# THE STUDY ON RATIONAL USE OF ENERGY IN THE REPUBLIC OF HUNGARY

## SUMMARY

SEPTEMBER, 1992

JAPAN INTERNATIONAL COOPERATION AGENCY

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# 1. INTRODUCTION

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## 1.1 Background to the study

The East European countries, which had established their socialist systems under the influence of the Soviet Union after World War II, carried out rapid political and economic reforms after 1989. In Hungary, reforms for democratization of the country progressed rapidly after the resignation of Kadar as secretary-general of the Socialist Workers' Party of Hungary in May, and the name of the country was changed in October of the same year from the People's Republic of Hungary to the Republic of Hungary. A cabinet based on free elections was formed for the first time since 1947.

In the area of economic affairs, the country is promoting a phased switch to a market economy through abolition in principle of restrictions on the introduction of foreign capital, the opening of a stock exchange, and abolition of unnatural price systems, etc. However, burdened with large sums of foreign debts and because of the contraction of the former Soviet market, the country is meeting with various economic difficulties in the transitional process to a free economy, such as inflation, lower factory operation rates and an increase in unemployment.

Meanwhile, Hungary, which depended on import for 65% of its energy supply in 1990, is required to diversify its energy supply sources, since oil production in the former Soviet Union, which is Hungary's main supplier of oil, is declining and its oil export capacity is decreasing. In this situation, energy prices, which had been held down to low levels under the Comecon system, divorced from their market prices, are being adjusted closer to their international levels, and the prices paid by domestic users have been substantially raised.

The industrial sector accounts for 36% of the country's energy consumption. The necessity of energy conservation is stressed, as it is necessary for the country to restrain its growing demand for energy, which is rising together with increased production, and to maintain its international competitive position under rising energy costs.

The Arche Summit of 1989 and the conference of countries for assistance to Eastern Europe (G24) resolved that the advanced democracies of the West should assist East European countries in their endeavors toward democratic reform. Japan, too, promised to extend as much assistance as possible to these countries.

The present study was conducted by the Japan International Cooperation Agency (JICA) as a first step toward this end. JICA made adjustments and arrangements with the concerned Hungarian government organizations several times from 1990, and as a result, it confirmed the need of the country for energy-conservation plans. Thus, in August 1990, it sent a preliminary study team to that country and signed an agreement on the Scope of Work (S/W) concerning various procedures required for conducting the study with the Ministry of Industry and Trade and the State Authority for Energy Management and Safety .

JICA decided to commission the Energy Conservation Center (foundation) to conduct this study.

## 1.2 Purpose and scope of the study

The purpose of this study is to contribute to the efforts of the Republic of Hungary to promote and strengthen energy conservation plans for its manufacturing industries.

(a) To explore possibilities of energy conservation in model factories through improvements in technology and management

(b) To prepare materials for the promotion of energy conservation in the manufacturing industries

The scope of this study is as follows.

(1) Survey of energy conditions in the Republic of Hungary

Survey of energy demand/supply conditions in the Republic of Hungary

Survey of energy consumption conditions in the industrial sector of the Republic of Hungary

(2) Survey of activities for the promotion of energy conservation in the manufacturing sector of the Republic of Hungary

Survey of the implementation conditions of measures for energy conservation

Survey of the activities of the State Authority for Energy Management and Safety of the Republic of Hungary

a. Survey of present activities for energy conservation

b. Actual achievements of its activities in the past

c. Future plans

(3) Survey of energy consumption at model factories in different industries

Survey of energy consumption in individual factories

a. Factory profiles

b. Energy management conditions

c. Energy flowcharts

d. Conditions of energy-consuming equipment

e. Problems related to the utilization of energy and measures which can be taken without changing the present processes

f. Estimated effect that can be achieved through implementation of measures

Preparation of the reference of a technical guideline for promotion of energy conservation

(4) Proposals concerning measures for energy conservation in the Republic of Hungary

Proposals concerning measures for energy conservation in the manufacturing sector of the Republic of Hungary

Proposals concerning the activities of the State Authority for Energy Management and Safety in the area of energy conservation

## 1.3 Subjects of study — organizations and factories

A) Five factories in five industries selected by the State Authority for Energy Management and Safety

| | | |
|---|---|---|
| Dyeing factory | Budaprint SECOTEX Textilfestó Rt. | (Location: Budapest) |
| Tyre factory | TAURUS Hungarian Rubber Works | (Location: Nyíregyháza) |
| Alumina plant | HUNGALU | (Location: Almásfüzitő) |
| Cement plant | Beremendi Cement és Mészipari RT. | (Location: Beremend) |
| Iron and steel mill | DUNAFERR, Dunai Vasmú | (Location: Dunaújváros) |

