4.3 Economic Evaluation of Energy Conservation Measures at the Equipment Level

As described in Chapter 2, no well-organized statistics are available regarding equipment. Therefore, in order to evaluate energy conservation measures, we used data from the questionnaire survey and the factory energy audit, as well as general relevant data and information available.

First, we examine the current status of equipment being used to formulate necessary measures for energy conservation. Next, based on the results of such an examination, we economically evaluate the measures that permit quantitative analyses. In the evaluation, we employ the same method as used in 4.1.

4.3.1 Lighting

(1) Technical measures

The following are measures considered necessary for equipment:

a. Replacement of low-performance incandescent lumps with fluorescent or tungsten halogen lumps
b. Reduction of excess illumination
c. Correction of distance between the light source and the work place
d. Installation of local lighting
e. Use of reflective, mirror, or metal-plated lampshades
f. Replacement of factory's interior colors with lighter ones

(2) Economic evaluation

Among the measures above, the following are considered to allow a qualitative analysis:

a. ---- The factory energy audit indicates that using tungsten halogen lumps is more economical than incandescent lumps at an output of 200 W or below. To be more specific, with lumps of 700W, a reduction of 1 MWh of electric power will be realized against their costs of about PLN200 in 2000 and PLN780 in 2003.

As shown below (PLN/MWh), 1 MWh of power is estimated to bring savings of PLN676 in 2000 and PLN2,003 in 2003 even in the ammonia industry, which currently enjoys the lowest electricity charges. As a result, we conclude that replacing lumps of 200W or below is economically feasible.

	Iron & Steel	Ammonia	Truck	Tractor	Glass / S.L.B.	Food Processing
(2000)	692	676	800	869	723	892
(2003)	781	763	904	983	816	1,009

Regarding lumps over 200 KW, the measures will be economically feasible if economic incentives such as long-term low-interest loans are available. With 300W lumps, for example, cost per 1 MWh is about PLN930. If a long-term, low-interest loan as described in 4.1 is extended, savings from this measure will be almost doubled (about PLN1,350 even in the ammonia industry) from the usual level, fully covering accrued costs.

According to the questionnaire survey, most incandescent lumps in use operate at outputs ranging from 60 W to 500 W in targeted industries. We estimated how much electricity would be saved in the industries if the lumps at the output of 200 W and below are converted.

In the cost estimation, we assumed that this measure does not require special design or construction work, without using the location factor presented in 4.1.

b.---- This measure is also considered to be economically feasible to a large degree. Nonetheless, we did not conduct a quantitative analysis of the measure, because the questionnaire survey provided only minimal energy savings for all industries.

c.---- The results of the factory audit suggest that, on the whole, this measure will demand a substantial degree of construction work, making it less feasible economically.

4.3.2 Compressor

(1) Technical measures

The following are the possible measures concerning compressors:

a. Improvement in the pressure at startup and stop of operation
b. Improvement in the margin ratio of operation
c. Installation of air coolers
d. Reduction of air leakage
e. Improvement of air pressure

(2) Economic evaluation

Among the measures listed above, the ones that allow quantitative analysis were evaluated as follows:

a. and b. ---- No cost is estimated to accrue in these measures.

c. ---- About 40 units of compressor, if we take into account compressors over 3.7KW, require the installation of coolers in targeted industries. The installation is estimated to bring the energy saving rate in electricity to about 15%, whereas the implementation of the measure will cost about PLN300 per MWh in the year 2000. Consequently, the effects of the measure will be more than twice its costs (at least PN676/MWh), making the measure economically feasible.

c. and e. ---- Based on the results of the factory energy audit, these measures, proposed for a large number of factories, will cost about PLN40 to PLN420 per MWh in 2000, with the effects far exceeding the costs.

4.3.3 Motor

(1) Measures

The following measures are considered to be available for motors:

a. Halting operation when no load is applied
b. Controlling motor rotation
c. Output adjustment in accordance with the power of motor axis

(2) Economic evaluation
Of the measures mentioned above, the following allows a quantitative evaluation:

a.---- From the results of our factory energy audits, we estimate that the installation of inverters under this measure will cost about PLN1,030 per MWh in 2000 and PLN1,150 in 2003. It is suggested then that this measure will be economically feasible if economic incentives are given.

4.3.4 Transformer

(1) Measures
The following measures are considered necessary for transformers:

a. Reduction of loss of iron and copper
b. Improvement power factor
c. Removal of excess or unnecessary transformers

(2) Economic evaluation
The three measures above permit a quantitative evaluation, as follows:

a. ---- If we assume that this measure only comprises replacement with transformers of an equal capacity that minimizes energy loss, its cost is presumed to be PLN100,000 to 150,000 per MWh in the year 2000, making this measure economically infeasible.

b. ---- The cost of this measure is expected to be about PLN2,220 per MWh in 2000. We conclude that this measure is not economically feasible, because only part of it may be feasible even with the economic incentives provided.

c. ---- This measure, proposed in some of our factory energy audits, does not entail high costs. We will deal with this measure in "Improvement of management" in 5.3.

4.3.5 Heating (Air conditioning)

(1) Technical measures
For heating (air conditioning), the following measures are considered necessary:

a. Correction of ventilation frequency
b. Recovery of drain
c. Reinforcement of insulation for factory buildings

d. Implementation of humidity control measures
e. Prevention of heat release from piping
f. Installation of curtains at entrances and exits
g. Introduction of external air

(2) Economic evaluation
Of the measures above, the following permit a quantitative analysis:

a. ---- Because it does not cost much to implement this measure, it will be dealt with in "Improvement of management" in 5.3.

b. ---- The results of the questionnaire survey indicate that, in factories using hot-water heating systems, almost all drain is recovered, with only a small portion of the premises of factories using steam heating systems showing a low drain recovery rate. We conclude, therefore, that this measure need not to be considered.

f. and g. ---- These two measures were proposed in the energy audit of meat processing factories. As already suggested in 4.2, these measures will be economically feasible in most cases.

4.3.6 Boiler

(1) Technical measures
The following measures are considered necessary for boilers:

a. Reduction of excess air
b. Improvement of load factor
c. Correction of thermal level for boiler housings

(2) Economic evaluation
The following measure permits a quantitative analysis:

a. ---- This measure does not demand high costs. A number of proposals are presented in the factory energy audit.

4.3.7 Industrial furnace

(1) Technical measures
The following measures may be considered for boilers:

a. Reduction of excess air
b. Installation of heat recovery devices
c. Reinforcement of seals on openings
d. Reinforcement of insulation
e. Reduction of time for cooling furnaces and time for waiting for operation start

(2) Economic evaluation

Of the measures above, the following permit a quantitative evaluation:

a. ---- This measure does not demand high costs. A number of proposals were presented in our factory energy audits.

b. ---- This measure is proposed in the energy audit at Labedy's factory. The cost of this measure is about PLN110 per GJ in the year 2000, compared to its effect of about PLN2,460, making the measure sufficiently feasible economically. The feasibility of this measure is also corroborated by the questionnaire survey (the effect-to-cost ratio is estimated at about 50).

c. ---- This measure is proposed in the factory energy audit at Ostorawiec. The cost of this measure will be only about PLN7 per GJ in 2000, with its effect (PLN2,460 as with above) by far surpassing its cost.

d. ---- This measure was also proposed in the factory audit at both Labedy and Ostorawiec. This measure will cost PLN35 to PLN90 per GJ in 2000, far exceeded by its effects (PLN2,460).

[Reference]

(1) The Japan Machinery Federation and the Japan Society of Industrial Machinery Manufacturers (1997), "Survey Report on the Establishment of Plant Cost Indices" (annual edition) (In Japanese).

(2) Oak Ridge Associated Universities (1980), "Industrial Energy Use Data Book," Garland STMP Press.

(3) UK Department of Energy (1984), "Energy Use and Energy Efficiency in UK manufacturing Industries up to the Year 2000," Her Majesty's Stationary Office.

5. ESTIMATION OF FUTURE ENERGY INTENSITIES FOR TARGETED INDUSTRIES AND EQUIPMENT

5. ESTIMATION OF FUTURE ENERGY INTENSITIES FOR TARGETED INDUSTRIES AND EQUIPMENT

5.1 Method of Estimation

In this chapter, we will estimate the future energy intensity (E.I.) for the targeted industries and equipment. For both industries and equipment, E.I. (for 2000 and 2003) is estimated by the method described below, in accordance with the four component factors of the policy scenarios mentioned in Chapter 3.

In Figure 5.1, the flow (including the source and the use of data / information) of E.I. estimation work for each industry (as well as for each equipment in each industry) is shown.

In the following paragraphs, details of assumptions on which the estimation is based are discussed for each of the component factors of scenarios, in accordance with the flow chart.

First, for improved management, the rate of energy conservation (the rate of reduction from the E.I. in 1997) is estimated based on:

a. The results of the factory energy audit,

b. Data concerning energy use in each industry (That is, it shows that the E.I. of an industry does not differ so much when compared to the excellent factories, or that the E.I. of another industry differs widely from them), and

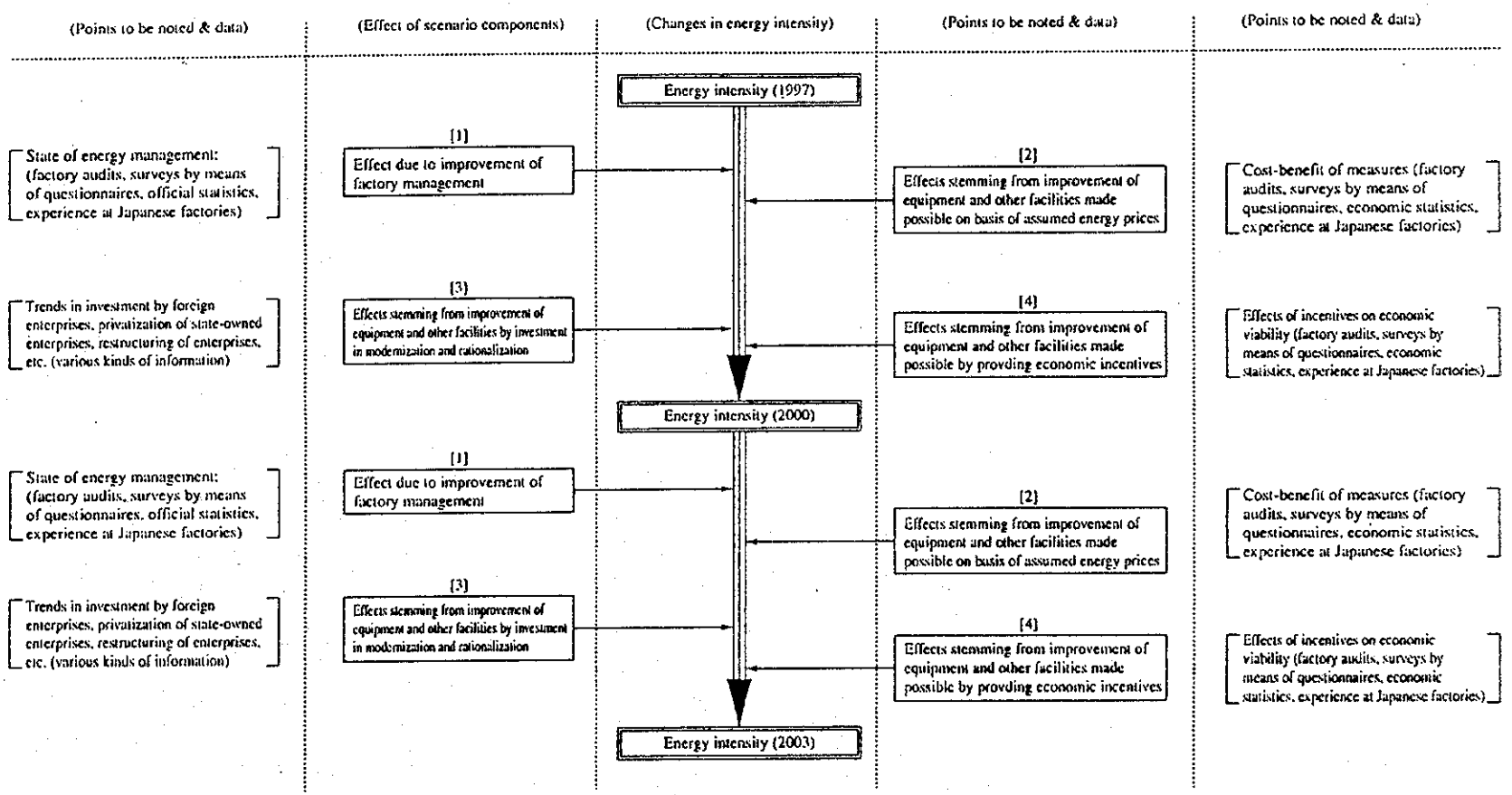
c. Experiences in Japan.

It is assumed that energy will be conserved more by the "improved management" in the A.E.C. Scenario than in the E. C. Scenario.

In addition, the measures for "improved management" mentioned here include, in principle, only those with no "cost" (on equipment / factory) for implementation. In other words, of the measures listed in the "improved management" for the economic evaluation in each industry in Chapter 4, those that incur a certain cost for implementing are included in the "modification of equipment," mentioned in the next paragraph.

Second, the economic evaluation of energy conservation investment (for the "modification of equipment") in each industry, based on assumed energy prices (which are the same in both Scenarios), is made using the method mentioned in Chapter 4.

Figure 5.1 The Effects of the Four Components in the Scenarios on Changes in Energy Intensity



Notes:
[1] ··· will be strengthened under the AEC scenario compared with the EC scenario
[2] [3] ··· common to both EC and AEC scenarios
[4] ··· applicable only to the AEC scenario

Third, concerning the policy for the "modernization and rationalization of process," the assumption was made that the current policy would be maintained as already mentioned in Chapter 3.

Fourth, concerning "economic incentives," an assumption was made, as already discussed in Chapter 4, that low-rate, long-term loans, as shown below, would be offered (for the A.E.C. scenario only).

a. Interest rate (annual rate in the real term): 3% (2000), 2% (2003)
b. Loan period: 10 years (2000 and 2003)

5.2 Estimation Results concerning Targeted Industries

The results of the estimation for each sector and sub-sector are shown in Table 5.1(1/9)-(9/9) below.

5.2.1 Iron and Steel

(1) Improved management

a. E. C. Scenario

When various energy conservation measures at the "first step," involving no cost, are implemented, their effects in terms of heat (which have been converted into fuel; hereinafter, the same) amount to a total of 1,097MJ/t, as shown in Table 4.1 in Chapter 4. The rate of energy saving brought by the no-cost measures would be 6.1%, according to the calculation: 1,097/17,925=0.061.

Also from Table 4.1, the effect of the no-cost measures in terms of electricity is estimated to be 15.2kWh/t, and from the same calculation, the rate of saving in 1997 would be 2.7%.

Based on these estimation results, the rates of saving in 2000 are assumed to be 5% for fuel and 3% for electricity. Furthermore, they are assumed to be 3% and 2%, respectively, for 2003. The reasons are, as shown below, it is concluded from the results of the factory energy audit, that the saving would be much greater when compared to the estimated values above.

That is, at Labedy, one of the two factories at which the factory energy audit has been conducted, the effects of the no-cost measures are estimated to be 8.1% for fuel and 4.9% for electricity. Furthermore, the additional effects of 21.0% and 5.7%, respectively, are assumed to be derived from other measures that were planned or in progress at the time of the audit. At the other factory, Ostrowice, the rates of saving realized by these measures are estimated to be 10.1% and 4.2%, and additional rate of 2.3% with17.7%, in the respective order as above.

b. A.E.C. scenario

First, for 2000, considering the results of the factory energy audit mentioned above, the effects are assumed to be 7% for fuel and 5% for electricity, both 2% above the rates under the E. C. scenario.

Next, for 2003, it is assumed that additional savings of 5% for fuel and 3% for electricity would be realized over the 2000 figures, based on the same reasoning.

(2) Improvement of equipment (based on the economic evaluation)

(2)-1 In 2000

According to the economic evaluation in Chapter 4, in terms of fuel, some of the measures can be implemented for coke ovens, blast furnaces, and the hot rolling process in 2000 (Table 4.1). When measures that are assumed impossible to implement due to the "limit of funding", which is mentioned later, are excluded, the following measures remain, with the expected saving totaling 786MJ/t.

a. Coke ovens ---- "General improvement including revision of the steam utilization method, reinforcement of the control of heat reduction time, and optimization of the air/fuel ratio" (IS-1 in Table 4.1. Possible saving amounting to 123MJ/t. The same, hereinafter.)

b. Blast furnaces ---- "General improvement including stabilizing operation and improvement of the air/fuel ratio of hot blast stove (IS-3. 246MJ/t).

c. Hot rolling process ---- "General improvement including improvement of the air/fuel ratio of heating furnaces and reinforcement of heating furnace seals" (IS-9. 417MJ/t).

Next, for electricity, considering the same "limit of funding," the following measures are expected to be possible to implement, which would result in a total saving of 46.6kWh/t.

a. Coke oven ---- "Optimization of capacity of pumps and blowers" (IS-13. 1.1kWh/t).

b. Sintering plant ---- "Prevention of air leakage and improvement of ventilation, and enhancing the efficiency of operation by replacing fan impellers" (IS-14. 7.6kWh/t).

c. Blast furnace ---- "Optimization of pumps and blowers, and reinforced control of air volume of dust collector" (IS-17. 10.0kWh/t).

d. Converter ---- "Optimization of capacity of pumps and blowers" (IS-19. 6.4kWh/t) ; "reinforced control of air volume of dust collectors" (IS-20. 3.2kWh/t).

e. Electric furnaces ---- "pre-heating of scraps" (IS-21. 6.4kWh/t); "Improvement of dust collector blowers" (IS-22. 1.0kWh/t).

f. Hot rolling process ----"General improvement including optimization of the air/fuel ratio in heating furnaces and reinforcement of heating furnace seals" (IS-9. 4.1kWh/t); "Enhancing rolling efficiency and optimization of capacity of pumps and blowers" (IS-25. 4.1kWh/t).

g. Cold rolling process ---- "Optimization of capacity of pumps and blowers" (IS-27. 2.7kWh/t).

(2)-2 In 2003

As mentioned above, there are also several other measures that could be implemented in 2000,

according to the economic evaluation in Chapter 4. These measures, however, will be implemented by 2003 or later, due to the difficulties for the Polish companies in obtaining the large funds that are necessary to implement them.

The level of the fund that is difficult to obtain is assumed at approximately 3.5 PLN for one ton of crude steel production. The reasons are as follows.

Let us assume implementing a measure of the "reduction of coke ratio by improving the ratio of gas use in blast furnace"(IS-15). To implement the measure, the total cost to the overall iron and steel industry in Poland amounts to 22.7 million PLN (1 billion yen*0.7 / 30.85 yen). Such "costs to the industry" (2.2 PLN/t) are listed in Table 4.1, because they are necessary for estimating the total cost of the measures in future.

In reality, however, these costs will have to be paid by factories that are installed with blast furnaces. There are three such steelworks in Poland, and the cost to these three companies would be 3.5 PLN for one ton of crude steel production (This can be called "costs to the company." Here, it is assumed that crude steel production and its breakdown by production method in 2000 are the same as in 1997.) Furthermore, the total cost to Katowicie, the largest steelworks, is estimated to be 14.3 million PLN (assuming that crude steel production is the same as in 1997).

On the other hand, the total amount of loans to companies from NFEP&WN in 1995 was 492.7 million PLN, on 49 loans, averaging approximately 10 million PLN per loan. Since the producer price (the whole sale price) rose by 35.4% between 1995 and 1998, 10 million PLN in 1995 is equal to 13.5 million PLN in 1998 price. Assuming that this amount would be limit at which funding by companies becomes difficult, the above-mentioned 14.3 million PLN exceeds the limit.

Furthermore, assuming that a) total fund on hand for implementing a measure is in proportion to the crude steel production of that factory, b) the factory's ability to obtain fund is in proportion to the production, and c), if a loan is not offered even to the largest corporation due to the size of the loan, loans to other companies are not made, it can be concluded that the cost at 3.5 PLN per one ton of crude steel production represents the current limit of funding by Polish companies.

Based on these assumptions, the above-mentioned measure of IS-15 (445MJ/t) would not be implemented in 2000, but would be postponed until 2003.

For three other measures ---- IS-6 (increase of 91MJ/t in fuel consumption, but decrease of 107MJ/t in electricity consumption), IS-36 (decrease of 215MJ/t in fuel), and IS-37 (We assume that 24MJ/t would be saved in electricity consumption because this measure has been already implemented for around 60% of crude steel production by the blast furnace-converter method, which is estimated

based upon the questionnaire survey, although this measure can bring 60MJ/t savings for all factories) ---- that have been evaluated as economical in Chapter 4, the cost ("cost to the company") exceeds 3.5 PLN/t. We assume that these measures also will not be implemented in 2000, but be postponed until 2003.

(3) Modernization of equipment

We assume the following five measures will be implemented, based on the restructuring plan for the iron and steel industry:

---- Conversion of open-hearth furnaces to electric furnaces.
---- Introduction of continuous casting equipment.
---- Modernization of the thick-plate mills in the hot rolling process.
---- Modernization in the cold rolling process.
---- Modernization of pipe mills.

