Japan International Cooperation Agency (JICA)
The Republic of Poland
Ministry of Economy
Polish National Energy Conservation Agency (KAPE)

THE MASTER PLAN FOR ENERGY CONSERVATION IN THE REPUBLIC OF POLAND

FINAL REPORT

Summary

June 1999

The Energy Conservation Center, Japan (ECCJ)
The Institute of Energy Economics, Japan (IEEJ)

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SUMMARY

Contents

List of Tables

List of Figures

[Definition of Terms]

1. Excellent factory:

"Excellent factory" refers to a factory in Japan or other industrialized country of a similar size and in the same industrial sector as each subject factory of this study, and having an energy intensity better than average.

2. Energy price:

For the prices of coal, coke, natural gas and electricity in the table "Summary of Energy Conservation Potential" for each factory, the estimated average prices in the period 1998 to 2005 have been utilized, which are as shown below:

Coal : 0.170 PLN/kg
Coke : 0.400 PLN/kg
Natural gas: 0.514 PLN/m^3N
Electricity : 0.172 PLN/kWh

3. Breakdown of Energy Conservation Potential for Each Factory in Graphs:

(1) Step Zero:
Energy conservation measures in this step have already been implemented or are currently under planning, and are not included in the data on the previous year.

(2) Step 1: The effort is primarily aimed at the enhancement of operation, maintenance and management; energy conservation measures at this phase include installation of measuring instruments and other such minor measures, which require only a small amount of investment.

(3) Step 2: Energy conservation measures through improvements to equipment or such means, which do not require a large amount of investment

(4) Step 3: Energy conservation measures through process improvement, etc., which require a large amount of investment

(5) Others: Items which could not be quantified during the factory surveys, which are presumed to be principally affected by availability (shutdown time, downtime due to faults, maintenance time) and such factors.

(6) External: External factors such as differences in energy intensity attributable to radiation heat loss due to differences in temperatures or in manufacturing processes

(7) Space heating: Energy required for space heating in plant buildings; this level of heating may not be needed in factories in Japan or other industrial countries that are located in warm climates.

4. Investment Amount and Payback Period

The investment amount is the equipment cost or construction cost in Japan converted on a basis of 1PLN = 30 yen.

The investment payback period is based on a simple payback method, i.e., [investment amount/ annual benefit]

[Abbreviations]

JICA	Japan International Cooperation Agency
KAPE	Polish National Energy Conservation Agency
NAPE	National Energy Conservation Agency
RAPE	Regional Energy Conservation Agencies
ARP	The Industrial Development Agency
NFEP & MW	The National Fund for Environmental Protection and Water Management
BOS	The Environmental Protection Bank
ECTC	Energy Conservation Technology Center
GUS	The Central Statistical Office
MTOE	Million Ton Oil Equivalent
MJ	Mega Joule
PJ	Peta Joule
TJ	Tera Joule
S.L.B.	Silica Lime Block
ENEX	Energy Conservation Exhibition
ESCO	Energy Service Company
E.C.Scenario	Energy Conservation Scenario
A.E.C. Scenario	Accelerated Energy Conservation Scenario
REF.	Reference Scenario
HOPP	Human Oriented Program for Production
OJT	On the JOB Training

1. OBJECTIVE, RESPONSIBLE ORGANIZATION AND SCOPE OF THE STUDY

1. OBJECTIVE, RESPONSIBLE ORGANIZATIONS AND SCOPE OF THE STUDY

1.1 Objective of the Study

The objective of the study is to survey the current situation of energy consumption in Poland and recommend appropriate policies for the promotion of energy conservation based on the said survey results so as to help facilitate KAPE's planning and formulation of "Master Plan EC-2001 for Energy Conservation".

1.2 Organizations Responsible for the Implementation of the Study

1.2.1 Polish Counterparts

(1) Counterparts

The steering committee comprised of the Ministry of Economy, Ministry of Finance (since 1998), Ministry of Environmental Protection, and Ministry of Physical Planning and Construction, and Polish Energy Conservation Agency, KAPE S.A.

a. Steering committee

(1997)
Chairman
1) Mr. Wielslaw Pawliotti: Advisor to Minister, Ministry of Economy

Committee members
2) Mr. Wojciech Jaworski : Director of Department of Air and Land Protection, Ministry of Environmental Protection, Natural Resources and Forestry
3) Mr. Andrzej Pogorzelski: Department of Architecture and Building Policy, Ministry of Physical Planning and Construction
4) Mr. Jozef Pawelec : Department of Communal Policy, Ministry of Physical Planning and Construction
5) Dr. Krzystof Zmijewski : President, The National Energy Conservation Agency (KAPE)

(Since 1998)
Chairman
1) Dr. Krzystof Zmijewski: President, The National Energy Conservation Agency (KAPE)

Committee members
2) Ms. Teresa Kubacka : Department of National Economy Finance, Ministry of Finance
3) Mr. Jozef Pawelec : Central Office of Housing and Town Development

4) Dr. Wieslaw Pawliotti : Department of Energy and Environment, Ministry of Economy
5) Dr. Andrzej Pogorzelski: Ministry of Internal Affairs and Administration
6) Mr. Jan Sikora : Department of National Economy Finance, Ministry of Finance

Steering committee meetings were held on:
March 18, 1997 (1st meeting)
March 10, 1998 (2nd meeting)
October 30, 1998 (3rd meeting).

b. Polish National Energy Conservation Agency (KAPE S.A.)
1) Dr. Krzystof Zmijewski: President
2) Dr. Ludomir Duda: Vice President
3) Dr. Roman Babut: Director of International Cooperation Division
4) Mr. Ryszard Wnuk: JICA Project Manager
5) Mr. Dariusz Koc: Manager of the Energy Audit Secretary

(2) Local consultants

The following local consultants offered their cooperation in the implementation of simplified and detailed factory energy audits.

(In simplified factory audits)
a. Research Center of Warsaw University of Technology
1) Dr. Krzysztof Wojdyga : Heat management
2) Mr. Maciey Chorzelski : Heat management
3) Dr. Wieslaw Szadkowski: Heat management
4) Dr. Leszek Krycki : Electricity management
5) Mr. Wrobel Waldemar : Electricity management
6) Mr. Staniseaw Kozinski : Electricity management

b. POLESCO Investment SA
1) Dr. Tadeusz Kruczek: Heat management
2) Dr. Krzysztof Wilk : Heat management
3) Dr. Wieslaw Goc : Electricity management
4) Dr. Marcin Szega : Heat management
5) Dr. Joachim Bargiel : Electricity management

c. Baltic Energy Conservation Agency
1) Dr. Edmund Wach : Heat management
2) Dr. Andrzej Szajner: Heat management
3) Dr. Pawel Bucko : Electricity management

(In detailed factory energy audit)

a. Research Center of Warsaw University of Technology
   1) Dr. Krzysztof Wojdyga : Heat management
   2) Mr. Maciey Chorzelski : Heat management
   3) Dr. Krzyszof Duszczyk : Electricity management
   4) Dr. Pawel Skowronski : Heat management
   5) Dr. Jozef Lastowiecki : Electricity management
   6) Dr. Tomas Wisnniewski : Heat management
   7) Dr. Wieslaw Szadkowski: Heat management
   8) Dr. Tadeusz Kruczek : Heat management
   9) Dr. Krzysztof Wilk : Heat management
   10) Dr. Joachim Bargiel : Electricity management
   11) Mr. Piotr Szewczyk : Heat management

1.2.2 Japanese Organizations Responsible for the Study

(1) Study team

The study was implemented by the joint venture of The Energy Conservation Center, Japan (Representative) and The Institute of Energy Economics, Japan (IEEJ).

a.	Dr. Yozo Takemura	: Leader
b.	Mr. Toru Kimura	: Sub leader, energy conservation policy
c.	Ms.Yukie Kawaguchi	: Energy conservation policy (domestic tasks only)
d.	Dr. Hisao Kibune	: Energy planning
e.	Mr. Shigeaki Kato	: Energy planning
f.	Mr. Zhang Ji Wei	: Energy planning
g.	Mr. Norio Fukushima	: Leader in factory energy audit, energy management technology (Heat)
h.	Mr. Jiro Konishi	: Energy management technology (Heat)
i.	Mr. Kazuo Usui	: Energy management technology (Electricity)
j.	Mr. Toshio Sugimoto	: Energy management technology (Electricity)
k.	Mr. Seiichiro Maruyama	: Process management technology (Iron and steel industry)
l.	Mr. Masashi Miyake	: Process management technology (Chemicals)
m.	Mr. Sadao Nozawa	: Process management technology (Machinery)
n.	Mr. Masami Kato	: Process management technology (Non-metallic materials)
o.	Mr. Shiro Honda	: Process management technology (Food processing)
p.	Mr. Tetsuo Oshima	: Measuring engineering
q.	Mr. Kiyotaka Nagai	: Measuring engineering
r.	Mr. Akihiro Koyamada	: Measuring engineering
s.	Ms. Ayako Sato	: Coordination

(2) Advisory committee

An advisory committee composed of specialists in Polish economy and representatives from Japanese industrial circles was organized to offer assistance in formulating policies for the study and making recommendations.

