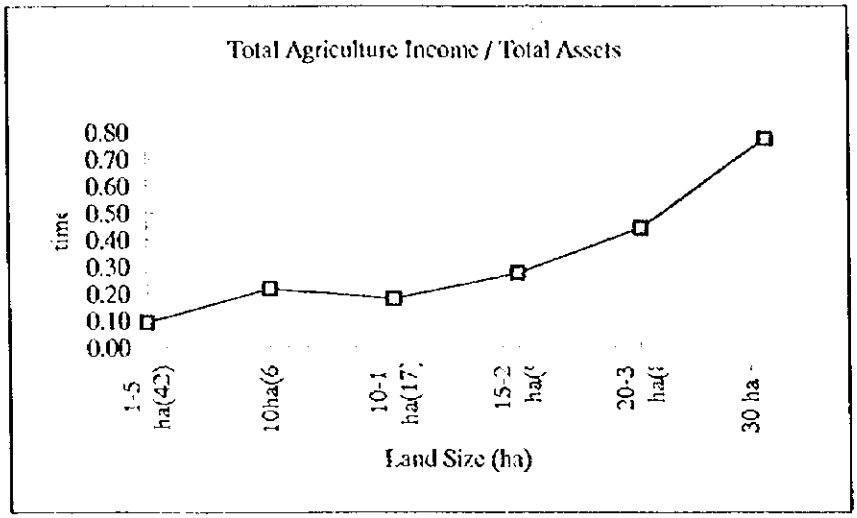
Figure 1.5-2 AVERAGE AGRICULTURE PROFITABILITY OF 4 TYPES OF FARMING OPERATIONS

Figure 1.5-3 SALES TO ASSETS RATIO ACCORDING TO LAND SIZE



(4) Productivity

Productivity is analyzed in terms of land and labor. In the case of land, productivity is obtained in the forms of production volume and sales value per hectare of land. Regarding labor productivity, the sales value one man can generate per day is estimated.

Calculations were made as follows.

Land Productivity = 1) Total Production / Cultivated Area (ton /ha)
2) Total Agriculture Income / Cultivated Area (PLN/ ha)

Labor Productivity = Total Agriculture Income / Total Working Time (PLN / manday)[2]

1) Land productivity

Figures 1.5-4 to 1.5-6 show that the economies of scale in terms of land size are realized in the cases of cereals, fodder crops and sugar beets. Therefore, food-processing companies which purchase these raw materials wish to make production contracts with producers with a certain land size. For instance, a sugar company is considering purchasing raw materials from producers with more than 4 ha of land in the future.

[2] Due to data limitation, labor productivity in terms of volumes of production is not available.

Regarding potatoes, which is an important industrial raw material, 166 farms in the survey produce then. However, the production size in general is small, as the majority of producers (110 out of 166 farms) are producing potatoes on less than 1 ha of land. It also confirms the saying that, presently, many producers mainly produce vegetables for self-consumption rather than for sale to food processing companies. Under such circumstances, it is impossible for producers to supply certain amounts of produce regularly at this moment.

As far as the survey is concerned, vegetables are produced on small land areas with less than 1 ha (48 out of 57 samples answered) and large-scale operators are hardly seen. In addition, the economies of scale in terms of land size are not realized in the case of vegetable production. In the case of fruit, specialized producers are observed in the survey and the land productivity increases as the land size is bigger to a certain extent.

Figure 1.5-4 PRODUCTION YIELD OF CEREALS

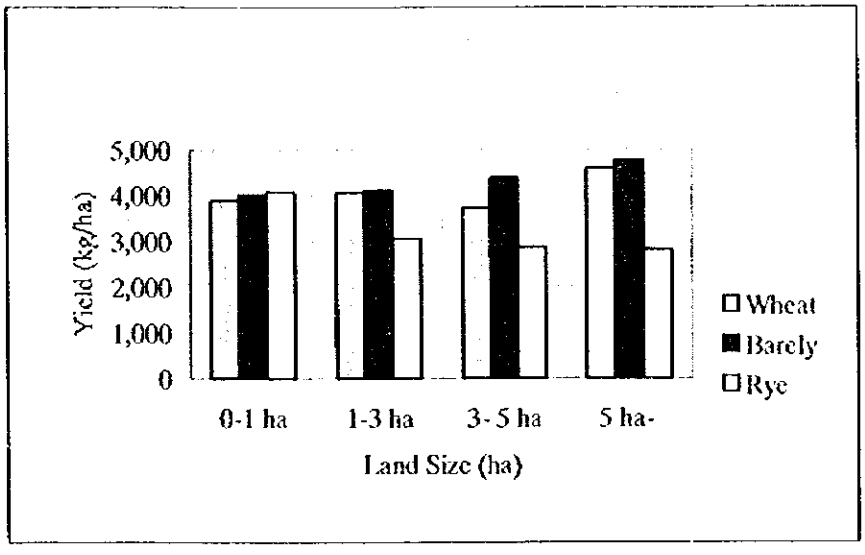


Figure 1.5-5 PRODUCTION YIELD OF FODDER CROPS

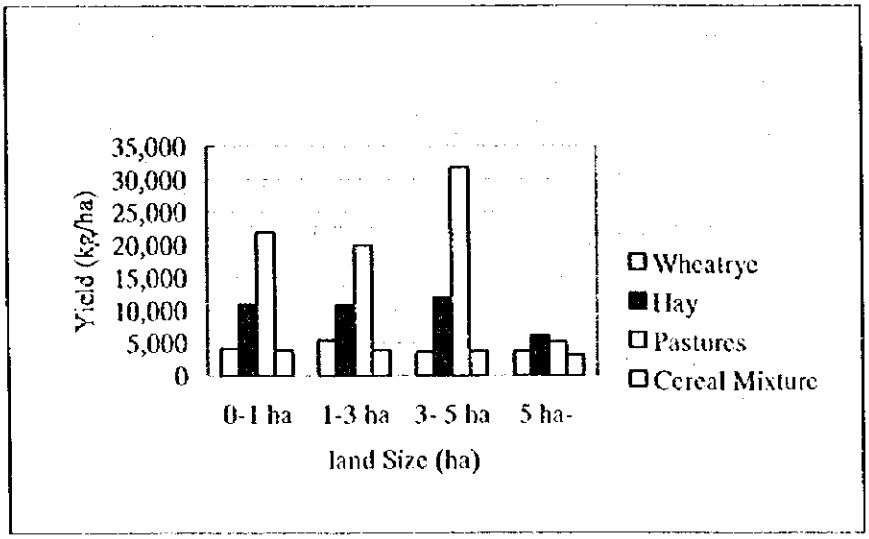
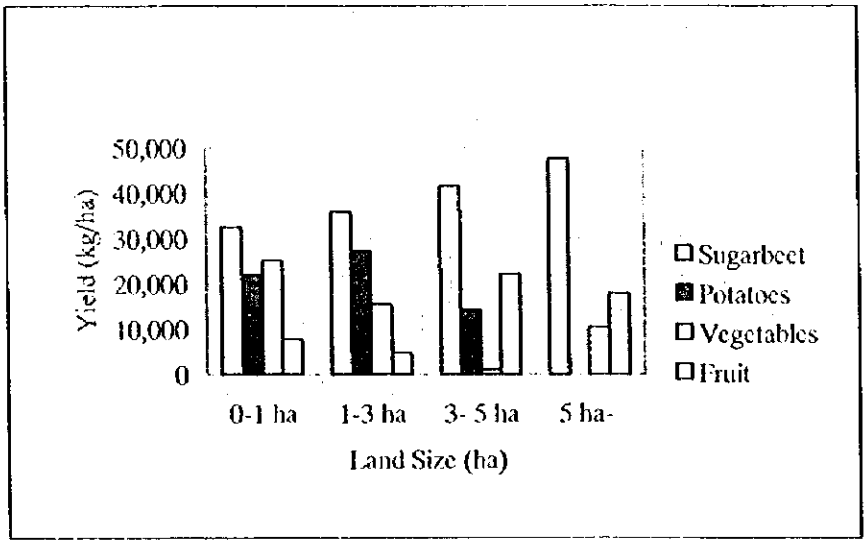


Figure 1.5-6 PRODUCTION YIELD OF VEGETABLES AND FRUIT



2) Labor productivity

Although the economies of scale in terms of production are realized in the cases of cereals and fodder crops, profitability of these per 1 ha of land is smaller than for vegetables and fruit and livestock farms. Tables 1.5-4 (1)-(6) show land productivity and labor productivity of farming operations according to land size and types of operation. On average, land productivity of vegetables and fruit and of livestock farms are higher than

those of cereals and mixed farms. In other words, vegetables and fruit, as well as livestock producers can generate higher income on the same size of land.

As clearly shown in Tables 1.5-4 (1) -(6), labor productivity in terms of sales (amount of money a producer can generate per day) is also small if land size is small in the cases of cereals, mixed and vegetables and fruit farms. The livestock sector shows a different trend as both small and large scales of farms show high labor productivity. This seems to be a result of different farming styles achieved by the livestock sector, where capital-intensive production was commonly observed during the field survey.

Table 1.5-4 (6) implies a problem associated with vegetable and fruit production. As the table shows, vegetable and fruit farms with less than 5 ha of land show lower labor productivity compared with other farming types. Even though vegetable and fruit production is not generally constrained by land size, its labor productivity could be constrained by land size to a certain extent. Since it is labor-intensive production, a certain production size is necessary to generate enough income to cover labor costs.

1.5.3 Working Hours

Figures 1.5-7 (1) -(5) show average working hours of 4 types of farming operations. It is obvious that a vegetable and fruit farming operation is the most labor-intensive farming operation among the 4 types. For example, during the field survey a vegetable producer said that he spent about 500 mandays to produce 60 tons of broccoli on 6 ha of land.

Table 1.5-4 (1)-(6) AVERAGE LAND LABOR PRODUCTIVITY

(1) By Types of Farming Operations

	Land Productivity (PLN/ha)	Labour Productivity (PLN/manday)
Total	5,816	491
Mixed	2,655	368
Cereals	2,093	351
Livestock	9,731	681
Vegetables & Fruit	9,262	604

(2) By Land Size

	Land Productivity (PLN/ha)	Labour Productivity (PLN/manday)
1-5 ha(62)	11,154	436
5-10 ha(66)	3,500	296
10-15 ha(21)	2,347	469
15-20 ha(9)	3,464	507
20-30 ha(14)	2,229	834
30 ha-(10)	2,425	1,676

(3) Mixed Farms

	Land Productivity (PLN/ha)	Labour Productivity (PLN/manday)
1-5 ha(22)	2,536	53
5-10 ha(34)	3,051	186
10-15 ha(9)	2,378	425
15-30 ha(11)	1,965	1,148
30 ha- (4)	2,458	1,382

(4) Livestock

	Land Productivity (PLN/ha)	Labour Productivity (PLN/manday)
1-5 ha(15)	34,011	1,635
5-10 ha(34)	3,296	236
10-15 ha(8)	2,787	581
15-20 ha(5)	2,977	320
20 ha-(8)	2,717	1,113

(5) Cereals

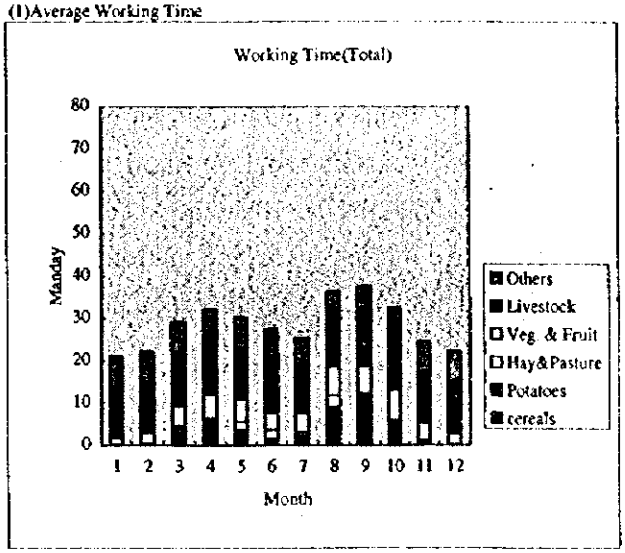
	Land Productivity (PLN/ha)	Labour Productivity (PLN/manday)
1-5 ha(15)	1,875	141
5-10 ha(2)	2,092	46
10-20 ha(5)	2,915	356
20 ha-(4)	1,884	1,285

(6) Vegetables and Fruit

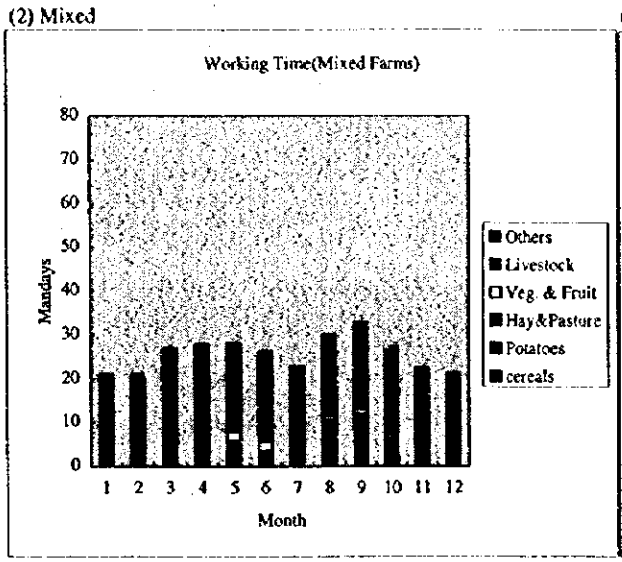
	Land Productivity (PLN/ha)	Labour Productivity (PLN/manday)
1-3 ha (5)	12,084	38
3-5 ha(5)	7,408	127
5-7 ha(3)	8,752	2,053
7-9 ha(2)	7,608	1,039

Figure 1.5-7 (1)-(5) WORKING TIME

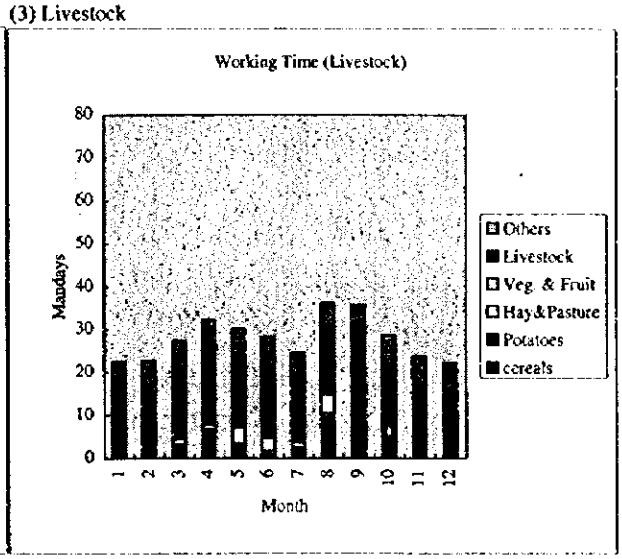
(1)Average Working Time



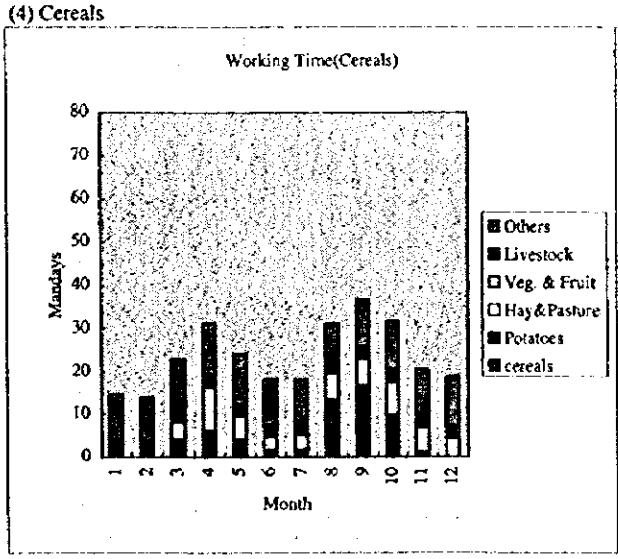
(2) Mixed



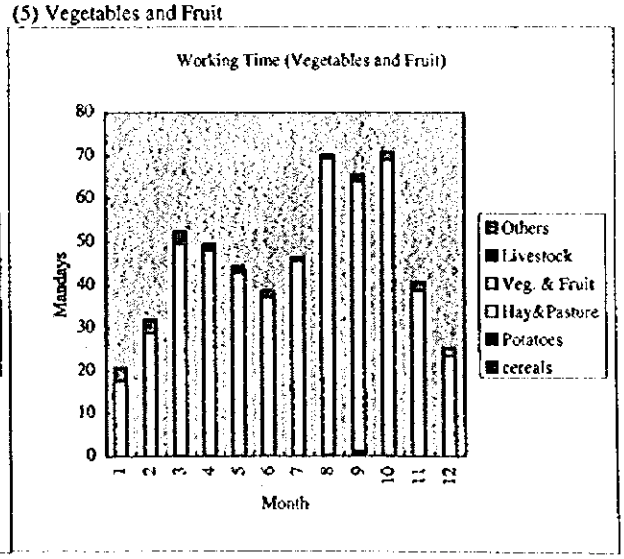
(3) Livestock



(4) Cereals



(5) Vegetables and Fruit



1.5.4 Marketing

(1) Marketing channels

Figures 1.5-8 to 1.5-10 show how the final output is used or purchased in the cases of cereals, vegetables and fruit, and livestock. Figures in parentheses are numbers of sample farms. It is obvious that the share of nonmarketed produce (either self-consumed or used for production) is relatively high in the cases of cereals and fruit and vegetables compared with livestock produce.

These results confirm the interviews conducted in the field surveys. Vegetables and fruit are mainly produced for self-consumption purposes due to producers' inadequate access to markets. Cereals are used for feeding animals. During the field surveys, this phenomena was commonly observed at cattle-breeding farms which did not want to feed cattle with expensive feed, as prices of cattle meat were too low to recover the purchasing costs.

However, as the land size of farms becomes bigger, the shares of marketed produce among total produce also increase to a certain extent. This implies that it is easier for large-scale producers to meet buyers' demand in terms of both quality and quantity, which results in better marketing channels. In the case of livestock, most produce is sold and the amount which is utilized for self-consumption and production purposes is small.

Figure 1.5-8 SALES CHANNELS OF CEREALS

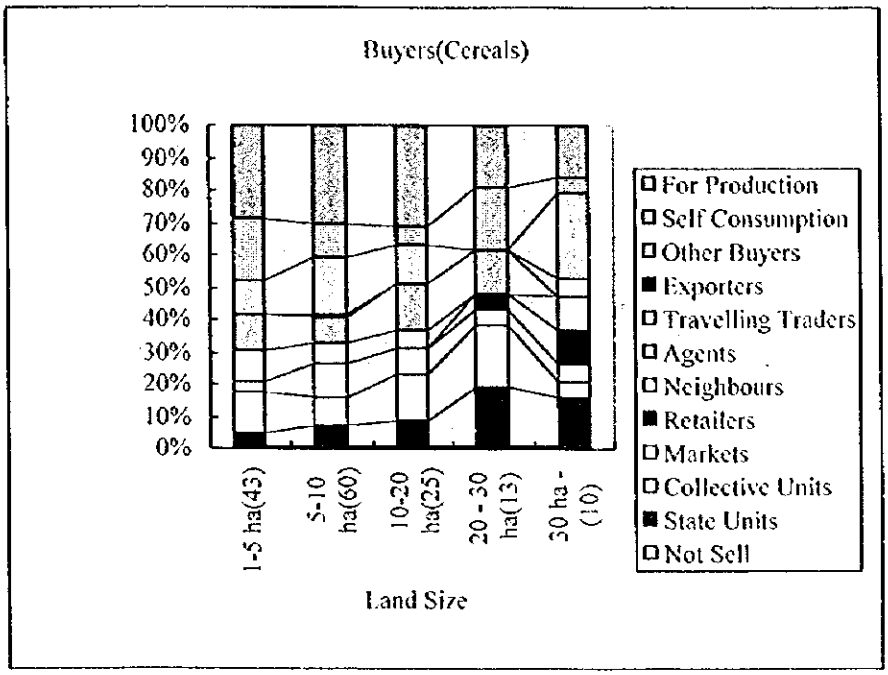


Figure 1.5-9 SALES CHANNELS OF VEGETABLES AND FRUIT

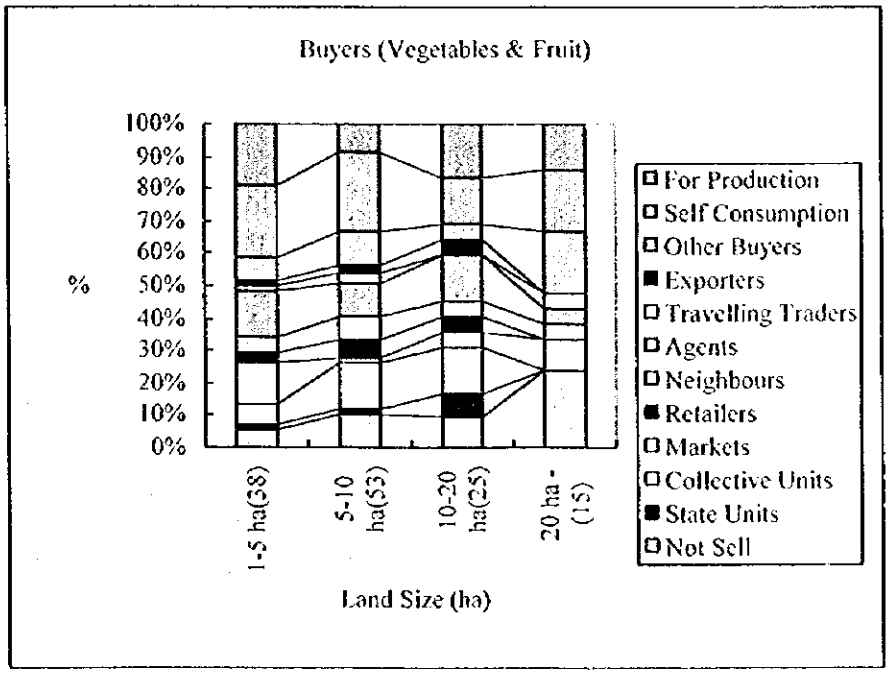
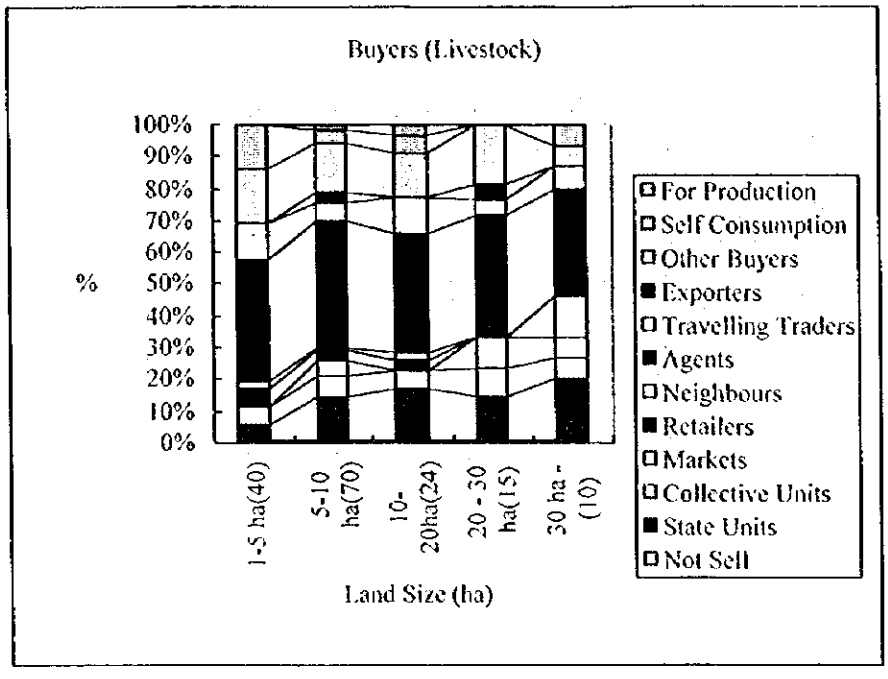


Figure 1.5-10 SALES CHANNELS OF LIVESTOCK



(2) Self-consumption

As seen in the previous section, one of the characteristics of the present agriculture situation in Konin Province is its high share of self-consumption. Table 1.5-5 shows average self-consumption rates of main plant products. Since the self-consumption rate of livestock produced is small, inadequate data are available, so an analysis of livestock products was not included. The results suggest that, at present, many producers use products for self-consumption rather than selling outside of the farms. In the case of fruit, the result of 100% is not considered to represent the real situation, as the sample number is far smaller than the others.