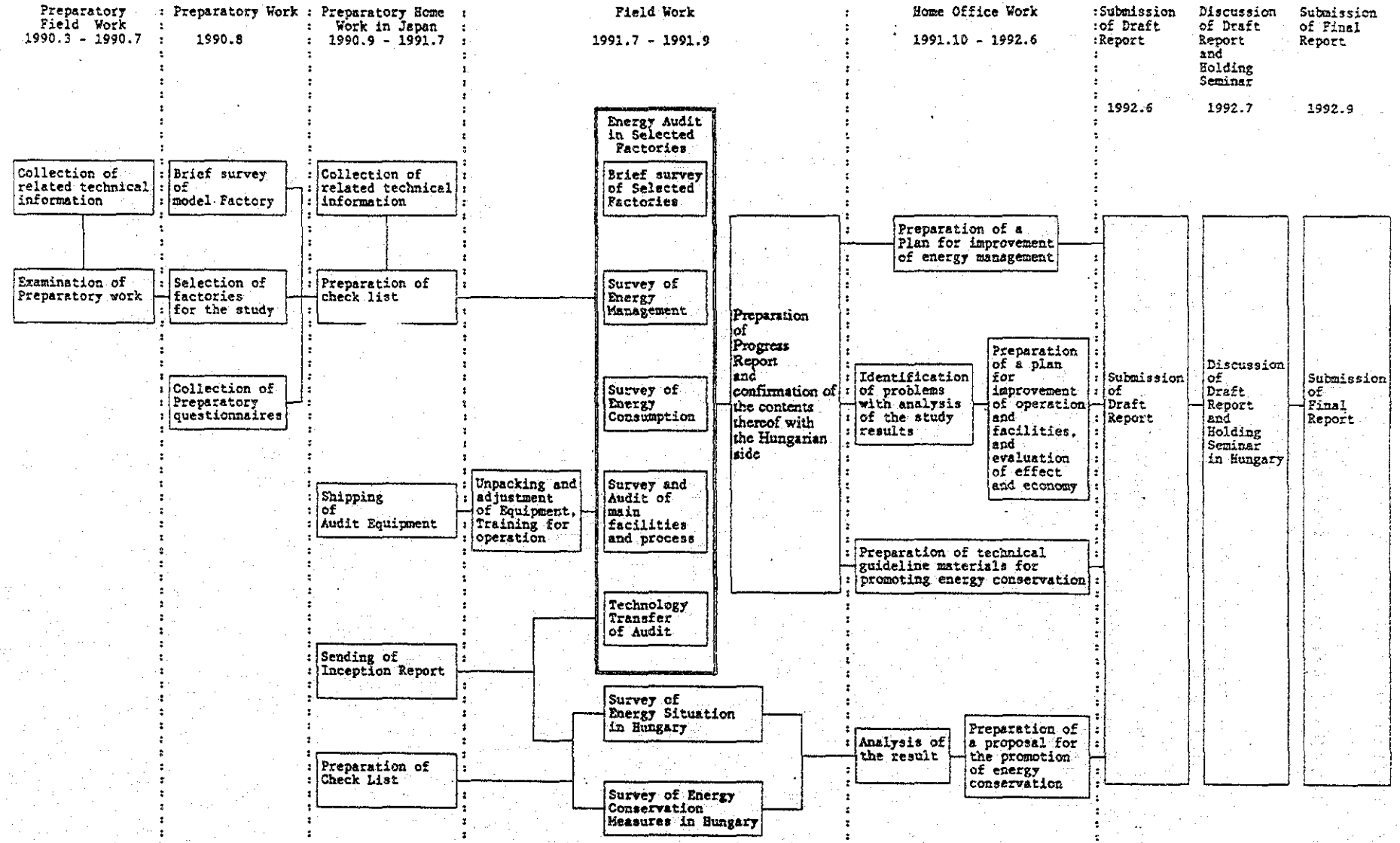
B) Energy-related organizations

Ministry of Industry and Trade
Ministry of Finance
Ministry for Environment and Regional Policy
Ministry of International Economic Relations
Central Statistical Office
State Authority for Energy Management and Safety
AEEF: Energy Efficiency Office
Hungarian Electricity Works Trust
Hungarian National Oil and Gas Trust
Institute of Electric Power Research
Hungarian Chamber of Commerce: Federation of Energy Industries Companies
EGI-Contracting/Engineering Hungary

## 1.4 Method of study

The outline of the study is shown in Fig. 1.1.

Fig. 1.1 Outline of the Study on the Rational Use of Energy
in Industry in the Republic of Hungary



(1) Field survey of factories (July - September, 1992)

a. Prior to starting the survey of factories, the study mission explained to the counterpart organizations how to use diagnosis equipment and trained them in the use of the equipment.

Furthermore, explanations were made according to a checklist to the counterparts and persons in charge of the factories selected as study subjects, concerning the study method, and requested preparations for the installation of measuring instruments and provision of necessary data and materials.

b. The survey was done separately by two teams. One team surveyed the dyeing, tyre and alumina plants where the main processes were steaming and heating, while the other team surveyed the cement and iron and steel works where high temperature heating processes were employed.

c. The number of days spent in surveying each factory was, in principle, five days.

d. Research into the outline of each factory and its energy management situation was done by interviewing the personnel concerned according to the checklist, while data and materials were gathered, data books were checked, and the factory was inspected in order to obtain information on its present state, discover its problems, and formulate its future plans.

The inspection of energy-using equipment and the survey to identify problems in the utilization of energy were carried out by making measurements with diagnosis equipment brought by the mission, examining diagrams and past data, and observing operations. The actual operation methods and performance of the factory equipment were examined and problems were identified.

In conducting the survey of factories, attention was paid to technology transfer of diagnosis and analysis procedures to the counterparts.

e. When the survey of a factory was completed, the results of measurements were made known to its managers, suggestions were made to them, and an exchange of opinions was made.

(2) Survey of the energy situation and energy conservation measures (August - September, 1991)

The energy situation, energy policy and implementation of energy conservation measures and plans were surveyed by interviewing responsible personnel in the Ministry of Industry and Trade and related organizations, and also by analyzing the data and materials obtained from them.

(3) Domestic study (September 1991 - June 1992)

a. Problems in energy management and energy utilization at the factories concerned and countermeasures

Problems in energy management will be examined regarding the system for energy conservation as a whole including energy management organization, target setting, the recording and utilization of energy consumption data, and the education of employees, referring to the methods of management which have been adopted effectively by similar factories in Japan, and also in the light of conditions in Hungary. At the same time feasible methods of improvement will be proposed.

As for problems in the utilization of energy and their solutions, measures for the improvement of energy conservation such as small scale renovation of existing equipment or addition of facilities which do not require a change in the existing processes will be studied and measures for improvement which are considered suitable to the factories concerned will be proposed.

b. Provision of data and materials for the preparation of a technical guideline for the promotion of energy conservation

Those points which require attention in energy management and energy utilization in the different industries concerned will be sorted out on the basis of the results of the inspection of the factories concerned, and main energy conservation technologies and examples of implementation of such technologies will be shown to the counterpart organizations so that they may formulate their own technical guidelines for energy conservation on their own.

c. Proposals concerning the energy conservation measures of the Republic of Hungary in the manufacturing sector and proposals concerning the activities of the State Authority for Energy Management and Safety

Measures suitable to the conditions in the Republic of Hungary will be proposed on the basis of the information obtained by the study mission and also the results of inspection of the factories concerned, and also in reference to energy conservation measures taken by the Japanese government and the governments of foreign countries.

## 1.5 Field surveys

(1) Survey of the energy situation and energy conservation measures

The survey was conducted smoothly thanks to proper arrangements made by the Ministry of Industry and Trade and the counterpart organizations, and the study mission was able to achieve its desired purpose.

(2) Inspection of factories

As the cement factory which was originally planned to be inspected by the study mission, had been forced to close temporarily due to an accidental fire, a factory of similar scale and equipment was substituted at short notice. Thanks to the enthusiastic attitude taken by the factory people, the study mission was able to do its work smoothly without any trouble.

(3) Counterparts

The counterpart members were technically proficient, and quickly acquainted themselves with the handling of the diagnosis equipment, so that they were able to do measurement work on their own. Furthermore, the work morale of the staff members was very high, and they were very cooperative.

(4) Diagnosis equipment

The diagnosis equipment operated normally. After the survey was over, the equipment was donated to the Hungarian side in the presence of the Japanese Ambassador to Hungary and the Vice Minister of Industry and Trade. Many reporters were present at the presentation ceremony and showed great interest in the mission's work.

(5) Progress report

When the field survey was over, a progress report concerning the content of the study work, identified problems and measures of improvement to be incorporated in a future report was prepared and submitted to the State Authority for Energy Management and Safety, which was signed by both sides.

(6) A list of study mission members, a list of counterparts, and the itineraries of the field survey teams are shown in attached materials (1) - (3).

