6. ESTIMATION OF THE ENERGY CONSERVATION POTENTIAL IN THE TARGETED SECTOR/EQUIPMENT AND ITS ENVIRONMENTAL IMPROVEMENT EFFECT

6. ESTIMATION OF THE ENERGY CONSERVATION POTENTIAL IN THE TARGETED SECTOR/EQUIPMENT AND ITS ENVIRONMENTAL IMPROVEMENT EFFECT

6.1 Estimation of the Energy Conservation Potential

6.1.1 Method of Estimation

The energy conservation potential (for the years 2000 and 2003) of both targeted sectors and equipment was estimated as described below according to the four components in the policy scenarios mentioned above, and in two stages as follows:

In Stage 1, the energy intensity (hereinafter referred to as E.I.) of each industry (and of each type of equipment within each industry) under each scenario is estimated.

In Stage 2, the energy consumption of each industry (and of each type of equipment within each industry) under each scenario is estimated on the basis of the above estimations of energy intensity.

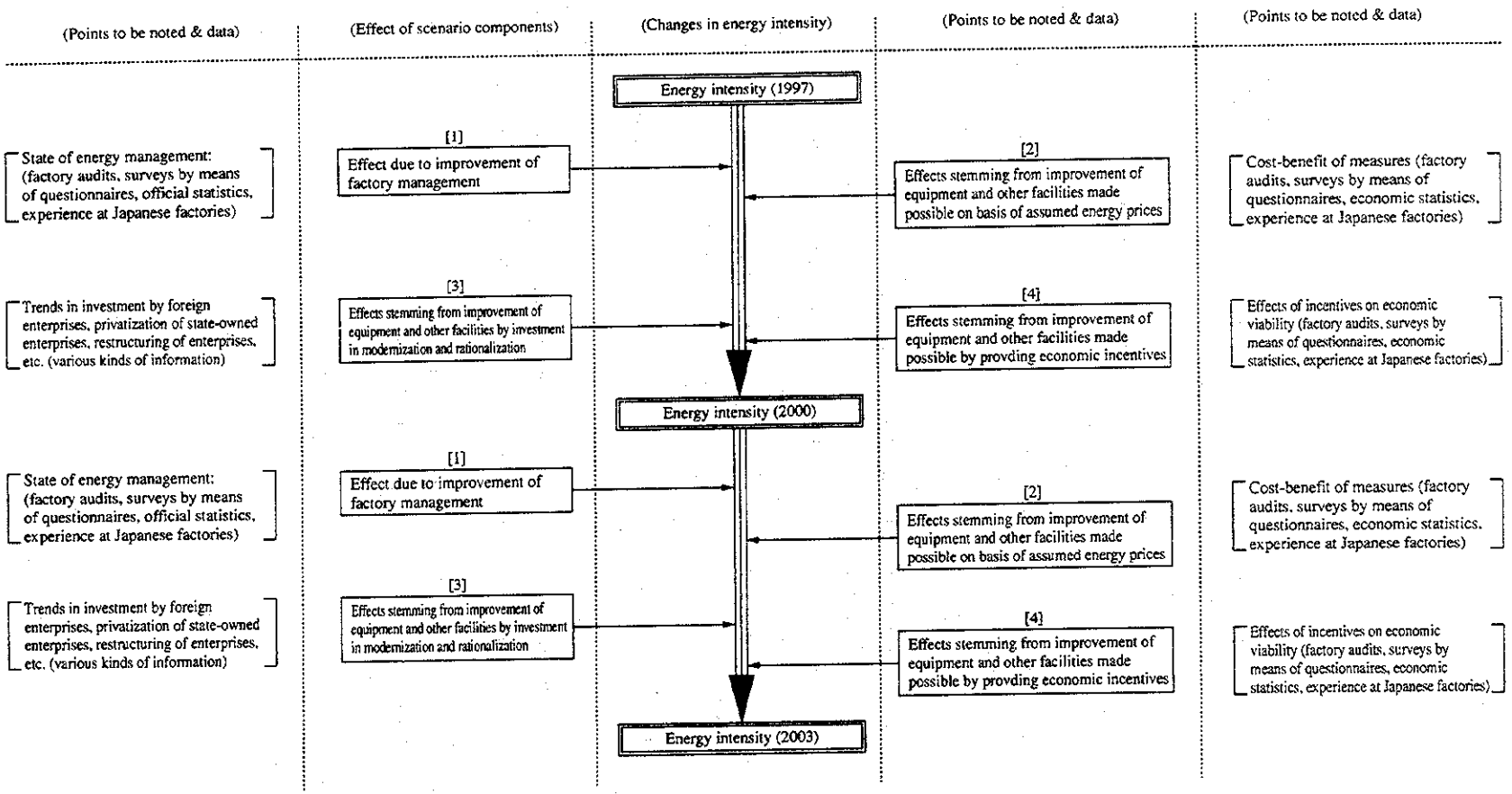
Finally, the energy consumption of each industry (and of each type of equipment within each industry) in 2000 and 2003, are estimated on the assumption that the E.I. in the reference scenario remains as it was in 1997, and the energy consumption of each industry (and of each type of equipment within each industry) in both the EC and AEC scenarios are calculated to obtain the difference between these values. This value is then used as the energy conservation potential of each industry (and of each type of equipment within each industry).

(1) Estimates of E.I. figures for each industry (and for each type of equipment within each industry)

Figure 6.1 shows the process flow (including data sources and methods of utilization) ob estimating the E.I. of each industry (and of each type of equipment within each industry).

Below, the details of the estimates on which the preconditions are based and the methods of utilizing data/information will be explained for each component of the scenarios.

Figure 6.1 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

Firstly, regarding the energy conservation effect achievable through improved supervision at factories, the rate of energy conservation for each industry (and for each type of equipment within each industry) was estimated by utilizing the following three important sources of data on which our judgments are based.

a. Results of factory audits
b. Industry statistics and other information
c. Experience gained in the practice of energy conservation in Japan

Next, the evaluation was carried out regarding the economic effects of investment in the energy conservation measures by each industry (and each type of equipment within each industry) that are made possible on the basis that energy prices will be such as assumed in the policy scenario on the basis of preconditions (1) and (2) below. We have assumed that those industries with a sufficient estimated return on investment will actually implement investment for the purpose of improving their facilities.

1) Investment cost

① Equipment cost:
Mainly based on performance and experience in Japan

② Escalation factor:
This factor was used to adjust the prices in raw data, for example, in 1980 to those in 1998.

③ Location factor:
This factor was used to convert the prices in raw data into those in Poland. According to estimates made by the specialist institution, Richardson Inc. of the US, the index figure for the cost of investment in Japan as of the end of 1996 was 135, while that of Poland was 95. In other words, the value of this factor stands at 0.7.

④ Exchange rate:
1 US$ = 120 Yen = 3.89 PLN (the year 2000)
4.34 PLN (in the year 2003)
In other words, 1 PLN = 30.85 Yen (in the year 2000)
27.65 Yen (in the year 2003)

The grounds for these assumptions are given below. The PLN has been devalued in planned manner since 1991 under the so-called "crawling peg" system. That is to say, the core level of the fluctuation range of the Polish currency's exchange rate has been lowered each month at a specific rate based on a fixed ratio to a basket of five foreign currencies - the US dollar, the pound sterling, the French franc, the deutschmark, and the Swiss franc. Based on the movements of the exchange rate up to now and also on the rate predicted in the budget for 1999 (Jan.~Dec.), we have assumed that the exchange rate of the Polish currency for the US dollar will decline by 5 % in 1999 and 2000, by 4 % in 2001 and 2002, and by 3 % in 2003. As a result, the exchange rate in the year 2000 should be $1/3.89PLN, and that in 2003 $1/4.34PLN. Moreover, the rate of exchange of the Japanese yen and the US dollar as of January 1999 is moving in the direction of strengthening of the Japanese currency, particularly by comparison with the Oct.~Nov. 1998 period, due to short-term factors such as the start of the European Monetary Union system (the start of trading in the euro). From here on, however, in view of the gap in economic growth rates over the past several years between Japan on the one hand and America and Europe on the other, the yen is expected to weaken slightly to the level of 120 yen to the dollar.

2) Evaluation of Return on Investment

① Period for evaluation of return on investment = 5 years

② Discount rates (real rates per annum) used in calculating rebates to current value

10 % (year 2000)
7 % (year 2003)

See section 5.2.2, clause ④ for the grounds on which ① and ② above are based.

③ Energy Prices:

These have been estimated on the basis of the policy scenario. Prices are those in real terms as of 1998 (see Table 5.2).

Investment in the improvement of machinery and various devices is expected to be implemented in those cases in which, according to our evaluation, a sufficient return will be achieved on such investment. In addition, as pointed out in Chapter 4, the present policy of promoting modernization and rationalization is assumed to be maintained.

Finally, regarding economic incentives, investment in equipment improvement should be made in those cases where benefit is expected to be obtained over a 10-year evaluation period if the low-interest, long-term funding described below is to be implemented (this applies only to the AEC scenario).

① Interest rates (real rates per annum):
3 % (2000), 2 % (2003)

② Loan period:
10 years (2000, 2003)

For the grounds on which these projections are based, see 5.2.2, Clause (4).

(2) Estimations of Energy Consumption of Each Industry (and each type of equipment)

Firstly, the energy consumption amounts for each industry (and each type of equipment within each industry) under each scenario were obtained by multiplying the E.I. levels as explained above for each industry (and each type of equipment within each industry) by the production volumes for each industry which were separately forecast. Next, the energy conservation potential of each industry (and each type of equipment within each industry) was obtained by calculating the difference between the energy consumption amount under the reference scenario and the energy consumption amount under each of the EC scenario and the AEC scenario.

6.1.2 Result of Estimation for Industries

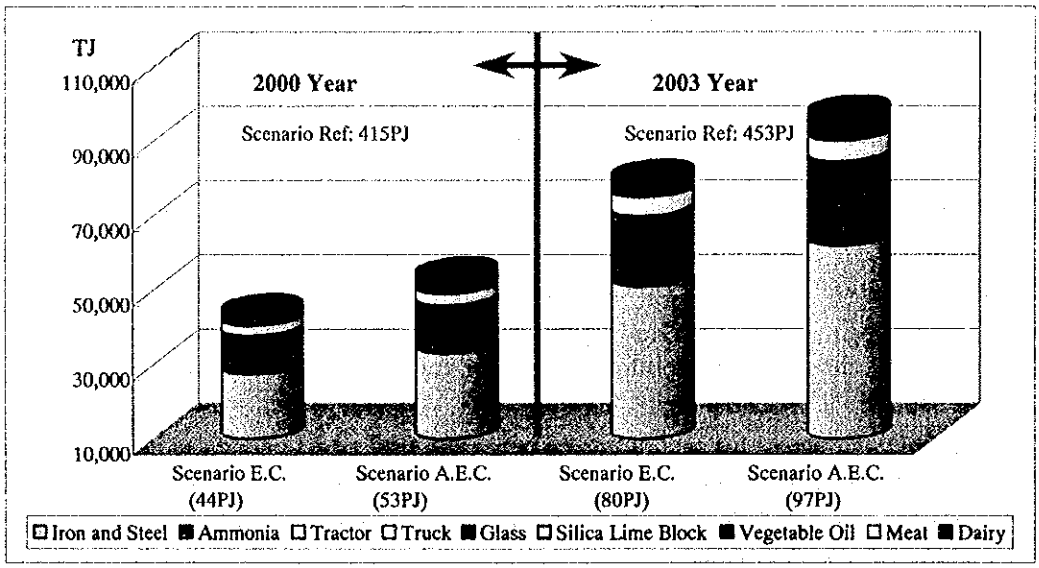
(1) E.I. of the targeted industries

The energy intensity reduction rates shown in Table 6.1 were obtained.
In the E.C. scenario, the minimum saving rate is 5 % in the ammonia sector and the maximum saving rate is 21 % in the meat processing sector in 2000. In 2003, the minimum saving rate is 7 % in the ammonia sector and maximum saving is 33 % in the meat processing sector. Similarly, in the A.E.C. scenario, the minimum saving rate is 6 % in the ammonia sector, while the maximum saving rate is 27 % in the meat processing sector in 2000. In 2003, the minimum saving rate is 8 % in the ammonia sector, while the maximum saving rate is 41 % in the meat processing sector.

(2) Energy conservation potential of the targeted industries

Figure 6.2 shows the energy conservation potential in each sector in 2000 and 2003 with the 1997 level as 100, in terms of the energy conservation amount. Table 6.2 shows it as the energy conservation rate.

Figure 6.2 Energy Saving by Targeted Sectors



Source: JICATeam

The energy conservation potential for all of the targeted sectors will be 11 % in 2000 and 18 % in 2003 according to the E.C. scenario. In the A.E.C. scenario, it will be 13 % in 2000 and 21 % in 2003.

(3) Estimation of the energy conservation potential for all industries

The energy consumption amount in the nine targeted sectors and sub-sectors in this investigation accounts for approximately 30 % of the total energy consumption in the entire manufacturing industry.