When estimating the effects of these measures in 2000 and 2003, the ratio of main processes in the overall crude steel production is assumed as follows:

< Ratio of major process > (%)

	(1997)	(1998)	(1999)
Converter	65	65	65
Electric furnace	24	29	35
Open-hearth furnace	11	6	0
Hot rolling ratio	81	85	90
Continuous casting ratio	37	70	95

The estimated energy savings, based on these assumptions, are as follows:

	(2000)	(2003)
Fuel	272MJ/t	323MJ/t
Electricity	35kWh/t	42kWh/t

(4) Economic incentives

Here, the effects are estimated for those measures, which were assumed impossible to implement in the economic evaluation in the section (2) above, but which could be implemented with the addition

of the economic incentives.

Since the effect will be larger due to providing long-term, low-rate loans, the measures, of which the cost-effectiveness rate in the discussion in Chapter 4 is around 0.5, would become possible to implement (refer to Table 4.1). In the iron and steel industry, these measures include "the reduction of steam through heat recovery from the hot drain in the cold rolling process and the enhanced air pre-heating by using exhaust gas" (IS-26), with the E.I. being reduced by 59MJ/t.

5.2.2 Ammonia

(1) Improved management

As discussed in Chapter 2, the E.I in ammonia production in Poland exceeds that of the excellent factories only by approximately 10%. Therefore, considering the small difference with the E.I. of excellent factories, substantial savings are not estimated for measures to improve management. The results are as follows.

a. E. C. scenario

For 2000, the estimated values are 3% for fuel and 5% for electricity. Also for 2003, they are assumed to be 1% and 3%, respectively, both are 2% lower than those in 2000.

b. A.E.C scenario

For 2000, the estimated values are 1 to 2% higher than the E. C. scenario, with a saving of 4% for fuel and 3% for electricity. Also for 2003, they are 2% higher than the E. C. scenario, with a saving of 3% and 5%, respectively.

(2) Modification of equipment

As discussed in Chapter 4 (Table 4.2), a majority of the measures for ammonia production can be implemented. Nevertheless, as mentioned above, the E.I in ammonia production in Poland exceeds that of excellent factories by only approximately 10%.

Therefore, it is assumed that, in reality, only the "pre-heating of combustion air of the primary reformer" would be put in place at all the factories as the future measure for main processes. The reasons are that, from the questionnaire survey, it is assumed that the measures have already been implemented widely in the synthesis process, and that the possibility of implementing this particular measure is high as a relatively minor improvement on equipment.

The total saving from this measure is estimated to be 800MJ/t, 80% of which or 640MJ/t would be realized in 2000, and the remaining 20% or 160MJ/t realized in 2003.

(3) Modernization of process

As discussed in Chapter 2, it is assumed that much of the investment for modernization has already been conducted in the ammonia industry, and that no further investment would be carried out between now and 2000/2003.

(4) Economic incentives

As shown in Table 4.2, the cost effectiveness of "controlling motor revolutions" is 0.6, and the measure becomes possible to implement, when the long-term, low-interest rate loans are offered. The effects are estimated to be 36MJ/t (10kWh/t) for both 2000 and 2003.

5.2.4 Truck

(1) Improved management

As discussed in Chapter 2, the E.I. in the Poland's truck manufacturing sector is estimated to be six- to seven-times that of the excellent factory, therefore, the energy saving realized by the improved management is also likely to be large (particularly for fuel, which has a high E.I.).

a. E. C. scenario

It is assumed that both STAR/JELCZ group and Knocked-down (KD) group discussed in Chapter 2, would be able to achieve 10% savings from 1997 on fuel, in 2000, as well as in 2003. For electricity, the assumed values are 8% for the S/J group and zero for the KD group (assuming that much of the improved management has already been implemented as a majority are foreign companies), both in 2000 and 2003.

b. A.E.C. scenario

The assumed saving rates for fuel are 15% for the S/J group and 10% for the KD group, in 2000, as well as in 2003. The same rates for electricity as those in the E. C. scenario are also assumed for both 2000 and 2003, because the level of E.I. is relatively low compared to that for fuel.

(2) Modification of equipment

In the discussion in Chapter 4, it was concluded that a saving of approximately 30GJ/pcs would be possible through the modification of equipment. Based on this, first, for fuel, the assumed saving in 2000 is two-thirds of that figure or approximately 20GJ/pcs for STAR, half of the STAR figure or approximately 10GJ/pcs for JELCZ, and approximately 1 GJ/pcs for the KD group.

The same values in 2003 apply to the remaining 10 GJ/pcs or so for STAR, approximately 5GJ/pcs for JELCZ, over the 2000 figures, but the saving rate for the KD group is assumed to be zero.

The saving for electricity in 2000 is assumed to be 2,160MJ/pcs at STAR, and half of that figure at

JELCZ, based on the result of discussion in Chapter 4. The saving for the KD group, on the other hand, is assumed to be zero, for the same reason as mentioned in section (1), "Improved management."

Also in 2003, STAR is assumed to achieve 1,000MJ/pcs of saving, and JELCZ 500MJ/pcs, in addition to the 2000 saving.

(3) Modernization of process

It is assumed that, although the STAR/JELCZ group is a domestic Polish firm, it has the capital to carry out the modernization investment, and that, when some of the investment is made, energy conservation would progress due to such "indirect" measures.

(4) Economic incentives

As clearly seen from the results of the discussion in Chapter 4, there are no measures that become possible to implement by adding economic incentives. Therefore, no attempts were made to assume the rate of saving achieved by these measures.

5.2.5 Tractor

(1) Improved management

It is estimated, from the factory energy audit, that the energy conservation realized by the improved management will amount to 5.7% of the E.I. in 1997 for fuel, and 3.2% of the same for electricity (refer to Chapter 4). Judging from the situation of energy consumption at a factory of URSUS, it is expected that greater savings can be realized on a company-wide basis. Based on this, the following assumption has been made for URUSUS factories.

In addition, it is assumed that management improvements have already been implemented at the KD group, as many of those factories are under the control of foreign companies.

a. E. C. scenario

First, it is assumed that 10% savings will be possible for both fuel and electricity in 2000. Next, in 2003, savings of 5% are assumed for fuel, as well as for electricity.

b. A.E.C. Scenario

First, it is assumed that 13% savings will be possible for both fuel and electricity in 2000. Next, in 2003, savings of 7% are assumed for fuel, as well as for electricity.

(2) Modification of equipment

As indicated in the discussion in Chapter 4, the effects of the measures that are assessed as economically feasible are estimated to be, in total, 6,300MJ/pcs for fuel and 470kWh/pcs for

electricity. As these figures are not too big (particularly in the case of electricity), when compared to the E.I. in 1997, these measures will be implemented at the same time.

Therefore, it is assumed that the above-mentioned saving will be realized in 2000, through the implementation of all the measures, resulting in the savings of 4.0GJ/pcs in fuel and 1.6GJ/pcs in electricity for all of this industry (This is based upon the same calculation as for trucks. We assume that other KD factories than URSUS, which is supposed to account for 63% of total truck production in Poland, have already implemented this kind of measures, because many of them are under the management of foreign companies. In fuel consumption for example, savings for total industry are calculated as follows: 6.3GJ/pcs * 0.63 = 4.0 GJ/pcs).

(3) Modernization of process

Judging from the developments of privatizing URSUS as well as those of its negotiating direct investment with foreign firms, it is expected that large scale investments for modernization will not be carried out by 2000 or 2003.

(4) Economic incentives

As indicated in the conclusion in Chapter 4, the two measures "control of motor revolution" and "improved lighting" are expected to be economically feasible when long-term, low-interest rate loans are offered. It is estimated, therefore, that a total saving of 204kWh/pcs will be possible in 2000 through these measures.

5.2.6 Glass

(1) Improved management

Based on the results of the factory energy audit, the effects of energy conservation at the audited factors manufacturing bottle glass and glass for tableware/lighting, are estimated to be small approximately 1 to 3% of the E.I. in 1997. Also, for sheet glass, it is most likely that much of the improvement in management has already been implemented, because of the entry of glass manufacturers from the U.K. and France, and the introduction of the latest furnaces brought by them, as described in Chapter 2.

Therefore, energy consumption savings at the glass factories, which will be realized by the improved management, are assumed to be low, as shown below.

a. E. C. scenario

First, in 2000, the savings, for both fuel and electricity, are assumed to be 2% for sheet glass, and 3% each for bottle glass and glass for tableware/lighting. In 2003, the assumed rates are 1% for sheet glass, and 2% each for bottle glass and glass for tableware/lighting, for both fuel and

electricity.

b. A.E.C. scenario

In 2000, the saving rates, for both fuel and electricity, are assumed to be 3% for sheet glass, and 5% each for bottle glass and glass for tableware/lighting. In 2003, the assumed rates are 2% for sheet glass, and 3% each for bottle glass and glass for tableware/lighting, for both fuel and electricity.

(2) Modification of equipment

In the discussion in Chapter 4, it is concluded that, for fuel, savings of 2,150MJ/t at bottle glass factories and 28,900MJ/t at factories of glass for tableware/lighting will be realized through the economically feasible measures. For those two groups, the savings in each year are projected, based on the above estimates.

For sheet glass, assuming that the measure to "improve burners in furnaces" is economically feasible at those factories where the most advanced melting furnaces have not been yet introduced, it is assumed that savings of approximately 4,320MJ/t will be realized through the measure, and, based on that assumption, yearly savings are projected.

In addition, as mentioned in Chapter 2, the critical task in manufacturing glass is how to achieve savings in the use of fuel (heat) centering on melting furnaces, and no measures have been found that realize substantial electricity savings, judging from the factory energy audit and other data. Therefore, it is expected that no measures will be implemented that achieve electricity savings, in any of the above groups, concerning "modification of equipment."

Next, for 2000, the following ratio is assumed for each sub-sector: approximately 20% (the share of the factories that are expected to implement the measure in the total output) of the above-mentioned possible savings for sheet glass; about 55% (same as above) for bottle glass; and, around 20% (same as above) for glass for tableware/lighting.

For 2003, it is assumed that all of the factories producing sheet glass will have implemented the above measure; that for bottle glass, approximately 45% of the above-mentioned possible savings (2,150MJ/t) will be realized additionally; and, that for glass for tableware/lighting, savings roughly equal to that in 2000 will be possible.

(3) Modernization of process

For sheet glass, it is expected that further investments for modernization will not be carried out by the companies themselves, and that energy conservation will progress, when certain conditions are met, with the support of economic incentives. On the other hand, for the other two groups, modernization investments are expected to be made, to some extent, mainly by the leading

companies introduced in Chapter 2.

In quantitative terms, for both in 2000 and 2003, as well as for both fuel and electricity, it is assumed that savings will be realized through such investment, which is equivalent to 10% of the difference between the average E.I. among each groups in 1997 and that of the excellent factory.

(4) Economic incentives

It is concluded in the discussion in Chapter 4 that in 2000 savings of approximately 600MJ/t will be realized for fuel by the measure of "increasing recovered heat " and around 50MJ/t will be realized by the measure of "controlling motor revolution by inverter" for electricity in the bottle glass group. It is then assumed that these measures will be implemented in all factories in this group in 2000. Savings for all glass industry are calculated as follows: (599MJ/t +51MJ/t) * 0.61 = 396.5MJ/t (We assume that this group will account for the same share of production in 2000 as in 1997, which is 61%).

It is also concluded that savings of 3MJ/t will be realized for electricity by the measure of "replacing motor" in the group of glass for table ware/lighting. We, however, do not take into account the savings in estimating future E.I. for all glass industry, because it is negligible if we consider the share of this group in total glass production (3MJ/t * 0.09 = 0.27MJ/t).

In addition, for sheet glass, the measure "modification of furnace" is discussed, however, it is concluded that its benefits (savings) will fall short for both 2000 and 2003, by a negligible difference, even when long-term, low-interest rate loans are offered.

5.2.6 Silica Lime Block (S.L.B)

(1) Improved management

As discussed in Chapter 4, improved management at the S.L.B. factories is mainly targeted at auto claving, or others related to the steam used in that process. In the factory energy audit, "reduction of the excess air in boiler" and "enhanced insulation of steam valve" are suggested as well (with the possible saving rate estimated to be a total of 10.2%).

In the factory energy audit, the possible saving rate for electricity realized by these of measures are not explicitly discussed, however, a certain level of saving, although not as much as for heat (fuel), will be possible. Based on this, the following assumptions, for fuel and electricity, are made.

a. E. C. scenario

It is assumed that, for both fuel and electricity, savings of approximately 5% over the E.I. in 1997

will be possible. Also, in 2003, it is assumed that saving of about 3% will be realized for fuel and electricity.

b. A.E.C. scenario

For fuel, the assumed savings are approximately 8% in 2000 and about 2% in 2003. For electricity, the assumed figures are around 5% in 2000 and roughly 2% in 2003.

(2) Modification of equipment

As discussed in Chapter 4, implementation of three measures is expected to realize a total saving of 470MJ/t. Based on the following assumptions, however, the possible savings are estimated to be approximately 150MJ/t in 2000 and about 75MJ/t in 2003.

a. The factories at which these measures are not yet implemented account for about two thirds of the total (From the questionnaire survey, energy conservation measures have already been implemented extensively at two factories out of the six that replied.)

b. Furthermore, some of the factories that have not yet implemented the measures will not be able to implement them at all, due to such reasons as the inability to obtain funds.

Therefore, it is assumed that the factories that can implement the measures in 2000 will be approximately a half of the factories that have not yet implemented the measures. In 2003, it is assumed that the measures will be implemented at half of the remaining factories.

(3) Modernization of process

According to industry sources, all of S.L.B. production is carried out by Polish companies, and entries by foreign firms are not expected in near future. Furthermore, it is reported that large-scale investments will not be made, as the funds of Polish companies are limited.

Therefore, it is assumed that there will be no possibility of energy savings through the modernization of processes in 2000 or 2003.

(4) Economic incentives

As discussed in Chapter 4, no measures have been identified that will become feasible with the long-term, low-interest rate loans. For this reason, possible savings through the measure are assumed to be zero, both in 2000 and 2003.

5.2.7 Vegetable Oil

In the factory energy audit, it is concluded that energy savings of 10.7% for fuel and 0.3% for electricity will be possible. As mentioned in Chapter 2, the E.I. in Poland's vegetable oil production,

estimated from the energy statistics and production data, amounts to 9,050MJ/t, three times that of the excellent factory. The following assumption has been made, based on these data.

a. E. C. scenario

It is assumed that, for both fuel and electricity, saving of approximately 5% over the 1997 figure will be possible. In 2003, additional savings of 5% are expected for fuel, however, no further saving is assumed for electricity, since the E.I. in 1997 is very low at 945MJ/t (From some of the data in Japan, the E.I. at excellent factories is estimated to be somewhere in the range of 770-800MJ/t).

b. A.E.C. scenario

For fuel, it is assumed that, both in 2000 and 2003, savings of 8%, three percent-point above the E.C. scenario, are possible. For the same reason as above, assumed rates for electricity are 5% in 2000 and zero in 2003.

(2) Modification of equipment

As mentioned in Chapter 4, four measures were assessed as economically feasible. First, assuming that, judging from its process, "heat recovery from solvent vapor in the batch solvent extraction method" is feasible only at mid- and small-scale companies, it is expected that it will be applicable to one third of the production capacities at these firms (35MJ/t).

Next, it is assumed that each of the three measures of "heat recovery in the decolorarization process" (132MJ/t in the average of the two cases), "reduction of the reaction time in the process of hydrogenation " (186MJ/t) and "enhanced insulation of steam valve" (84MJ/t) will be applied to 50% of the overall production capacity, both in 2000 and in 2003 (200MJ/t in each of the years).

(3) Modernization of process

As mentioned in Chapter 4, energy consumption in the oil exploitation process is a large share in the production of vegetable oil. In addition, considering the funding aspect, modernization investment is more likely to be made at large-scale corporations.

Therefore, it is expected that, both in 2000 and in 2003, modernization of the oil exploitation process will be carried out by the "large-scale/domestic" group mentioned in Chapter 2, and that, through the measure, the E.I. on fuel at these factories will be improved substantially. In this estimation, it is assumed that the measure will be implemented for approximately one fourth of the production capacity of these companies, and that the E.I. of fuel consumption in the oil exploitation process will be improved from 4,000MJ/t to 6,400MJ/t through modernization.

(4) Economic incentives

As discussed in Chapter 4, the measure of "heat recovery in the deodorization process" will be

carried out if an economic incentive is provided. We assume that this measure will be implemented by factories which will represent one fourth of total production capacity in 2000 and 2003, respectively (Because savings achieved through this measure are about 280MJ/t of the average of the four cases, it will be around 70MJ/t on an industry average in 2000 and 2003, respectively).

In addition, as seen in Table 4.7, although "improved operation method of hammer mill" will become feasible through economic incentives, its effect is very limited, and the savings are not assumed.

5.2.8 Meat Products

In the factory energy audit, it is estimated that, through improved management, savings of approximately 13% on fuel and about 3% on electricity will be realized at a Lubmeat's factory. On the other hand, at a Kosian's factory, only a small saving of 0.3% is expected for fuel, and for electricity, the possible saving rate is not mentioned. As such, a clear guidance for the saving rate through improved management cannot be obtained only from the result of the factory energy audit.

However, considering that the E.I. at meat product factories, estimated from Poland's energy statistics and production data in Chapter 2, is twice that of excellent factories, the following assumption is made on saving rates obtained through improved management.

a. E. C. scenario

First, in 2000, it is assumed that savings of 10% on fuel and 3% on electricity will be possible. And, in 2003, it is assumed that savings of 5% on fuel and 2% on electricity will be realized.

b. A.E.C. scenario

It is assumed that each of the saving rates in 2000 will be 2 percent-points higher than that of the E.C. scenario, i.e., 12% for fuel and 5% for electricity. The assumed saving rates in 2003 are 7% and 3%, respectively.

(2) Modification of equipment

As mentioned in Chapter 4, such measures as " recovery of drain," "installation of curtains," and "heat insulation of steam valve" are evaluated as economically feasible for fuel, with a total effect of 874MJ/t. For electricity, "performance enhancement of compressors," "introduction of external air" and "installation of curtains" are considered possible, with total savings of about 100MJ/t.

Based on this, it is assumed that 50% of the possible savings will be realized each in 2000 and 2003, respectively (440MJ/t for fuel and 50MJ/t for electricity).

(3) Modernization of process

It is expected that, in this industry, modernization investments will not proceed much due to the following reasons:

---- Foreign firms have not expressed much interest in this sector.

---- Much of the new investments seen in the sector is made by small-scale investors.

---- Expected investments will be targeted mainly at hygiene and environmental protection.

---- Facility's rate of utilization is low.

On the other hand, it is also possible to assume that certain investments on modernization will be carried out, because the about 100 companies compiled in the AME (Energy Market Agency) statistics, i.e., the targeted firms of the E.I. estimation in this report are the large corporations in this sector.

Therefore, it is assumed that modernization investment will be made at approximately 5% of the overall production capacity. In the estimation, it is assumed that the industry's E.I. on average will improve to the level of that of excellent factories (6,400MJ/t for fuel and 1,200MJ/t for electricity).

(4) Economic incentives

As mentioned in Chapter 4, "enhanced insulation of steam valve" (with an effect of approximately 280MJ/t) is evaluated to be feasible when long-term, low-interest rate loans are offered. Including the small effect of the latter, it is assumed that these measures will be implemented for 50% of the total production capacity (saving of around 142MJ/t), each in 2000 and 2003.

5.2.9 Dairy Products

(1) Improved management

According to the results of the factory energy audit, at the targeted factories, the expected energy savings realized by improved management are 9.8% for fuel and 0.4% for electricity. On the other hand, as mentioned in Chapter 2, based on our estimation, the E.I. in Poland's dairy product production is very high, when compared to that of excellent factories, therefore, it is considered that a considerable energy conservation will be achieved through improved management. Based on this, the following assumption has been made.

a. E. C. scenario

First, in 2000, it is assumed 10% savings will be possible for both fuel and electricity. In 2003, 5% savings will be realized for both.

b. A.E.C. scenario

It is assumed that, in 2000, savings that exceed the E. C. scenario by 5 percent-points will be

possible, for both fuel and electricity. In 2003, it is assumed that savings of a further 3% will be realized.

(2) Modification of equipment

As mentioned in Chapter 4, such measures as "installation of inverters for fans"(in each factory), "improved operation of freezing machines"(in each factory), "higher degree of vaporization in the powdered milk production process"(in powdered milk factories), and "reinforcing heat insulation for steam valves"(in processed milk and butter factories) are economically feasible.

Based on this, it is assumed that these measures will be implemented at around two thirds of the factories that can implement them in 2000. It is also assumed that, in 2003, they will be implemented at half of the remaining factories.

In addition, we estimate the savings per each product, using the yield of each product (each product-ton/input materials-ton) and the production share of each product (each product-ton/all products-ton). This is the same as in (4) below.

(3) Modernization of process

In the dairy product industry, while a certain level of entry by foreign firms is observed, it is assumed that, in general, no large-scale investments for modernization will be carried out. In other words, in the whole industry, approximately 5% of the total production capacity is expected to receive such investments, realizing energy conservation.

However, as mentioned in Chapter 2, there is a huge gap between the E.I. in Poland and that at excellent factories. Therefore, it is assumed that the improvement in the E.I. brought by modernization investments will be about a half of the gap between the current E.I. in Poland and that at excellent factories.