Table 1.5-5 AVERAGE SELF-CONSUMPTION RATES

	Barely	Vegetables	Fruit	Potatoes	Rye	Wheat
No. of Farms	72	55	18	142	121	116
Self Consumption Rate	37.6%	38.6%	100.0%	44.2%	43.6%	37.7%
Land Size (ha)	11.2	10.5	7.3	9.8	10.4	11.5

1.5.5 Group Formation

(1) Sales group

Presently, only 11 farms sell their produce together with other producers (see Table 1.5-6).

Table 1.5-6 PRESENT GROUP SALES ACTIVITIES

	Vegetable & Fruit	Livestock	Plant & Rapeseed	Others
Less than 5 ha	1	1	1	0
5 to 10 ha	0	0	0	0
More than 10 ha	0	5	3	0
Total	1	6	4	0

(2) Membership in groups

Presently, producers are members of the following groups or organizations.

Agriculture Chamber	14.69 %
Agriculture Association	6.0%
Group of Countryside Women	3.33 %
Association of Pig Breeders	2.0 %
Association of Vegetable and Fruit Products	2.0 %
Cattle Breeders Association	1.33 %
Polish Peasants' Party	1.33 %
"Solidarise" of Individual Farmers	1.33 %
Bee-Keepers Circle	0.66 %

(3) Membership in producers' groups

Figures 1.5-11 and 1.5-12 show producers' opinions about group formation.

Figure 1.5-11 WHAT KIND OF PRODUCTS DO YOU BUY WITH OTHER PRODUCERS?

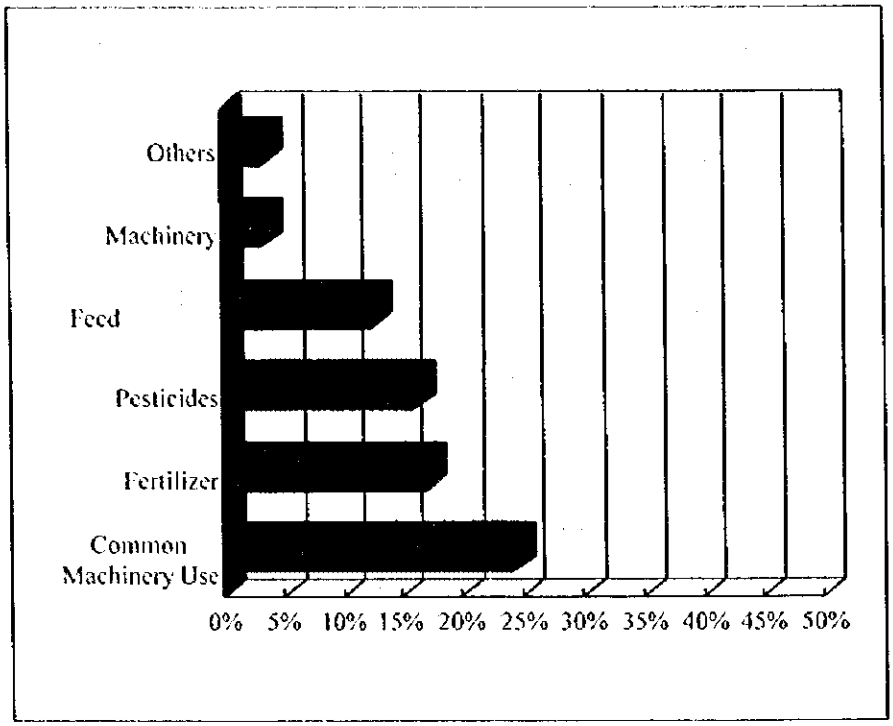
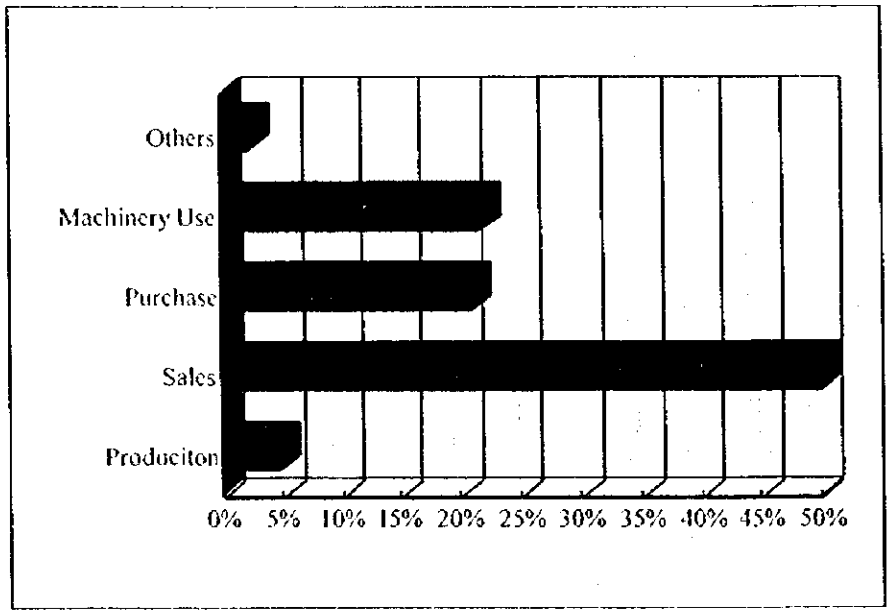


Figure 1.5-12 WHEN DO YOU FEEL THE NECESSITY OF FORMING A PRODUCERS GROUP?



1.5.6 Credit

(1) Source of credit

Out of 200 farms, 112 farms borrowed money from the following sources.

Cooperative Banks 112 farms
Other Banks 10 farms
Others 1 farm

(2) Purpose of credit

As far as 88 farms out of 121 farms are concerned, demand for implementing fertilization and plant protection ranks the highest. The most common guarantee is land (see Table 1.5-7).

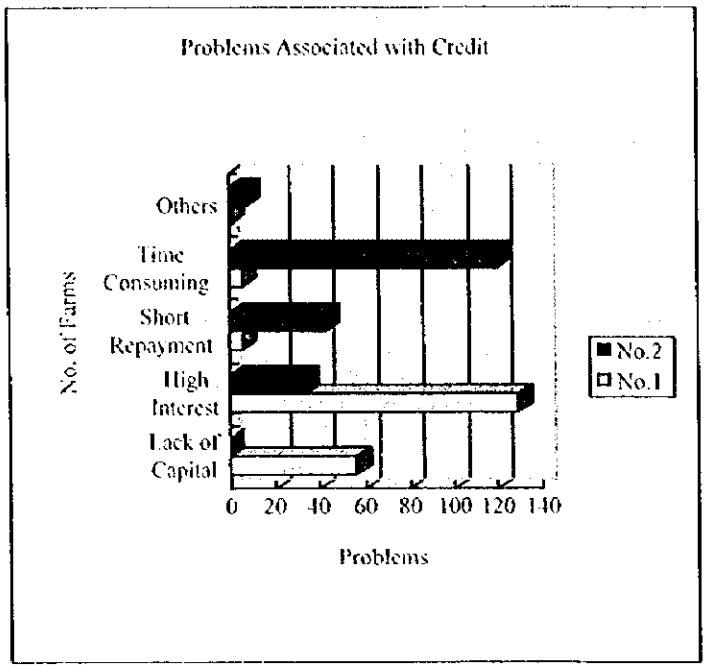
Table 1.5-7 PURPOSES OF CREDIT (88 SAMPLE FARMS)

	Land Purchase	Machinery	House/ Building	Fertilization /Plant Protection	Consumption	Others
No. of Farms	8	11	3	57	1	8
Average Credit (PLN)	22,260	24,073	9,000	4,820	13,800	42,030
Interest Rates (%)	5.75	6.73	6.30	1.50	31.00	4.00
Repayment Years	7.1	7.2	15.7	10.2	1	12.9
Guarantees (No. Of Farms)*						
Land	10	11	3	57	0	0
Building	2	1	1	2	0	4
Machinery	1	3	1	7	0	0
Others	3	1	1	41	1	4
State guarantee	0	0	0	1	0	0

*multiple choice

Figure 1.5-13 shows present problems of credit. Some 64.5% (129 farms) selected "High Interest Rates" as the most important problem, whereas 59.5% (119 farms) considered "Time Consuming Procedures (associated with borrowing)" to be the second important problem.

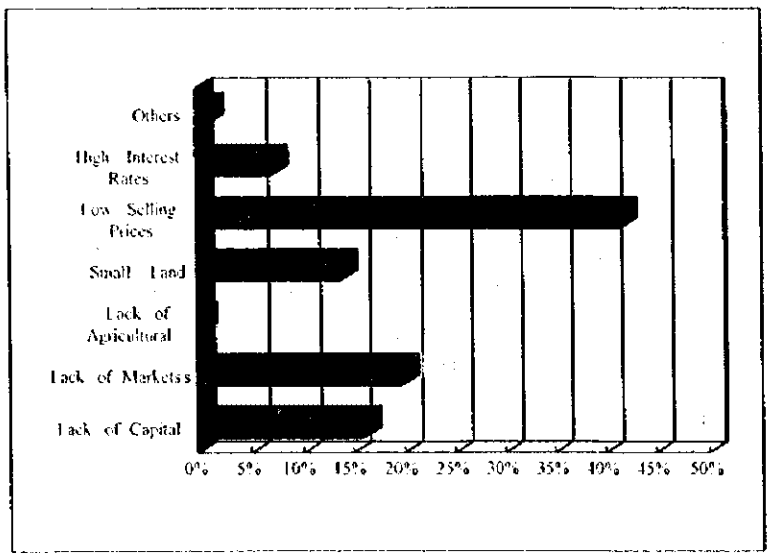
Figure 1.5-13 PROBLEMS ASSOCIATED WITH CREDIT



1.5.7 Opinion Surveys

Figure 1.5-14 shows major problems. Producers selected "Low selling prices" as the most serious problem followed by lack of markets and lack of capital.

Figure 1.5-14 WHAT IS THE MOST IMPORTANT PROBLEM?



1.6 Conclusion and Key Issues

(1) Basic agricultural conditions in Konin Province

There are two disadvantages of natural conditions in Konin Province compared with the national average. One is low soil quality and the other is non-controllable water supply conditions caused by both draught and floods. Looking at arable land quality, the share of soil which is appropriate for cultivation (class I to IV) is 50.6 percent in Konin Province, whereas the national average is 67.7 percent. Annual precipitation around Konin province, which is approximately 500mm in an average year, is around 20% less than in mmost of other areas. This is a major reason for frequent water shortage in the province. Therefore, Konin province has been selected as one of the priority districts of water resource development.

Konin is a typical agriculture province in terms of land size per farm. The share of farms with less than 5 ha is 55 percent, which is almost the same as the national average. According to the farm survey, 5 ha is found to be a difficult size for producers to operate in a financially sustainable way without income from the nonagriculture sector. However, farmers in general are reluctant to sell the land because of deep respect for ancestors and life security. Therefore, the speed of land intensification (enlargement of land size) is still low.

Thus, low quality of land, water shortage and existence of small-scale farms, all of which are difficult problems to be solved, become basic constraints for further development of agriculture.

(2) Distribution and marketing problems after the transition to the market economy

Economic and social reform towards the market economy began in 1989 at the onset of price liberalization of agricultural produce and came into force with the implementation of the Balcerowicz plan in 1990. The shift from a socialist to a market economy exerted a great influence on the agriculture sector within the economic reforms, which aimed at reducing national budgets allocated for the agriculture sector. Four major reforms have been conducted in the sector: price liberalization; reduction of subsidies;

liberalization of foreign trade; and privatization of public sectors including state and collective farms. Distribution and marketing systems for agricultural produce were substantially changed by the series of reforms.

During the socialist period, an agricultural cooperative (GS) existed in each Gmina which procured agricultural produce from producers and sold raw materials to state enterprises and cooperatives. It gave producers no choice but to sell to cooperatives in order to secure purchasing for inputs. About 85 percent of total production of private farms was procured by the government procurement systems.

After the transition to the market economy, producers basically had to find buyers by themselves. Presently, private buyers such as food processing companies, traders and distributors are increasing their shares in procurement of agricultural produce directly from producers. These are typically observed in the vegetable and fruit markets, which are completely liberalized.

These situations have driven small-scale producers into a corner. Problems are as follows.

1) Production volume is not attractive enough to draw buyers to farmsteads.
2) Reliance on traders for selling reduces producers' receivables
3) Since buyers have negotiation power over producers, producers have to concentrate on "quality" rather than "quantity".

(3) Improvement of agriculture structure and agriculture technology

As previously stated, low soil quality, lack of water and large numbers of small-scale producers are basic constraints for agriculture development in Konin Province. Taking these constraints into consideration, it is necessary for Konin Province to develop an agriculture production pattern suitable for Konin in order to survive in the long run. Since different institutions are engaged in development of agriculture technology, there is room for integrating these efforts and making comprehensive development plans.

The following issues will need to be considered when Konin's comprehensive agriculture development plan is designed.

1) Appropriate operation size for cereals, vegetables and fruit, and livestock producers.
2) Cropping patterns suitable for Konin's soil conditions
3) Introduction of new variety
4) Methodology to improve production technology of producers.

(4) Development of agriculture infrastructure

Development of the agriculture infrastructure is a prerequisite for supporting Konin-type agriculture development. In Konin, water shortage is more serious than in the other provinces and is ranked lowest at 5th in water condition rankings conducted by the Research Institute of SoilCultivation, Fertilizing and Pedology. Notwithstanding, only 0.8 percent (1,980 ha) of total cultivated areas (263,018 ha) was irrigated by watering facilities in 1996 and most producers are using rain-fed irrigation methods. Thus, water resource development is one of the most important issues for the future agriculture in Konin province.

Presently, construction of main irrigation facilities such as dams and water reservoirs is planned and implemented by the public sector, whereas the installation of on-farm irrigation facilities is done by each individual farm without any public financial support. These systems are considered to be appropriate; however, they are not functioning well. "The Small Retention Program" has been formulated for expanding irrigated areas in Konin Province. However, due to a lack of financial resources, implementation of these public development programs are delayed. On the other hand, while some individual farms are using underground water or water from lakes and rivers by installing water pumps, the majority cannot afford to install such watering facilities by themselves, due to inadequate financial resources.

In addition, facilitating drainage systems is also important, as Konin Province has suffered from floods several times, including the one in 1997. Without coping with flood disasters, funding which can be used for

irrigation system development will not increase in the future. Land reclamation and development of storage facilities to improve post-harvest practices are also needed for further development of agriculture in Konin Province.

(5) Support for small-scale farms

Supporting small-scale farms is one of the important issues for the whole country. In Konin Province, where 55% of farms hold less than 5 ha of land, the situation is not economically sustainable for farming operations.

Basic problems that small-scale farms are now facing in Konin Province are summarized as follows.

1) Small-scale farming operation is not financially feasible.
2) Small-scale farms can hardly meet buyers' request in terms of types, quantity and quality of produce.
3) Small-scale farms do not have adequate financial resources, nor access to credit, which prevents further investment.
4) Small-scale farms are not well mechanized, which results in high production losses during the cultivation and harvest seasons preventable on mechanized large-scale farmland.
5) Small-scale farms have inadequate access to information needed to cut costs without decreasing production.

In order to reduce the numbers of small-scale farms, either intensification of land plots or afforestation are considered. In fact, Konin Province has an"Afforestation Program", which is planned to be implemented mainly on low-quality land such as swamps and class VI soil. On the other hand, farmers in general are inclined to stick to their own land and are reluctant to sell to others, which can be observed all over the world as farmers' nature. Therefore, it is necessary to take action to support these small-scale farms now.

1.7 Direction of Development of Agriculture Sector

Based on the study and analyses of the present conditions and the results of PCM workshops, the direction of development of the agriculture sector is covered in this section. First, development potentials, which are advantages or factors which can expert great effects on solving problems, are stated, followed by constraints. As constraints, problems which cannot be easily solved are listed. In principle, solutions are considered within areas excluding these constraints. Then the development concept, which is the basic development direction of the agriculture sector, is described. Based on that concept, strategies are laid out in order to achieve the development concept. Lastly, concrete projects, which are tools for implementing strategies, are proposed according to each strategy.

1.7.1 Development Potentials and Constraints

(1) Development potentials

1) Germination of some entrepreneur-type producers

There are some producers who have a clear vision and a strong will to modernize and improve their farming operations, taking into account future accession to the EU. There is a possibility that they will play a leading role for modernization of agriculture in Konin Province.

2) High potential to improve current agricultural farming

The agricultural area in Konin Province has potentials, as described below, which are considered to be promising for the future increase of production.

a) Because of widespread livestock farming, it would be easy to introduce the method of organic farming with a combination of cultivation farms and livestock farms. Though farms are scattered and not grouped, relatively low transportation costs would make it easy to establish a production and distribution system of organic fertilizers.

b) The refilled land of coal mining sites could be developed as farm land, and practically used; for example, for sugar beet cultivation.

3) Existence of agriculture schools and agriculture extension service centers

Agriculture education, extension and research-related institutions are located in Koscielec, which is almost a center of Konin Province. They maintain close cooperation, which will contribute to improving current agriculture technologies.

4) Good location for goods distribution

Konin is located close to the international highway from West and East European countries. Presently, there is a plan to establish a commodity exchange near the road in Gmina Stare Miyasto. Since the candidate place is located in the center of Konin province, it would function as a collecting point for agricultural produce, which will further be connected to big cities in other provinces.

(2) Development constraints

1) Small farm size

While productivity, efficiency and profitability of farming operations are constrained by small land size, the number of such small farms is not expected to decrease substantially by 2010 due to the following reasons. First, land markets are not functioning yet in Konin Province. As a result, enlargement of land size by purchase is not so common now. Second, most agriculture producers are exempt from income taxes, which is likely to discourage land disposition. Third, the present agriculture pension system requires producers to hold land when they receive pensions if the insured period is less than 12 years.

2) Poor soil quality

Poor soil quality limits agricultural production for the following reasons;

a) Improvement of productivity and the quality of products is prevented by the strong acidity of soils which are generally not suitable for agriculture.
b) Poor soil quality limits the diversification of crops; for example, high-added-value crops cannot be easily introduced.

The soil acidity can be neutralized by means of Ca-fertilizers, and, for that purpose, a subsidy is available.

However, the impact of farmland pollution on agriculture and the natural environment is gradually becoming greater, though the impact is small at present. Also, agricultural production partly has an effect on soil and water pollution. Without a total solution to environmental protection, future agricultural development would be limited.

3) Water shortage problems

The water shortage problem is one of the serious problems in Konin Province. The low rate of irrigated areas and inadequate on-farm watering devices prevent producers from improving quality as well as diversifying their production profile to a profitable profile such as vegetables and fruit. Lack of financial resources in the public sectors has delayed implementation of various water development programs. Besides, most producers cannot facilitate installation of farm watering equipment due to lack of money and inadequate access to credit.

4) Policy and institutional constraints

Frequent changes in government policies prevent producers from engaging in long-term and sustainable production. For example, government policies on cereal procurement fail to balance demand and supply, which resulted in increases in imports when there was a surplus of cereals in farm storage. Likewise, lack of an export insurance system makes producers suffer from delayed payments or defaults when they export to some countries. In addition, lack of uniform regulations on functioning of organic farming will hinder promotion of organic production in the future.

1.7.2 Development Concept and Strategies

(1) Development concept

The development concept and strategies of the agriculture sector were devised through a series of PCM workshops. The discussion process and results are explained below.

"Improvement of profitability of farms in Konin Province"

The participants in PCM workshops, held in August, 1997, agreed upon a core objective of the agriculture sector as stated above (See ANNEX II). This is deemed to be the sectorial development concept in the agricultural sector.

This development concept contains two meanings. First, taking into account the present deteriorating situations of small-scale farms in Konin Province, it is necessary for such small-scale farms to improve profitability. Second, it is crucial factor for the agriculture sector in Konin Province to survive in severe competition within an enlarged market of EU countries, after Poland enters the EU.

When Poland becomes a member of the EU in the early 21st century, the following impacts will occur in farming operation, even in the period of pre-accession. They are:

a) Present preferential treatments provided to producers will be eliminated or reduced to a certain extent.
b) Strict quality control including regulations on veterinary health, plant health and animal nutrition and food hygiene will be imposed;
c) An influx of EU agricultural produce will be accelerated; and
d) Exports to EU markets will increase, provided that quality of produce satisfies demand in those countries and that EU countries deregulate border protection.

(2) Development strategies

The PCM workshops identified eight Approaches, categorizing means similar to those in the objective tree shown in ANNEX II.

A) Agriculture Knowledge
B) Technological Devices
C) Supplies for Agriculture Production
D) Job Opportunities in Non-agricultural Sectors
E) Farm Management
F) Marketing System

G) Quality
H) Services for Agriculture

The Study Team grouped the eight Approaches into four strategies based upon the field surveys, the analysis of farm surveys and the formation of feasible implementation schemes. Four strategies come from eight Approaches in the following manner.

(Strategy 1) Quality and Productivity Improvement
Approaches (A), (B), (C), (G) and (H) are transferred to this strategy.

(Strategy 2) Modernization of Farm Management
Approaches (E) and part of (A) and (H) are transferred to this strategy.