# 2. SURVEY OF THE ENERGY SITUATION IN HUNGARY

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Trends in energy consumption after 1980 are shown in Table 2.1, and the supply of primary energy in Fig. 2.1. Characteristic features of the energy situation in the country emerge from these figures.

① The Hungarian economy recorded an annual average growth rate of 2.3% until 1987, but the growth rate leveled off or slipped into negative growth after 1988 under the impact of the stagnation of the economy of the former Soviet Union.

② In the meantime, energy consumption per unit of GDP improved about 10% as a result of change in the industrial structure and also of energy conservation.

③ Compared with Japan, energy consumption per head of population is lower in Hungary than in Japan, but energy consumption per unit of GNP is about seven times higher in Hungary.

④ The supply of primary energy followed a slow upward curve until 1987, corresponding to an increase in GDP, but it stayed unchanged or followed a downward curve after that, until it fell in 1990 below the level of 1980.

⑤ The percentage of solid fuels declined and that of nuclear energy grew to make up for the decline, in the composition of primary energy.

⑥ As for domestically produced energy, the production of both natural gas and coal declined after 1985. As a result, the country's dependence on imports rose from 52% to 65%. (Nuclear power is treated as imported energy.)

It is estimated that of the domestic resources, crude oil will last about 20 years and natural gas 22 years at the present rate of production. Deposits of lignite are estimated to be exhausted in 60 years. However, its quality is inferior.

⑦ Electricity consumption is growing at a high annual rate of 2.8%. Hungary depends on the former Soviet Union for about 30% of its electric power requirement.

⑧ Hungary imports a larger part of its energy from the former Soviet Union, and its one-sided energy dependence on a single country poses a problem.

⑨ The industrial sector accounts for 36% of the total final energy consumption of the country. However, the tendency is toward an increase in the percentage of consumer-related consumption.

⑩ There is a remarkable increase in the number of plastics, machinery and metal products factories, and these three industries account for about half the total number of factories, but they account for only about 10% of the country's energy consumption.

It is the iron and steel, chemical and glass industries that represent a large share of energy consumption.

⑪ According to a neutral scenario in the country's long-term energy supply-demand plan, Hungary plans to achieve an annual economic growth rate of about 3% by developing industries of low energy consumption and to hold down the annual growth of energy consumption to about 0.5%.

**Table 2.1 GDP and energy consumption in Hungary figures 1980 to 1990**

| Item | 1980 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 |
|---|---|---|---|---|---|---|---|
| Population Mil | 10.7 | 10.7 | 10.6 | 10.6 | 10.6 | 10.5 | 10.5 |
| GDP Bil Ft(1981) | 738.8 | 819.4 | 832.0 | 865.7 | 864.8 | 863.2 | 812.3 |
| GDP/Capita Ths Ft | 69.0 | 76.6 | 78.5 | 81.7 | 81.6 | 82.2 | 77.4 |
| TPE PJ | 1,260.5 | 1,323.0 | 1,318.8 | 1,356.9 | 1,336.8 | 1,316.3 | 1,244.2 |
| TPE/GDP MJ/Ft | 1,706 | 1,616 | 1,585 | 1,567 | 1,546 | 1,525 | 1,532 |
| TPE/Capita GJ | 117.8 | 123.7 | 124.4 | 128.0 | 126.1 | 125.4 | 118.5 |
| Total Elec. TWh | 31.3 | 37.6 | 38.6 | 40.4 | 40.5 | 40.7 | 39.8 |
| TEC/GDP KWh/Ft | 42.4 | 45.9 | 46.4 | 46.7 | 46.7 | 47.2 | 49.0 |
| TEC/Capita KWh | 2,925 | 3,514 | 3,642 | 3,811 | 3,821 | 3,876 | 3,790 |
| Dependence on Import | 52.2 | 54.7 | 56.7 | 57.0 | 60.4 | 61.5 | 64.9 |

Source: AEEF

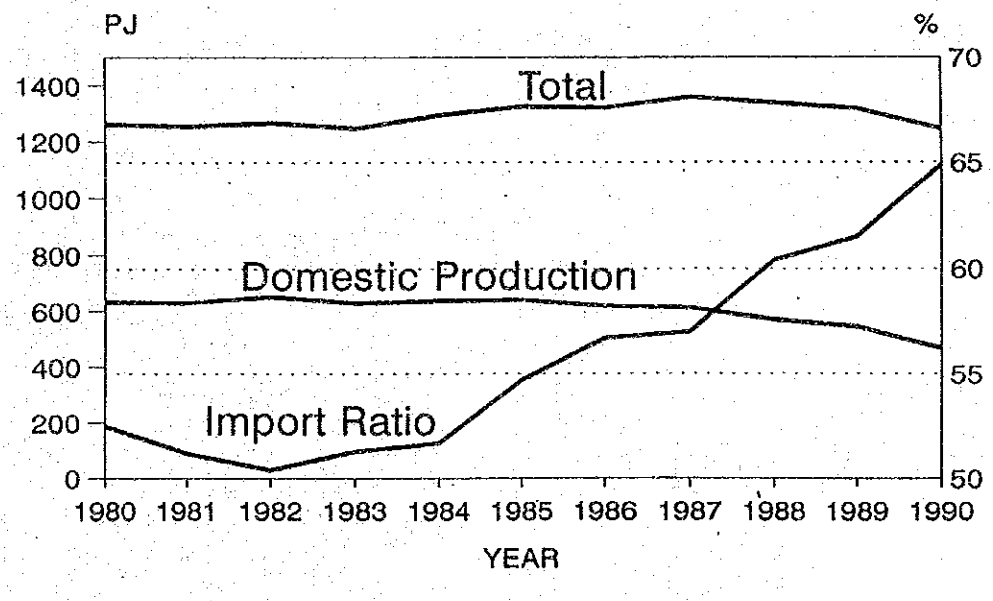



**Fig. 2.1 Total energy supply**

# 3. ACTIVITIES FOR PROMOTION OF ENERGY CONSERVATION IN THE MANUFACTURING SECTOR OF HUNGARY AND PROPOSALS CONCERNING THE MEASURES

## 3. ACTIVITIES FOR PROMOTION OF ENERGY CONSERVATION IN THE MANUFACTURING SECTOR OF HUNGARY AND PROPOSALS CONCERNING THE MEASURES

(1) Organizations promoting energy conservation

① It is the Ministry of Industry and Trade that is in charge of energy policy, and one of its four bureaus is the Energy Bureau, which consists of the Energy Supply Department, the Energy Policy Department and the Environment and Safety Department.

The energy supply sector under the control of the ministry consists of the Hungarian Electricity Trust, the Hungarian National Oil and Gas Trust and the Mining Trust, and its energy management department is the State Authority for Energy Management and Safety, which is our counterpart organization in our study.