Japan's experience of energy conservation clearly shows that during the period of approximately 10 years after the so-called oil crisis, the energy conservation rate of all industries progressed at roughly the same pace as those of several major energy-intensive industries. Thus, in the belief that the same type of trend would be observed in Poland, too, we decided to carry out a rough estimate of the amount of energy conservation that was feasible (the gap with the reference scenario) for the whole of the Polish manufacturing sector. For this purpose, it was assumed that the all-industry figure would be three times that of the 9 selected industries, and the following figures were obtained (PJ/y).

	Year 2000		Year 2003	
	Energy saving amount (PJ/y)	Energy saving rate (%)	Energy saving amount (PJ/y)	Energy saving rate (%)
E.C. scenario	131	11	239	18
A.E.C. scenario	161	13	291	21

Energy consumption in the ammonia manufacturing sector in 1997 was 74 PJ. (See Table 3.1.) Therefore, the energy conservation amount in 2000 under the E.C. scenario above will be twice larger. The energy conservation amount in 2003 under the E.C. scenario will be considerably larger than the energy consumption amount in the iron and steel making sector in 1997.

Thus, if the policies contained in the two scenarios for energy conservation policies are to be implemented, a significant amount of energy conservation will be accomplished in the entire manufacturing industry in any case.

6.1.3 Result of Estimation Regarding the Targeted Equipment

(1) E.I. of the targeted industries

As shown in Table 6.3, E.I. for lighting in the iron and steel making sector drops from 100 in 1997 (used as the base) to 96 in 2000 and 89 in 2003 according to the E.C. scenario. Similarly, E.I. for space heating (air conditioning) drops to 93 in 2000 and to 86 in 2003.

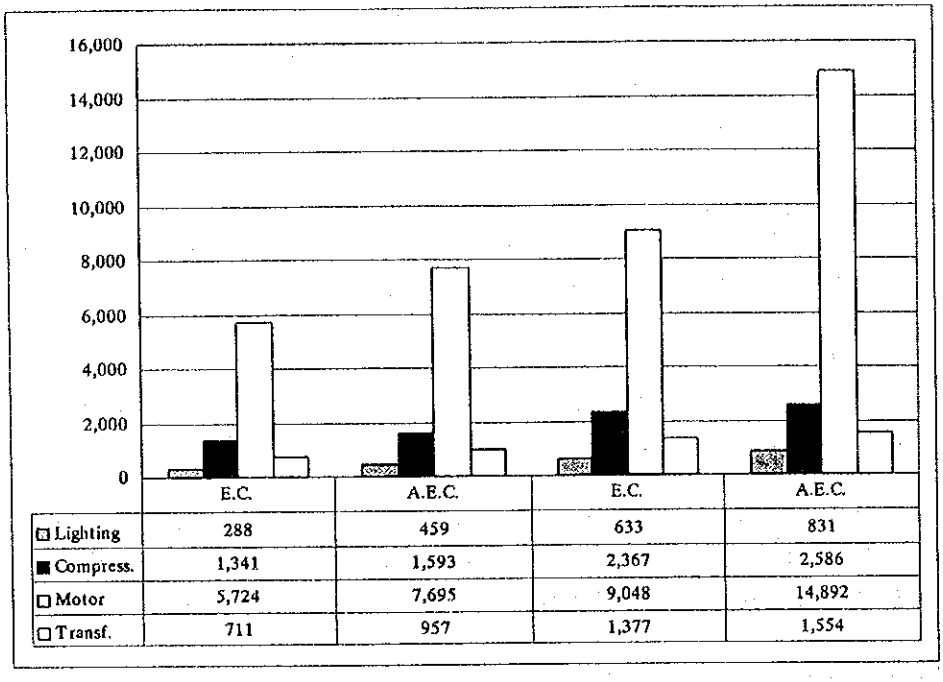
(2) Energy conservation potential of the targeted industries

As shown in Table 6.4, lighting, for example, has a 7 % energy conservation potential in 2000 and a 15 % energy conservation in 2003 in the E.C. scenario compared with the REF scenario.

(3) Estimation of the energy conservation potential for all industrial sectors

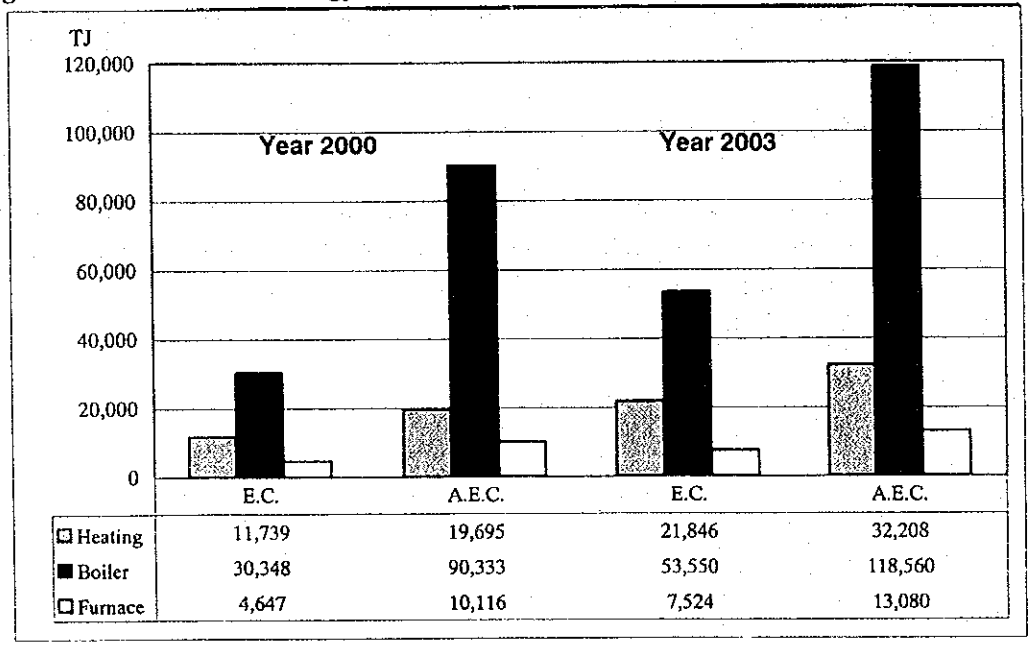
Also regarding equipment, if it is assumed that the energy conservation amount in the entire manufacturing industry is three times larger than that in the nine targeted sectors, the energy conservation amount for each of seven targeted equipment is as shown in Figure 6.3 and Figure 6.4.

Figure 6.3 Potential of Energy Conservation of 4 Types of Electrical Equipment



	E.C.	A.E.C.	E.C.	A.E.C.
Lighting	288	459	633	831
Compress.	1,341	1,593	2,367	2,586
Motor	5,724	7,695	9,048	14,892
Transf.	711	957	1,377	1,554

Figure 6.4 Potential of Energy Conservation of 3 Types of Combustion Equipment



	E.C.	A.E.C.	E.C.	A.E.C.
Heating	11,739	19,695	21,846	32,208
Boiler	30,348	90,333	53,550	118,560
Furnace	4,647	10,116	7,524	13,080

In order to obtain the scale of each energy conservation, comparison with nine targeted sectors in 1997 was made (Table 3.1). For example, the energy conservation amount for the compressor in 2000 according to the E.C. scenario is nearly equivalent to the energy consumption for the tractor or S.L.B. The energy conservation amount for the boiler in 2000 in the same scenario exceeds the energy consumption amount in each of the glass sub-sector, meat product sub-sector, and dairy product sub-sector in 1997.

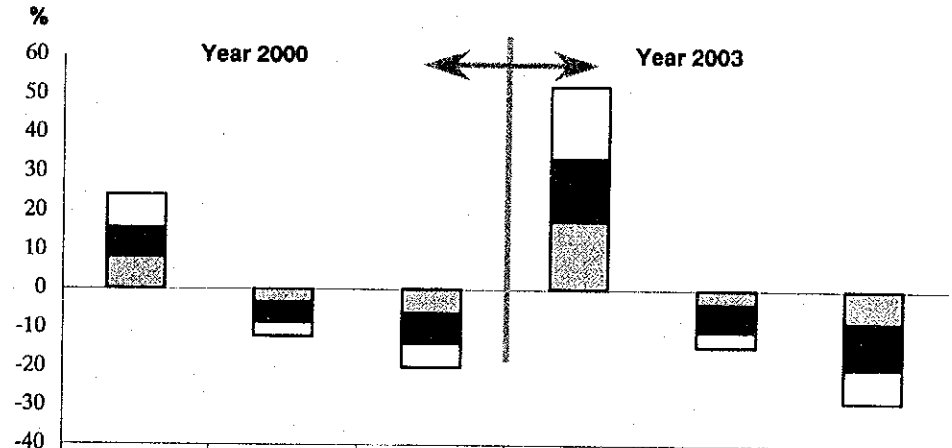
6.2 Estimation of Environmental Improvement Effect

Based on the estimation of the energy conservation potential described above, the scale of improvement effect which energy conservation would exert on the environment was evaluated. Evaluation was conducted with regard to three air pollutants, i.e., CO_2, SO_2, and NO_2.

In this evaluation, the emission factor was first presumed for each of the said air pollutants in cooperation with environmental experts in Poland. Then, by using this factor and the predicted future energy consumption amount, the emission amount of these air pollutants in future was estimated. Table 6.2 shows the emission amount of each substance in 2000 and 2003 (with the 1997 level as 100).

According to this result, the emission amounts of air pollutants are expected to decline in the E.C. and A.E.C. scenarios as shown in Figure 6.5, in comparison with the REF scenario.

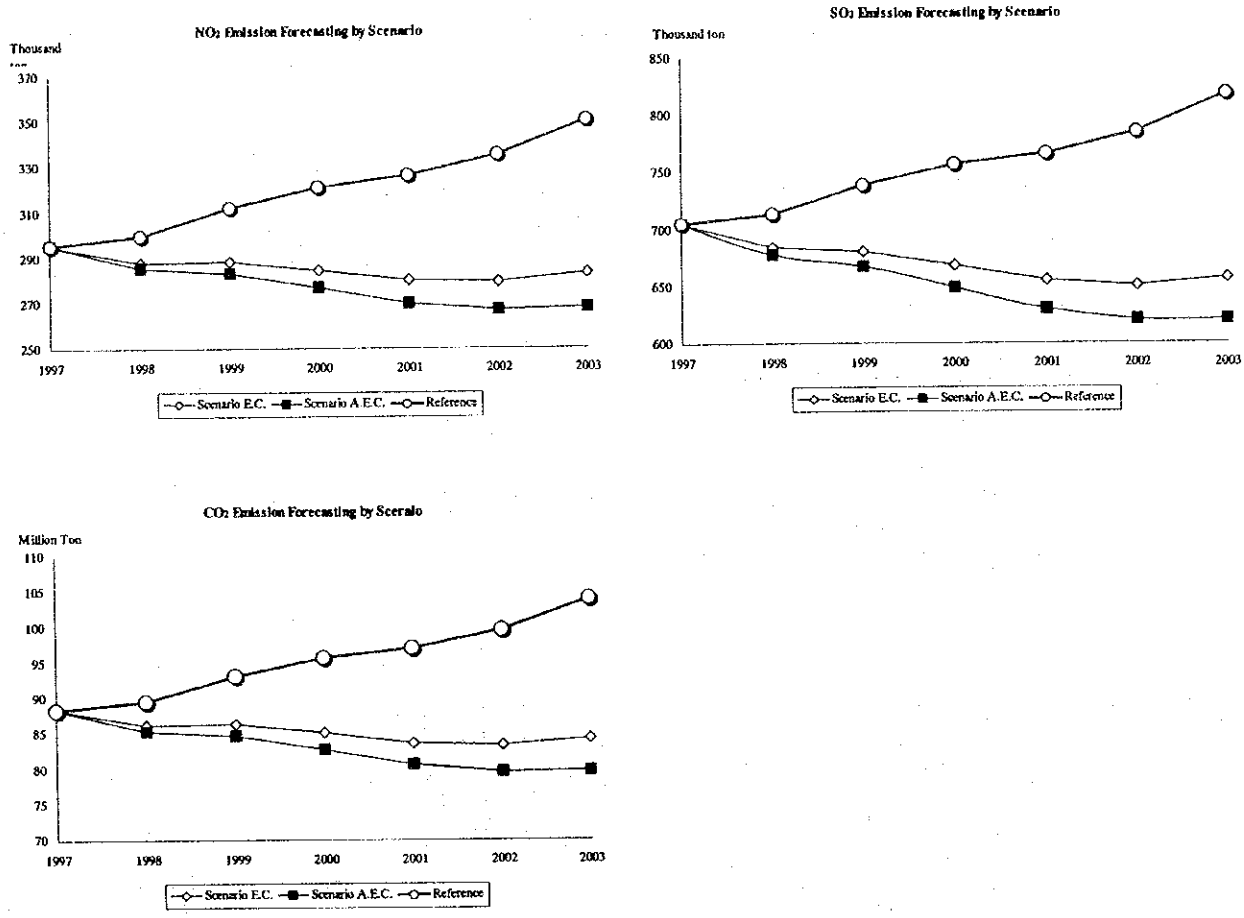
Figure 6.5 Rate of Chages in Emissions of Air Pollutant (97 = 100)



	Ref.	Scenaio E.C.	Scenaio A.E.C.	Ref.	Scenaio E.C.	Scenaio A.E.C.
□NO2	8.6	-3.6	-6.2	18.56	-4.14	-8.78
■SO2	7.3	-5.1	-7.8	16.07	-6.87	-11.68
▨CO2	8.2	-3.5	-6.1	17.54	-3.74	-8.40

Based on this estimation, the environmental improvement effects of the manufacturing industry is presumed as shown in Figure 6.6, in the same manner as for estimation of the energy conservation potential.