(Strategy 3) Development of Effective Marketing Systems
Approaches (F) and part of (A) and (H) are transferred to this strategy.

(Strategy 4) Diversification of Agriculture
Approach "(D) Job opportunities in nonagricultural sectors" is transferred to this Strategy.

After "Improvement of profitability of farms in Konin Province" was agreed on as the development concept of the agriculture sector, four strategies were made in order to achieve the goal. They are: "to improve quality of agriculture produce and productivity"; "to promote modernization of farming operation"; "to develop more effective marketing systems"; and "to diversify agriculture operation including increasing nonagriculture income sources". All of these strategies take practical and problem-solution types of approaches which directly focus on producers.

(Strategy - 1) Quality and Productivity Improvement

In order to "improve profitability" of the agriculture sector of Konin, or each individual farm, it is necessary to improve productivity as well as to

provide agricultural produce whose quality meets market demand. This is the purpose of this strategy. Market demand has shifted from quantity to quality. For instance, a supermarket wants to purchase agriculture produce which is classified by size and quality. Likewise, a private slaughter company offers different purchase prices according to meat content (excluding bones) and percentage of lard, and the price gaps between high-and low-quality park is 7.5 percent per kg. Regarding export markets, demand for high quality but lower prices of Polish agricultural produce have increased. Taking into account the future accession to the EU, it is a prerequisite for Poland to produce according to EU standards. A recent event in which the EU limited imports of milk from Poland was basically a result of quality standard.

In order to achieve this strategy, it is necessary to support Konin-style agriculture development by establishment of farming practices suitable for Konin's natural conditions, as well as by development of an appropriate agriculture infrastructure as pointed out in "1.6 Conclusion and Key Issues".

From this point of view, the Team proposes the following projects as concrete implementation tools.

For the purpose of establishment and extension of agriculture technologies suitable for Konin's natural conditions, the following project is proposed.

Project AG-1 "Strengthening of experimental activities on agricultural technologies"

This project aims at strengthening experimental activities and transferring applied technologies to farms. This project is expected to solve producers' complaints about miscommunication between producers and experimental institutions by transferring producers' real demands to experimental institutions. For more detailed information, please refer to the Project Report.

On the other hand, human resource development (training of producers) will be a prerequisite for transferring and disseminating agriculture

technology which can contribute to increase productivity and improve quality. In general, it is said that numbers of people who could lead different sectors in Konin Province are inadequate at this moment and the agriculture sector is no exception. Therefore, there is a strong need for emergence of new leaders who can lead agriculture development under the market economy. In fact, ODR (the agriculture extension center) is conducting a series of training courses about market economies whose targets are young producers. Under these conditions, the following project is proposed in order to train young students to be future leaders of Konin's agriculture development. Koscielce is located in the middle of Konin Province, and agriculture-related institutions such as ODR, the school of agriculture complex, and an agriculture experimental station exist.

Project AG-2 "Strengthening agriculture technology schools in Koscielce"

Regarding development of an agriculture infrastructure, the following "Project AG-3" is proposed taking into account the serious development constraint associated with water shortage problems which need to be solved immediately. Detailed contents of the project are explained in Project Report.

Project AG-3 "Establishment of comprehensive irrigation management system"

While Project AG-3 is aimed at improving productivity directly, it is necessary to take appropriate actions to protect agriculture production from heavy rains and floods. Productivity will also be increased by reducing damage caused by a one-time flood which not only annihilates the year's production, but sometimes affects following years' cultivation, too. Therefore, Team proposes Project AG-4.

AG-4 "Development of on-farm drainage systems"

There is a project which is proposed under a different strategy, but directly and indirectly could contribute to "quality and productivity improvement".

AG-5* "Promotion of Group Sales Activities"

(Strategy - 2) Modernization of Farm Management

In order to improve profitability of farms, modernization of farm management becomes an important strategy. In general, farm management could be modernized either by increasing sales values or by reducing production costs. For the former purpose, improving marketing methods of farms is crucial, and a related project is proposed in Strategy 3.

AG-5* "Promotion of group sales activities"

In addition, introduction of produce whose unit prices are high will also contribute to increases in sales. According to the farm survey, profitability of vegetables and fruit producers (net agriculture profit rate to total profit is 31.8 percent) is higher than cereals (15.0 percent), livestock (8.3 percent) and cereals and livestock mix (24.7 percent). Therefore, research on introduction of particular types of vegetables and fruit which are produced in Konin and sold at higher prices is of great importance. In this regard, the Team proposes the following project proposed under Strategy 4.

AG-6* "Detailed study for vegetables and fruits promotion plan"

The other reason which prevents farm management from being modernized is disguised unemployment. According to the general agriculture census conducted in 1996, the number of small-scale producers with less than 5 ha of land increased to fifty-five percent of total farms, whereas the average land size per farm increased to 8.35 ha. The fragmentation of land was caused by inheritance. To improve productivity and improve profitability, it is necessary to reduce the numbers of producers presently employed by the agriculture sector. In order to absorb an excessive labor force, it is necessary to find jobs in the nonagriculture sector, which is proposed by another sector report. Therefore, a project on a job intermediary center is proposed under this Strategy 2. Although this project is proposed within "Manpower sector", the main purpose is to help unemployed producers find jobs in the nonagriculture sector.

Project MP-4** "Establishment of a job intermediary center with data base"

(Strategy - 3) Development of Effective Marketing System

Development of an effective marketing system is also an important strategy for improving profitability of farms. In general, a similar project is proposed in this report in order to collect and sell agricultural produce effectively. The basic concept underlined in the idea is to share profits which would not have been realized without effective marketing systems enabling reduced transaction costs by both producers and buyers. Another alternative to increase profitability for suppliers is seasonal adjustment of shipments by keeping produce after the harvest and selling it in non-harvesting periods. Appropriate cooling storage facilities are required for realizing this method.

In Konin, producers are discouraged to produce more without having any assurance of selling. During farm interviews, many producers mentioned that they adjusted production amount and could increase production volumes if they could find buyers and sell at reasonable prices. According to statistics, between 1990 and 1996, production of tomatoes (6,715 tons to 2,472 tons), and potatoes (850,803 tons to 640,497 tons) dropped sharply, whereas apples (10,344 tons to 22,182 tons) and onions (12,935 tons to 25,189 tons) increased. These figures clearly show that producers are changing production profiles and production volumes every year according to market demand. In addition, most producers do not have appropriate on-farm storage facilities, which increases losses during storage.

As stated in "1.6 Conclusion and Key Issues", the most important problem existing in Konin's agriculture sector is how to assure incomes for these small-scale farms. One of the key factors to approach this problem is to assure stable selling channels to these small-scale farmers who cannot easily find buyers by themselves, after the demise of the former vertically integrated government procurement systems. As a tool, the Team proposes the following project.

Project AG-5 "Promotion of group sales activities"

This project aims at two things. First is to solve the basic problems of small-scale farmers who cannot increase production volumes, nor invest in modernization of farm management, under uncertain market conditions. Second is to reduce transaction costs of buyers needed for visiting each farm to collect produce. Please refer to the Project Report for more detailed information about this project.

In order to strengthen seasonal adjustment of shipment, construction of a cold warehouse is proposed in the Key Industry sector. This is a heat-utilization project based on heat obtained from hot water generated by the power station. Therefore, it is proposed in the Key three-industry sector. However, this cold warehouse can be operated by utilizing electric power from the agriculture sector's point of view.

Project KI-8** "Construction of a cold warehouse(s) for agricultural products"

Since Project AG-5 focuses on small scale producers, the project site of a collecting point for group sales activities is assumed to be a production area. In the future, such collecting points are expected to be established in many areas. On the contrary, the following DT-7 project aims at providing Konin's agriculture produce to both the province as well as other provinces based on well-developed transportation systems. Please refer to the Project Report for further information about this project.

Project DT-7** "Construction of a distribution center for fruits and vegetables"

(Strategy -4) Diversification of Agriculture

In order to improve farm income, it is necessary to consider other sources of income. The Polish government's integrated rural development policy recommended further promotion of organic farming and agro-tourism. Even though being in an early stage of development, several attempts have already been made in Konin Province, too.

One development strategy is to promote regional specialization in certain produce which is profitable to produce and can represent Konin Province. As an example, the following project proposes to conduct a detailed study on vegetables and fruit which could be promoted in Konin Province.

Project AG-6 "Detailed study for vegetables and fruits promotion plan"

As alternatives to increase farm incomes, organic farming and herb production is proposed. Regarding organic produce, future demand for organic produce is expected to increase and could be a big business chance. Besides, it will contribute to disseminating new production ideas which will diversify agriculture production itself.

Project AG-8 "Promotion of organic farming"

Herbs are suitable for Konin's natural conditions, in the sense they can be grown on less fertile land. In addition, herbs are labor-intensive produce, including the drying process, which will contribute to employing an abundant labor force in rural areas. Besides, the profitability is high, with the profits to sales ratio between 15 to 16% according to a private company's estimate. If the present semi-dried herbs are dried completely, the sales value could be higher. Under these conditions, the Team proposes the following project.

Project AG-7 "Construction of Konin Herb Garden"

Presently, there are twelve agrotourism farms in Konin Province, out of which fifty percent make profits. Some farms already earn about fifty percent or more of total income from agrotourism and many farms have started to have interests in agrotourism operations. In addition, there are some tourist sites for promoting agrotourism in the northwestern part of Konin. Under these conditions, the Team proposes the following project in order to disseminate agrotourism to producers and give them a chance to consider the possibility of obtaining nonagriculture incomes from agrotourism. Please refer to the Project Report for detailed project contents.

Project AG-9 "Promotion of agrotourism"

Extensive agriculture has been practiced for 20 years on the refilled land of mines. However, intensive farming has not been attempted so far. The refilled land has well-maintained, widespread areas, and the discharge water from the mining area is available for irrigation. Good sites are provided for the start of large-scale intensive farming. Under these conditions, this project offers a experimental trial for such large scale farming as one of the possibilities of future diversification of agriculture production.

Project AG-10 "Experimental intensive farms on the refilled land of mines"

The following project is proposed in the sector of the three key industries but can also contribute to the diversification of agriculture in Konin Province.

Project KI-10** "Construction of a greenhouse park"

Chapter 2

ENERGY AND THE THREE KEY INDUSTRIES

Chapter 2 ENERGY AND THE THREE KEY INDUSTRIES

2.1 Introduction

This study takes up the following companies as the three key industries in Konin Province:

- The brown coal mines: KWB Konin, KWB Adamow
- The power stations: ZE PAK S.A. (Patnow, Adamow and Konin Power Stations Group)
- The aluminum industry: Huta Aluminum Konin

Konin province fuel-energy industries started in 1945, when KWB Konin started extraction. Then in 1958, the Konin Power Station started firing brown coal and related industries including the aluminum industry have been developed.

Presently, total brown coal production of the mines amounts to 18 million tons (28.6% of Polish brown coal production), 95 % of which is supplied to ZE PAK. ZE PAK generated net 13,200 GWh of electricity firing brown coal (99.5 % of its' fuel consumption) in 1996. Huta Aluminum produced 52 thousand tons of aluminum in 1996, consuming 955GWh of electricity from ZE PAK which correspond to 7.2% of the total net electricity generated by ZE PAK.

The socioeconomic status of the three key industries in Konin Province is as follows:

- direct employment: 7.8%
- production: 45.7%

Refer to Table 2.7-1 (GDP of Konin Province in 1996 was estimated from the amount in 1995, multiplied by 1.06 of net growth rate and 1.198 of inflation rate). Including the affiliate companies and the supporting companies, it is said that the three key industries carry more than 50 % of the economy in Konin Province.

Table 2.1-1 SOCIOECONOMIC STATUS OF THE THREE KEY INDUSTRIES IN 1996

Company	Sales amount	% of GDP in Konin Province	Number of employees	% of population in Konin Province
Unit	million PLN	%	person	%
Total Konin Province	3,968	100.0	198,400	100.0
KWB Konin	489	12.3	6,900	3.5
KWB Adamow	161	4.1	2,570	1.3
ZE PAK SA	771	19.4	4,450	2.2
Huta Aluminum Konin	393	9.9	1,598	0.8
Total of three key industries	1,814	45.7	15,518	7.8

Source: RDA

Almost fifty years have passed since the first extraction of brown coal. Now Poland and Konin Province are in the midst of reform. Reserves in most of the existing brown coal deposits will be exhausted within 15 years. Power plant facilities have become obsolete and it has been ever more difficult to meet regulations for environmental protection which will be further more stringent, taking Poland's integration into the EU into consideration. Aluminum smelting industry, major-electricity-consuming industry, can only survive if cheap electricity can be obtained.

Owing to the above-mentioned circumstances, it is necessary to study the three key industries--the brown coal mines, the power stations and aluminum smelting industry--as a string, as far as the regional development plan is concerned. In this Section, results of investigation of present situations and future prospects are described as well as issues on district heating and natural gas situations in Konin Province.

2.2 Overview of Energy Situation and Energy Policy in Poland

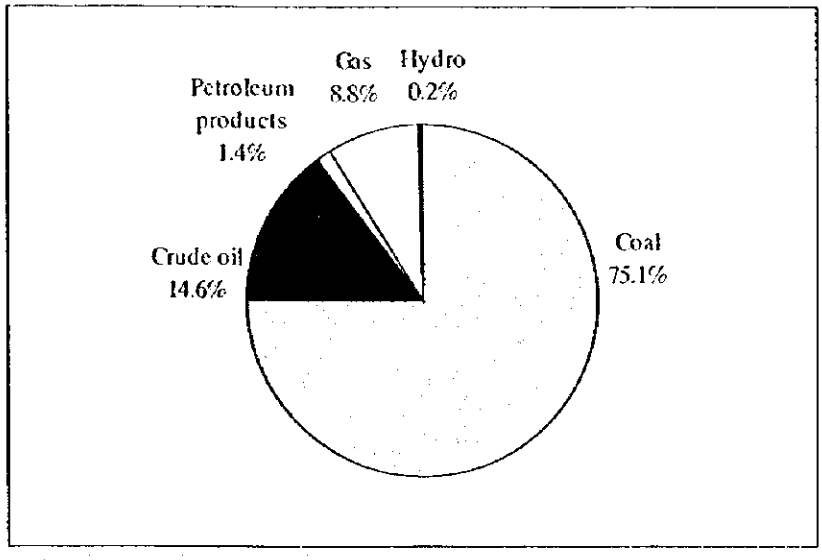
2.2.1 Historical Overview and Present Situation of Fuel-Energy Sector

(1) General

It is reported that Poland's energy use per unit of GDP has been two to three times higher than that of the European Union due to lack of a comprehensive government policy for energy conservation, high share of heavy, energy-intensive industries in GDP, inefficient and obsolete facilities and lack of management for energy conservation. Parts of Poland are known to be among the world's most polluted areas.

Polish primary energy supply has always been dominated by coal. In 1994 the share of coal in total primary energy supply was 75 percent of 92.5 million tones of oil equivalent. The share of oil was 16 percent, reflecting fairly rapid growth. The gas share was 9 percent, rapidly growing in the distribution pipeline network and household gas use. Refer to Figure 2.2-1.

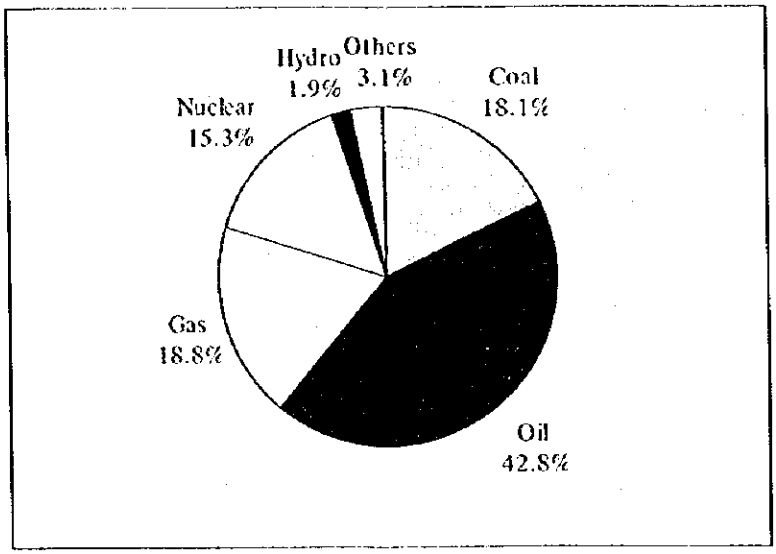
Figure 2.2-1 TOTAL PRIMARY ENERGY SUPPLY IN POLAND, 1994



TPES : 92.5 million tons of oil equivalent (Source : IEA)

As for comparison with the European Union, refer to Figure 2.1-2. There are significant differences in shares of fuel supply.

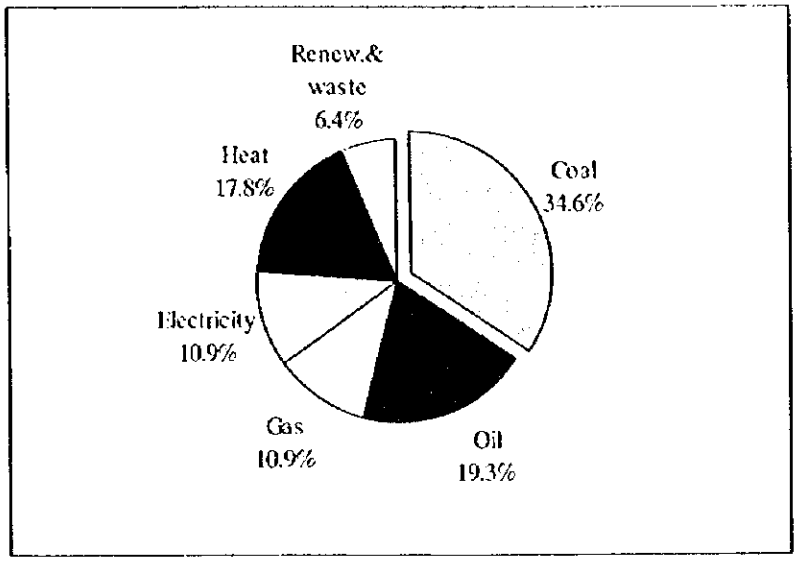
Figure 2.2-2 TOTAL PRIMARY ENERGY SUPPLY IN EUROPEAN UNION, 1994



Source: IEA TPES: 1349 million tons of oil equivalent

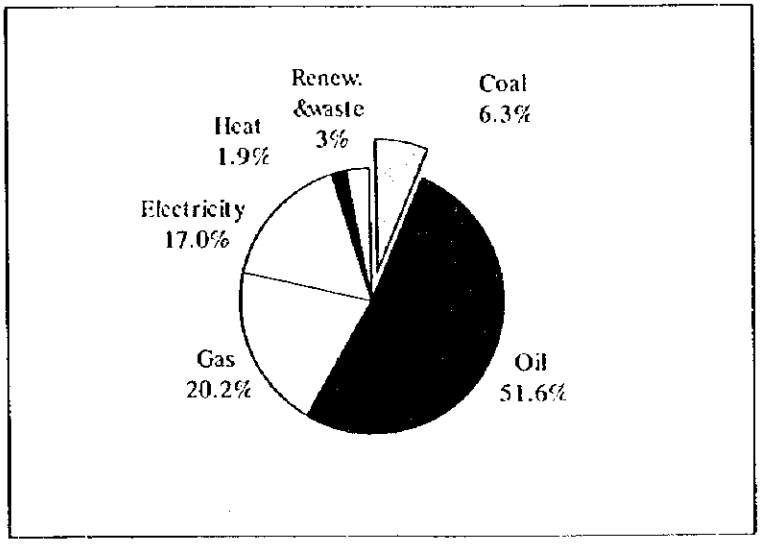
Figure 2.2-3 shows the total final energy consumption structure in Poland. Compared with the one in the European Union, the percentage of direct burning of coal is much higher and consumption of noble energy carriers (oil, gas, electricity) is lower in Poland.

Figure 2.2-3 TOTAL FINAL ENERGY CONSUMPTION IN POLAND,1994



Source: IEA TFC: 66.7 million tons of oil equivalent

Figure 2.2-4 TOTAL FINAL ENERGY CONSUMPTION IN THE EU,1994



Source: IEA TFC: 978 million tons of oil equivalent

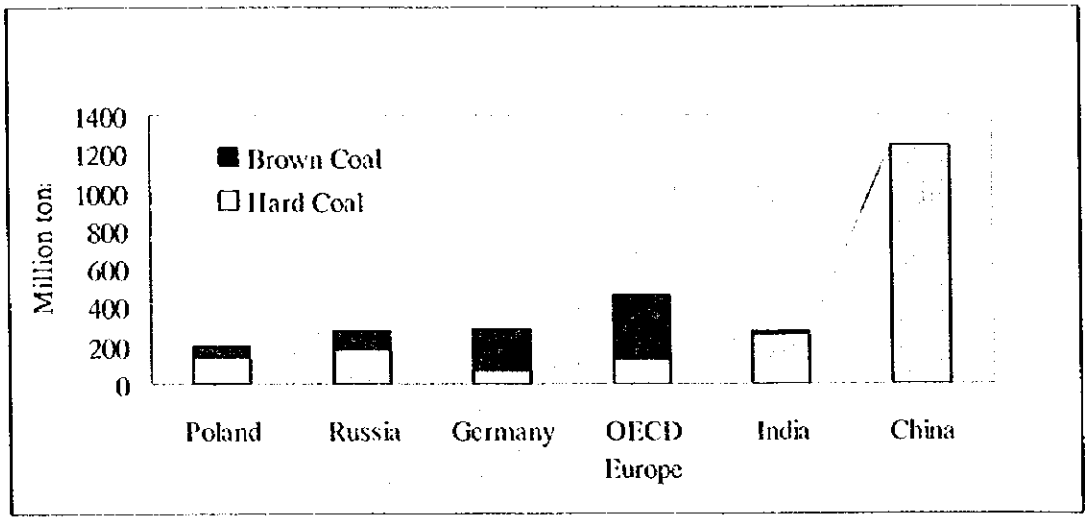
(2) Brown coal and hard coal

Hard coal has been and will be in the nearest future, the basic fuel in Poland. Brown coal is the cheapest primary fuel for the power industry in Poland, currently as well as in the future, at least until 2010.

Hard coal and brown coal production and consumption in Poland are summarized in Table 2.3-1.

Figure 2.2-6 shows brown coal and hard coal production in Poland and other countries.