Chairman

a. Mr. Nobuaki Mori: President, The Energy Conservation Center, Japan (ECCJ)

Members

b.	Mr. Mitsuo Iguchi	: Former senior technical advisor, ECCJ
c.	Mr. Kazuya Fujime	: Director, The Institute of Energy Economics, Japan (IEEJ)
d.	Mr. Kenichi Matsui	: Councillor, IEEJ
e.	Mr. Ichiro Arima	: Former Secretary General, JETRO, Warsaw
f.	Mr. Noriyoshi Nagamatsu	: Chief Economist, International Development Center of Japan
g.	Mr. Hiroshi Watanabe	: Director, Central-Eastern European Department, Japan Association for Trade with Russia and Central-Eastern Europe
h.	Mr. Masatane Chiba	: Director for International Division, Japan Productivity Center for Socio-Economic Development
i.	Mr. Kiyohiko Inoue	: General Manager, Environment and Energy Department, The Japan Iron and Steel Federation
j.	Mr. Yutaka Sawada	: Director, Production Technical Group, Technical Department, Japan Chemical Industry Association
k.	Mr. Ryuichi Tokunaga	: General Manager, Planning and Administration Dept., Japan Construction Manufacturers Association

Advisory committee meetings were held on:
June 3, 1997 (1st meeting)
January 9, 1998 (2nd meeting)
November 27, 1998 (3rd meeting)

1.3 Scope of the Study

The following surveys were conducted based on "the Scope of Work" for the study agreed upon on November 26, 1996.
This study consists of two types of approaches: "Policy approach" for proposing recommendations for energy conservation measures and the action plans therefor, which is the ultimate purpose of this study; and "Technical approach" intended for supporting the "Policy approach" from the technical aspect.

1.3.1 Survey for the Policy Approach

The purpose of the policy approach is to devise a master plan for the promotion of energy conservation in the industrial field in Poland. Following are the content and the structure of the master plan.

The master plan summarizes various measures (technical measures and methods) to be implemented by industries as well as policy measures and methods to be implemented by the government, which are to be recommended to the policy decision-maker and executor (the government) so that a given goal for energy conservation can be achieved by a given point in the timeframe (including plural points in the timeframe).

In conjunction with the formulation of such master plans, the following surveys and analyses were conducted based on the data/information obtained from the relevant ministries, organs and factories in the targeted sectors (targeted industrial sectors) and through discussions with experts and a questionnaire survey of 500 factories in the selected industrial sectors.

(1) Surveying the current situation of energy supply and demand and energy policies
(2) Analyzing the current status of energy consumption in the targeted sectors: Iron and steel, chemicals, machine manufacturing and non-metallic industry, and food processing
(3) Evaluating the energy conservation measures in industrial sectors and setting up scenarios for energy conservation
(4) Evaluating the energy conservation measures for targeted sectors and equipment in terms of cost-benefit
    Targeted equipment: Lighting apparatuses, air compressor, electric motor, transformer, factory space heating (air conditioning), boiler and heating furnace
(5) Evaluating energy conservation potential for the targeted sectors and equipment
(6) Estimating the environmental improvement effect of energy conservation
(7) Formulating a master plan and action plan for energy conservation in industries

1.3.2 Surveys for Technical Approaches

(1) Estimation of energy conservation potential for each targeted factory

Factory energy audits were conducted for the targeted sectors for the purpose of estimating the energy conservation potential for each factory as follows.

a. Preliminary factory study (during the first study in Poland)

Preliminary factory surveys were conducted and thereafter the factories for which simplified and detailed factory audits would be conducted were selected upon discussion with KAPE.

b. Simplified factory audit (during the second study in Poland)

A 3-day simplified energy audit was conducted for each of the following 12 factories. The targeted factories are as follows.

Industrial sectors	Factory name	Major products
Iron and steel	Ostrowiec	Bar steel
	Labedy	Shaped steel
Chemicals	Blachownia	Coal/petroleum chemicals
	Poch	Industrial reagent
Machinery	Ursus	Tractor
	Star	Truck
Non-metallic materials	Wolomin	Glass bottles/tableware
	Silikaty	Silica block
Food processing	Olvit	Vegetable oil
	Koscian Meat	Meat
	Lubmeat	Meat
	Obrzanska	Dairy products

c. Report on the results of simplified factory audits (during the third study in Poland)

The results of the audits were reported to KAPE, consultants and factory personnel concerned based on the interim report that summarizes the results of the simplified factory audits.

d. Detailed factory audit (during the fourth study in Poland)

A 5-day detailed factory audit was conducted for each of the following five factories. The targeted factories are as follows.

Industrial sectors	Factory name	Major products
Iron and steel	Lacznikow	Cast products
Chemicals	Boruta	Dyestuff
Machinery	Ursus	Tractors
Non-metallic materials	Wolomin	Glass
Food processing	Mlecz	Powdered milk

Additionally, after completion of the factory audits, specialists on process management technology stayed at the factory for 2 or 3 days to hold in-depth discussions and thereby evaluate energy conservation measures with factory personnel concerned and consultants.

(2) Preparing a measurement manual for energy audits

A measurement manual was prepared to conduct energy audits for the targeted sectors and equipment.

(3) Preparing a guideline for energy conservation

A guideline for each targeted sector and equipment was prepared.

(4) Measuring equipment

Measuring instruments owned by The Energy Conservation Center, Japan were used for simplified factory audits.
The measuring instruments procured by the JICA team shown in Table 1.1 were used for detailed audits.

Table 1.1 Equipment List

Type of measuring equipment	Equipment name	Quantity
1. Pressure gauge	Pressure gauge (bourdon tube) 0-1.0 MPa	1
	Pressure gauge (bourdon tube) 0-2.0 MPa	1
	Pressure gauge (bourdon tube) 0-3.5 MPa	1
	Pressure gauge (bourdon tube) 0-5.0 MPa	1
	Low pressure difference indicator	1
	Pressure transmitter	2
2. Thermometers	Glass thermometer	4
	Thermo-hygrometer	5
	Thermocouple (type-K, 1 m)	6
	Thermocouple (type-K, 2 m)	2
	Compensating leads (type-K)	6
	Thermocouple (type-R, 2 m)	3
	Compensating leads (type-R)	3
	Surface thermometer	1
	Radiation thermometer (Low temperature)	1
	Radiation thermometer (High temperature)	1
	Suction pyrometer	1
	Infrared thermovideo	1
3. Flowmeters	Portable ultrasonic flowmeter	1
	Vortex flowmeter	3
	Hot-wire anemometer	1

Type of measuring equipment	Equipment name	Quantity
4. Water quality analysis	Conductivity meter	1
	PH meter	1
5. Gas analysis	Sampling gas pre-treatment unit	1
	Portable oxygen analyzer (continuous type)	2
	Portable oxygen analyzer (spot type)	2
6. Steam trap	Steam trap checker	1
7. Electric power measurement	Low-voltage detector	2
	Tester	2
	Clamp-on power meter	3
	Clamp-on AC power meter	1
	Transducer	1
	3p-4w 1000 W 110 V/5A	
	AC current transducer (5 A AC)	1
	AC voltage transducer (110 V AC)	1
	Reactive power transducer (3p-3w 100 V/5 A	1
	Transducer	1
	3p-3w 1000 W 110 V/5 A	
8. Tachometer	Contactless tachometer	1
9. Illuminance meter	Portable lux meter	1
10. Recorder	Recorder with memory function	

(5) Technology transfer

Technologies related to factory auditing were transferred to KAPE and local consultants. Before implementing energy audits for each factory, methods of using measuring equipment, energy conservation measures for each sector and key points in factory audits were explained through lectures. Thus, factory auditing was implemented, while technology transfer was also conducted through OJT (on-the job training). This technology transfer has enabled KAPE and the local consultants to improve their factory auditing ability to such a level as to conduct auditing by themselves.

1.3.3 Seminars

On March 11, 1998 during the third study in Poland, we held a seminar at the Mariot Hotel in Warsaw City mainly regarding the content of the interim report, in which about 120 persons from not merely governmental organs, including the Ministry of Economy and the Ministry of Finance, but also those from universities, consultants, factory personnel, etc. participated. Also, at the request of the counterpart, a demonstration on measuring equipment was given at Warsaw University of Technology on October 17, 1998 during the fourth study in Poland. About 60 professors and students took part in the demonstration.

1.3.4 Training for Counterparts

Training was provided in Japan to the Polish counterparts, while discussions were held with them about the scope of this study and the content of the report. Meanwhile, the current promotion status of energy conservation and the policies were introduced to them through lectures and observation tours of factories, thereby assisting them in building further understanding of such matters.