Figure 6.6 Effect of Energy Conservation on Improved Air Quality for the Targeted Sectors and Sub-sectors



Source: JICA Team

To verify the scale of the improvement effect, for example, a reduction ((REF.) – (EC) or (AEC)) the SO_2 emission volume (87,957 t) in 2000 under the E.C. scenario is 1.5 times the total emission volume (57,028 t) in eight sectors in 1997 excluding iron and steel making. Also a reduction (23,000 × 1,000 t) in the CO_2 emission level in 2003 in the A.E.C. scenario is equivalent to approximately 80 % of the emission volume (29,469 × 1,000 t) in all of nine sectors in 1997. Thus, it can be mentioned that the environmental improvement effect resulting from energy conservation is significantly large.

Table 6.1 Effect of Technical Measures on the Energy Intensity by Component of Scenarios (1/5)

(1/9) STEEL (Unit : MJ / ton or pcs)

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	1,637	17,608	14,540	1,427	15,967	15,553	1,599	17,152	13,764	1,370	15,134
	0.89	0.86	0.89	0.73	0.75	0.81	0.87	0.84	0.87	0.77	0.72	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	1,720	31,543	29,349	1,666	31,015	29,510	1,648	31,158	29,036	1,521	30,557
	0.95	0.95	0.95	0.88	0.92	0.93	0.94	0.91	0.94	0.92	0.84	0.92

Table 6.1 Effect of Technical Measures on the Energy Intensity by Component of Scenarios (2/5)

(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	9,661	28,011	15,412	9,548	24,960	17,592	9,661	27,253	14,333	9,548	23,881
	0.73	0.98	0.80	0.61	0.97	0.71	0.70	0.98	0.78	0.57	0.97	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	16,409	51,392	32,943	15,608	48,551	33,691	15,463	49,154	30,824	14,342	45,166
	0.81	0.86	0.83	0.76	0.82	0.78	0.78	0.81	0.79	0.72	0.75	0.73

Table 6.1 Effect of Technical Measures on the Energy Intensity by Component of Scenarios (3/5)

(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

Table 6.1 Effect of Technical Measures on the Energy Intensity by Component of Scenarios (4/5)

(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

Table 6.1 Effect of Technical Measures on the Energy Intensity by Component of Scenarios (5/5)

(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

Table 6.2 Energy Consumption and Air Pollutant Emmission in 9 industries in 2000 and 2003

	2000			2003		
	Reference	E.C.	A. E. C.	Reference	E.C.	A.E.C.
< Effects of energy conservation >						
(Energy consumption in 1997 = 100)						
Iron and steel	107	95	92	114	92	87
Chemicals						
Ammonium	110	105	103	119	111	110
Machinery						
Tractor	116	90	86	139	102	94
Truck	109	87	85	118	84	81
Non-metallic minerals						
Glass	125	107	102	154	114	107
Silicate lime block	109	84	82	119	78	76
Food processing						
Vegetable oil	112	100	96	126	100	91
Meat products	101	86	96	112	84	81
Dairy products	112	99	93	125	105	96
Total	109	97	95	119	98	93
< Effects of environmental improvement >						
(Emission in 1997 = 100)						
[CO2] Iron and steel	107	94	92	114	91	86
Ammonia	110	105	103	119	110	109
Tractor	116	91	86	139	102	94
Truck	109	88	85	118	85	82
Glass	125	106	101	154	113	106
S.L.B.	109	84	82	119	78	75
Vegetable oil	112	100	96	126	98	89
Meat products	101	86	84	112	85	82
Dairy products	112	99	93	125	105	96
Total	108	97	94	118	96	92
[Sox] Iron and steel	107	94	92	114	90	86
Ammonia	110	105	100	119	110	100
Tractor	116	94	88	139	102	94
Truck	109	99	99	118	103	102
Glass	125	113	108	154	127	120
S.L.B.	109	86	84	119	81	79
Vegetable oil	112	101	97	126	102	94
Meat products	101	89	87	112	90	90
Dairy products	112	97	93	125	102	93
Total	107	95	92	118	93	88
[Nox] Iron & steel	107	94	92	114	91	86
Ammonia	110	105	103	119	111	108
Tractor	116	94	88	139	105	96
Truck	109	97	95	118	99	97
Glass	125	107	102	154	114	107
S.L.B.	109	86	84	119	81	79
Vegetable oil	112	101	97	126	102	94
Meat products	101	89	87	112	90	91
Dairy products	112	97	93	125	105	93
Total	109	96	94	118	96	91

Table 6.3 Effect of Technical Measures on the Energy Intensity by Component of Scenarios (1/5)

STEEL (Unit : MJ / ton or pcs)

Scenario	Name of equipment	Energy Intensity in 1997	Decrease in Energy Intensity in 2000					Energy Intensity in 2000	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	2.28	0.228	0.76	0	3.268	73	1.52	0	3.6366	0	5.1566	68
	Compressor	86	2.58	2.58	0.86	0	6.02	80	1.72	0	3.999	0	5.719	74
	Motor	455	13.65	0	5	0	18.2	437	9.1	0	21.84	0	30.94	406
	Transformer	140	4.2	0	6	0	9.8	130	2.8	0	6.51	0	9.31	121
									0					
	Heating(Air conditi.)	1954	98	0	39	0	136.78	1817	39.08	0	90.861	0	129.941	1687
	Boiler	3115	156	0	62	0	218.05	2897	62.3	0	144.8475	0	207.1475	2690
	Heating furnace	1009	20	85	20	0	125.36	884	20.18	0	44.182	0	64.362	819
									0					
A.E.C.	Lighting	76	5.32	0.23	0.76	0.76	7.068	69	1.52	0	3.4466	0.76	5.7266	63
	Compressor	86	6.02	2.58	0.86	0.00	9.46	77	1.72	0	3.827	0	5.547	71
	Motor	455	31.85	0	4.55	45.50	81.9	373	9.1	0	18.655	45.5	73.255	300
	Transformer	140	9.80	0	5.60	0	15.4	125	2.8	0	6.23	0	9.03	116
									0					
	Heating	1954	136.78	0	39	0	175.86	1778	39.08	0	88.907	0	127.987	1650
	Boiler	3115	218.05	0.00	62	0.00	280.35	2835	62.3	0.00	141.7325	0.00	204.0325	2631
	Heating Furnace	1009	70.63	85.00	20	97	272.81	736	20.18	0	36.8095	0	56.9895	679

AMMONIA (Unit : MJ / ton)

Scenario	Name of equipment	Energy Intensity in 1997	Decrease in Energy Intensity in 2000					Energy Intensity in 2000	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	0												
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	0	11	152	8	0	0	0	8	143
	Motor	362	25	0	0	36	62	300	18	0	0	36.2	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	0	0	0	0	0								

Table 6.3 Effect of Technical Measures on the Energy Intensity by Component of Scenarios (2/5)

TRUCK

Scenario	Name of equipment	Energy Intensity in 1997	Decrease in Energy Intensity in 2000					Energy Intensity in 2000	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	0.581	0	0	0	0.581	580	11.62	0	0	0	11.62	569
	Compressor	1000	1	83	0	0	84	916	20	0	0	0	20	896
	Motor	2906	2.906	0	0	0	2.906	2903	58.12	0	0	0	58.12	2845
	Transformer	1475	1.475	0	0	0	1.475	1474	29.5	0	0	0	29.5	1444
									0					
	Heating(Air conditi.)	8335	834	480	583	0	1896.95	6438	166.7	0	257.522	0	424.222	6014
	Boiler	16599	1,660	0	1,162	0	2821.83	13777	331.98	0	551.0868	0	883.0668	12894
	Heating furnace		0	0	0	0	0	0	0	0	0	0	0	0
									0					
A.E.C.	Lighting	581	5.81	0.00	0.00	0	5.81	575	11.62	0		0	11.62	564
	Compressor	1000	10.00	83.00	0.00	0.00	93	907	20	0		0	20	887
	Motor	2906	29.06	0	0.00	290.60	319.66	2586	58.12	0		290.6	348.72	2238
	Transformer	1475	14.75	0	0.00	0	14.75	1460	29.5	0		0	29.5	1431
									0					
	Heating	8335	834	480	583	0	1896.95	6438	166.7	0	257.522	0	424.222	6014
	Boiler	16599	1,660	0.00	332	0.00	1991.88	14607	331.98	0.00	584.2848	0.00	916.2648	15691
	Heating Furnace		0.000	0.00	0	0	0	0	0	0	0	0	0	0

TRACTOR

Scenario	Name of equipment	Energy Intensity in 1997	Decrease in Energy Intensity in 2000					Energy Intensity in 2000	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	3728	224	726	0	0	950	2,778	75	0	0	0	75	2,704
	Motor	8514	511	0	0	0	511	8,003	170	0	0	0	170	7,833
	Transformer	3468	208	0	0	0	208	3,260	69	0	0	0	69	3,191
									0					
	Heating(Air conditi.)	12101	1,210	0	0	0	1,210	10,891	242	0	0	0	242	10,649
	Boiler	18377	1,838	0	0	0	1,838	16,539	368	0	0	0	368	16,172
	Heating furnace		0	0	0	0	0.000	0.000	0	0	0	0		
A.E.C.	Lighting	642	53	0	0	23	76	566	26	0	0	0	26	541
	Compressor	3728	305.3	726.0	0	0	1,031	2,697	149	0	0	0	75	2,622
	Motor	8514	697.3	0	15	851	1,563	6,951	341	0	0	851	1,192	5,759
	Transformer	3468	284.0	0	0	0	284	3,184	139	0	0		139	3,045
									0					
	Heating	12101	1,349	0	0	0	1,349	10,752	578	0	0	0	578	10,173
	Boiler	1377	154	0	0	0	154	1,223	66	0	0	0	66	1,158
	Heating Furnace	0	0.000	0.00	0	0	0.000	0	0	0	0	0	0	0

Table 6.3 Effect of Technical Measures on the Energy Intensity by Component of Scenarios (3/5)

GLASS

Scenario	Name of equipment	Energy Intensity in 1997	Decrease in Energy Intensity in 2000					Energy Intensity in 2000	2,003					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
							0	0	0					0
	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		0				0	0	0				0	0
							0	0	0				0	0
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
			0				0	0	0				0	0
	Heating	1,045	110	0	0	0	110	935	21	0			21	914
	Boiler	2,541	267	0	0	0	267	2,274	51	0			51	2,223
	Heating Furnace	0	0	0	0	0	0	0	0	0	0	0	0	0

S.L.B.

Scenario	Name of equipment	Energy Intensity in 1997	Decrease in Energy Intensity in 2000					Energy Intensity in 2000	2,003					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	0.1	0	0	0	0.1	1.9	0.06	0	0	0	0.06	1.8
	Transformer	2	0.1	0	0	0	0.1	1.9	0.06	0	0	0	0.06	1.8
									0				0	0
	Heating(Air conditi.)	267	13.35	0	0	0	13.35	253.7	8.01	0	0	0	8.01	246
	Boiler	753	37.65	0	0	0	37.65	715.4	22.59	0	0	0	22.59	693
	Heating furnace						0	0					0	0
							0	0					0	0
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
			0				0	0	0				0	0
	Heating	267	21.36	0	0	0	21.36	245.6	5.34	0	0	0	5.34	240
	Boiler	753	60.24	0	0	0	60.24	692.8	15.06	0	0	0	15.06	678
	Heating Furnace													

Table 6.3 Effect of Technical Measures on the Energy Intensity by Component of Scenarios (4/5)

VEGETABLE OIL

Scenario	Name of equipment	Energy Intensity in 1997	Decrease in Energy Intensity in 2000					Energy Intensity in 2000	2,003					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		0				0	0	0				0	0
			0				0	0					0	0
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													

MEAT

Scenario	Name of equipment	Energy Intensity in 1997	Decrease in Energy Intensity in 2000					Energy Intensity in 2000	2,003					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
			0						0				0	0
	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						0	0					0	0
							0	0					0	0
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
			0				0	0	0				0	0
	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													0

Table 6.3 Effect of Technical Measures on the Energy Intensity by Component of Scenarios (5/5)

DAIRY PRODUCTS

Scenario	Name of equipment	Energy Intensity in 1997	Decrease in Energy Intensity in 2000					Energy Intensity in 2000	2,003					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
			0				0	0					0	0
	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						0	0					0	0
							0	0					0	0
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
							0	0	0				0	0
	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													

Table 6.4 Energy Consumption in 7 Types of Equipment in 1997, 2000 and 2003

Scenario	Equipment	Share in	Energy Consumption (TJ)			EC or AEC / REF	
		Total(%)*	1997	2000	2003	2000	2003
E.C.	Lighting	7.34	1,235	1,222	1,223	0.93	0.85
	Compress.	16.64	2,798	2,723	2,803	0.86	0.78
	Motor	61.93	10,416	9,443	9,550	0.83	0.76
	Transf.	14.09	2,370	2,327	2,335	0.91	0.84
	Heating	31.81	57,770	58,961	61,025	0.94	0.89
	Boiler	61.76	112,165	111,870	115,622	0.92	0.87
	Furnace	6.44	11,694	10,922	10,831	0.88	0.81
A.E.C	Lighting			1,165	1,157	0.88	0.81
	Compress.			2,639	2,730	0.83	0.76
	Motor			8,786	7,602	0.77	0.60
	Trnasf.			2,245	2,276	0.88	0.81
	Heating			56,309	57,571	0.90	0.84
	Boiler			91,875	93,952	0.75	0.70
	Furnace			9,099	8,979	0.73	0.67
REF.	Lighting			1,318	1,434		
	Compress.			3,170	3,592		
	Motor			11,351	12,566		
	Transf.			2,564	2,794		
	Heating			62,874	68,307		
	Boiler			121,986	133,472		
	Furnace			12,471	13,339		

* Shares in electricity consumption for lighting,air compressor,motor,and transformer,and in fuel consumption for heating,boiler,and furnace in 1997,respectively.

