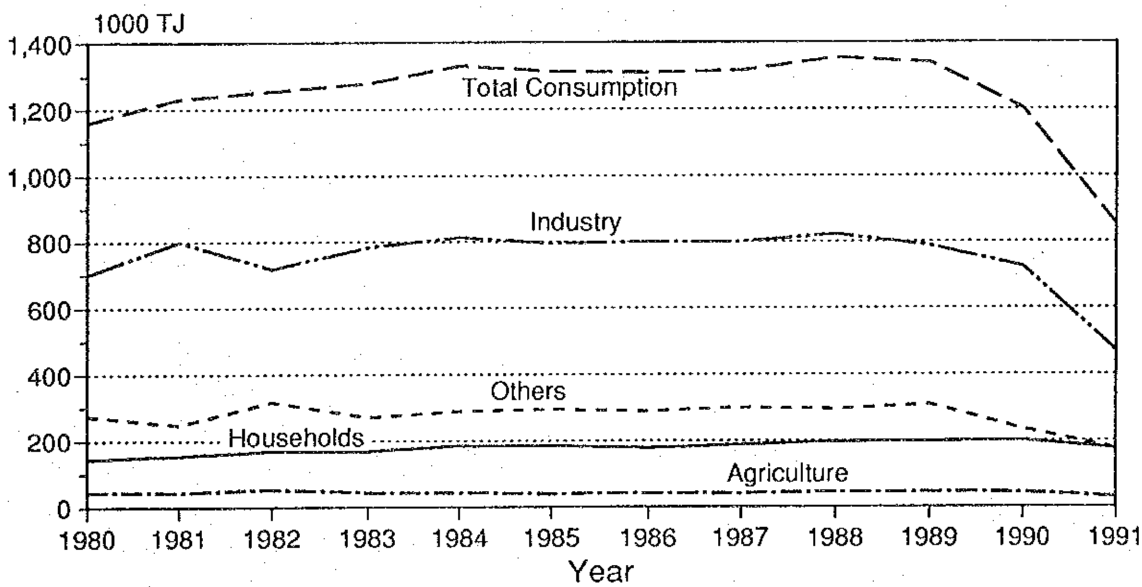
Year	1989		1990		1991		1992	
		%		%		%		%
Mining and manufacturing industry	23,507	59.39	23,273	51.27	62,843	47.95	90,800	46.56
Agriculture	4,331	10.94	8,055	17.74	20,139	15.36	20,200	10.35
Others	11,741	29.66	14,062	30.98	48,076	36.68	84,000	43.07
Total	39,579	100.0	45,390	100.0	131,058	100.0	195,000	100.0

(Source: National Statistical Institute)

The energy consumption in the industrial sector in Bulgaria occupies about 60 percent of the total consumption in the country, as illustrated in Figure 2.5 and Table 2.11. This is the time of confusion due to political and economic system reforms, and economic activities are depressed. Therefore, energy consumption in the industrial sectors is reduced, and that for the entire country is also reduced. Many people consider that ten years will be required to recover the level of energy consumption in 1980s.

Figure 2.5 Trend of Energy Consumption by Sectors

(Including Electric Power)



Source : National Statistical Institute

Table 2.11 Trend of Energy Consumption by Sectors

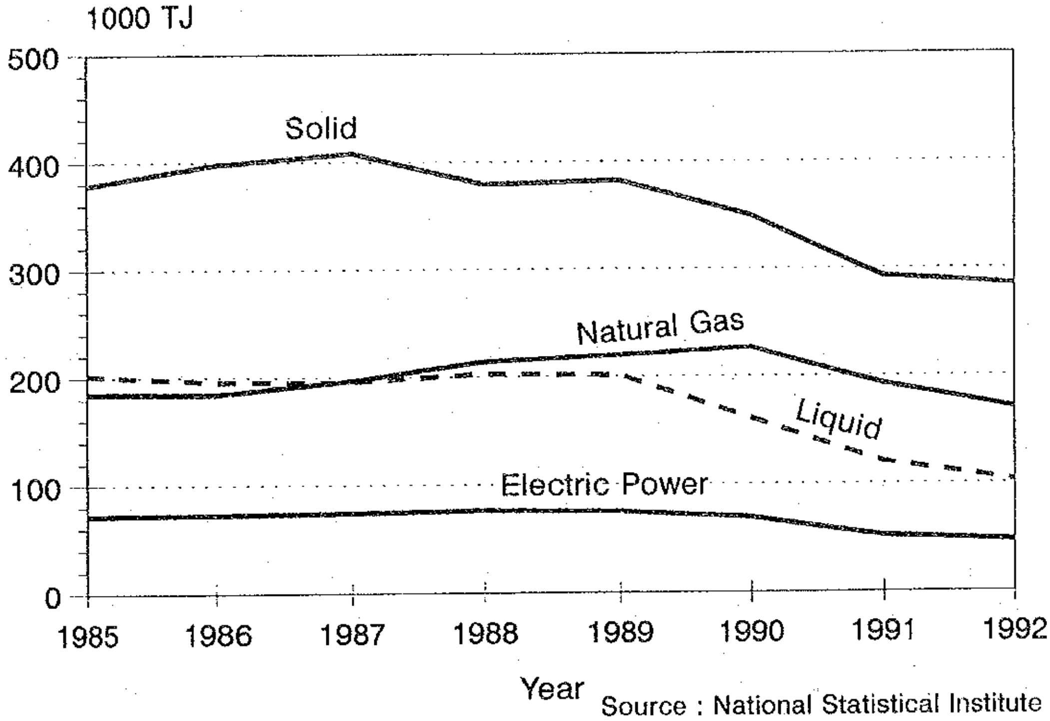
Year	Industry	Agriculture	Household	Total	Industry %
1980	701,595	45,539	145,230	1,160,158	60.4
1981	796,354	45,995	147,470	1,236,759	64.3
1982	727,040	55,154	166,083	1,265,090	57.4
1983	784,791	52,047	168,787	1,280,596	61.2
1984	813,086	52,275	182,544	1,334,793	60.9
1985	795,533	47,915	182,800	1,311,066	60.6
1986	801,540	47,931	175,359	1,307,953	61.2
1987	799,902	49,686	187,615	1,331,105	60.0
1988	822,440	50,744	193,018	1,353,790	60.7
1989	781,219	54,968	199,868	1,330,512	58.7
1990	722,738	49,207	195,757	1,247,567	57.9
1991	467,074	34,447	174,327	997,173	46.8

(Source: National Statistical Institute)

b) Energy consumption by fuels

Figure 2.6 and Table 2.12 show the trend of energy consumption in Bulgaria, when the fuels are classified by solid fuel, gas fuel, liquid fuel and electric power. In 1990 and thereafter, consumption tend to decrease with regard to all the fuels, particularly liquid fuel.

Figure 2.6 Trend of Energy Consumption in Industries



Source : National Statistical Institute

Table 2.12 Trend of Energy Consumption in Industries

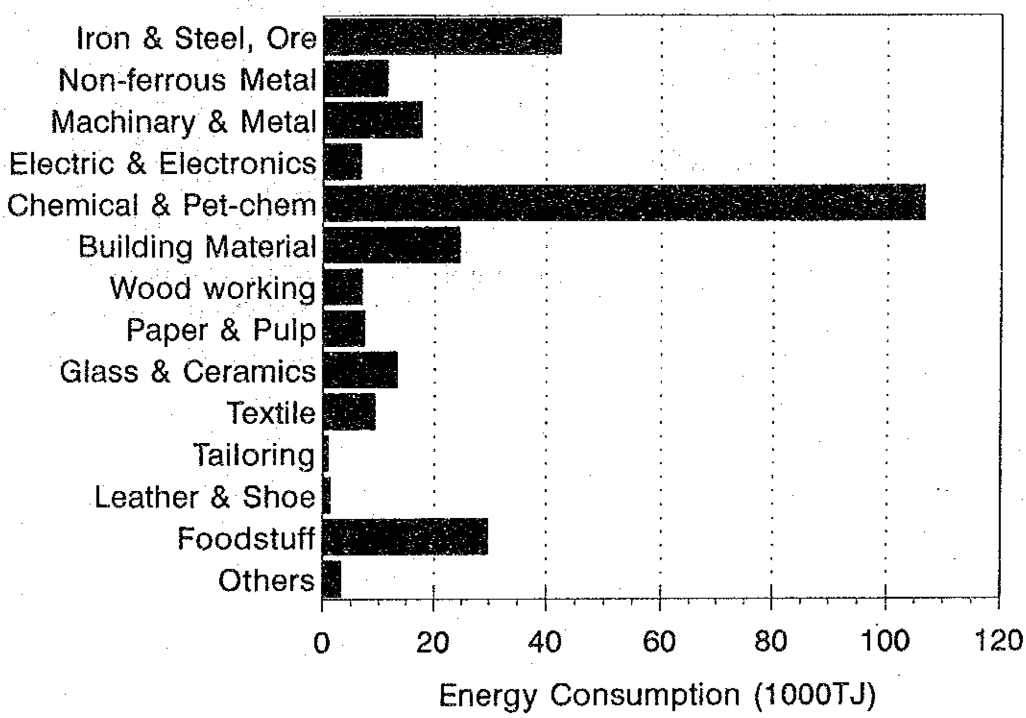
Name of fuels	Unit	1985	1986	1987	1988	1989	1990	1991	1992
Coal	1000t	7270	7141	6886	6581	6528	5901	4471	3857
	PJ	178.1	175.8	169.5	162.0	160.7	145.2	110.0	94.9
Lignite	1000t	30084	33658	36264	32936	33617	31024	27797	29045
	PJ	193.9	217.0	233.8	212.3	216.7	200.0	179.2	187.2
Total of solid fuels	PJ	372.9	392.7	403.2	374.3	377.4	345.2	289.2	282.2
Natural gas	million m^3	5450	5432	5795	6300	6469	6663	5676	5014
	PJ	186.5	186.2	198.7	216.0	221.8	228.4	194.6	171.9
Gasoline	1000t	119	112	121	126	136	126	75	69
	PJ	5.2	4.9	5.3	5.5	6.0	5.5	3.3	3.0
Kerosene	1000t	4.9	4.3	4.4	4.0	4.0	1.9	1.3	0.7
	PJ	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.0
Diesel oil	1000t	260	256	271	287	288	274	194	171
	PJ	11.1	10.9	11.5	12.2	12.2	11.6	8.2	7.3
Diesel oil for industrial use	1000t	366	328	329	344	339	281	160	107
	PJ	14.6	13.1	13.1	13.7	13.5	11.2	6.4	4.3
Dark fuel	1000t	4247	4174	4142	4283	4233	3313	2560	2217
	PJ	170.2	166.3	165.1	170.7	168.7	132.0	102.0	88.4
Total of liquid fuels	PJ	201.3	195.4	195.2	202.3	200.6	160.5	120.0	103.0
Total of solid, gas and liquid fuels	PJ	760.6	774.3	797.1	792.5	799.7	734.1	603.8	557.0
Electric power	GWh	20002	20251	20616	21149	20773	19149	14325	13173
	PJ	72.1	73.0	74.3	76.2	74.9	69.0	51.6	47.5
Grand total	PJ	832.7	847.3	871.4	868.7	874.6	803.1	655.4	604.5