(4) Economic incentives

As indicated in the discussion in Chapter 4, there are several measures with a cost-effectiveness rate around 0.5, or above (but less than 1). It is assumed that, of these measures, "recovery of dryer drain "(in powdered milk, processed milk, and butter factories) and "recovery of waste heat from continuous blowing" (in processed milk and cheese factories), both of which satisfy the conditions in many cases to be economically feasible, will be given economic incentives.

Assumed savings are one third (40MJ/t) of total estimated savings (120MJ/t) in 2000 and its one sixth (20MJ/t) in 2003 in the former and one eight (30MJ/t) of total estimated savings (230MJ/t) in 2000 and its one tenth (25MJ/t) in 2003 in the latter, totaling 70MJ/t in 2000 and 45MJ/t in 2003.

Table 5.1 Effect of Technical Measures on the Energy Intensity by Component of Scenarios in Targeted Industries

(Unit : MJ / ton or pcs)

(1/9) STEEL

Components of Scenarios and Energy Intensity	Energy Conservation						Accelerated Energy Conservation					
	2000			2003			2000			2003		
	Fuel	Electricity	Total	Fuel	Electricity	Total	Fuel	Electricity	Total	Fuel	Electricity	Total
Energy Intensity (1997)	17,925	1,897	19,822									
(I) Improved management	896	57	953	538	38	576	1,255	95	1,350	896	57	953
(II) Modification of equipment	786	168	954	570	130	700	786	168	954	570	130	700
(III) Modernization of process	272	35	307	323	42	365	272	35	307	323	42	365
(IV) Economic incentives	0	0	0	0	0	0	59	0	59	0	0	0
Total decrease in Ene.Intens.	1,954	260	2,214	1,431	210	1,641	2,372	298	2,670	1,789	229	2,018
Energy Intensity (2000; 2003)	15,971 0.89	1,637 0.86	17,608 0.89	14,540 0.73	1,427 0.75	15,967 0.81	15,553 0.87	1,599 0.84	17,152 0.87	13,764 0.77	1,370 0.72	15,134 0.76

(2/9) AMMONIA

Components of Scenarios and Energy Intensity	Energy Conservation						Accelerated Energy Conservation					
	2000			2003			2000			2003		
	Fuel	Electricity	Total	Fuel	Electricity	Total	Fuel	Electricity	Total	Fuel	Electricity	Total
Energy Intensity (1997)	31,406	1,811	33,217									
(I) Improved management	943	91	1,034	314	54	368	1,256	127	1,383	314	91	405
(II) Modification of equipment	640	0	640	160	0	160	640	0	640	160	0	160
(III) Modernization of process	0	0	0	0	0	0	0	0	0	0	0	0
(IV) Economic incentives	0	0	0	0	0	0	0	36	36	0	36	36
Total decrease in Ene.Intens.	1,583	91	1,674	474	54	528	1,896	163	2,059	474	127	601
Energy Intensity (2000;2003)	29,823 0.95	1,720 0.95	31,543 0.95	29,349 0.88	1,666 0.92	31,015 0.93	29,510 0.94	1,648 0.91	31,158 0.94	29,036 0.92	1,521 0.84	30,557 0.92

(3/9) TRUCK

Components of Scenarios and Energy Intensity	Energy Conservation						Accelerated Energy Conservation					
	2000			2003			2000			2003		
	Fuel	Electricity	Total	Fuel	Electricity	Total	Fuel	Electricity	Total	Fuel	Electricity	Total
Energy Intensity (1997)	25,150	9,830	34,980									
(I) Improved management	2,560	9	2,569	1,258	38	1,296	3,318	9	3,327	1,579	38	1,617
(II) Modification of equipment	2,410	160	2,570	750	75	825	2,410	160	2,570	750	75	825
(III) Modernization of process	1,830	0	1,830	930	0	930	1,830	0	1,830	930	0	930
(IV) Economic incentives	0	0	0	0	0	0	0	0	0	0	0	0
Total decrease in Ene.Intens.	6,800	169	6,969	2,938	113	3,051	7,558	169	7,727	3,259	113	3,372
Energy Intensity (2000;2003)	18,350 0.73	9,661 0.98	28,011 0.80	15,412 0.61	9,548 0.97	24,960 0.71	17,592 0.70	9,661 0.98	27,253 0.78	14,333 0.57	9,548 0.97	23,881 0.68

(4/9) TRACTOR

Components of Scenarios and Energy Intensity	Energy Conservation						Accelerated Energy Conservation					
	2000			2003			2000			2003		
	Fuel	Electricity	Total	Fuel	Electricity	Total	Fuel	Electricity	Total	Fuel	Electricity	Total
Energy Intensity (1997)	43,075	19,078	62,153									
(I) Improved management	4,123	1,601	5,724	2,040	801	2,841	5,415	2,082	7,497	2,867	1,121	3,988
(II) Modification of equipment	3,969	1,068	5,037	0	0	0	3,969	1,068	5,037	0	0	0
(III) Modernization of process	0	0	0	0	0	0	0	0	0	0	0	0
(IV) Economic incentives	0	0	0	0	0	0	0	465	465	0	0	0
Total decrease in Ene.Intens.	8,092	2,669	10,761	2,040	801	2,841	9,384	3,615	12,999	2,867	1,121	3,988
Energy Intensity (2000;2003)	34,983 0.81	16,409 0.86	51,392 0.83	32,943 0.76	15,608 0.82	48,551 0.78	33,691 0.78	15,463 0.81	49,154 0.79	30,824 0.72	14,342 0.75	45,166 0.73

(5/9) GLASS

Components of Scenarios and Energy Intensity	Energy Conservation						Accelerated Energy Conservation					
	2000			2003			2000			2003		
	Fuel	Electricity	Total	Fuel	Electricity	Total	Fuel	Electricity	Total	Fuel	Electricity	Total
Energy Intensity (1997)	15,984	1,904	17,888									
(I) Improved management	446	53	499	284	34	318	730	87	817	375	53	428
(II) Modification of equipment	1,510	0	1,510	1130	0	1130	1,510	0	1,510	1130	0	1,130
(III) Modernization of process	498	62	560	498	62	560	498	62	560	498	62	560
(IV) Economic incentives	0	0	0	0	0	0	365	30	395	0	0	0
Total decrease in Ene.Intens.	2,455	115	2,569	1,912	96	2,008	3,104	179	3,282	2,004	115	2,119
Energy Intensity (2000;2003)	13,529	1,789	15,319	11,617	1,693	13,310	12,880	1,725	14,606	10,876	1,611	12,487
	0.85	0.94	0.86	0.73	0.89	0.74	0.81	0.91	0.82	0.68	0.85	0.70

(6/9) Silicate Lime Block

Components of Scenarios and Energy Intensity	Energy Conservation						Accelerated Energy Conservation					
	2000			2003			2000			2003		
	Fuel	Electricity	Total	Fuel	Electricity	Total	Fuel	Electricity	Total	Fuel	Electricity	Total
Energy Intensity (1997)	810	30	840									
(I) Improved management	40	2	42	24	1	25	57	2	59	24	1	25
(II) Modification of equipment	150	0	150	75	0	75	150	0	150	75	0	75
(III) Modernization of process	0	0	0	0	0	0	0	0	0	0	0	0
(IV) Economic incentives	0	0	0	0	0	0	0	0	0	0	0	0
Total decrease in Ene.Intens.	190	2	192	99	1	100	207	2	209	99	1	100
Energy Intensity (2000;2003)	620	28	648	521	27	548	603	28	631	504	27	531
	0.77	0.93	0.77	0.64	0.90	0.65	0.74	0.93	0.75	0.62	0.90	0.63

(7/9) VEGETABLE OIL

Components of Scenarios and Energy Intensity	Energy Conservation						Accelerated Energy Conservation					
	2000			2003			2000			2003		
	Fuel	Electricity	Total	Fuel	Electricity	Total	Fuel	Electricity	Total	Fuel	Electricity	Total
Energy Intensity (1997)	8,105	945	9,050									
(I) Improved management	405	47	452	405	0	405	648	47	695	648	0	648
(II) Modification of equipment	235	0	235	200	0	200	235	0	235	200	0	200
(III) Modernization of process	300	0	300	300	0	300	300	0	300	300	0	300
(IV) Economic incentives	0	0	0	0	0	0	70	0	70	70	0	70
Total decrease in Ene.Intens.	940	47	987	905	0	905	1,253	47	1,300	1,218	0	1,218
Energy Intensity (2000;2003)	7,165	898	8,063	6,260	898	7,158	6,852	898	7,750	5,634	898	6,532
	0.88	0.95	0.89	0.77	0.95	0.79	0.85	0.95	0.86	0.70	0.95	0.72

(8/9) MEAT PRODUCTS

Components of Scenarios and Energy Intensity	Energy Conservation						Accelerated Energy Conservation					
	2000			2003			2000			2003		
	Fuel	Electricity	Total	Fuel	Electricity	Total	Fuel	Electricity	Total	Fuel	Electricity	Total
Energy Intensity (1997)	11,644	2,616	14,260									
(I) Improved management	1,164	78	1,242	582	52	634	1,397	131	1,528	815	26	841
(II) Modification of equipment	440	50	490	440	50	490	440	50	490	440	50	490
(III) Modernization of process	262	71	333	262	71	333	262	71	333	262	71	333
(IV) Economic incentives	0	0	0	0	0	0	0	3	3	0	0	0
Total decrease in Ene.Intens.	1,866	199	2,065	1,284	173	1,457	2,099	255	2,354	1,517	147	1,664
Energy Intensity (2000;2003)	9,778	2,417	12,195	8,494	2,243	10,737	9,545	2,361	11,906	8,028	2,214	10,242
	0.84	0.92	0.86	0.73	0.86	0.75	0.82	0.90	0.83	0.69	0.85	0.72

(9/9) DAIRY PRODUCTS

Components of Scenarios and Energy Intensity	Energy Conservation						Accelerated Energy Conservation					
	2000			2003			2000			2003		
	Fuel	Electricity	Total	Fuel	Electricity	Total	Fuel	Electricity	Total	Fuel	Electricity	Total
Energy Intensity (1997)	7,880	1,260	9,140									
(I) Improved management	734	129	863	168	26	193	1,064	161	1,226	213	101	314
(II) Modification of equipment	50	40	90	25	20	45	50	40	90	25	20	45
(III) Modernization of process	126	12	138	126	12	138	126	12	138	126	12	138
(IV) Economic incentives	0	0	0	0	0	0	70	0	70	45	0	45
Total decrease in Ene.Intens.	910	182	1,091	318	58	376	1,310	214	1,524	409	134	542
Energy Intensity (2000;2003)	6,970	1,078	8,049	6,652	1,020	7,672	6,570	1,046	7,616	6,162	912	7,074
	0.88	0.86	0.88	0.84	0.81	0.84	0.83	0.83	0.83	0.78	0.72	0.77

5.3 Estimation Result for the Targeted Equipment

5.3.1 Method of Estimation

The estimation method for the targeted equipment is in principle the same as the method used for the targeted industry. The details are given below.

(1) Improved management

The same saving rates applied to the targeted industries are used for the targeted equipment. In other words, the rates applied to the targeted industries' electricity are used for lighting, air compressors, motors and transformers, and the rates applied to the targeted industries' fuel (heat) are used for heating (air conditioning), boiler, and industrial furnace.

(2) Improvement of equipment

The possible energy savings are estimated based on the economic evaluation in Chapter 4.

(3) Modernization of process

Considering that the same effects should be seen for equipment in accordance with the effects to the targeted industries realized by the modernization investments, it is assumed that reduction in energy consumption in equipment will be possible at the ratio of the "effect in the targeted industries in each year" to the "E.I. in each of fuel and electricity in 1997"

For example, assuming that, in a given industry, the savings for fuel in 2000 were 10MJ/t, and the E.I. on fuel in 1997 were 100MJ/t, it would be estimated that a 10% (10MJ/100MJ) reduction of energy consumption would be realized for boilers as well.

(4) Economic incentives

Based on the economic evaluation in Chapter 4, those measures, which will be feasible when the economic incentives (long-term, low-interest rate loans) are provided, are selected, and the amount of possible savings in each year is estimated based on the scale of their effects.

5.3.2 Estimation Result

The result of the estimation is shown in Table 5.2. As can be seen in the table, the reduction of E.I. is substantial for each item of equipment.

For example, in the iron and steel industry, in which the rate of reduction is relatively small, the E.I. on lighting, under the E.C. scenario, will be 96 in 2000 and 89 in 2003, with that in 1997 being 100, and the E.I. for heating (air conditioning) will be 93 in 2000, and 86 in 2003.

Table 5.2 Effect of Technical Measures on the Energy Intensity by Component of Scenarios in Targeted Equipment

(1/9) STEEL

(Unit : MJ / t)

Scenario	Name of equipment	Energy Intensity in 1997	Decrease in Energy Intensity in 2000					Energy Intensity in 2000	Decrease in Energy Intensity in 2003					Energy Intensity in 2003
			Improved Manage.	Modific. of equipm.	Moderniz. of process	Economic incentive	Total		Improved Manage.	Modific. of equipm.	Moderniz. of process	Economic incentive	Total	
E.C.	Lighting	76	2.3	0.2	0.8	0.0	3.3	73	1.5	0	3.6	0.0	5.2	68
	Compressor	86	2.6	2.6	0.9	0.0	6.0	80	1.7	0	4.0	0.0	5.7	74
	Motor	455	13.7	0.0	4.6	0.0	18.2	437	9.1	0	21.8	0.0	30.9	406
	Transformer	140	4.2	0.0	5.6	0.0	9.8	130	2.8	0	6.5	0.0	9.3	121
	Heating(Air conditi.)	1,954	97.7	0.0	39.1	0.0	136.8	1,817	39.1	0	90.9	0.0	129.9	1,687
	Boiler	3,115	155.8	0.0	62.3	0.0	218.1	2,897	62.3	0	144.8	0.0	207.1	2,690
	Heating furnace	1,009	20.2	85.0	20.2	0.0	125.4	884	20.2	0	44.2	0.0	64.4	819
A.E.C.	Lighting	76	5.3	0.2	0.8	0.8	7.1	69	1.5	0	3.4	0.8	5.7	63
	Compressor	86	6.0	2.6	0.9	0.0	9.5	77	1.7	0	3.8	0.0	5.5	71
	Motor	455	31.9	0.0	4.6	45.5	81.9	373	9.1	0	18.7	45.5	73.3	300
	Transformer	140	9.8	0.0	5.6	0.0	15.4	125	2.8	0	6.2	0.0	9.0	116
	Heating	1,954	136.8	0.0	39.1	0.0	175.9	1,778	39.1	0	88.9	0.0	128.0	1,650
	Boiler	3,115	218.1	0.0	62.3	0.0	280.4	2,835	62.3	0	141.7	0.0	204.0	2,631
	Heating Furnace	1,009	70.6	85.0	20.2	97.0	272.8	736	20.2	0	36.8	0.0	57.0	679

(2/9) AMMONIA

(Unit : MJ / t)

Scenario	Name of equipment	Energy Intensity in 1997	Decrease in Energy Intensity in 2000					Energy Intensity in 2000	Decrease in Energy Intensity in 2003					Energy Intensity in 2003
			Improved Manage.	Modific. of equipm.	Moderniz. of process	Economic incentive	Total		Improved Manage.	Modific. of equipm.	Moderniz. of process	Economic incentive	Total	
E.C.	Lighting	4	0.2	0.2	0	0	0.4	4	0.1	0.2	0	0	0.3	3
	Compressor	163	8	0	0	0	8	155	5	0	0	0	5	150
	Motor	362	18	0	0	0	18	344	11	0	0	0	11	333
	Transformer	36	2	0	0	0	2	34	1	0	0	0	1	33
	Heating(Air conditi.)	11,620	349	0	0	0	349	11,271	116	0	0	0	116	11,155
	Boiler	15,703	471	0	0	0	471	15,232	157	0	0	0	157	15,075
	Heating furnace													
A.E.C.	Lighting	4	0.3	0.2	0	0	0.5	4	0.2	0.2	0	0	0.4	3
	Compressor	163	11	0	0	0	11	152	8	0	0	0	8	143
	Motor	362	25	0	0	36	62	300	18	0	0	36	54	246
	Transformer	36	3	0	0	0	3	33	2	0	0	0	2	32
	Heating	11,620	465	0	0	0	465	11,155	349	0	0	0	349	10,807
	Boiler	15,703	628	0	0	0	628	15,075	471	0	0	0	471	14,604
	Heating Furnace													

(3/9) TRUCK

(Unit : MJ/pcs)

Scenario	Name of equipment	Energy Intensity in 1997	Decrease in Energy Intensity in 2000					Energy Intensity in 2000	Decrease in Energy Intensity in 2003					Energy Intensity in 2003
			Improved Manage.	Modific. of equipm.	Moderniz. of process	Economic incentive	Total		Improved Manage.	Modific. of equipm.	Moderniz. of process	Economic incentive	Total	
E.C.	Lighting	581	0.6	0.0	0.0	0.0	0.6	580	11.6	0	0.0	0	11.6	569
	Compressor	1,000	1.0	83.0	0.0	0.0	84.0	916	20.0	0	0.0	0	20.0	896
	Motor	2,906	2.9	0.0	0.0	0.0	2.9	2,903	58.1	0	0.0	0	58.1	2,845
	Transformer	1,475	1.5	0.0	0.0	0.0	1.5	1,474	29.5	0	0.0	0	29.5	1,444
	Heating(Air conditi.)	8,335	833.5	480.0	583.5	0.0	1897.0	6,438	166.7	0	257.5	0	424.2	6,014
	Boiler	16,599	1659.9	0.0	1161.9	0.0	2821.8	13,777	332.0	0	551.1	0	883.1	12,894
	Heating furnace													
A.E.C.	Lighting	581	5.8	0.0	0.0	0.0	5.8	575	11.6	0		0	11.6	564
	Compressor	1,000	10.0	83.0	0.0	0.0	93.0	907	20.0	0		0	20.0	887
	Motor	2,906	29.1	0.0	0.0	290.6	319.7	2,586	58.1	0		290.6	348.7	2,238
	Transformer	1,475	14.8	0.0	0.0	0.0	14.8	1,460	29.5	0		0	29.5	1,431
	Heating	8,335	833.5	480.0	583.5	0.0	1897.0	6,438	166.7	0	257.5	0	424.2	6,014
	Boiler	16,599	1659.9	0.0	332.0	0.0	1991.9	14,607	332.0	0	584.3	0	916.3	13,691
	Heating Furnace													

(4/9) TRACTOR

(Unit : MJ/pcs)

Scenario	Name of equipment	Energy Intensity in 1997	Decrease in Energy Intensity in 2000					Energy Intensity in 2000	Decrease in Energy Intensity in 2003					Energy Intensity in 2003
			Improved Manage.	Modific. of equipm.	Moderniz. of process	Economic incentive	Total		Improved Manage.	Modific. of equipm.	Moderniz. of process	Economic incentive	Total	
E.C.	Lighting	642	39	0	0	0	39	603	13	0	0	0	13	591
	Compressor	3,728	224	726	0	0	950	2,778	75	0	0	0	75	2,704
	Motor	8,514	511	0	0	0	511	8,003	170	0	0	0	170	7,833
	Transformer	3,468	208	0	0	0	208	3,260	69	0	0	0	69	3,191
	Heating(Air conditi.)	12,101	1,210	0	0	0	1,210	10,891	242	0	0	0	242	10,649
	Boiler	18,377	1,838	0	0	0	1,838	16,539	368	0	0	0	368	16,172
	Heating furnace													
A.E.C.	Lighting	642	53	0	0	23	76	566	26	0	0	0	26	541
	Compressor	3,728	305	726	0	0	1,031	2,697	149	0	0	0	75	2,622
	Motor	8,514	697	0	15	851	1,563	6,951	341	0	0	851	1,192	5,759
	Transformer	3,468	284	0	0	0	284	3,184	139	0	0		139	3,045
	Heating	12,101	1,349	0	0	0	1,349	10,752	578	0	0	0	578	10,173
	Boiler	1,377	154	0	0	0	154	1,223	66	0	0	0	66	1,158
	Heating Furnace													

(5/9) GLASS

(Unit : MJ/t)

Scenario	Name of equipment	Energy Intensity in 1997	Decrease in Energy Intensity in 2000					Energy Intensity in 2000	Decrease in Energy Intensity in 2003					Energy Intensity in 2003
			Improved Manage.	Modific. of equipm.	Moderniz. of process	Economic incentive	Total		Improved Manage.	Modific. of equipm.	Moderniz. of process	Economic incentive	Total	
E.C.	Lighting	26	2	0	4	0	6	20	1	0	2	0	3	18
	Compressor	562	48	0	77	0	124	438	11	0	46	0	57	381
	Motor	934	79		127		207	727	19	0	76	0	95	633
	Transformer	66	6		9		15	51	1	0	5	0	7	45
	Heating(Air conditi.)	1,045	89	0	0	0	89	956	21	0	0	0	21	935
	Boiler	2,541	216	0	0	0	216	2,325	51	0	0	0	51	2,274
	Heating furnace													
A.E.C.	Lighting	26	3	0	4	0	6	20	1	0	2	0	3	17
	Compressor	562	59	0	77	0	136	426	11	0	44	0	56	371
	Motor	934	98	0	127	93	319	615	19	0	64	93	176	439
	Transformer	66	7	0	9	0	16	50	1	0	5	0	7	44
	Heating	1,045	110	0	0	0	110	935	21	0	0	0	21	914
	Boiler	2,541	267	0	0	0	267	2,274	51	0	0	0	51	2,223
	Heating Furnace													

(6/9) S.L.B.