7. PRESENTATION OF MASTER PLAN AND ACTION PLAN

7. PRESENTATION OF MASTER PLAN AND ACTION PLAN

7.1 Overall Evaluation of Policy Scenarios

In this chapter, an overall evaluation of the aforementioned two scenarios will be made from the viewpoints of the cost-effectiveness and forecasts of macroconomic and energy situation based on the results of estimating Poland's energy conservation potential and environmental improvement effect, according to these scenarios. This is thus expected to help policy decision-makers to choose between these scenarios.

7.1.1 Cost-Benefit

(1) Estimation of Costs

The necessary costs that must be taken into consideration include the various administrative costs, mainly those borne by the government of Poland, as well as those costs borne by the factories, including both miscellaneous expenses and investment.

a. Administration Costs

1) Establishment and operation of a core Energy Conservation Technical Center (ECTC) for the promotion of energy conservation

It is assumed that the above-mentioned center will carry out the following activities for the promotion of energy conservation.

- training of factory staff able to carry out self-auditing in factories
- training of factory managers in factories
- training of factory-auditing experts
- selection of energy conservation model factories and providing guidance on their business operation
- introduction and dissemination of energy conservation technologies and equipment.
- other work related to publicity and dissemination of energy conservation methods

Table 7.1 shows a calculation based on Japan's experience in this field.

2) Policies for the Purpose of Promoting Energy Conservation

As in the case of the categories listed above, the costs of the following policy categories were estimated. For these results, see Table 7.1.

- introduction and development of ESCO enterprises
- designation of energy-intensive factories
- authorization of qualifications of energy managers and assignment of such persons where required
- operation of deliberative councils (advisory committees) on energy conservation matters
- implementation of energy conservation-related cooperative activities with industrial bodies
- implementation of energy conservation-related cooperative activities with labor unions

b. Costs of Investment in Energy Conservation Measures

The total costs necessary for each industrial sector and sub-sector to implement those measures that are judged to be economically feasible were estimated based on evaluations of the economic effects of the various energy conservation measures taken by each sector and sub-sector. Table 7.1 shows the results of this estimation.

(2) Estimation of Effect

"Effect", as considered hereunder, consists of the amount of energy conservation achieved, and the environmental improvement effect.

a. Energy conservation amounts

The estimated amount of energy conservation achieved has been converted into monetary terms based on the prices of the various forms of energy. The results are shown in Table 7.1.

b. Environmental improvement effect

The environmental improvement effect of energy conservation has been converted into monetary terms based on Poland's air pollutant fee (emission fee). These fees are determined anew each year: Those for 1998 are shown below. These figures were used in our estimates. (The estimates are shown in Table 7.1.)

- CO_2: 0.15 PLN/t-CO_2
- SO_2: 300 PLN/t-SO_2
- NO_2: 300 PLN/t-NO_2

(3) Evaluation of results of analysis

As can be seen in Table 7.1, the effect stemming from energy conservation greatly exceeds the cost required for improvement of management and equipment necessary for energy conservation. With regard to the figures for the year 2000, the effect is 29 times (Total Benefit/Grand Total Cost) the cost in the EC scenario, and 23 times the cost in the AEC scenario. The figures for 2003 are much higher than those for 2000; 12 times and 14 times, respectively.

These results are attributable, firstly, to the significantly large contribution to energy conservation by one of the four components of the scenario - "improvements in energy management". Secondly, "modernization and rationalization" is also expected to contribute significantly to energy conservation.

In order to clarify the effect of modernization and rationalization on energy conservation, the energy conservation effect was recalculated after removing the contribution expected to be made by this factor. The results are seen in Table 7.2.

This calculation shows that if energy conservation policies were pursued without any modernization or rationalization at all, the ratios of effect to investment cost in the year 2000 for the two scenarios (29 times and 12 times; see Table 7.1) would decline to around 25 times and 10 times. Furthermore, the figures of 23 times and 14 times for the year 2003 would fall to around 20 times and 11 times respectively (see Table 7.2, (B)). Thus, the economic merit would be substantial even if the energy conservation effect stemming from modernization/rationalizaition is excluded.

7.1.2 Evaluation Based on Macroeconomic & Energy Supply-and-Demand Forecasts

Based on the results of macroeconomic and energy supply & demand forcasts, the following points can be pointed out with respect to economic, energy, and environmental indicators (see Table 7.3).

(1) Of the various economic indicators, the economic growth rate is higher in the case of both the EC scenario and the AEC scenario than in the case of the REF scenario. Comparison of the EC with AEC scenarios reveals that the average annual growth rate from 1996 to 2003 is higher in the AEC scenario than in the EC scenario, although by only 0.1 %. Meanwhile, the rate of price increase, at both the wholesale and retail levels, is higher in both the AEC and EC scenarios than in the REF scenario. Comparison of the AEC and EC scenarios discloses that the annual average from 1996 to 2003 is higher by 0.1 % in the case of the AEC scenario. Additionally, the average wage levels in both the year 2000 and in 2003 show virtually the same figures in the EC and AEC scenarios (more than 20 % higher than in the REF scenario).

(2) With regard to energy indicators, firstly, the growth rate of demand for energy is in the plus zone in the REF scenario but shows minus growth in the EC and AEC scenarios from 1996 to 2000 and virtually zero growth in the 2000~2003 period. Moreover, in response to changes in the structure of energy consumption, the level of consumption of coal is considerably lower in both the EC and AEC scenarios than in the REF scenario.

(3) The following three points should be noted with respect to the need to lower CO2 emission levels in order to protect the global environment.

a. The CO_2 emission levels in both the EC and AEC scenarios are lower than in the REF scenario.
b. The CO_2 emission level is lower in the AEC scenario than in the EC scenario.
c. The levels of CO_2 emission in both scenarios are lower than the 1990 level (equivalent to 104 million tons of carbon).

(4) It should, however, be noted that these estimation results are based on the assumption of exogenous variables; with specific regard to prices, the recent results suggest that the actual rate of increase may probably decline.

7.2 Master Plan

7.2.1 Setting the Targets

(1) To increase the degree of precision of economic forecasts in estimating energy conservation potential, two comparatively short time frames were utilized – to fiscal 2000 and to fiscal 2003. In drafting a master plan, the result is regarded as more realistic if the following two points are borne in mind.

a. The full-scale promotion of a master plan would be carried out by the central Energy Conservation Technical Center (ECTC) and the actual activities would commence around the middle of 1999. This would start to produce a benefit in individual companies after the year 2000.

b. In order to achieve sufficient results from energy conservation efforts mainly by "energy management", estimated for the year 2000, we must allow a period of around three years from the year 2000, when energy conservation activity at the corporate level is scheduled to start, so as to provide a maturation period during which the movement can permeate companies and spread from one company to another.

c. In the EC and AEC scenarios, according to our estimate for the year 2003, approximately 11 to 14 % of energy conservation potential (2 to 3 % of the energy conservation rate) would arise from capital investment in modernization and rationalization.

The achievement of energy conservation of 2 to 3 % over three years by equipment investment is, however, somewhat unfeasible in terms of capital investment planning, and the period may have to be extended by about another three years.

In master plans, in due consideration of the foregoing points, the time for the start of reaping the energy conservation fruit is set to the beginning of 2000, the time for the completion of reaping the fruit of energy conservation potential for the 2000 to the end of 2003, and the time for the completion of reaping the fruit of potential for 2003 to the end of 2006.
Thus, it is advisable to set the targets of the master plans as follows. Figure 7.1 shows the process in the master plans.

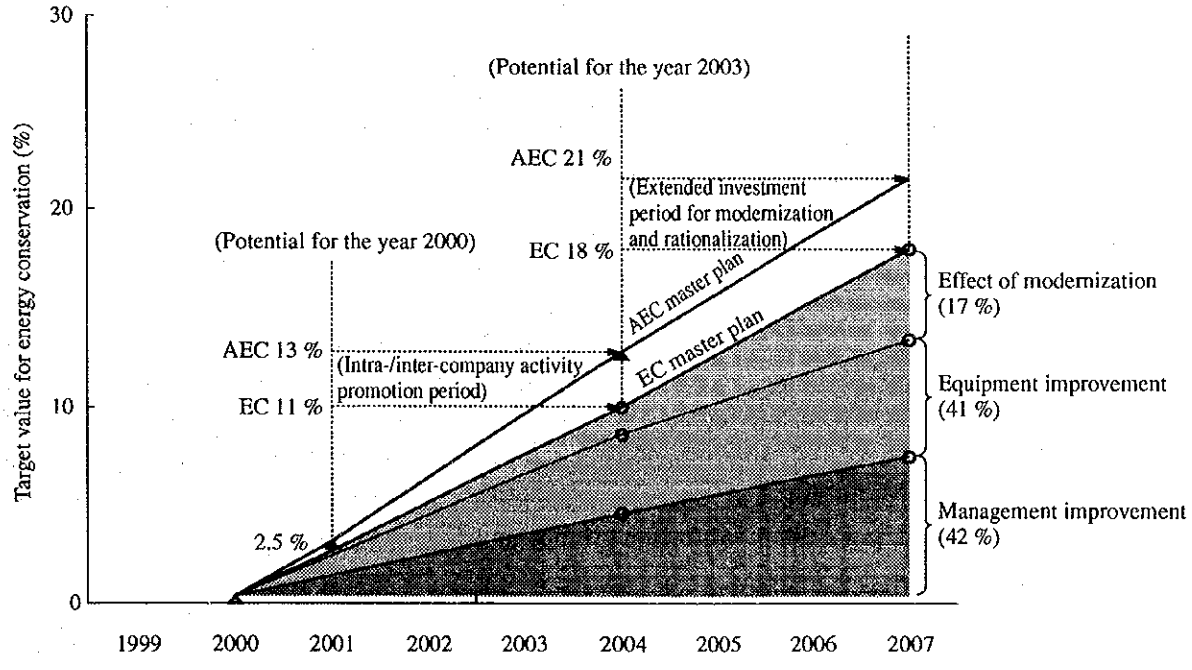
Target Values of Reduction in Energy Intensity (%)

Scenarios	Year 2000	Year 2003	Year 2006
E.C. scenario	2.5	11.0	18.0
A.E.C. scenario	3.0	13.0	21.0

Target Values of Reduction in Emission Gases (based on 1997 %)

Scenarios	Gas	Year 2000	Year 2003	Year 2006
E.C. scenario	NO_X	0.5	2.1	6.2
	SO_2	0.5	2.1	9.9
	CO_2	1.1	4.4	7.1
A.E.C. scenario	NO_X	1.5	5.8	11.4
	SO_2	1.4	5.6	14.2
	CO_2	2.1	8.2	12.1

Figure 7.1 Trends in Energy Conservation Target Values in Master Plans

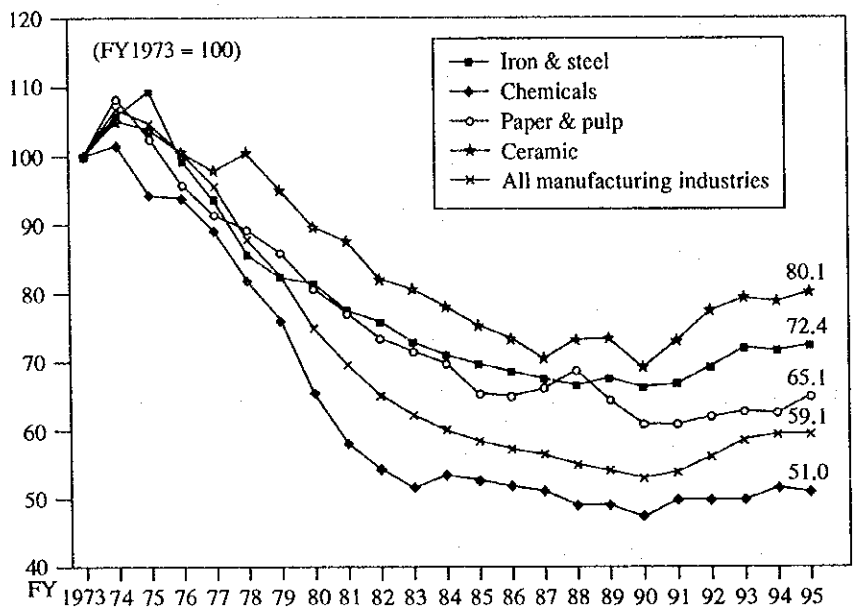


(2) Now the Master Plan target figures are compared with the energy savings actually achieved in Japan in the period following the oil crisis. The background factors pertaining to energy conservation in Japan at that time and the development thereof will be discussed and explained below.

a. Energy intensity in Japan in the period after the oil crisis

As can be seen in Figure 7.2, the trend of the energy intensity (IIP) of Japanese industry, based on the Mining & Manufacturing Production Index, showed a decline of approximately 40 % (annual average of approximately 3.5 %) in the manufacturing sector in the period 1973~1985.