The first training

Period : March 31 to April 29, 1998

Trainees: Dr. Ludomir Duda, Vice President, KAPE
Dr. Roman Babut, General Manager,
Director of International Cooperation Division, KAPE

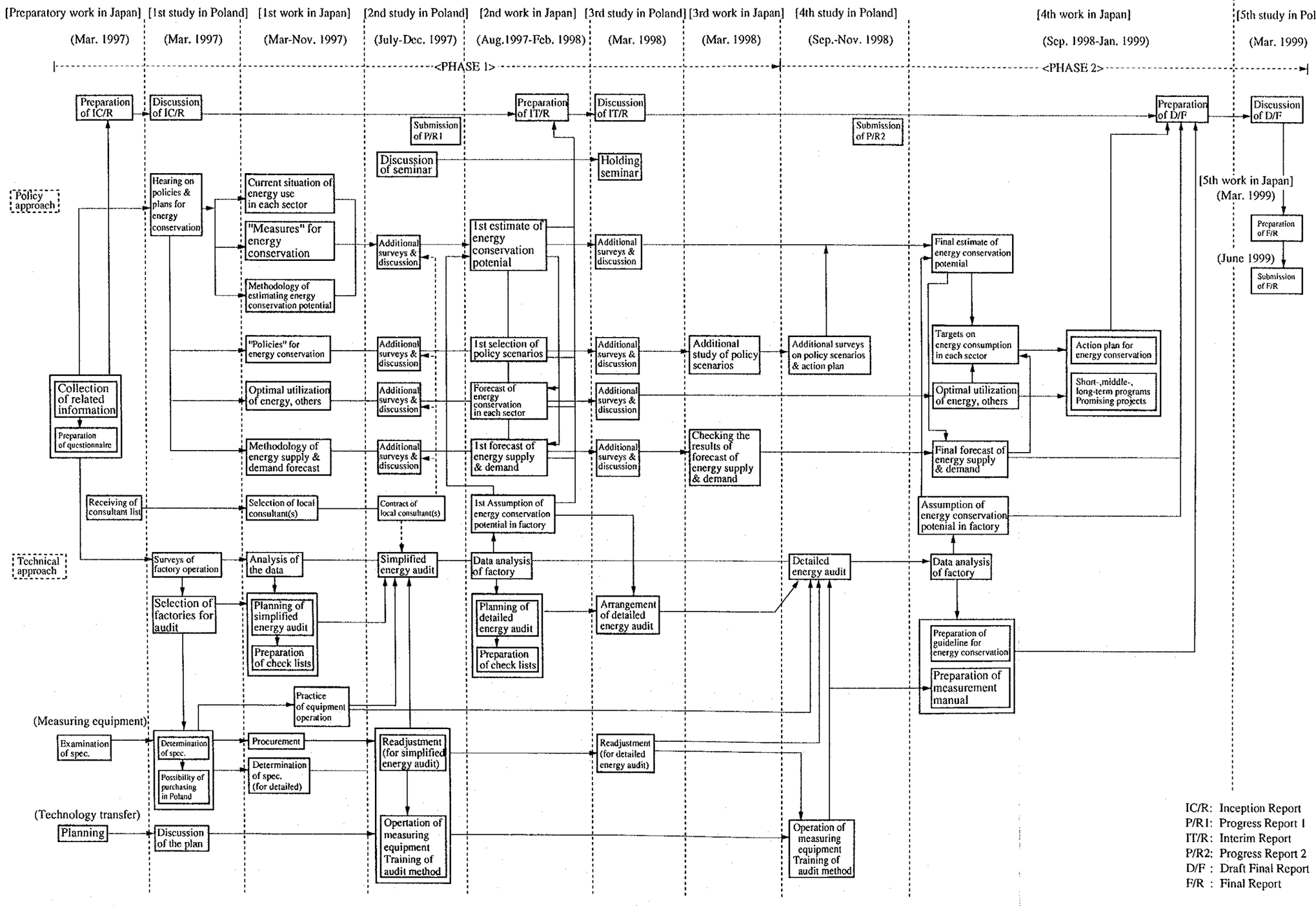
The second training

Period : November 1 to 26, 1998

Trainees: Mr. Pawliotti Wieslaw
Head, Division of Energy Efficiency and Environment, Department of Energy and Environment, Ministry of Economy

The overview of the study is schematically represented in Figure 1.1.

Figure 1.1 Overview of the Study



2. ENERGY DEMAND AND ENERGY CONSERVATION POLICIES IN POLAND

2. ENERGY DEMAND AND ENERGY CONSERVATION POLICIES IN POLAND

2.1 Energy Supply-and-Demand Trends

The Polish economy, which began the process of transition to a market system in 1989, recorded minus growth in 1990 and 1991, but moved back into the plus zone from 1992. Recently, it registered real growth rates of 6.1 % in 1996 and 7.0 % in 1997.

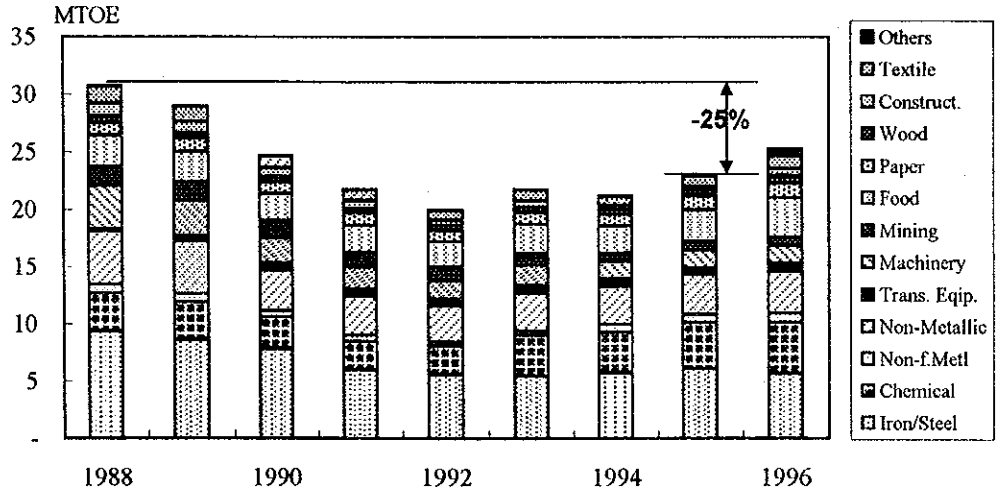
Final energy consumption in Poland has been growing slowly since hitting a low of 66.2MTOE (equivalent to 1 million tons of oil: 2,780PJ) in 1994.

Trends of Final Energy Consumption (Unit: MTOE)

	1985	1990	1991	1992	1993	1994	1995
Total	83.2	69.3	67.5	67.4	66.4	66.2	66.9
Industry	33.7	24.7	21.8	20.0	21.8	21.2	23.0

Meanwhile, the industrial field accounted for 34 % of the total Polish energy consumption in 1995. Polish industry's energy consumption, after hitting bottom in 1992, has been growing at a slightly faster pace than that of the country as a whole. Energy consumption by Polish industry recorded an all-time high in 1986, and still had not recovered that level even as of 1995 (see Figure 2.1).

Figure 2.1 Breakdown of Energy Consumption Trends by Industrial Sector



The reason why the recent energy consumption level of Polish industry is still below that of the late 1980s lies in sluggish production by material production industries, such as iron & steel, ammonia, fertilizer, and cement, as well as certain machinery industries, including tractors, and mining industries involving coal in particular. As a result, the proportion of energy-intensive industries in total Polish industrial production has declined.

This situation indicates that there is a possibility of a resumption of strong growth in high-level energy consumption by industry as a whole triggered by a recovery in production by the material production sector. Moreover, considering the fact that Poland will become a member of the EU in the near future, it is regarded as a pressing issue for the country to examine industrial energy conservation policies as soon as possible, and to move into the implementation stage.

2.2 Energy Policy

2.2.1 Development of an Energy Conservation Policy

(1) Relationship between energy conservation policy and economic & other policies

Poland's energy conservation policy is clearly an important issue to be handled within the framework of the country's overall economic policy.