(Source: National Statistical Institute)

c) Energy consumption by industries

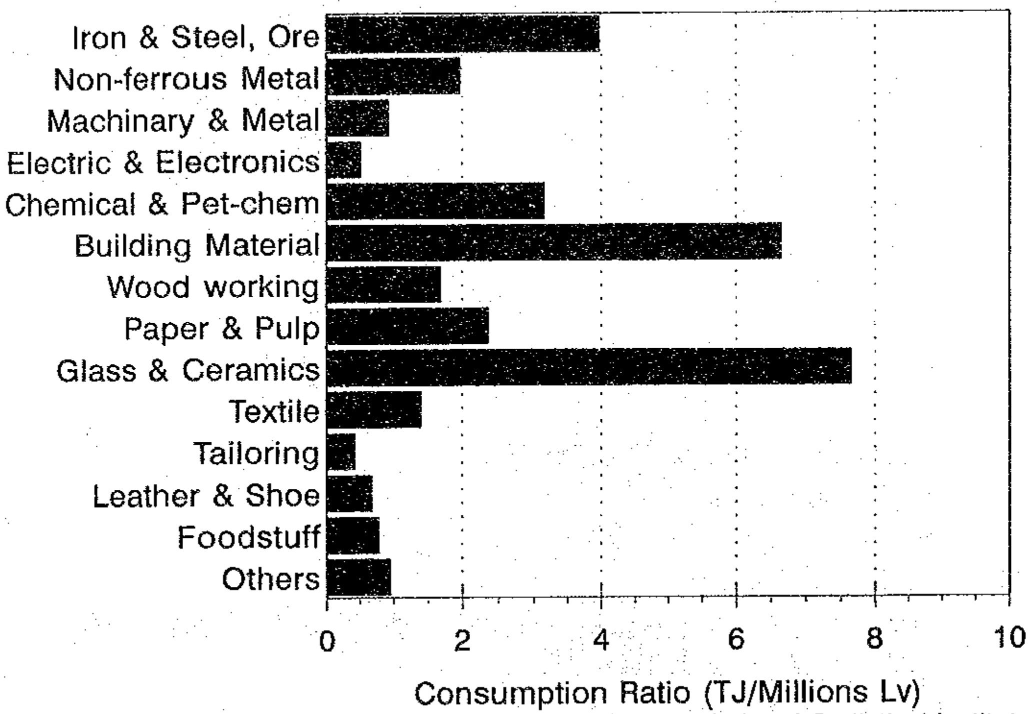
Regarding the manufacturing industry in Bulgaria, much energy consumption is observed in five sectors; chemical, iron and steel, foodstuff, building material, machinery and metal sectors, as shown in Table 2.13 and Figure 2.7. These five sectors consume almost 80 percent of the entire consumption. Energy consumption per production amount shows a high value in five sectors; iron and steel, glass, ceramic, building material, iron and steel, chemical and paper and pulp sectors, as shown in Figure 2.8.

Figure 2.7 Energy Consumption in Industries (1991)



Source : National Statistical Institute

Figure 2.8 Energy Unit Consumption Rate by Industries (1991)



Source : National Statistical Institute

Table 2.13 Production Amount and Final Energy Consumption

Name of industry	1990 Production million Lv	1990 Consumption TJ	1990 Electric power GWh (internal value)	1991 Production MLV	1991 Consumption TJ	1991 Electric power GWh	1992 Production MLV
Power generation, heat supply	2262	1360	14	13969	908	10	20139
Coal, oil, gas	617	2417	33	4108	1030	33	6401
Iron and steel, iron ore	1810	57893	2873	10691	42439	2317	8737
Non-ferrous metal	1235	14212	1777	5834	11506	1534	8890
Machinery and metal	8627	30373	2162	19119	17761	1483	24398
Electric and electronics	6316	8553	700	12903	6719	511	12291
Chemical and petrochemical	6717	129458	5047	33667	106491	4136	42762
Building material	1466	42459	1162	3704	24641	679	4579
Woodworking	1367	9794	380	4088	6926	253	5647
Paper and pulp	628	7836	481	3109	7365	329	2809
Glass and ceramics	553	17384	505	1735	13295	312	2573
Textile	3285	13112	663	6574	9207	415	9082
Tailoring	1314	1439	46	2179	927	54	3006
Leather products and shoe making	818	1682	47	1890	1290	37	3019
Foodstuff	14188	36428	1314	37774	29760	1014	51093
Others	1868	5450	452	3419	3276	278	3109
Total	53071	379850	17656	164763	283541	13395	208535

(Source: National Statistical Institute)

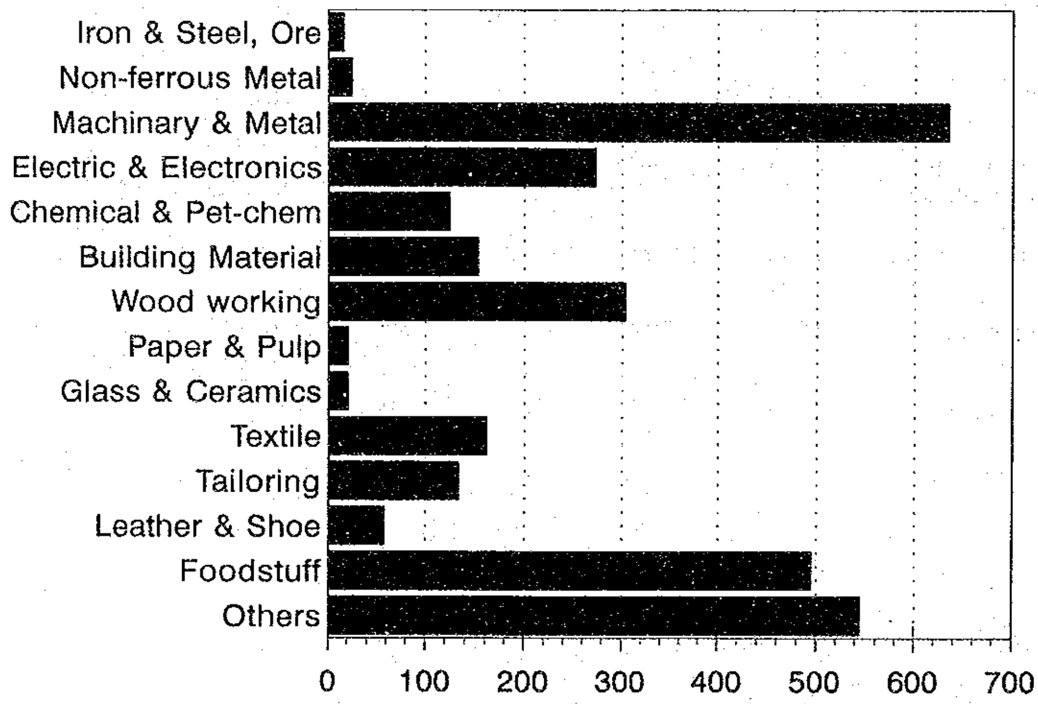
Noto: "Consumption" includes "Electricity".
Value of "Production" is valid only for each year.

d) Number of factories by industries

The total number of factories in Bulgaria was 2,998 in 1991. According to the type of industries, many factors are found in five sectors; machinery and metal, foodstuff, woodworking, textile, and electric and electronics, as given in Figure 2.9 and Table 2.14.

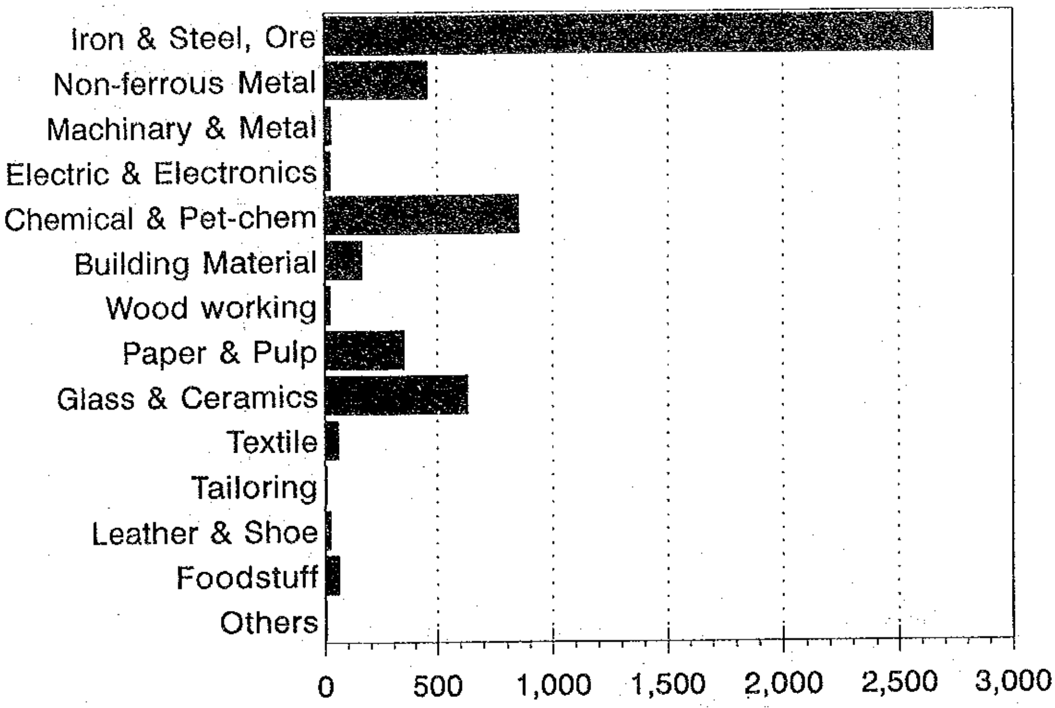
Figure 2.10 shows energy consumption for each factory. As can be seen, energy consumption is overwhelmingly great in the iron and steel making plants, followed by chemical, glass and ceramic industries.

Figure 2.9 Number of Factories (1991)



Source : National Statistical Institute

Figure 2.10 Energy Consumption per Factory (1991)



Source : National Statistical Institute

Table 2.14 Number of Factories by Industries (1991)

Name of industry	Number of employees ~ 140	141 ~ 200	201 ~ 500	501 ~ 1000	1001 ~ 2000	2001 ~ 3000	3001 ~ 5000	5001 ~ 10000	10000 or more	Cooperative association	Total
Power generation, heat supply	2	–	4	5	4	6	2	–	–	–	23
Coal, petroleum	1	–	1	–	1	1	2	2	1	–	9
Iron and steel, iron ore	3	1	3	2	3	1	2	1	–	–	16
Non-ferrous metal	4	1	3	4	8	3	1	1	–	–	25
Machinery and metal	260	68	180	58	35	12	5	1	1	15	635
Electric and electronics	80	21	76	46	35	11	2	–	–	2	273
Chemical and petrochemical	42	7	35	13	10	6	5	1	1	5	125
Building material	70	20	43	13	5	–	–	–	–	2	153
Woodworking	175	36	57	16	2	–	–	–	–	18	304
Paper and pulp	3	1	3	9	2	1	–	–	–	2	21
Glass and ceramics	1	1	3	6	5	2	1	–	–	2	21
Textile	32	14	45	48	15	5	–	–	–	3	162
Tailoring	19	11	38	17	12	2	1	–	–	33	133
Leather products and shoe making	14	3	16	12	5	1	–	–	–	7	58
Foodstuff	189	59	139	35	15	2	–	–	–	56	495
Others	171	44	148	18	3	–	–	–	–	161	545
Total	1066	287	794	302	160	53	21	6	3	306	2998

(Source: National Statistical Institute)

3. Study on the Promotion of Rational Use of Energy in Industry

3. STUDY ON THE PROMOTION OF RATIONAL USE OF ENERGY IN THE INDUSTRY

3.1 Energy Conservation Policies under the Former Institution

(1) Energy prices

For the trade between Bulgaria and the former Soviet Union under the COMECON system, the settlement of accounts for petroleum, coal and natural gas imported from Soviet Union was to be made on the account book in Rubles. Actually, however, such products were bartered for the machinery, foodstuffs and other products made in Bulgaria. Furthermore, the products from Bulgaria were considerably highly evaluated, and the trade between the two countries was really an aid from Soviet Union to Bulgaria. For example, the crude oil was to be traded at the internationally average price for the most recent five years. However, since the products to be bartered were highly evaluated, energy was imported to Bulgaria on a stable basis at the price which was much lower than the international level.

Furthermore, as a part of the social policy, the Government provided subsidies to energy suppliers, so electric power, coal and heat were supplied at the price lower than the cost, as shown in Table 3.1.