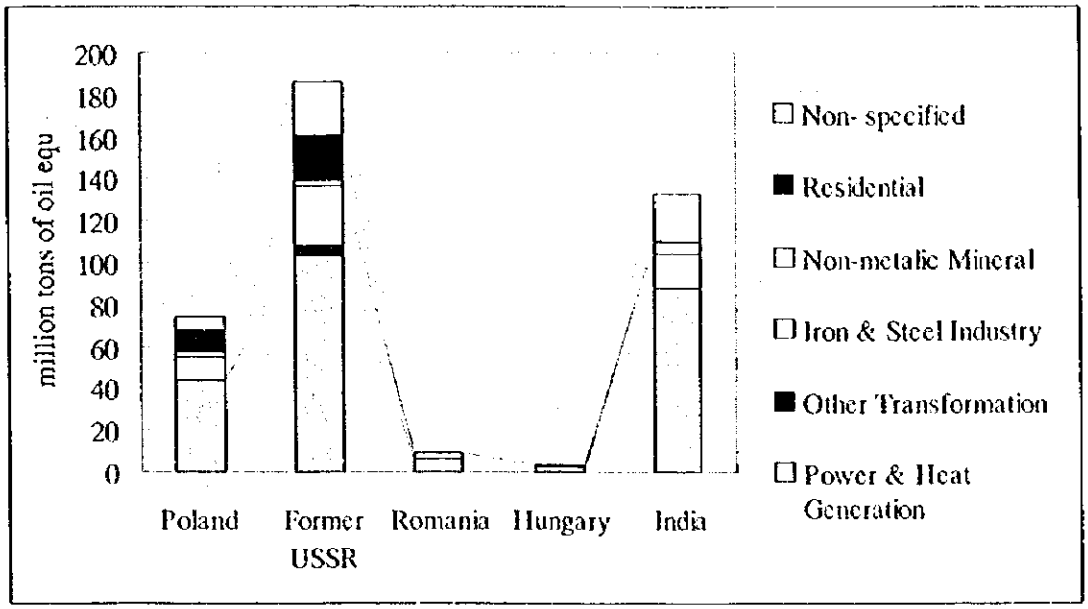
Figure 2.2-5 HARD COAL AND BROWN COAL PRODUCTION IN 1994



Source : IEA

Figure 2.2-6 shows a comparison of hard coal and brown coal consumption in coal-intensive countries. All of the Polish major power plants burn hard coal or lignite, district heating systems are based mainly on coal, and industries, service enterprises and households use coal directly.

Figure 2.2-6 HARD COAL AND BROWN COAL CONSUMPTION IN 1994



Source: IEA

(3) Natural gas

The Polish gas system possesses about 17,000km of transmission gas grids at high pressure and about 84,000km of gas distribution network. The system supplies about 3,900 localities (including 520 towns) in which gas is used by 6.5 million receivers (5.9 million in towns, 0.6 million in the countryside). In 1996, total gas consumption in Poland equaled 10.9 billion m3 (converted into high methanated gas). Industry used 5.4 billion m3 and individual receivers consumed 5.5 billion m3. National resources covers 33% of demand (3.6 billion m3) and import from Russia covers 67% (7.3 billion m3). It is estimated that the consumption of natural gas in Poland for household purposes will increase up to 7 to 8 billion m3/year in 2010. As far as industry demand is concerned, the number of industrial users of natural gas has been increasing not only to new investment but also to modernization. The demand for gas in industries is estimated to increase up to 9 to 11 billion m3 in 2010. In Poland gas has not been used to generate electric energy. However, with regard to requirements for environmental protection, gas is expected to be used for cogeneration using gas turbines in the electro-energetic sector.

The demand for under-ground gas storage to absorb seasonal demand fluctuation is estimated to be 2 billion m3 in 2000 and 4.5 billion m3 in 2010.

The reported natural gas resources in Poland equal 149 billion m3 and content of methane varies from 18% to 98%. Presently, 4 billion m3/year is the output and the natural resources are not sufficient to satisfy domestic needs, so it is necessary to increase import of gas. Considering the prognosis of gas demand and potential gas output in Poland, the supplies of gas from abroad should equal about 9.5 billion m3 in 2000 and 22 billion m3 in 2010. Import from Russia and from the northern sea areas, is considered to be the most economical solution. The gas pipeline running from Russia to Western Europe via Poland offers possibilities of importing increasingly up to 13 billion m3/year until the year 2010 and later.

(4) Electricity and district heat

Generation and consumption of electricity are summarized in Table 2.2-1.

Table 2.2-1 POWER SYSTEM IN POLAND

Items	1990 GWh	1995 GWh	1996 GWh
1 Gross Generation	136,351	139,005	143,138
among which	-	-	-
pablic thermal plant	124,899	126,777	131,088
autoproducing thermal plant	8,152	8,363	8,125
hydro plant	3,300	3,851	3,910
renewable sources	0	14	15
2 Import	10,437	4,356	5,483
3 Export	11,477	7,157	7,925
4 Domestic Consumption	135,311	136,204	140,696
among which	-	-	-
auxiliary consumption of public plants	11,182	11,044	11,683
pumped-storage consumption for pumping	2,614	2,761	2,745
HV and MV consumers (without rail)	53,353	51,943	52,513
household consumers	20,587	18,075	19,224
transmission and distribution losses	11,362	18,070	18,631

Source: Energy Information Center

Concerning public thermal power and district heat production, refer to Table 2.5-4 in Section 2.5.

2.2.2 Energy Policy of Polish Government

Poland's guide lines for energy policy through 2010 (adapted in late 1995) emphasize greater use of oil and natural gas, but coal is expected to remain the dominant fuel, particularly in the electric power sector.

In April 1997, Poland's Sejm approved and the President ratified the new Energy Law for implementing reform in the energy sector. The framework is as follows:

(1) Legislation of a guidelines for energy policy :
Ministry of Economy will make a long-term plan for 15 years.

(2) Introduction of licensing system for energy related enterprises :
Any enterprises can go into business if they satisfy certain standards of legal, technical and financial conditions.

(3) Introduction of a pricing policy for energy :
Free market price determination and price determination for each category of customers based on supply costs.

(4) Establishment of Energy Regulatory Authority :
The organization which gives the license mentioned above. Pricing policy is decided provisionally by the Ministry of Treasury for the coming two years and then shifted to ERA.

(5) Licensing third-party access to the national electricity transmission grid :
Promotion of competitive market mechanism among the electric producers and distributors.

Regarding the new energy policy, the Minister of Economy, Mr. Wiestaw Kaesmarek, mentioned in the newspaper Rzeczpospolita, dated September 9, 1997 that the structure of energetic fuel should be changed, shifting from coal, as a main energetic mineral, toward natural gas and in the future toward nuclear power.

2.2.3 Energy Pricing

In socialist Poland, energy prices were set by the central government. As they were conceived of mainly as a social policy instrument, they were kept artificially low - well below economic cost. This is particularly true for coal, electricity, gas and heat. The energy industries received subsidies enabling them to maintain high-cost production. Since 1990, however, energy prices and pricing systems have undergone real changes.

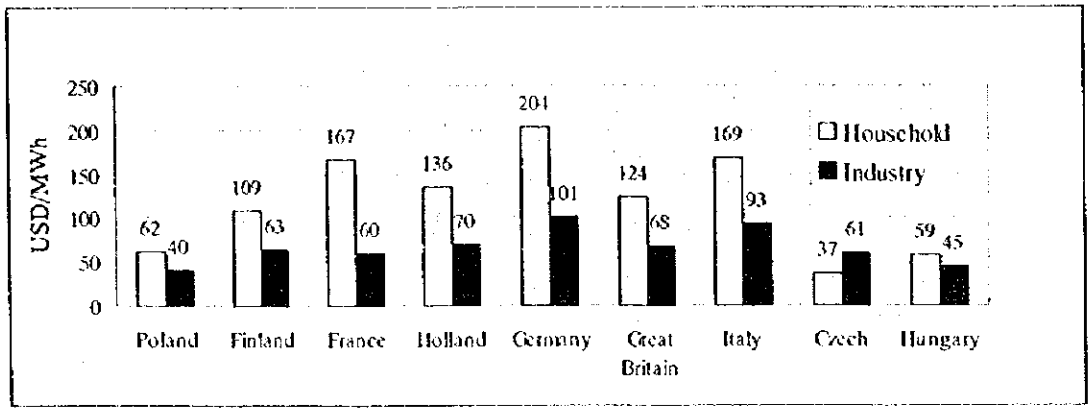
The Government's strategy was first to raise official prices to households to a parity with official prices to industries. In the second step, all electricity, gas and heat prices would have been shifted from direct price control to indirect supervision, i.e. as part of a regulatory framework for energy networks. A second phase of price adjustment to full economic cost would have then taken place within this framework, starting at the end of 1992. For various reasons this policy has been implemented more slowly than envisaged.

Concerning hard coal prices, the long-term interference of the state into determining prices is not expected. The prices since 1990 have been set on the basis of two formulas, one for steam coal and one for coking coal. These formulas relate the prices of all steam and coking coal types and qualities produced in Poland to the prices of reference steam coal and reference coking coal. There have been dispute among the coal and electricity industries on the pricing.

Brown coal prices will be subject to regulatory control because of the non-market character of this energy carrier.

Electricity prices since early 1991 have only kept up with the general rate of inflation, to the detriment of the electricity companies' earnings. In 1993 prices were 40-50 percent below economic costs. There is broad agreement that further real price increases are necessary, and the Ministry of Finance has responded with a plan to raise prices to cost-covering levels, but only very gradually. Electricity price comparison on the basis of 1995 is shown in Figure 2.2-7.

Figure 2.2-7 ELECTRICITY PRICE COMPARISON IN 1995



Source: Polish Energy Information Center

Heat price developments have allowed a reduction in the ratio of subsidies to total costs of heat supplies from 78 percent in late 1991 to about 27 percent at the beginning of 1994. The Ministry intended to implement nominal price increases amounting to about 65 percent during 1994, so that from 1995 the district heating systems in about half of the Voivodships would not need further subsidization. The remaining systems would receive subsidies for two more years. Progress was delayed, but from 1998 the price of heat will be liberalized.

At presents under the above mentioned situations, energy prices in the Konin market are as shown in Table 2.2-2.

Table 2.2-2 ENERGY PRICES IN KONIN MARKET

	Price with VAT	Unit	1997	1996	Unit	1997	1996
	Exchange rate				PLN/USD	3.397	2.876
A	Electricity daily tariff	PLN/MWh	234.00	210.00	USD/MWh	68.90	73.00
	Electricity daily and night tariff	PLN/MWh	180.40	160.00	USD/MWh	53.10	55.60
	Electricity night tariff	PLN/MWh	105.30	90.00	USD/MWh	31.00	31.30
B	Thermal Energy from Energogaz	PLN/MWh	76.00	65.00	USD/MWh	22.40	22.60
	Thermal Energy from Energogaz	PLN/GJ	21.20	18.12	USD/GJ	6.20	6.30
C	Propane and butane	PLN/kg	0.98	0.90	USD/kg	0.29	0.31
D	Fuel oil	PLN/kg	0.93	0.87	USD/kg	0.27	0.30
E	Natural gas	PLN/m3	0.65	0.55	USD/m3	0.19	0.19
F	Hard coal-thick	PLN/kg	0.350	0.276	USD/kg	0.103	0.096
	Hard coal-nut	PLN/kg	0.300	0.248	USD/kg	0.088	0.086
	Hard coal-dust	PLN/kg	0.183	0.135	USD/kg	0.054	0.047
G	Brown coal	PLN/kg	0.187	0.157	USD/kg	0.055	0.055
	Brown coal briquette	PLN/kg	0.070	0.493	USD/kg	0.021	0.171

Source : Energogaz

2.3 Fuel-Energy Sector in Konin Province

2.3.1 Brown Coal in Konin Province

Extraction of brown coal is done by Kopalnia Wegla Brunatnego Konin (KWB Konin) and Kopalnia Wegla Brunatnego Adamow (KWB Adamow). Total extraction amounts to 18.2 million tons which accounts for 28.6 % of total national brown coal production and total sales revenue of 650 million PLN in 1996. Refer to Table 2.1-1 and Table 2.3-1.

Around 95 % of the brown coal extracted from KWB Konin and Adamow is supplied to the Power Plants of ZE PAK S.A. located adjacent to the mines. A part of brown coal is sold as raw material for lignite briquettes. Detailed descriptions are covered in Section 2.4.

Table 2.3-1 PRODUCTION AND CONSUMPTION OF HARD COAL AND BROWN COAL IN POLAND AND KONIN

Items	Hard Coal (in thousand tons)			Brown Coal (in thousand tons)		
	1990	1995	1996	1990	1995	1996
1.Production in Poland	148,296	139,691	139,420	67,584	63,564	63,909
National Production	147,736	138,194	137,444	67,584	63,551	63,870
Import	560	1,497	1,976	0	13	39
2.Consumption in Poland	148,296	139,691	139,420	67,584	63,564	63,909
National Consumption	119,926	108,301	109,702	67,391	63,355	63,864
(Power, CHP, Heat Plants)	81,996	55,808	59,950	67,045	62,282	62,769
Reserve Increase	305	0	798	0	0	0
Export	28,065	31,868	28,920	193	368	45
Balance	0	-478	0	0	-159	0
3.Reference						
Production in Konin				17,245	18,375	18,240
Konin Percentage to Poland(%)				25.5	28.9	28.6

Source : IEA and Statistical Office of Konin

2.3.2 Electricity in Konin Province

Electricity is generated by the ZE Patnow-Adamow-Konin S.A.(ZE PAK S.A.). Fuel for electricity generation is brown coal mainly supplied by KWB Konin and Adamow. Total electricity generation in 1996 amounted to 12.3 TWh, which accounts for 11% of total national electricity generation. ZE PAK S.A. is the second largest of the Polish power plants burning brown coal. Refer to Section 2.4 and Table 2.3-2.

Table 2.3-2 KONIN'S STATUS OF ELECTRICITY AND THERMAL ENERGY PRODUCTION IN POLAND

Items	Electricity (in TWh)				Heat Energy (in PJ)			
	1980	1990	1995	1996	1980	1990	1995	1996
1.Production in Poland	122	122	136	143	715	631	674	709
2.Production in Konin		13.4	14.1	14.4			5.4	6.1
3.Konin Percentage to Poland (%)		10.9	10.3	10.1			0.8	0.9

Source : Statistical Office of Konin

Generated electricity is sold to the transmission company, the Polish Power Grid Company, and resold to a local distribution company. It is said that the ZE PAK S.A. has directly concluded a long-term power supply contract with Huta Aluminum S.A., which is producing primary aluminum adjacent to ZE PAK S.A. As for consumption of electricity in Konin, refer to Table 2.3-3. Detailed descriptions are covered in Section 2.5.

Table 2.3-3 ENERGY CONSUMPTION IN KONIN

Item	Heat Energy (GJ)		Electricity (MWh)		Natural Gas (dam3)	
	1995	1996	1995	1996	1995	1996
Province in Total	3,082,639	3,423,256	2,342,471	2,379,423	14,316	29,027
Industry						
Household			181,594	200,606	9,932	12,918
Towns in Total					14,316	28,708
Industry						
Household			117,241	127,828	9,932	12,673
Village In Total						319
Industry						
Household			64,353	72,778		245
Konin City in Total					5,743	8,127
Industry						
Household			46,917	55,024	5,648	7,290
Kolo City in Total					5,827	17,383
Industry						
Household			13,488	11,646	1,592	2,342
Slupca City in Total						
Industry						
Household			8,259	8,179		
Turek City in Total					2,746	3,188
Industry						
Household			16,942	18,824	2,691	3,041

Source : Statistic Office of Konin

2.3.3 District Heating in Konin Province

(1) Overview of district heating systems

Many inhabitants and industries in Konin Province use heat distribution networks. The heat distribution systems are concentrated in densely populated areas of the region and supply heat to consumers from the power stations, cogenerating heat and electricity, or central boiler houses. The total length of heat distribution networks reached 51.3 km of main pipelines and 107.9 km of distribution lines in 1996. Table 2.3-4 shows the consumption of heat distribution networks in Konin Province.

Table 2.3-4 HEAT DISTRIBUTION NETWORKS IN THE KONIN PROVINCE

Gmina	Total Population	Capacity of Heat Plants Installed (in MW)	Number of Central Boiler Houses	% of Population using Heat Distribution Network
Konin City	82,500	300	1	79.0
Kolo City	24,000	22	1	62.0
Slupca City	15,000	29	1	57.0
Turek City	31,000	45	3	30.0
Chodow	4,000	3	1	20.0
Klodawa	7,500	38	1	32.0
Witkowo	11,000	12.5	2	31.9
Total	175,000	450	10	59.8

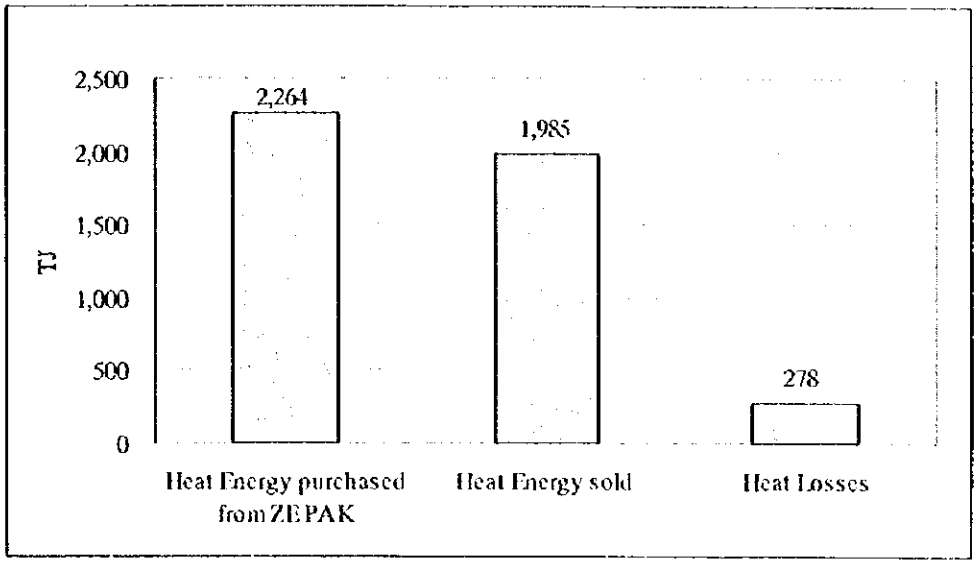
Data source: Voivod Inspection Office of Environmental Protection, 1996

(2) Heat distribution network in Konin city

The Konin Power Station of ZE PAK SA supplies heat to Energogaz, a heat distribution company, and Energogaz supplies heat to consumers through the heat distribution network. Supply capacity of the Konin Power Station is 515 MW. Konin Power Station also directly supplies steam to Huta Aluminum Konin and heat to a greenhouse company.

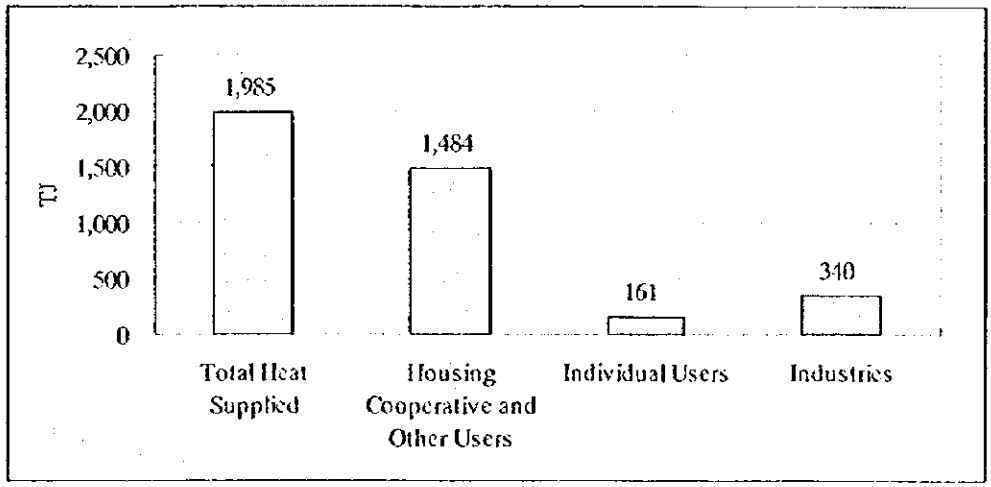
The following Figure 2.3-1 shows heat energy distributed by Energogaz in 1996. The Konin Power Station generated heat energy of about 2,700 TJ including direct supply from the power station in 1996. If the power station generates heat at 100% of heat generation capacity 515 MW in a whole year, total generated heat is 16,240TJ. Therefore, percentage of usage of heat capacity is 16.6 %.

Figure 2.3-1 HEAT SUPPLIED BY ENERGOGAS IN 1996



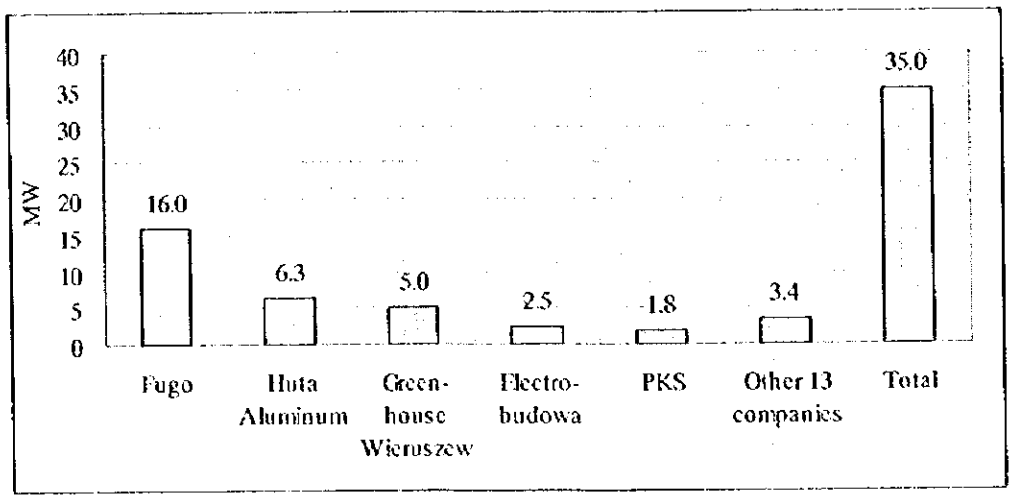
The breakdown of consumption is shown in Figure 2.3-2. Most of the consumption is for household heating and heat consumption for industries is small.

Figure 2.3-2 HEAT SUPPLY FROM ENERGOGAS IN 1996



Supply capacity to industries by Energogaz is shown in Figure 2.3-3.