(Unit : MJ/t)

Scenario	Name of equipment	Energy Intensity in 1997	Decrease in Energy Intensity in 2000					Energy Intensity in 2000	Decrease in Energy Intensity in 2003					Energy Intensity in 2003
			Improved Manage.	Modific. of equipm.	Moderniz. of process	Economic incentive	Total		Improved Manage.	Modific. of equipm.	Moderniz. of process	Economic incentive	Total	
E.C.	Lighting	1	0.05	0	0	0	0.05	1.0	0.03	0	0	0	0.03	0.9
	Compressor	3	0.15	0.09	0	0	0.24	2.8	0.09	0	0	0	0.09	2.7
	Motor	2	0.10	0	0	0	0.10	1.9	0.06	0	0	0	0.06	1.8
	Transformer	2	0.10	0	0	0	0.10	1.9	0.06	0	0	0	0.06	1.8
	Heating(Air conditi.)	267	13.35	0	0	0	13.35	253.7	8.01	0	0	0	8.01	245.6
	Boiler	753	37.65	0	0	0	37.65	715.4	22.59	0	0	0	22.59	692.8
	Heating furnace													
A.E.C.	Lighting	1	0.08	0	0	0	0.08	0.9	0.02	0	0	0	0.02	0.9
	Compressor	3	0.24	0.09	0	0	0.33	2.7	0.06	0	0	0	0.06	2.6
	Motor	2	0.16	0	0	0.2	0.36	1.6	0.04	0	0	0.2	0.24	1.4
	Transformer	2	0.16	0	0	0	0.16	1.8	0.04	0	0	0	0.04	1.8
	Heating	267	21.36	0	0	0	21.36	245.6	5.34	0	0	0	5.34	240.3
	Boiler	753	60.24	0	0	0	60.24	692.8	15.06	0	0	0	15.06	677.7
	Heating Furnace													

(7/9) VEGETABLE OIL (Unit : MJ/t)

Scenario	Name of equipment	Energy Intensity in 1997	Decrease in Energy Intensity in 2000					Energy Intensity in 2000	Decrease in Energy Intensity in 2003					Energy Intensity in 2003
			Improved Manage.	Modific. of equipm.	Moderniz. of process	Economic incentive	Total		Improved Manage.	Modific. of equipm.	Moderniz. of process	Economic incentive	Total	
E.C.	Lighting	19	1	1	0	0	2	17	0	0	0	0	0	17
	Compressor	85	4	0	0	0	4	81	0	0	0	0	0	81
	Motor	142	7	0	0	0	7	135	0	0	0	0	0	135
	Transformer	28	1	0	0	0	1	27	0	0	0	0	0	27
	Heating(Air conditi.)	3,647	182	0	270	0	452	3,195	160	0	0	270	580	2,615
	Boiler	5,674	284	0	420	0	704	4,970	249			420	249	4,722
	Heating furnace													
A.E.C.	Lighting	19	1	1	0	0	2	17	0	0	0	0	0	17
	Compressor	85	4	0	0	0	4	81	0	0	0	0	0	81
	Motor	142	7	0	0	14	21	121	0	0	0	14	14	107
	Transformer	28	1	0	0	0	1	27	0	0	0	0	0	27
	Heating	3,647	292	0	270	0	562	3,085	292	0	0	270	712	2,373
	Boiler	5,674	454	0	420	0	874	4,800	454	0	0	420	454	4,346
	Heating Furnace													

(8/9) MEAT (Unit : MJ/t)

Scenario	Name of equipment	Energy Intensity in 1997	Decrease in Energy Intensity in 2000					Energy Intensity in 2000	Decrease in Energy Intensity in 2003					Energy Intensity in 2003
			Improved Manage.	Modific. of equipm.	Moderniz. of process	Economic incentive	Total		Improved Manage.	Modific. of equipm.	Moderniz. of process	Economic incentive	Total	
E.C.	Lighting	146	15	1	4	0	20	126	7	0	4	0	11	115
	Compressor	86	9	3	2	0	14	72	4	0	2	0	7	65
	Motor	1,416	142	0	38	0	180	1,236	71	0	38	0	109	1,127
	Transformer	127	13	0	3	0	16	111	6	0	3	0	10	101
	Heating(Air conditi.)	2,318	232	40	52	0	324	1,994	116	0	52	0	168	1,826
	Boiler	10,995	1,100	0	247	0	1,347	9,648	550	0	247	0	797	8,851
	Heating furnace													
A.E.C.	Lighting	146	22	1	4	0	27	119	10	0	4	0	14	104
	Compressor	86	13	3	2	0	18	68	6	0	2	0	8	59
	Motor	1,416	212	0	38	142	392	1,024	99	0	38	142	279	744
	Transformer	127	19	0	3	0	22	105	9	0	3	0	12	92
	Heating	2,318	348	40	531	0	919	1,399	162	0	52	0	214	1,185
	Boiler	10,995	1,649	0	2,518	0	4,167	6,828	770	0	247	0	1,017	5,811
	Heating Furnace													

(9/9) DAIRY PRODUCTS

(Unit : MJ/t)

Scenario	Name of equipment	Energy Intensity in 1997	Decrease in Energy Intensity in 2000					Energy Intensity in 2000	Decrease in Energy Intensity in 2003					Energy Intensity in 2003
			Improved Manage.	Modific. of equipm.	Moderniz. of process	Economic incentive	Total		Improved Manage.	Modific. of equipm.	Moderniz. of process	Economic incentive	Total	
E.C.	Lighting	25	3	1	1	0	5	20	1	0	1	0	2	19
	Compressor	126	13	4	5	0	22	104	3	0	5	0	8	97
	Motor	302	30	0	12	0	43	259	6	0	12	0	18	241
	Transformer	88	9	0	4	0	12	76	2	0	4	0	5	70
	Heating(Air conditi.)	473	47	0	31	0	79	394	9	0	31	0	41	354
	Boiler	6,698	670	0	444	0	1,114	5,584	134	0	444	0	578	5,007
	Heating furnace													
A.E.C.	Lighting	25	3	1	1	0	5	20	1	0	1	0	2	18
	Compressor	126	16	4	5	0	25	101	3	0	5	0	8	93
	Motor	302	39		12	30	81	221	7	0	12	30	49	171
	Transformer	88	11		4	0	15	73	2	0	4	0	6	67
	Heating	47	7	0	3	0	10	37	1	0	3	0	4	33
	Boiler	670	101	0	44	0	145	525	16	0	44	0	60	465
	Heating Furnace													

6. ENERGY CONSERVATION POTENTIAL IN TARGETED INDUSTRIES AND EQUIPMENT

6. ENERGY CONSERVATION POTENTIAL IN TARGETED INDUSTRIES AND EQUIPMENT

An economic evaluation of energy conservation measures for targeted industries and equipment was made in chapter 4 and their future energy intensities were estimated in chapter 5. Based upon the results of the evaluation and the estimation, the future potential for energy conservation in each industry and equipment is forecasted in this chapter.

6.1 Forecasting Production in Targeted Industrial Sectors and Sub-sectors

6.1.1 Methodology

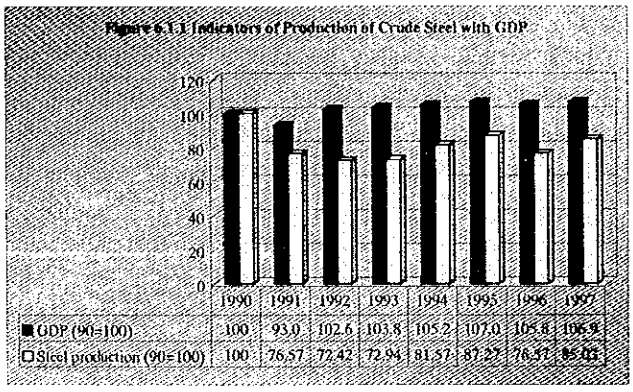
Future potential for energy conservation is very sensitive to changes in the output of products, which is in turn determined by GDP growth rate, structural changes in the economy, and world trade. We forecast the output of 21 product categories in nine industries, taking into account these factors, as well as referring to the results of simulations made by the macro-economic model in chapter 9 and the views of Polish experts on industries.

6.1.2 Iron and Steel

It is projected that crude steel production will increase at an average annual growth rate of about 2.2% from 1997 to 2003, if the Polish government maintains its policy of expanding steel output and restructuring of the sector is successful. The results of the projection are shown in Table 6.1.1.

The main factors affecting the results are domestic demand and export of steel products. The following will have an influence:

- ❖ GDP growth rate which is forecast about 5% per year;
- ❖ Restructuring procedures, improving product quality, and changing product structure;
- ❖ Improving quality of environment;
- ❖ Demand of the European Union for steel output in Poland.



Source: JICA Team

Table 6.1.1 Production Forecast for the Steel Industry

Item	Unit	Actual		Forecasting Results	
		1990	1997	2000	2003
Production	million ton	13.62	11.59	12.36	13.22
Index (1990=100)		100	85.03	90.69	97.06
			'97/'90	'00/'97	'03/'97
Growth Rate (%)			-2.29	2.17	2.23

Source: JICA Team

6.1.3 Ammonia

It is projected that ammonia production will amount to 2,480 thousand tons in 2000 and 2,687 thousand tons in 2003. The annual growth rate of ammonia production will be about 3.3% from 1997 to 2000 and 2.7% from 2000 to 2003. The results of the projection are shown in Table 6.1.2.

Table 6.1.2 Forecast for Ammonia Production

Product	Unit	1990		1995		1997		2000		2003	
		Production 1000t	'90/85 %	Production 1000t	'95/90 %	Production 1000t	'97/95 %	Production 1000t	'00/97 %	Production 1000t	'03/00 %
Ammonia	1000 ton	1,484		2,248		2,252		2,480		2,687	
Average Growth Rate			-3.92		8.67		0.07		3.27		2.72

Source: JICA team

6.1.4 Machinery

(1) Tractors

Based Central Statistical Office (GUS) data, production of tractors in 1997 was about 23 thousand, and was 9.2% lower than in the previous year. It is projected that until 2003 the production level will grow at a slower pace. The annual growth rate of tractor production will be 5.1% from 1997 to 2000 and 6% from 2000 to 2003 as shown in Table 6.1.3. The following factors will effect the results:

- ❖ Restructuring of the sector;
- ❖ Introduction of modern manufacturing technologies;
- ❖ Reduction of costs of production to capture domestic market;
- ❖ Higher production against cheap imports of finished tractors and components for assembly in Poland;
- ❖ Availability of subsidized loans to farmers willing to buy Polish tractors.

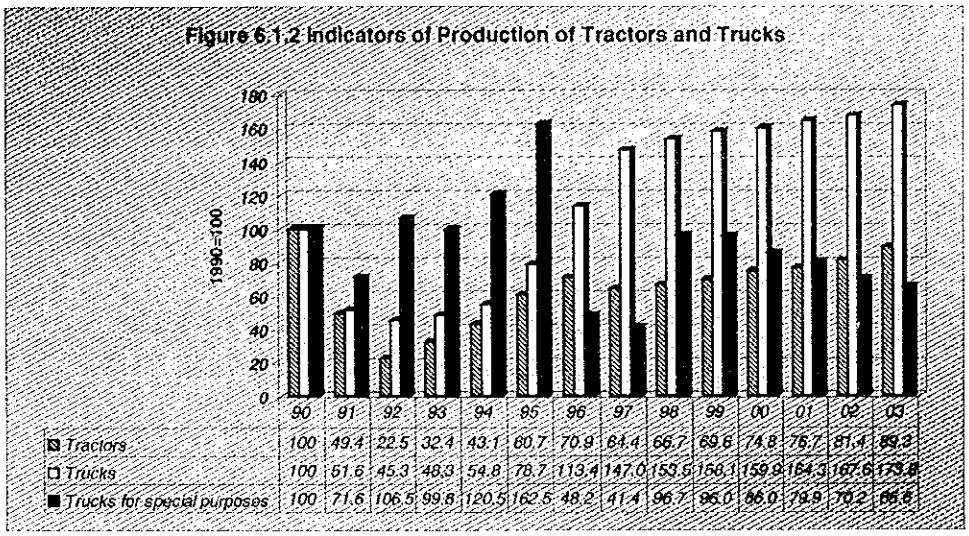
(2) Trucks

It is projected that the production of trucks including those for special purposes will increase to 160% of the 1990 level in 2000 and to 173% in 2003, as shown in Figure 6.1.2. There are two reasons for these trends. First, potential demand for trucks is large, because of quickly growing transportation needs. Second, the industrial policy program of the Polish government has been designed to restructure the motor vehicles sector to increase the competitiveness of Polish products, to introduce innovations, and to adapt products to world standards, as well as to increase exports.

Table 6.1.3 Production Forecast for Tractor and Truck Production

Product	Unit	1980		1985		1990		1995		1997		2000		2003	
		Production 1000t	% in total %	Production 1000t	% of total %	Production 1000t	% of total %	Production 1000t	% of total %	Production 1000t	% of total %	Production 1000t	% of total %	Production 1000t	% of total %
Tractors	000Numb	58	48.68	59	52.19	35	46.24	22	38.56	23	28.17	27	29.22	32	31.39
Trucks	000Numb	54	45.40	49	43.43	39	50.87	31	54.98	57	70.70	62	68.68	68	67.17
Trucks for special purposes	000Numb	7	5.92	5.0	4.38	2.2	2.90	3.6	6.46	0.9	1.13	1.9	2.10	1.5	1.44
Total	1000t	118	100.00	113	100.00	77	100.00	56	100.00	81	100.00	91	100.00	101	100.00
Average Growth Rate				1980-1985		1985-1990		1990-1995		1995-1997		1997-2000		2000-2003	
Tractors	%			0.51		-9.71		-9.49		3.00		5.12		6.08	
Trucks	%			-1.76		-4.53		-4.68		36.65		2.86		2.81	
Trucks for special purposes	%			-6.69		-14.83		10.20		-49.50		27.55		-8.64	
Total	%			-0.88		-7.50		-6.15		20.51		3.85		3.58	

Source: JICA Team

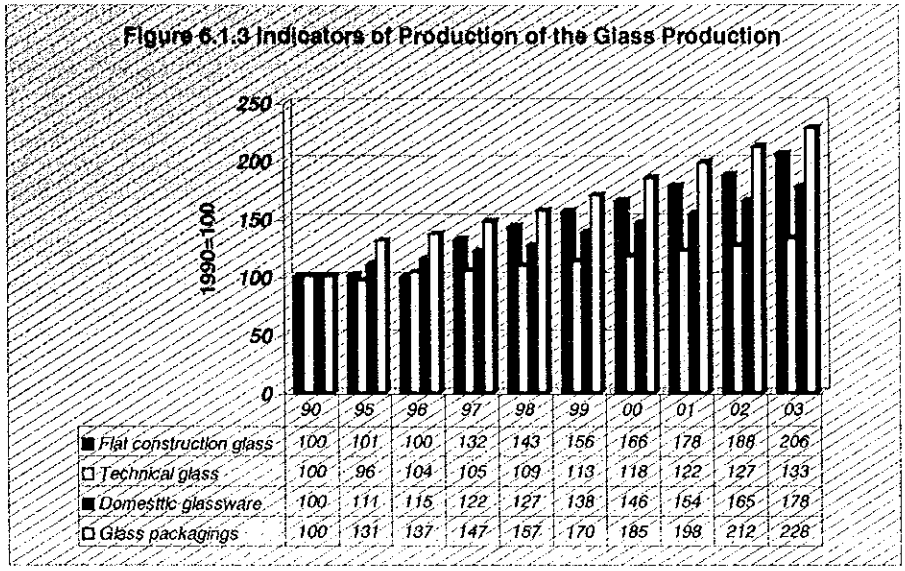


Source: JICA Team

6.1.5 Non-metallic Materials

(1) Glass

It is projected that production of glass products will increase from 1,420 thousand tons in 1997 to 1,776 thousand tons in 2000. As shown in Table 6.1.4, demand is expected to grow at an annual average rate of 7.7% from 2000 to reach 2,183 thousand tons in 2003. The biggest increase rate is expected to be recorded for flat construction glass, followed by glass packaging. The reason is that construction of office building, and houses, and bottle consumption will show big increases.



Source: JICA Team

Table 6.1.4 Production Forecast for Glass Products

Product	Unit	1980		1985		1990		1995		1997		2000		2003	
		Production 1000t	% of total %	Production 1000t	% of total %	Production 1000t	% of total %	Production 1000t	% of total %	Production 1000t	% of total %	Production 1000t	% of total %	Production 1000t	% of total %
Flat construction glass	1000t	459	35.69	401	31.75	345	32.62	327	26.90	426	29.96	536	30.16	664	30.42
Technical glass	1000t	100	7.74	88	6.97	74	7.00	48	3.94	52	3.67	59	3.30	66	3.04
Domestic glassware	1000t	89	6.94	78	6.14	62	5.86	64	5.26	70	4.94	85	4.76	103	4.70
Glass packagings	1000t	638	49.62	696	55.13	577	54.52	777	63.91	873	61.43	1,097	61.78	1,350	61.84
Total	1000t	1,285	100.00	1,263	100.00	1,058	100.00	1,216	100.00	1,422	100.00	1,776	100.00	2,183	100.00
Average Growth Rate				1980-1985		1985-1990		1990-1995		1995-1997		1997-2000		2000-2003	
Flat construction glass	%			-2.65		-2.97		-1.07		14.14		7.93		7.43	
Technical glass	%			-2.42		-3.41		-8.35		4.37		3.96		4.18	
Domestic glassware	%			-2.75		-4.38		0.60		4.84		6.37		6.70	
Glass packagings	%			1.77		-3.70		6.14		6.04		7.90		7.16	
Total	%			-0.35		-3.49		2.82		8.15		7.69		7.12	

Source: JICA Team

(2) Silicate lime blocks

As shown in Table 6.1.5, it is projected that production of Silicate lime block will fall to 41% of the 1990 level in 2000 and increase to 45% in 2003. One reason for these trends is that the growth rate of private investment in housing will be very low until 2000, because the annual inflation rate from 1997 to 2000 will be 10.2%. It is expected that annual inflation rate will be lower than 4% after the year 2000. Another reason is the high and quickly growing cost of residential housing construction. In small towns the cost of 1 m^2 of housing space is approx. equal to two average monthly wages and in large cities to three or five monthly wages. Mortgage loans have interest rates of about 25% annually. This prevents most of the population from drawing them. The state was almost stopped subsidizing residential construction.

Table 6.1.5 Production Forecast for Silicate Lime Block Product

Product	Unit	1990		1995		1997		2000		2003	
		Production	Index 90=100	Production	Index 90=100	Production	Index 90=100	Production	Index 90=100	Production	Index 90=100
Concrete Block	Mln pcs	4,296		3,212		3,245		3,327		3,390	
	%		100		74.8		75.5		77.4		78.9
Limestone	Mln pcs	999		429		374		409		447	
	%		100		42.9		37.5		41.0		44.8
Total	Mln pcs	5,295	100	3,641	68.8	3,619	68.4	3,736	70.6	3,837	72.5

Source: JICA Team

6.1.6 Food Processing

In this sector, three sub-sectors and 10 main products were investigated.

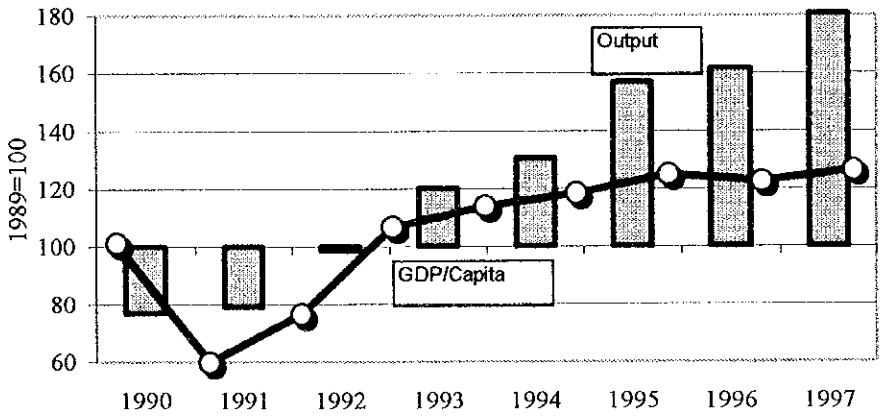
(1) Vegetable Oil Products

It is projected as shown in Table 6.1.6 that production of vegetable oil products will increase from 602 thousand ton in 1997 to 677 thousand tons in 2000 and 757 thousand tons in 2003. The main factors affecting the results will be the domestic demand for vegetable oil. It will be influenced by the following:

- ❖ The growth rates of GDP and real income, which are projected 5% and 3% per year;
- ❖ The growth rate of prices of vegetable oil products is lower than the price of butter.
- ❖ Investment in plants for pressing and extraction, as well as for margarine manufacturing.

Figure 6.1.4 shows the relationship between income level and output level. It is very clear that domestic demand is the main impacting factor on output.