Table 3.1 Transition of Energy Prices

Energy	Unit	1985	1986	1987	1988	1989	1990	1991	1992
Coal	(Lv/t)	13.5	12.9	13.2	13.2	13.0	12.6	117.3	184.1
Petroleum	(Lv/t)	159.2	259.2	231.3	231.3	254.7	298.8	1369.9	3020.0
Gas accompanying the petroleum	(Lv/m^3)	91.7	91.7	160.9	161.9	163.2	172.1	590.0	2040.0
Electric power	(LV/MWh)	35.6	36.1	36.3	38.8	39.2	42.8	244.2	370.95

(Source: National Statistical Institute)

Consequently, energy conservation incentive did not work effectively even in the industrial sector whose energy consumption occupied about 60 percent of the total, resulting in the formation of an energy wasteful industrial structure. The energy efficiency in the industry of this country is regarded as 30 to 40 percent lower than the world's standard level.

(2) Regulation

a) Energy conservation policy through mere administrative measures

Energy conservation under the old political system was promoted by the administrative measure, without any law or regulation for the rational use of energy.

However, the Electric Power Act was available for the supply and operation of electric power. The Energy Management Section (Inspection Bureau) of the Committee of Energy checked if a factory met the requirements of energy unit consumption rate determined by the Government. If not, it proposed an improvement program and submitted a recommendation. Especially in 1978 and 1984, the factory was diagnosed in order to overcome the shortage of electric power caused by deterioration of the power plant and shortage of fuels.

The Energy Management Section was set up in the Ministry of Electric Power in April 1962. After that, this Ministry was reorganized as the Ministry of Electric Power and Fuels, as the Ministry of Electric Power Industries (in 1977 and thereafter), as the Ministry of Energy Resources (in 1984 and thereafter) and then as Energy Committee in 1985 and thereafter. The Energy Management Section, just after being established, took charge of only the electric power, starting the management business with the staff comprising fifteen engineers (ten heat engineers and five electric engineers).

From 1976 to 1986, the energy conservation program was implemented. To meet this requirement, the Energy Management Section came to manage the energy resources in addition to management of the electric power, and started diagnostic activities to realize an effective use of the energy.

The diagnosis of energy in the factories was conducted by the fifteen engineers of Energy Management Section, as well as by about 100 engineers belonging to seven branches throughout the country. These engineers entered the factories within the area under their control, and conducted diagnosis and study on the use of energy in order to evaluate the energy unit consumption rate and to check the possibility of energy conservation promotion. The study result was submitted to the factories, accompanied by improvement program. The factories were required to follow these improvement programs; otherwise, they were punished with fines.

The period for the diagnosis and study of large factories reached even 1 to 1.5 months, and 400 factories were diagnosed in a year; even 700 factories were studied in a year at the most active times.

However, the required amount of energy was supplied to the factories by the Government at a cheap cost under the planned economy, so each factory did not very much recognize the need of promoting energy conservation, and the diagnosis could not obtain the expected result.

With the change of the political system, the seven branches of the Committee of Energy were transferred to the National Electric Company in 1991. As a result, only ten engineers remained under the Energy Management Section, and this diagnostic activities were abolished.

b) Sections and personnel in charge of energy in factories

Factories were legally required to assign personnel in charge of energy in 1960's. Their major role was to maintain the electric power equipment in the factory according to the Electric Power Act, and their status within the company was not necessarily high.

When the energy conservation program was implemented in 1976, energy sections were established in large factories and energy other than electric power was added to their duties. In some large factories, these energy sections still remain today.

In 1985 the basis for rationing materials and energy in the factory was changed from volume to monetary value by the Planning Commission. Then some factories abolished the energy sections and determined not to assign the personnel in charge of energy.

(3) Holding of seminars

The seminars concerning energy have been frequently held by the Energy Scientist Union under the Scientific and Technical Union. The Scientific and Technical Union is successor of the Scientific Architecture Association which was established ninety years ago, and the Energy Scientist Union is one of the eighteen groups under the Scientific and Technical Union.

The Energy Scientist Union was set up twenty years ago, and has held symposiums and seminars under the theme of "energy equipment", "energy conservation", etc. Since it is not a Government organization, it does not receive any Government subsidy and is supported by the membership fee of 10 Leva per person and participation fees for the symposiums and seminars. It has 2500 members mainly consisting of professors or engineers relating energy in universities, manufacturing industries, etc. It has 34 branches throughout the country.

It opens 50 courses of seminars every year, and specialists in energy in universities, research institutes and factories serve as lectures for these seminars. The participation fee is about 200 Leva per day. The maximum number of the participants in one seminar was 200.

It issues publications whenever required, which may be sent to non-members if requested.

(4) Technological development and factory guidance

Industrial Energetics belongs to the Committee of Energy. It was financed by the Committee of National Science and Technology, and was established in 1970s by the Ministry of Electric Power. Immediately after establishment, it had eleven branches in addition to the headquarters, staffed with a maximum of 200 engineers. Its activities covered the development and commercialization of the equipment and machinery using energy (burners, boilers, traps and measuring instruments), evaluation of energy efficiency for the equipment and machinery, analysis of energy consumption by factories, improvement proposal, setting up of energy consumption standards for typical processes, etc.

At present it is reorganized as an independent state-run company, and is staffed by 38 researchers and 32 engineers.

3.2 Current Situation of Energy Conservation

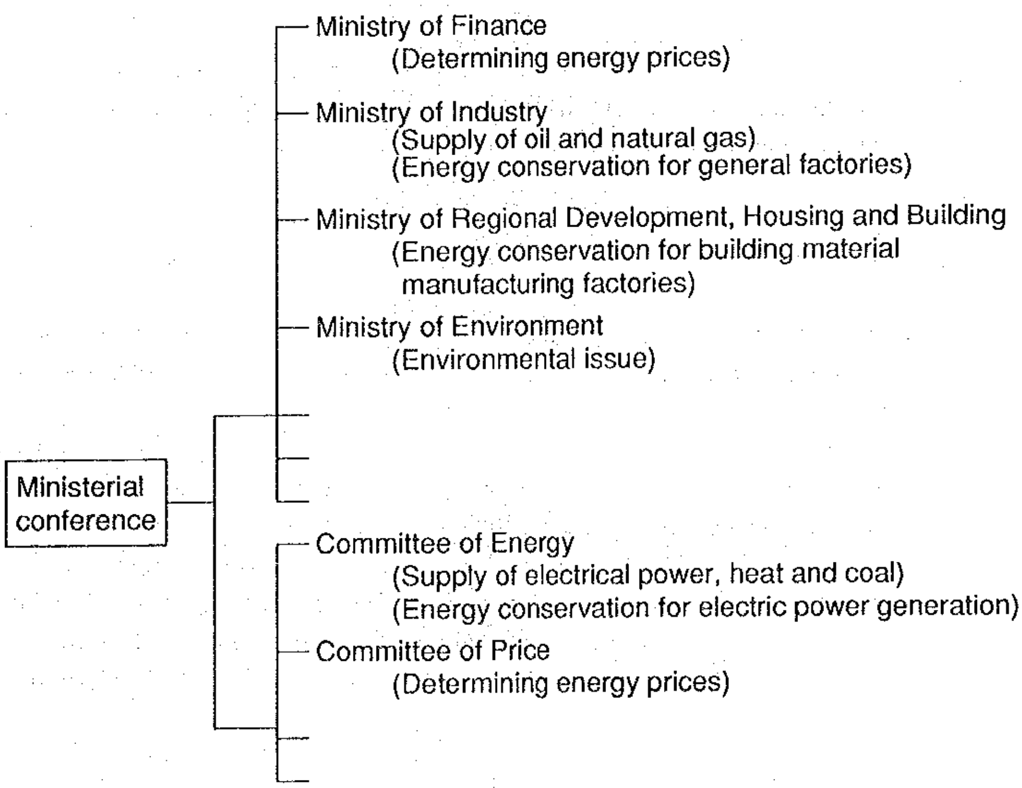
(1) Government organization

Government organizations change with the change of regime. There is no Government organization which determines unitedly energy policies and provides an integrated administration of demand and supply of energy.

With the reform of the political system, the present Ministry of Industry was established in December 1990 as the Minister of Industry, Trade and Services, and was reorganized as the Minister of Industry and Trade in November 1991. It was further reorganized and divided into the Ministry of Industry and the Ministry of Trade in May 1992. Since such a reorganization took place repeatedly in a short period, the Ministry is currently engaged in establishing its internal organizations, and is not yet functioning as a Government organization.

Figure 3.1 shows the organization for energy conservation promotion of the Government of Bulgaria:

Figure 3.1 Government Organization Chart



Regarding energy supply, the Committee of Energy is in charge of supply of electrical power, heat and coal, while the Ministry of Industry takes charge of supply of petroleum and natural gas.

With respect to the promotion of energy conservation, the Ministry of Regional Development, Housing and Building controls the building material manufacturing fields including that of cement, whereas the Ministry of Industry controls the other manufacturing fields.

The Committee of Energy manages the supply of electrical power, heat and coal, and serves the function of supervising the National Electric Company, twenty-four heat supply companies and nineteen coal mine companies, as well as promoting the electric power conservation.

In October 1992, the "National Agency for Energy Efficiency" was set up as the organization to design and carry out a national plan for higher energy efficiency in cooperation with ministries. Because its activities had not been budgeted, however, the Agency was dissolved in June 1993 with no actual actions.

There is no private organization that is assigned the job of encouraging systematic energy conservation activities on the national level.

(2) Energy price

The basis of interdependent energy supply between Bulgaria and former Soviet Union was lost by dissolution of the COMECON system and former Soviet Union, and energy came to be imported at prices close to international market prices.

As part of the effort for economic reforms, the Government started to liberalize energy prices in June 1991 to reflect the actual cost in the domestic energy price.

At present, all petroleum products are imported, and are traded at free market prices conforming to the international prices. Natural gas prices are determined linked with petroleum prices.

However, the fixed price system is applied to electric power, heat and coal. This price is determined by the Government with consideration given to the economic load of the consumers. It is not based on the rational price system which reflects the production cost of energy, but offers subsidies to compensate for the cost differences. Regarding abolition of the subsidies, there is much concern about various possible social frictions due to sudden inflation or slowdown of the economic reform. It seems that much time will be required to abolish them.

The following describes the outline of energy prices and charges:

(1) Electric power

The contract is concluded with the user whose power consumption is over 50 kW. The user who consumes less power is required to pay general charges, without using the individual contract format:

To conclude the contract, the factory submits the annual consumption program for each time zone to the power utility company. The term of the contact is one year. The three-voltage charge system is introduced from May, and lower prices are applied to the contract for higher voltages.

The charge depends on time zones. The charge for the peak zone is fixed by the Government depending on the season and the supply and demand. When required power cannot be supplied, 10 to 20 percent of power supply will be cut down or the operation time may be limited. Double the specified charge must be paid for the amount exceeding the contract amount.

For the power factor, the country has a bonus and penalty system with 0.93 (determined in May 1992) as a basis. Currently, however, a demand for electric power is at the low level in the tendency toward a leading power factor. Thus, the system remains pending.

The charge is revised every three months. There is no demand charge system; only the meter charge system is used.

(2) Heat supply

The contract between the heat suppliers and factories is signed on the basis of annual consumption rate, pressure, temperature, the number of holidays, peak load, the amount of condensate and other factors. Factories are required to submit the consumption program every three months.

No individual contract is signed for household and business use.

There is no demand charge system; only the meter charge system is used. The charge is updated nearly twice a year. The charge of industrial steam is near its production costs.

For the fluctuation of steam quality exceeding plus-minus 15 percent, penalties are imposed on heat suppliers.

For the fluctuation of the amount, purity and temperature of condensate, there is a severe penalty system on the part of the users.

When consumption is reduced below the 30 percent of the contracted value, the charge equivalent to 30 percent of the contracted consumption amount is imposed.