② The State Authority for Energy Management and Safety (AEEF) was established in 1953 as a nonprofit organization under the direct control of the Ministry of Industry and Trade. All its staff members are government officials. Its personnel strength was 450 in August 1991. Its business scale is 300 million Ft (about ¥560 million), of which one-tenth is subsidized by the government.

Its activities are classified into energy management (supply-demand planning, statistics, supply-demand adjustment, restrictions on electricity supply in case of emergency), guidance to local factories (promotion of district heat supply, improvement of lighting, etc.), energy technology (diagnosis of energy conservation in factories, performance tests on boilers, etc.), and safety management related to energy. Energy efficiency work is undertaken by the Technical Office (with 35 staff members).

In addition, the Energy Efficiency Office has been established as a separate entity at the proposal of the World Bank, and is engaged in education and public information (preparation of pamphlets, holding of seminars, etc.), management of assistance funds from the World Bank and business related to international relations.

(2) Survey of implementation of energy conservation measures

① In the past, energy conservation measures were incorporated into five-year economic plans under the socialist system. Excepting some, all these measures were abolished in the course of the country's political reform. The following measures for energy conservation were actually implemented.

1) System of designation of energy-managed factories

About 4,000 state-run enterprises were designated as such, and were obligated to make reports on energy consumption to AEEF. At present, factories consuming 5,000GJ or more annually are designated as such.

2) System of energy managers

Factories consuming 10,000GJ or more annually are obligated to post energy managers.

3) Preferential system for introduction of energy conservation equipment

Hungary had a fund-financing system for investments in energy conservation equipment in factories, under which funds were supplied according to the energy conservation effect. This system was abolished in 1989.

4) Energy diagnosis of factories

AEEF has conducted an energy conservation diagnosis of about 400 enterprises in the past five years.

5) Citation system for energy conservation

The Ministry of Industry and Trade awarded prizes to individual engineers and groups of engineers according to their achievements in energy conservation.

The citation system also applied to factories that showed a shorter period of investment recovery than their plan after introducing energy conservation equipment.

6) Popularization and information activities for energy conservation in the industrial sector

The Ministry of Industry and Trade, jointly with AEEF, holds an energy conservation seminar every year for energy specialists in large enterprises as well as in small and medium enterprises.

Furthermore, the Ministry of Industry and Trade holds a meeting for persons in charge of energy management at factories twice a year to explain the energy situation and exchange information.

It also published a specialized magazine and held exhibitions devoted to energy conservation.

② Under the new system, the government decided in June 1990 on the following eight-point energy policy.

1) Improvement of energy efficiency through promotion of energy conservation and the restructuring of industry

2) Diversification of energy sources and suppliers in order to avoid excessive energy dependence on a single country

3) Introduction of the principles of a market economy and establishment of a free pricing system reflecting international prices

4) Reduction of energy cost

5) Publication of policy information and promotion of social awareness of energy

6) Establishment of new organizations in response to the introduction of a market economy and abolition of monopoly capital

7) Reduction of government interference to the minimum necessary level

8) Consideration for environmental problems

③ Although concrete energy conservation measures are being prepared mainly by the Ministry of Industry and Trade, the following basic framework is presently under consideration.

1) Tax incentives for energy conservation investment

2) Reduction of revenue tax for energy conservation equipment makers

3) Reduction of tariffs on energy conservation equipment

4) Provision of energy conservation information and education

(3) Proposals on Energy Conservation Measures in the Manufacturing Sector of Hungary

Proposals are made on the measures considered useful for the promotion of national level energy conservation in the manufacturing sector on the basis of the results of surveys on the energy supply-demand situation and the implementation of energy conservation measures in the manufacturing sector.

1) Proposals on energy conservation measures in the manufacturing sector of Hungary

2) Proposals on the energy conservation activities of AEEF

These proposals are outlined in Table 3.1. Table 3.2 and Table 3.3.