According to the "Energy Policy Guideline for Poland until 2010", an important official document relating to the country's energy policy, the Polish government's basic stance is contained in the three points listed below. These points are expected to be major factors affecting the scope, nature and orientation of the country's future energy policy and strategy.

a. The economy shifting from centralized state control to a market economy system.
b. Abolishment of providing subsidies to companies from the state's fiscal resources.
c. Promotion of privatization of companies

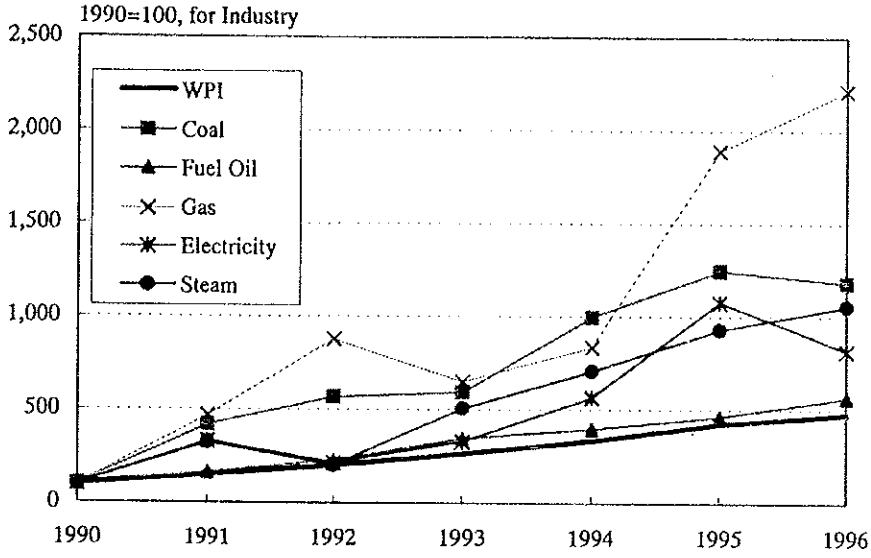
In addition, the above-mentioned document stresses the point that international pledges made by the government of Poland will exert a major effect on the formation of the country's energy policy.

(2) Development of policies related to energy conservation

The Polish government has taken the following measures since 1989, which have made a direct or indirect contribution to the promotion of energy conservation.

a. Energy price hike

Figure 2.2 Trends of Domestic Energy Prices for Industry



b. Modernization and streamlining measures for facilities and management
c. Environmental protection measures
d. Enactment of "Energy Law" and stipulations related to energy conservation promotion
e. Establishment of organizations responsible for promoting energy conservation and the promotion of international cooperation (KAPE)

3. ANALYSIS OF ENERGY CONSUMPTION BY INDUSTRIES AND EQUIPMENT SURVEYED

3. ANALYSIS OF ENERGY CONSUMPTION BY INDUSTRIES AND EQUIPMENT SURVEYED

3.1 Estimation of Energy Consumption by Industries and Equipment Surveyed

3.1.1 Energy Consumption in Industries Surveyed

The subjects of the study hereunder are one industrial sector (iron and steel making industry) and eight sub-sectors shown below (ammonia, truck, tractor, glass, silica lime block, vegetabe oil products, meat products, and dairy products).
(Note: the word "sector" as used herein refers to major industrial divisions (iron & steel making, chemicals, machinery, non-metallic materials, and food processing), as defined in the "Minutes of Meeting" on the "Scope of Work" of this study related to "Master Plan for Energy Conservation in The Republic of Poland"; smaller industrial divisions contained within these are referred to as "sub-sectors".)

(1) Iron and steel making industry

(2) Chemical industry

   a. Ammonia

(3) Machine manufacturing industry

   a. Truck
   b. Tractor

(4) Non-metallic materials industry

   a. Glass
   b. Silica lime block (S.L.B.)

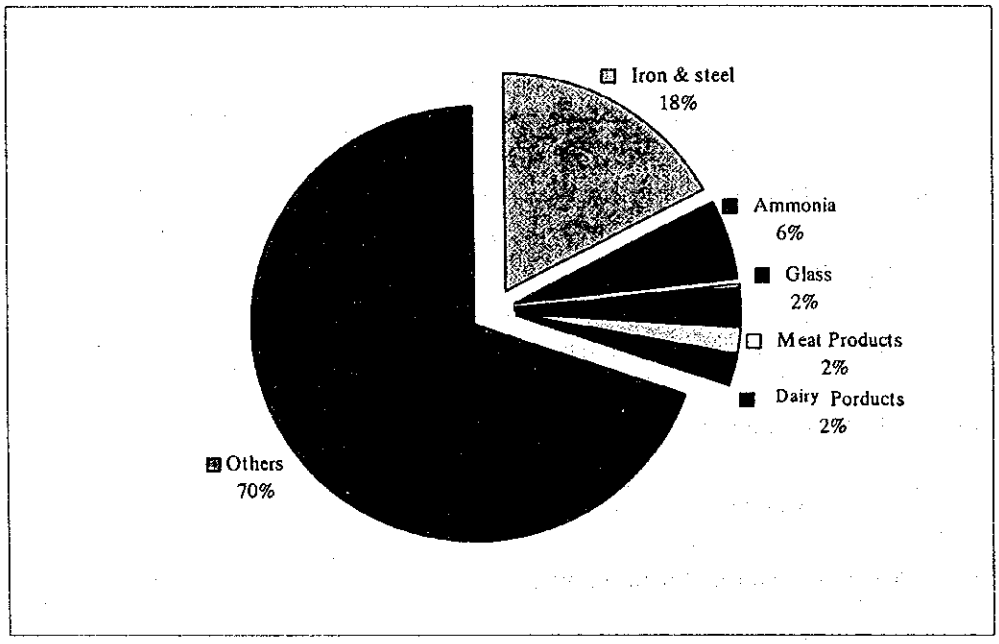
(5) Food processing industry

   a. Vegetable oil
   b. Meat products
   c. Dairy products

In principle, the industries thus selected for "policy survey" are those to which factories where energy audits were carried out belong. This is because energy conservation potential and the environmental effect need to be estimated, which are prerequisites for "policy survey". With regard to the chemical industry, however, those factories that were originally selected as the subjects of auditing are in the sub-sectors of coal-derived chemicals, industrial chemicals, and dyestuff. As these sub-sectors account for an extremely small proportion of the energy consumption of the whole chemical sector, we determined that they would not be suitable targets for a 'policy survey', and therefore included in the survey only the most energy-intensive sub-sector in the chemical sector, i.e., the ammonia manufacturing industry.

These industrial sector and sub-sectors together account for approximately 30 % of the total energy consumption by the manufacturing industries in Poland. Among these industries, the iron and steel making industry accounts for the largest proportion (18 %), followed by the ammonia manufacturing sub-sector (6 %). In contrast, the percentage of each of trucks, tractors, silicate lime block (S.L.B.) and vegetable oil products is smaller than 1 %.

Figure 3.1 Share of Energy Consumption of Targeted Sectors in Manufacturing Industries



3.1.2 Overview of Industries

(1) Iron and steel making industry

In Poland, approximately 11 million tons of crude steel is produced a year. The percentages of production by production method are as follows:

- Converter steel : 6,755,800 t
- Electric furnace steel: 2,554,000 t
- Open hearth steel : 1,121,000 t
- Total : 10,433,000 t

Converter steel is produced at two major steel mills: Katowice and Sendzimira. As shown above, it accounts for about 2/3 of the entire amount of crude steel produced. There are seven factories producing crude steel with the electrical furnace, while seven factories are equipped with an open-hearth furnace.

Additionally, there are a significant number of factories that are engaged in simply machining of steel but the precise number of them is unavailable. For reference, the number of iron and steel making companies whose statistics are contained in Energy Statistics for the year 1997 is 27.

Since 1993, restructuring is in progress in the iron and steel making industry and the following items are currently being implemented:

(1) Installation of the continuous casting facility
(2) Conversion of the open-hearth furnace into the converter or electric furnace
(3) Reduction of workers, etc.

For example, the "continuous casting rate" increased from 9 % in 1990 to 38 % in 1996, and to 49 % in 1997.

Although investment by foreign companies had been a small-scale one for Lucchini (by Italian companies), two major companies, i.e., Katowice and Sendzimira described above, are negotiating with companies in UK, Austria, and Holland regarding acceptance of investment from these companies.

(2) Ammonia

In Poland, there are five factories manufacturing ammonia from natural gas. They are manufacturing all of ammonia consumed in Poland. The production volume was 2.25 million tons plus in 1997 and has levelled off at nearly the same level since 1995.

As with the iron and steel making industry, the ammonia manufacturing industry (as a segment of the fertilizer industry) is proceeding with the modernization and restructuring plan for the target year, 2005, as a sub-sector of the chemical sector. This plan—"Great Chemical Synthesis"—is aimed at reducing energy consumption by 30 % on an average. On the other hand, there is no foreign company which is expected to invest in ammonia manufacture.

(3) Trucks

There are about 15 truck companies in Poland, among which, two companies have an integrated production system for the processes ranging from engine manufacturing to vehicle assembling. One is STAR for which factory auditing was conducted, and the other is JELCZ, both of which are under the ZASADA group which is a newly emerging enterprise in Poland.

Some other companies are manufacturing engines in their own factories, but many are knock-down factories that procure parts domestically or from overseas.

In 1997, 57,300 trucks were produced, of which approximately 5,000 trucks are presumably produced by the above-mentioned two companies that employ the integrated production system, while the rest (52,300 trucks) are supposed to be manufactured by the other companies.

Foreign companies have already entered the knock-down segment. According to an expert in the Ministry of Economy, these companies are expected to increase local procurement of parts in Poland, thus gradually increasing the rate of domestic production.