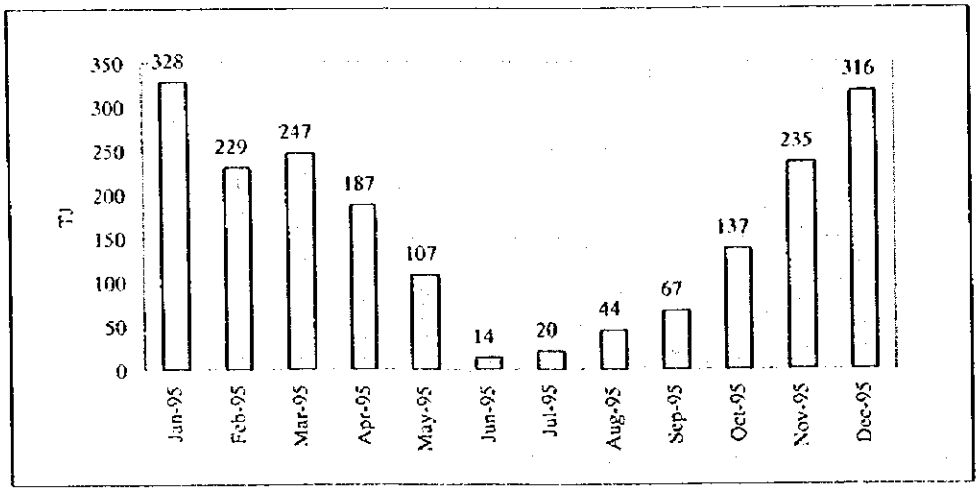
Figure 2.3-3 HEAT SUPPLY CAPACITY TO INDUSTRIES IN KONIN



Source: Energogaz

The seasonal fluctuation of heat consumption is shown in Figure 2.3-4. Maximum consumption occurs in December and January and corresponds to about 25% of the heat generation capacity of the power plant on an average hourly basis of a peak month. In summer, especially in June and July, consumption decreases to less than one twentieth of peak consumption.

Figure 2.3-4 FLUCTUATION OF HEAT CONSUMPTION



Source: Energogaz

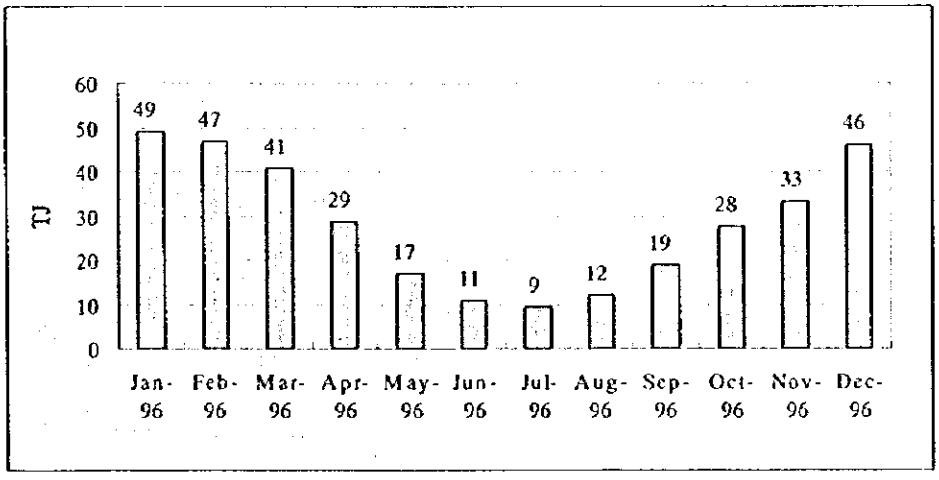
A schematic map of the network in Konin is shown in Figure 2.3-5. It is said that the system for the old Konin area was planned by supposing a 60,000 population. Therefore, there are allowances in the pipeline capacity of heat supply.

(3) Heat distribution network in Turek city

The Adamow Power Station of ZE PAK SA supplies heat to Communal Housing Economy Company (Prezedsiebiorstwo Gospodarki Komunalnej i Mieszkaniowej), a heat distribution company, and the company supplies heat to 60% of Turek city through the heat distribution network. Supply capacity of the Adamow Power Station is 93 MW. Adamow Power Station also directly supplies steam to Miranda, a textile company, and heat to several users. The Communal Housing and Economy Company has a small boiler having a capacity of 5.5 MW which covers an area far from the power station. The boiler will be stopped after the pipeline from the power station is extended to the area. The following Figure 2.3-6 shows heat energy distributed by the Communal Housing and Economy Company in 1996. In Turek, consumers are mainly households for heating. Based on the same calculation as Konin, percentage of heat capacity usage is 11.6%. At peak month it is about 20%.

Figure 2.3-6 HEAT CONSUMPTION IN TUREK CITY

Total Heat Consumed = 340.6 TJ/Year



Source: Turek Communal Housing Economy Company

(4) Heat distribution network in other districts

The source of heat in Slupca is a boiler house located in the biggest company in the area of Slupca City, Mostostal Steel Constructions Factory. The boiler house for the municipality and the factory is provided with a dust collector of 80% efficiency and burns hard coal.

In Kolo, a municipal boiler house is supplying heat. According to the plans of the other communes, it is expected that a significant increase in the length of the heat distribution network will be constructed. Central heating boiler houses will be subjected to modernization for economizing and rationalization. It is also required to minimize heat losses in the supply lines and on the sides of receivers.

2.3.4 Natural Gas in Konin Province

(1) Overview of natural gas status

Natural gas is supplied through a gas pipeline network to households and industries in Konin Province by Polish Mineral Oil Mining and Gas Company (PGNiG). As for the existing and future pipeline network of natural gas in Konin, refer to Figure 2.3-7. The main pipe line with a diameter of 500 mm at the pressure of 5.5MPa crosses Konin Province passing through Turek and Kolo Cities. The branch line with the diameter of 200 mm reaches to Konin City. Another main line already installed from Kalisz to Turek will be extended in parallel with the existing one by the year 2000. Through the pipelines Konin Province can be supplied with domestic and imported natural gas.

Development of natural gas usage in Konin Province is to be one of the most important pro-ecological tasks especially in urban areas. During the 1990 to 1997 period, total length of the gas pipeline network was remarkably extended from 14.7 to 175 km mainly in such large towns, as Konin, Kolo and Turek. In the small gminas, such as Koscielec, Stare Miastro, Babiak, Osiek, development has been started. The main purpose is to replace the obsolete energy-consuming coal boilers with highly efficient gas boilers.

The following Table 2.3-5 shows the development of gas pipeline networks in the major cities and gminas in Konin Province.

Table 2.3-5 NATURAL GAS DISTRIBUTION NETWORK DEVELOPMENT IN KONIN PROVINCE

Gmina	Population	Length of gas pipeline network km (Press.:up to 5kPa)	Length of gas pipeline network km (Press.:5kPa to 0.4MPa)	Length of gas pipeline network km (Press.:over 0.4MPa)	% of population using gas for heating	% of population going to use gas for heating	Nr. of population going to use gas for heating
Konin city	82,500	47.2	28.9	0	2.2	8.1	6,683
Kolo city	24,000	0	24.7	0	3.5	30.0	7,200
Turek city	31,000	14.8	1.7	0	10.0	20.0	6,200
Stare Miastro	8,300	0	19.3	0	0	80.0	6,640
Babiak	2,100	0	under construction	0	0	2.5	53
Kolo	7,000	0	under construction	0	0	3.0	210
Koscielec	6,600	0	under construction	0	0	3.0	198
Other Gminas	317,500	0	0	0	0	13.3	42,272
Total	479,000	62.0	74.6	0	1.2	14.5	69,455

Data source: Voivod Inspection Office of Environmental Protection, 1996

The following Table 2.3-6 shows the rapid development in length of pipeline networks and the consumption with a breakdown for households and industries. According to the gas company's estimation, demand in Konin Province in 2010 will be 270 million m3.

Table 2.3-6 DEVELOPMENT OF NATURAL GAS IN KONIN PROVINCE

Description	1994		1995		1996		1997/10/31		2010	
Total Length of Distribution Network (km)	96		132		156		175		-	
	Household	Industry	Household	Industry	Household	Industry	Household	Industry	Household	Industry
Gas Consumers	7,595	2	8,009	2	8,557	3	8,786	6	86,038	-
% of Gas Consumers using Gas Central Heating	-	-	-	-	-	-	16.1	-	-	-
Gas Sales (thousand m3)	3,737	393	4,202	1,730	5,466	6,387	4,377	8,891	269,290	

Source: Polskie Gornictwo Naftowe I Gazownictwo S.A.

(2) Gas distribution network in Konin city

The gas network in Konin has been planned to supply gas, first of all, to detached housing quarters. Most of the inhabitants are utilizing a heat network from the power station. Separately from the natural gas network supply, Energogaz sold bottled gas (propane and butane) at 1,043 tons (approximately 42TJ: equivalent natural gas volume=1.2 million m3) in 1996 to households.

(3) Gas distribution network in Kolo city

Presently 3.5 % of the population is using gas as fuel for heating. According to plans, it will increase to 30%. Kolo is classified as one of the areas ecologically threatened. Developing the gas network for heating purposes is considered to be a priority task for the Provincial Funds, although 62 % of Kolo's population is using a hot water heating system. Big industries in Kolo are modernizing their boilers from hard coal or brown coal to gas-burning.

(4) Gas distribution network in Turek city

The present gas network was constructed in the new individual housing estates located in the southern part of the city. The network will be extended and 20% of the population will use gas.

Figure 2.3-5 SCHEMATIC FLOW OF HEAT NETWORK IN KONIN CITY

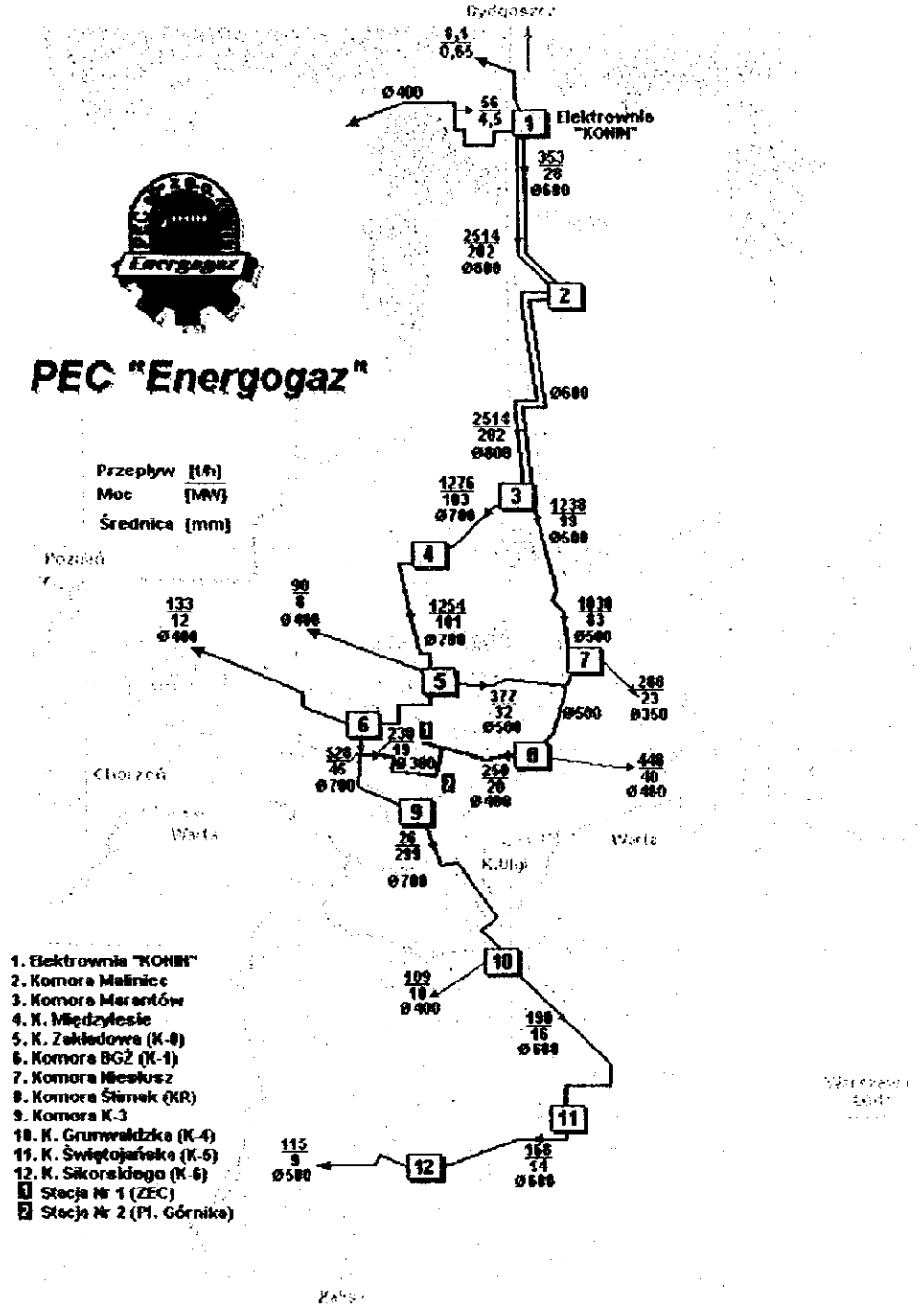
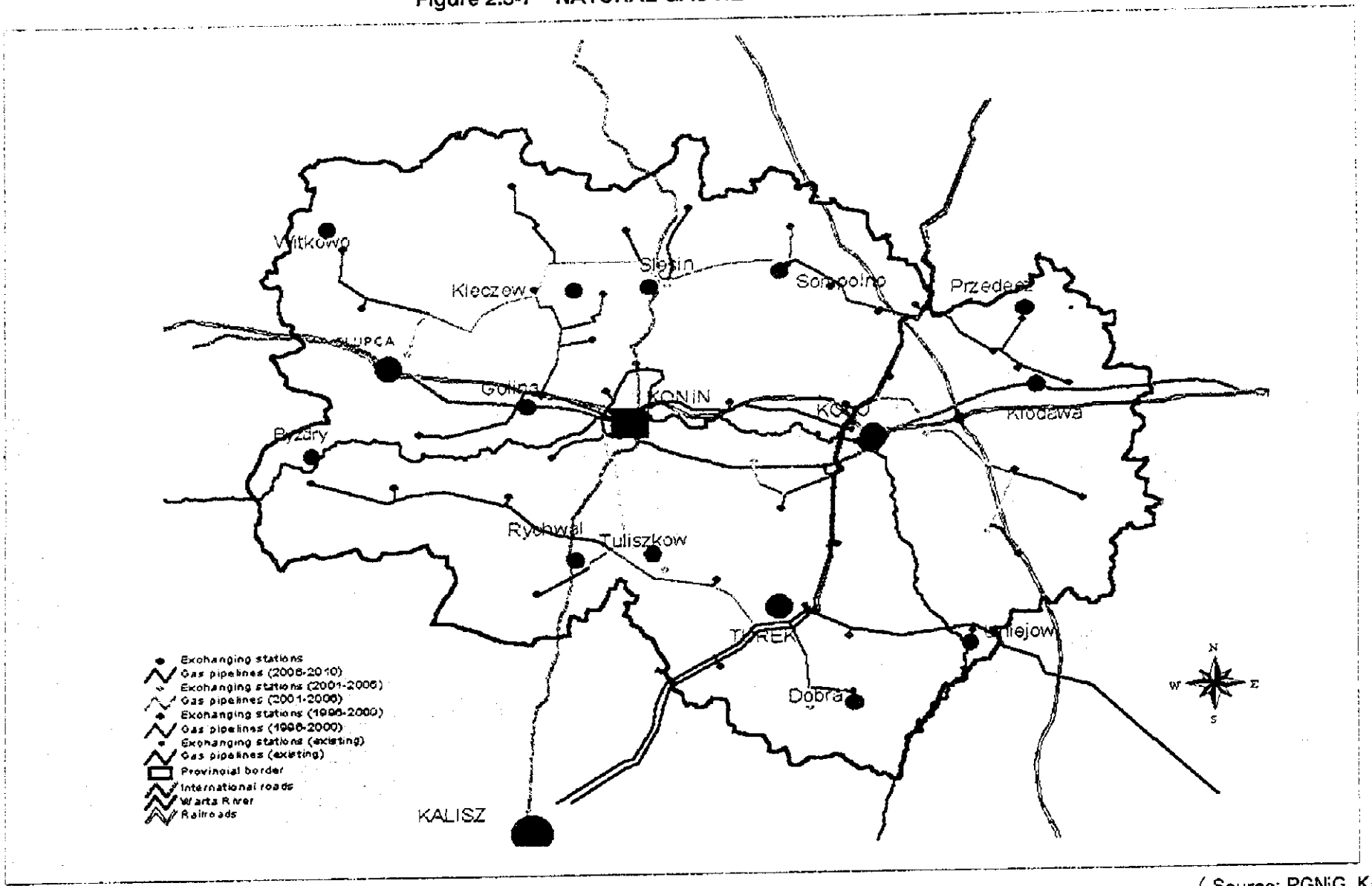


Figure 2.3-7 NATURAL GAS NETWORK IN KONIN PROVINCE



(Source: PGNiG, Kalisz)

2.4 Brown Coal Mines in Konin Province

2.4.1 Introduction

There exist two brown coal mines in Konin Province. One is KWB Konin in Kleczew and the other is KWB Adamow in Turek. KWB Konin was established in 1945 and had 6,882 employees in 1997. KWB Adamow was established in 1959 and had 2,574 employees in 1997. Both of them are state-owned companies.

2.4.2 Brown Coal Deposits and Future Development of New Deposits

(1) KWB Konin

1) Brown coal deposits

Since the start of extraction in 1945, brown coal mines in Konin have developed together with power plant development by ZE PAK S.A. and several open pits laid field to field. Characteristics of brown coal deposits in Konin are summarized as having a number of small deposits of diversified geologic, mining and quality parameters. On the contrary, the "Belchatow" or "Turow" deposits have thicker layers and therefore, an open pit can exist for a longer period.

Open pits of KWB Konin, working and being built are shown in Table 2.4-1. Presently four open-pits at Patnow, Jozwin, Kazimierz North and Lubstow are working and the Jozwin IIb open-pit is now under development. Reserves of deposits in the working and open pits under development are estimated to be 200 million tons and will be exhausted within approximately 14 years at the present extraction rate. In order to meet ZE PAK S.A.'s demand by 2030 to 2040, the company have started research and geological works since the 1980's and several brown coal satellite deposits were discovered and substantiated. Those are listed in Table 2.4-1. It is reported that the deposits have geologic and mining parameters that make mining use of the deposits profitable. The industrial reserves of the newly discovered deposits are estimated to be 369 million tons and have approximately 26 years of life, which is sufficient for meeting the demand planned by ZE PAK S.A.

Table 2.4-1 BROWN COAL DEPOSITS IN KWB KONIN

Present State	Deposit	Category of Deposit studies	Open Pit	Industrial Reserves in Mton	Calorific Value (kcal/kg)	Ash Content (%)	Sulfur Content (%)	Cover (m)	End of Deposit Life (Year)
Working	Patnow II	B	Patnow	9.9	2,153	8.2	0.88		2000 to 2001
Working	Patnow II & III	B	Jozwin I and II A	25.5	2,057	10.1	0.74		2003
Working	Patnow III	B	Kazimierz Pd.	0.3	2,100	7.3	1.25		1997
Working	Patnow III	B	Kazimierz Pn.	53.3	2,056	10.4	0.81		2013
Working	Lubstow	B+C1	Lubstow	51.6	2,150	8.2	0.50		2008
	Total 'Working'			140.6	2,098	9.4	0.7		2008 to 2009
Being built	Patnow IV	B	Jozwin II B	60.0	1,980	13.5	0.99		
	Total 'Being built'			60.0	1,980	13.5	0.99		
	Grand Total			200.6	2,062	10.6	0.78		
Future	Drzewce	B+C1	Drzewce	38.2	1,974	9.0	0.70	75	2017
Future	Piaski	B+C1+C2	Piaski	113.9	1,957	12.1	0.69	45	2031
Future	Makoszyn-Grochowiska	C1+C2	Makoszyn	46.2	1,901	12.1	0.38	45	
Future	Morzyczyn	C1+C2	Morzyczyn	26.1	1,795	18.0	0.81	50	
Future	Deby Szlach. - Izbica Kuj.	C1+C2	Deby Szlach	112.6	2,000	12.6	0.73	27	
Future	Tomislawice	D1	Tomislawice	32.0	1,929	12.4	0.27	47	
Future	Total 'Future'			369	1,951	12.4	0.6		

Source:KWB Konin

It is also reported that, because of the fact that particular deposits are diversified as far as some important parameters are concerned and because there are brown coal deposits in the Konin region which were not thoroughly geologically investigated so far, it is highly provable that there are other brown coal deposits (possibly of better geologic and mining parameters). Those should join the mine's reserve base to replace some of present deposits. Having done an appropriate analysis, the State Institute of Geology approved the concept proposed by KWB Konin. In 1998, search works will be done on the most promising areas.

Financial plans for the exploitation of the new deposits are being elaborated by the company. The scale of investment costs for construction is estimated below. At the moment the schedule of the realization of these investments is not fully prepared, because the deposit search is still in progress and it depends largely on the realization of ZE PAK S.A.'s modernization. Uncertainty concerning financial sources might also influence the schedule of the realization. The present price of brown coal does not guarantee sufficient financing. Depreciation deductions cover only 30% of the cost. In order to keep the supply of 13 million tons/year, the total investment and maintenance cost would amount to 100 million PLN each year between 2003 to 2010. Thus, a more possible scenario would be to keep the level of coal production at the level of 8 to 9 million tons per year and to develop new open-pits with a possibility to finance them.

Table 2.4-2 INVESTMENT COST FOR DEVELOPMENT OF NEW DEPOSITS

Deposit	Development Period million PLN	Development Costs million PLN	Invest. Costs to maintain cap. million PLN	Total million PLN "A"	Reserves million tons "B"	Unit Cost PLN/ton "A"/"B"
Jozwin IIB	1996-2004	230	186	416	60	7
Drzewce	1999-2004	215	83	298	38	8
Piaski	2003-2010	795	580	1,374	114	12
Makoszyn	2008-2012	173	not yet estimated		46	

Source : KWB Konin, price estimation : on 1997 basis

2) Mining facilities

The company has various mining machinery such as excavators, winches, belt conveyers, etc. mainly introduced in the 1960s and 1970s. Modernization of basic machinery will be made by 2003 and will cost about 35 million PLN.

(2) KWB Adamow

1) Brown coal deposits

KWB Adamow was established to supply brown coal exclusively to Adamow Power Station of ZE PAK S.A. Characteristics of brown coal deposits in Adamow are quite similar to those of KWB Konin. Brown coal from Adamow is characterized by higher ash content and lower sulfur content than those from KWB Konin. Ash contains a high percentage of Ca and therefore, SOx emission by burning the coal is much lower than those by burning other brown coals.

Open pits of KWB Adamow, working, being built and in the future, are shown in Table 2.4-3. Three open-pits of Adamow, Kozmin and Władysławow are working. KWB Adamow projects the same rate of output, based upon the present deposits, up to the year 2020. The end of exploitation work on particular open pits will be compensated by production intensification on the remaining pits. The company will start exploitation work on new pits, e.g. "Kozmin Pn". Coal mine existence after the year 2020 is conditioned by discovery of new profitable deposits, as well as by ZE PAK's decision concerning modernization of Power Station Adamow.

The company will make a feasibility study in 1998 on the new development of Kozmin Polnoc, the exploitation of which will supplement the exploitation of the Kozmin open-pit after its liquidation. The work is financed by the company's own resources.

