Text No.19

ENERGY CONSERVATION IN THE AUTOMOBILE INDUSTRY

自動車産業の省エネルギー

June 13, 2003

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Facilities

Nissan Motor Co., Ltd. Yokohama Plant

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工務部工務課長

Progress of Energy-Saving in the Automobile Industry

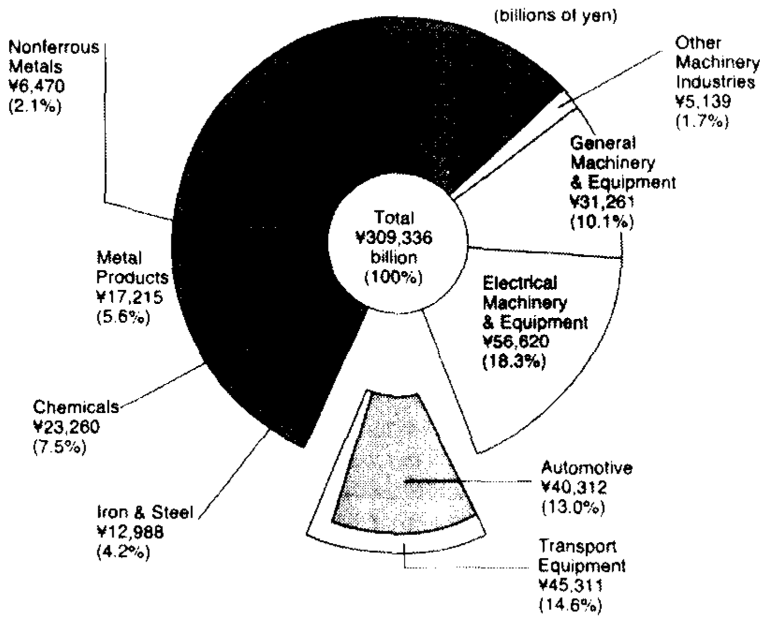
Nissan Motor Co., Ltd.

1. General Situation of the Japanese Automobile Industry

1.1 Automotive shipments in value terms (1998)

Automotive shipments are the second largest industrial sector of the Japanese economy (after electrical machinery and equipment). By the latest accounts, they represent 13% of the value of the nation's total manufacturing shipments and 29.1% of the value of the machinery industries' combined shipments. After two years of gains, the value of domestic automotive shipments declined 5.1% in 1998 to ¥40,312 billion.

The number of people in Japan engaged in work related to automobiles is approximately 7.3 million. Given that there are currently around 65.7 million workers in Japan, this means that about one in every ten workers is employed directly or indirectly by the automobile industry.



<Breakdown of Automotive Shipments>
- Automobile manufacturers (including motorcycles) ¥21,054
- Automobile body & related manufacturers ¥2,534
- Automobile parts & accessories manufacturers ¥16,724

Fig. 1 1998 Shipments of major manufacturing industries

Table 1 Shipments of major manufacturing industries in value terms (billions of yen)

Year	Chemicals	Iron & Steel	Nonferrous Metals	Metal Products	Machinery Industries: General Machinery/ Equipment	Machinery Industries: Electrical Machinery/ Equipment	Machinery Industries: Transport Equipment	Machinery Industries: Transport Equipment: Automotive	Machinery Industries: Other Machinery Industries	Machinery Industries Subtotal	Other	Total	Automotive Shipments: % of Machinery Industries Value	Automotive Shipments: % of Manufacturing Industries Value
1998	23,260	12,988	6,470	17,215	31,261	56,620	45,311	40.312	5.139	138,331	111,071	309,336	29.1	13.0
1997	24,580	14,563	7,188	18,125	32,575	60,381	47,448	42,483	4,503	144,907	113.709	323,072	29.3	13.2
1996	23,490	13,890	6,710	17,933	31,424	57,748	45,145	40.601	4.089	138,406	112,640	313,069	29.3	13.0
1995	23,362	14,073	6,490	17,647	29,884	54,831	44,215	39.561	4,107	133,037	111,421	306,030	29.7	12.9
1994	22,519	13,574	5,931	17,488	27,594	51,928	44,652	39.682	4.209	128,383	111,132	299,027	30.9	13.3
1993	23,260	14,932	6,140	18,732	29,171	52,103	47,065	41.767	4,488	132,827	115,309	311,200	31.4	13.4
1992	24,169	16,558	6,865	19,805	33,192	54,566	49,426	44.295	5,051	142,235	119,888	329,520	31.1	13.4
1991	24,270	18,631	7,697	20,230	35,847	58,624	48,960	44.192	5,510	148,941	121,066	340,835	29.7	13.0
1990	23,503	18,269	7,822	18,573	33,225	54,529	46,858	42.311	5,132	139,744	115,462	323,373	30.3	13.1
1985	20,552	17,754	6,384	13,094	24,191	40,842	36,179	27.693	4,381	105,593	101,943	265,320	26.2	10.4
1980	17,979	17,896	8,118	10,646	17,600	22,235	24,954	21,235	3,457	68,246	91,815	214,700	31.1	9.9
1975	10,438	11,306	3,909	6,573	10,611	10,821	14,794	10,524	1,729	37,955	57,252	127,433	27.7	8.3
1970	5,540	6,565	3,055	3,728	6,803	7,330	7,276	5,467	892	22,301	27,846	69,035	24.5	7.9

Source: Industry Statistics, Ministry of International Trade and Industry

1.2 Motor vehicle production

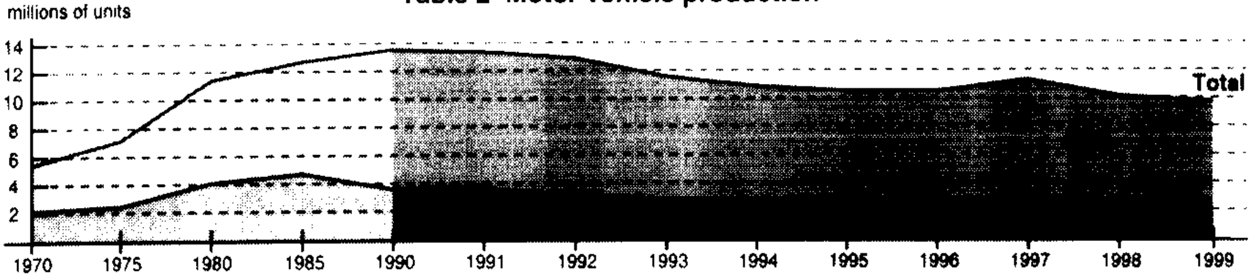
Production of motor vehicles in Japan experienced its second straight year of decline in 1999, posting a year-on-year drop of 1.5% to 9,895,476 units. This decline is attributable to exports weakening under the impact of the strong yen and to a downturn in domestic sales.