(4) Tractors

As with trucks, there are about 15 tractor (for agricultural use) manufacturing companies, among which only URSUS, a state-owned enterprise, is manufacturing tractors in the integrated production system

In 1997, 22,800 tractors were produced, and URSUS manufactured 14,500 tractors, which account for more than a half of all tractors produced. However, the number of tractors produced by URSUS is showing a downward trend from 16,518 tractors in 1995 and 16,717 tractors in 1996. While the entire production in Poland is maintaining about the same level, the share of URSUS has been declining. (It is expected that production volume by URSUS in 1998 will be approximately 11,000 tractors.)

The factors behind such figures include the delay in shifting this company to a private company and the concurrent delay in overall rationalization.

Meanwhile, foreign companies have already entered the knock-down production, predicting the future domestic/overseas market in spite of the sluggish tractor market.

(5) Glass

In Poland, many types of glass products are produced. They are categorized into a) sheet glass, b) bottle glass and c) tableware/lighting appliances. The production volume in 1997 is as follows:

- Sheet glass : 426,000 t
- Bottle glass : 873,000 t
- Glass for tableware and lighting appliances: 122,000 t
- Total : 14,221,000 t

There are eight sheet glass manufacturing companies. Among two major companies—HSO Sandomierz and HSO Szczakowa—the latter has already installed a float type melting furnance on the state-of-the-art technology of Pilkington in UK. Recently, Saint Govin in France has established the branch factory in Poland and entered plate glass production.

There are 14 bottle glass manufacturing companies. The largest company, HSO Jaroslow, has a 31 % market share. The top three companies, i.e., the above-mentioned company and two other companies, HS Ujscie and Wielkopolska HS, both of which have an approximately 10 % market share, govern more than a half of the market.

There are 14 tableware/lighting glass manufacturing companies. When this field is broken down into sub-fields such as crystal glass, a world-class company, "Krosno" Glassworks SA (crystal glass) is contained in the sub-field. There are one or two major companies in each sub-field, which take a leading position in the respective professional section.

(6) Silica Lime Block (S.L.B.)

Production of the S.L.B. used as the material for walls and floors of buildings has reduced from 429 million blocks in 1995 to 379 million blocks in 1997 due to the recent unfavorable situation such as recent stagnating residence construction business in particular and the relative growth of the competitive product.

There are about 24 major companies that are manufacturing the S.L.B. They are all Polish corporations running 34 factories. Reflecting the market environment described above, no investment is currently made by foreign companies.

(7) Vegetable oil

This industry producing vegetable oil for cooking (i.e. oil and margarine) include about 15 factories, of which 8 factories manufacture final products. The four of these 8 companies are major companies, which occupy approximately 80 % of the entire production volume of final products. Three of these factories are owned by foreign companies.

The other seven or eight companies do not manufacture the final products but are simply engaged in extracting raw oil from the material.

The flow from the material to the final products shows that eight companies manufacturing the said final products can further be divided into two groups. The first one of these groups makes raw oil by processing the material and finishes the raw oil to the products. The other group purchases raw oil domestically or from overseas and finishes it to the products. Although information on the volume purchased from domestic suppliers by the latter is unknown, the raw oil imported is estimated to be about 1/3 of the total raw oil volume processed.

In recent years, production of vegetable oil is increasing, amounting to 602,000 t in 1997.

(8) Meat processing

This sub-sector includes the butchery of cattle, pigs, chickesn, etc., their raw meat processing and the processes making them up to ham, bacon, sausage, etc.

These meat products sold to ultimate consumers in 1997 amounted to 1,241,000 t, among which beef and poke accounted for the largest proportion (1,086,000 t). Recently, however, the growth of chicken is notable.

It is presumed that 5,000 to 6,000 factories are involved in manufacturing the beef and poke-processed products in Poland. Among them, products supplied by three major companies—ANIMEX, Sokolow, and Farm Food—seem to be governing an approximately 20 % market share. Additionally, two state-owned companies—Lukuw and Bialystok—belong to the major companies.

400 to 500 factories are said to be engaged in chicken processing. Factories under four enterprise groups, i.e., ANIMEX described above plus DROBIMEX, DROSET, and INDYKPOL, have an approximately 35 % share of the market.

In addition to grouping by Poland companies, an increasing number of foreign companies are making their way into this market.

(9) Dairy products

This sub-sector includes about 300 companies as of the end of 1996. It is presumed that 260 companies are cooperative associations with about 700 factories, while about 40 of these companies are private enterprises. In addition to these factories producing milk, powder milk, butter, cheese, etc., there are seven major companies which are mainly producing ice cream.

Compared with the other two sub-sectors in the food processing sector, investment by foreign companies and consolidaiton by major domestic companies seems relatively less active. It should be noted, however, that companies in Germany, France, Holland, Denmark, etc. have entered the market.

3.1.3 Estimation of Energy Consumption

Estimation of energy consumption and energy intensity (E.I.) of each industry is based on the factory audit results, questionnaire, and statistics documents. Table 3.1 shows the results.

Table 3.1 Energy Consumption and Energy Intensity in Targeted Industries

Name of industries	Production (1000t/y or 1000pcs/y)	Energy consumption		Energy Intensity		
				Fuel	Electricity	Total
		(TJ/y)	(%)	(MJ/t or pcs)	(MJ/t or pcs)	(MJ/t or pcs)
Iron & steel	11,590	218,803	17.54	17,925	1,897	19,822
Ammonia	2,252	73,931	5.93	31,406	1,811	33,217
Trucks	58	2,002	0.16	25,150	9,830	34,980
Tractors	23	1,423	0.11	43,075	19,078	62,153
Glass	1,422	25,241	2.02	15,984	1,904	17,888
Silica Lime Block	1,496	1,256	0.10	810	30	840
Vegetable Oil	602	4,754	0.38	8,105	945	9,050
Meat Products	1,241	21,566	1.73	11,644	2,616	14,260
Dairy Products	2,615	28,256	2.27	7,880	1,260	9,140
Sub-total		377,232	30.24			
Manufacturing Total		1,247,423	100.00			

(Note) "pcs" means pieces which are used for trucks and tractors.
(Source) Central Statistical Office(GUS) ; JICA Team' estimates.

3.1.4 Estimation of Energy Consumption by Type of Targeted Equipment

As with the targeted industries, energy consumption by the targeted equipment was estimated, the result of which is shown in Table 3.2. This table lists the shares of energy intensity and consumption by each designated equipment.

Table 3.2 Energy Consumption in Seven Types of Equipment in Targeted Industries in 1997

	Steel	Ammonia	Truck	Tractor	Glass	S.L.B.	Veget.	Meat	Dairy	Total
[Share in Total(%)]										
Lighting	4.0	0.2	5.9	3.4	1.4	2.0	2.0	5.6	2.0	3.3
Compressor	4.5	9.0	10.2	19.5	29.5	11.0	9.0	3.3	10.0	7.6
Motor	24.0	20.0	29.6	44.6	49.1	7.0	15.0	54.1	24.0	28.2
Transformer	7.4	2.0	15	18.2	3.5	7.0	3.0	4.9	7.0	6.4
Total Electricity	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Heating	10.9	37.0	33.1	28.1	6.5	33.0	45.0	19.9	6.0	16.8
Boiler	17.4	50.0	66.0	42.7	15.9	93.0	70.0	94.4	85.0	32.5
Heating Furnace	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.4
Total Fuel	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
[Energy Intensity(MJ/t or pcs)]										
Lighting	76	4	581	642	26	1	19	146	25	
Compressor	86	163	1,000	3,728	562	3	85	86	126	
Motor	455	362	2,906	8,514	934	2	142	1,416	302	
Transformer	140	36	1,475	3,468	66	2	28	127	88	
Total Electricity	1,897	1,811	9,830	19,078	1,904	30	945	2,616	1,260	
Heating	1,954	11,620	8,335	12,101	1,045	267	3,647	2,318	473	
Boiler	3,115	15,703	16,599	18,373	2,541	753	5,674	10,995	6,698	
Heating Furnace	1,009	0	0	0	0	0	0	0	0	
Total Fuel	17,925	31,406	25,150	43,075	15,984	810	8,105	11,644	7,880	