Fig.6.1.4 Indicators of Income per Capita and Output of the Vegetable Oil Production



Source: JICA team

Table 6.1.6 Forecast for Vegetable Oil Production

Product	Unit	1980		1985		1990		1997		2000		2003	
		Production 1000t	% of total %	Production 1000t	% of total %	Production 1000t	% of total %	Production 1000t	% of total %	Production 1000t	% of total %	Production 1000t	% of total %
Refined Oil	1000t	63	25.38	94	35.12	77	29.95	208	34.49	230	34.00	258	34.00
Margarine	1000t	184	74.62	173	64.88	179	70.05	395	65.51	447	66.00	500	66.00
Vegetable Oil	1000t	247	100.00	267	100.00	256	100.00	602	100.00	677	100.00	757	100.00
				1980-1985		1985-1990		1990-1997		1997-2000		2000-2003	
Refined Oil	%			8.34		-3.94		15.32		3.48		3.82	
Margaine	%			-1.28		0.70		11.94		4.22		3.82	
Total	%			1.52		-0.84		13.02		3.97		3.82	

Source: JICA Team

(2) Meat and Poultry Products

It is assumed that the annual growth rate of production of meat and poultry products from 1997 to 2000 will be 0.2% and 3.4% from 2000 to 2003. The total demand for production will be 1,249 thousand tons in 2000 and 1,389 thousand tons in 2003.The main factors affecting the results will be domestic demand and exports of meat. It will be influenced by the following:

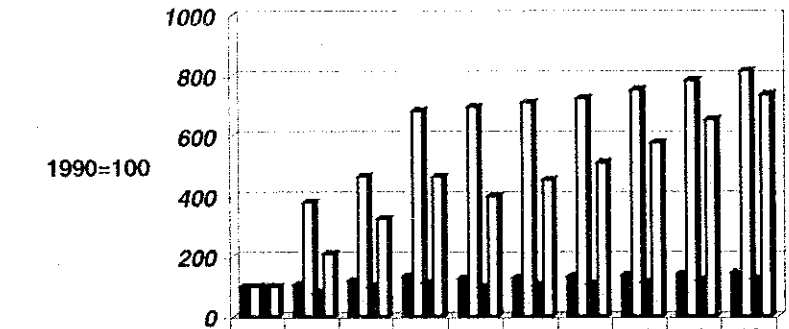
- ❖ The state of the economy which should grow by about 5%, and real incomes by 3%.
- ❖ Consumption of meat products per capita is expected to reach 75kg before 2003.
- ❖ Exports to Eastern markets – especially Russia, which have already declined in the second half of the year 1998, may stagnate or fall still further, if the financial crisis there continues.

Table 6.1.7 Forecast for the Meat and Poultry Production

Product	Unit	1980		1985		1990		1997		2000		2003	
		Production 1000t	% of total %	Production 1000t	% of total %	Production 1000t	% of total %	Production 1000t	% of total %	Production 1000t	% of total %	Production 1000t	% of total %
Cured meat	1000t	811	81.84	692	85.45	714	82.52	945	76.09	946	75.74	1,031	74.25
Cured poultry	1000t	0	0.00	0	0.00	18	2.03	120	9.65	127	10.18	143	10.30
Meat preserves	1000t	171	17.29	112	13.81	126	14.55	141	11.34	136	10.90	157	11.33
Poultry preserves	1000t	9	0.87	6	0.74	8	0.90	36	2.91	40	3.18	57	4.12
Total	1000t	991	100.00	810	100.00	865	100.00	1,241	100.00	1,249	100.00	1,389	100.00
Average Growth Rate				1980-1985		1985-1990		1990-1997		1997-2000		2000-2003	
Cured meat	%			-3.11		0.61		4.08		0.05		2.91	
Cured poultry	%							31.57		2.00		4.00	
Meat preserves	%			-8.16		2.39		1.61		-1.12		4.94	
Poultry preserves	%			-6.85		5.23		24.55		3.24		12.92	
Total	%			-3.94		1.32		5.29		0.21		3.59	

Source: JICA Team

Figure 6.1.5 Indicators of Production of Meat Products



	90	95	96	97	98	99	00	01	02	03
■ Cured meat	100	106	118	132	127	129	132	136	140	144
□ Cured poultry	100	379	466	683	696	710	724	753	784	815
■ Meat preserves	100	79	99	112	97	103	108	115	121	125
□ Poultry preserves	100	208	324	465	400	455	512	577	654	737

Source: JICA Team

(3) Dairy Products

It is forecasted, as shown in Table 6.1.8, that in 2000 processed milk production will reach 1,443 thousand tons. Up to 2003, the volume of the product demand is expected to average an annual growth of about 3.2% compared to 2000. In 2000, production of powdered milk will be reduced from 161 thousand ton in 1997 to 113 thousand tons and fall to 96 thousand tons in 2003. The share of production of cheese and others in the sector will increase.

Table 6.1.8 Forecast for Dairy Products Production

Product	Unit	1980		1985		1990		1997		2000		2003	
		Production 1000t	% of total %	Production 1000t	% of total %	Production 1000t	% of total %	Production 1000t	% of total %	Production 1000t	% of total %	Production 1000t	% of total %
Processed milk	1000t	2,680	77.52	2,536	65.95	2,037	63.39	1,340	51.23	1,443	49.13	1,585	48.47
Powdered milk	1000t	134	3.87	207	5.39	216	6.74	161	6.16	113	3.85	96	2.92
Butter	1000t	253	7.31	275	7.16	272	8.45	139	5.32	139	4.72	141	4.31
Cheese and Others	1000t	391	11.30	827	21.50	688	21.43	975	37.29	1,242	42.30	1,448	44.30
Total	1000t	3,457	100.00	3,846	100.00	3,213	100.00	2,615	100.00	2,936	100.00	3,269	100.00
Average Growth Rate				1980-1985		1985-1990		1990-1997		1997-2000		2000-2003	
Processed milk	%			-1.10		-4.29		-5.81		2.50		3.18	
Powdered milk	%							-4.13		-11.12		-5.46	
Butter	%			1.72		-0.28		-9.12		-0.12		0.56	
Cheese and Others	%			16.19		-3.60		5.10		8.40		5.25	
Total	%			2.15		-3.53		-2.90		3.94		3.64	

Source: JICA Team

6.2 Estimating Economic Potentials for Energy Conservation in Targeted Industries

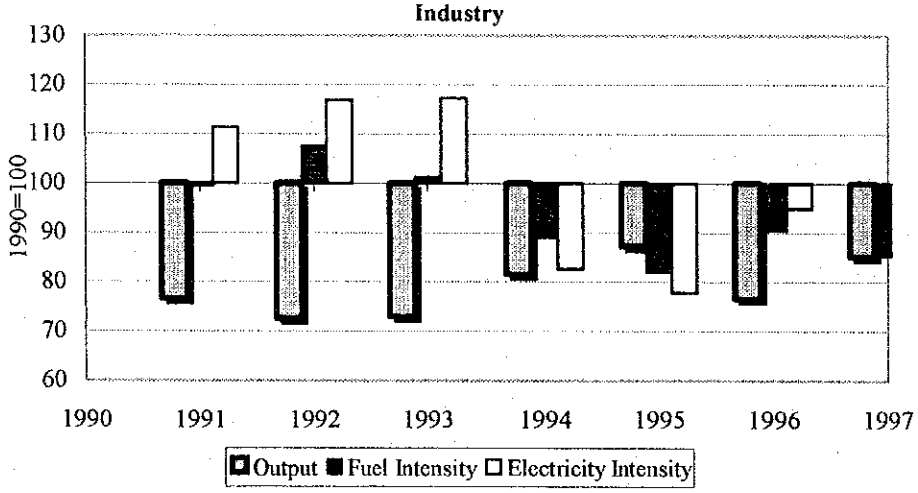
In chapter 5, the average energy intensity for targeted sectors and sub-sectors in 2000 and 2003 is estimated. Based on the above information, in this section we estimate the economic potential of energy saving for 2000 and 2003 using scenarios.

6.2.1 Iron and Steel

(1) Introduction

The iron and steel industry is the largest individual user of energy. In 1997 this sector consumed 207,660TJ of fuel and 6,105GWh of electricity. Fuel accounts for 16.6 percent of the manufacture's fuel consumption and electricity accounts 13.6 percent of the manufacture's electricity consumption. Between 1990 to 1997, the output of crude steel decreased at 2.3% per year. Using 1990 as the base year, the iron and steel industry recorded an increase in energy efficiency of approximately 2.4% to 1997. Indicators of energy intensity and output for this sector are shown in Figure 6.2.1.

Figure 6.2.1 Indicators of Energy Use & Output of the Iron and Steel Industry



Source: JICA Team

(2) Energy demand forecast using the "Reference scenario"

Based on assumption of future output and energy intensity of 1997, energy consumption in this sector will increase from 229,638TJ in 1997 to 244,920TJ in 2000 and 262,110TJ in 2003.

(3) Potential for energy conservation in 2000

In the "scenario E.C.," the energy intensity of the iron and steel industry is assumed to fall by 12% due to energy conservation measures. Overall energy intensity of the industry is assumed

to decrease from 19,822MJ/ton in 1997 to 17,608MJ/ton.

In the "scenario A.E.C.," the energy intensity of this sector decreases from 19,822MJ/ton in 1997 to 17,152MJ/ton due to energy conservation measures.

Comparing the "Reference scenario," the potential for energy conservation is estimated to be 27,354TJ in the "scenario E.C." and 32,989TJ in the "scenario A.E.C."

(4) Potential for energy conservation in 2003

Under the "scenario E.C.," the energy efficiency of iron and steel industry is assumed to improve by 19% due to run energy conservation measures. The energy intensity of this sector could be reduced to about 15,967MJ/ton.

Under the "scenario A.E.C.," the energy efficiency of the industry is assumed to improve by 26% due to energy conservation measures. Energy use per ton of crude steel falls from 19,822MJ in 1997 to 15,134MJ in 2003.

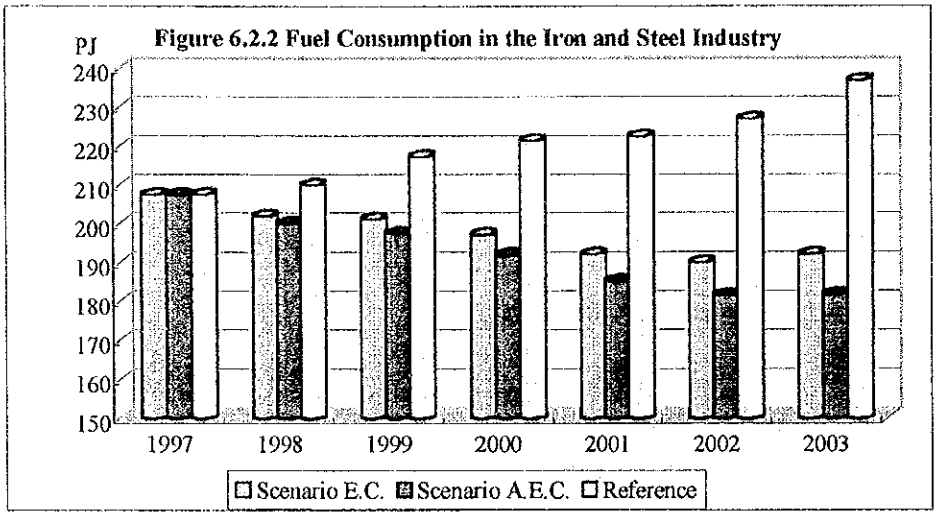
Comparing the "reference scenario," the potential for energy saving is estimated to be 50,974TJ in the "scenario E.C." and 61,989TJ in the "scenario A.E.C." The projected energy intensity of crude steel is shown in Table 6.2.1.

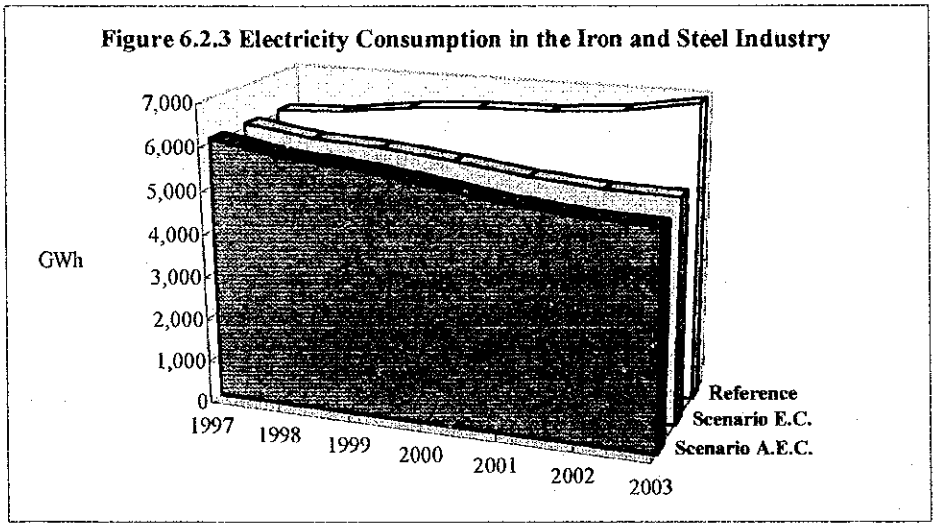
Table 6.2.1 Energy Demand Forecast for the Steel Industry of Poland

Item			*Actual*	*Simulation Results*						Growth Rate(%)		Index(1997=100)	
		Unit	1997	1998	1999	2000	2001	2002	2003	'00/'97	'03/'97	00/'97	'03/'97
Scenario E.C	Fuels	TJ	207,660	202,073	201,306	197,339	192,221	190,156	192,267	-1.7	-1.3	95.0	92.6
	Electricity	GWh	6,105	5,877	5,793	5,619	5,394	5,260	5,242	-2.7	-2.5	92.0	85.9
	Total	TJ	229,638	223,232	222,161	217,566	211,641	209,090	211,137	-1.8	-1.4	94.7	91.9
	Fuel Intensity	MJ/t	17,925	17,248	16,597	15,971	15,479	15,002	14,540	-3.8	-3.4	89.1	81.1
	Electricity Intensity	kWh/t	527	502	478	455	434	415	396	-4.8	-4.6	86.3	75.2
	Energy Intensity	MJ/t	19,822	19,054	18,317	17,608	17,043	16,496	15,967	-3.9	-3.5	88.8	80.6
Scenario A.E.C	Fuels	TJ	207,660	200,295	197,778	192,174	185,431	181,715	182,006	-2.6	-2.2	92.5	87.6
	Electricity	GWh	6,105	5,832	5,703	5,488	5,239	5,079	5,032	-3.5	-3.2	89.9	82.4
	Total	TJ	229,638	221,289	218,309	211,931	204,291	199,998	200,121	-2.6	-2.3	92.3	87.1
	Fuel Intensity	MJ/t	17,925	17,096	16,306	15,553	14,932	14,336	13,764	-4.6	-4.3	86.8	76.8
	Electricity Intensity	kWh/t	527	498	470	444	422	401	381	-5.5	-5.3	84.3	72.2
	Energy Intensity	MJ/t	19,822	18,888	17,999	17,152	16,451	15,779	15,134	-4.7	-4.4	86.5	76.4
Reference	Fuels	TJ	207,660	209,998	217,405	221,479	222,593	227,200	237,024	2.2	2.2	106.7	114.1
	Electricity	GWh	6,105	6,174	6,392	6,511	6,544	6,679	6,968	2.2	2.2	106.7	114.1
	Total	TJ	229,638	232,224	240,415	244,920	246,152	251,246	262,110	2.2	2.2	106.7	114.1
	Fuel Intensity	MJ/t	17,925	17,925	17,925	17,925	17,925	17,925	17,925				
	Electricity Intensity	kWh/t	527	527	527	527	527	527	527				
	Energy Intensity	MJ/t	19,822	19,822	19,822	19,822	19,822	19,822	19,822				

Source: JICA Team

Figure 6.3.2 and Figure 6.3.2 show the potential for fuel and electricity conservation from 1997 to 2003.



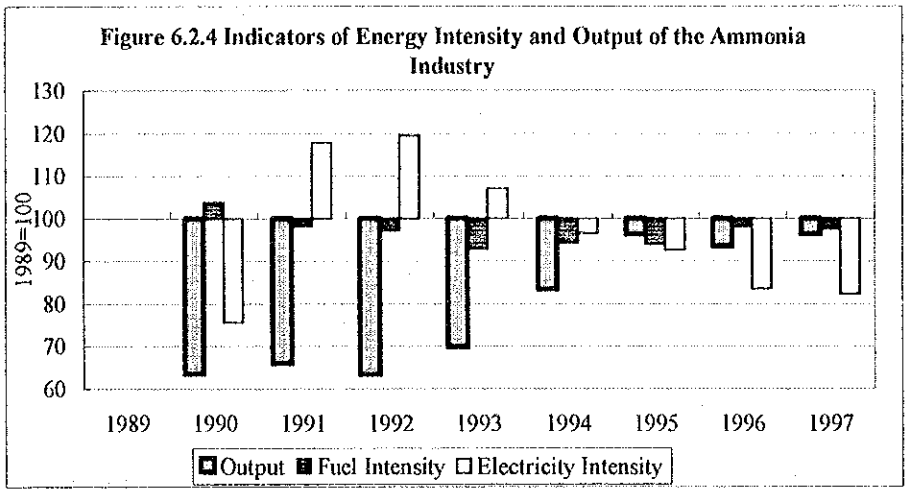


Source: JICA Team

6.2.2 Ammonia

(1) Introduction

In 1997, this sector consumed 72,954TJ of fuel and 1,133GWh of electricity. Fuel accounts for 5% of the manufacture's fuel consumption and electricity accounts about 4% of electricity consumption of manufacture. Indicators of average energy intensity and total of output are shown in Figure 6.2.4.



Source: JICA Team

Before discussing the potential for energy conservation of the chemical industry, Table 6.2.2 shows the assumed results of energy intensity and conservation potential for the ammonia industry.

Table 6.2.2 Energy Demand Forecast for the Ammonia Industry

Item			*Actual*	*Simulation Results*						Growth Rate(%		Index 97=100	
		Unit	1997	1998	1999	2000	2001	2002	2003	'00/'97	'03/'97	00/'97	'03/'97
Scenario E.C	Fuels	TJ	70,714	69,539	72,063	73,948	74,454	76,829	78,870	1.5	1.8	104.6	111.5
	Electricity	GWh	1,133	1,114	1,154	1,185	1,186	1,218	1,244	1.5	1.6	104.6	109.8
	Total	TJ	74,792	73,549	76,219	78,213	78,726	81,213	83,347	1.5	1.8	104.6	111.4
	Fuel Intensity	MJ/t	31,406	30,869	30,342	29,823	29,664	29,506	29,349	-1.7	-1.1	95.0	93.5
	Electricity Intensity	kWh/t	503	494	486	478	473	468	463	-1.7	-1.4	95.0	92.0
	Energy Intensity	MJ/t	33,217	32,649	32,091	31,543	31,366	31,190	31,015	-1.7	-1.1	95.0	93.4
Scenario A.E.C	Fuels	TJ	70,714	69,295	71,558	73,172	73,669	76,014	78,029	1.1	1.7	103.5	110.3
	Electricity	GWh	1,133	1,098	1,122	1,135	1,119	1,130	1,135	0.1	0.0	100.2	100.2
	Total	TJ	74,792	73,248	75,597	77,258	77,696	80,081	82,116	1.1	1.6	103.3	109.8
	Fuel Intensity	MJ/t	31,406	30,761	30,129	29,510	29,351	29,193	29,036	-2.1	-1.3	94.0	92.5
	Electricity Intensity	kWh/t	503	487	472	458	446	434	423	-3.1	-2.9	91.0	84.0
	Energy Intensity	MJ/t	33,217	32,516	31,830	31,158	30,956	30,755	30,557	-2.1	-1.4	93.8	92.0
Reference	Fuels	TJ	70,714	70,748	74,591	77,873	78,826	81,775	84,398	3.3	3.0	110.1	119.4
	Electricity	GWh	1,133	1,133	1,195	1,247	1,263	1,310	1,352	3.3	3.0	110.1	119.4
	Total	TJ	74,792	74,828	78,892	82,363	83,372	86,491	89,265	3.3	3.0	110.1	119.4
	Fuel Intensity	MJ/t	31,406	31,406	31,406	31,406	31,406	31,406	31,406				
	Electricity Intensity	kWh/t	503	503	503	503	503	503	503				
	Energy Intensity	MJ/t	33,217	33,217	33,217	33,217	33,217	33,217	33,217				

Source: JICA Team

(2) Energy demand forecast using the "Reference scenario"

Based on assumption of output and energy intensity in 1997, energy consumption in this sub-sector will increase from 74,792TJ in 1997 to 82,363TJ in 2000 and 89,265TJ in 2003.

(3) Potential for energy conservation in 2000

As shown in the above table, in the "scenario E.C.," the energy intensity of ammonia industry is

assumed to fall by 5% due to energy conservation measures and energy intensity to decrease from 33,217MJ/ton in 1997 to 31,543MJ/ton.

In the "scenario A.E.C.," the energy intensity of this industry is assumed to decrease by around 6% due to energy conservation measures. The energy intensity of ammonia industry will decrease to 31,158MJ/ton.

Comparing the "Reference scenario," the potential for energy conservation is estimated to be 4,151TJ in the "scenario E.C." and 5,105TJ in the "scenario A.E.C."

(4) Potential for energy conservation in 2003

Under the "scenario E.C.," the energy efficiency of ammonia industry is assumed to improve by 7% due to energy conservation measures. Energy intensity will fall from 31,543MJ/ton in 1997 to 31,015MJ/ton.