Production figures for most models registered year-on-year falls, with the result that production of cars, trucks and buses sank below the 10 million-unit level for the first time since 1979.

Passenger car production slipped 0.6% from the previous year to 8,100,169 units. However, the mini-vehicle category (which includes minicars and minitrucks) surged by 32.6%, benefiting from the strong demand for new models built to specifications revised in October 1998 to boost crashworthiness, and thus partially offsetting the decline in the small car category since 1997.

Truck production continued to decline for the fifth year straight, reflecting a fall in goods distribution and a slump in construction resulting from the slowdown in some areas of business activity and in consumer spending. Production of buses was down for the second year straight, falling by 15.0% to 48,395 units.

Table 2 Motor vehicle production



Year	Cars	Chg.(%)	Trucks	Chg.(%)	Buses	Chg.(%)	Total	Chg.(%)
1999	8,100,169	0.6	1,746,912	-9.8	48,395	15.0	9,895,476	-1.5
1998	8,055,763	-5.1	1,937,076	-20.0	56,953	-8.5	10,049,792	-8.4
1997	8,491,440	8.0	2,421,413	-0.3	62,234	17.1	10,975,087	6.1
1996	7,864,676	3.3	2,428,897	-4.3	53,126	12.4	10,346,699	1.5
1995	7,610,533	-2.5	2,537,737	-6.1	47,266	-3.8	10,195,536	-3.4
1994	7,802,037	-8.1	2,702,970	0.6	49,112	2.2	10,554,119	-6.0
1993	8,493,943	-9.4	2,685,528	-12.5	48,074	-7.6	11,227,545	-10.2
1992	9,378,694	-3.8	3,068,585	-11.0	52,005	17.0	12,499,284	-5.6
1991	9,753,069	-2.0	3,447,914	-1.4	44,449	10.6	13,245,432	-1.8
1990	9,947,972	9.9	3,498,639	-11.0	40,185	-4.5	13,486,796	3.5
1985	7,646,816	8.1	4,544,688	5.2	79,591	10.2	12,271,095	7.0
1980	7,038,108	14.0	3,913,188	15.2	91,588	46.4	11,042,884	14.6
1975	4,567,854	16.2	2,337,632	-9.2	36,105	-21.2	6,941,591	5.9
1970	3,178,708	21.7	2,063,883	2.1	46,566	11.3	5,289,157	13.1
1965	696,176	20.1	1,160,090	4.6	19,348	41.5	1,875,614	10.2
1960	165,094	110.0	308,020	73.5	8,437	25.3	481,551	83.2
1955	20,268	40.0	43,857	-11.5	4,807	-16.4	68,932	-1.6
1950	1,594	—	26,501	—	3,503	--	31,597	—

Note Percentage figures represent the change from the preceding year

Table 3 1999 Domestic production by manufacturer

Manufacturer	Cars	Chg.(%)	Trucks	Chg.(%)	Buses	Chg.(%)	Total	Chg.(%)
Daihatsu	478,598	17.8	182,998	22.1	—	·	66,196	19.6
Fuji Hvy. Ind.	395,042	11.9	86,222	17.3			481,264	12.8
Hino			36,338	0.8	3,195	-15.7	36,533	-0.7
Honda	1,143,459	-0.3	77,496	-19.4	---	--	1,220,955	-1.8
Isuzu	37,630	-19.0	221,248	-15.0	2,078	-22.5	260,956	-15.8
Mazda	705,134	-0.2	76,357	-42.0	—	–	781,491	-6.8
Mitsubishi	752,940	0.7	254,311	-21.7	6,644	21.0	1,013,895	-6.2
Nissan	209,702	-10.6	169,979	-11.7	5,461	-12.2	1,385,142	-10.7
Nissan Diesel			21,553	-21.9	1,069	-26.2	22,622	-22.1
Suzuki	679,143	8.6	230,197	26.2		·	909,340	12.6
Toyota	2,698,503	1.1	389,775	-15.5	29,948	-12.7	3,118,226	-1.5
Total	**8,100,169**	**0.6**	**1,746,912**	**-9.8**	**48,395**	**-15.0**	**9,895,476**	**-15.0**

Note Percentage figures represent the change from the preceding year

1.3 Domestic sales of new motor vehicles

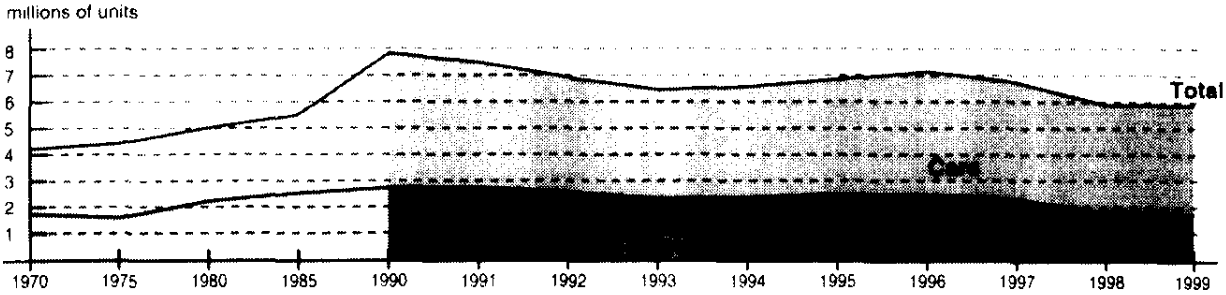
Registrations of new motor vehicles in 1999 sank for the third year straight, totalling 5,861,216 units, or a decline of 0.3% from the previous year. This decline reflects the ongoing slump in consumer spending and corporate capital investment as a result of the protracted economic slowdown.

Sales of passenger cars, however, posted a year-on-year rise of 1.5% to 4,154,084 units, marking the first increase in three years. The minicar category took the spotlight, continuing to benefit from these vehicles' improved crashworthiness since the revision of specifications in 1998. Sales of minicars surged to 1,236,000 units, up by 30.5% over the previous year to mark a record high.

Demand for trucks was adversely affected by the continued economic slowdown, a reduction in the number of vehicles owned by transport operators and an increase in joint shipping operations, as well as by extensions in the length of vehicle service. New truck registrations fell to 1,692,654 units, a year-on-year drop of 4.5%, marking a decline for the fourth year straight.

Registrations of new buses increased by 2.4%, the first rise since 1990.