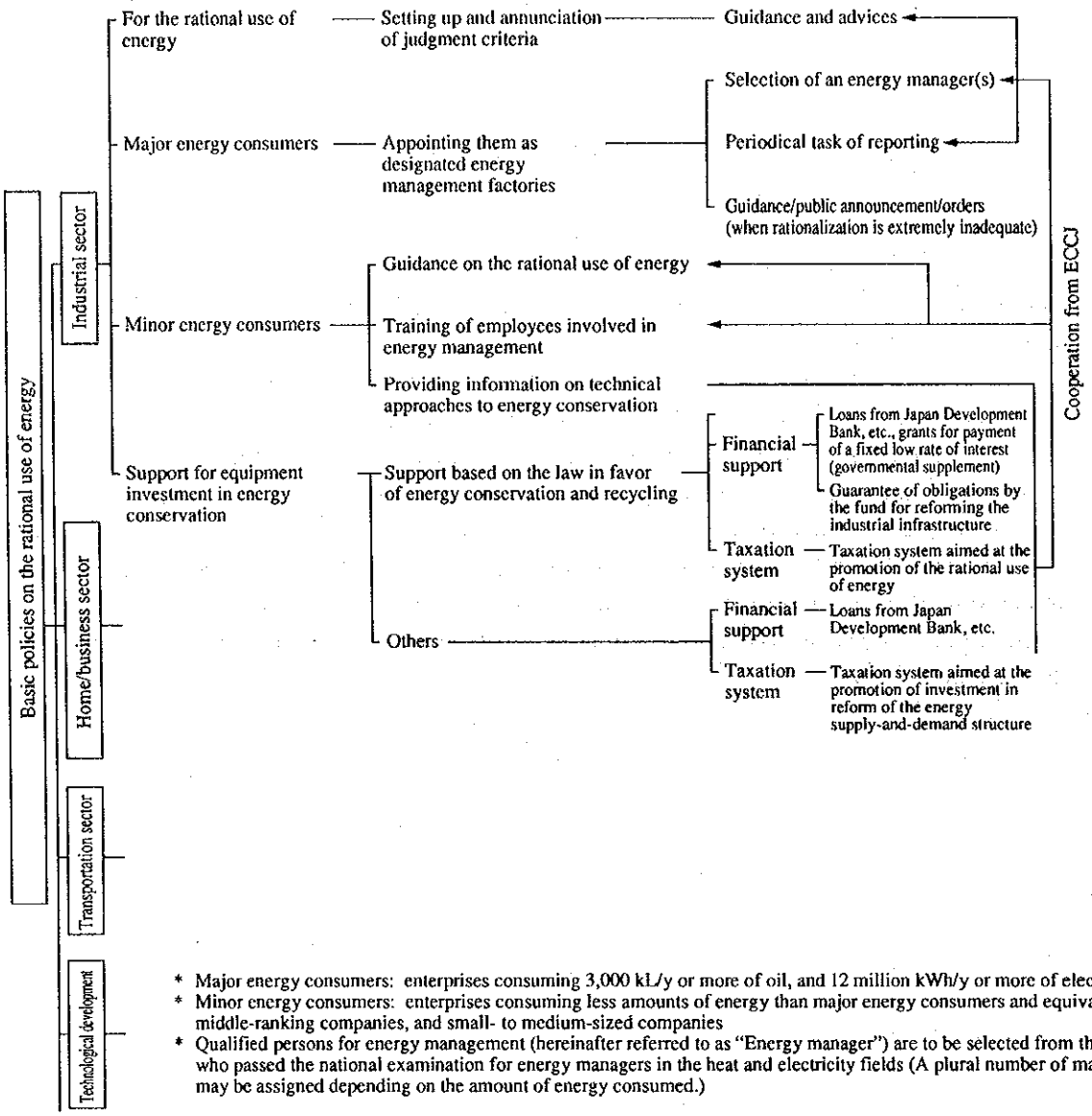
4. CONSIDERATIONS REGARDING EVALUATION OF ENERGY CONSERVATION MEASURES

4. CONSIDERATIONS REGARDING EVALUATION OF ENERGY CONSERVATION MEASURES

This project is aimed at assisting Poland in formulating "Master Plan EC-2001 for Energy Conservation" based on the related experiences in Japan from both the technical and policy aspects.

In Japan, the Energy Conservation Law took effect in 1979 in the aftermath of the first oil crisis (1973) and the second oil crisis (1979). Thereafter, The Energy Conservation Center, Japan (hereinafter referred to as ECCJ) was established under the cooperation of about 3,300 companies (supporting members of the Center) in the industrial field who contribute fund and pay annual membership fee as supporting members. Thus various activities for energy conservation have been so far implemented through the joint efforts of both the government and the private sector. The efforts have attained such a substantial effect of an about 35 % improvement in terms of energy consumption per unit of GNP compared to that during the oil crisis.
In conjunction with evaluation of energy conservation measures in Poland, it is vitally important to enhance understanding of the current situation of energy conservation measures in Japan as well as the present situation of Poland where it has not been long since it shifted to a market economy system, and where a major political and economic reform is also under way in preparation of its admission to the EU close at hand. Meanwhile due consideration should be given to the master plan based on the situation in Poland and actual results so far achieved in energy conservation.

4.1 Overview of Energy Conservation Activities under the Framework for Energy Conservation in Japan



* Major energy consumers: enterprises consuming 3,000 kL/y or more of oil, and 12 million kWh/y or more of electricity
* Minor energy consumers: enterprises consuming less amounts of energy than major energy consumers and equivalent to middle-ranking companies, and small- to medium-sized companies
* Qualified persons for energy management (hereinafter referred to as "Energy manager") are to be selected from those who passed the national examination for energy managers in the heat and electricity fields (A plural number of managers may be assigned depending on the amount of energy consumed.)

The following shows a conceptual representation of energy conservation activities carried out by the various industries within the policy framework shown above.

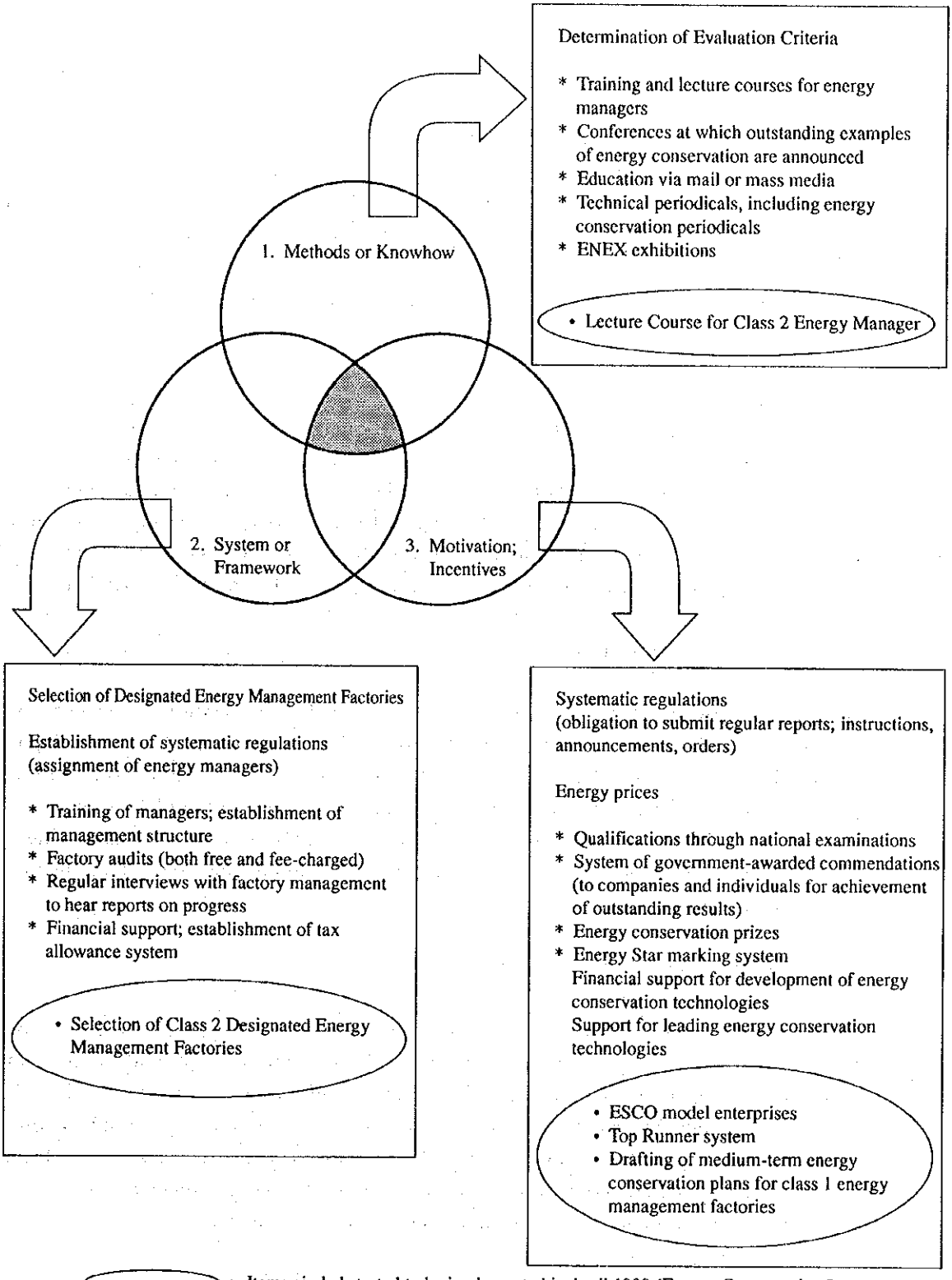
To promote energy conservation, the following should be considered:

① How can energy conservation be achieved? (knowledge regarding methods of energy conservation)

② How can significant results be achieved swiftly ? (ways or system for effectively promoting energy conservation activities)

③ What are the merits of energy conservation ? (motivation, incentives)

When these three factors are organically combined, energy conservation activities are promoted in the most active manner, thus achieving satisfactory results.