2) Mining facilities

In the years 1990 to 1996 the Company conducted many undertakings aimed at reducing technical costs. That took the form of changing the oldest excavators of the highest operating cost with new, bigger highly efficient excavators. Adamow open-pit possesses two Polish excavators of KWK1500 and a dumping conveyer of ZGOT 8800. Applying new, highly efficient machines allowed a reduction in the number of cover lines. General repair and modernization of 35 years old machines operating in

smaller open-pits is the other goal of modernization work. The process has almost come to an end.

Table 2.4-3 BROWN COAL DEPOSITS IN KWB ADAMOW

Present State	Deposit	Category of Deposit studies	Open Pit	Industrial Reserves in Mton	Calorific Value (kcal/kg)	Ash Content (%)	Sulfur Content (%)	Cover (m)	End of Deposit Life (Year)
Working	Adamow	B+C1+ C2	Adamow	70.6	2,151	20.0	0.53	41.7	2020
Working	Kozimin Poludnie	B+C1+ C2	Kozimin	20.8	2,003	23.8	0.57	33.4	2009
Working	Wladyslawow	B	Wladyslawo w	13.1	1,757	31.4	0.85	31.5	2006
	Total 'Working'			104.5	2,072	22.2	0.58	38.8	2020
Being built				-	-	-	-	-	-
	Total 'Being built'			-	-	-	-	-	-
	Grand Total			104.5	2,072	22.2	0.58	38.8	2020
Future	Kozimin Polnoc	C1+C2		12.9	1,950	27.8	0.46	33.4	
Future	Piaski	B+C1+C2		113.9	2,082	24.8	1.44	42.8	
Future	Total 'Future'			126.8	2,069	25.1	1.34	41.8	

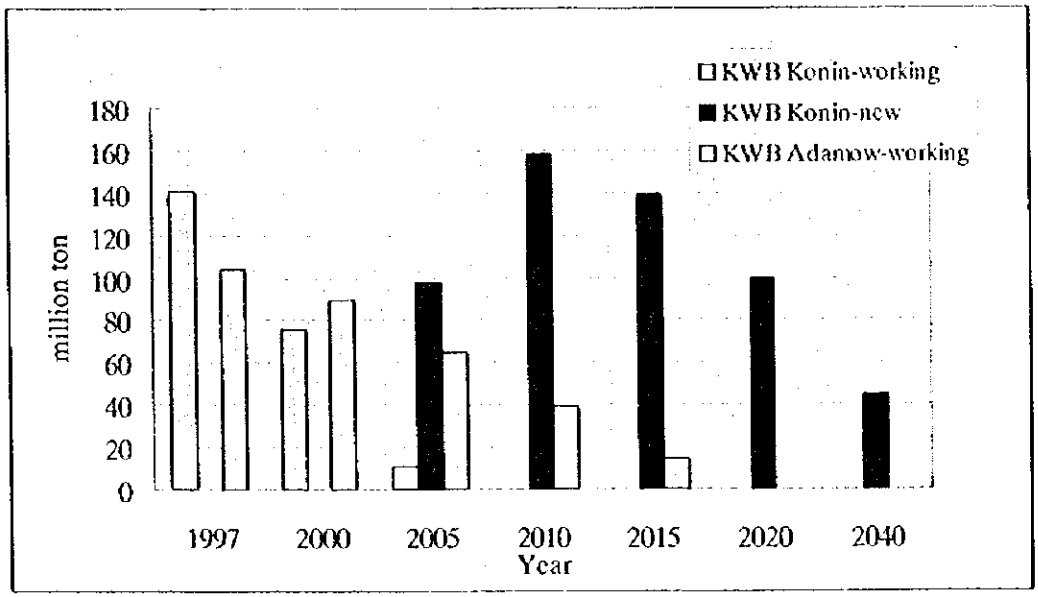
Source: KWB Adamow

2.4.3 Production and Sale of Brown Coal (Present and Future)

(1) Exploitation plan and estimated exhaustion

According to the production plans made by KWB Konin and Adamow, transitions of the reserves in the two mines are shown in Figure 2.4-1. The plans are that production will be kept at the same level as present production (Konin: 13 million tons/year, Adamow: 5 million tons/year) by 2020 and gradually decreased after 2020. In order to match the plans, KWB Konin must develop four new deposits by 2012 (Jozwin IIB is now under development) and more three deposits by 2040.

Figure 2.4-1 TRANSITION OF RESERVES IN KWB KONIN AND ADAMOW



source: KWB Konin and Adamow

(2) KWB Konin

In 1994, KWB Konin extracted a total of 13.4 million tons, of which 12.8 million tons (95.5%) was sold for use in power generation.

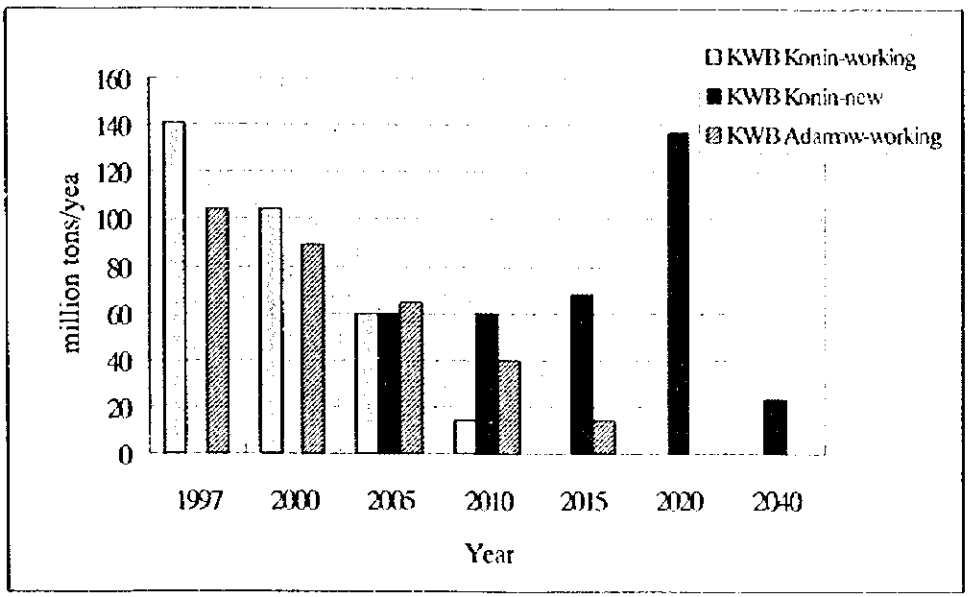
Present plans of ZE PAK S.A. ensure the activity of both of the mine and power plants at the present level, until the year of 2025, and then with a decreasing trend by the year of 2040. By that time the total Konin and Patnow Power Plants' demand forthcoming amounts to 430 million tons. Industrial reserves of existing and being built open pits and balance reserves of future deposits (amounting to 600 million tons) will ensure meeting demand. In order to extract such an amount of coal, it is necessary to start another five open pits by 2020.

KWB Konin and ZE PAK S.A. concluded a coal supply contract for 20 years for the Patnow and Konin Power Stations in 1996. Both companies can acquire great integrity for investment programs.

The above-mentioned plan is based on the scenario that funds for the development of new deposits are successfully financed and no serious

obstacles would appear. Therefore, there will be another scenario to keep production at the level of 8 to 9 million tons/year and to develop new open pits with a possibility to finance them. In this case, development of four deposits including Jozwin IIB now under development will suffice by 2040. Figure 2.4-2 shows the transition of reserves in KWB Konin to a low production basis.

Figure 2.4-2 TRANSITION OF RESERVES IN KWB KONIN AND ADAMOW (LOW PRODUCTION CASE)



Source : Estimation based on KWB Konin's Data

The following Table 2.4-4 shows the working open pits in the above-mentioned two cases. In the case of full production, 3 or 4 open pits will work and in the case of 70% load, 2 or 3 open pits will work. Presently, in an open pit, around 800 to 1,000 employees are working. It would be efficient to concentrate production and to minimize operating open pits. In such ways, rationalization and reduction of employees will be achieved.

Table 2.4-4 EXPLOITATION CASE STUDY OF KWB KONIN

Open pit	Status	Reserves	13million/y production							9 million/y production						
		mil. tons	1997	2000	2005	2010	2015	2020	2040	1997	2000	2005	2010	2015	2020	2040
Patnow	working	9.9	O							O	O					
Jozwin I & IIA	working	25.5	O	O						O	O	O				
Kazimierz Pn.	working	53.3	O	O	O	O				O	O	O	O	O		
Lubstow	working	51.6	O	O	O					O	O	O	O			
Jozwin IIB	under develop.	60			O	O	O	O					O	O	O	
Drzewce	future	38.2			O	O	O							O	O	
Piaski	future	113.9				O	O	O	O						O	O
Makoszyn	future	46.2					O	O	O							O
Morzyczyn	future	26.1						O								
Deby szlach	future	112.6							O							
Tomislawice	future	32							O							

Source : Estimation based on KWB Konin's Data

(2) KWB adamow

Coal extraction, in recent years, has been at the highest level in the whole mine history at about 5 million tons. This results from big demand by Power Station Adamow for coal. The company sells about 20 thousand tons of brown coal to local customers. Maintaining this level of extraction ensures a relatively stable economic situation for the mine.

The coal supply contract with ZE PAK S.A. is concluded on a yearly basis.

2.4.4 Analysis of Operating Data and Competitiveness of Brown Coal

(1) Operation cost analysis

Cost structures of KWB Konin and Adamow in recent years are compared in the following Table 2.4-5.

Concerning the dynamics of each cost items (ratio of the year's figure to the previous year's), the following is pointed out:

- Inflation rates were 128 in 1995 and 120 in 1996.
- Most dynamics of the cost items in 1995 are higher than the inflation rate, but in 1996 the figures become lower than the inflation rate,

especially in KWB Konin. The results reflect progress of rationalization in the company.

- Wage/salaries and related costs are increasing, exactly following the inflation rate.
- Dynamics of income from product sales were lower than the inflation rate. The results depressed profits.

More specifically speaking, the profitability of the mining sector has been lowered because of the negative influence of price regulation by the government. The reason for the low profitability of the mining sector is explained by an analysis of the price increase in the mining sector and the inflation rate. The data are shown below.

1994 from Sept.	Price increase of Brown coal	4.1%
	Inflation rate	11.5%
1995	Price increase of Brown coal	1.5%
	Inflation rate	21.6%
1996	Price increase of Brown coal	8.7%
	Inflation rate	18.8%

For these three years, the increase in brown coal price has been smaller than the inflation rate. That was the result of the depressed price of brown coal.

Concerning the cost structure (percentage of each cost item to total cost), the following can be pointed out:

- Costs for material usage and energy consumption occupy a relatively high percentage, around 30%.
- Wage/salaries and benefits for employees account for 37% in Konin and 46% in Adamow.
- Depreciation costs are less than 10%.

Table 2.4-5 COST STRUCTURE OF BROWN COAL MINES

	Specification	Dynamics (previous year=100)				% structure					
		KWB Konin		KWB Adamow		KWB Konin			KWB Adamow		
		1995	1996	1995	1996	1994	1995	1996	1994	1995	1996
A	Total costs : out of which	135	112	125	122	100.0	100.0	100.0	100	100	100
1	Material usage	148	105	81	150	19.4	21.2	19.7	24.0	15.5	19.1
2	Energy consumption	129	111	125	111	10.0	9.6	9.5	12.2	12.1	11.0
3	Extend/outside services	142	108	221	70	12.7	13.3	12.9	2.6	4.6	2.6
4	Tax & charges	119	117	150	123	9.7	8.5	8.9	6.9	8.2	8.3
5	Wages/salaries	128	120	126	121	24.6	23.2	24.9	31.0	31.3	31.1
6	Benefits for employees	143	104	130	123	12.7	13.4	12.6	14.4	15.0	15.1
7	Depreciation	118	97	157	128	9.2	8.0	7.0	7.2	9.0	9.5
8	Other costs	214	168	299	93	1.7	2.8	4.5	1.8	4.3	3.3
B	Inflation rate	128	120			-	-	-			
	Specification	Dynamics (previous year=100)				Income and Costs in million PLN					
C	Income from products' sale	124.5	105.9			302.5	376.7	393.9			
D	% of total cost to income					86.1	93.6	98.9			
E	Total costs in PLN					260.6	352.5	389.4	98.5	123.0	149.7
1	Material usage					50.7	74.8	76.8	23.7	19.1	28.6
2	Energy consumption					26.2	33.8	36.9	12.0	14.9	16.5
3	Extend/outside services					33.0	46.9	50.3	2.5	5.6	4.0
4	Tax & charges					25.4	30.0	34.7	6.7	10.1	12.4
5	Wages/salaries					64.0	81.7	97.1	30.5	38.5	46.6
6	Benefits for employees					33.0	47.3	48.9	14.2	18.4	22.6
7	Depreciation					23.8	28.2	27.1	7.1	11.1	14.2
8	Other costs					4.5	9.7	17.7	1.8	5.3	4.9

Source: KWB Konin and Adamow

(2) Competitiveness of the brown coal mines

According to the IEA Survey of Energy Policies of Poland made in 1994, it has been analyzed, based on the case of the Turow mine rehabilitation plan, as follows:

- Operating costs for lignite production are estimated at 0.75-0.90 USD/GJ depending on the geological structure of the mine and quality of the lignite.
- Capital costs ; 0.55 USD/GJ
- Full economic costs ; 1.30-1.45 USD/GJ. This corresponds to 28.5-32 USD/tons of hard coal price
- Accordingly, lignite produced from the existing mines is competitive with coal for power generation at the prevailing hard coal price of 32 USD/tons.

The following Table 2.4-6 shows unit cost of brown coal of KWB Konin in 1995 on a GJ basis. Total unit cost is estimated to be 1.13 USD/GJ in 1995. Due to lack of detailed data, it is assumed that the cost figures in 1994 to 1997 on a dollar basis are almost the same as those for 1995. Compared with the above-mentioned IEA analysis, although it is difficult to make an exact comparison, operational cost is a little bit higher than their estimation but capital cost is much lower.

Presently, the cost is fairly lower than the international market price for hard coal. However, working open pits will be exhausted within 15 years, but new open pits will be developed as shown in Table 2.4-2. This requires a large sum of investment and the capital cost will increase. Table 2.4-7 shows the trial balance on the present value basis. The total investment costs for development of new deposits of 212 million tons are estimated to be about 2088 million PLN. The capital cost (cost related to the investment cost) is assumed to be 20% per year. In this case, the total cost of brown coal is 2.05 USD/GJ and much higher than the market price of coal.

In order to compete with hard coal, it is necessary to decrease costs including manpower related costs. Case studies are shown in Table 2.4-6, supposing 30% of manpower decrease in a case of low production and 30% of manpower decrease in a case of full production and other costs are

reduced by 30%. Despite such rationalization taking place, the total cost will exceed the coal market price level.

It is said that Polish coal mines are suffering from big losses due to high costs (in 1995, unit costs of coal sold was 93.59 PLN /t = 37.3USD/t: from Hard Coal Mining Policy of the State and Sector for 1996-2000).

Table 2.4-6 COST OF BROWN COAL MINE

Items	Unit Cost	Full production	70 % load		New open pit: full production	
		1997	No improvement	Manpower 70%	No improvement	manpower:70%, other improv.
Material usage	USD/GJ	0.24	0.31	0.31	0.24	0.17
Energy consumption	USD/GJ	0.11	0.14	0.14	0.11	0.08
Extend/outside services	USD/GJ	0.15	0.00	0.00	0.15	0.11
Tax & charges	USD/GJ	0.10	0.10	0.10	0.10	0.10
Wages/salaries	USD/GJ	0.26	0.00	0.26	0.26	0.18
Benefits for employees	USD/GJ	0.15	0.00	0.15	0.15	0.11
Depreciation and capital cost	USD/GJ	0.09	0.00	0.13	1.01	1.01
Other costs	USD/GJ	0.03	0.00	0.04	0.03	0.02
Total costs	USD/GJ	1.13	0.55	1.14	2.05	1.77
Equival. hard coal price to the cost	USD/t	27.6	13.3	27.6	49.8	43.0
Equivalent hard coal price	USD/t	32.0	32.0	32.0	32.0	32.0

Source : Estimation based on KWB Konin's Data

Table 2.4-7 COSTS OF BROWN COAL NEW OPEN PIT

	Items	Unit	Case-1
A	Total development cost	million PLN	2,088
B	Reserves developed	million tons	212
C	Exploiting capacity	million t/y	13
D	Capital cost per year	% of A/y	20
E	Capital cost per year	million PLN/y	418
F	unit capital cost	PLN/t	32
G	unit capital cost	PLN/ GJ	3.61
H	unit capital cost	USD/ GJ	1.01
I	operation cost	USD/ GJ	1.04
J	Total cost	USD/ GJ	2.05
K	Equivalent hard coal price	USD/t	49.9

Source : Estimation based on KWB Konin's Data

The price escalation of the primary energy carriers on the world market anticipated by IPPT PAN and IEA is shown in Table 2.4-8. According to the estimation, prices of carriers other than hard coal will increase rapidly, and coal and brown coal will be competitive as far as price is concerned.

Table 2.4-8 PRICE ESCALATION OF THE PRIMARY ENERGY CARRIERS (1993-USD)

Items	Source	1995		2000		2010	
		USD/GJ	Ratio	USD/GJ	Ratio	USD/GJ	Ratio
Crude oil, imports from Russia	IPPT PAN	2.96	197	3.51	223	4.37	247
	IEA	2.94	195	3.96	252	4.82	273
Natural gas, import from Russia	IPPT PAN	2.96	197	3.46	220	4.08	231
	IEA	2.72	181	3.65	232	4.42	250
Hard coal, export to Europe	IPPT PAN	1.50	100	1.58	100	1.77	100
	IEA	1.86	124	1.98	126	2.10	119
Brown coal, cost: present	Study team	1.13	75				
Brown coal, cost: new open pit with rationalization	Study team	1.77	118				

source: Energy Information Center

Concerning the price competitiveness among the brown coal mines and hard coal, the following Table 2.4-9 shows that brown coal is more than 40% cheaper than hard coal. In paticular, brown coal from Belchatow is the most competitive. This can be due to the high efficiency of coal mine productivity.

Table 2.4-9 COMPARISON OF FUEL PRICES

Description	Unit Price	Unit Price	Calorific Value	calorific Unit Price		Relative Price
Unit	PLN/Mg (without VAT)	USD/Mg (without VAT)	GJ/Mg	PLN/GJ	USD/GJ $=3.545PLD	
Brown Coal KWB Konin	32.00	9.22	9.00	3.55	1.00	100.0
Brown Coal KWB Adamow	29.36	8.46	7.66	3.83	1.08	107.8
Brown Coal KWB Belchtow	21.31	6.14	7.79	2.74	0.77	77.0
Hard Coal for Power	111.10	32.00	21.98	5.05	1.43	142.2
Hard Coal Small Nut	269.00	77.48	29.45	9.13	2.58	257.0

Source: KWB Konin, 19.11.1997

The following Table 2.4-10 shows the comparison of coal industries' technical economic indices. Productivity of brown coal mines is very high, especially in Belchatow. Productivity in KWB Konin and Adamow is lower, provably due to excess numbers of employees and high ratios of cover/coal and water index.

According to the New Energy Act, the price of brown coal up to the year 2000 is determined by the Energy Regulation Office established by the Ministry of Economy. After 2000, the price shall be liberalized and determined through the negotiation process among KWB Konin, Adamow and ZE PAK S.A.

Table 2.4-10 COAL INDUSTRIES TECHNICAL-ECONOMIC INDICES

Nr.	Item		Hard coal	Brown Coal				
1	Year		1995	Av. of 1997-Jan.toSep	Av. of 1997-Jan.toSep	Av. of 1997-Jan.toSep	Av. of 1997-Jan.toSep	Av. of 1997-Jan.toSep
2	Coal mine	Unit	Total hard coal mines	Total brown coal mines	Adamow	Belchatow	Konin	Turow
3	Average employment	man	274,851	26,910	2,588	10,841	6,970	6,511
4	Number of existing pits	no.		9	3	1	4	1
5	Ratio N(cover)/W(coal)	m3/ton		4.40	7.35	3.42	5.67	4.75
6	Water index (water pumped/coal extacted)	m3/ton		6.33	19.46	5.07	8.33	2.08
7	Average production per month	thous. tons/mon	11,272	5,103	396	2,852	1,011	844
8	Average mass volume removedper month	thous. m3/mon (dw=1.2t/m3)		27,018	3,254	12,160	6,751	4,852
9	Average mass tons removed per month	thous. tons/mon (dn=1.5t/m3)		39,237	4,783	17,526	9,867	7,061
10	Income from entire activity per month	mill. PLN/mon	1,013.0	199.4	14.1	98.1	38.2	49.1
11	Cost of entire activity per month	mill. PLN/mon	1,055.0	197.3	13.9	99.8	36.2	47.4
12	Gross profit per month	mill. PLN/mon	-42.02	2.10	0.14	-1.75	1.99	1.71
13	Cost level index (11/10)	%	104.15	98.95	98.98	101.78	94.77	96.51
14	Index of productivity-1	ton-coal/man/y	492	2,276	1,834	3,157	1,741	1,556
15	Index of productivity-2	thous.PLN/man/y	44.2	88.9	65.2	108.5	65.7	90.5

Source: KWB Konin and Ministry of Economy

2.4.5 Environmental Protection

Strategic activities for environmental protection are bound up with side-effects of brown coal exploitation through cut-and-cover method. Environmental problems are noted below:

- exclusion of a large surface area from agricultural and forestry usage and destruction of soil cover, together with the whole ecosystem, as well as disruption of geological structure within the area of the workings, dumping areas and back-up facilities.

- disturbance of the water system, reduction in the water cavity level, restructuring of the surface water system, and changes in the quality of the surface water such as water dumps from the surface of open pit drainage polluted with coal and mineral suspension and water dumps from the bottom of open pit drainage having the quality of drinking water
- noise of basic machines, supplementary equipment, belt conveyers, drive stations and loading station
- disordered waste management

Environmental protection is one of the most important issues for the mining companies. The mining companies spend a lot of money on environmental investments, i.e. approximately 7 to 10% of total exploitation costs.
KWB Konin and Adamow have taken countermeasures for recultivation and water as follows:

(1) KWB Konin

1) Recultivation of the affected area

Successive recultivation operations at dumping areas behind the front line of mining activities have been continued. A total of 8,881 ha of ground has been used and recultivation covers 3,500 ha, while 4,726 ha are under mining operation.

The exhausted open pit areas are recultivated and brought back into use according to the decisions of local self-governments, which are concerned with the future use for agriculture, forestry or recreation. In the case of agricultural use, the land is used for farming purposes for 10 years, after biological recultivation. Then the class of soil is defined. Usually it can be classified as II-IV class. In the case of forestry use, the land is cultivated and fertilized for 5 years, which makes it possible for the forest stand to get thicker. The following Table 2.4-11 shows the usage plan of recultivated land in the future.