Table 4 New motor vehicle registrations



Year	Cars	Chg.(%)	Trucks	Chg.(%)	Buses	Chg.(%)	Total	Chg.(%)
1999	4,154,084	1.5	1,692,654	-4.5	14,478	2.4	5,861,216	-0.3
1998	4,093,148	-8.9	1,772,136	-20.1	14,141	-10.3	5,879,425	-12.6
1997	4,492,006	-3.8	2,217,257	-7.3	15,763	-8.5	6,725,026	-5.0
1996	4,668,728	5.1	2,391,790	-0.5	17,227	-0.4	7,077,745	3.1
1995	4,443,906	5.6	2,403,825	4.6	17,303	-3.0	6,865,034	5.2
1994	4,210,168	0.3	2,298,685	2.2	17,843	-6.2	6,526,696	0.9
1993	4,199,451	-5.7	2,248,803	-9.4	19,025	-11.8	6,467,279	-7.1
1992	4,454,012	-8.5	2,483,484	-6.3	21,577	-9.3	6,959,073	-7.5
1991	4,868,233	-4.6	2,632,730	-0.6	23,796	-4.5	7,524,759	-3.2
1990	5,102,659	15.9	2,649,909	-6.3	24,925	-5.9	7,777,493	7.2
1985	3,104,083	3.3	2,431,178	4.7	21,573	6.4	5,556,834	2.2
1980	2,854,176	-6.0	2,137,947	2.2	23,387	-2.5	5,015,510	-2.7
1975	2,737,641	19.7	1,551,454	0.7	19,836	-12.6	4,308,931	11.9
1970	2,379,137	16.8	1,693,502	-4.4	27,828	4.2	4,100,467	6.9
1965	586,287	18.8	1,073,832	9.0	14,843	-2.4	1,674,962	12.1
1960	145,227	98.8	255,693	61.2	7,260	12.2	408,180	71.4
1955	20,055	—	40,498	—	3,977	—	64,530	—

Notes 1 Figures include imported vehicles
2 Percentage figures represent the change from the preceding year

Sources Japan Automobile Dealers Association, Japan Mini-Vehicles Association

Table 5 1999 domestic registrations by manufacturer

Manufacturer	Cars	Chg.(%)	Trucks	Chg.(%)	Buses	Chg.(%)	Total	Chg.(%)
Daihatsu	341,574	7.6	180,950	24.9			522,524	19.5
Fuji Hvy. Ind.	219,953	14.0	82,111	-3.5			302,064	8.7
Hino			28,397	3.8	2,132	-11.2	30,529	2.6
Honda	611,063	3.8	76,328	-17.5			687,391	0.9
Isuzu	1,886	-27.7	72,382	-12.7	1,227	-4.2	75,495	-13.1
Mazda	251,806	5.0	63,454	-19.0			315,260	-0.9
Mitsubishi	324,603	0.2	255,307	-4.7	324,603	0.2	255,307	-4.7
Nissan	568,170	-7.3	204,008	-4.0	1,347	-7.1	773,552	-14.2
Nissan Diesel			15,563	-14.7	590	-25.1	16,153	-15.1
Suzuki	410,225	14.0	208,988	7.1			619,213	11.6
Toyota	1,153,368	1.2	498,394	-10.5	4,879	41.0	1,656,641	-2.6
Imports	271,436	2.1	6,772	-32.2	17	56.4	278,225	0.9
Total	**4,154,084**	**1.5**	**1,692,654**	**-4.5**	**14,478**	**2.4**	**5,861,216**	**0.3**

Note. Percentage figures represent the change from the preceding year
Sources Japan Automobile Dealers Association, Japan Automobile Importers Association

1.4 Motor vehicles in use and cars per capita

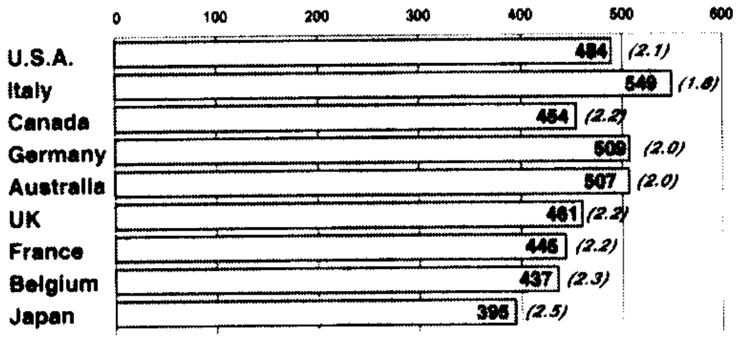
The number of motor vehicles in use on Japanese roads as of year-end 1999 increased by 0.5% to 71,857,480 units.

The United States remains the overwhelming global leader in the number of vehicles in use, with almost 210 million units, accounting for about one out of three automobiles in use in the world. Japan holds second place, accounting for about one-tenth of the estimated 700 million motor vehicles in use worldwide.

The average age of passenger cars on Japan's roads has been increasing, rising by 0.3 (or one-fourth) of a year as of the end of March 1999 to 5.6 years, its highest age ever. For passenger cars, the average service life lengthened by 0.19 (or about one-sixth) of a year to 9.63 years, another record-setting figure. In terms of passenger cars per capita, Japan stands lower than the United States and Europe, according to 1998 statistics, which show Japan with 395 cars per thousand persons, or one car for every 2.5 persons.

Table 6 Passenger cars' average service life (as of March of each year)

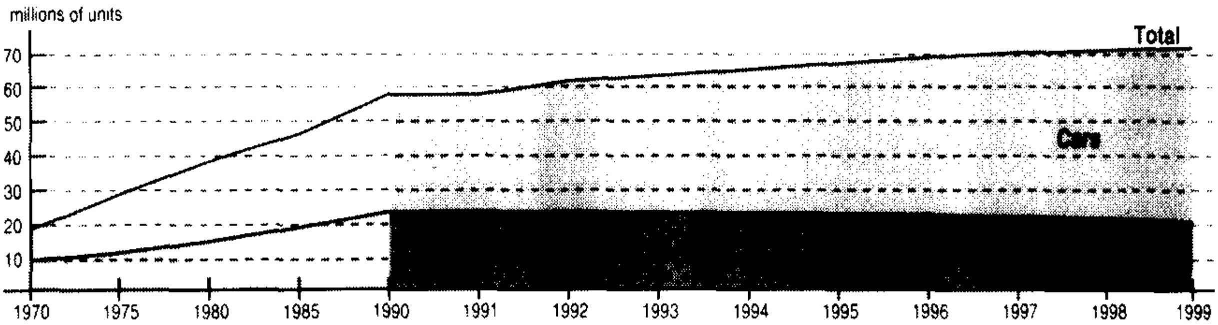
Year	Average age	Average service life
1975	3.30	6.72
1980	4.25	8.29
1985	4.57	9.17
1990	4.64	9.26
1995	4.88	9.43
1996	5.04	9.27
1997	5.14	9.28
1998	5.33	9.44
1999	5.60	0.93



Note: Based on 1998 statistics from each country.