Under the "scenario A.E.C.," it is assumed to improve 8% due to energy conservation measures. The energy intensity of this sub-sector will decrease from 31,543MJ/ton in 1997 to 30,557MJ/ton.

Comparing the "Reference scenario," the potential for energy conservation is estimated to be 5,917TJ in the "scenario E.C." and 7,148TJ in the "scenario A.E.C."

The relationship between output and energy intensity in the ammonia industry is shown in Figure 6.2.5. The potential of energy conservation from 1998 to 2003 is shown in Figure 6.2.6.

Figure 6.2.5 Products Supply & Energy Intensity for the Ammonia Industry

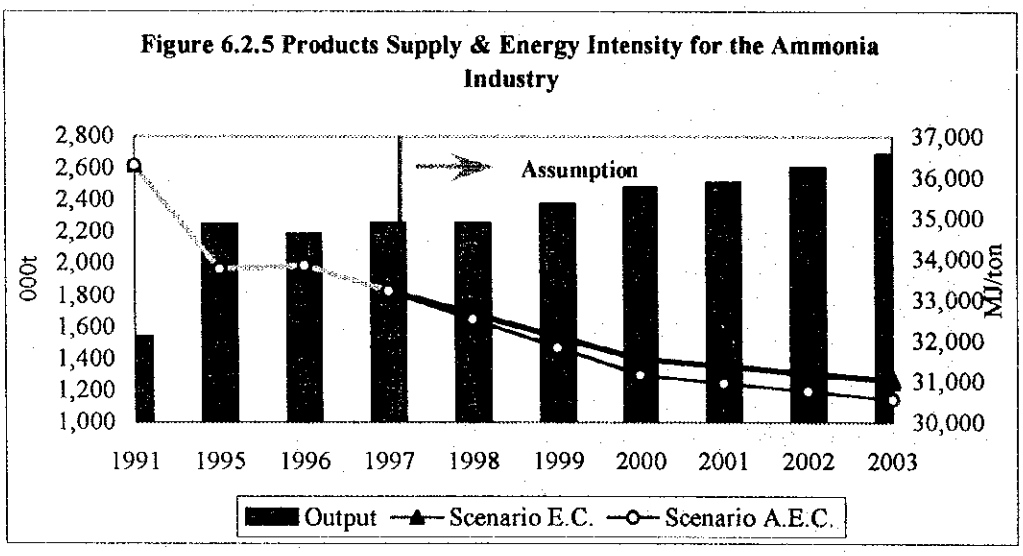
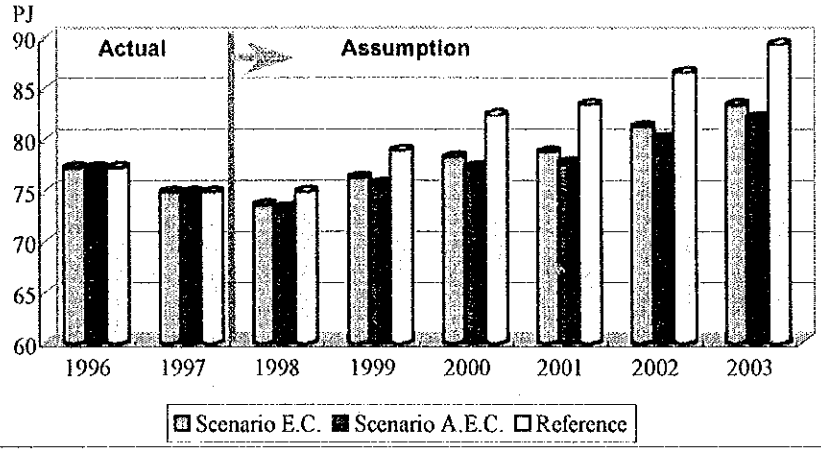


Figure 6.2.6 Total Energy Consumption in the Ammonia Industry



Source: JICA Team

6.2.3 Tractors and Trucks

(1) Tractors

a. Energy demand forecast for the "reference scenario"
Base on assumption of future output and energy intensity in 1997, energy consumption in this sector will increase from 1,418TJ in 1997 to 1,647TJ in 2000 and 1,966TJ in 2003.

b. Potential for energy conservation in 2000
In the "scenario E.C.," the energy intensity of the Tractor industry is assumed to fall by 17.3% due to energy conservation measures. Energy intensity of the tractor industry will decrease from 62GJ/tractor in 1997 to 51GJ/tractor. Comparing the "Reference scenario," the energy saving is 285TJ.

In the "scenario A.E.C.," the energy intensity of this sector is assumed to decrease by around 21% due to energy conservation measures. Energy intensity of the tractor industry will decrease to 49GJ/tractor. Comparing the "Reference scenario," the total energy saving is 345TJ.

c. Potential for energy conservation in 2003
Under the "scenario E.C.," the energy efficiency of the tractor industry is assumed to improve by 22% due to energy conservation measures. Energy intensity of the industry will fall from 62GJ/tractor in 1997 to 49GJ/tractor. Comparing the "Reference scenario," the energy saving is 430TJ.

Under the "scenario A.E.C.," the energy efficiency of the tractor industry is assumed to improve by 27.5% due to energy conservation measures. Energy intensity of this sector will decrease to 45GJ/tractor. Comparing the "Reference scenario," the total energy saving in 2003 will be 537TJ.

The estimated energy conservation potential is shown in Table 6.2.3 and Figure 6.2.7, Figure 6.2.8.

Table 6. 2.3 Energy Demand Forecast for the Tractor Industry

Item			*Actual*	*Simulation Results*						Growth Rate(%)		Index 97=100	
		Unit	1997	1998	1999	2000	2001	2002	2003	'00/'97	'03/'97	'00/'97	'03/'97
Scenario E.C	Fuels	TJ	983	950	924	927	931	968	1,042	-1.9	1.0	94.3	106.1
	Electricity	GWh	121	119	118	121	122	127	137	0.0	2.1	99.9	113.5
	Total	TJ	1,418	1,379	1,349	1,362	1,369	1,425	1,536	-1.3	1.3	96.1	108.3
	Fuel Intensity	GJ/Tractor	43.1	40.2	37.5	35.0	34.3	33.6	32.9	-6.7	-4.4	81.2	76.5
	Electricity Intensity	kWh/Tractor	5,299	5,040	4,793	4,558	4,482	4,408	4,336	-4.9	-3.3	86.0	81.8
	Energy Intensity	GJ/pcs	62	58	55	51	50	49	49	-6.1	-4.0	82.7	78.1
Scenario A.E.C	Fuels	TJ	983	938	901	893	888	915	975	-3.1	-0.1	90.9	99.2
	Electricity	GWh	121	117	114	114	114	118	126	-2.0	0.7	94.2	104.3
	Total	TJ	1,418	1,358	1,310	1,303	1,298	1,338	1,429	-2.8	0.1	91.9	100.8
	Fuel Intensity	GJ/Tractor	43.1	39.7	36.6	33.7	32.7	31.8	30.8	-7.9	-5.4	78.2	71.6
	Electricity Intensity	kWh/Tractor	5,299	4,941	4,607	4,295	4,189	4,085	3,984	-6.8	-4.6	81.1	75.2
	Energy Intensity	GJ/pcs	62	57	53	49	48	46	45	-7.5	-5.2	79.1	72.7
Reference	Fuels	TJ	983	1,018	1,062	1,142	1,170	1,241	1,363	5.1	5.6	116.2	138.7
	Electricity	GWh	121	125	131	140	144	153	168	5.1	5.6	116.2	138.7
	Total	TJ	1,418	1,469	1,532	1,647	1,688	1,790	1,966	5.1	5.6	116.2	138.7
	Fuel Intensity	GJ/Tractor	43.1	43.1	43.1	43.1	43.1	43.1	43.1				
	Electricity Intensity	kWh/Tractor	5,299	5,299	5,299	5,299	5,299	5,299	5,299				
	Energy Intensity	GJ/pcs	62	62	62	62	62	62	62				

Source: JICA team

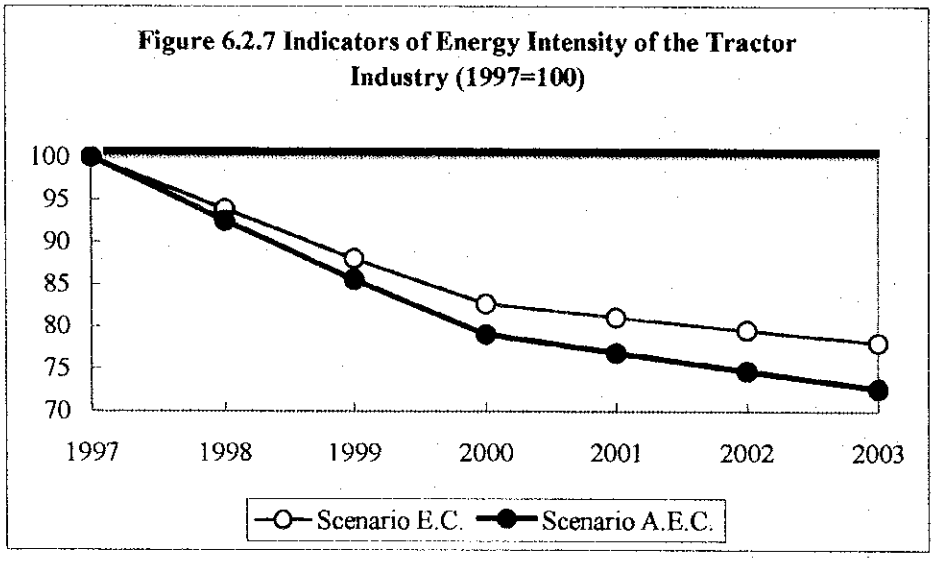
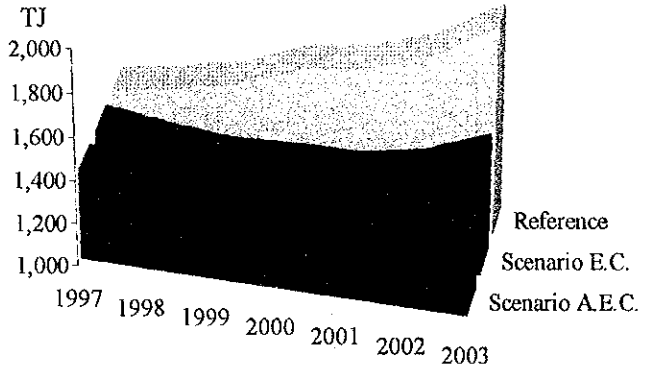


Figure 6.2.8 The Potential Energy Saving in the Tractor Industry



Source: JICA Team

(2) Trucks

a. Energy demand forecast using the "Reference scenario"
Based on assumption of future output and energy intensity in 1997, energy consumption in this sector will increase from 2,003TJ in 1997 to 2,179TJ in 2000 and 2,368TJ in 2003.

b. Potential for energy conservation in 2000
In the "scenario E.C.," the energy intensity of the truck industry is assumed to fall by 20% due to energy conservation measures which have been described. Energy intensity of the industry will decrease from 35GJ/truck in 1997 to 28GJ/truck. Comparing the "Reference scenario," energy conservation is estimated to be 434TJ.

In the "scenario A.E.C.," the energy intensity of this sector is assumed to decrease by around 22% due to energy conservation measures. Energy intensity of the industry will decrease to 27GJ/truck. Comparing the "Reference scenario," the energy saving is estimated to be 481TJ.

c. Potential for energy conservation in 2003
Under the "scenario E.C.," the energy efficiency of the truck industry is assumed to improve by 29% due to energy conservation measures. Energy intensity of the truck industry will fall from 35GJ/truck in 1997 to 25GJ/truck. Comparing the "Reference scenario," the total energy saving is estimated to be 678TJ.

Under the "scenario A.E.C.," the energy efficiency of the industry is assumed to improve by 32% due to energy conservation measures. Energy intensity of this sector will decrease to 24GJ/truck. Comparing the "Reference scenario," energy conservation is estimated to be 751TJ.

Table 6.2.4 shows the estimated energy conservation potential. Figure 6.2.9 reflects the

relationship of output and energy intensity of truck industry in the future. Fig.6.2.10 shows the potential for energy conservation from 1997 to 2003.

Table 6.2.4 Energy Demand Forecast for the Truck Industry

Item		Unit	*Actual*	*Simulation Results*						Growth Rate(%)		Index 97=100	
			1997	1998	1999	2000	2001	2002	2003	'00/'97	'03/'97	00/'97	'03/'97
Scenairo E.C	Fuels	TJ	1,440	1,354	1,256	1,143	1,108	1,067	1,043	-7.4	-5.2	79.4	72.5
	Electricity	GWh	156	162	166	167	171	174	180	2.3	2.3	106.9	114.9
	Total	TJ	2,003	1,938	1,854	1,745	1,724	1,693	1,690	-4.5	-2.8	87.1	84.4
	Fuel Intensity	GJ/Truck	25.2	22.6	20.4	18.4	17.3	16.3	15.4	-10.0	-7.8	73.0	61.3
	Electricity Intensity	kWh/Truck	2,731	2,715	2,699	2,684	2,673	2,663	2,652	-0.6	-0.5	98.3	97.1
	Energy Intensity	GJ/Truck	35	32	30	28	27	26	25	-7.1	-5.5	80.1	71.4
Scenairo A.E.C	Fuels	TJ	1,440	1,335	1,221	1,096	1,052	1,002	970	-8.7	-6.4	76.1	67.4
	Electricity	GWh	156	162	166	167	171	174	180	2.3	2.3	106.9	114.9
	Total	TJ	2,003	1,919	1,819	1,698	1,668	1,628	1,617	-5.4	-3.5	84.8	80.7
	Fuel Intensity	GJ/Truck	25.2	22.3	19.8	17.6	16.4	15.3	14.3	-11.2	-8.9	69.9	57.0
	Electricity Intensity	kWh/Truck	2,731	2,715	2,699	2,684	2,673	2,663	2,652	-0.6	-0.5	98.3	97.1
	Energy Intensity	GJ/Truck	35	32	30	27	26	25	24	-8.0	-6.2	77.9	68.3
Reference	Fuels	TJ	1,440	1,504	1,549	1,567	1,610	1,642	1,703	2.9	2.8	108.8	118.2
	Electricity	GWh	156	163	168	170	175	178	185	2.9	2.8	108.8	118.2
	Total	TJ	2,003	2,092	2,155	2,179	2,239	2,284	2,368	2.9	2.8	108.8	118.2
	Fuel Intensity	GJ/Truck	25	25	25	25	25	25	25				
	Electricity Intensity	kWh/Truck	2,731	2,731	2,731	2,731	2,731	2,731	2,731				
	Energy Intensity	GJ/Truck	35	35	35	35	35	35	35				

Source: Jica team

Figure 6.2.9 The Relationship between Output and Energy Intensity

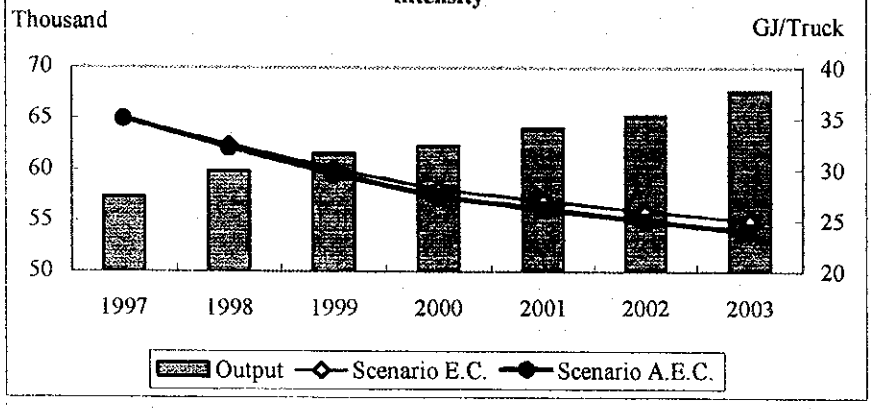
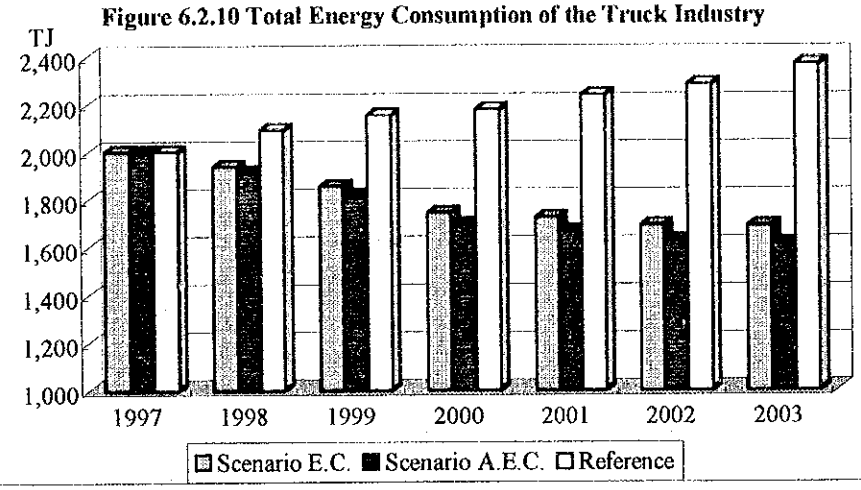


Figure 6.2.10 Total Energy Consumption of the Truck Industry



Source: JICA Team

6.2.4 Non-metallic Materials

(1) Glass

a. Energy consumption

In 1997 the glass industry consumed 22,728TJ of fuels and 752GWh of electricity. The total output of glass in 1997 was 1,422 thousand tons.

b. Energy demand forecast using the "Reference scenario"

Based on assumption of future output and energy intensity of 1997, energy consumption in this sector will increase from 25,435TJ in 1997 to 31,768TJ in 2000 and 39,052TJ in 2003.

c. Potential for energy conservation in 2000

In the "scenario E.C.," the energy intensity of the glass industry is assumed to fall by 14% due to energy conservation measures. Energy intensity of the glass industry will decrease from 17.9MJ/kg in 1997 to 15.3MJ/kg. Comparing the "Reference scenario," the energy saving is estimated to be 4,564TJ.

In the "scenario A.E.C.," the energy intensity of this sector is assumed to decrease by around 18% due to energy conservation measures. Energy intensity of the glass industry will decrease to 14.6MJ/kg. The energy conservation potential is 5,830TJ.

d. Potential for energy conservation in 2003

Under the "scenario E.C.," the energy efficiency of the glass industry is assumed to improve by 26% due to energy conservation measures. Energy intensity of the glass industry will fall from 17.9MJ/kg in 1997 to 13.3MJ/kg. Comparing the "Reference scenario," energy conservation is estimated to be 9,994TJ.

Under the "scenario A.E.C.," the energy efficiency of the glass industry will decrease from

17.9MJ/kg in 1997 to 12.5MJ/kg. Energy conservation is estimated to be 11,791TJ.

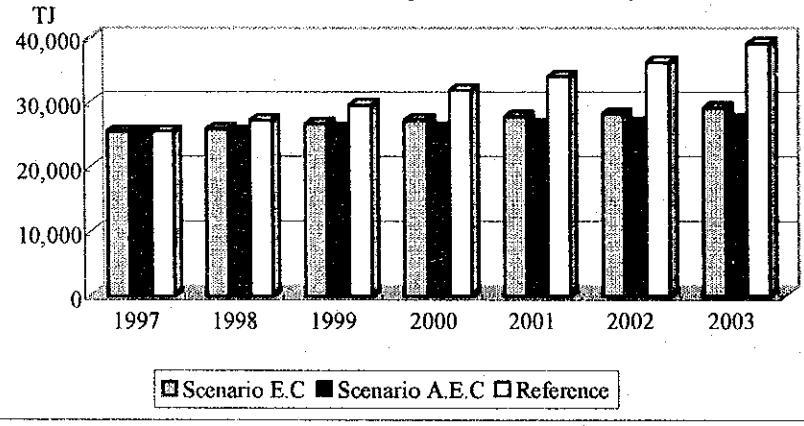
The estimated energy conservation potential is shown in Table 6.2.5. Energy consumption and electricity consumption in the scenarios is shown in Figure 6.2.11, 6.2.12.