(3) Coal

The imported coal is based on free prices. The price of the domestic coal is fixed by the Government. It was raised in 1991, so that almost all the required costs could be covered by the increased price. The price is about 506 Leva/Gcal though this depends on the quality.

(4) Petroleum product

Prices of petroleum products are liberalized, but the Government determines and announces the upper limit according to the exchange rate every 15 days.

(5) Natural gas

Natural gas is mostly consumed for the industry, and there is no difference of prices between the industrial and household uses.

From 1992, the price of 1 m^3 of the natural gas has been set at 90 percent of the price for one ton of heavy oil (s= 3.5%) which the Government announces every 15 days, independently of the import price. For the same calorie, the price of natural gas is about 7 percent higher than that of heavy oil.

The factories sign the contract according to the annual amount of use. Their monthly consumption program must be approved.

There is no charge system by time zones or penalty for excessive or insufficient consumption.

(3) Energy conservation policies

At present, since Bulgaria has neither long-term energy policy nor energy conservation policy, no energy conservation activity is done by the Government. Only studies are made under the project through cooperation with foreign countries.

The Committee of Energy and Ministry of Regional Development, Housing and Building are interested in energy conservation promotion activities, and each of them is studying and planning energy conservation measures. The contents are still fluid. Both organizations are in charge of only part of energy problems, therefore to promote overall energy conservation, measures taken by these two organizations are not sufficient.

The Ministry of Industry is currently being reorganized, and the future prospect is not clear. The Ministry of Industry is required to take the lead in promoting nation-wide energy conservation activities.

(4) Aids from foreign countries

a) USAID "Energy Diagnosis on Factories"

In 1991, USAID conducted energy conservation diagnoses on eight factories of the industrial fields in Bulgaria using simple measuring instruments with the total budget amounting to 47,000 dollars (US dollars).

The consultant organization of the United States was USED (United States Energy Association), and the counterpart on the Bulgaria side was the Ministry of Industry. In the earlier phase, the counterpart on the Bulgaria side was the Committee of Energy. With the reorganization within the Bulgarian Government, the counterpart changed to the Ministry of Industry and Trade, and then to Ministry of Industry. The Unites States carried out the project using the local consultant in Bulgaria.

According to their interim report, the possibility of saving heat energy in the factories is estimated at 12 percent. The final report is not yet submitted.

b) UNIDO "Energy Conservation 2000"

The Project "Energy Conservation 2000" was established by the UNIDO for the purpose of exchanging information among the energy experts in the Western and Eastern Europe including Bulgaria.

c) World Bank "Energy Policy Study in Bulgaria"

This is a macroscopic view of the energy situation in Bulgaria. Its draft report was submitted in December 1991 to the Ministry of Industry and Trade, the Bulgarian counterpart at that time. The report analyzes the price, demand and supply of electric power, petroleum, natural gas, coal and other energy. It briefly touches energy conservation.

d) EC "PHARE Program" (Poland, Hungary Aid for Restructural Economy)

The PHARE Program is an EC's program to aid the East European countries. In the beginning, the aid was given to Poland and Hungary, and has been extended to all the east European countries and three Baltic countries. Thirty million ECUs (equivalent to 43.5 million U.S. dollars) are granted to these countries: 11.5 million ECUs to ensure safety of the nuclear power plants, 10 million ECUs to assist import of the energy when the nuclear power plants were decommissioned, and remaining 10 million (approx.) ECUs to improve the electric power industry.

e) EC "Thermi-Program"

A center is set up within the Energy Project Co. on the basis of the EC fund in July 10, 1992, and a Greek consultant company has been decided to run the center for a minimum of two years. The major activity of the center is concerned with energy conservation. Bulgaria Government does not participate in this project.

f) France

A French Foundation has made investment to promote improvement of the heat supply equipment. This program is carried out in three cities in east European countries. One of these cities is Sofia.

(5) Activities of consultant

The Industrial Energetica is staffed by 70 people including researchers and engineers. Since it has an accumulation of information on the factory energy situation studied in the past, it plans to guide the energy conservation project for factories.

Several private consultant firms have been established for the promotion of energy conservation, and have already started activities. They conclude yearly agreement with the factories. When the factory implements a specific project, these consultant firms conclude agreement for each project, thereby giving advice for the promotion of energy conservation.

To combat the recent price spiral, factories in Bulgaria tend to request the consultant firms to give advice as to the energy conservation. So there is much room for the consultant firms to assist them.

4. Recommendation

4. RECOMMENDATION

4.1 Problems Concerning Energy Demand and Supply, and Energy Conservation Policy

The situation of energy demand and supply, and policies with regard to energy conservation in Bulgaria are considered to involve the following problems:

(1) Problems concerning energy demand and supply

(1) Excessive dependency (67%) on imports for energy

(2) Most of the energy is imported from one country, the former Soviet Union

(3) The lignite, the major domestic energy resource, is of low calorie (1200 to 1300 kcal/kg), and requires desulfurization and denitrification from combustion exhaust gas.

(4) The nuclear power plants are made by the former Soviet Union, and face the safety problems.

(5) Some of the thermal power plants are deteriorated and require a thorough improvement.

(6) The energy consumption efficiency for the industrial sector is poor.

(7) Electric power is used for room heating in general households.

(2) Problems concerning energy conservation policy

(1) All the past policies have been abolished in the process of political reform, and there is no policy in a blank state.

(2) There is no Government organization to take charge of integrated administration of energy problems; the functions are currently decentralized and dispersed. Therefore, the policies are studied separately and sporadically in various sections.

(3) A long-term economic program is not yet worked out.

(4) The energy price is liberalized to a considerable extent, but the Government subsidies are granted for energy for household use, and the price is kept politically low.

The electric power for industrial use and steam are based on the meter rate system alone. The effective system is not yet adopted to ensure a stable balance between the revenue and expenditure on the part of the supplier, or to ensure promotion of energy conservation on the part of the user.

(5) The shares of the factories are held by the Government; the factories are not yet privatized in real terms.

(6) Both the Government and enterprises are financially pressed, and have no fund for taking measures or making the required investment.

4.2 Determination of Energy Policies

(1) Energy supply policies

Bulgaria depends on imports for 60 to 70 percent of the energy supply. Natural gas through the pipeline, and other types of primary energy were supplied mostly from the former Soviet Union. In recent years the petroleum production in the former Soviet Union is undergoing a remarkable reduction, and the supply is getting unstable.

Energy is indispensable not only to the industries but also to the transportation and household use; it is essential to maintain people's living. It is, therefore, necessary to ensure a stable long-term supply of high-quality, inexpensive energy. The development of energy resources and the construction of receiving and conversion plant requires a huge sum of funds and a long period of time. The energy supply program should be worked out from a long-term viewpoint.

Regarding energy consumption, it is necessary to improve the consumption structure into energy conservation structure, in order to intensify international competitiveness of the industry, to save foreign currency for energy import and to increase resistance against fluctuating energy price. When factories make efforts to promote energy conservation, they can expect to enjoy such secondary advantages as reduced energy consumption, stable operation and improved quality, thereby intensifying the international competitiveness.

Furthermore, it is not sufficient in recent years to consider the benefits in one's countries alone. Each country is required to make a contribution to solve international environmental problems on the global scale —— problems involved in global warning caused by increase of greenhouse effect gas and acid rain which is caused by sulfur compound and nitride compound.

Most of the energy resources, especially petroleum, are located largely in the Middle East, so the world's petroleum demand and supply or prices are subjected to many unstable factors.

It is essential to work out the optimum energy demand and supply program which meet these requirements and to determine the energy policies which achieve the required objectives.

In order to ensure that each Ministry and every bracket of the people have common understanding and move in the direction appointed by the Government, basic requirements of the energy policy must be announced, and effective publicity activities must be continued.

(2) Energy conservation policies

OPEC countries adopted a petroleum strategy at the time of the fourth Middle East war which broke out between Arab and Israel in 1973. This caused a remarkable hike of petroleum price and temporary suspension of oil export, giving a serious impact to the world's economy. This brought out major factors which caused a long-term global economic depression thereafter. Furthermore, the so-called second oil crisis took place in 1979 as a result of political change in Iran. Oil market on the global scale was placed under stringent conditions. Oil producing countries, mainly OPEC nations, raised the oil price one after another, causing an oil price spiral. This put the world economy into depression for many years thereafter.

In the face of these two oil crises, the Government and the people in the main countries of the free world got together to review the energy policies and actively promoted energy conservation policies. As a result the economy barely recovered around 1984.

At present, Bulgaria and other East European nations are encountered with economic crisis when shifting from the centralized planned economy to a market economy. From the energy point of view, the situation of unstable energy supply and spiraling oil price is similar to the case of the first and second oil crises the Western nations had experienced. So both Government and people in Bulgaria are required to combine efforts to promote energy conservation, as those in the free world countries did at the time of oil crises.

Thus, "energy conservation" is to "rationalize the use of energy" to ensure that the maximum effect is output with the minimum energy input. Accordingly, energy conservation promotion measures are taken to eliminate unnecessary energy consumption in all phases and to ensure the most effective use of energy, while meeting the requirements of the society, such as development of the nation's economy, improvement of the people's standard of living and preservation of the environment. It is not to restrict production activities of the enterprises or people's living through forcible control or quota of the energy use by the Government.

For Bulgaria which depends on imports for most of the energy resources, energy conservation activities are defined as major "energy resources".

To ensure effective implementation of energy conservation, the Government is required to pave the way in both economic and technical fields.

Apparently the energy price plays a major role in motivating energy conservation activities. Implementation of energy conservation provides direct benefit of saving energy. So some people consider as follows; if the energy price is set at the optimum value, energy conservation will be promoted automatically by the market principle. Therefore special energy conservation measures are not necessary, and should be left at discretion of enterprises and individuals.

However, the majority of the nations consider that energy conservation promotion by the Government is essential for the following reasons:

① The energy market price is affected by the short-term demand and supply, and does not necessarily reflect the long-term prospective.

② The energy problem does not easily become the major concern of the enterprises and individuals.

③ If adequate information on the method and means to implement the energy conservation is not obtained, concrete action cannot be taken. Satisfactory results cannot be gained even if some action is taken.

International Energy Agency (IEA) reviewed the energy conservation measures taken by member nations in the face of oil crises. It concluded in its evaluation that both the market mechanism and Government role are important, and the measures taken so far should be continued.

Especially in the Bulgarian factories, there has been no need to promote energy conservation so far, so their understanding of energy conservation is not sufficient. If the Government does not take any measures for the promotion of energy conservation, they cannot be expected to take energy conservation activities voluntarily.

The energy conservation measures taken in countries of the world include the following:

1) Setting the target for energy conservation

2) Setting reasonable energy prices

3) Regulation to some extent (requirements for recording, reporting, assigning the personnel in charge of energy management)

4) Supply of information on energy situation and technology related to energy conservation, and publicity

5) Instructions for education, training and diagnosis

6) Incentive for energy conservation activities

7) Development of technology

To implement these policies, the basic policy of the nation must be determined, and should be notified extensively as a law, President decree or national energy program. In Japan this is enacted into "Law Concerning the Rational Use of Energy" to show the authenticity.

4.3 Clarification of the Relevant Organization in Charge of Energy Administration

The optimum energy mix plan must be worked out with consideration given to the following factors:

a) Amount, properties and distribution of domestic energy resources

b) Possibility of purchasing imported energy, stability of its supply, its quality and estimated prices

c) Estimated consumption of energy according to types and sectors

d) Prospect of establishmet and operating condition of the energy receiving and converting equipment (such as power plant)

e) Energy price and tax

f) Prospect of efficiency of energy use

So the section in charge of energy policies must be organized so that it can get an overall picture of the production and consumption of the primary and secondary energies.

Bulgaria has the Committee of Energy in charge of the supply administration of coal, electric power and heat, and the Ministry of Industry in charge of the supply administration of the petroleum product and natural gas.