Fig. 2 Passenger cars per 1,000 people (Persons per car)

Table 7 Motor vehicle in use (as of the end of each year)



Year	Cars	Trucks	Buses	Other	Total	Chg.(%)
1999	51,164,901	18,763,891	235,676	1,693,012	71,857,480	1.5
1998	49,896,326	19,083,546	237,701	1,600,791	70,818,364	1.2
1997	48,611,230	19,654,917	240,354	1,500,548	70,007,049	1.7
1996	46,868,712	20,092,120	242,243	1,601,444	68,805,073	2.9
1995	44,680,254	20,432,988	243,095	1,500,784	66,857,121	2.8
1994	42,678,566	20,670,360	245,387	1,420,734	65,015,047	2.8
1993	40,772,407	20,884,257	247,794	1,361,722	63,266,180	2.6
1992	38,963,861	21,134,660	248,624	1,314,761	61,661,906	2.9
1991	37,076,065	21,326,629	248,258	1,267,569	59,918,521	3.8
1990	34,924,213	21,324,848	245,668	1,206,996	57,701,725	4.7
1985	27,844,601	17,145,178	231,228	942,377	46,163,384	3.7
1980	23,659,528	13,193,439	230,020	790,911	37,873,898	10.4
1975	17,236,326	10,089,051	226,284	586,895	28,138,556	4.6
1970	8,778,975	8,517,507	187,980	341,315	17,825,777	15.4
1965	2,181,287	4,539,728	102,695	159,259	6,882,969	19.3
1960	457,451	1,589,965	56,192	72,077	2,175,685	24.2
1955	153,924	679,880	34,421	32,572	900,797	8.5
1950	45,006	261,579	18,306	12,494	337,385	--

Note Percentage figures represent the change from the preceding year
Source Ministry of Transport

1.5 Motor vehicle exports

Exports of motor vehicles in 1999 slipped by 2.6% to 4,408,943 units for the second straight year of decline.

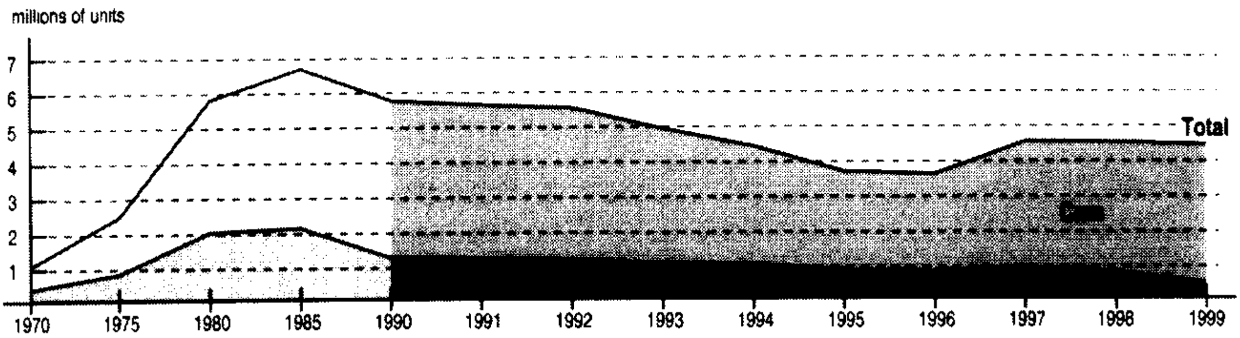
By destination, exports to North America and Asia were buoyant, up 18.1% and 9.6%, respectively, whereas exports to Latin America and the Middle East dropped sharply, down 38.3% and 32.3%, respectively. By country, exports to the US rose by 18.5%, making it the biggest export destination, with a share of 35.3%.

Exports as a proportion of Japan's total domestic production dipped to 44.6%. Meanwhile, the globalization activities of Japanese automakers continued to make steady progress, with overseas production in 1999 amounting to 6,534,740 units.

Table 8 Motor vehicle exports

Destination	1970	1975	1980	1985	1990	1995	1996	1997	1998	1999
Asia	149,787	290,134	581,116	710,587	569,143	616,027	620,016	606,389	264,987	290,436
Middle East	26,635	241,511	542,955	401,598	283,866	206,446	284,881	346,154	455,159	308,114
Europe	126,275	528,486	1,226,954	1,363,694	1,750,497	918,831	948,976	1,254,879	1,370,931	1,329,206
(EU)	(51,514)	(383,589)	(955,974)	(995,489)	(1,484,588)	(792,058)	(802,122)	(1,025,688)	(1,132,535)	(1,155,082)
North America	495,608	1,003,954	2,592,577	3,384,562	2,521,823	1,301,218	1,169,073	1,412,055	1,459,338	1,723,598
(U.S.A.)	(422,464)	(919,949)	(2,407,645)	(3,131,997)	(2,236,988)	(1,228,096)	(1,098,504)	(1,271,095)	(1,313,583)	(1,556,419)
Latin America	79,678	143,509	382,231	290,417	216,375	329,064	279,641	437,848	450,128	277,825
Africa	111,244	217,294	322,329	137,729	129,278	137,718	134,027	174,325	170,836	131,489
Oceania	97,316	251,426	316,865	426,075	344,236	274,828	265,478	310,776	347,194	337,288
Other	233	1,298	1,934	15,810	15,994	6,676	9,626	10,776	10,302	10,302
Total	**1,086,776**	**2,677,612**	**5,966,961**	**6,730,472**	**5,831,212**	**3,790,809**	**3,771,718**	**4,553,202**	**4,528,875**	**4,408,943**

Table 9 Exports by destination



Year	Cars	Chg.(%)	Trucks	Chg.(%)	Buses	Chg.(%)	Total	Chg.(%)
1999	3,757,450	2.0	613,113	-28.4	38,380	-17.7	4,408,943	-9.3
1998	3,684,430	2.9	795,528	-13.5	48,917	-10.4	4,528,875	-0.5
1997	3,579,131	25.1	919,469	13.8	54,602	24.5	4,553,202	22.7
1996	2,860,080	-1.2	807,772	-5.0	43,866	-2.0	3,771,718	-2.1
1995	2,896,216	-13.8	849,859	-17.2	44,734	-39.2	3,790,809	-15.0
1994	3,359,814	-14.1	1,026,878	-0.7	73,600	-0.6	4,460,292	-11.1
1993	3,910,584	-11.3	1,033,063	-12.7	74,009	-1.4	5,017,656	-11.5
1992	4,408,864	-1.0	1,183,686	-5.1	75,096	39.4	5,667,646	-1.5
1991	4,452,233	-0.7	1,247,263	-4.7	53,883	34.8	5,753,379	-1.3
1990	4,482,130	1.8	1,309,121	-9.4	39,961	13.7	5,831,212	-0.9
1985	4,426,762	11.2	2,238,104	8.0	65,606	16.7	6,730,472	10.2
1980	3,947,160	27.2	1,953,685	37.2	66,116	79.4	5,966,961	30.8
1975	1,827,286	5.8	833,672	-4.7	16,654	4.3	2,677,612	2.3
1970	725,586	29.5	351,611	20.9	9,579	41.6	1,086,776	26.7
1965	100,716	50.4	90,923	11.3	2,529	45.8	194,168	29.1
1960	7,013	43.6	31,028	122.3	768	73.8	38,809	24.6
1955	2	100.0	907	33.6	322	4.5	1,231	24.6
1950	7	—	5,409	—	93	—	5,509	—

Note: Percentage figures represent the change from the preceding year.