Table 6.2.5 Energy Demand Forecast for the Glass Industry

Item			*Actual*	*Simulation Results*						Growth Rate %		Index 97=100	
		Unit	1997	1998	1999	2000	2001	2002	2003	'00/'97	'03/'97	00/'97	'03/'97
Scenario E.C	Fuels	TJ	22,728	22,967	23,602	24,027	24,440	24,706	25,361	1.9	1.8	105.7	111.6
	Electricity	GWh	752	787	837	883	927	968	1,027	5.5	5.3	117.4	136.5
	Total	TJ	25,435	25,800	26,616	27,204	27,778	28,191	29,057	2.3	2.2	107.0	114.2
	Fuel Intensity	MJ/kg	16.0	15.1	14.3	13.5	12.9	12.2	11.6	-5.4	-5.2	84.6	72.7
	Electricity Intensity	Wh/kg	529	518	507	497	488	479	470	-2.1	-1.9	94.0	88.9
	Energy Intensity	MJ/kg	17.9	17.0	16.1	15.3	14.6	13.9	13.3	-5.0	-4.8	85.6	74.4
Scenario A.E.C	Fuels	TJ	22,728	22,594	22,841	22,874	23,138	23,259	23,744	0.2	0.7	100.6	104.5
	Electricity	GWh	752	777	817	851	890	925	977	4.2	4.5	113.2	129.9
	Total	TJ	25,435	25,393	25,783	25,938	26,343	26,591	27,261	0.7	1.2	102.0	107.2
	Fuel Intensity	MJ/kg	16.0	14.9	13.8	12.9	12.2	11.5	10.9	-6.9	-6.2	80.6	68.0
	Electricity Intensity	Wh/kg	529	512	495	479	468	458	448	-3.2	-2.7	90.6	84.6
	Energy Intensity	MJ/kg	17.9	16.7	15.6	14.6	13.9	13.2	12.5	-6.5	-5.8	81.6	69.8
Reference	Fuels	TJ	22,728	24,280	26,377	28,387	30,379	32,309	34,895	7.7	7.4	124.9	153.5
	Electricity	GWh	752	803	873	939	1,005	1,069	1,155	7.7	7.4	124.9	153.5
	Total	TJ	25,435	27,172	29,519	31,768	33,998	36,158	39,052	7.7	7.4	124.9	153.5
	Fuel Intensity	MJ/kg	16.0	16.0	16.0	16.0	16.0	16.0	16.0				
	Electricity Intensity	Wh/kg	529	529	529	529	529	529	529				
	Energy Intensity	MJ/kg	17.9	17.9	17.9	17.9	17.9	17.9	17.9				

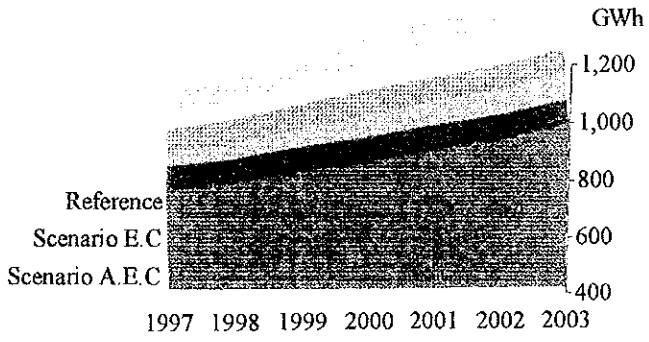
Source: Jica team

Figure 6.2.11 Fuel Consumption in Glass Industry



Source: JICA Team

Figure 6.2.12 Electricity Consumption in the Glass Industry



Source: JICA Team

(2) Silicate lime blocks

a. Energy demand forecast using the "reference scenario"
Base on assumption of future output and energy intensity of 1997, energy consumption in this sector will increase from 1,258TJ in 1997 to 1,375TJ in 2000 and 1,502TJ in 2003.

b. Potential for energy conservation in 2000
In the "scenario E.C.," the energy intensity of this sector is assumed to fall by 23% due to energy conservation measures. Energy intensity is assumed to decrease from 0.84MJ/kg in 1997 to 0.65MJ/kg.

In the "scenario A.E.C.," the energy intensity of this sector is assumed to decrease by around 25% due to energy conservation measures described before. Energy intensity will decrease to 0.63MJ/kg.

Comparing the "Reference scenario," the potential for energy conservation is estimated to be 314TJ in the "scenario E.C." and 342TJ in the "scenario A.E.C."

c. Potential for energy conservation in 2003
Under the "scenario E.C.," the energy efficiency of this industry is assumed to improve by 35% due to energy conservation measures. The energy intensity of this sector could be reduced to about 0.55MJ/kg.

Under the "scenario A.E.C.," the energy efficiency of this sector is assumed to improve by 37% due to energy conservation measures. Energy use per kg of silicate lime block falls from 0.84MJ in 1997 to 0.53MJ in 2003.

Comparing the "Reference scenario," the potential of energy saving is estimated to be 522TJ in the "scenario E.C." and 553TJ in the "scenario A.E.C."

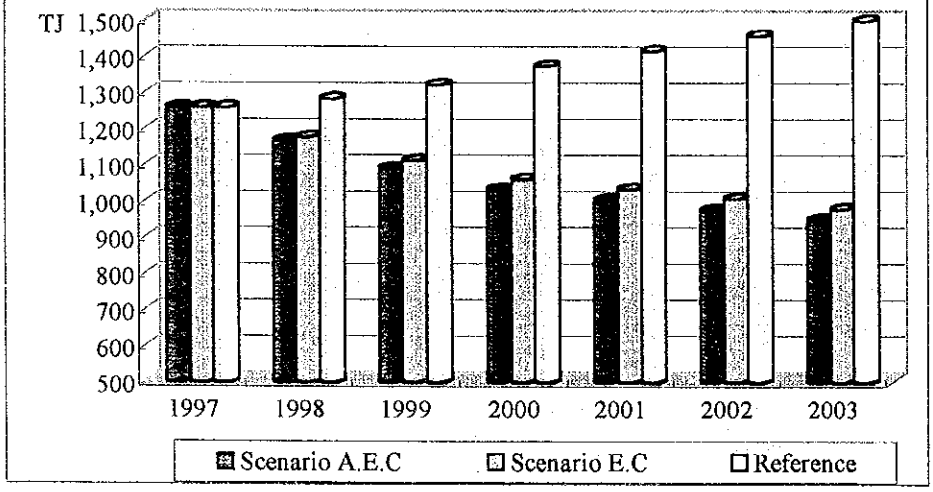
The potential energy efficiency improvement in silicate lime block production is shown in Table 6.2.6. Figure 6.2.13 and Figure 6.2.14 shows total of fuel and electricity consumption from 1997 to 2003.

Table 6.2.7 Energy Demand Forecast for Silica Lime Blocks

Item			*Actual*	*Simulation Results*						Growth Rate(%)		Index(1997=100)	
		Unit	1997	1998	1999	2000	2001	2002	2003	'00/'97	'03/'97	00/'97	'03/'97
Scenario E.C	Fuels	TJ	1,213	1,132	1,067	1,015	986	959	932	-5.8	-4.3	83.6	76.8
	Electricity	GWh	12	12	13	13	13	13	13	0.5	1.2	102.0	107.5
	Total	TJ	1,258	1,177	1,112	1,061	1,033	1,006	980	-4.2	-4.1	84.3	77.9
	Fuel Intensity	MJ/kg	0.81	0.74	0.68	0.62	0.59	0.55	0.52	-6.5	-7.1	76.5	64.3
	Electricity Intensity	Wh/kg	8.33	8.14	7.96	7.78	7.68	7.59	7.50	-1.7	-1.7	93.3	90.0
	Energy Intensity	MJ/kg	0.84	0.77	0.71	0.65	0.61	0.58	0.55	-6.3	-6.9	77.1	65.2
Scenario A.E.C	Fuels	TJ	1,213	1,122	1,047	987	958	929	901	-5.0	-4.8	81.3	74.3
	Electricity	GWh	12	12	13	13	13	13	13	0.5	1.2	102.0	107.5
	Total	TJ	1,258	1,166	1,092	1,033	1,004	976	950	-4.8	-4.6	82.1	75.5
	Fuel Intensity	MJ/kg	0.81	0.73	0.67	0.60	0.57	0.54	0.50	-7.1	-7.6	74.4	62.2
	Electricity Intensity	Wh/kg	8.33	8.14	7.96	7.78	7.68	7.59	7.50	-1.7	-1.7	93.3	90.0
	Energy Intensity	MJ/kg	0.84	0.76	0.69	0.63	0.60	0.56	0.53	-6.9	-7.4	75.1	63.2
Reference	Fuels	TJ	1,213	1,238	1,275	1,326	1,365	1,406	1,449	2.2	3.0	109.3	119.4
	Electricity	GWh	12	13	13	14	14	14	15	2.2	3.0	109.3	119.4
	Total	TJ	1,258	1,283	1,322	1,375	1,416	1,459	1,502	2.2	3.0	109.3	119.4
	Fuel Intensity	MJ/kg	0.81	0.81	0.81	0.81	0.81	0.81	0.81				
	Electricity Intensity	Wh/kg	8.33	8.33	8.33	8.33	8.33	8.33	8.33				
	Energy Intensity	MJ/kg	0.84	0.84	0.84	0.84	0.84	0.84	0.84				

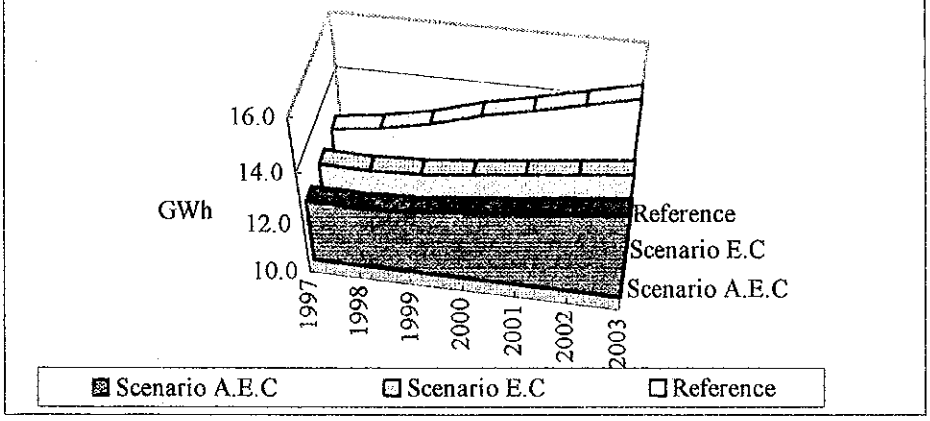
Source: JICA Team

Figure 6.2.13 Fuel Consumption in Silicate Lime Block Industry



Source: JICA Team

Figure 6.2.14 Electricity Consumption in the Silicate Lime Block Industry



Source: JICA Team

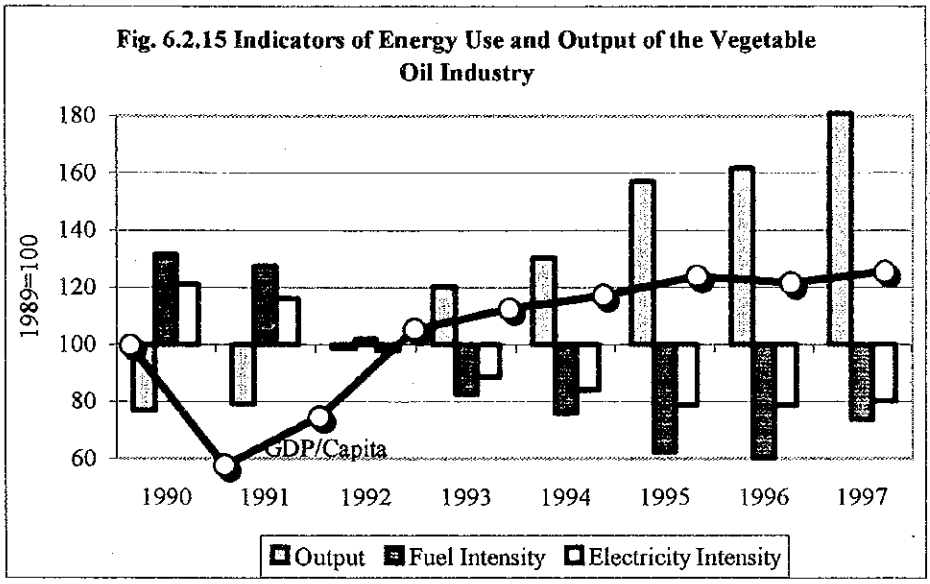
6.2.5 Food Products

(1) Vegetable Oil Products

a. Introduction

Total energy use in the vegetable oil products industry was about 5,450TJ in 1997, accounting for 3.4% of energy consumption in the food industry. Trend of energy use in the vegetable oil products industry is shown in figure 6.2.15.

Fig. 6.2.15 Indicators of Energy Use and Output of the Vegetable Oil Industry



Source: JICA Team

b. Energy demand forecast using the "Reference scenario"
Based on assumption of future output and energy intensity of 1997, energy consumption in this sector will increase from 5,450TJ in 1997 to 6,125TJ in 2000 and 6,855TJ in 2003.

c. Potential for energy conservation in 2000
In the "scenario E.C.," the energy intensity of the vegetable oil products industry is assumed to fall by 11% due to energy conservation measures. Energy intensity of the industry will decrease from 9.1MJ/kg in 1997 to 8.1MJ/kg.

In the "scenario A.E.C.," the energy intensity of the industry is assumed to decrease by around 14% due to energy conservation measures. Energy intensity of this sector will decrease to 7.8MJ/kg.

Comparing the "Reference scenario," the potential for energy conservation is estimated to be 668TJ in the "scenario E.C." and 880TJ in the "scenario A.E.C."

d. Potential for energy conservation in 2003
Under the "scenario E.C.," the energy efficiency of the vegetable oil products industry is assumed to improve by 21% due to energy conservation measures described in chapter 4. Energy intensity of the industry will fall from 9.1MJ/kg in 1997 to 7.2MJ/kg.

Under the "scenario A.E.C.," the energy efficiency of the industry is assumed to improve by 28% due to energy conservation measures. Energy intensity of this sector will decrease to 6.5MJ/kg.

Comparing the "Reference scenario," the potential of energy conservation is estimated to be 1,433TJ in the "scenario E.C." and 1,907TJ in the "scenario A.E.C."

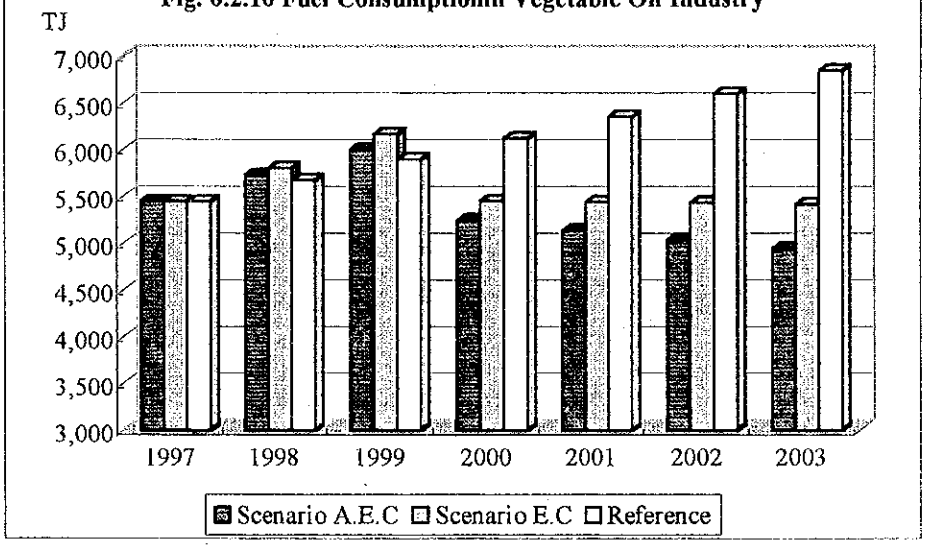
The assumptions, which have been made in projecting the future energy intensity of the vegetable oil products industry, are shown in table 6.2.7 and total fuel and electricity consumption is shown in figure 6.2.16, 6.2.17.

Table 6.2.7 Energy Demand Forecast for the Vegetable Oil Industry

Item			*Actual*	*Simulation Results*						Growth Rate %		Index1997=100	
		Unit	1997	1998	1999	2000	2001	2002	2003	'00/'97	'03/'97	00/'97	'03/'97
Scenario E.C	Fuels	TJ	4,881	5,222	5,563	4,849	4,813	4,777	4,741	-0.2	-0.5	99.3	97.1
	Electricity	GWh	158	163	168	169	175	182	189	2.2	3.0	106.8	119.5
	Total	TJ	5,450	5,809	6,167	5,457	5,444	5,432	5,422	0.0	-0.1	100.1	99.5
	Fuel Intensity	MJ/kg	8.1	8.3	8.5	7.2	6.8	6.5	6.3	-4.0	-4.2	88.4	77.2
	Electricity Intensity	Wh/kg	263	260	257	249	249	249	249	-1.7	-0.8	95.0	95.0
	Energy Intensity	MJ/kg	9.1	9.3	9.5	8.1	7.7	7.4	7.2	-3.8	-3.8	89.1	79.1
Scenario A.E.C	Fuels	TJ	4,881	5,145	5,400	4,638	4,511	4,387	4,267	-1.7	-2.2	95.0	87.4
	Electricity	GWh	158	163	169	169	175	182	189	2.2	3.0	106.8	119.5
	Total	TJ	5,450	5,732	6,010	5,245	5,142	5,042	4,947	-1.3	-1.6	96.2	90.8
	Fuel Intensity	MJ/kg	8.1	8.2	8.3	6.9	6.4	6.0	5.6	-5.4	-5.9	84.5	69.5
	Electricity Intensity	Wh/kg	263	260	260	249	249	249	249	-1.7	-0.8	95.0	95.0
	Energy Intensity	MJ/kg	9.1	9.1	9.2	7.8	7.3	6.9	6.5	-5.0	-5.3	85.6	72.2
Reference	Fuels	TJ	4,881	5,089	5,284	5,486	5,695	5,913	6,139	4.0	3.9	112.4	125.8
	Electricity	GWh	158	165	171	178	184	192	199	4.0	3.9	112.4	125.8
	Total	TJ	5,450	5,683	5,900	6,125	6,359	6,602	6,855	4.0	3.9	112.4	125.8
	Fuel Intensity	MJ/kg	8.1	8.1	8.1	8.1	8.1	8.1	8.1				
	Electricity Intensity	Wh/kg	263	263	263	263	263	263	263				
	Energy Intensity	MJ/kg	9.1	9.1	9.1	9.1	9.1	9.1	9.1				

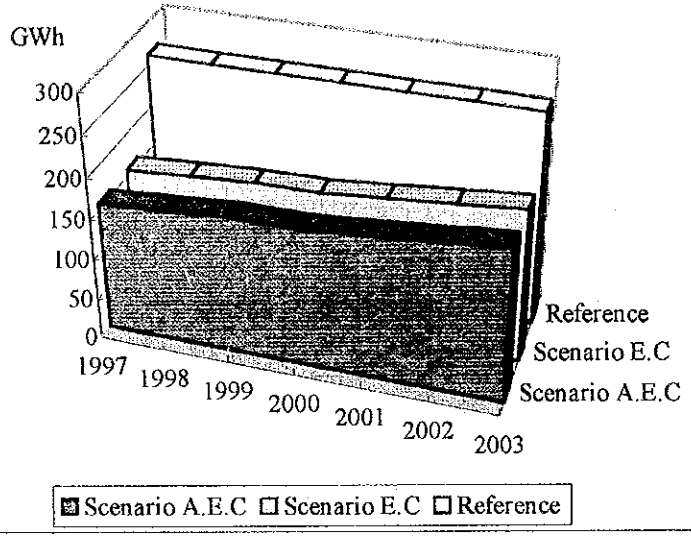
Source: JICA Team

Fig. 6.2.16 Fuel Consumptionin Vegetable Oil Industry



Source: JICA Team

Fig. 6.2.17 Electricity Consumption in Vegetable Oil Industry



Source: JICA Team

(2) Meat products

a. Introduction

Total energy use in the meat products industry was about 17,700TJ in 1997, accounting for 16.1% of energy consumption in the food industry. Trend of energy use in the meat products industry is shown in Table 6.2.8.

Table 6.2.8 Energy Consumption in the Meet and Meat Products Industry

Item	Unit	1989	1990	1991	1992	1993	1994	1995	1996	1997
Direct Energy Consumpt	TJ	11,656	11,091	11,661	11,419	11,540	13,917	18,084	21,566	17,700
Electricity consumption	GWh	398.4	361	406.1	435.1	486.8	606.8	759.2	948.4	902
Coal consumption	TJ	11,910	9,863	10,573	10,145	9,695	8,723	12,340	12,130	10,025
Fuel oil consumption	TJ	268	256	248	216	348	456	652	968	480
Natural gas consumption	TJ	287	249	427	529	641	1,467	732	2,818	1,330
Others	TJ	1,327	2,181	2,195	2,070	1,942	1,348	1,845	2,528	2,618
Total energy consumptio	TJ	15,226	13,847	14,904	14,525	14,378	14,177	18,302	21,858	17,700
Total production	1000t	896	865	829	834	834	861	938	1,077	1,241
Fuel Intensity	MJ/kg	11.41	11.32	12.31	11.81	11.74	13.63	16.36	16.85	11.64
Electricity Intensity	Wh/kg	444.6	417.2	490.0	521.7	583.8	705.0	809.0	880.4	726.7
Energy Intensity	MJ/kg	13.01	12.82	14.07	13.69	13.84	16.17	19.27	20.02	14.26

Source: GUS "Industry Statistics Year Book of Poland"

b. Energy demand forecasting of the "Reference scenario"

Based on assumption of future output and energy intensity of 1997, energy consumption in this sector will increase from 17,700TJ in 1997 to 17,811TJ in 2000 and 19,801TJ in 2003.

c. Potential for energy conservation in 2000

In the "scenario E.C.," the energy intensity of the meat products industry is assumed to fall by 14% due to energy conservation measures. Energy intensity of the industry will decrease from 14.3MJ/ton in 1997 to 12.2MJ/ton.

In the "scenario A.E.C.," the energy intensity of the industry is assumed to decrease by around 16% due to energy conservation. Energy intensity of this sector will decrease to 11.9MJ/ton.

Comparing the "Reference scenario," the potential for energy conservation is estimated to be 2,579TJ in the "scenario E.C." and 2,940TJ in the "scenario A.E.C."

d. Potential for energy conservation in 2003

Under the "scenario E.C.," the energy efficiency of the meat products industry is assumed to improve by 24.7% due to energy conservation measures. Energy intensity of the industry will fall from 14.3MJ/ton in 1997 to 10.7MJ/ton.