We recommended to set up an agency under the Ministry of Industries, which will integrate the functions relating energy of the Committee of Energy and the Ministry of Industry, and will take charge of comprehensive energy policies and energy conservation policies.

The following are included in the responsibility of an organization in charge of integrated energy administration:

Working out an energy demand and supply program, and adjusting demand and supply
Working out a long-term demand and supply program
Working out an annual demand and supply program and adjusting demand and supply

Energy supply measures

- Exploration and development of energy resources
- Stabilization, rationalization and safety control of domestic energy production
- Import program for overseas energy resources
- Construction, maintenance and repair of the equipment for energy import
- Construction, maintenance and repain, and efficiency improvement of energy conversion plant such as power plant and oil refinery
- New energy development and energy substitution program

Energy demand control measures

- Determining energy prices
- Supply of information, education and instruction for a rational use of energy
- Promotion of investment for rationalization
- Promoting the efficiency of the equipment using energy and consumption structure improvement
- Technologies development

To show the case of Japan by way of an example, National Resources and Energy Agency was established in the Ministry of International Trade and Industry (MITI) in 1973 as an Agency at the same level as the Department. The organization is as shown below. It provides an integral administration of resources and energy policies.

General Coordination Division: General coordination and publicity

Energy Policy Planning Division: Working out comprehensive policies, studying energy related matters both in Japan and abroad

International Energy Policy Division: Overseas mining resource development and international cooperation

Energy Conservation Division:

Alternative Energy Policy Division:

Mining Department

Petroleum Department: Petroleum policy, demand/supply planning, refining, distribution, stockpiling, exploitation

Coal Department: Coal policy, demand/supply planning, import, mining, rationalization, promotion of coal producing areas, mining pollution measures

Electric Power Business Department: Electric power policy, demand/supply planning, price administration of electric company, power source development, electric technology, power generation, nuclear power generation safety control

Gas Business Department: City gas policy, demand/supply policy, price, production, safety control

District Heating Department: Heat supply policy, demand/supply policy, price, supply, safety control

Other Departments: Ocean development, geothermal policy, liquefied petroleum gas

4.4 Optimization of Energy Prices

(1) Setting the optimum price according to the cost

When energy prices are intentionally set low, the incentive does not work, and people will get less interested in energy conservation.

There is an agreement among the IEA member nations: If there is an international market, energy consumer prices should reflect international market prices. If not, it should reflect the long-term cost to maintain energy supply. Actually many IEA countries determine power and gas prices according to the actual costs.

At the same time, energy prices should internalize external factors such as environment protection cost in energy production and use, whenever possible.

In Bulgaria, there has been a remarkable development in bringing consumer prices of petroleum, natural gas and coal closer to international market prices, but there still remain control of consumer prices of electric power and heat supply for household use, and granting of subsidies. The subsidies for electric power and heat supply for household use should be abolished as soon as possible, and the price should be made as close as possible to that reflecting the cost.

In this case, it goes without saying that the utility companies and heat suppliers should make efforts to reduce the cost.

(2) Introducing the demand charge system

In Bulgaria all the current electric power and heat supply charges are based on the meter rate system. Accordingly, if users make energy conservation efforts, energy suppliers have to increase the charge in order to make ends meet. For users, if the energy unit price is increased by saving energy, the saved money will diminish. The incentive for energy conservation does not work.

By the introduction of the charge system comprising the demand charge and the meter charge, suppliers should use the demand charge system to cover the fixed expenses (equipment charges including depreciation and interest, personnel expenses and administration expenses), and should use the meter charge system to cover the variable expenses. This will allow users to reduce the meter charges by energy conservation, with the demand charge remaining unchanged. Suppliers can use the revenue from the demand charge to cover the fixed expenses regardless of the volume of sales. So if there is no substantial variation in heavy oil or natural gas prices, it will be possible to maintain the balance between revenues and expenses.

The demand charge is set according to the amount of the contract with users, namely, the peak value of consumption. The equipment of suppliers are built at the capacity to meet the maximum demand requirements, and this cost must be borne by the users. Naturally suppliers are required to make efforts to absorb the increment of the personnel expenses and the repair charges which increase with the lapse of time.

As described above, the introduction of the demand charge system ensures stable revenue of energy suppliers. In this case, the penalty for the case where the users do not consume the contracted amount should be abolished and a charge system effective to promote energy conservation could be established.

For information, the following shows examples of electric power and city gas charge system in Japan. Based on the request by suppliers, these charges are determined by approval of the Minister of International Trade and Industry after going through the procedures of review by National Resources and Energy Agency of the MITI, public hearing and approval at related ministerial conference.

a) Electric power

The current electric power charge system in Japan is a three-step charge system for the electric light, having been worked out on the basis of the fundamental requirements of realizing the high level of welfare society and promoting energy conservation. Namely, the first step charge of up to 120 kWh a month which is required for people's living is comparatively cheap, and the second step charge for up to additional 130 kWh is the average price, while the third step charge is set to the price which reflects the upward movement of the marginal expense to promote energy conservation.

Furthermore, in Japan, which belongs to the subtropical zone, the peak time occurs in summer because of cooling demand in that season. In order to suppress the peak demand, the "season-dependent charge system" is adopted for the contract of electric power.

The following describes the major points:

① The fixed rate charge (electric light or small equipment with the total capacity of 400 VA or less) is the flat rate corresponding to the contracted load, independently of the used power. However, even when power is not used at all, the charge of 50% must be paid.

② If the contracted power is reduced, the basic charge is reduced in proportion.

③ The basic charge is calculated on the basis of the power factor of 0.85. The price is changed according to power factor; the basic charge is decreased and increased by each 1 percent according to the increase or decrease in the increment of 1% of power factor.

④ The electric light system according to the meter charge system includes the electric light system according to the time zone. The charge is reduced when the nighttime heat storage type equipment is used.

⑤ When the night load is over 30 percent, the night charge is reduced by the power contract for business use.

⑥ For high tension voltage and special high tension power contract, there is a charge system according to seasons and time zones. When power consumption is increased at night, the electric power charge is reduced.

b) City gas

The gas charge is determined according to the following three principles:

① Cost principle

The charge should be determined so that total cost, namely the adequate profit added to the costs related to gas production, supply and sales based on the efficient management, will agree to the revenue from the charge.

② Adequate profit principle

The level of the business profit included in the total cost should be adequate for the payment of interest and dividend sufficient to procure funds required for the effective development of the business.

③ Principle of fairness

The charge should be determined so that the specific users will not be subjected to unduly discriminative treatment.

The gas charge system is available in two types; general charge system and charge system with load adjustment stipulation.

The general charge system includes the following two types:

① Block charge system

The minimum consumption rate is determined according to the size of the gas meter. The charge is fixed within that range. For the consumption exceeding the limit, the charge is imposed in proportion to the use. The majority of the small-sized local gas enterprises use this system.

② Multiple charge system

The scale of consumption is divided into two or three blocks, and the demand charge and meter charge are applied to each of them. This system is used by the leading gas companies.

The gas use varies greatly according to the seasons and time zones. So by making it as flat as possible, the charge system with load adjustment intends to increase the utility rate of all the equipment and to reduce the cost, thereby stabilizing the charge. At present, this is applied to the users who consume more than the specified amount for industrial use and air conditioning use and whose consumption is not subject to much fluctuation through the year. The price is reduced for such users.

4.5 Establishing an Energy Conservation Promotion Agency

The energy conservation promotion measures include supply of information and other services rendered to the unspecified number of enterprises and individuals. These services should not be carried out directly by the Government officials. So some appropriate organization (temporarily called Energy Conservation Center) should preferably be set up to render these services.

The services to be provided are in conformity to the nation's policies, and are not intended for profit. So it must not be utilized by the profit-making firms. It should be a private organization having neutral characteristics to be run under direct supervision of a Government organization, namely, a new Energy Agency to be established. Accordingly, its establishment should preferably be regulated by laws.

The management expenses should be covered by the contribution from the member companies which use supply of the information, and by the revenue gained from the training course and similar activities. The subsidies according to the nation's budget will be necessary until the services are placed on the right track.

Until the amount of services is expanded to a specified level, it seems difficult to establish an Energy Conservation Center as an independent organization. Continued implementation of the instruction and diagnosis of factories to which the technique has been transferred according to the present study, and earlier start of the training courses are essential. So for the time being, such services can be entrusted to the existing organization, for example, the Industrial Energetics or Echotec Product, while the training course can be entrusted to the Scientist and Engineer Union.

The services rendered by the Energy Conservation Center include the following:

- Collection of data and information on energy conservation, research and study
- Publicity
- Technical diagnosis and instruction regarding energy conservation
- Education and training for the engineers
- Training of "Energy Manager" to be described below

4.6 Energy Conservation Promotion Measures in Factories

(1) Special promotion of energy conservation for energy intensive factories

a) Designation of priority factories for energy management

Energy conservation in factories should be promoted voluntarily. For large-sized energy consuming factories, however, the Government should always have correct information on how energy conservation efforts are being made, and must give adequate instruction whenever required.

For this purpose, factories which use more than a specified amount of energy should be designated as "priority factories for energy management", and it is effective to create a system which will make these factories submit record and report, so that the personnel of the Government in charge of energy conservation promotion may get a clear picture about how energy is used and how energy conservation efforts are being made in these designated factories.

The criterion for designating "priority factories for energy management" should be determined preferably on the basis that the total energy consumption of all designated factories is 80% of the total energy consumed by the entire industrial sector of Bulgaria.

b) Institutionalizing energy managers

Energy conservation must be an activity involving the entire factory. Otherwise, it will be difficult to obtain good results. So it is necessary to appoint an "energy manager", an expert who manages the effective use of energy in the entire factory as a central force for energy conservation activities. He should be placed in "designated factories".

This "energy manager" should be selected from among the engineers who are qualified by the Government. He is responsible to promote an effective use of energy in the factory and to report the use of energy to the Government.

(2) Establishing technological standards for judgement in factories for energy conservation promotion

The Government should announce technical items or the level for energy conservation which should be implemented by the factory basically, regardless of the type of business. This is intended to ensure that factory engineers and "energy managers" can easily make an adequate evaluation. This criterion is not a legal standard which must be achieved, but will offer a guiding index or standard for judgement to be used when the factory works out an independent implementation program voluntarily.

(3) Promoting the equipment investment for energy conservation promotion

a) Establishing an incentive tax system

When the factory purchases the Government-specified machines and equipment which will feature high energy efficiency and assist energy conservation, the Government should assist the factory in purchasing such products, for example, by reducing the tax on profits.

In Japan, there is a system where for 241 equipment specified by the Japanese Government, seven percent of the purchase price is deduced from the tax on profit.

b) Establishing the financing system at low interest rate

A system should be set up so that when the factory purchases an energy conservation equipment, it can be financed at a lower interest rate than the normal interest rate.

(4) Dissemination of energy conservation, supply of related information and commendation systems

Information on energy situation, Government policies and energy conservation progress should be supplied to management people through the management conference, and the need for the energy conservation should be appealed to them, so that they will take active measures.

For the factory to set to energy conservation measures, it is essential to provide the information on energy conservation technology. It is important to supply energy conservation information over an extensive range through technical instruction and advice for the factory, factory energy diagnosis, opening of the seminar, exhibition and publications.

Especially, introduction of the successful example is effective in removing a sense of their concern about investment.

To commend officially companies which achieved a remarkable success in energy conservation and individuals who made a great contribution in energy conservation and to make public recognition of their services is an effective way of improving their morale and arousing interest in energy conservation activities in the factories. To honor the individuals who have developed the equipment and processes which are highly effective for energy conservation will increase the willingness for development and promote spread of the use of such equipment. In this case, however, severe technical evaluation by the neutral organization is extremely important. In Japan, award is given in the cases of successful improvements, posters for general public and theses in addition to the above cases.