2. Efforts for the Environment and Actions for Energy-Saving in the Automobile Industry

2.1 Efforts for the environment in the automobile industry

The Japan Automobile Manufacturers Association, Inc. and automobile manufacturers consider responding to environmental issues to be of paramount importance, and they make efforts to develop environmentally less-burdensome motor vehicles and to realize an automotive social system based on environmental preservation, according to the following action principles.

Action Principles

1. Manufacturers will make comprehensive assessments of the environmental impact of the vehicles they produce, beginning with the planning and development stage, in their effort to provide automobiles that are more environmentally friendly. In the production process, too, they will strive to develop cleaner production technologies.
2. For a better society, manufacturers will make strenuous efforts to help bring about a viable social infrastructure for automobiles, with environmental protection as a priority task.
3. On a global scale, manufacturers will also make strenuous efforts in the context of international cooperation to preserve the natural environment, based on the application of appropriate technology, expertise, and the knowledge gained from past experience.
4. Manufacturers will, in addition, promote a system that allows for quick and appropriate action in response to all environmental problems related to automobiles.

The relation between the Environment Action Plan formulated to respond to the environmental problems of motor vehicles and environmental preservation is shown in Table 10.

Table 10

Environment Action Plan \ Environmental preservation	Prevention of global warming	Protection of the ozone layer	Improvement of the atmospheric environment	Improvement of the roadside environment	Conserve natural resources	Reduction of waste
Improvement of motor vehicles for environmental preservation						
Improvement of motor vehicle fuel economy	○				○	
Prevalent use of low-emission vehicles	○		○	○	○	
Promotion of recovery of refrigerant for car air conditioners, etc.		○				
Effective utilization of shredder dust generated from end-of-life vehicles					○	○
Development of end-of-life vehicles disassembling techniques and presentation of information					○	○
Improvement of the car recyclable rate					○	○
Decrease in the use of environmentally burdensome materials					○	○
Inhibition of emission gas			○	○		
Reduction of vehicle noise				○		
Control of chemical substances			○			
Cooperation for two-nation collaborative activities	○		○	○	○	
Production stage						
Inhibition of CO_2 emitted from production plants	○				○	
Decrease of waste discharged from production plants					○	○
Traffic						
Improving transportation efficiency	○		○	○	○	

2.2 Percentages of energy consumption in the respective stages of automobile life

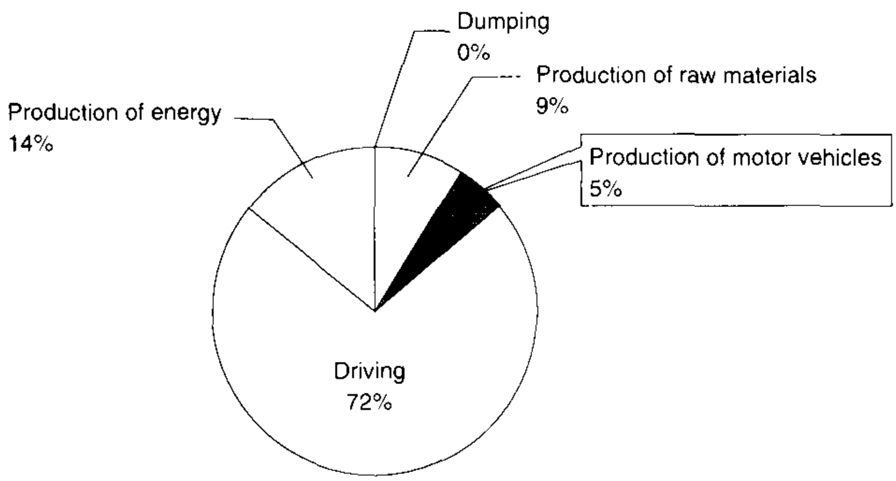


Fig. 3 Percentages of energy consumption of passenger cars

2.3 General conditions of the automobile manufacturing industry

(1) Members of the Japan Automobile Manufacturers Association, Inc.

Thirteen manufacturers of motor vehicles and motorcycles in Japan

(2) Production items

- Passenger cars, trucks, buses and motorcycles
- Engines, transmissions, and other parts
- Parts for overseas production

(3) Production activities of automobile manufacturers

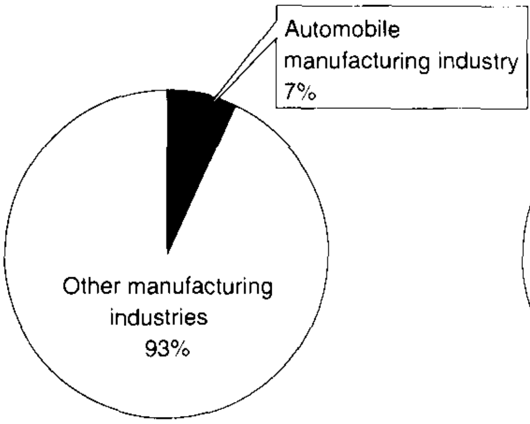
A motor vehicle consists of approximately 30,000 parts, 30% of which are produced by automobile manufacturers, with the remaining 70% produced by subcontractors. Automobile manufacturers assemble the parts supplied by parts manufacturers, and the engines and transmissions they manufacture themselves, into bodies, to complete motor vehicles.

< Major production steps of automobile manufacturers >

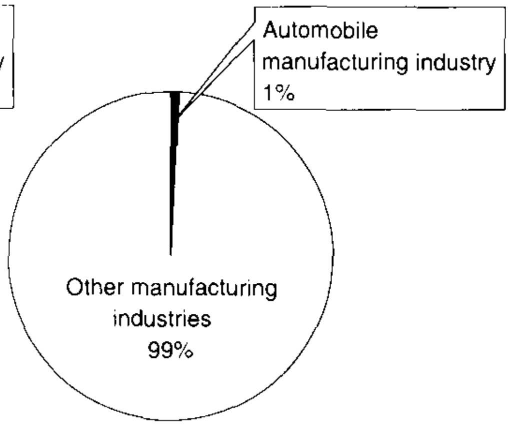
- Casting, forging, heat treatment, machining and assembling of engines and transmissions
- Press forming, welded assembling, and painting of bodies
- Motor vehicle assembling
- Power system

(4) Energy consumption scale in the automobile industry

Since the production of motor vehicles is based on assembling, the energy consumption can be said to be small compared to the industrial scale.