: Items circled started to be implemented in April 1999 (Energy Conservation Law amended).

* : Items marked with an asterisk are to be implemented by ECCJ either on its own initiative or at the direction of, and on behalf of, the government.

4.2 Considerations Regarding the Current Situation in Poland

(1) Positioning of an energy conservation law

Although Energy Law, which took effect in January 1999, partially contains provisions related to energy conservation, they do not seem sufficient. With its admission to the European Union near at hand, the country faces a host of important tasks to be tackled, including environmental regulations, reform of the energy situation, particularly deregulation of the electric power market, drastic restructuring of the coal industry and agricultural problems. In the view of the Polish authorities, it is likely to take at least 5 years to enforce an energy conservation law equivalent to that in Japan. For the time being, therefore, Poland will presumably need to base its energy policy on the existing Environmental Protection Law (containing the stipulations relating to energy conservation).

(2) Financial support by the government

The Polish Ministry of Economy, which is strongly in favor of the principle of free market competition, is not expected to grant much financial support for the restructuring of enterprises. Under the present circumstances, the Environmental Protection Fund, which will be mentioned later in Section 7.2.3, is regared as the only means to rely on. From such aspects as systems and organizations, however, there is every reason to expect that the ministry will provide sufficient lateral cooperation for KAPE to operate efficiently.

(3) Promotion of decentralization

New Prime Minister Buzek places first priority on decentralization. The current 48 provinces are scheduled to be integrated into 16 provinces, thus positively proceeding with further decentralization. Hence, environmental and energy conservation issues will most probably be transferred to the jurisdiction of local governments and thus in terms of implementing the foregoing matters, consideration should be given to the establishment of cooperation between the central and local governments and the necessity to divide up the tasks between them.

(4) Governmental support for the industrial sectors

The Polish industrial world will probably shift to the structure composed of three categories of enterprises, i.e., newly-emerging enterprises affiliated with foreign funds, joint venture of existing companies and overseas corporations, and wholly Polish companies. The former two groups will naturally proceed with energy conservation supported by foreign funds and technological knowhow, whereas Polish domestic industries lacks both sufficient funds and technical knowhow. It will thus be necessary to develop routes by which capital can be made available to such companies, and to train technical staff.

(5) Strengthening public institutions for the promotion of energy conservation

KAPE operating under the direct authority of the central administrative government is engaged in energy conservation tasks related to international cooperation, buildings and the industrial field; NAPE—an independent organ—is involved mainly in energy-related surveys; and RAPE (Regional Energy Conservation Agencies) are operating in regions: These three organs are individually or jointly pushing forward with energy conservation policies. However, no definite guidelines are made regarding the division of their tasks. Thus, clear demarcations between the tasks by each organ must be implemented; for KAPE, in particular, staff must be allocated in such a way as to allow KAPE to efficiently pursue the master plans under the central government, while due consideration for budgeting of the required funds and support from the system as a whole are also a prerequisite.

(6) Management concept of executives/plant supervisors

Since Polish companies for many years were all state-owned (there are still many state-owned enterprises), both managements and supervisory staff at factories lack sufficient understanding of the principles of management and supervision in a free market economy. These groups should therefore be educated in modern management methods.

(7) Energy conservation is an important management index.

During the era when enterprises were state-owned, they needed only to apply to the relevant authorities for the energy supply which they required. The state supplied to them without any conditions attached. Owing to this historical background, few Polish managers fully understand the relationship between energy consumption and the efficient operation of a business. Hence their experience of investment in energy conservation as part of a management strategy, as well as their understanding of this concept, seem to be both extremely limited.

(8) Lack of technical information

Plant managers (including energy engineers) have a considerable amount of knowledge of the equipment in their own factories, while on the other hand they are less knowledgeable about the way in which things are handled in other factories and about the situation in other countries. Thus, they do not seem to be able to assess the degree of competitiveness of their own factories. This may be partly attributable to their insufficient ability in foreign langages, particularly English, but in any event, there is clearly a pressing need for publicity and dissemination of technical information.

5. BASIC CONCEPTS OF ENERGY CONSERVATION MEASURES AND POLICIES, AND DRAWING UP OF POLICY SCENARIOS

5. BASIC CONCEPTS OF ENERGY CONSERVATION MEASURES AND POLICIES, AND DRAWING UP OF POLICY SCENARIOS

5.1 Basic Concepts of Energy Conservation Measures and Policies

Fundamentally, the promotion of energy conservation leads to lowering the costs of production in manufacturing industries and strengthening the corporate management structures. In this regard, for example, energy conservation measures recommended as a result of a factory audit should therefore independently and voluntarily be implemented by each company. However, from the standpoints of the country's energy supply-and-demand plan, its responsibility for a stable supply of energy, strengthening of the international competitiveness of one's own country's enterprises and protecting the global environment, governments must naturally give such support as will help individual corporations to promote energy conservation policies. Particularly in the case of Poland, which will soon join the EU, the government should promptly take appropriate measures in view of the huge effect in monetary terms estimated as result of energy conservation in the year 2003 (economic effect consisting of savings of 1.8~2.1 bil. PLN per annum, and an environmental protection effect consisting of a reduction in SO_2 by 160,000~200,000 t), which will be shown later in sections of energy conservation potential. Moreover, it is advisable for the Polish government to position energy conservation as an important part within its policy framework. The detatils of the government's supportive measures that will help to achieve these aims therefore constitute the basic concepts in formulating polices.

The following points regarding policies by the Polish government are believed to be of fundamental importance in view of the results of factory audits and interview with factory managers, the results of questionnaire surveys, the current energy policies and the results of an examination of energy conservation measures actually implemented by Poland.

1. Reform of company management's awareness
2. Establishment of energy management systems within each company
3. Publicity and dissemination of information regarding energy conservation policies, technologies, and equipment
4. Establishment of a system for carrying out factory audits, including self-auditing
5. Introduction of energy conservation knowhow
6. Financing support for investment in energy conservation
7. Providing of incentives to companies implementing energy conservation measures
8. Establishment of a core Energy Conservation Technical Center (ECTC)

These will be described in more detail in Section 7.2.2 "Proposal of Measures" and Section 7.2.3 "Policy Methods". Additionally, more specific policy implementation plan and measures will be shown in Section 7.3 Action Plan.

5.2 Concept of Energy Conservation Measures, and Policy Scenario Components

5.2.1 Components of a Policy Scenario

A scenario comprises the following four components or main elements.

(1) A policy mainly for the improvement of energy management
(2) An energy price policy (policy relating to ways of recovering the cost of investment in energy conservation measures)
(3) Modernization/rationalization policies (this policy is not aimed solely at promoting energy conservation, and its costs are thus not included in the calculation of the cost of implementation of investment in energy conservation measures)
(4) Economic incentives (policy for promoting ways of recovering the cost of investment in energy conservation measures)

5.2.2 Details of Two Policy Scenarios

The following two policy scenarios have been drawn up:

- The Energy Conservation Scenario (hereinafter referred to as the EC scenario)
- The Accelerated Energy Conservation Scenario (hereinafter referred to as the AEC scenario)

These two scenarios contain the above-listed four components, of which numbers (1), (2), and (3) are included in both the EC and AEC scenarios, while number (4) applies only to the AEC scenario. Each component will be explained in detail below (see Table 5.1).

(1) Policy for the improvement of energy management

<In the EC scenario>
In order for enterprises to rapidly obtain the benefits of their energy conservation effort principally through improved energy management, the government should take supportive measures for the activities listed below, from both the institutional and financial aspects.

a. Training of corporate executives and energy managers

From the standpoint of the large proportion of total production costs occupied by energy, corporate executives and energy managers should be trained to recognize the importance of energy conservation within their management strategies, and thus to set up management systems in their companies, which will allow the PDCA (Plan, Do, Check, Action) circle method to function smoothly.

b. Training of energy-related engineers and factory auditing experts

Engineers involved in energy matters, i.e. heat and electricity, should be trained so as to fully understand the most efficient methods of energy conservation and the means of promoting them. Additionally, an organ (ECTC described later) should be established so as to develop experts capable of energy auditing in their companies, and thereby allow individual companies to set up a system for the promotion of energy conservation.

c. Providing information relating to energy conservation policies, technologies, equipment, and successful cases of energy conservation

For the purpose of promoting energy conservation measures, the relevant authorities should establish the organ (ECTC), which will provide company executives and staff involved in energy matters with information on the government's energy policies and systems, energy conservation technologies and leading equipment in use both within Poland and abroad, and examples of the successful application by companies of such techniques and equipment.

d. Setting up energy conservation model factories

The government will set up energy conservation model factories for each industrial sector, and arrange for energy conservation technical and management specialists to observe the results of such model factories so that such methods will be applied to their similar line and equipment.

e. Providing incentives for the promotion of energy conservation

With the aim of providing incentives for tackling the task of energy conservation, both the government and companies themselves will award prizes, certificates and so on to companies' successful cases of energy conservation, excellent energy-saving equipment, and companies and individuals respectively who have made outstanding contributions to the promotion of energy conservation.

f. Introduction of ESCO and support for setting up of ESCO enterprises

In the United States of America, considerable growth has been achieved by enterprises involved in comprehensive energy-related work intended for energy conservation of buildings and factories, thus contributing significantly to the promotion of energy conservation movement in that country. These enterprises cover a wide range of tasks, including auditing of buildings/factories, remodeling, operation improvement, and maintenance/servicing of equipment as well as funding for the implementation of such measures. The Polish government should attract such companies to operate in Poland, to introduce similar systems, offer financial assistance for the development of wholly Polish ESCO enterprises and thus efficiently promote the adoption of energy conservation methods. The development of ESCO enterprises that can raise the fund for improving energy conservation by themselves will be a very important means of minimizing governmental financial assistance for investment in energy conservation equipment.

g. Establishment of a central Energy Conservation Technical Center (ECTC)

For the purpose of comprehensively promoting the above-listed measures, the government will establish an energy conservation promotion body.