## Table 3.1 Proposals concerning energy conservation measures in the manufacturing sector of Hungary

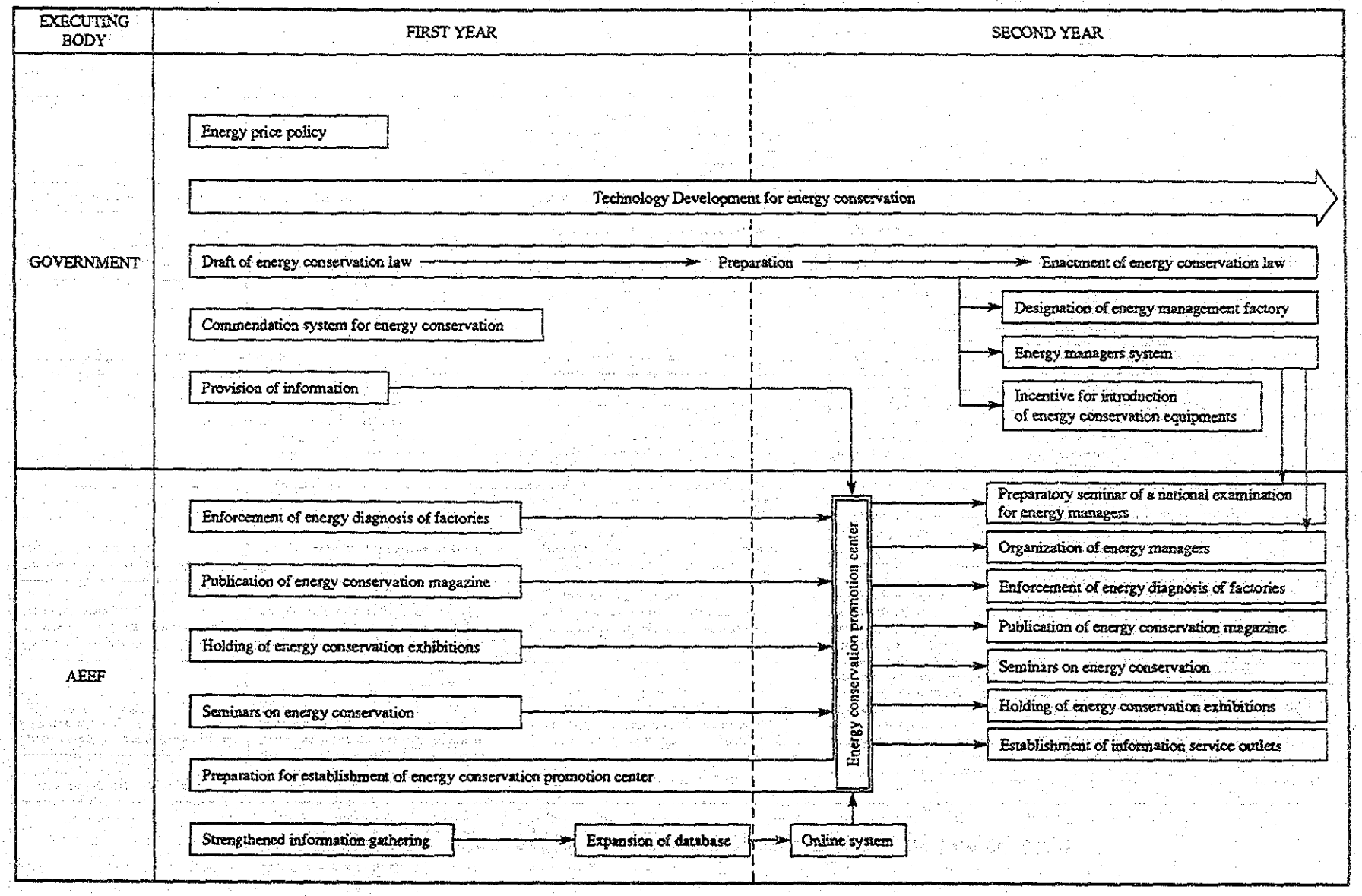
| Itemized energy conservation measures | Present state | Problems and analysis | Proposals | Priority order |
|---|---|---|---|---|
| Energy pricing policy | The government is taking measures to adjust the domestic prices of energy to international levels as one of the basic points of its energy policy. | This policy may lead to a lowering of the competitive position of enterprises but is effective for the promotion of energy conservation. | It is desirable to decide on an energy pricing policy in an integrated way in consideration of the country's industrial, trade and price policies. Basically, however, energy pricing should be based on the principles of a market economy. | A |
| Energy conservation law | None at present | In order to promote energy conservation, there is a need for a law on which various energy conservation measures can be based. | To formulate an energy conservation law in order to implement measures aimed at various social sections smoothly | A |
| System of designation of energy-managed factories | Factories consuming 5,000GJ annually are designated as energy-managed factories, and at present, 1,400 factories are designated as such. | It is necessary to obtain accurate information on trends in energy consumption by large-lot users. | To incorporate this system in the proposed energy conservation law, to review the past categories of energy consumption volume and designate energy-managed factories so that they may cover 80% or more of energy consumption, in order to obtain accurate information on energy consumption conditions and lead them to develop energy conservation activities | B |
| System of energy managers | Factories consuming 10,000GJ or more of energy annually are obligated to have energy managers corresponding in number to the level of energy consumption. | The qualification of an energy manager should be a socially authoritative one. At present, this qualification is not linked to the system of designation of energy-managed factories. | The qualification of an energy manager should be made a national license system in order to ensure the social position of energy managers and should be incorporated in the proposed energy conservation law. | B |
| Preferential measures for introduction of energy conservation equipment and method of selection of such equipment | The preferential loan system which assisted factories in improving their energy conservation equipment according to its energy conservation effect, was abolished in 1989. At present, the Ministry of Industry and Trade is studying various subsidy systems. | Enterprises are suffering from a shortage of funds for investment in energy conservation equipment, so some kind of government assistance is needed. | All the assistance measures now under consideration are considered to be effective. Such measures should be incorporated in the proposed energy conservation law as measures for energy conservation, and public information activities should be undertaken to increase the utilization rate of such assistance measures. | B |
| Citation system for energy conservation | There was a citation system with an annual budget of 50 million Ft under which individual factory engineers or groups of engineers were commended. This system was abolished. | Such a citation system is effective for motivating factory managers and engineers to be interested in energy conservation. | If the government or a government-subsidized organization once a year regularly commends factory engineers who have made successful efforts in energy conservation and cases of excellent energy conservation and energy conservation equipment, such a commendation system will serve to heighten the interest of factory employees in energy conservation. | C |
| Development of energy conservation technology | Technology development activities are being promoted by technical development organizations under the control of the State Technical Development Committee and other individual institutes. | It is necessary to develop technologies meeting the actual conditions of Hungarian enterprises. | While it is desirable that technical development for energy conservation should be undertaken by private enterprises, public organizations should undertake development projects which are risky and require large sums of funds. Furthermore, government assistance is needed for risky technical development and demonstration work by private enterprises. | B |
| Provision of information | AEEF is conducting guidance activities for factory diagnosis, the Ministry of Industry and Trade and AEEF are jointly holding seminars, and a magazine for energy conservation is published. | Provision of information serves to upgrade the technical levels of factories and stimulate them in their energy conservation activities. | Guidance in factory diagnosis, seminars, publication of technical information magazines and newspapers | B |

## Table 3.2 Proposals on the energy conservation activities of AEEF

| Itemized energy conservation measures | Present state | Problems and analysis | Proposals | Priority order |
|---|---|---|---|---|
| Enforcement of energy diagnosis of factories | Paid energy conservation analysis was conducted at about 400 factories. | Analysis technology and equipment were not sufficient. Government budget allocation is needed for implementation of free factory analysis. | It is necessary to conduct free energy diagnosis of factories without energy managers in order to interest factories in energy conservation. It is also necessary to conduct paid diagnosis of factories at their request to lead them to take energy conservation measures for factory equipment. | A |
| Gathering, sorting out and publication of energy conservation data and technology | It is engaged in the gathering, storage, provision and publication of information on energy conservation. | It is necessary to establish proper channels of information, and increase public trust to it as a suppply source of information to the people and enterprises. | Strengthened information gathering (at home and abroad)<br>Expansion of database<br>Expansion of on-line system for information provision<br>Establishment of information service outlets | B<br>C<br>C<br>B |
| Publication of a magazine devoted to energy conservation | Energy conservation magazine is issued four times a year with the participation of 10 European countries as a UNIDO project. | Sufficient information on energy conservation is not provided to factory managers and engineers. | It is necessary to provide factory managers and engineers with the latest information on energy conservation technology, excellent factories, energy conservation equipment and successful examples of energy conservation, and arouse their interest in energy conservation. | B |
| Seminars on energy conservation | Seminars are held regularly. Furthermore, the Ministry of Industry and Trade holds meetings twice a year to explain the energy situation and exchange opinions. | There is a shortage of engineers at factories and factory managers are not sufficiently aware of the need for energy conservation. | It is necessary to hold seminars concerning successful examples of energy conservation in factories and give education in energy conservation to engineers in and managers of small and medium factories by holding seminars.<br>It is also necessary to hold seminars to prepare engineers to take a national examination for energy managers. | B<br>B |
| Organization of energy managers | None | No exchange of information among energy managers | To organize and register energy managers to enable them to exchange opinions, to communicate government measures effectively to them and provide specialist technical education to them, and at the same time to utilize them as factory diagnosis engineers and consultants | B |
| Holding of exhibitions devoted to energy | The Hungarian government set up its own booth at international exhibitions. | There was no domestic exhibition intended to promote energy conservation and arouse public interest in energy conservation. | For the government and related government organizations to hold an exhibition once a year to increase public awareness about energy conservation | B |
| Energy Conservation Promotion Center | None at present | It is necessary for AEEF to unify energy conservation promotion organizations to assist enterprises in their energy conservation efforts indirectly through provision of information and win public trust through such activities. | In order to promote energy conservation on a national level, it is necessary to establish within AEEF an organization which will develop activities for the purpose in a unified way. | B |

(Note) Priority
A: Highest
B: Higher
C: Generally important

## Table 3.3 Recommendations on Energy Conservation Measures



# 4. SURVEY OF ENERGY CONSUMPTION IN MODEL FACTORIES

## 4. SURVEY OF ENERGY CONSUMPTION IN MODEL FACTORIES

(1) Overview of factories surveyed

Five factories were surveyed by the study teams, whose characteristics are outlined in Table 4.1.