Production value rate of the automobile manufacturing industry



Energy use rate of the automobile manufacturing industry

(5) Features of energy consumption in the automobile industry

1) Lean production system

Production activities of Japanese automobile manufacturers adopt a lean production system, which is highly evaluated in the world. For the system, the following actions are practiced, to achieve efficient use of energy (energy-saving).

a. Eliminating quality failures — To eliminate repairs and waste losses of products.
b. Decreasing equipment problems — To eliminate problem shutdown losses by realizing problem-free lines.
c. Just in time — To decrease the stock of work-in-process goods, and to eliminate the energy for storage.
d. Higher efficiency of materials used — To decrease machined quantities and used quantities.
e. High labor productivity — To shorten processing time

2) Production stepwise energy control

Since automobile manufacturers have diverse production steps as a comprehensive assembling industry, there is no production step in which large energy-saving can be achieved. As such, efforts are made to take careful energy-saving measures at the respective production sites.

The automobile production steps include iron casting, aluminum casting, forging, machining (engines, transmissions, and axles), pressing, car bodies, painting, resin molding, final assembling, etc., and these are respectively quite different in pattern; the percentages of energy consumption in the respective steps are shown in Fig. 4.

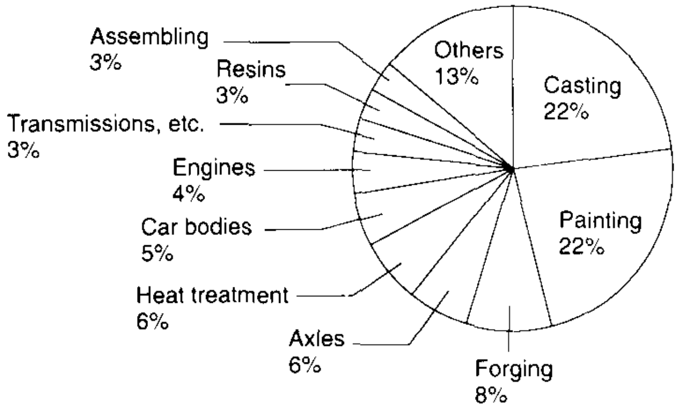


Fig. 4 Percentages of energy consumption in respective production steps

3) Percentages of respective energy resources

The high percentage of electric power is characteristic. The percentages of respective energy resources are as follows:

- Electric power 62.6%
- Oil 14.1%
- City gas 11.9%
- LPG 5.3%
- Coal 4.1%
- Coke 1.9%

2.4 Target of the Environment Action Plan of the automobile industry

The Japan Automobile Manufacturers Association, Inc. set the target of CO_2 decrease in the Environment Action Plan in November 1996, as follows.

> The total CO_2 emission from automobile production plants will be stabilized at the FY 1990 level by the FY 2000.

Furthermore, in May, 1998, the following target was set for the decrease to be achieved in FY 2010.

> The total CO_2 emission from automobile production plants in FY 2010 will be decreased by 10% compared with that of FY 1990, by further promotion of energy-saving.

2.5 Conventional energy-saving measures taken in the automobile industry

The following are various major energy-saving measures taken in the automobile industry.

Production step	Operation efforts and intensified control	Equipment measures
Boilers and compressors	1) Introduction of a comprehensive supervisory control system 2) Improvement of boiler efficiency 3) Improvement of air and steam supply methods – Supply of air and steam separately for respective systems – Stopping of air and steam supply to equipment not in use – Lowering the air and steam supply pressures – Lowering the water supply pressure 4) Change of boiler compound, and decrease of blow by electric conductivity control of boiler water	1) Introduction of boiler economizers 2) Introduction of steam pipe electromagnetic valves 3) Introduction of energy-saving boilers 4) Efficiency enhancement of compressors 5) Recovery of compressor cooling waste heat 6) Recovery of steam by industrial waste recovery
Casting	1) More intensified control of molten metal temperature	1) Intensified heat insulation of the remaining heat portion of cupolas 2) Oxygen enriched operation 3) Introduction of cold box mold-making machines
Painting	1) Intensified operation control – Baking furnace air ratio improvement – Optimization of the air-conditioning temperature and humidity of painting booths – Improved operation of baking furnaces	1) Improvement of thermal efficiency by modification of furnace bodies, etc. – Adoption of gable roofs for paint-baking furnaces – Lining of heat insulating material – Closing of apertures – Use of double doors 2) Introduction and expansion of paint deposition efficiency-improvement equipment (Mini-Bell, etc.)
Machining		1) Expanded load control of motors 2) Introduction of high-speed machining 3) Decrease of resistance at mechanical sliding portions
Private power generation		1) Introduction of cogeneration equipment
Heat treatment		1) Intensified heat insulation of heat treatment furnace body 2) Use of N2 as atmosphere gas
Forging	1) Reduction of heated weight, and continuous forging	1) More hot forging and cold forging 2) Smaller gaps of induction heating coils 3) Shortening and heat insulation of heated work-carrying passages
Others and the production process in general	1) Lowering of the standard temperature of washing liquid 2) Intermittent operation – Equipment shutdown during non-operation – Intermittent operation of conveyors, etc. 3) Review of workshop air-conditioning – Temperature and humidity control for space heating and cooling 4) Stopping of power transmission when secondary substations are not used, decrease of electric lamps, and keeping lamps turned off when they are not needed 5) Improvement of yield 6) Introduction of working-ratio-improvement equipment	1) Introduction of ice thermal storage layers 2) Introduction of transformer built-in welding guns 3) Intensified heat insulation of washing machines 4) Adoption of thyristor control for electric heaters 5) Rotating speed control of pumps, fans, etc. (including inverter control) 6) Introduction of 400 V-class wiring 7) Energy conversion (from electricity to gas) 8) Introduction of low temperature waste heat recovering equipment 9) Introduction of energy-saving-type industrial furnaces 10) From open-air-introduced space heating to the indoor circulation type

2.6 Problems for reduction of energy use

(1) Increase of energy use for safety equipment, etc., of motor vehicles

The safety equipment, such as air bags and side impact beams, must be provided as standard equipment, and various environmental measures must be adopted. They increase the number of processed parts and the number of processing man-hours due to complicated forms, to increase the energy use.

(2) Increase of energy for improvement of the working environment

Automobile production processes are left behind in the provision of air-conditioning (space heating and cooling) for workshops. To improve the working environment, air-conditioning, and automation & semi-automation, are promoted, to increase energy consumption.

(3) Lowering of energy efficiency due to fluctuation of production

The production load has changed greatly since FY 1990, but the equipment cannot catch up with the decrease of production. The energy use does not decline in proportion to it, in many production steps.