Figure 7.2 Breakdown of Trends of Indices of Industrial Production (IIP) by Industry

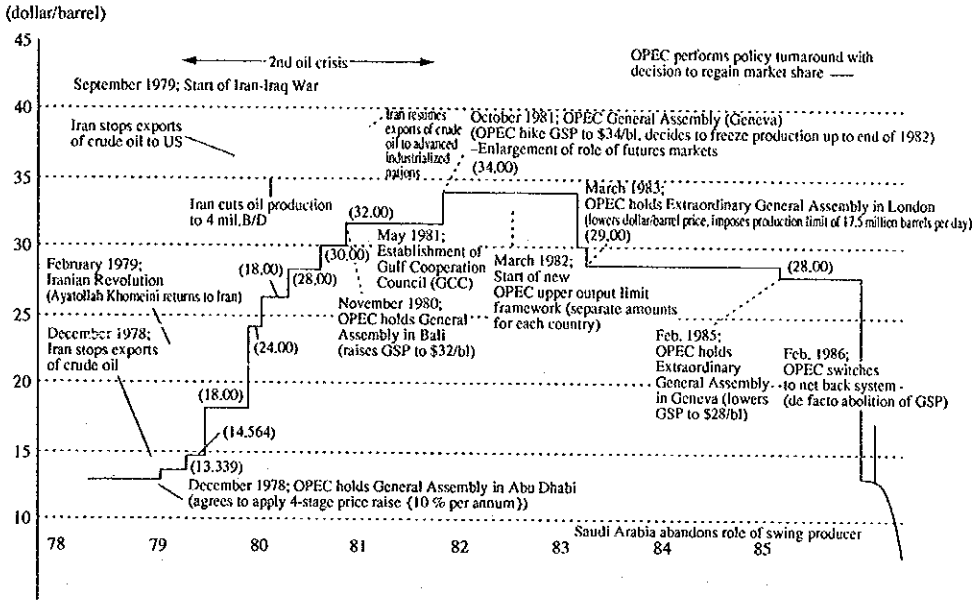


Note: IIP means indices of industrial production.

b. Energy prices

At that time, oil accounted for around 75 % of Japan's total primary energy resources, and thus overall energy prices were determined by crude oil prices. The price of crude oil rose from $10 to $35 per barrel in the period 1979~1985 (compared with approximately $3/bl prior to 1973). The maximum price in the 1980~85 period was thus over 10 times the pre-crisis level, and this created a considerable potential for the promotion of energy conservation.

Figure 7.3 Crude Oil Spot Price Trends



c. Legal/Institutional framework

In 1951 the Heat Management Law (the forerunner of the current Energy Conservation Law) was enacted, and at the time of the oil crisis, a system was in effect, under which designation of some factories as energy management factories, promotion of methods of effective utilization of heat, and the assignment of heat managers were available. Thus, high energy-intensive companies had already established a fairly extensive energy management system.

In 1979 the Heat Management Law was further strengthened in legal terms with the inclusion of electric power, and was reborn as the newly-enacted Energy Conservation Law, thereby completing the legal and institutional framework for the promotion of energy conservation,

d. Establishment of the energy conservation center

With the support both of the Ministry of International Trade and Industry and of industrial circles, the Energy Conservation Center was set up in 1978 to serve as the core institution for the promotion of energy conservation in Japanese industry, thus significantly contributing to the promotion of energy conservation in the industrial field. (The Center's head office is in Tokyo (staff number: 40), and it has 8 branches (staff number 90.)

e. In-house energy managers

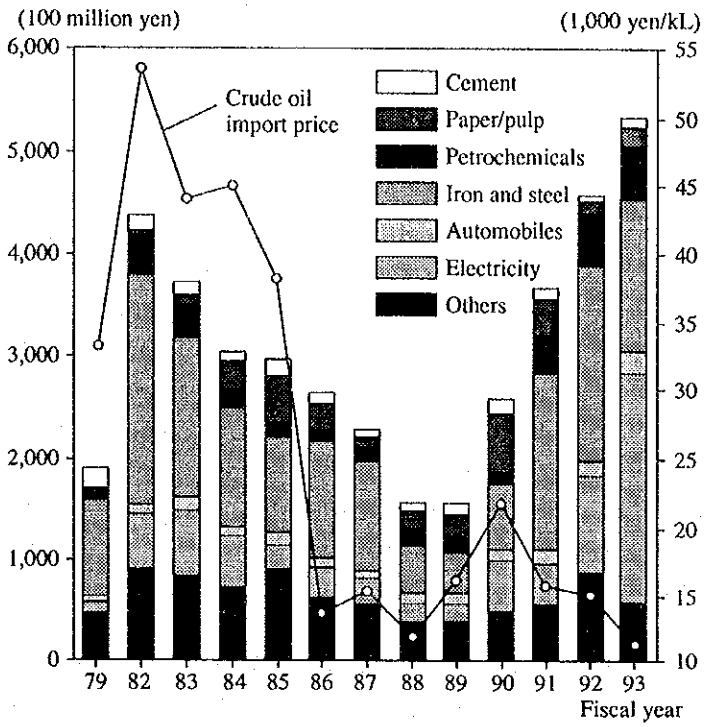
The heat managers defined under the Heat Management Law hold qualifications awarded by the central government under a system dating from 1948, and by the time of the oil crisis there were already 25,600 persons holding such qualifications working in private companies. In 1979, the name of the qualification was changed to energy managers, and the number of such qualified specialists including both heat and electricity managers was increasing at a rate of 1,000~2,000 per year. The nation thus possessed a considerable number of engineers capable of promoting energy conservation.

f. Investment in equipment

With the enactment of the Energy Conservation Law in 1979, a system of tax allowances or incentives and a system for providing financial support for energy conservation measures were simultaneously set up. As Figure 7.4 shows, investment of 3 trillion yen (26 billion US dollars) (an annual average of approximately 300 billion yen (2.6 billion dollars)) in energy-saving equipment was implemented between 1979 and 1989. This investment was directed towards the promotion of energy conservation through improvements in equipment and processes.

Meanwhile, the energy conservation targets proposed for Poland under the Master Plan are approximately equal to the rate of energy conservation achieved in Japan following the oil crisis. Poland is currently at the initial phase of promoting energy conservation in industry. Although they are making the effort to bring energy prices to those in real terms, the incentives seem to be condiderably weak compared with those during the oil crises in Japan. Its achievements regarding the matters discussed in b, c, d, and e. above are as yet zero. The successful accomplishment of the Action Plan described later is thus a prerequisite for the attainment of the targets set under the Master Plan.

Figure 7.4 Trends of Investment in Energy-saving Equipment and Crude Oil Prices



Sources: Equipment Investment Research (Ministry of International Trade and Industry), Japan Export and Import (Ministry of Finance)

7.2.2 Proposal of Measures

Comprehensive measures are required to enable Poland to attain the targets outlined above. These comprehensive measures must center on the measures for the improvement of energy management and the improvement of equipment for which costs are comparatively low in view of the fact that: a) the time frame for implementation of the measures must be comparatively short, i.e., to 2000 and to 2003; and b) that not many factories have yet begun to thoroughly tackle the task of energy conservation.
These measures are explained below.

(1) Improvement of energy management

a. Establishment of corporate in-house systems for the promotion of energy conservation activities

Many companies in Poland are still state-owned, or have not been long privatized, and thus the number of their management staff who are including energy conservation within their management strategies is small. Firstly, corporate management staff must be more fully acquainted with the examples of successful energy conservation results as found in the factory audits recently carried out by the JICA's teams. (Training for Management Staff)

Secondly, each company must set up a system for the promotion of energy conservation activity, consisting of the energy managers from each section of the company with higher management staff in charge of the PDCA (Plan, Do, Check, Action) for facilitating the management of progress in achieving energy conservation targets, as the top.

b. Establishment of a self-auditing system

A mere theoretical understanding of the principles of the use of heat, electric power, etc., is not enough for the actual promotion of energy conservation; it must be supplemented by skills or knowhow in the application of the necessary techniques. For this purpose, company staff must be fully acquainted with the experience accumulated by the pioneers in this field. The absorption of such knowledge is the most effective method of achieving success. Energy-related engineers within companies, who will form the core of each company's energy conservation promotion activities, should be trained to approach their jobs from the standpoint of energy conservation (Training for Energy Managers), and employees must be trained to improve in the techniques needed to conduct self-audits.

On the other hand, those actually handling energy-consuming equipment are front-line workers (employees) on the job-site at factories. The attitude of these employees toward energy conservation, and their cooperation and advices regarding the various energy conservation measures promoted by energy managers responsible for promoting energy conservation, will be crucial factors in the overall process of promoting energy conservation. Consequently, the training of employees (On-the-Job Training) is absolutely essential. With regard to cooperation with workers on the jobsite, the "HOPP" activities being implemented by the tool manufacturing plant of URSUS provide a valuable example. It is essential for labor union leaders and corporate management staff to hold extensive discussions with regard to cooperation between management and workforce in the implementation of energy conservation measures (for example, concerning the distribution of the benefits from energy saving, and methods of evaluating the performance of employees). It is equally important to train factory auditing specialists (Auditing Experts) capable of making specific proposals for the rational use of energy within factories through factory audits (Training for Experts).

c. Proposing energy conservation methods and disseminating results

The most effective means of making energy conservation methods available is for experts to propose specific methods of achieving energy conservation at particular factories after conducting factory audits (Factory Auditing Activities).

Additionally, if energy service companies possess sufficient technical knowhow regarding energy conservation, it would be effective as well to have these service companies carry out factory audits to undertake energy service businesses. (Introduction of ESCO Enterprises and their Development).

When companies provide training in new work procedures, the most effective method is on-the-job training. In view of this, certain factories should be selected as energy conservation model factories from each industrial sector or sub-sector to intensively carry out energy conservation measures at the said factories. Following this, staff at other companies in the same industry who are involved in energy conservation should be allowed to observe the results for themselves. By this means, the results of energy conservation measures will be made widely available (Model Factory System).

From here onward, if many companies actively engage in energy conservation operations, a large number of successful examples will surely emerge. Thus, the announcement of examples of the successful application of energy conservation methods once a year for the publicity and dissemination of the results of energy conservation would be a useful guide for energy engineers in particular. This method, which has been in use in Japan for almost 20 years, is regarded as significantly useful and effective, and has greatly contributed to lateral application of energy conservation technologies (Conferences at which Successful Examples of Energy Conservation are Announced).

d. Providing information relating to energy conservation

In order to effectively promote energy conservation activities in Poland from here on, it is important that corporate managements and energy specialists are made aware, as quickly as possible, of overseas developments in this field, such as new technologies and examples of the successful examples of energy conservation. Channels for making such information available include magazines, the Internet, and exhibitions (Providing Overseas Information on Energy Conservation).

Regarding energy utilization equipment that is widely used in the private sector, it would be extremely useful from the standpoint of equipment user if such equipment were to carry labels indicating its comparative energy utilization efficiency, or Energy Star marking system (Energy Efficiency Indication System).

e. Providing incentives for energy conservation activities

The direct means of offering incentives to persons engaged in energy conservation activities is by awarding monetary rewards or honors. Regarding monetary rewards, Japanese companies generally adopt a system in which employees who have made proposals that are accepted and put into practice receive lump-sum payments in reward, while employees who have made a large number of successful proposals, thereby contributing to the company's profits, are rewarded by promotion or salary increases. This kind of in-house system of rewards is highly effective in providing an incentive for employees to use their expertise and imagination to improve work processes (In-house Personnel Promotion and Commendation System)

Examples of honors that might be awarded to persons who have contributed to energy conservation include official commendations from the government awarded to employees who have made a significant contribution to energy conservation at their companies, or who are responsible for particularly excellent examples of the successful application of energy conservation measures (Governmental Commendation System).

The establishment of a national system of qualifications for energy-related engineers would serve to raise the average level of expertise among such staff: this is a matter worthy of serious consideration (System of Qualifications).