**Table 4.1 Outline of factories surveyed (1990)**

| Industry | Textile | Rubber | Chemical | Ceramics | Iron and steel mill |
|---|---|---|---|---|---|
| Name of factory | SECOTEX | TAURUS | HUNGALU | Beremendi Cement | DUNAFERR Dunai V. |
| Product | Dyeing and finishing | Tyres for agricultural machinery | Alumina | Cement | Rolled steel plate |
| Management form | Privatized in 1989 | Private enterprise | Privatized in 1991 | Privatized in 1988 | Became concern in 1991 |
| Annual production capacity | 70 $Mm^2$ | 20,000 t | 330,000 t | 910,000 t (Clinker) | 1,500,000 t |
| No. of employees | 1,100 | 1,280 | 1.291 | 850 | 12,000 |
| Energy consumption | | | | | |
| Natural gas $Gm^3$ | 16.3 | | | | |
| Fuel gas TJ | | | | | 2,474 |
| Heavy oil 1,000 t | | | 118.4 | | 62.1 |
| Steam t | | 93,300 | | | |
| Purchased electricity GWh | 2.7 | 17.5 | 63.8 | 106.2 | 8.9 |
| Annual operation hours h | 4,800 | 7,920 | 8,760 | 6,780 | 7,200 |
| Production | 37.5 | 17,651 | 324,200 | 767,500 | 1,002,997 |

All these factories are relatively large-scale factories. Excepting the tyre factory, all the others were once state-run factories. They have been privatized since 1988. Actually, however, they are in the process of privatization. They have been changed to stock companies or limited companies organizationally, but the stock of some of these is still held by the government.

Of these companies, the dyeing and alumina factories, which had depended heavily on trade with the former Soviet Union, recently lowered their production to about one-third of their capacities under the impact of the stagnation of the economy of the former Soviet Union.

There were found some old production equipment or energy facilities, but new equipment and microcomputer control systems were being introduced into some of them.

(2) Conditions of energy management

All these factories are interested in energy conservation in view of a sharp increase in the price of energy.

However, none of these plants had a long-term energy conservation target as the nation's economy was in the process of transition to a market economy and also because of uncertainty about future economic activity. Therefore, it is true that some of these factories were taking separate energy conservation measures for different equipment, but no long-range energy conservation activities involving all employees to attain a certain target were being developed.

All these factories appoint persons in charge of energy management. Although there were differences between factories in the organizational positions of energy managers, the scope of their duties and their authority, they were engaged in tasks related to the gathering and analysis of energy consumption data and the study of energy conservation equipment.

Actual data on energy consumption were obtained at all these factories, but the data obtained were not made known in many cases to workers in the workshops.

Engineers were educated fairly well by permitting them to participate in seminars outside their factories, but workers themselves were not so well educated in this respect.

According to replies to a questionnaire sent to the five factories in the stage of preliminary study, energy managers considered the following points shown in Table 4.2 to be factors responsible for obstructing the promotion of energy conservation.

**Table 4.2 Obstacles to promotion of energy conservation**

| Item | Alumina | Dyeing | Tyre | Cement | Iron-Steel |
|---|---|---|---|---|---|
| 1. Uncertainty about energy price prospects | | * | * | * | * |
| 2. Effect of energy cost limited | | | | | |
| 3. Cost increase can be passed on in prices | | | | | |
| 4. Possibility of energy shortage small | | | | | |
| 5. Small scope of energy conservation | | | | | |
| 6. Shortage of engineers | | | | | |
| 7. Difficulties in obtaining energy conservation equipment | | | * | | |
| 8. Reliability of energy conservation equipment poor | | | | | |
| 9. Uncertain about effect of investment in energy conservation | | | | | |
| 10. Shortage of technical information on energy conservation | | | | | |
| 11. System of technical development not proper | * | | | | |
| 12. Shortage of funds for equipment improvement | * | * | * | * | * |
| 13. Superannuation of equipment | | * | | * | * |
| 14. Lack of employee awareness | | | | * | * |
| 15. Absence of leaders for employee education | | * | | | |
| 16. Shortage of measuring instruments | * | * | * | | * |
| 17. Absence of personnel in charge of analysis of energy consumption per unit output | | | | | |
| 18. Shortage of information on government policy and measures | | | | * | |
| 19. Shortage of government assistance | | | * | * | |

Of the points, those cited by them most frequently were "shortage of improvement funds," "uncertainty about price prospects," and "shortage of measuring instruments."

(3) Trends in energy consumption per unit of production over the past five years

Trends in energy consumption per unit of production over the past five years are given in Fig. 4.1. The tyre factory achieved a substantial improvement in its energy consumption rate by improving the condensate discharge system of its vulcanizer. Energy consumption per unit of production at the dying factory suffered a setback due to a decrease in production.