(4) Change in the users' taste

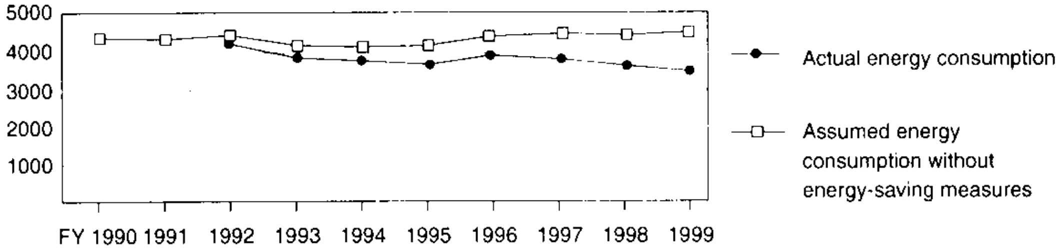
The ratios of ordinary passenger cars and recreational vehicles increased, to increase the vehicle weight, the number of production steps, etc., thus increasing energy consumption.

	Sales of ordinary passenger cars (10,000 units)	Ratio to FY 1990	Sales of recreational vehicles (10,000 units)	Ratio to FY 1990
1990	51	100	73	100
1991	72	141	83	114
1992	71	139	94	129
1993	66	129	97	133
1994	74	145	111	152
1995	90	176	137	188
1996	94	184	183	251
1997	81	159	204	279
1998				
1999				

2.7 Actual energy use in the automobile industry

With the above energy-saving measures taken, the following energy consumption is realized.

(1) Actual energy use



	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Energy consumption (10^3 kl)	4,302	4,226	4,194	3,857	3,775	3,672	3,885	3,822		
Ratio to FY 1990	100	98	97	90	88	85	90	89		
Fuel, etc., consumption (10^3 kl)	1,537	1,422	1,480	1,409	1,424	1,442	1,492	1,429		
Ratio to FY 1990	100	93	96	92	93	94	97	93		
Electric power consumption (one million kWh)	10,431	10,581	10,239	9,237	8,870	8,416	9,029	9,029		
Ratio to FY 1990	100	101	98	89	85	81	87	87		
If no energy-saving measures are taken	4,302	4,272	4,302	4,035	4,041	4,056	4,391	4,439		
Ratio to FY 1990	100	99	100	94	94	94	102	103		
Production in value (1,000,000 million yen)	18.56	18.96	18.56	15.46	16.37	15.89	17.31	17.41		
Ratio to FY 1990	100	102	100	89	88	86	93	94		
Specific consumption in reference to production in value	231.79	222.89	225.97	234.33	230.60	231.09	224.44	219.53		
Ratio to FY 1990	100	96	97	101	99	100	97	95		

* Each value of production is obtained by adding the value of automobile parts exports for overseas production by members of the Japan Automobile Manufacturers Association, Inc. to the value of motor vehicles and motorcycles stated in Statistics of the Manufacturing Industry.

The specific consumptions in reference to the production in value are shown for reference. The production in value as the denominator does not always agree with the production quantity related to energy consumption, since the price for adoption of safety equipment as standard equipment, etc., may be pegged.

(2) CO_2 emission

	FY 1990	FY 1996	FY 1997
CO_2 emission	7,590,000 t-c	6,620,000 t-c	6,410,000 t-c
Ratio to FY 1990	100	87	84

* Electric power consumption was converted at 0.104 kg-c/kWh.

3. Energy-Saving Activities of Nissan Motor Co., Ltd.

3.1 Environmental management of Nissan Motor Co., Ltd

[Nissans Environmental Philosophy and Policies]

Under Nissan's vision & mission, we have set the following environmental philosophy and environmental policy toward realizing its "Customer-Focused and Environmental Friendly" guideline.

Nissan's mission in society is to foster the attainment of sustainable development and the formation of the recycling-based society and economy by pursuing business based on these philosophies.

Nissan's Environmental Philosophy

Symbiosis of people, vehicles and nature

It is our view that the basis of environmental protection lies in the human capacity to show kindness and concern. Along with striving to understand the environment better, all of us at Nissan bring a shared concern for people, society, nature and the Earth to bear on our activities. This commitment and concern are embodied in every Nissan product and throughout all of the company's operations as the driving forces of Nissan's ongoing contributions to the advancement and enrichment of society.

Action Policy

1. To promote creative activities

2. To advance comprehensive activities

3. To foster cooperative activities

Environmental Policy

Nissan is taking the initiative to promote wide-ranging activities aimed at improving the environment both globally and locally in line with the guidelines noted here. These efforts are being pursued in all areas of the company's operations, including product development, manufacturing, sales and service, in order to make Nissan's Environmental Philosophy a reality.

1. Achieving a cleaner automotive society

Nissan aims to reduce the environmental impact at every stage of the vehicle life cycle, namely product development, manufacturing, use and disposal, in order to create a cleaner living environment. Besides working to improve vehicles themselves, Nissan also contributes to the improvement of social systems involving vehicle use.

2. Conserving natural resources and energy

Because the earth's natural resources and energy supplies are finite, Nissan is advancing efforts to minimize their consumption at every stage of the vehicle life cycle.

3. Expanding and continuously improving Nissan's environmental management system

Nissan is implementing an in-house environmental management system that conforms to the environmental management system standard formulated by the International Organization for Standardization (ISO).

(1) Preventing environmental issues in the first place and observing laws and regulations

- Observing laws and regulations is the first step toward environmental protection. Nissan's environmental measures go far beyond simple compliance with legal and regulatory requirements to address the actual environmental circumstances of the local area.
- Prior environmental impact assessments are conducted when mapping out new plans for product development projects or manufacturing processes. In this way, every effort is made to prevent environmental issues in the first place

(2) Cultivating a corporate culture dedicated to environmental protection

- Extensive educational activities are conducted in-house with the aim of cultivating a corporate culture in which everyone from senior management on down is positively committed to the resolution of environmental concerns

(3) Undertaking cooperative activities with subsidiaries and affiliates

- Nissan works closely with its subsidiaries and affiliates at home and abroad on ways to address environmental issues

(4) Strengthening communications and cooperation with customers

- The cooperation of customers is indispensable to environmental protection at the stage where Nissan products are used. In line with this understanding, Nissan provides information and undertakes educational activities as part of its efforts to work closely with customers on protecting the environment.

4. Issuing reports on environmental activities

Nissan regularly issues announcements and publications explaining the company's efforts to address environmental concerns.

To promote its activities, Nissan has established an environmental management organization, with CEO at its top, which contains an Environmental Integration Committee to set up corporate policies and objectives and to conduct evaluation and confirmation of the progress.

[Environmental Management Program]

The Nissan Green Program is created to realize the Nissan environmental philosophy of the "Symbiosis of People, Vehicles and Nature." The activities are of course promoted by the product development and manufacturing groups, but also to sales and service and all other business areas as well. This means that an environmental action plan with goals and plans for company business activities are established for the medium to long-term, and concerted efforts are made to ensure its continuous improvement.