Table 2.4-11 PERSPECTIVES FOR THE USE OF THE FORMER OPEN PITS

Open Pit	Cultivation Period	Total Surface Area in ha	Agriculture	Forest	Water Reservoir	Other Reclaimed Area	Without reclamation (roads, flood dikes,etc.)
Patnow	1995 to 1997	62	0	62	0	0	0
Kazimierz Pld.	2001	711	464	147	99	0	0
Kazimierz Pln.	2010	597	597	0	0	0	0
Jozwin	2017	1,624	568	568	487	0	0
Lubstow	2011	872	329		543	0	0
Drzewce	2018	1,098	569	244	125	36	125
Total		4,964	2,527	1,021	1,255	36	125

Source: KWB Konin in 1997

Final use of deposits will be:

a) Kazimierz Pld open pit; water sports and recreational use
b) Patnow open pit; water reservoir
c) Jozwin open pit; water reservoir
d) Drzewce open pit; water sports and recreational use

2) Water protection

A problem which still needs to be solved is water pumped out from open-pits. At the moment most of the water remains unused and goes to rivers and streams. The mine pumps out water from drainage wells and water cleaned in decanters. All such water could be used if it were distributed to users and appropriate funds could be obtained. The company thinks that the funds for such systems should be provided by the local self-governments.

In order to prevent direct loss of water at farm wells in the area, 700 km of water pipeline networks and 31 water pumping stations were installed by 1994. Later these facilities will be turned over to interested Gmina water service institutions. Most of the land which is being taken over by the mine

have been provided earlier with water supply systems by the Voivodship water and amelioration service. If there is no such a system and there is a proven influence from the mine, the system will be constructed from the mine's own fund and turned over to interested institutions.

Treatment of water from mines in settling ponds has brought them up to Grade II of purity.

(2) KWB adamow

1) Recultivation of the affected area

Total open pit area used from the very beginning of the mine covers 4,795 ha. The present open-pit area covers 2,214 ha. Reclaimed dumping grounds used for agriculture, forest and water reservoir are 1,390 ha, 748 ha and 247 ha respectively.

2) Water protection

a) Land surface drainage
In 1996 the tank in Wladystawow was modernized. Dirty water is filtered in off-road tanks up to the II class. Pollution concentrations of dump water depend on hydrogeological and meteorological factors; a high degree of turbidity occurs during rain, spring thaw and strong winds.

b) Bottom/deep land drainage
Pure/clean water does not pose a pollution problem in water and sewage management. It is a I-class water with the quality of drinking water and does not need filtering. This water is partly used in social back-up facilities and in neighboring villages.

In 1996;

- Water treatment station in Warenka was modernized.
- Water treatment station in Kamionka was modernized.

The modernization works concerned installation of iron removers in order to improve water quality and reduce the amount of Fe and Mn.

In order to reuse water from pits' drainage, there were attempts to store it in artificial reservoirs:

- in 1994, a reservoir was set up (10ha and 600 thousand m3) on the territory of a dumping ground in the Bogdatow open pit, supplied with water from Adamow open-pit surface drainage.
- since 1995, a water reservoir has been set up (205ha, 5.0 mill.m3) on the territory of the inside dumping ground in the Adamow open pit.
- the company is planning to built a water reservoir (90ha, 9.0 mill.m3) on the territory of the inside dumping ground in the Wladystawow open pit.

The volume of the water pumped out from the mining wells and surface water drainage amounts to 174 m3/minute. Presently, the water is diverted to the rivers without effective use. There are no volunteers to use mining water in a different way, which may be a problem. There are no legal regulations, or financial incentives for economic entities using abyssal water (e.g. from the fund of deposit fees partially paid to Gminas).

2.4.6 Present Situation of Privatization, Diversification and Modernization

(1) Commercialization and privatization

Commercialization and privatization in the hard coal and brown coal sectors has not progressed. The Ministry of State Treasury, as the owner of the coal mines, many times declared the possibilities of enterprise commercialization. However, Government policy seems to put the first priority on the modernization and privatization of the power enterprises. It is considered that the brown coal industries still have competitiveness and there is time to wait a formation of a social consensus for privatization.

(2) Progress of diversification and restructuring

1) KWB Konin

In 1990 KWB Konin established the chief engineer section dealing with restructuring and technological development.

a) Most important restructuring undertakings realized in KWB Konin between 1992 and 1995.

- Separation of Repair Workshops as an entity with a full internal accountability.
- Separating the Sonata Hotel as an entity with a full internal accountability.
- Introduction of information systems for various needs in the company
- Change in the system of calculating coal supply for the power plant (actual weighing of wagons with the use of electronic wagons).
- Introduction of INTERGRAPH and INTERTECH design systems for mining, geological and geodesic design (1995)
- Installation of LAN computer systems in the Administrative Workshop Center
- Starting organic mineral fertilizer production based on brown coal (1994)
- Starting up a crushing plant using stones from the open pits (1992)
- Taking over a major share in Honoratka brickyard and financial restructuring of the company (1995)
- Foundation of Aquakon Jsc which produces natural mineral water (1995)
- Sale of company's flats to the residents (1994 to now)

b) On going restructuring

As a basis of all studies concerning restructuring, the company assumes that they are aimed at improving functioning of mines, but, they do not disrupt the already achieved rights of the employees. The company also judges that it is necessary and the right time to make restructuring to minimize costs and to improve management efficiency because of estimated high costs of future new deposit exploitation, although the present company's brown coal is competitive with other fuels and the company's financial conditions is rather good. The following is the company's strategy for restructuring.

One of the solutions aiming at improvement of management efficiency is to separate organizational units from the company's structure. The company has potential opportunities to achieve the following:

- decrease the employment rate and costs, especially emerging from incomplete use of employees
- decrease the size of fixed assets and costs
- limit administrative service activities and costs
- improve management efficiency
- increase the flexibility of actions

What emerges from the analysis of the organizational structure of the mine, is that the selection may concern, first of all :

- Companies with their own accountancy; including Repair Workshops, Mining Works Company, Transport Company, Sonata Hotel and Recreational and Healing Center in Kolobrzegu. These companies are prepared, on the possibility of their selection, to shift from the structure of the mine business into the form of commercial law companies.
- Services and units in the social background of the mine; including Mass Sports Department, Gornik Hotel, Oskard Community Center, Recreational Center in Slesin, Center in Patnow, Mine Refectory in Kleczew
- Administration units: Industrial Guards, Scavengers, Laundry
- Units chosen on the technical basis: Briquette Plant, Repair Department for Support Equipment, Repairs Department, Mechanical and Electric Department of the open-pits
- Basic units: Procurement Department, Marketing Department, ETO, Accountancy, Investment Department.

All of the units mentioned above would act, after separation, as independent economic entities in the form of a commercial law company. The company will carry out the study for realization of restructuring, taking a full consensus among all employees of the mine.

2) KWB Adamow

The company's policy is to maintain the present situation until ownership transformation and organizational changes occur. According to the present long-term plan, the company will be liquidated in 2020 when all deposits are exhausted.

Byproduct materials which can be used for an industrial purpose include Poznan loam. The company sells loam to neighboring pottery companies with signed contracts. The Poznan loam is selectively exploited and stored at the top of the dumping ground near a traffic route. Selective mining of loam requires additional costs bound up with temporary exclusion of loam excavators from exploitation and insufficient usage of transportation units capacities. The sales volume of loam has been 7,000 to 20,000 m3 per year, and the loam sold in 1996 was 11,610 m3. It is said the deposit of loam amounts 1 to 5 million tons.

Apart from loam, the company also sells small amounts of gravel and erratic boulders.

(2) Management improvement activities

1) Employment

a) KWB Konin

KWB Konin was employing 6,882 employees in 1997. The average age of the employees is 41 years old, and the average wage of the employees is 1,500 PLN. The wage level at KWB Konin is more than 25% higher than the national average.

The 6,822 employees are a heavy burden for KWB Konin in terms of personnel cost. The company recognizes the need to reduce the number of the employees. However, considering the socio-economic conditions, the company decided not to conduct a radical restructuring of the organization. Only natural retirement will reduce the number of employees. Last year, 400 employees retired.

b) KWB Adamow

The situation at KWB Adamow is similar to that at KWB Konin. Around 600 employees have been let go since 1990. Employment reduction has been made gradually according to retirement and dismissal at employee's option.

2) Reward system

a) KWB Konin

The company's reward system has a flaw: the company agreement concluded between the management and the six trade unions. That agreement includes issues such as wage rate and retirement payment. Because of the agreement, the management cannot reward well-performing employees apart from under-performing employees other than by promoting them to higher positions. But to increase wages, the management need to get acceptances from six trade unions. The rule is "a single wage rate for the same posts" regardless of performance. There is no fluctuation in the wage rate by work performance of each employee. Moreover, the amount of a bonus is also determined as mainly based on seniority.

Another issue is about retirement payment. There is a negative influence of retirement payment on personnel reform. In order to facilitate the retirement of employees, an early retirement scheme can be introduced. However, there is no room to introduce such a scheme in the company because of the agreement with the trade unions. On the contrary, employees entitled to retirement payment at the time of retirement are limited to persons aged more than 50 and having worked for more than 25 years. This system will motivate employees to stay longer in the company.

According to the company, a modern personnel management system is being prepared.

b) KWB Adamow

High labor cost in the mining sector is an indisputable fact, but taking into account legal and social conditions, any big changes in the near future should not be expected. The hypothesis that it may threaten the company's future is, on the one hand, quite reasonable, but on the other hand experiences to date do not entitle the company to make this problem more serious than it actually is.

The managerial staffs' activities are directed at increasing effectiveness/ efficiency of the labor forces, which signify equipment/machine changes, technological changes and withdrawing from such activities as obtaining both service and goods outside the mine. The results thus far are highly satisfactory and have allowed the mine to function properly recent years. The production volume is 20% higher now, with employment lower by 20%. Introducing further solutions aimed at isolating "pure" mining activity could decreasethe labor force cost further.

The company motivates employees for hard work and initiative using an incentive system :

- bonus system
- prizes (money) from Zadaniowy Fundun Nagoo (Price- Task Fund)

and privileges from Karta Gornika; special salary, anniversary prize, brown coal allowance, Minors' Day prize (4th December), additional annual prize - so-called 14th salary. There is not special system for assessing each employee's performance, but just a current evaluation of workers by a supervisor.

3) Training

The following is the system done at KWB Konin.
Training of technical employees is mainly performed in-house. Technical employees are divided into four levels. In order to be promoted to a higher level, an employee has to pass an examination by study through self-education.

Training of managers is also conducted. This training is provided by an outside training institute. The courses include marketing. If necessary, the company sends employees to the Academy of Economics in Poznan.

2.5 Power Generation Industry in Konin Province

2.5.1 Introduction

Power generation in Konin started in 1958, burning brown coal extracted in brown coal mines in Konin Province. The business expanded with construction on the Konin, Patnow and Adamow Power Plants. The Patnow-Adamow-Konin Power Plant Group (ZE PAK S.A.) was established on December 31, 1994 through a conversion from a state-owned company into a State Treasury Joint Stock Company.

2.5.2 Fuels and Power Generation Facilities and Plan for Modernization

(1) Present power generation facilities

Power Generation Facilities in ZE PAK S.A. includes:

1) The Patnow Power Station

The Patnow Power Station has been operating for 30 years. At present it has a generating capacity of 1,600 MW and consists of:

- 6 boilers with steam generation capacity of 650 t/h, fueled with brown coal (which started in 1967 to 1969).
- 6 condensing turbines of 200MW each (which started in 1967 to 1969).
- 2 boilers and turbines of 200MW each, fueled with fuel oil (which started in 1973 to 1974, but 2 boilers have been stopped)

2) The Adamow Power Station

The Adamow Power Station has been operating for 33 years. At present it has a generating capacity of 600 MW and consists of:

- 5 boilers with steam generation capacity of 380 t/h, fueled with brown coal (which started in 1964 to 1966)
- 5 condensing extraction turbines of 120 MW each (which started in 1964 to 1966).
- thermal heat source of 93 MWt.

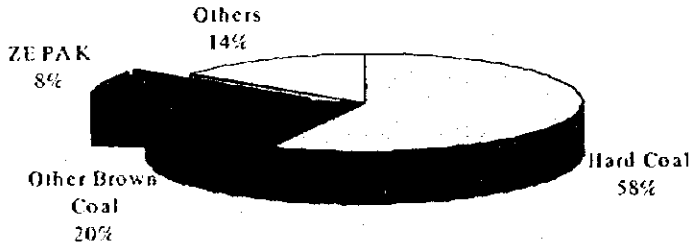
3) The Konin Power Station

The Konin Power Station has been operating for 39 years. At present it has a generating capacity of 538 MW and consists of:

- 5 boilers with steam generation capacity of 130 t/h (which started in 1958 to 1961 and with 2 boilers which were converted into fluidized bed conbustors in1996)
- 1 boiler with steam generation capacity of 230 t/h (which started in 1958 to 1961)
- 2 boilers with steam generation capacity of 280 t/h (which started in 1958 to 1961 and now under modernization)
- 1 back pressure turbine of 28 MW (which started in 1964 and was modernized)
- 3 condensing extraction turbines of 55 MW(which started in 1958 to 1961)
- 3 condensing turbines of 50 MW(which started in 1958 to 1961)
- 2 condensing turbines of 120 MW(which started in 1963)
- Thermal heat sources, started in 1964, and in the following years gradually expanded to the present capacity of 515MWt. The break down of thermal heat generation is as follows:
  a) TG1-SKODA : maximum 65MWt (cogenerated power: 28MW)
  b) TG2-ESCHER WYSS : max. 84MWt (cogenerated power: 50MW)
  c) TG4-7CK60 : max.116.5MWt (cogenerated power: 55MW)
  d) TG5-TK50 : max. 87.5MWt (cogenerated power: 45MW)
  e) Peak Exchanger : max. 162 MWt

The combined capacity of the power turbines installed in ZE PAK S.A. is 2,738 MW which amounts for 8% of total installed capacity in Poland, as of 1995. Refer to Figure 2.5-1.

Figure 2.5-1 INSTALLED POWER PLANT CAPACITY IN POLAND, 1995



Total Capacity in Poland 33GW (Source: ZE PAK)

The Konin and Adamow Plants are adjusted to produce thermal heat:

- Adamow Power Station; 93 MWt
- Konin Power Station; 515 MWt
- Total; 608 MWt

Available thermal energy in Poland is 24,874 MW in 1996 and ZE PAK accounts for 2.5% of it. Refer to Table 2.5-4.

The cooling system in Patnow and Konin is utilizing five lakes as a natural cooling device. Water from one lake is utilized for condenser cooling and then recycled to a more distant lake in order to create a big water circulation. The cooling system in the Adamow Plant is a cooling tower system.

(2) Modernization during the 1984-1997 year period (cost about 200 million USD)

At the beginning of the 1980s', ZE PAK management decided to start a comprehensive modernization of facilities, which was done in several stages. The modification took into consideration modern technological solution and more restrictive requirements for environmental protection. Modernization was done during a shutdown of the facilities for major repairs. In the modernization of power generating facilities, the following activities have been completed:

1) Patnow Power Station
   - replacement of worn-out heating surfaces and their modernization
   - repair of boiler structure and replacement of some beams
2) Adamow Power Station
   - major rebuilding of boiler II line
   - replacement of refractories and insulation
   - development of new start-up system
   - modernization of turbines
   - modernization in the automatic control and electric systems
   - modernization of carbonizing system
   - rebuilding ash removal systems
3) Konin Power Station
   - OB-280P boiler was constructed

- flue gas desulfurization facility was constructed for two OB-280P boilers
- 7CK 60 back pressure turbine was constructed
- major reconstruction of 4 EKM-type boilers and technology of hybrid combustion (HUS) was implemented in two of them
- new water purification plant was constructed
- works related to replacement of supply pumps and some pipelines

Up to the present, the group's modernization activities have upgraded its operation in the following aspects. In terms of the technical aspects, its nominal power was restored and the breakdown rate was decreased from 10-14% to 2-5%. Availability of devices was also increased. As a result, the group's overall technical state was improved.

In terms of the economic aspects, the indices of conventional fuel consumption decreased from 389 g/kWh average in 1980 to 371 g/kWh in 1993. The indices for consumption of electric energy on its own needs was also decreased. Consequently, production efficiency was improved.

In terms of work conditions, danger connected with pressure, voltage, temperature etc. decreased. Dust in boiler rooms was reduced, and the noise level of equipment was lowered. With regard to environmental protection, the emission indices were decreased, and the efficiency of electro-filters was improved.

(3) The major direction of the 1995-2007 development strategy

Technical conditions of facilities in Patnow and Konin Power Stations requires considerable financial outlays for further modernization and reconstruction in next coming years. The amount of necessary investment outlays is estimated to be about one billion USD. The program of technical restructuring covers the period up to the year 2007. Main investment undertakings are listed below:

1) Patnow Power Station

Patnow Power Station needs to modernize 6 units, increasing power generation capacity from 200 MW to 230 MW.

- replacement of 2 fuel oil boilers with fluidized bed combustors on brown coal
- replacement of 4 pulverized brown coal boilers with fluidized bed combustors on brown coal
- replacement or thorough modernization of turbines and machinery-room equipment
- modernization of the power station's general devices

2) Konin Power Station

In the process of modernization,

- finishing construction of boiler No.8
- modernization of carbonizing devices and oil management
- modernization of machinery-room devices

3) Adamow Power Station

After modernization,

- The power station will operate with regular repair activities

In the targeted system, Patnow I Power Station will have power of 920 MW and will burn about 6.7 million tons of brown coal per year, Patnow II-460 Mw and 3.3 million tons of brown coal per year. Konin Power Station will be a power-heat cogenerating plant with maximum power: electricity at 248 MW and heat at 515MWt. About 2 million tons of coal per year till 2004, are reserved for its needs. Gradual expansion of heat sources in the Konin and Adamow Power Stations will enable new receivers to be connected to the heat network. Due to that connection, individual heating and emission of low emitters will be reduced.

The strategy focuses on adjusting electricity generation capacity to the projected coal output at the Konin and Adamow Brown Coal Mines.

Cost estimates for the implementation of the strategy were made with special emphasis on assessing the cost of investment in environmental protection. Estimated environmental protection spending in fixed prices is 811 million PLN, which includes construction of CFB boilers in the Patnow Plant. (CFB boiler has a sulfur removal function.)
In order to implement the above investment projects, the assistance of the National and Provincial Environmental Protection and Water Management Funds in the form of loans and donations is needed. The letter of agreement

was already signed between NEPWMF and ZEPAK SA. A special emphasis was put on the Patnow Plant.

VAP, a joint-venture company to overhaul and subsequently operate what are currently Units 7 and 8 of the Patnow Power Plant, will be created. Therefore, the units are to be separated from ZEPAK S.A.

(4) Funds for modernization

ZE PAK S.A. signed with the Polish Power Network S.A. a contract on power and supply from Units 7 and 8 in the Patnow Power Station II, where ZE PAK S.A. is obliged to thoroughly modernize Units 7 and 8 and PPN SA will ensure power purchase at a price which ensures return of spent investment outlays with a reasonable profit.

Internal resources are to be devoted to the modernization of a successive four units in the Patnow Power Station. Internal resources will be obtained from its own profits and depreciation, as well as by selling ZE PAK S.A.'s shares.

It is assumed that the restructuring program (with total outlays of about one billion USD) will be 70% financed from loans and credits. Still, 30% of the amount has to be financed from internal resources. Financial projections show that ZE PAK S.A.'s own resources may cover only about 40% of its required share in financing investment outlays. Therefore, it is necessary for ZE PAK S.A. to seek additional capital by issuing stocks which would be purchased by investors.

Sources of investment financing in the year 1997 to 2007 (without cost of financial services : price level ; 1997-January):

- Own resources (depreciation+ profit) ; 392 mil. PLN : 13%
- Resources from stock issue ; 512 mil. PLN : 17 %
- Loan from Provincial Environmental Protection & Water Economy Fund ; 112 mil. PLN : 3.7 %
- Loan from National Environmental Protection & Water Economy Fund ; 142 mil. PLN : 4.7 %
- Other credits and loans ; 1857 mil. PLN : 61.6 %

- Total credits and loans ; 2.1 bil. PLN : 70 %

(5) Actions of ZEPAK in harmony with "Assumptions of Energy Policy of Poland until 2010"

Actions target the following three points:

- Sustainable extraction of brown coal in the Konin area on the level of technical possibilities of exploitation for the identified deposits.
- Adjustment to the requirements of environmental protection and extension of durability as well as economic work of about 25-30 years through the next 5 years of the modernization program for power stations.
- Ecological priorities of reduction of SO2 emission and increase in the level of dedusting flue gases.

Continued program of modernization and reconstruction, with specific regard to ecological undertakings, enables minimized burdens of the fuel-energy complex in relation to the environment, and also enables preservation of significant production facilities until 2030, along with perspectives for further work.

(6) Alternation

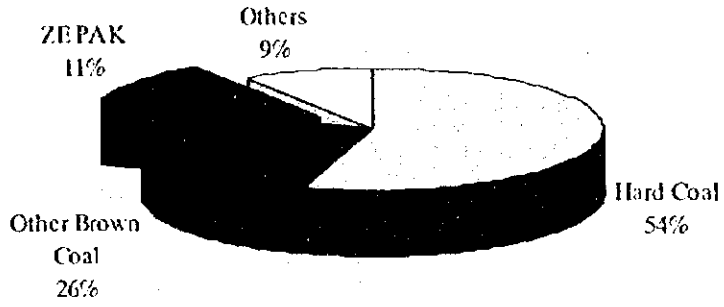
ZE PAK S.A. has an alternative plan to construct combined cycle units with gas turbines. The efficiency will exceed 50% and the location of ZE PAK S.A. is advantageous because it is close to the gas pipeline of Russia-West Europe and big underground gas storage facilities.

2.5.3 Production and Sales

(1) Generated power and heat, fuel consumption and other operation records

Net power generated by ZE PAK S.A. in 1996 was 13.2 TWh. ZE PAK's share of gross generated power in Poland was 11 % in 1995. Therefore, power plants in ZE PAK have been running at a relatively high operation rate among power plants in Poland. Refer to Figure 2.5-1 and Figure 2.5-2.
ZE PAK S.A. produced approximately 2,700 TJ of thermal energy in cogeneration mode in 1995, which accounted for 1.3% of heat generation in Poland. Refer to Table 2.5-4.