(2) Specific measures for each industrial sector and sub-sector

	Heat	Electricity	Process
Iron and steel making	• Scrap heating furnace for electric furnace	• Renovation of pumps, blowers, etc. in the processes involving a coke oven to a rolling mill, and modification of dust collectors	
Ammonia	• Installation of an air preheater in the water vapor reforming process		• Installation of a device for recovering ammonia and hydrogen in the purge gas
Truck	• Modification of the drying oven	• Improvement of air leakage/air pressure in air compressor	
Tractor	• Improvement of the casting process	• Improvement of air leakage/air pressure in each process • Rotational speed control of motors	
Glass	• Reinforcement of the heat insulation of the melting furnace • Improvement of excess air of the melting furnace		
S.L.B	• Heat recovery from the autoclave	• Modification of related equipment including weigher, mixer, etc.	
Vegetable oil	• Heat recovery in the decoloring process • Reinforcement of the heat insulation of steam valves		• Modification of the hydrogenation device
Meat processing	• Enhancement of condensate recovery • Reinforcement of the heat insulation of steam and valves	• Modification of the compressor for refrigeration	
Dairy products	• Reinforcement of the heat insulation of steam valves	• Modification of the compressor for refrigeration • Modification of fans for drying	• Increasing of concentration in the concentration process

7.2.3 Proposal of "Governmental Measures"

(1) Necessity for Enactment of Energy Conservation Law

It would be advisable to enact an Energy Conservation Law so as to orientate the basic policies for energy conservation.

Based on the said Law, energy conservation should be promoted through the "Governmental Measures" as described below.

(2) Categories of "Governmental Measures"

As a means of supporting and promoting the various measures proposed in section 7.2.2, the following proposals are recommended, which are broadly divided into the three categories – improvement of management, recovery of investment costs, and others.

a. Improvement of management

Three principal governmental measures should be adopted in order to implement the above-mentioned improvement in energy management. The following governmental measures are necessary in both the EC and AEC scenarios.

1) Consideration of feasibility of establishing a core Energy Conservation Technical Center

From the standpoints both of number of staff and of the scale of its budget, the present setup of KAPE, an organization actively promoting energy conservation, is insufficient for the implementation of the above-described "measures" in accordance with the government's policy. The Polish authorities shoud establish a core Energy Conservation Promotion Center (ECTC) capable of comprehensively promoting training programs, factory audits, dissemination of successful examples, providing of information, and the operation of a system of awards and qualifications so as to help achieve the targets set out under the Master Plan. They need also to consider the near-term economic activities required for the operation and the future independence of the said center from the institutional aspect.

2) Budgetary support for energy conservation policies

In carrying out the various measures mentioned above, such as training programs, factory audits, and the establishment of model factories, the costs should naturally be borne by the companies themselves, as it is they who will reap the benefits in the future. Unfortunately, the managements of many companies are still insufficiently aware of the beneficial economic effects of energy conservation. In regard of this situation, the government will have to provide budgetary support for a certain period, or offer loans at low interest rates until reform of awareness among corporate management staff spreads widely throughout Poland.

The results of the factory audits carried out in this study show that if the factories included in the survey were to implement energy conservation measures, they would be able to achieve reductions of 25 % in emissions of CO_2, SO_2, NO_2, and dust (equal to approximately 5 % of total national emissions). This would reduce companies' payments of "Emission Fee", which is air pollutant fee levied on companies that emit CO_2 etc. However, as shown in Table 7.1 and the factory survey figures, the amount of reduction in Emission Fees resulting from energy conservation would be only 1~2 %, which would make little contribution to shortening the payback period of the necessary investment. Consequently, this degree of reduction in Emission Fees would not act as a significant incentive for factory managers to push ahead with energy conservation measures. In our view, the Polish government should recognize that energy conservation measures taken by companies would make a major contribution to protecting the environment, and in order to encourage energy conservation in factories, it is recommended that they should provide support for such activities by widening the scope of application of the Environmental Protection Fund.

3) Establishment of systems for awarding of commendations and the examination of qualifications

Official systems must be set up for the commendations and qualifications to be awarded by the government mentioned above, and efforts must be made to deepen the understanding of the objectives and details of these systems among company staff involved in such matters.

b. Recovery of Investment Costs

1) Energy prices

As stated in the discussion of the scenario in Chapter 5, the Polish government has drawn up a policy under which it will use its influence to move energy prices to levels that reflect the costs involved, reduce the difference with international prices and introduce domestic competitive pricing. It is recommended that this policy be maintained.

Such a pricing policy is expected to encourage the implementation of energy conservation measures.

2) Economic Incentives

In our opinion, a certain amount of government intervention during the periods of transition to a market economy, up to the year 2000 or 2003, would be a logical means of improving the efficiency of the Polish economy.

Generally speaking, it is our view that, in the type of market economy that the Polish government is attempting to foster, a complete reliance on the regulatory forces of the market will inevitably result in a failure to allocate resources efficiently. Therefore, government intervention in the economic system is necessary to rectify such imbalances. This is regarded as equally applicable in the field of energy conservation.

It is crucial to stress the fact that such government intervention is particularly important for economic nations in a transition period, and for the economies of developing nations.

That being the case, as stated in our proposal in the discussion of the scenarios, the provision of long-term financing at low interest rates would be advisable from the standpoint of promoting energy conservation.

Additionally, in our view, the funds needed for such loans could be obtained from the following organizations.

1) The Industrial Development Agency (ARP)
2) National Fund for Environmental Protection and Water Management (NFEP & WM)
3) Regional Funds for Environmental Protection and Water Management
4) The Environmental Protection Bank
5) Other state-run financial institutions

In the Japanese system, as of Dec. 16, 1998, low-interest loans (annual rate of 1.3 %) were available from the Japan Development Bank for the purchase of equipment that contributes to energy conservation up to a limit of 40 % of the cost. (For purposes of comparison, the market interest rate on long-term loans in December 1998 was 2.20 %, giving a differential of 0.90 %).

c. Other Policies

1) Setting of standards for energy-related equipment

Under the "Energy Law", the Polish government has already announced its basic policy relating to the establishment of equipment standards. This should be followed up by immediate consideration of the establishment of a system of specific standards for efficiency of energy utilization equipment.

2) Introduction and development of high-efficiency energy-related equipment

One important point regarding the promotion of the wider use of highly energy-efficient equipment by Polish companies, particularly over the short term, is the need to keep companies precisely and promptly informed about new developments in those types of equipment available abroad, as well as about newly developed technologies.

Over the short-to-medium term, the introduction of advanced equipment and techniques through various forms of business tie-ups with foreign companies would also make a valuable contribution to the energy conservation movement. For this purpose, too, the ECTC, which will act as a pivotal organization for the promotion of energy conservation, and other such organizations, would play an important role.

In addition, over the long term, it is most advisable for Polish companies to make efforts to develop more energy-efficient equipment and new technologies themselves. It is therefore recommended that the Polish government examine the possibility of providing some sort of support for companies' own efforts towards this end during the period of transition to a market economy. (Such support could consist of, for example, the examination of development methods by advisory committees composed of specialists, and assistance for the systematic organization by companies of joint research and development bodies.)

(3) Drafting of Program for Policy Implementation and Cost Plan

Depending on the way in which Polish companies tackle the task of energy conservation, it is important to move the various policies outlined above into the implementation stage.

We have therefore examined the program shown in Table 7.4. This table proposes various "governmental measures" for the government depending on the "level" which particular factories have reached in their energy conservation activities. In addition, each corresponding "institutions or organizations" have been proposed to support each policy measure.

Taking the example of the short term (1999~2000), with regard to those factories which have not yet initiated energy conservation measures (referred to as the NY ["not yet"] group), it will firstly be necessary to start with the provision of the most basic information and data. For this purpose, existing organizations, including the Ministry of Economy and KAPE, must operate to the best of their ability, while at the same time the establishment of an organization such as the aforementioned ECTC, will surely be a prerequisite.

Secondly, with regard to those factories which have already implemented energy conservation measures (referred to as the "AI" group), the implementation of a wide variety of governmental measures is needed. These include the development of trained staff (training of factory managers and other employees, and courses for training factory audit specialists), the implementation of priority projects, the setting up of a proper system of regulations for energy management (the legal obligation of the assignment of qualified energy managers at factories, and the systematic designation of energy intensive factories), and the introduction of a system of economic incentives, among other measures. To this end, the Polish government must establish and strengthen related organizations and institutions, including the establishment of the abovementioned ECTC, as well as rearrangement or establishment of an institution in charge of the granting of economic incentives.

Additionally, Table 7.5 summarizes the possibilities of Poland receiving cooperation from foreign governments and international organizations in the event that the country embarks on the foregoing programs as mentioned above.

This table lists governmental measures and institutions/organizations, with the short term as an example, which could be more effectively implemented in cooperation with foreign governments and international organizations: These governmental measures and organizations include projects related to the establishment of ECTC, implementation of priority projects, funding for economic incentives, etc.

Table 7.6 summarizes the funds required for implementation of various policies, by policy item and by international cooperation item.

An option for raising the funds for economic incentives is cooperation with foreign governments and international organizations. At the bottom in Table 7.6, the amount of the total economic incentive fund that will be procured through such cooperations is shown.

7.3 Proposal of Action Plan

As an essential requirement for effective and continuous implementation of the said program, an action plan in Table 7.7 containing arrangement of the institutions and organizations is proposed. Table 7.7 (1/2) shows the schedule for the items to be implemented and details of such items based on the energy conservation goal and activity period in the action plan.
Table 7.7 (2/2) shows the details for which the core Energy Conservation Technical Center (ECTC) should bear the expenses, policies to be implemented by the government, and finally, the organization reform plan.

The Polish government should urgently tackle the task of examining and discussing plans for the setting up of a preparatory organizaition at the earliest possible time for the establishment of a core energy conservation promotion institution, as well as the details of matters to be implemented under an action plan, such as: industrial sectors to be targeted; employees to be included into the training program, and the number; the nature and frequency of the training courses; the overall schedule under which the action plan is to be put into practice; the number of staff required; and the cost.

Here we will discuss how ministries and agencies of the Government of Poland are expected to support and cooperate with ECTC. Their support will be indispensable to the effective implementation of the Action Plan by the ECTC. The areas in which the ministries and agencies concerned should offer support are described below:

(1) The Ministry of Economy

For the Ministry which is responsible for industry-wide energy conservation, the Master Plan estimates a conservation effect of enormous dimensions: reduction of crude oil consumption by about 7 million tons/year or about 2.1 billion PLN/year (AEC-2006 Scenario). For Poland, which intends to join the EU in early 2000, it is imperative to achieve sustainable economic growth and to improve the competitive edge of its domestic industries. Energy conservation programs can be an answer to this challenge. It is hoped that the Ministry will undertake to establish the ECTC, lay down an institutional and regulatory groundwork for the ECTC so that it can stand on its own in the future, seek necessary technical cooperation from other nations, and offer support to individual businesses through more favorable interest rates and tax policies.

(2) The Ministry of Environmental Protection, Natural Resources and Forestry

Projected environmental improvement effects through energy conservation are also enormous (AEC2006 Scenario): about 22 million tons in CO_2 and about 162,000 tons in SO_2.

Those enterprises that were privatized only recently do not have sufficient funds to renovate their equipment and facilities. It is expected that the Ministry will channel some of the resources it manages, such as the National Environment Conservation and Water Control Fund, in order to help these businesses.

(3) The Ministry of Finance

It is expected that the Ministry will provide enterprises with financial assistance: subsidies as an incentive to investment in the renovation of energy-saving facilities and equipment, preferential interest rates and tax incentives, and official guarantee of foreign government loans. Further development of domestic industries, in the long run, will generate revenues that will contribute to the future well-being of the nation.

(4) The Ministry of Treasury

At present, the process of privatization of state-owned companies is proceeding at quite a brisk pace, but there is nonetheless a rather large number of companies whose stocks are owned by the Polish Treasury Ministry. In its capacity as a shareholder, the Treasury Ministry is in a position to provide across-the-board cooperation to companies that are making efforts to promote energy conservation and strengthen their management structure. The Ministry is also in a position to request all other ministries and government agencies to cooperate with the ECTC and corporations in their efforts to promote energy conservation.

(5) EU Committee

This committee should cooperate promptly with the ECTC and corporations by setting up a system for smoothly processing the paperwork and other procedures required to invite overseas engineers who are needed to introduce manufacturing technology and energy conservation technology from advanced industrial nations.

7.4 Priority Project Proposal

In 1998, 7-day detailed audit was conducted at five factories. Of these, the following factories were selected as model factories that can be recommended for the implementation of the the following three energy conservation items proposed as the priority projects in the action plans:

(1) Cast iron pipe fittings manufacturing factory — Lacznikow: Natural gas-fired regenerative radiant burner type heat treatment furnace

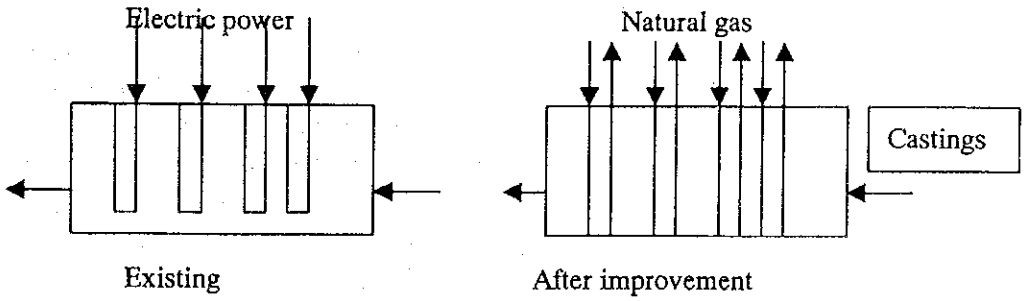
(2) Bottle glass factory — Wolomin: Full electrical fusion type heat-resistant glass melting furnace

(3) Powder milk factory — MLECZ: Co-generation utilizing natural gas

The summary of each project is described below.