Under the "scenario A.E.C.," the energy efficiency of the industry is assumed to improve by 27.3% due to the energy conservation measures. Energy intensity of this sector will decrease to 10.4MJ/ton.

Comparing the "Reference scenario," the potential for energy conservation is estimated to be 4,892TJ in the "scenario E.C." and 5,398TJ in the "scenario A.E.C."

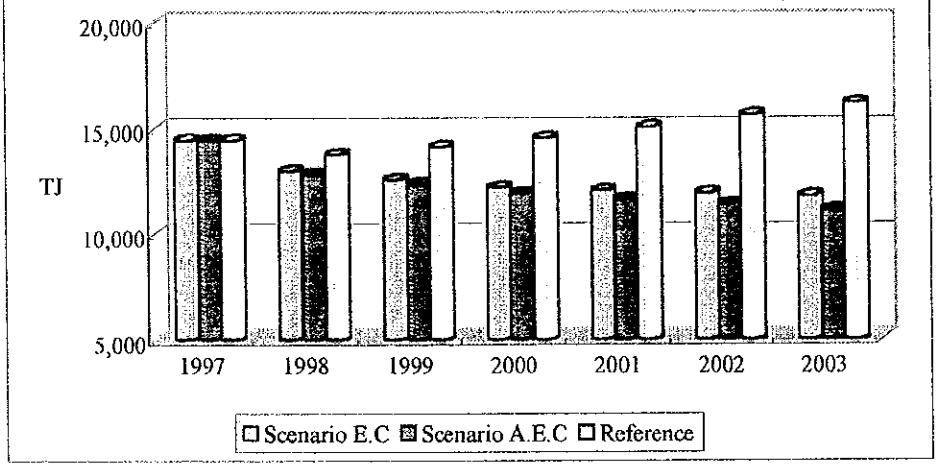
The assumptions, which have been made in projecting future energy intensity of meat products industry, are shown in table 6.2.9 and other results are shown in fig.6.2.18 to fig. 6.2.19.

Table 6.2.9 Energy Demand Forecast for the Meat and Meat Products Industry of Poland

Item	Item	Unit	*Actual*	*Simulation Results*						Growth Rate(%)		Index(1997=100	
			1997	1998	1999	2000	2001	2002	2003	'00/'97	'03/'97	00/'97	'03/'97
Scenario E.C	Fuels	TJ	14,453	12,996	12,582	12,213	12,068	11,944	11,794	-5.5	-3.3	84.5	81.6
	Electricity	GWh	902	837	837	839	847	857	865	-1.8	-0.7	93.0	95.9
	Total	TJ	17,700	16,010	15,595	15,232	15,117	15,029	14,909	-3.7	-2.8	86.1	84.2
	Fuel Intensity	MJ/kg	11.6	11.0	10.4	9.8	9.3	8.9	8.5	-4.3	-5.1	84.0	72.9
	Electricity Intensity	Wh/kg	727	708	689	671	655	639	623	-2.0	-2.5	92.4	85.7
	Energy Intensity	MJ/kg	14.3	13.5	12.8	12.2	11.7	11.2	10.7	-3.8	-4.6	85.5	75.3
Scenario A.E.C	Fuels	TJ	14,453	12,892	12,381	11,922	11,654	11,411	11,147	-4.7	-4.2	82.5	77.1
	Electricity	GWh	902	831	824	819	846	876	904	-2.4	0.0	90.8	100.2
	Total	TJ	17,700	15,882	15,347	14,871	14,701	14,563	14,403	-4.3	-3.4	84.0	81.4
	Fuel Intensity	MJ/kg	11.6	10.9	10.2	9.5	9.0	8.5	8.0	-4.8	-6.0	82.0	68.9
	Electricity Intensity	Wh/kg	727	702	679	656	654	653	651	-2.5	-1.8	90.3	89.6
	Energy Intensity	MJ/kg	14.3	13.4	12.6	11.9	11.4	10.9	10.4	-4.4	-5.2	83.5	72.7
Reference	Fuels	TJ	14,453	13,775	14,136	14,543	15,061	15,622	16,168	0.2	1.9	100.6	111.9
	Electricity	GWh	902	860	882	908	940	975	1,009	0.2	1.9	100.6	111.9
	Total	TJ	17,700	16,870	17,312	17,811	18,445	19,132	19,801	0.2	1.9	100.6	111.9
	Fuel Intensity	MJ/kg	11.6	11.6	11.6	11.6	11.6	11.6	11.6				
	Electricity Intensity	Wh/kg	727	727	727	727	727	727	727				
	Energy Intensity	MJ/kg	14.3	14.3	14.3	14.3	14.3	14.3	14.3				

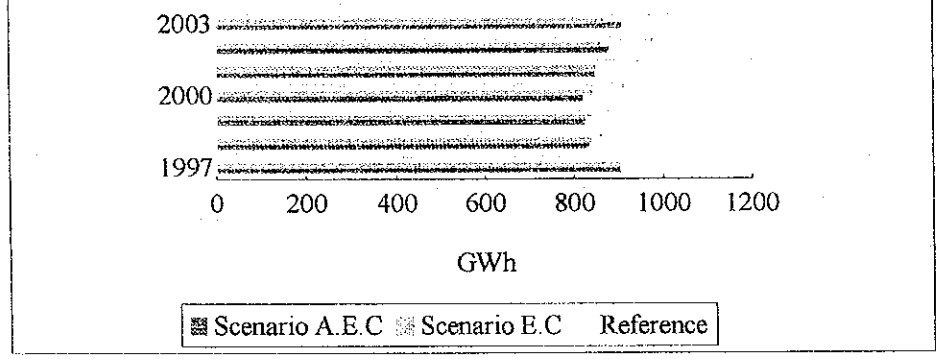
Source: JICA Team

Fig. 6.2.18 Fuel Consumption in the Meat Products Industry



Source: JICA Team

Fig. 6.2.19 Electricity Consumption in the Meat Products Industry



Source: JICA Team

(3) Dairy Products

a. Energy demand forecast using the "Reference scenario"
Based on assumption of future output and energy intensity of 1997, energy consumption in this sector will increase from 23,901TJ in 1997 to 26,839TJ in 2000 and 29,881TJ in 2003.

b. Potential for energy conservation in 2000
In the "scenario E.C.," the energy intensity of the dairy products industry is assumed to fall by 12% due to energy conservation measures. Energy intensity of the dairy products industry will decrease from 9.1MJ/kg in 1997 to 8.0MJ/kg.

In the "scenario A.E.C.," the energy intensity of this sector is assumed to decrease by around 17% due to energy conservation measures. Energy intensity of dairy products industry will decrease to 7.6MJ/kg.

Comparing the "Reference scenario," the potential for energy conservation is estimated to be 3,265TJ in the "scenario E.C." and 4,534TJ in the "scenario A.E.C."

c. Potential for energy conservation in 2003

Under the "scenario E.C.," the energy efficiency of the dairy products industry is assumed to improve by 16% due to energy conservation measures described in chapter 4. Energy intensity of dairy products industry will fall from 9.1MJ/kg in 1997 to 7.6MJ/kg.

Under the "scenario A.E.C.," the energy efficiency of the dairy products industry is assumed to improve by 23% due to the energy conservation measures. Energy intensity of this sector will decrease to 7MJ/kg.

Comparing the "Reference scenario," the potential of energy conservation is estimated to be 4,897TJ in the "scenario E.C." and 6,852TJ in the "scenario A.E.C."

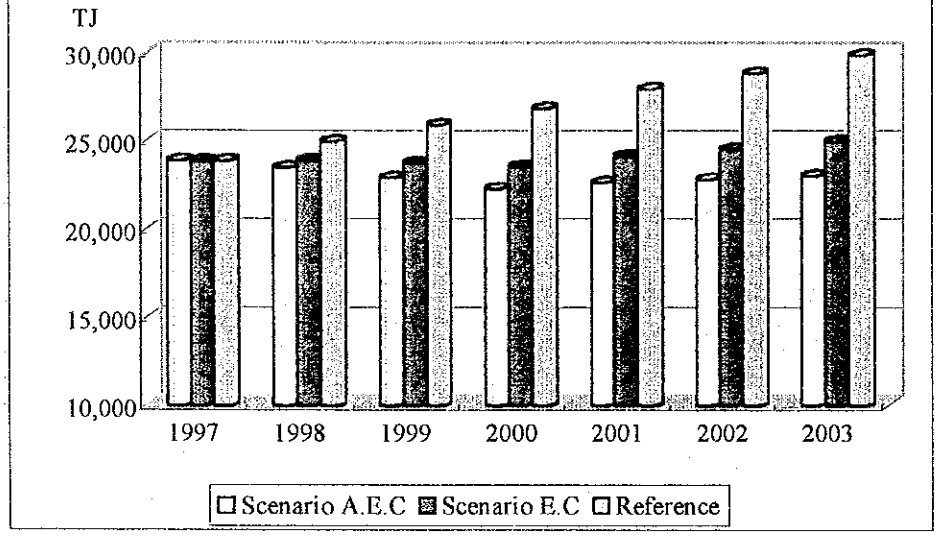
The estimated results are shown in the following table and figures.

Table 6.2.10 Energy Demand Forecast for the Dairy Products Industry

Item			*Actual*	*Simulation Results*						Growth Rate %		Index 1997=100	
		Unit	1997	1998	1999	2000	2001	2002	2003	'00/'97	'03/'97	00/'97	'03/'97
Scenario E.C	Fuels	TJ	20,606	20,687	20,603	20,467	20,992	21,335	21,747	-0.2	0.9	99.3	105.5
	Electricity	GWh	915	903	884	863	879	888	899	-1.9	-0.3	94.3	98.2
	Total	TJ	23,901	23,938	23,786	23,573	24,157	24,531	24,984	-0.5	0.7	98.6	104.5
	Fuel Intensity	MJ/kg	7.9	7.6	7.3	7.0	6.9	6.8	6.7	-4.0	-2.8	88.5	84.4
	Electricity Intensity	Wh/kg	350	330	312	294	287	281	275	-5.7	-3.9	84.0	78.6
	Energy Intensity	MJ/kg	9.1	8.8	8.4	8.0	7.9	7.8	7.6	-4.2	-2.9	87.8	83.6
Scenario A.E.C	Fuels	TJ	20,606	20,283	19,807	19,292	19,672	19,879	20,145	-2.2	-0.4	93.6	97.8
	Electricity	GWh	915	894	866	837	829	814	801	-2.9	-2.2	91.4	87.5
	Total	TJ	23,901	23,501	22,925	22,305	22,657	22,808	23,029	-2.3	-0.6	93.3	96.3
	Fuel Intensity	MJ/kg	7.9	7.4	7.0	6.6	6.4	6.3	6.2	-5.9	-4.0	83.4	78.2
	Electricity Intensity	Wh/kg	350	327	305	285	271	258	245	-6.6	-5.8	81.4	70.0
	Energy Intensity	MJ/kg	9.1	8.6	8.1	7.6	7.4	7.2	7.0	-6.0	-4.2	83.1	77.1
Reference	Fuels	TJ	20,606	21,551	22,360	23,139	24,105	24,883	25,762	3.9	3.8	112.3	125.0
	Electricity	GWh	915	957	993	1,028	1,071	1,105	1,144	3.9	3.8	112.3	125.0
	Total	TJ	23,901	24,997	25,935	26,839	27,959	28,862	29,881	3.9	3.8	112.3	125.0
	Fuel Intensity	MJ/kg	7.9	7.9	7.9	7.9	7.9	7.9	7.9				
	Electricity Intensity	Wh/kg	350	350	350	350	350	350	350				
	Energy Intensity	MJ/kg	9.1	9.1	9.1	9.1	9.1	9.1	9.1				

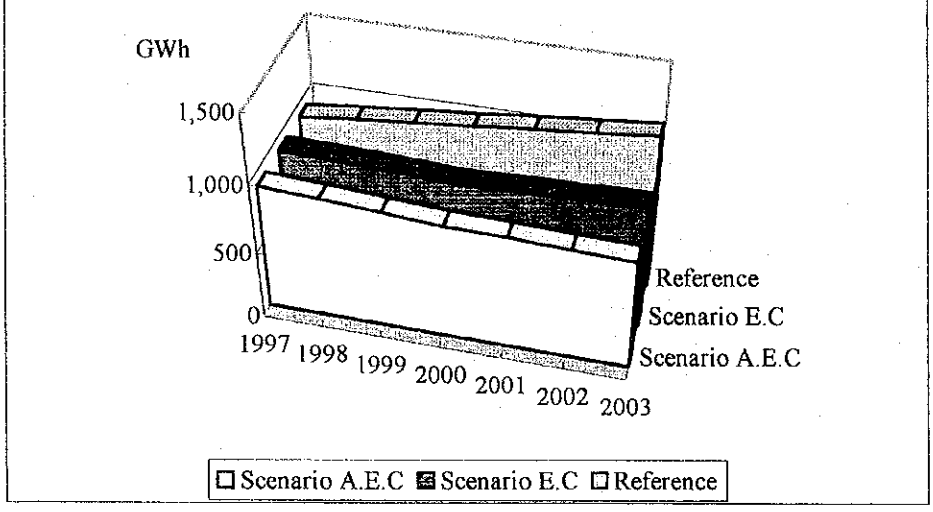
Source: JICA Team

Fig. 6.2.20 Total Energy Consumption in the Dairy Products Industry



Source: JICA Team

Fig. 6.2.21 Electricity Consumption in the Dairy Products Industry



Source: JICA Team

6.2.6 Conclusions

The potential for energy conservation in one industrial sector and eight sub-sectors has been estimated in the two scenarios. Table 6.2.11 displays the indicators and the growth rates of energy intensity from 1997 through 2003 for selected industrial sub-sectors by the scenarios.

Table 6.2.12 shows the estimated energy consumption in 2000 and 2003 by three scenarios and by the targeted sub-sectors. In 2003, total energy demand of nine sub-sectors will increase from 382PJ in 1997 to 453PJ if no energy conservation measures are taken in exiting facilities. Comparing the

"reference scenario," energy consumption is 373PJ in "scenario E.C." and 356PJ in "scenario A.E.C.," due to improved energy efficiency is 80PJ in the "scenario E.C." and 97PJ in the "scenario A.E.C."

The projected improvement in energy efficiency in the selected sub-sector could be readily measured by comparing the estimated of future energy intensity with 1997 value of the energy intensity (Figure 6.2.22 and Figure 6.2.23).

Table 6.2.11 Simulation Results of Energy Intensity by Industrial Sector and Sub-Sector

(Unit: %, MJ/ton, MJ/Pcs)

Industry / Sector	Sub-sector	Actual 1997		*Simulation 2000*					
				Scenario E.C. 2000		'00/'97	Scenario A.E.C. 2000		'00/'97
		Intensity	Indicators	Intensity	Indicators		Intensity	Indicators	
Iron and Steel		19,822	100	17,608	88.83	-3.87	17,152	86.53	-4.71
Chemical	Ammonia	33,217	100	31,543	94.96	-1.71	31,158	93.80	-2.11
Non-metallic Material	Silica Lime Block	840	100	648	77.14	-8.29	631	75.12	-9.10
	Glass	17,888	100	15,318	85.63	-5.04	14,605	81.65	-6.54
Transportation Equipment	Tractor	64,696	100	51,392	79.44	-7.39	49,154	75.98	-8.75
Machinery	Truck	34,980	100	28,011	80.08	-7.14	27,253	77.91	-7.98
Food	Dairy	9,140	100	8,028	87.83	-4.23	7,596	83.11	-5.98
	Meat	14,260	100	12,195	85.52	-5.08	11,906	83.49	-5.84
	Vegetable Oil	9,050	100	8,063	89.09	-3.78	7,750	85.64	-5.04

Industry / Sector	Sub-sector	Actual 1997		*Simulation 2003*					
				Scenario E.C. 2003		'03/'97	Scenario A.E.C. 2003		'03/'97
		Intensity	Indicators	Intensity	Indicators		Intensity	Indicators	
Iron and Steel		19,822	100	15,967	80.55	-3.54	15,134	76.35	-4.40
Chemical	Ammonia	33,217	100	31,015	93.37	-1.14	30,557	91.99	-1.38
Non-metallic Material	Silica Lime Block	840	100	548	65.24	-6.87	531	63.21	-7.36
	Glass	17,888	100	13,310	74.41	-4.81	12,487	69.81	-5.81
Transportation Equipment	Tractor	64,696	100	48,551	75.05	-4.67	45,166	69.81	-5.81
Machinery	Truck	34,980	100	24,960	71.36	-5.47	23,881	68.27	-6.16
Food	Dairy	9,140	100	7,642	83.61	-2.94	7,044	77.07	-4.25
	Meat	14,260	100	10,737	75.29	-4.62	10,372	72.74	-5.17
	Vegetable Oil	9,050	100	7,158	79.09	-3.83	6,532	72.18	-5.29

Source: JICA Team

Table 6.2.12 Estimated Future Energy Consumption for Each Targeted Industrial Sector

(Unit: TJ)

Industrial Sector	*Actual* 1997	*Estimated Results*					
		2000			2003		
		Reference	Scenario E.C.	Scenario A.E.C	Reference	Scenario E.C.	Scenario A.E.C.
Iron and Steel	229,638	244,920	217,566	211,931	262,110	211,137	200,121
Ammonia	74,792	82,363	78,213	77,258	89,265	83,347	82,116
Tractor	1,418	1,647	1,362	1,303	1,966	1,536	1,429
Truck	2,003	2,179	1,745	1,698	2,368	1,690	1,617
Glass	25,435	31,768	27,204	25,938	39,052	29,057	27,261
Silica Lime Block	1,258	1,375	1,061	1,033	1,502	980	950
Vegetable Oil	5,450	6,125	5,457	5,245	6,855	5,422	4,947
Meat	17,700	17,811	15,232	14,871	19,801	14,909	14,403
Dairy	23,901	26,839	23,573	22,305	29,881	24,984	23,029
Grand Total	381,596	415,027	371,412	361,581	452,800	373,061	355,873

Source: JICA Team

Figure 6.2.22 Estimated Future Energy Consumption by Sector

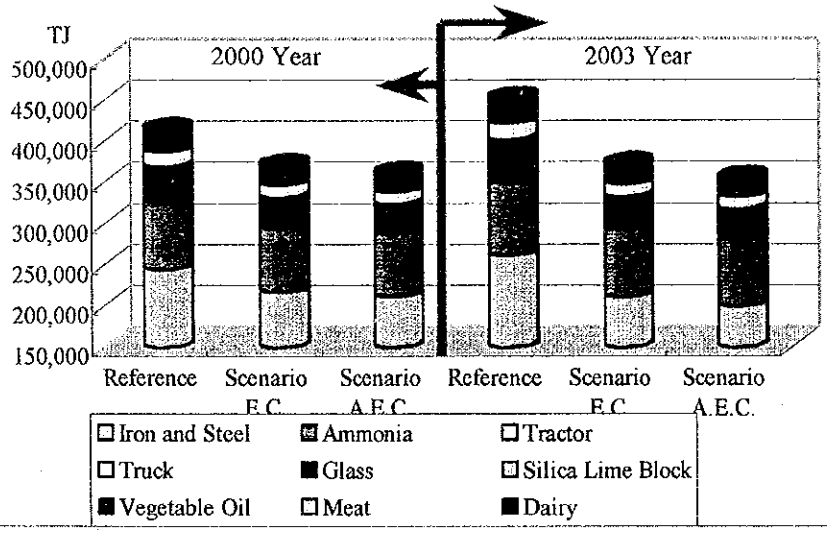
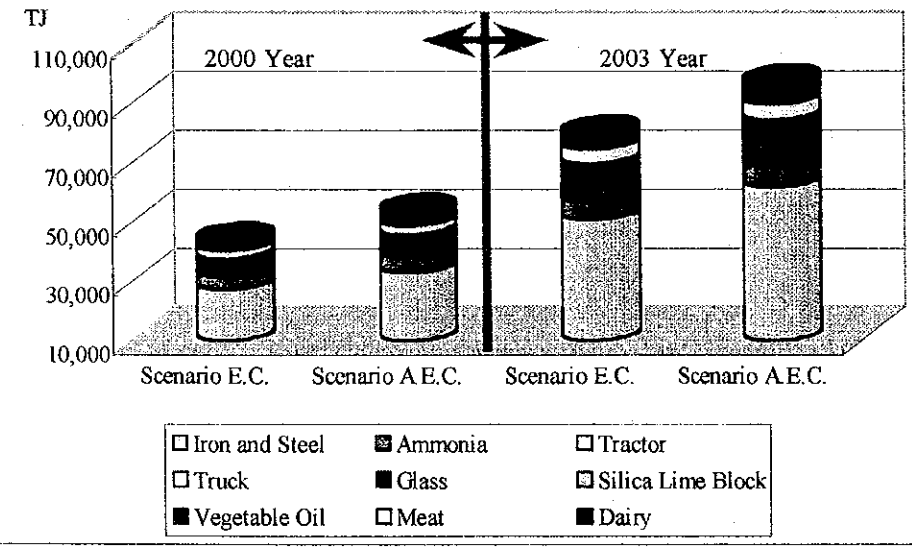


Figure 6.2.23 Energy Savings by Targeted Sector



Source: JICATeam