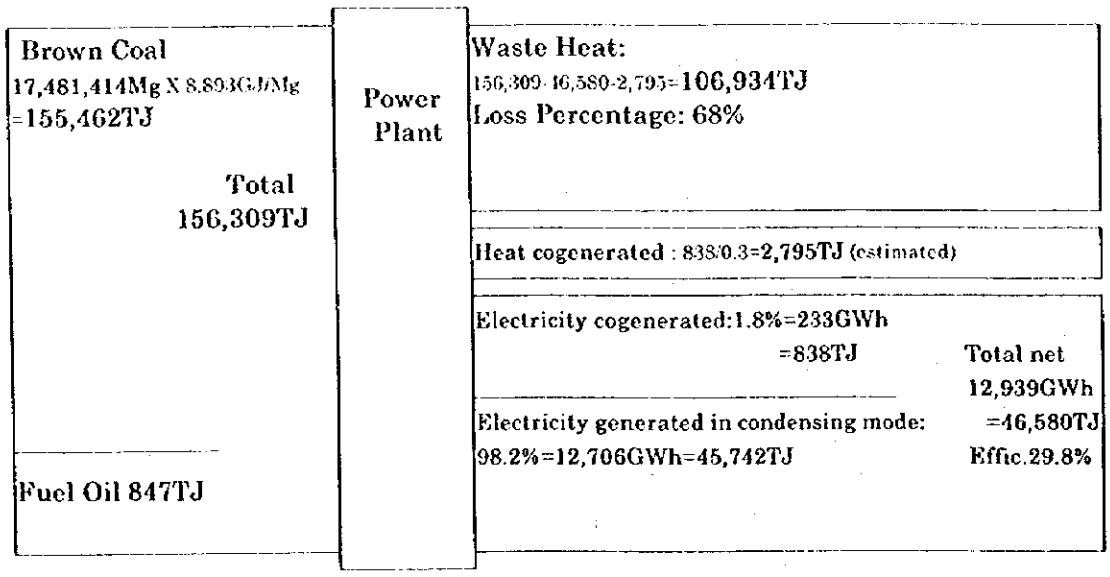
Figure 2.5-2 PRODUCTION OF ELECTRICITY IN POLAND, 1995



Total Production : 139 TWh (Source: ZE PAK)

Operation records in 1994 and 1995 are tabulated in Table 2.5-1 and Table2.5-2. Amount of brown coal consumption was 17.5 million tons in 1995, mainly supplied from KWB Konin and Adamow.
Efficiency of power generation of total facilities in ZE PAK S.A was 29.8% in 1995. Energy Balance is shown in Figure 2.5-3.

Figure 2.5-3 ZE PAK POWER STATION HEAT BALANCE



Source : Estimation from ZE PAK operation data

Table 2.5-1 PERFORMANCE DATA OF ZE PAK POWER STATION

Item	Unit	94-ZE PAK Total	95-ZE PAK Total	95-ZE PAK Patnow	95-ZE PAK Adamow	95-ZE PAK Konin
Total electricity generated	GWh	13,749	14,043	7,340	3,514	3,189
Electricity in cogeneration	GWh	255	260	0	66	194
Electricity in condensing operation	GWh	13,494	13,784	7,340	3,449	2,995
Cogeneration factor	%	1.86	1.85	0.00	1.87	6.08
Loss in the station	GWh	1,080	1,104	535	274	295
Loss in the station	%	7.85	7.86	7.29	7.81	9.24
Net electricty generated	GWh	12,670	12,939	6,804	3,240	2,895
Total fuel energy consumed	TJ	151,015	156,318	78,598	38,220	39,504
Brown coal energy consumed	TJ	150,277	155,471	78,238	37,875	39,358
Fuel oil energy consumed	TJ	738	848	360	341	147
Brown coal energy percentage	%	99.51	99.46	99.54	99.11	99.63
Fuel consumption per net electricity	kJ/kWh	11,919	12,081	11,551	11,749	13,456
Efficiency of power generation	%	30.2	29.8	31.2	30.6	26.8
Cogenerated heat	GJ					
Efficiency of heat & power generation	%					

Source : ZE PAK S.A

Table 2.5-2 FUEL DATA FOR ZE PAK POWER STATION

Source of Data	Unit	ZE PAK S.A. Annual Report 1994	ZE PAK S.A. Annual Report 1995	IEA Survey of Poland Energy Policy 1994	IEA Survey of Poland Energy Policy 1994	ZE PAK S.A. Annual Report 1994	ZE PAK S.A. Annual Report 1995	IEA Survey of Poland Energy Policy 1994
Fuel		Brown coal	Brown coal	Brown coal	Hard Coal	Light fuel oil	Light fuel oil	Natural gas for industries
Calorific value	GJ/ton	8.749	8.893	9.448	24.300		41.021	
Calorific value	Kcal/kg	2,090	2,125	2,257	5,805		9,800	
Calorific value	GJ/Nm3							0.034
Ash content	%	7.300	7.700					
Average price	US$/ton		10.5	12.3-13.7	32.0	67.2	78.0	
Average price	US$/Nm3							0.14-0.16
Calorific price	PLN/GJ	2.39 to 2.73	2.87 to 3.22			4.050	4.770	
Exchange rate	PLN/US$	2.431	2.510	2.431	2.431	2.431	2.510	2.431
Calorific price	US$/GJ	1.016	1.179	Net cost 1.30-1.45	1.317	1.666	1.901	4.11-4.70
Calorific price	US$/Gcal	0.243	0.282	Net cost 0.311-0.346	0.315	0.398	0.454	0.98-1.12
Calorific price	US$/MBtu	0.963	1.118	Net cost 1.232-1.374	1.248	1.579	1.801	3.90-4.46

Source: ZE PAK S.A. and IEA

(2) Sales

In 1996, value of income from selling products and services reached approximately 875 million PLN. ZE PAK S.A. has two basic customers, namely Huta Aluminum and the Polish Power Grid Company (PPGC). Sales to PPGC are based on the medium-term power purchase contract covering the period of 1996-1998.

The quantity of electricity ordered by PPGC amounted to 11,453 GWh and the quantity sold reached 12,315 GWh exceeding the planned quantity by 7.5% in 1996. Another fundamental customer, Huta Aluminum, is the only company in Poland which has a contract concluded in 1996 for direct

purchase of electricity from a power station. The quantity sold to Huta Aluminum was 955 GWh in 1996.

Heat energy is sold to the distribution company, Energogaz, and directly to some companies.

Records of sales revenues in 1994 and 1995 are analyzed in Table 2.5-3. Average electricity price is estimated to be 50.3PLN/MWh (20.7 USD/MWh) in 1994 and 57PLN/MWh (22.7 USD/MWh) in 1995 at the exchange rates of the respective years. According to the data reported by the Poland Energy Information Center, average electricity prices sold by distributors were estimated to be 40 USD/MWh for industrial use and 62 USD/MWh for household use, respectively, in 1995. Refer to Table 2.5-3 and Figure 2.2-7.

Thermal energy price sold by ZE PAK is estimated to be 4.2 USD/GJ in 1995.

Current market prices of energies for household use in Konin are tabulated in Table 2.2-2. Average prices of electricity and thermal energy for household use are 52.4 USD/MWh and 5.2 USD/GJ, respectively, including VAT.

Table 2.5-3 SALES REVENUE OF ZE PAK S.A.

	Items	Unit	ZE PAK SA Group Total 1994	ZE PAK SA Group Total 1995	ZE PAK SA Group Total 1996	Unit	ZE PAK SA Group Total 1994	ZE PAK SA Group Total 1995	ZE PAK SA Group Total 1996
S	Total sales Revenue	Thous. PLN	665,182	770,917	881,756	Thous. USD	273,602	307,163	306,591
A	Electricity Sales Revenue	Thous. PLN	637,779	737,033	837,951	Thous. USD	262,331	293,662	291,360
	Capacity related	Thous. PLN	217,104	221,382	240,885	Thous. USD	89,299	88,207	83,757
	Energy related	Thous. PLN	420,675	515,651	597,066	Thous. USD	173,032	205,455	207,603
B	Heat Sales Rev.	Thous. PLN	22,986	28,014	33,558	Thous. USD	9,455	11,162	11,668
	Capacity related	Thous. PLN	12,657	15,506	18,016	Thous. USD	5,206	6,178	6,264
	Energy related	Thous. PLN	10,329	12,508	15,543	Thous. USD	4,249	4,984	5,404
C	Revenue for tangible service	Thous. PLN	256	267	3,251	Thous. USD	105	106	1,130
D	Social benefits rev.	Thous. PLN	2,783	3,704	3,987	Thous. USD	1,145	1,476	1,386
E	Rev. from sales of materials	Thous. PLN	1,378	1,899	3,009	Thous. USD	567	757	1,046
	Sales of zone capacity	PLN/MW /month	10,321	10,395		USD/MW/ month	4,245	4,142	
	Sales of zone capacity	PLN/MW /h	14.33	14.44		USD /MW/h	5.90	5.75	
	Total sold zone capacity	MW	1,753	1,775	1,836	MW	1,753	1,775	1,836
	Total sold electricity	GWh	12,670	12,939	13,273	GWh	12,670	12,939	13,273
	Total Sold heat	TJ	2,500	2,700		TJ	2,500	2,700	
	Electricity Price	PLN /MWh	50.3	57.0	63.1	USD /MWh	20.7	22.7	22.0
	Heat Price	PLN/GJ	3.78	4.15		USD/GJ	3.78	4.15	

Source : ZE PAK S.A.

2.5.4 Analysis of Operation Data and Competitiveness in the Power Industry

(1) Position in Polish Power Industries

ZEPAK SA's position is significant in the domestic electro-energy sector, both in respect of its installed electric power capacity and share in the

domestic wholesale electric energy market (measured by production amount). Refer to Figure 2.5-1 and Figure 2.5-2.

The importance of ZEPAK SA is increasing if one takes into consideration the geographical location of the Group and other power stations.
The vast majority of power stations is concentrated in Upper Silesia, while ZEPAK SA, together with the ZE Dolna Odra and Ostroieka power stations is one of the three power stations located in the northern half of Poland. Liquidation of the PAK power station would cause need to build new power stations and additionally rebuild high-tension systems. Those would be very expensive investment undertakings.

Table 2.5-4 shows a comparison of the performances of Polish thermal power plants with ZE PAK. Regarding the gross specific fuel consumption for power generation, ZE PAK's figure (11,341 kJ/kWh) is 18% higher than the Polish average (9600 kJ/kWh). Employment per 1MW of installed capacity at ZE PAK (1.63) is much higher than the average (1.01).

(2) Operation cost analysis and competitiveness

Table 2.5-5 shows the cost data for electricity and heat generation. Cost of electricity generation is estimated to be 46.3 PLN/MWh (19.1USD/MWh) in 1994 and 55.6 PLN/MWh (22.2USD/MWh) in 1995. Corresponding selling prices are estimated to be 50.3 PLN/MWh (20.7USD/MWh) in 1994 and 57.0 PLN/MWh (22.7USD/MWh) in 1995. There are very little margins for electricity generation.

The cost structure of the company is shown in Table 2.5-6. The largest portion of costs is fuel and energy consumption (68.7% in 1995). Brown coal cost is estimated at 60.6%. Wages/ salaries and related benefits increased from 13.4% in 1995 to 15.6% in 1996.

As for dynamics, the dynamic values for total costs were 123 in 1995 and 111 in 1996. Inflation values are 125 in 1995 and 106 in 1996 and sales revenues values are 116 and 114. As a result, profit in 1995 deteriorated, but in 1996 it improved. Wages and salaries and benefits increased more than the inflation rate.

Table 2.5-4 ZE PAK's POSITION IN POLISH THERMAL PLANTS

Public Thermal Plants	Total Poland			ZE PAK		Ratio%
Items	1990	1995	1996	1995	1996	1995
Installed Capacity (MW)	26,781	28,027	28,392	2,738	2,738	9.77
of this: brown coal-fired plants	9,058	9,058	9,058	2,738	2,738	30.23
:hard coal-fired plants	17,723	18,969	19,334			
Available Capacity (MW)	25,687	27,270	27,686	1,775	1,836	6.51
of this: brown coal-fired plants	8,923	8,640	8,651	1,775	1,836	20.54
:hard coal-fired plants	16,764	18,630	19,035			
Gross electricity Generation (GWh)	124,899	126,775	131,088	14,043	14,267	11.08
of this: brown coal-fired plants	52,182	50,737	50,858	14,044	14,267	27.68
:hard coal-fired plants	72,717	76,037	80,230			
Electricity cogenerated (GWh)	11,222	14,971	15,763	260		1.73
Brown Coal Consumption (thousand tons)	66,418	62,176	62,769	17,482		28.12
of this: electricity generation	65,837	61,353	62,077	17,482		28.49
average calorific value of brown coal (kJ/kg)	8,290	8,492	8,504	8,893		104.72
Hard Coal Consumption (thousand tons)	47,681	42,752	44,941			
of this: electricity generation	36,041	32,359	34,652			
average calorific value of hard coal (kJ/kg)	19,570	21,455	21,875			
Liquid Fuel Consumption (1000t)	306	264	668			
Gas Consumption (TJ)	293	3,350	6,939			
Specific fuel consumption for electricity						
: gross (kJ/kWh)	10,000	9,600	9,550	11,341		118.14
: net (kJ/kWh)	10,790	10,322	10,290	12,081		117.04
Available Thermal Power (MW)	26,442	24,145	24,874	608		2.52
Heat Production (TJ)	235,046	204,477	224,077	2,700		1.32
of this: cogenerated	141,545	163,921	173,213	2,700		1.65
: separately produced	93,501	40,556	50,864			
of this ; heating boilers	67,017	27,897	37,833			
Specific fuel consumption for heat generation(MJ/GJ)	1,215	1,191	1,183			
Auxiliary Consumption Coefficient (%)	7.29	7.00	7.20	7.86		112.29
Capacity Utilization Time (hours)	4,664	4,523	4,617			
of this: brown coal fired plants	5,711	5,601	5,615			
: hard coal fired plants	4,088	4,008	4,150			
Employment (person)	56,338	56,524	55,371		4,450	
of this: at electricity generation	31,105	28,922	28,636			
Employment per 1MW of Installed Capacity	1.16	1.03	1.01		1.63	

Source : Energy Information Center and ZE PAK S.A.

Table 2.5-5 COST DATA OF ZE PAK S.A.

	Items (Unit cost)	Unit	ZE PAK Group Total 1994	ZE PAK Group Total 1995	ZE PAK Group Total 1996	Unit	ZE PAK Group Total 1994	ZE PAK Group Total 1995	ZE PAK Group Total 1996
	Exchange rate					PLN/USD	2.431	2.510	2.876
S	Total Operation Cost	PLN/MWh	48.7	58.4	63.5	USD/MWh	20.0	23.3	22.1
A	Electricity Cost	PLN/MWh	46.3	55.6	60.2	USD/MWh	19.1	22.2	20.9
	Capacity-related	PLN/MWh	14.1	15.8	16.5	USD/MWh	5.8	6.3	5.7
	Energy-related	PLN/MWh	32.2	39.8	43.7	USD/MWh	13.3	15.9	15.2
B	Heat Cost	PLN/MWh	1.90	2.17	2.37	USD/MWh	0.78	0.87	0.83
	Capacity-related	PLN/MWh	0.99	1.00	1.07	USD/MWh	0.41	0.40	0.37
	Energy-related	PLN/MWh	0.91	1.17	1.30	USD/MWh	0.37	0.47	0.45
C	Cost of Tangible Service	PLN/MWh	0.01	0.02	0.23	USD/MWh	0.00	0.01	0.08
D	Social Benefit Cost	PLN/MWh	0.40	0.53	0.56	USD/MWh	0.17	0.21	0.20
E	Cost of Materials sold	PLN/MWh	0.06	0.11	0.15	USD/MWh	0.03	0.04	0.05
	Total Net Elec. generated	GWh	12,670	12,939	13,273	GWh	12,670	12,939	13,273
	Electricity Cost	PLN/MWh	46.3	55.6	60.2	USD/MWh	19.1	22.2	20.9
	Total heat gener.	TJ	2,500	2,700	3,200	TJ	2,500	2,700	3,200
	Heat Cost	PLN/GJ	9.6	10.4	9.8	USD/GJ	4.0	4.1	3.4

Source : Estimation from the data of ZE PAK S.A.

Table 2.5-6 COST STRUCTURE OF ZE PAK S.A.

	Items	1994	1995	1996	1995	1996
		Cost Structure in kPLN			Dynamics in %	
1	Material & energy usage	425,526	521,745	577,044	122.6	110.6
2	Extend/outside services	44,038	50,626	41,022	115.0	81.0
3	Tax & charges	1,738	3,950	4,782	227.3	121.1
4	Wages/salaries	56,101	68,999	81,586	123.0	118.2
5	Benefits for employees	26,579	35,111	40,936	132.1	116.6
6	Depreciation	23,204	27,810	32,199	119.9	115.8
7	Other costs	38,396	50,845	64,432	132.4	126.7
7	Total	615,582	759,086	842,001	123.3	110.9
8	Sales revenue	665,185	770,920	881,756	115.9	114.4
		Cost Structure in %				
9	Material & energy usage	69.1	68.7	68.5		
10	Extend/outside services	7.2	6.7	4.9		
11	Tax & charges	0.3	0.5	0.6		
12	Wages/salaries	9.1	9.1	9.7		
13	Benefits for employees	4.3	4.6	4.9		
14	Depreciation	3.8	3.7	3.8		
15	Other costs	6.2	6.7	7.7		
16	Total	100.0	100.0	100.0		
17	Cost/Sales revenue	92.5	98.5	95.5		

Source : ZE PAK S.A.

Table 2.5-7 shows the cost data from ZE PAK converted into USD. Total cost per total net generated electricity was 22.1 USD/ MWh in 1996. In these costs, cogenerated heat costs are included. As shown in the Table 2.5-5, net electricity cost excluding costs for heat etc. was 20.9USD/MWh.

Supposing that modernization investment occurs and is completed, and with 16.85 USD/MWh of capital cost taken into account in 1996, total cost will increase up to 38 USD/MWh. The capital costs are calculated on the assumption as follows:

- 30% of total investment; own resources—no interest
- Loan from National and Provincial Environmental Protection and Water Economy Fund; 8.4% of total investment—at 16% interest
- Other credits and loans; 61.6% of total investment—at about 30% interest
- Total investment; 1 billion USD
- Refund; 15 years, straight line 21.3% of total investment per year

Furthermore, in case a price increase for brown coal is taken into account, the total cost will be 49USD/MWh and net cost excluding heat cost will be 47USD/MWH.

ZE PAK is now proceeding with restructuring as well as modernization of facilities. Even if a 30% reduction of employees and efficiency improvement in generation efficiency, etc. are taken into account, the cost will be 43 USD/MWh (net cost of electricity generation excluding heat cost; 41USD/MWh). The cost will be doubled from the cost at the present value.

Table 2.5-7 COST ESTIMATION OF THE POWER STATIONS

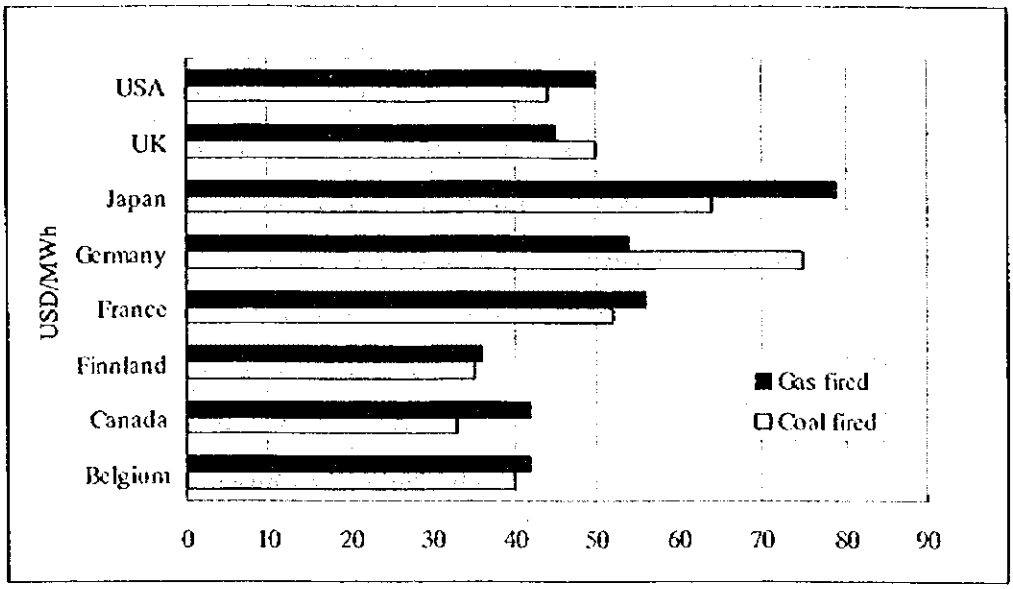
Items (Unit cost)	Unit	A Actual records 1994	A Actual records 1995	A Actual records 1996	B Capital cost added 1996	C Coal price-up 1996	D Rationali-zation 1996
Material & energy use	USD/MWh	13.82	16.07	15.12	15.10	26.10	22.37
Outside services	USD/MWh	1.43	1.56	1.07	1.10	1.10	0.77
Taxes, fees	USD/MWh	0.06	0.12	0.13	0.10	0.10	0.10
Salaries wages	USD/MWh	1.82	2.12	2.14	2.10	2.10	1.47
Employees' benefits	USD/MWh	0.86	1.08	1.07	1.10	1.10	0.77
Depreciation & capital cost	USD/MWh	0.75	0.86	0.84	16.85	16.80	16.80
Others	USD/MWh	1.25	1.57	1.69	1.70	1.70	1.19
Total cost	USD/MWh	19.99	23.37	22.06	38.05	49.00	43.47
Total net electricity generated	GWh	12,670	12,939	13,273	13,273	13,273	13,273
Brown coal consumed	GJ/MWh	11.86	12.02		12.00	12.00	12.00
Fuel oil consumed	GJ/MWh	0.02	0.03				
Brown coal cost consumed	USD/MWh	12.05	14.17		14.20	25.20	21.60
Fuel oil cost consumed	USD/MWh	0.10	0.12				
Total fuel cost	USD/MWh	12.15	14.29				

Source: Estimation from the data from ZE PAK

Figure 2.5-4 shows the cost estimates made by OECD/NEA on the basis of 1992. The increased costs of ZE PAK still have competitiveness, referring to Figure 2.5-4.

Electric prices in European countries are shown in Figure 2.2-7 in Section 2.2. According to the new Energy Law, the prices of electricity will be liberalized and will reach the level of other European countries.

Figure 2.5-4 ESTIMATED COSTS OF ELECTRICITY GENERATION



Source: OECD/NEA in 1992

Table 2.5-8 shows the recent progress in efficiency of pulverized hard and brown coal-fired power stations in the world. To compete with such highly efficient plants it will be necessary to further cut costs in ZE PAK S.A.

Table 2.5-8 PROGRESS IN THE EFFICIENCY OF PULVERIZED FUEL FIRED PLANT

Company	Country	Completion Year	Pressure	Temperature	Reheat Temperature	Normalized Efficiency
			bar	deg c	deg c	%
Aalborg	DK	1997	300	580	580	46
Esbjerg	DK	1992	240	560	560	43.5
Fynsvaerket	DK	1991	240	540	540	42.5
Avedore	DK	1990	240	540	540	41.5
Studstrup	DK	1985	240	540	540	41
Ratcliffe	UK	1967	160	568	568	38
Hekinan No.1	Japan	1991	246	538	569	41.6
Hekinan No.3	Japan	1993	246	538	593	42.1
World standard		1967	160	540	540	37.5
ZE PAK Patnow		1967	127	540	540	31.2
ZE PAK Patnow		2007				37.1
ZE PAK Konin		1958	80	500	500	26.8
ZE PAK Adamow		1964	140	540	540	30.6

Source : IEA and Others