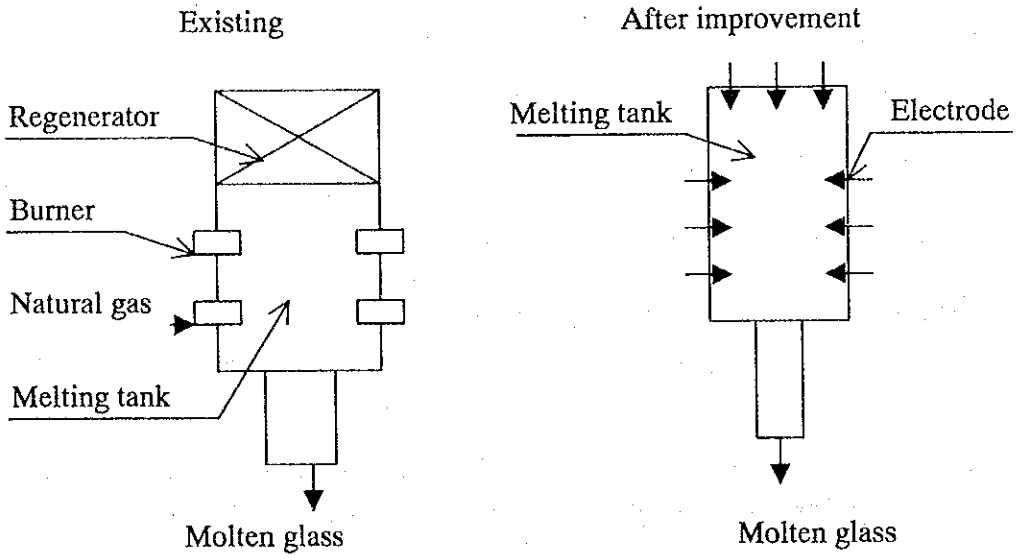
(1) Cast iron pipe fittings manufacturing factory — Lacznikow: Natural gas-fired regenerative radiant burner type heat treatment furnace

This heat treatment furnace is used for heat treatment of white iron castings at 1,020 °C to create white core malleable iron, and heating is applied by the 360 kW electrical resistance heat. The electricity intensity is 800 kWh/t (8,719 MJ/t), and 7,600 MWh electricity is consumed a year. As a result of changing the heating source to the natural gas-fired regenerative radiant burner, the energy intensity is reduced to 4,115 MJ/t, thus achieving a 52 % energy savings. The investment amount is 600,000 PLN/set and the payback period is 5 or 6 years.
Natural gas will be supplied to the Lacznikow factory 3 years later.



(2) Bottle glass factory — Wolomin: Full electrical fusion type heat-resistant glass melting furnace

This glass melting furnace melts glass at 1,300 to 1,500 °C. A full electrical fusion type furnace is suitable for 20-30 t/d small-sized furnaces. By renewing the four existing natural gas tank furnaces for heat-resistant glass to full electrical fusion furnaces, the energy intensity will be improved to 40 %. Although the investment amount is 21,190,000 PLN, it will be 5,930,000 PLN if 15,260,000 PLN as the periodic repair cost for every 9 years is subtracted. The payback period is 5.5 years.



(3) Powder milk factory — MLECZ: Co-generation utilizing natural gas

This powder milk factory consumes electricity for preserving and cooling milk, steam for dryer and condenser for powder milk. These facilities are run for 24 hours a day. Presently, electricity is purchased, while steam is generated by the coal-fired boiler in the factory.

Since natural gas is to be supplied to this factory three years later, a natural gas-fired boiler and a 400 kW back pressure steam turbine power generator will be newly installed to generate electricity and low-pressure steam in 24-hour operation.

The investment amount is 4,000,000 PLN. The payback period is 7 years.

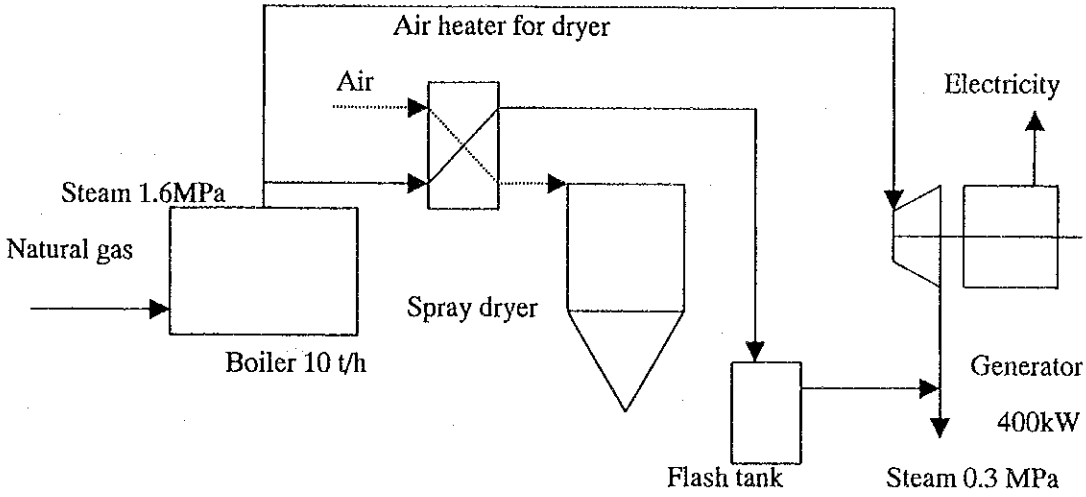

Air heater for dryer
Air
Electricity
Steam 1.6MPa
Natural gas
Spray dryer
Boiler 10 t/h
Generator
400kW
Flash tank
Steam 0.3 MPa

Table 7.1 Comparison of Two Scenarios on the "Cost-Benefit Analysis"

(Unit : 1,000 PLN)

	2000		2003	
	E. C.	A.E.C.	E.C.	A.E.C.
(Costs)				
Administration costs[A1] ;				
ECTC	5,808	5,803	7,173	7,173
ESCO	0	0	453	453
Designating enc. intensive factories	0	547	0	735
Allocating energy managers	0	958	0	1,284
Advisory committee	260	260	348	348
Cooperation with business assn.	260	260	348	348
Cooperation with labor union	260	260	348	348
Joint R.& D.	260	260	348	348
Model factories	1,250	1,250	1,250	1,250
Total	8,098	9,598	10,268	12,287
Investments for energy conservation[A2]				
Iron and steel	98,364	103,703	361,751	367,459
Chemicals				
Ammonium	38,589	64,183	11,661	42,616
Machinery				
Truck	1,250	1,250	596	596
Tractor	4,365	9,428	0	0
Non-metallic minerals				
Glass	61,554	152,605	57,243	57,243
Silicate lime block	2,257	2,257	1,376	1,376
Food processing				
Vegetable oil	4,683	6,371	5,250	7,355
Meat products	26,344	27,964	32,677	32,677
Dairy products	17,687	25,912	9,991	15,876
Total	255,093	393,673	480,545	525,198
Manufacturing Total	765,279	1,181,019	1,441,635	1,575,594
Grand total[A=A1+A2]	773,377	1,190,617	1,451,903	1,587,881
(Benefits)				
Energy conservation	7,249,608	8,853,759	5,881,501	7,049,302
Environmental improvement	113,549	138,094	88,448	106,215
Total	7,363,157	8,991,853	5,969,949	7,155,517
Manufacturing total[B]	22,089,471	26,975,559	17,909,847	21,466,551
(Evaluation)				
B / A	29	23	12	14
B - A	21,316,094	25,784,942	16,457,944	19,878,670

(Note) Administration costs are total for the period of 1999-2001 and 2002-2004, respectively.

Table 7.2 Sensitivity Analysis of the Effect of Two Componets on the Benefit

		2000		2003	
		E.C.	A.E.C	E.C.	A.E.C
(T)Total Benefit (Shown in Table 7.1.)	1000 PLN	22,089,471	26,975,559	17,909,847	21,466,551
	(T)/Cost*	29	23	12	14
(B)Benefit excluding "Modernization and Rationalization"	1000 PLN	19,053,753	23,933,533	13,837,271	17,493,256
	(B)/Cost*	25	20	10	11

* Cost ("Grand total") shown in Table 7.1.

Table 7.3 Comparison of Three Scenarios on the "Macro-Analysis"

	2000			2003		
	REF	E.C.	A.E.C	REF	E.C.	A.E.C.
(Economic indicators)						
Economic growth per annum	4.0%	4.10%	4.30%	3.9% <3.9%>	4.0% <4.1%>	4.0% <4.2%>
Annual increase in consumer price	10.2%	14.0%	14.0%	4.2% <7.6%>	7.1% <11.0%>	7.3% <11.1%>
Annual increase in wholesale price	9.3%	12.1%	12.1%	0.9% <5.6%>	3.3% <8.2%>	3.5% <8.3%>
Average wage index (1990 = 100)	902	1,116	1,113	1,101	1,370	1,376
(Energy indicators)						
Annual increase in primary energy requirement	1.00%	-1.50%	-1.90%	1.60%	0.20%	0.00%
Energy mix (Coal consumption in 1,000 TOE)	26,261	22,645	22,119	24,747	19,587	18,793
(Environmental indicators)						
GHGs (CO2 in Million ton - carbon)	112	99	97	118	99	95

(Note) (1) Figures in < > are average annual rates for the period of 1996 to 2003.
(2) CO2 emission in 1990 was 104.0 Million ton - carbon.
(3)Figures in percentage in 2000 and 2003 show annual average increase rates for the period of 1996-2000 and 2000-2003, respectively.

Table 7.4 Program on Implementing Governmental Measures and Preparing Institutions and Organizations by Term

Terms	Governmental measures to be provided by the Government	Institutions or organizations necessary for the governmental measures
Short term (1999 - 2000)	< For Group NY * >	
	Improved public relations on basic direction of the Gov.'s policy	Ministry of Economy; KAPE; NAPE; other related agencies & organizations **Ene. Conser. Tech. Ctr. (ECTC)**
	Primary data & information on energy conservation in factories	Same as above
	< For Group AI * >	
	Economic incentives	ARP;NFEP&WM;Loc.funds;BOS;Ecofund
	Pricing of energy carriers	Ministry of Finance; Energy Regulatory Authority (ERA)
	D.I. on energy conservation programs (For 9 industries)	This JICA Study (Factory audits;guidelines)
	Implementing priority projects (For 9 industries)	Ministry of Economy (M.o.E.); This JICA Study (Priority projects) Cooperation with f. c. and i. o.
	Regulations on energy management	**Designating energy intensive factories Allocating energy managers**
	Human resource development *(1) Training experts or consultants* *(2) Training managers & employees*	KAPE; Universities **ECTC** (1) Qualifications (2) Improvements
	Information on improving coordination systems & incentive mechanisms	M.o. E; Cooperation with labor union; **Cooperation at business associations; Deliberative councils; ECTC; ESCO**
	Supply of energy efficient equipmennt (Introduction of foreign technologies)	**ECTC**
Middle term (2001 - 2003)	D.I. on energy conservation programs (For all industries)	**ECTC; Development of ESCO; Business Assn.; Others** (Factory audits; guidelines)
	Starting model factory projects (For all industries)	Same as above (Selection of model factories)
	Supply of energy efficient equipment (Joint production of energy efficient equipment with foreign companies)	**ECTC**
Long term (2004 -)	D.I. on energy conservation programs (For all industries)	**ECTC; Business Assn.; others** (Disclosing activities of model fac.) **ES** (Starting operations)
	Implementing model factory projects (For all industries)	Same as above Cooperation with f. c. and i. o.
	Supply of energy efficient equipment (Own development and production)	**ECTC; Government agencies**

(Note) Italics mean the measures implemented also in other terms and bold letters mean new instructions or otganizations.
(*) NY — Factories which have not yet implemented energy conservation measures.
AI — Factories which have already implemented the measures.