<In the AEC scenario>
In addition to the policies described above, the Polish government will also introduce the following measures, for example, from among those already in operation in Japan, in order to still further improve the level of energy management.

a. Designation of major energy consumers

In respect of factories consuming large amounts of energy, the government will list them as such and require the respective companies, as a matter of legal obligation, to set standards for the rational use of energy, to meet the said standards, notify the authorities regarding the state of their energy utilization and assign persons qualified in energy management. Energy conservation should thus be further promoted in factories.

b. Implementation of detailed factory audits

ECTC will conduct energy audits of the same sort as implemented by JICA's team by effective use of audit experts, and will provide the support necessary for a large number of companies to speedily take appropriate energy conservation measures.

(2) Energy price policy (applicable to both the EC and AEC scenarios)

The payback period (years) for the cost of investment in energy conservation measures are their judgement criteria, based on which enterprises should promote energy conservation through improvement of devices and equipment. With regard to energy prices that most affect the pay back of the cost, the Polish government has already begun to move in the direction of the principle of noninterference; however, the government's influence in certain fields, particularly coal, still cannot be ignored.
Hence, taking the government's basic policy principles into consideration, in this survey, the following assumption has been drawn up regarding the probable trends of various energy sources (see Table 5.2).

Firstly, in line with the government's rationalization policy for the coal industry, announced in June 1998, the price of coal (coking coal and steaming coal) is likely to remain at the 1998 level for some time to come. ("Price", both here and hereunder, refers to the price in real terms). The prices of various forms of coke are also assumed to follow the same trend.

Secondly, the prices of electric power, heat, and gas are expected to be deregulated in accordance with the government's fundamental policy, and the prices of these forms of energy in the year 2000 are estimated to rise to a level close to the estimated cost of supply (the figure is estimated at 90 % of the supply cost in the case of heat and gas and at 80 % of the supply cost in the case of electricity). Moreover, these prices are supposed to reach their cost-of-supply levels by the year 2003. Oil prices are not taken into account here due to a very small level of consumption.

(3) Modernization & rationalization promotion measures (applicable to both the EC and AEC scenarios)

The Polish government is likely to maintain its current policies relating to direct investment in Poland by foreign companies and the privatization and restructuring of state-owned enterprises. As a result, steady progress should be achieved in modernization and rationalization.

(4) Providing economic incentives (included solely in the AEC scenario)

The government will grant long- or short-term financing for investment in energy conservation measures. The conditions attached to such loans in the year 2000 are 3 % interest per annum with payback in 10 years, and the 2 % interest rate with payback in 10 years in 2003.

For the purpose of choosing feasible energy conservation measures on the basis of the estimated energy prices in (2) above, "normal loan conditions" are utilized. The nominal interest rates and inflation rates have been estimated to apply in the years 2000 and 2003; for the year 2000, an annual interest rate of 10 % over 5-year period, and for 2003 a rate of 7 % over a 5-year period.

The above estimates are based on the following considerations.

Firstly, in estimating the period for "normal loan conditions", a 5-year period for repayment has been chosen on the basis of the fact that, according to our information, the majority of current commercial loans to factories for investment purposes are medium-term loans repayable over 3~5 years.

Secondly, regarding interest rates, market loan rates are currently in the 24~25 % to 27~28 % range, and the average rate is estimated to fall to around 18 % by 2000 and to around 14 % by 2003. In addition, the hike rate of producers' prices (wholesale prices) is presumed to decline to approximately 8 % by 2000 and approximately 7 % by 2003. Based on these assumptions, the real discount rate per annum has been calculated.

Furthermore, regarding long-term, low-interest loans, a repayment period of 10 years was firstly estimated on the basis of the judgement that (a) the repayment period for this type of loan should be made much longer than the market average, and that (b) the equipment depreciation period at Polish factories is between 8 and 12 years.

Finally, the interest rates on these loans were estimated at 30 % of the market rate, i.e., at 3 % in 2000 and 2 % in 2003. This is based on the fact that (c) as of 1995, the interest rates on NFEP&WM loans was set at between 30 % and 80 % of the official rate, and that (d) from 1995 to the present, the lower levels of market rates have been at almost the same level as the official discount rate.

Table 5.1 Scenarios for Promoting Energy Conservation in Targeted Sectors

Scenarios Terms	Energy Conservation Scenario (E.C.)	Accelerated Energy Conservation Scenario (A.E.C.)
Short term (1999 - 2000)	< Improved management > (1)Training of experts for self-audits (2)Nominating model factories (3)Preparing incentives for energy conserv. (4)Establishing E.C.T.C.	< Improved management > (1)Training of experts for self-audits (2)Nominating model factories (3)Preparing incentives for energy conserv. (4)Establishing E.C.T.C. (5)Designating energy intensive factories (6)Implementing large scale energy audits
	< Energy pricing > (1) Prices of coals will be maintained in the real term. (2) Prices of electricity, heat, and gas will be increased nearly to cost levels by 2000 (0.9 of costs in the cases of heat and gas and 0.8 in electricity).	< Energy pricing > Same as left
	< Modernization & rationalizations > Energy savings will be accomplished by modernization and rationalizations of factories in targeted sectors.	< Modernization & rationalizations > Same as left.
	< Economic incentives > None	< Economic incentives > Favorable loans with interest rate of 3% per annum for ten years will be made to factories. (Note) 3% is in the real term, which can be compared to the commercial rate of 10% for five years in "E.C." Scenario.
Middle term (2001 - 2003)	< Improved management > Same as above	< Improved management > Same as above
	< Energy pricing > (1) Prices of coals will be maintained in the real term. (2) Prices of electricity, heat, and gas will be increased to cost levels by 2003	< Energy pricing > Same as left.
	< Modernization & rationalizations > Same as above	< Modernization & rationalizations > Same as left.
	< Economic incentives > None	< Economic incentives > Favorable loan with the interest rate of 2% per annum for ten years will be made to factories. (Note) 2% is in the real term, which can be compared to the commercial rate of 7% for five years in "E.C." Scenario.

Table 5.2 Scenarios on Prices of Energy Carriers

	Coking coal	Coke	Steaming coal					Gas				Electricity						
			Average	Truck	Tractor	S.L.B.	Food	Average	Steel	Chemical	Glass	Average	Steel	Chemical	Truck	Tractor	Glass	Food
	(PLN/t)	(PLN/t)	(PLN/t)					(PLN/1000m^3)				(PLN/MWh)						
1998	220	400	170	160	180	170	195	470	525	415	489	140	128	125	149	161	134	165
2000	220	400	170	160	180	170	195	498	556	439	518	165	151	148	175	190	158	195
2001	220	400	170	160	180	170	195	515	576	455	537	175	160	156	185	201	167	206
2002	220	400	170	160	180	170	195	534	597	471	556	184	169	165	195	212	177	218
2003	220	400	170	160	180	170	195	553	618	488	576	195	178	174	206	224	186	230
2004	220	400	170	160	180	170	195	553	618	488	576	195	178	174	206	224	186	230
2005	220	400	170	160	180	170	195	553	618	488	576	195	178	174	206	224	186	230
2006	220	400	170	160	180	170	195	553	618	488	576	195	178	174	206	224	186	230
2007	220	400	170	160	180	170	195	553	618	488	576	195	178	174	206	224	186	230
2008	220	400	170	160	180	170	195	553	618	488	576	195	178	174	206	224	186	230
2009	220	400	170	160	180	170	195	553	618	488	576	195	178	174	206	224	186	230
2010	220	400	170	160	180	170	195	553	618	488	576	195	178	174	206	224	186	230
2011	220	400	170	160	180	170	195	553	618	488	576	195	178	174	206	224	186	230
2012	220	400	170	160	180	170	195	553	618	488	576	195	178	174	206	224	186	230

(Note) Prices are in the real term of 1998 price, which are those of energy carriers delivered to factories. Prices in 1998 are from the statistics of Energy Market Agency.