4.7 Technological Development

The machinery, equipment and processes which will ensure efficient use of energy should basically be developed voluntarily by private companies at their own risk. However, when the development activity involves an extremely advanced technology or when the huge amount of development cost is required, progress cannot be expected if such efforts are left to the private enterprises alone.

Such important research and development projects should preferably be trusted to the research group composed of public organizations and multiple enterprises using national budget.

Table 4.1 Summary of Proposed Policies

	Item	Current problems	Priority items for implementation	Short-term items for implementation	Mid-term items for implementation
1	Energy policy administrative organizations	The relevant authorities are different according to the type of energy.	The agency in charge of the comprehensive energy policy should be set up within the Ministry of Industries. An inter-ministerial liaison conference should be organized.		
2	Energy policies	The basic energy policy is not yet worked out.	The mid- and long-term demand and supply prospect should be prepared. The basics for energy policies should be determined and publicized. Energy conservation policies should be determined.		Laws and regulations should be set up.
3	Energy prices	Energy prices are partly kept to low values for political reasons.		Energy prices should be raised to the international price levels or to a level reflecting the cost.	
		Promotion of energy conservation is adversely affected by some charge system.	The charge system should be modified so as to be oriented for energy conservation.		
4	Promotion measures of energy conservation for factories	All energy conservation promotion packages are left abolished owing to difficulties in national finance and poor factory funds.	Information on the situation of energy consumption in major factories must be collected.	Energy intensive factories should be designated. Energy manager should be assigned.	Technical criteria for energy conservation should be established.
			Motivation must be given.	The factories in designated factories and individuals posting remarkable achievements should be commended.	Incentives should be introduced (tax reduction).
		There is no systematic supply of information.	Information supply promotion should be budgeted. A seminar for training should be held. (Entrustment) A guide to diagnosis should be provided. (Entrustment)	Training courses should be held. (on commissioning basis) Diagnosis and guidance should be implemented. (on commissioning basis)	Periodicals should be published.
		The factory is hindered from investment by such economic reasons as poor funds.	Budget for investment promotion should be designed and budgeted. (Tax deduction and financing in low interest)	A system for financing at low interest should be set up.	A tax incentive system in favor of investment for energy conservation should be set up.
5	Organization to implement energy conservation promotion measures	There is no public organization to implement the concrete measures to promote energy conservation.	A policy implementation administrative section should be established within the Ministry of Industries.	An "Energy conservation center" should be set up.	
6	Technological development	No efforts have been made at the public level to develop energy conservation technologies.		A budget for technological development must be appropriated.	Technological development must be implemented at the public level.

5. Survey of Energy Use in the Model Factory

5.1 Results of Study at a Detergent Factory

5. SURVEY OF ENERGY USE IN THE MODEL FACTORY

5.1 Results of the Study at a Detergent Factory

5.1.1 Factory outline

(1) Factory name
Verila

(2) Type of industry
Chemical industry

(3) Major product name and production capacity

Synthetic detergent	Granule	30,000	tons/year
	Powder	12,000	
	Liquid	15,000	
Grease		14,000	
Textile Additives		8,000	
Alkylbenzene sulfonic acid		1,500	
Nonion surface active agent		6,000	
Polyol		12,000	
Antifreeze		1,500	
Auxiliaries for industry		18,000	

(4) Number of employees on the payroll
750

(5) Factory address
Ravno Pole-Verila Station, Sofia Reg.

(6) History
Starting as a machine oil reproduction factory in 1945, the factory took up production of industrial additives and synthetic detergent in the 1960s. Further in 1970s, the Verila factory set about production of the granule detergents, and alkylbenzene sulfonic acids and nonion surfactants as detergent materials. In and after the 1980s, it started production of Polyol as polyurethane resin materials, and implemented modernization and updating of the equipment to produce grease, industrial additives and alkylbenzene sulfonic acid.

Verila is the only factory producing granular detergents in Bulgaria, and accounts for 60 to 70 percent of the total detergent production of the nation, when the production of detergents in liquid and powder is included in the calculation.

Affected by the sluggish economy since the year brfore last, the operation rate of the Verila factory has remained low. During the current study period, the detergent dryers were operated for the study, though most of the production processes were stopped.

(7) Study period
March 8, 1993 to March 12, 1993

(8) Members of study group
Mitsuo Iguchi : Head of the study group, energy management
Teruo Nakagawa : Assistant head of the study group, measurement
Masashi Miyake : Chemical process
Masashi Endo : Thermal technology
Yukio Nozaki : Thermal technology
Yorihiko Tanaka : Electric engineering

(9) Interviewees
Mr. Stefan Javacheff : General Manager
Mr. Kosta Armyanov : Senior Engineer
Mr. Seferov : Head of Production Department
Mr. Lazarski : Head of Maintenance Department
Mr. Elika Tainova : Chief of Electric Division
Mr. Hristoforov : Heat Engineer

(10) Trend of production

Table 5.1.1 Trend of Production (t/y)

Name of Product		Unit	1987	1988	1989	1990	1991	1992
Detergent	Granule	t	18474	16426	14868	9311	5431	5385
	Powder	t	16840	19847	19397	15986	6513	2646
	Liquid	t	14945	12100	14036	14411	5341	9433
Grease		t	9817	9148	8366	2441	1221	1511
Non-ion Surfactant		t	17579	17424	18007	13365	4676	2676
Alkyl Benzene Sulfonate		t	6644	7910	7022	2958	193	3526
Polyol		t	0	1111	4162	1335	272	186
Antifreeze		t	1334	1882	1241	773	729	0
Auxiliaries for Industry		t	6630	6163	5626	4013	3717	3025

(11) Trend of sales amount

Table 5.1.2 Trend of Sales Amount (t/y)

Name of Product		Unit	1987	1988	1989	1990	1991	1992
Detergent	Granule	t					2533	5355
		t	36656	37972	35245	19692		
	Powder	t					11630	2639
	Liquid	t	14647	15033	13566	18812	5905	9433
Grease		t	9688	8364	7758	3198	1178	1493
Non-ion Surface Agent		t	9169	9423	9602	7425	1849	1594
Alkyl Benzene Sulfononate		t	2287	1818	2080	860	38	350
Polyol		t	0	219	4150	2093	234	186
Antifreeze		t	1547	2222	1240	668	233	0
Auxiliaries for Industry		t	5476	5197	5630	4628	3292	2700

(12) Trend of energy consumption

Table 5.1.3 Trend of Energy Consumption

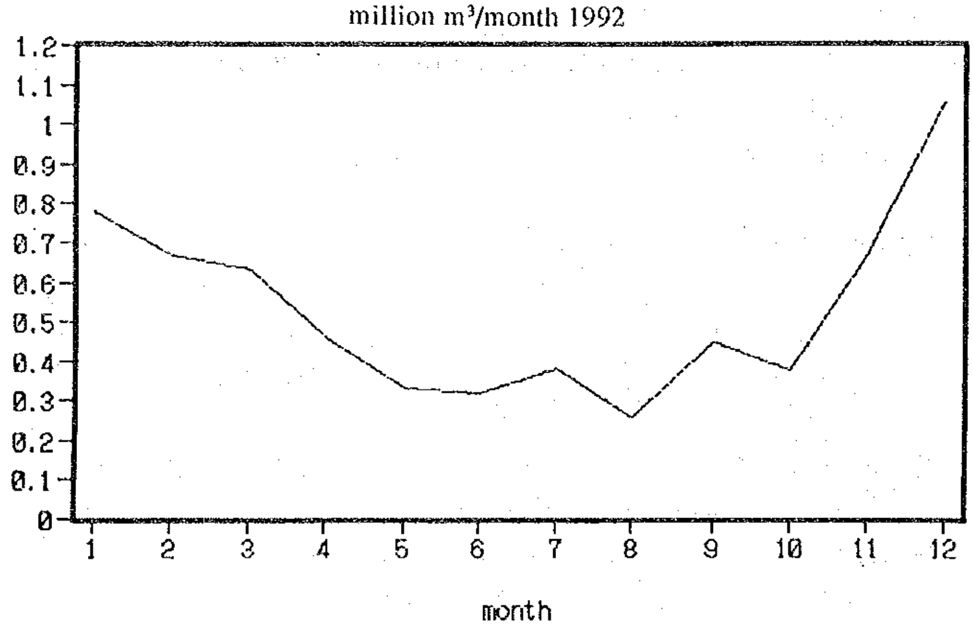
Energy	Unit	1987	1988	1989	1990	1991	1992
Fuel Oil	kl	11000	11500	11250	9300	2000	469
Diesel Oil	kl	1726	1578	2117	850	245	414
Natural Gas	$1000m^3$	0	0	0	0	2609	6377
Electric Power	MWh		11767	13378	8057	5626	6356

(13) Natural gas consumption by month (1992)

Table 5.1.4 Natural Gas Consumption by Month (1992)

Month	1	2	3	4	5	6	7	8	9	10	11	12	計
$1000Nm^3$	780	670	634	460	332	317	383	255	448	377	669	1052	6377

Figure 5.1.1 Natural Gas Consumption (1992) × 10^6 m^3

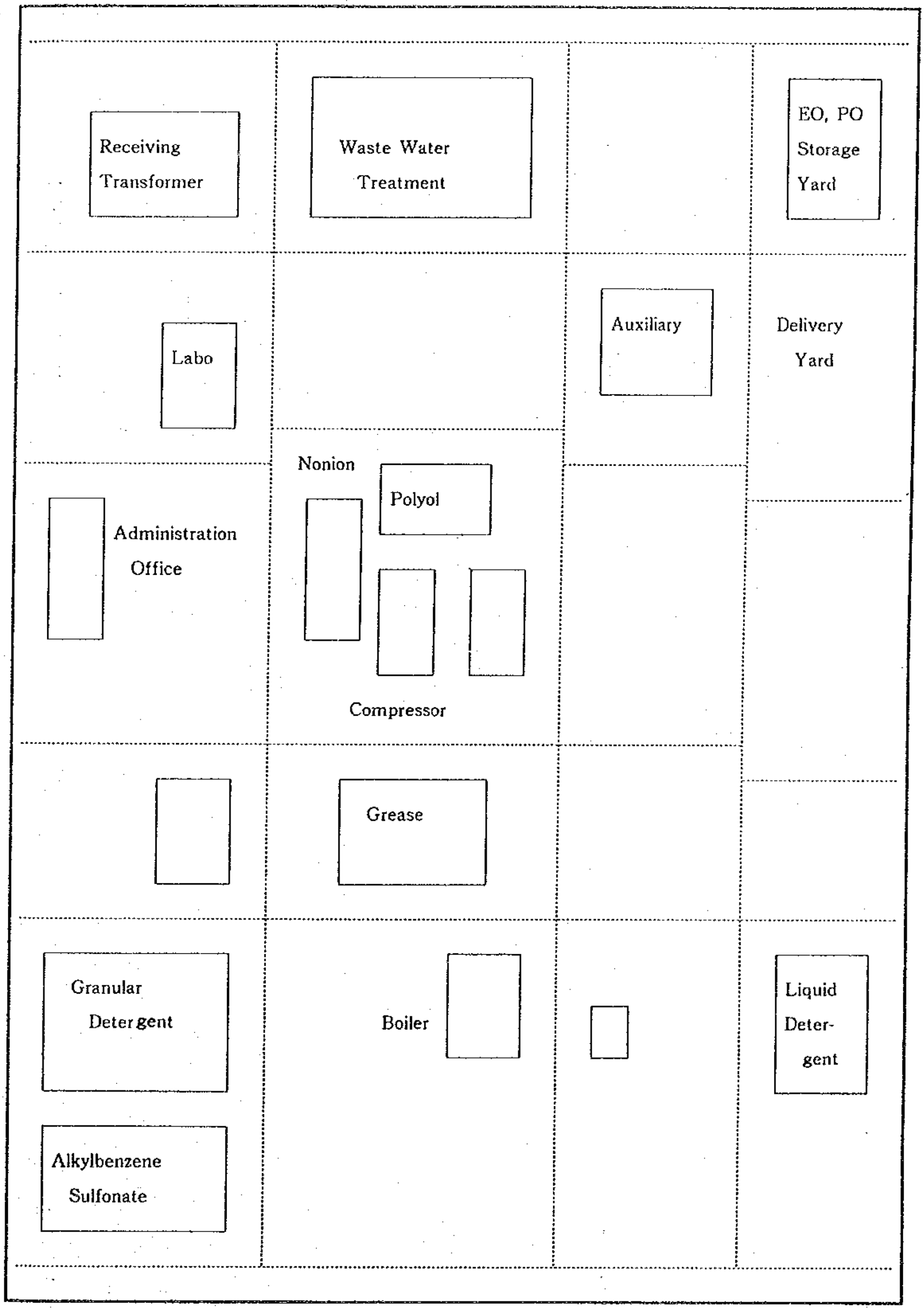


(14) Energy prices

Natural gas	7800 kcal/m^3	2360 Lv/1000 m^3 Summer			
		1715 Lv/1000 m^3 Winter			
Electric power	Time	Peak	Day	Night	
	Lv/kWh	1.395	0.754	0.374	Oct-Mar
	Lv/kWh	1.217	0.655	0.322	Apr-Sep