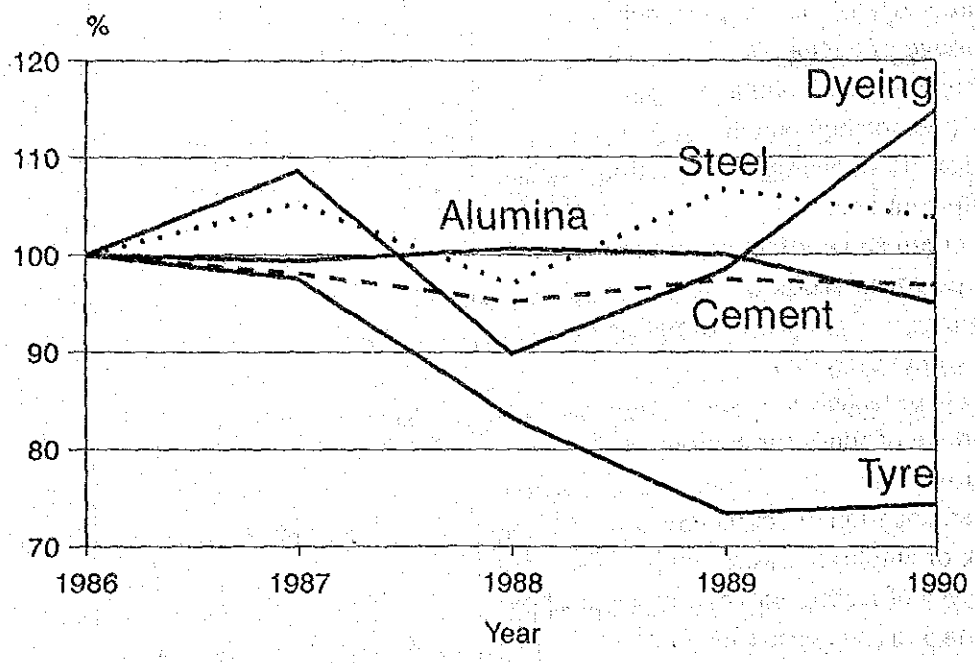



**Fig. 4.1 Trends in total energy unit consumption**

(4) Problems concerning the utilization of energy

(4.1) Dyeing factory

This is a specialized dyeing factory that dyes and finishes woven fabrics manufactured by other factory. Established in 1908, it was nationalized in 1949, but was privatized again in May 1989.

In the 1970s, the factory was renovated so that it could dye and finish broad cloth, and a rotary screen printing machine was introduced. A modern bleaching machine was also installed three years ago.

Since the economic reform, it has been exposed to competition with Western countries, and the factory needs to diversify and improve the quality of its products.

At present, it is being operated at less than one-third of its capacity. Thus, it is operated in an abnormal way, that is, it runs for three and one-third or four and one-third days one week, and then is closed the entire following week.

As the energy costs were low, no serious energy conservation efforts were made in the past. At present, it has rationalized its steam piping system and is recovering condensates.

The boiler is equipped with a top turbine, but the electricity line is not linked with commercial power supply network, so that steam is released into the atmosphere if demand for steam does not match that for electricity. This is one of the causes of higher energy costs at the factory.

The following were taken up in the present survey as problems related to the utilization of energy.

a. Cylinder dryer

① Stabilization of supply pressure of steam for drying and separation of condensates

② Repair of steam leaks in piping and equipment

③ Change in the arrangement and type of steam traps

④ Reuse of condensates

b. Washing equipment

① Reduction of washing water volume through standardization

② Recovery of heat from hot waste washing water

③ Heat insulation work

c. Frame dryer

① Reduction of exhaust gas loss through adjustment of the opening of exhaust air fan suction damper

② Air preheating through recovery of exhaust gas heat

③ Cleaning of filters for heated gas circulation fans

d. Boiler

① Improvement of air ratio

② Prevention of heat loss due to incomplete combustion

③ Strengthened recovery of condensates

④ Operation control according to data

⑤ Installation of automatic controller

⑥ Suspension of recirculation of combustion gas

⑦ Utilization of turbine exhaust during release

e. Heat insulation of steam piping

f. Electric power receiving and distribution and electrical equipment

① Improvement of the operation of transformers

② Extinguishing unnecessary lighting

③ Improvement of the operation of compressors

④ Improvement of the power factor of electricity utilization

If all the measures are taken to counter these problems, it is expected that 9.5% of fuel, 1.7% of electricity and 5.2% of water currently used will be saved, and the cost of these measures will be recouped within one year.

(4.2) Tyre factory

This is one of the two factories belonging to the operation division of the country's only tyre manufacturing company, and is engaged in the production of tyres for agricultural machinery and inner tubes. Its products are exported.

It has recently installed a modern calendering machine, and is introducing a total computer control system.

It does not have a boiler within the factory compound, but is being supplied with steam from the district heat supply trust two kilometers away. Energy costs account for 6 - 7% of the production costs.

The scope of the survey of this factory was confined to the curing process. In the past, energy conservation measures have been taken in this process, including strengthened heat insulation, improvement of the condensate take-out system of curing press, introduction of microcomputers, renovation of air-compressors, etc. As a result, energy consumption per unit of production has been improved about 25% over the past five years.

Energy consumption per unit of production is fairly high, as compared with that in Japan. This difference is believed to be due to ① inert gas curing process not being introduced, ② differences in scale, ③ suspension of operation on Saturdays and Sundays, ④ the long distance from the steam supply source, ⑤ differences in equipment management systems, ⑥ climate differences, etc.

The following are the problems related to the utilization of energy taken up by the team as a result of its survey.

a. Curing press and its accessory piping

① Strengthened heat insulation

② Maintenance of steam traps

③ Repairing of steam leaks

b. Steam supply system

① Prevention of heat radiation

② Recovery and utilization of condensates

c. Electrical equipment

① Improvement of the operation of compressors

② Improvement of lighting

If all these measures are taken, fuel savings of 9.0% and electricity savings of 1.9% can be expected, and the costs required will be recouped within one year.

(4.3) Alumina plant

This plant is just one of the alumina manufacturing facilities belonging to a large enterprise with 13 manufacturing, marketing and engineering departments, including bauxite mining, alumina extraction, aluminum refining and aluminum product manufacturing departments. It went into operation in 1950.

Later, its equipment was expanded and strengthened and efforts were made for technical development, so that it has developed into an aluminum enterprise not inferior to any in the world. Recently, it has installed new desiliconization tanks, flash tanks and heat exchangers to improve its steam consumption per unit of production by about 3%. Since it uses domestically produced bauxite poor in solubility, it requires high temperature steam.

Because of the deteriorating economic situation surrounding aluminum, its present production has fallen to half or one-third of its capacity. It was reorganized into a stock company in July 1991, but the stock is still held by the government.

The following are the problems taken up by our team in the survey work concerning the utilization of energy.

a. Digestion process

   ① Prevention of heat radiation from piping and equipment

   ② Prevention of steam leakage

   ③ Improvement of the methods of condensate discharge and degassing

b. Calcination process

   ① Prevention of suction of cold air from openings

   ② Improvement of alumina distribution to planetary cooler

c. Water balance

   ① Improvement of the washing efficiency of aluminum hydroxide

   ② Proper number of thickeners in reduced production

d. Reconsideration of the possibility of omitting the desiliconization process

e. Boiler

   ① Preheating of air in air preheater

   ② Prevention of heat loss by incomplete combustion

   ③ Shorter interval between soot blow operations

   ④ Operation control according to data

f. Electrical equipment

① Air flow control of rotary kiln exhaust gas blower

② Improvement of power factor

③ Improvement of operation of compressor

It is difficult to quantify the effect of these measures against the above problems, but none of these measures are very expensive.

(4.4) Cement factory

This plant started in 1910. New equipment with a suspension preheater was installed in 1973, together with limestone calcination equipment.

A computer system was introduced in 1984, to optimize material preparation, and factory operation came to be centrally controlled from the central control room in a unified way.