Table 7.5 Possible Cooperation with Foreign Governments and International Organizations

Terms	Governmental measures / Institutions and organizations / Priority projects	Cooperation with foreign governments and international organizations
Short term (1999 - 2000)	Energy Conservation Technology Center (ECTC) (1) Training (1) - 1. Consultants, experts (1) - 2. Managers, employees (2) Others (2) - 1. Energy conservation programs (2) - 2. Technology information (2) - 3. Others	Technical cooperation with foreign countries and international organizations
	ARP NFEP&WM Local funds for environmental protection Environment Protection Bank (BOS) Ecofund	Loans and other financial assistance from foreign countries and inter. organizations Others (EBRD*; IBRD-IFC*; EIB*, PHARE*; GEF*; PPC*; others)
	Priority projects for energy conservation	AIJ ("Activities Implemented Jointly")** Others
Middle term (2001 - 2003)	ECTC (Continued)	Technical cooperation with f. c. and i. o.
	ARP; NFEP&WM; Local funds; BOS; Ecofund (Continued)	Loans and other financial assistance from foreign countries and inter. organizations
	Priority projects for energy conservation Model factories for energy conservation	JI ("Joint Implementation")**
Long term (2004 -)	ECTC (Continued)	Technical cooperation with f.c. and i.o.
	ARP; NFEP&WM; Local funds; BOS; Ecofund (Continued)	Loans and other financial assistance from foreign countries and inter. organizations "Emissions Trading"**
	Model factories (Continued)	JI (Continued)**

(*) EBRD : The European Bank for Reconstruction and Development
IBRD-IFC : The International Bank for Reconstruction and Development (The World Bank)
- The International Finance Corporation
EIB : The European Investment Bank
PHARE : EU Financial and Technical Assistance to Central and Eastern Europe
GEF : Global Environment Facility
PPC : The Project Preparation Committee
(All these banks, agencies and others have already been cooperating with the Polish government.)

(**) These can be provided as a sort of "economic cooperation" in addition to usual ones.

Table 7.6 Estimated Costs and Expenditures for Energy Conservation in Manufacturing Industries and Assumed Amount to be Financed through International Cooperation

(1,000 PLN)

	1999	2000	2001	2002	2003	2004
< Total costs and expenditures>						
Administration costs						
E.C.Scenario	2,224	3,595	4,845	6,322	5,065	5,065
A.E.C.Scenario	2,526	4,197	5,447	6,994	5,738	5,738
Investment costs for energy conservation						
E.C.Scenario	76,528	229,584	229,584	229,584	576,654	432,491
A.E.C.Scenario	118,102	354,306	354,306	354,306	630,238	472,678
Loans for economic incentives						
E.C.Scenario	0	0	0	0	0	0
A.E.C.Scenario	41,574	124,722	124,722	124,722	53,584	40,188
< Costs which may be financed through international cooperation >						
Administrative costs						
E.C.T.C. (E.C. and A.E.C. Scenarios)*	0	0	10,263	4,217	3,675	3,675
Loans for economic incentives						
A.E.C.Scenario	41,574	124,722	124,722	124,722	53,584	40,188

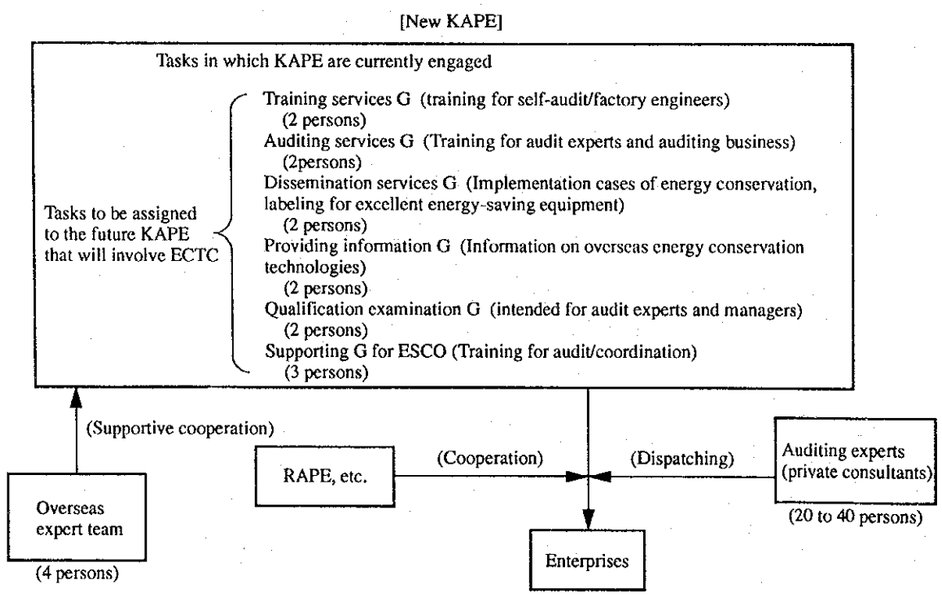
* ---- Not included in "Administration costs" in above column.

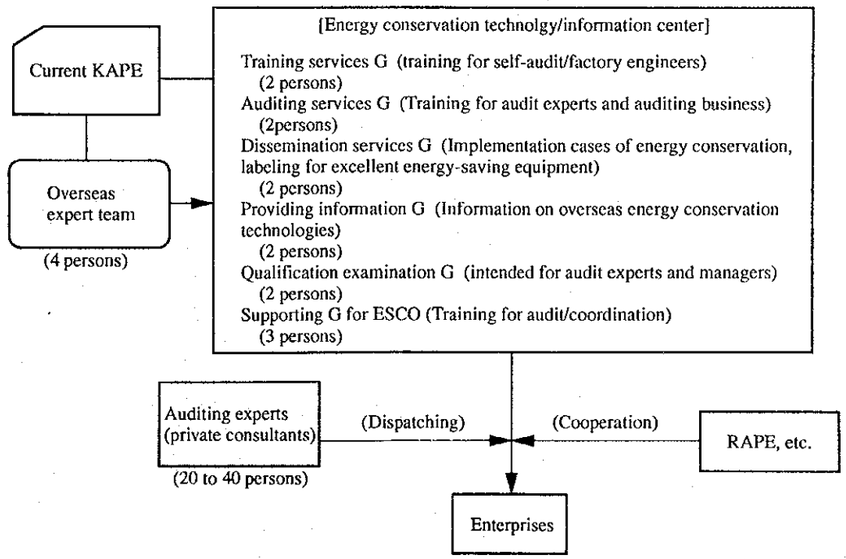
Table 7.7 Action Plan Implementation Schedule (1/2)

Fiscal year	1999 (1–12)	2000 (1–12)	2001 (1–12)	2002 (1–12)	2003 (1–12)	2004 (1–12)
Target for energy conservation	To decrease energy intensity by the end of 2003 (11.0 %: in E.C. scenario, 13.0 % in A.E.C. scenario)			Decreasing energy intensity by the end of 2006 (E.C. scenario: 18.0 %, A.E.C. scenario: 21.0 %)		
Basic concept	To improve the management attitude, management system and plant engineers. This period is intended as the period for reaping the benefit or fruit from steps 1 and 2, and the preparatory period for reaping the fruit from step 3. During this period, model factories for energy conservation are to be selected to play a leading role in energy conservation.			To improve the level of auditing experts/plant engineers and apply the effect achieved by model factories to other similar line or equipment. This phase is intended as the period for reaping the fruit from Step 3.		
Items for implementation: Promotion organ	Establishment of ECTC					
Items for implementation: Training services	① Training for self-auditing (courses intended for executives/managers)					
		② Training for factory engineers--1		③ Training of factory engineers--2		
	Establishment of an in-house energy management system (PDCA)			Energy conservation promotion activities involving both employees and engineers/upgrading the management system		
Items for implementation: Auditing services	④ Measurement by audit experts to assist in self-auditing (Preliminary audit)			⑤ Training for upgrading auditing skills provided by auditing experts. (Joint audit/self-audit)		⑥ Students to participate in auditing (practice training in auditing)
Items for implementation: Dissemination services	⑦ Selecting and starting up model factories	⑧ Publicity/dissemination activities through on-the-job training for model factories regarding energy conservation effect /technologies			⑨ Activities for dissemination of effects achieved by model factories	
Items for implementation: Information providing services		⑩ Publicity/dissemination activities of actual energy conservation cases and excellent energy-saving equipment for industrial use				
			⑪ Providing information on foreign energy conservation equipment and technologies			
Items for implementation: Institutions					⑫ Setting up institutions (Designation of energy-intensive factories, registration, authorization of qualification of auditing experts, energy managers, etc.)	
Items for implementation: Joint development				⑬ Joint development of energy conservation technologies with foreign companies		
Items for implementation: ESCO		⑭ Introduction of ESCO and training of ESCO enterprises in Poland				
Specific details of implementation	① To have the counterparts understand the need for management and the importance of energy measurement based on the study results of JICA, and establish the system for self-audit and energy management, thus making efforts toward the reaping of the fruit from Step 1.	② To deepen understanding of the actual situation of energy consumption and energy conservation measures in Poland based on the study results of JICA through case study.		③ To improve knowledge of energy conservation through group training by foreign experts in order to upgrade the technical level		
	④ To have audit experts perform measurement through self-audit using the measuring equipment donated by JICA for the purpose of reaping the fruit from Steps 1 and 2.			⑤ To improve the auditing skills through joint auditing with foreign experts as well as self-auditing by audit experts		⑥ To have students participate in auditing when experts have achieved an adequate level, thus attempting on-the-job training. Also the training practice is to be included in the university credits
	⑦ To select model factories based on the self-audit results submitted by individual companies and the results of audits by the JICA study team	⑧ To make the model factories available to the general public in order to help executives/plant managers improve understanding of investment/benefit of energy saving equipment, energy conservation technologies and management methods on the worksite, thus preparing for Step 3.			⑨ To provide financial support for model factories in order of self-audit evaluation level, thereby disseminating the achievement results of model factories	
		⑩ To hold a conference for announcement of successful cases of energy conservation, conduct examinations for excellent energy saving equipment for industrial use on a national level, and officially commend excellent applicants. The detailed information of such cases is to be made available on the Internet.				
			⑪ To provide information on foreign energy-saving equipment/technologies on the Internet.			
					⑫ To provide systematic regulation at the phase when company executives seem to have adequate understanding of the necessity for energy conservation and the cost-benefit, for the purpose of consistent promotion of energy conservation.	
				⑬ To implement development of necessary energy conservation technologies in Poland jointly with foreign companies.		
		⑭ To introduce foreign ESCO at the initial phase and eventually develop wholly Polish ESCO enterprises.				

(Note) Step 1: Energy conservation by energy management Step 2: Energy conservation by equipment improvement Step 3: Energy conservation by modernization (process improvement)

Table 7.7 Action Plan Implementation Schedule (2/2)

<table>
<tr><td>Raising the necessary funds</td><td>(1) Companies that take self-audit training are regarded as those registered for energy conservation promotion; thus, training courses ①, ②, and ③ are made chargeable.
(2) Information is to be provided on the Internet to energy conservation promotion companies only, who are to pay a specified amount of Internet fee annually.
(3) Factory audits ⑤ and ⑥ are to be free of charge, and 10 % of the amount of energy saved is to be paid as charge for auditing.
(4) For training at model factories, companies who wish to participate in it are to be recruited publicly; training is chargeable.
(5) With regard to the authorization of qualification of audit experts and energy managers, possible methods may include examinations, review of audits, lectures , etc., of which the most suitable one should be selected; however any of them will be made chargeable.
(6) Companies who are to be financially supported as model factories by the government in model factory lateral application are to pay the charge for self-audit evaluation.</td></tr>
<tr><td>Governmental support</td><td>(1) A key organ for the promotion of energy conservation is to be established in order to implement action plans.(Ministry of Economy and Ministry of Environmental Protection, Natural Resources and Forestry)
(2) Institutions for the above-mentioned (1) to (5) are to be established to facilitate their implementation.(Ministry of Economy, Ministry of Environmental Protection, Natural Resources and Forestry, Ministry of Finance and Ministry of Treasury)
(3) From the viewpoint that preparatory audit charges are a fundamental means for environmental improvement, auditing is to be supported by the environment protection funds. (Ministry of Environmental Protection, Natural Resources and Forestry)
(4) For the purpose of implementing ①, ②, ③, and ⑤, support by overseas experts, such as JICA's long-term or short-term expert dispatching, is to be applied for. (Ministry of Economy, Ministry of Environmental Protection, Natural Resources and Forestry and European Union Committee)
(5) ⑦ is to be covered and supported by individual companies' own funds, as well as local government funds, foreign official funds, and the government's low-interest loan. (Ministry of Economy and Ministry of Environmental Protection, Natural Resources and Forestry)
(6) ⑨ investment in modernization is to be supported by the government's low-interest loans (Ministry of Finance)
(7) When no substantial benefit is expected from the promotion of energy conservation through provision of incentives, a system or institution (described in the above-mentioned item ⑫) suitable for Poland is to be established.(Ministry of Economy)
(8) The prospective key organ for the promotion of energy conservation should, in principle, manage to raise the funds for various expenses; however, the governmental and international cooperation funds are to be used to make up the shortfall for the first 5 years. (Ministry of Economy and Ministry of Environmental Protection, Natural Resources and Forestry)
(9) Financial support is to be provided for ECTC activities to introduce ESCO enterprises and develop Poland's own ESCO enterprises.(Ministry of Economy and Ministry of Environmental Protection, Natural Resources and Forestry)</td></tr>
<tr><td>System for the promotion of energy conservation</td><td>(Plan-1): To implement a drastic structural reform of KAPE to carry out activities involving ECTC. KAPE will cooperate with regional organs for the promotion of energy conservation including RAPE in local governments.
 

(Plan-2): KAPE is to be positioned as an organ responsible for the management of implementation of action plans under the direct authority of the government, while an energy conservation/information center (ECTC) is to be established as the organ responsible for the implementation of those action plans.
 
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