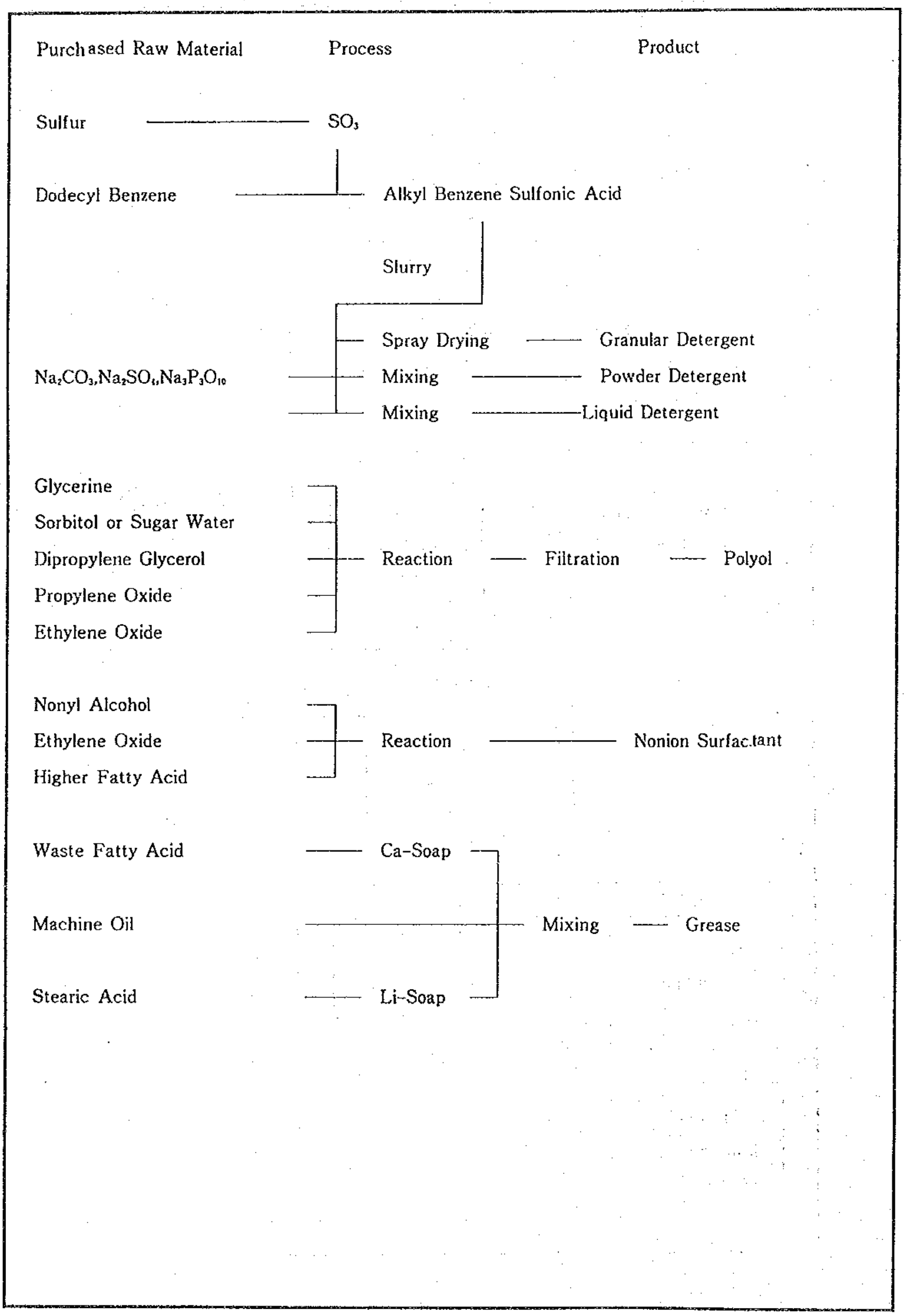
(15) Factory layout

Figure 5.1.2 Factory Layout



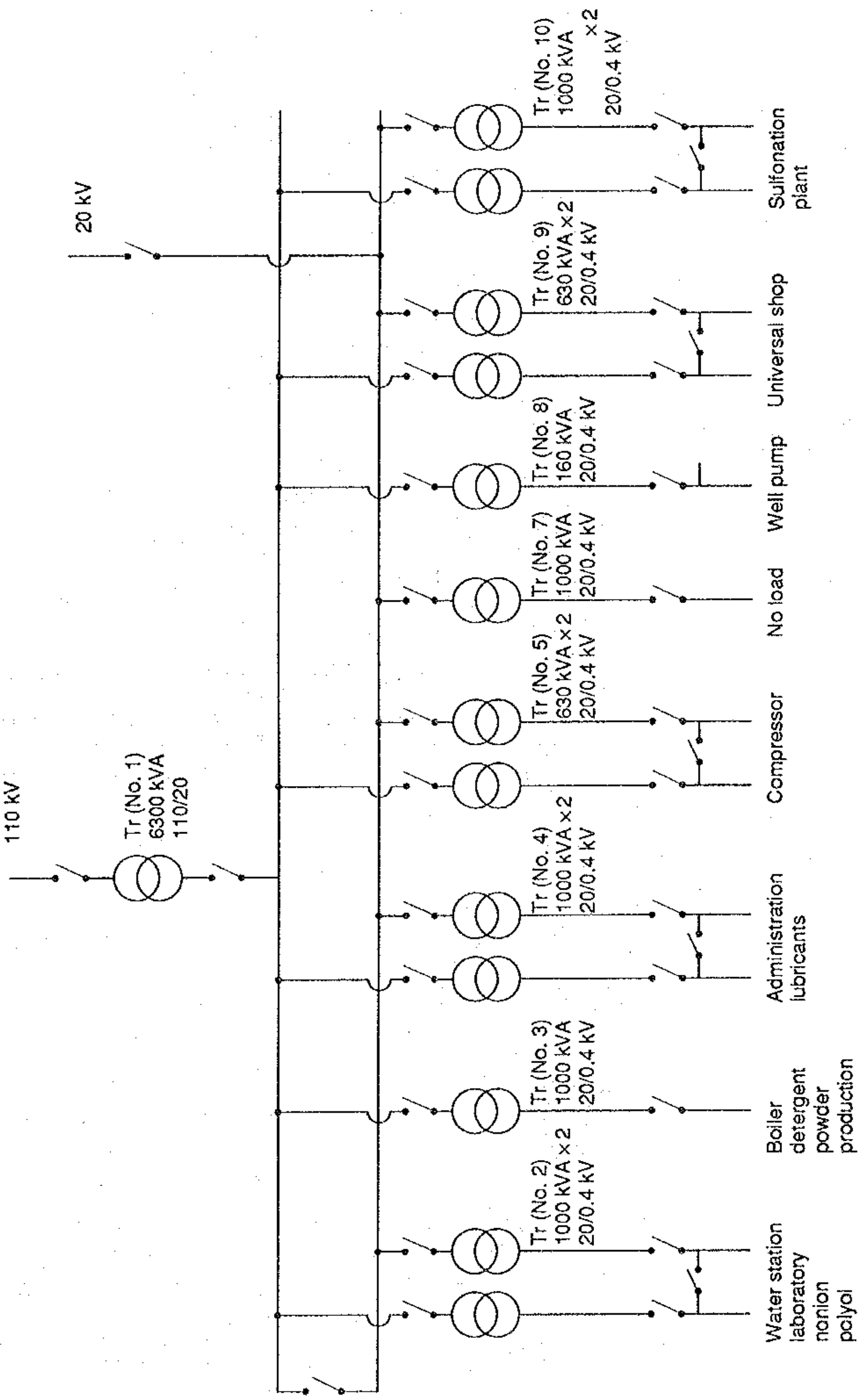
(16) Production processes

Figre 5.1.3 Production Processes



(17) Electric power one line diagram

Figre 5.1.4 Electric Power One Line Diagram



(18) Outline of principal equipment

Table 5.1.5 Outline of Principal Equipment

Name	Number	Specification	
Alkyl Benzene Sulfonate	1	Sodium Salt Paste (100 %) 1,500 kg/h	
Granular Detergent	1	Slurry (40 ~ 50 % H_2O) 5,00 ~ 7,000 kg/h	
Powder Detergent	1	Mixer	
Liquid Detergent	1	Mixer Plastic Bottle Extruder	
Polyol	1	18,000 t/year, 60 t/day Polyoxyethylating Reactor	 30 $m^3 \times 1$
Nonion Surfactant	1	6,000 t/y Polymerizing Reactor Sulfonating Reactor Neutralizing Reactor	 5 m^3 5 m^3 3 m^3
Grease	2	14,000 t/y Ca Contactor Li Contactor Heating Media Heater	 4.5 m^3 5.3 m^3 800,000 kcal/h
Boiler	4	Flue smoke tube boiler	6 bar, 12 t/h

5.1.2 Situation of energy management

The Verila factory has been making efforts to take energy conservation measures such as conversion of fuel from heavy oil to natural gas, trial introduction of the steam trap, electric power control during the peak hours, and setting up of the thermal study group. However, systematic energy conservation campaign involving all the employees has not been initiated yet.

Energy is used directly or indirectly in various sectors of the factory. Energy conservation potential can be present in all the sectors.

Energy consumption efficiency differs according to the performance of the equipment and machinery and operation methods, which depend greatly on the skills and actions of the personnel in charge of operation and maintenance.

Adequate maintenance and service must be taken to ensure design performance of the equipment, and minor modification should be made to provide improved performances. It is necessary not only to try to conform to operation standards but also to make improvement efforts to find out better operation methods.

This is related to all the members engaged in the work. To achieve an effective promotion of the energy conservation, it is essential to establish an organization to ensure that all the people of the factory make concerted efforts to achieve the purpose, as well as to take measures for the equipment improvement.

(1) Setting the target for energy conservation

To initiate energy conservation, the top management of the company must define the energy conservation as one of major management targets, demonstrating serious attitude and enthusiasm for energy conservation to the employees. This will convince the employees that making efforts for energy conservation will conform to the policy of the company, and will motivate them for positive efforts.

When policy is shown by the top management, mere abstract instruction for energy conservation is not sufficient; concrete target values and the deadline for the accomplishment of the goal must be shown to the employees. In response to these instructions, each section of the factory should set up some concrete targets for individual items which can be taken charge of within the scope of the responsibility, so that the overall target can be achieved. Only after the target has been set, concrete action plans to achieve the target can be worked out, including study of various approaches, preparation of the programs and assignment of the works.