The factory was changed from a state-run organization to a stock company in November 1988, and a German firm was scheduled to acquire up to 80% of the stock in November 1991.

The following are the problems taken up by the study team related to the utilization of energy in the factory.

a. Improvement of the operation of the prehomogenization process

b. Pyroprocess

① Reduction of air ratio

② Utilization of cooler exhaust air as primary air

③ Improvement of the system of combustion control

c. Conversion to solid fuels

d. Proper operation of ball mills for cement grinding

e. Electrical equipment

① Optimization of discharge pressure of air compressor for cement packers

② Extinguishing unnecessary lighting

The effect of these measures cannot be quantified easily. However, none of these measures require great expenditure.

(4.5) Iron and steel mill

This mill is an integrated manufacturing mill for pig iron and steel. Established in 1950, it is the largest steel mill in Hungary, equipped with blast furnaces, coke ovens, converters, hot rolling mills, cold rolling mills, a power plant, etc.

The state-run steel mill was reorganized in March 1991 into a Konzern with a number of limited companies in the metallurgical department, secondary and tertiary products departments, service department, and business operation departments.

Covered by the scope of study in this survey work was the heating furnace of the hot rolling mill.

The following are the problems pointed out as a result of our survey work related to the utilization of energy.

① Improvement of air ratio

② Inspection and repairing of air preheaters and flue

③ Prevention of mixed charging of hot and cold slabs

④ Repairing of furnace walls and strengthened heat insulation

⑤ Prevention of flame blowing from openings

⑥ Reduction of sideways temperature deflection inside the furnace

⑦ Installation of partitioning wall in the upper zone

⑧ Improvement of heat pattern

⑨ Improvement of the structure of the soaking zone

⑩ Improvement and provision of instrumentation

⑪ Control of the revolution speed of fans for blowing combustion air

It is difficult to quantify the effect of all of these measures. If measures ①, ② ④ and ⑤ which do not require a large cost, are taken into consideration, a 23.3 percent saving of fuel can be expected, if synergetic effects are taken into account. An electricity saving of 37.8% can be expected from the measure mentioned in item ⑪, but it will take 2.1 years to recoup the investment required.

# 5. MATERIALS FOR FORMULATION OF TECHNICAL GUIDELINES FOR PROMOTION OF ENERGY CONSERVATION

## 5. MATERIALS FOR FORMULATION OF TECHNICAL GUIDELINES FOR PROMOTION OF ENERGY CONSERVATION

In order that energy conservation may be promoted in Hungarian factories, it is expected that AEEF will play a leading role in factory diagnosis and education of factory engineers.

In order to promote these activities, it is necessary to formulate guidelines on which AEEF engineers can base their actions.

This report sums up technical items which are expected to prove useful to AEEF in formulating such guidelines, with special attention to the following matters.

(1) The guidelines can be used by AEEF engineers ① as a manual for guidance in factory diagnosis, ② as a text at seminars, or ③ for evaluating progress energy conservation in factories.

(2) The technical level of the guidelines should be appropriate for engineers with 4-5 years of experience after graduation from university, and should be understandable even by those who are not engaged in related work in factories.

(3) The scope of issues treated by the guidelines should correspond to the actual present conditions of Hungarian industry, and should be confined to the processes in the factories covered by the present survey, and contain basic matter reference values, and methods of energy conservation and suitable examples.

Their subjects should include the following.

Energy management
Dyeing
Tyre curing
Alumina
Cement
Reheating furnace for slab
Boilers
Use of steam
Electrical equipment
Calculation of heat insulation by personal computer

As for other industries, it is expected that AEEF will gather information through factory diagnosis and gradually add and expand the guidelines on the basis of this report.

# Supplementary Materials

List of study mission members

| No | Name | Duty | Description of responsibilities |
|---|---|---|---|
| 1 | Mitsuo Iguchi | Leader, administration affairs | Administration, management<br>Energy management |
| 2 | Teruo Nakagawa | Deputy-leader | Heat management technology, measurement technology<br>Liaison and negotiation |
| 3 | Tetsuo Oshima | Energy management technology | Survey of heat management technology |
| 4 | Toshiyuki Ochi | Energy management technology | Survey of heat management technology |
| 5 | Koichi Inaba | Process control | Survey of dyeing process and heat management technology |
| 6 | Taro Ihara | Process control | Survey of tyre process and heat management technology |
| 7 | Tatehiro Tanabe | Process control | Survey of alumina process and heat management technology |
| 8 | Toshio Ohnishi | Process control | Survey of cement process and heat management technology |
| 9 | Toshio Noda | Process control | Survey of iron and steel process and heat management technology |
| 10 | Kenichi Kurita | Electricity management technology | Survey of electric power receiving and distribution and electric equipment at dyeing, tyre, alumina factories |
| 11 | Kazuo Usui | Electricity management technology | Survey of electric power receiving and distribution, and electric equipment at cement and steel plants |
| 12 | Hirokazu Hirata | Energy equipment | Survey of energy conditions and energy facilities |
| 13 | Motoo Hori | Energy conservation popularization | Survey of energy conditions and conditions of energy conservation |
| 14 | Takao Shiomi | Energy management technology | Heat management technology in general<br>In charge of research work at home |
| 15 | Ayako Sato | Energy management technology | Heat management technology in general<br>In charge of research work at home |
| 16 | Yukie Kawaguchi | Energy measure<br>Energy conservation popularization | Conditions of energy measures and energy conservation<br>In charge of research work at home |
| 17 | Masao Fuse | Energy measures<br>Energy conservation popularization | Conditions of energy measures and energy conservation<br>In charge of research work at home |

List of counterpart personnel

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| No | Name | Assignment |
|---|---|---|
| 1 | Dr. Dénes Rácz | Head of Technical Dept. |
| 2 | Mr. Sándor Komáromi | Head of Energy Planning and Information Dept. |
| 3 | Mr. Imre Gáspár | Heat of Regional Energy Management Department |
| 4 | Ms. Ildikó Szücs Fekete | Deputy Heat of Energy Planning Dept. |
| 5 | Mr. János Becz | Factory Team Leader of Hungarian side |
| 6 | Mr. Ferenc Pardavi | Electrical Engineer |
| 7 | Mr. Kornél Jonás | Mechanical Engineer |
| 8 | Mr. Endre Slenker | Electric & Measurement Engineer |
| 9 | Mr. László Szabó | Instrument Engineer |
| 10 | Mr. József Stieber | Instrument Engineer |
| 11 | Mr. Gyula Petró | Electrical Engineer |

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| No | Name | Assignment |
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| 1 | Mr. Lajos Ropolyi | Mechanical Engineer |
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| 3 | Mr. Zoltán Dudás | Electrical Technician |
| 4 | Mr. Balács Csovics | |
| 5 | Mr. Gábor Mohácsi | |