However, setting the target requires correct information on the current energy consumption in the factory. In the Verila factory, watt-hour meters are installed for respective substations, but measuring instruments for purchased natural gas are not installed in the plant. Information is provided by the gas company twice a month, and the gas consumption is not placed under daily control. The volume of the steam generated by use of natural gas is not known due to lack of feed water flow meter; there is no steam meter in each process. Without correct information on the consumption of energy in each process, it is impossible to compare it with design conditions to evaluate the consumption and to set up the quantitative target value; even if energy conservation measures are taken, the effects cannot be confirmed. The top priority should be given to procurement of meters and measuring instruments.

(2) Systematic actions

The Verila factory has some staff members who are in charge of thermal energy, but there is no action taken for systematic energy conservation activity in which all the factory employees take part.

To implement the energy conservation campaign with concerted efforts of all the members, it will be effective to establish a committee comprising representatives of the management division, production division and auxiliary division, so that interaction can be provided between the processes particularly among the production-related divisions. This committee will work out the energy conservation program, determine the budget, approve the technical energy conservation measures, evaluate the results, and introduce various cases. This will ensure uniform understanding to be shared among different divisions, permitting the activity to be made on a priority basis. This will also make it possible to check if a particular action has a total effect including the effect given to the preceding and succeeding processes. It will also permit advice to be given from different angles. To ensure implementation of the items determined at the meeting of this committee, the meeting should be chaired by the chief factory manager or a person having an equivalent authority.

It is also necessary to hold various events in order to keep the employees interested in the energy conservation activity, or appoint coordinators to make arrangements among different related divisions, in order to ensure smooth implementation of the energy conservation activity.

The employees who work in the front line using energy consuming equipment are faced with some problems in thier everyday work. An effective use of energy cannot be achieved if the equipment are not used effectively and work standards are not observed, no matter how excellent they are. So it is effective to keep the employees in the front line interested in the energy conservation activity so that they will eagerly take part in the activity.

(3) Data-based management

In energy conservation activities, as in the quality control, steady improvement can be gained by repeating the PDCA circle where an improvement plan is worked out (Plan) and implemented (Do), the results are evaluated (Check), the work process is modified or fixed (Action) in accordance with the evaluated results; then an improvement plan on a higher level is worked out. Thus the control level is gradually increased, repeating the same cycle.

The problems accompanying energy consumption to be studied in working out the improvement plan and suggestions for improvements can be made clear only through an objective analysis of the data gained in the factory. The effects of the energy conservation efforts can be confirmed by means of statistical techniques such as unit consumption rate control chart, histogram and correlation analysis on the basis of the actual data. If there is abnormal data, a lot of information can be gained by checking the cause for it. So the energy measuring instruments must be equipped for each major process, and the consumption data on a periodic basis must be recorded so that it can be compared with the production situation.

It is important that the result of the evaluation is made public on a periodic basis so that the result of the efforts can be known to all employees. This will bring up rivalry in a good sense in the factory.

It is also important to award official commendation to job sites having achieved a good result or to effective proposals, thereby encouraging their further efforts.

(4) Education and training of employees

It is necessary to give sufficient information in order to promote voluntary activities of the employees. To motivate efforts for energy conservation, the employees should be informed of the trend of energy prices, the proportion of the energy cost in the production cost, possible causes for energy losses, preventive measures, and cases of successful energy conservation efforts in other factories. It is also necessary to promote education and training of the employees by giving instructions through competent staff members, by giving training courses, and by providing them with manuals; thereby increasing their level.

(5) Equipment management

If the equipment is not maintained in proper conditions, a great energy loss will occur. Steam leakages and insufficient or missing heat insulation works were found out in many places of this plant. Repairs for heat insulation and similar faults, which can be done at any time, should be done whenever required. To repair the steam leakages, which require suspension of steam supply, the faulty positions should be marked and noted on the record, and should be repaired on a periodic basis.

Steam leakage causes the wear to be accelerated by the steam force featuring the speed higher than that of acoustic velocity, resulting in an increased leakage. At the same time, steam causes the insulating materials to fall down. Much of the steam leakage in this plant is said to have been caused by freezing during the winter in the preceding year. Since it was left for one year, much energy has been lost.

Drawings are essential for the maintenance of the equipment. Revised drawings must be prepared immediately after any modification work has been made, and they must be put in order so that they can be easily used by anyone. Drawings are kept for each process in this plant, but are not placed in a systematic order. They were general drawings of equipment suppliers, and some of them were not suited to the actual condition of the factory.

5.1.3 Problems in the use of energy and countermeasures

(1) Production process

A) Sodium alkyl benzene sulfonate

This process was not operating when we visited for the present study.

This equipment, manufactured by Ballestra S. P. Milan, Italy, was installed in 1992 to replace the old equipment. It is designed in a continuous operation system, and has a production capacity of 1,500 kg/h, with the paste of sodium alkyl benzene sulfonate (100 %). It is composed of the following processes:

a) Drying air by silica gel
b) Production of sulfur trioxide by oxidation of sulfur with air
c) Production of alkylbenzene sulfonic acid by sulfonation of alkylbenzene (dodecyl benzene used as alkylbenzene)
d) Production of sodium alkyl benzene sulfonate by neutralization with caustic soda

Sodium alkyl benzene sulfonate is stored in a tank and is used as a synthetic detergent material in powder and liquid. Part of it is also sold on the market.
For use of thermal energy, heat produced in oxidation of sulfur is used for regeneration of the silica gel for air drying, and for steam generation; it is designed in a rationalized process.

B) Granular synthetic detergent

This equipment was operating at that time and measurement was conducted.

Manufactured by Mario Ballestra, it has been working since 1974. Operation is controlled in principle in the control room. However, the high pressure pump for the material slurry, nozzles, measuring instruments for additive supply system, and many other parts are operated manually. It is designed in a continuous system, comprising the following processes:

a) Generation of slurry drying hot air by natural gas combustion
b) Adjustment of slurry with additives added to sodium alkyl benzene sulfonate, and its pressurization
c) Production of granules by counterflow heat exchange between slurry sprayed into the drying tower and hot air
d) Grading of granules, addition of components and product packaging
e) Dust collection by cyclone dust collector and gas exhaust

The equipment has a production capacity of 5,000 to 6,000 kg/h in terms of synthetic detergent slurry (50 %).

This process consumes the greatest volume of thermal energy second to the boiler in this factory.

C) Powder synthetic detergent

This equipment has been operating since 1964, and is designed as a batch system.

Powdered components and liquid components such as sodium alkyl benzene sulfonate paste are mixed by means of a mixer, and are pulverized and packaged.

This process is at the normal temperature, without any problem related to thermal energy.

D) Liquid synthetic detergent

This equipment, designed as a batch system, has been working since 1964.

Powdered components and liquid components such as sodium alkyl benzene sulfonate paste are mixed by means of a mixer, and are pulverized and packed in plastic vessels.

This process is at the normal temperature, without any problem related to thermal energy. However, a considerable amount of cooling water is used for the molding machine for plastic vessels, and hot water is discharged from the machine. At present it is difficult to use the heat of this hot water, and this gives a heavy load to the waste water treatment facilities. The water is not contaminated and is preferred to be used in circulation.

As for the quality of product samples, the range of water contents and grain size distribution is slightly greater than that of the Japanese-made products, but this does not present any performance problem. In Japan, however, there is a trend of using less phosphor, and a great amount of zeolite has come to be used as the builder.

E) Polyol

This equipment was not working at the time of our visit.

It was manufactured by Pressindustria Engineering and Plants-S.P.A., Biassono Milan, Italy, and was installed in 1986. Operation is controlled in principle in the control room.

Designed as a batch system, it has the following processes:

a) Dewatering of glycerine
b) Polymerization by dewatered glycerine, sorbitol or sugar, and ethylene oxide or propylene oxide
c) Neutralization and filtering
d) Nitrogen replacement system
e) Vacuum system

Polyol is stored in a tank and is shipped as a polyurethane material. The main reactor has a capacity of $30m^3$, with an annual production capacity of 18,000 tons.

Regarding the use of thermal energy, the initial stage of reaction requires heating up to the temperature of 120 °C by heating medium. However, reaction is exothermic, and water cooling is made during the reaction. So there is no particular problem.

However, damages were observed on the heat insulation materials of the vessel and piping of the outdoor equipment, which need repair. To ensure work safety as well as energy conservation, unnecessary pipes must be trimmed or removed.

The quality of the product samples is almost the same as that of the Japanese products.

F) Nonion surfactant

This equipment was not working when we visited.

It is an equipment designed as a batch system, and had an annual production capacity of 6,000 tons. Designed as a manually operated system, it has the following processes:

a) Dewatering of higher alcohol
b) Polymerization by dewatered alcohol and ethylene oxide
c) Sulfation of polymerized ether alcohol by chlorosulfonic acid

d) Neutralization by caustic soda
e) Nitrogen replacement system
f) Vacuum system
g) Heating medium system

Nonion surfactants are stored in tanks and used as materials for synthetic detergents. They are also shipped to the market. This process is also used to produce brake oils.

There are two 5 m^3 reactors and one 3 m^3 reactor. Other small-capacity vessels and various pipes are installed. It is designed as a process to permit small quantity production of multiple product types, such as industrial auxiliaries.

Regarding the use of thermal energy, the initial stage of reaction requires heating up to the temperature of 120 °C by heating medium. However, reaction is exothermic, and water cooling is made during the reaction. So there is no particular problem.

However, damages were observed on the heat insulation materials of the vessel and piping of the equipment, which need repair. To ensure work safety as well as energy conservation, unnecessary pipes must be trimmed or removed.

The quality of the product samples is almost the same as that of the Japanese products.

G) Grease

This equipment, installed in 1980, is designed as a manually operated batch system. Two types of grease are available; calcium grease for low temperature and lithium grease for high temperature. The equipment is composed of the following processes:

a) Production of Ca-soap by saponification of the spent fatty acid (heated by steam at the temperature of 100 °C)
   Production of Li-soap by saponification of stearic acid (heated by thermal catalyst at the temperature of 200 °C)
b) Mixture with mineral oil and cooling
c) Packing into cans
d) Heating medium system

A series of 4.5 m^3 capacity reactors for calcium soap and a series of 5.3 m^3 capacity reactors for lithium soap are installed. The average production capacity is 7.5 tons per batch and 14,000 tons per year.

Regarding the use of thermal energy, the saponification stage of reaction requires heating. However, heat is effectively used to improve the efficiency of mixing with mineral oil. So there is no particular problem.

However, the oil discharged from the process gives a heavy load to the waste water treatment facilities.

The quality of the product samples is almost the same as that of the Japanese products.

H) Waste water treatment facilities for production process

Water supply is provided by underground water fed at the rate of 6,000 tons a day. Of this water, the waste water discharged as BOD load from the production process is about 2,000 tons per day. This waste water is mixed with coolant used for the molding machine for liquid detergent vessels and air compressor, and is collected in the treatment facilities through the embedded pipe. After it has been subjected to comprehensive treatment, it is fed by the pump to the sewage treatment center located in the city of Sofia. In this treatment facilities, it is subjected to the oil-water separation process, coagulating sedimentation process, and sand filtering process. The contaminated water and non-contaminated water are treated at the same time, resulting in reduced concentration of the contaminated matters.

However, the current treated water quality is much worse than that specified in water quality standards of the city, and much money is levied (500,000 Leva per month). This cost is likely to increase in future.

The future task is to get correct information on quality and quantity of waste water for each process, and to take actions to ensure optimization of the drain pipe route, and circulation of warm waste water by use of the cooling tower.

Concrete programs were once worked out and put into practice, but the works were suspended. This seems to be related to financial issues, but is a very important problem in cost reduction efforts in the overall plant. Though it will require a huge investment, improvement plans are expected to be worked out and implemented on the basis of adequate analysis of the current situation.

The current treatment method fails to meet the Japanese drain water standards. Not only biological treatment but also tertiary treatment are required. Assuming the tightening of the regulations in future, the important task is to find out effective combinations of unit operations, including oil-water separation, coagulating sedimentation, biological treatment, effective use of warm waste water and tertiary treatment.