The highest priority issue in the efforts for control of global warming in the automobile industry is to enhance the fuel efficiency of each vehicle since its traveling accounts for 87% of the total CO_2 release during its life cycle (life cycle assessment) as shown in Figure 5. Efforts are also made in car production plants where energy-efficient manufacturing processes and production facilities have been introduced actively.

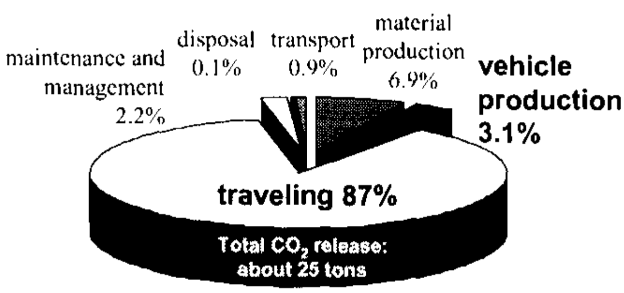
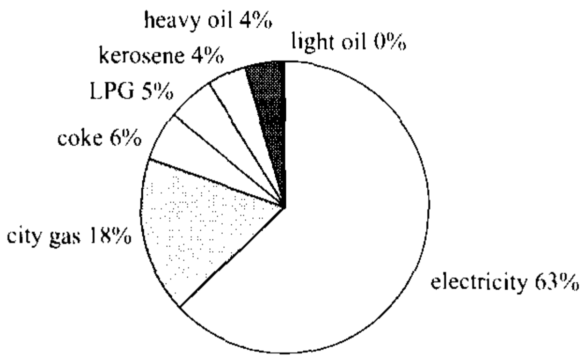


Fig. 5 Life-cycle CO_2 release of vehicles

3.2 Energy-saving efforts at Nissan Motor Co., Ltd.

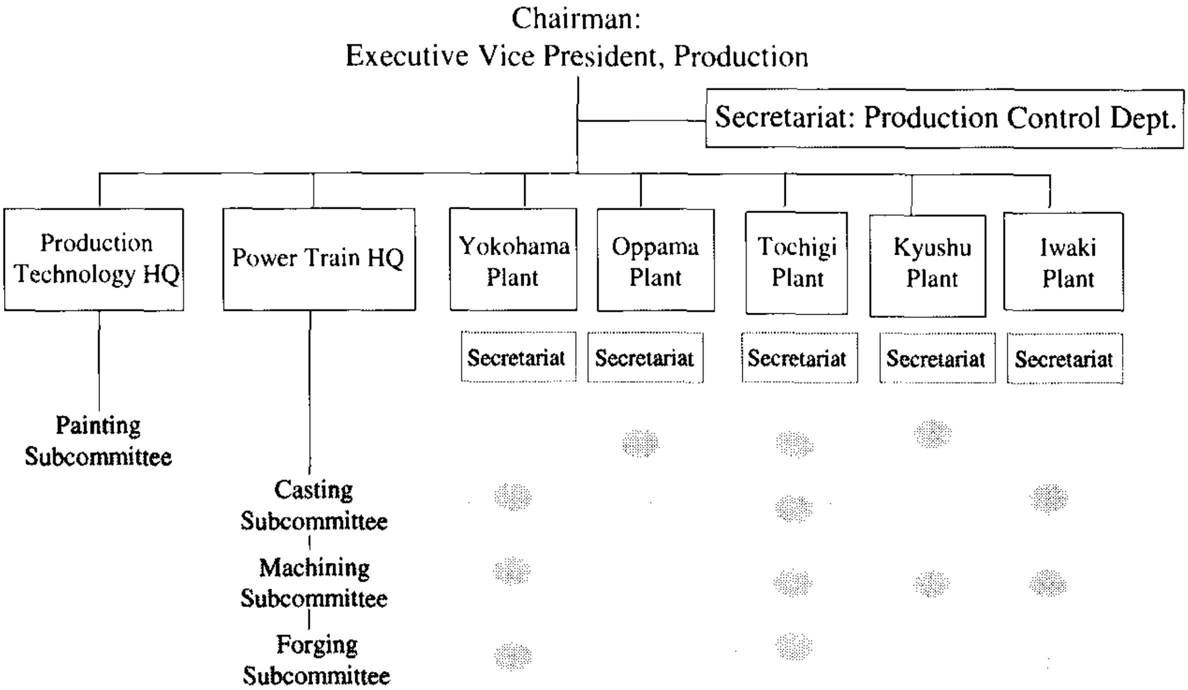
(1) Energy consumption

A breakdown of energy consumption at Nissan is illustrated in this figure, suggesting that electricity account for an overwhelming 63% followed by city gas accounting for 18%. This serves to determine an optimum balance among different energy sources and identify priority issues.



(2) Organization for promoting energy conservation

Production Environment and Energy Committee, which are responsible for all aspects of environment-related efforts made in production plants, develops the plan for promoting energy conservation and evaluates its progress. The Committee, which is chaired by the vice-president in charge of production, consists of the directors related, all plant managers, and division managers in charge of related functions.



(3) Objectives of energy-saving activities specified

Reduction of total CO_2 emissions by more than 10% from FY 1999's level by FY 2005

(4) Categories of energy-saving activities

Activities of different categories shown in Table 11, which may be commonly practiced, has been conducted in Nissan. Knowledge should be obtained first. Defects in management and useless parts in the existing facilities should be identified based on the knowledge, followed by carrying out required measures.

In implementing such energy-saving activities, it is important to instruct each of the plant workers to have consciousness, and to carry out adequate study during the processes of product development and equipment installation instead of resorting to corrective maintenance.

Thorough education designed for each level of workers should be the basis to achieve this.

Table 11 Categories and items of control

Category	Item	Detail	Example
Control, operation	- Control of total consumption - Control of consumption per unit production	- Disclosure of data - Control at consuming divisions/sections	- Downtime - Control of variation points
Existing equipment	- Measures for supply equipment - Measures for consuming equipment	- Proper consumption at proper time - Identification of wasters	- Air pressure compensation - The seven viewpoints - Effective energy analysis
New equipment	- Introduction of energy-saving type equipment	-Selection of properly designed equipment	- Routine checking
Basis	- Education for engineers	- Education for different levels of workers	- Energy cross section

3.3 Characteristic activities

(1) Examples of improved management and operations

The first step toward the improvement of management and operations should be to learn details of energy consumption. Ideas for improvement will be obtained from the details learned.

Studies in Figures 6 and 7 focused on time sections when production was not performed, and proposed a question ìwhy is energy consumed though production is not performed?" This serves to recognize the existence of useless consumptions and to identify and eliminate energy-wasting equipment.

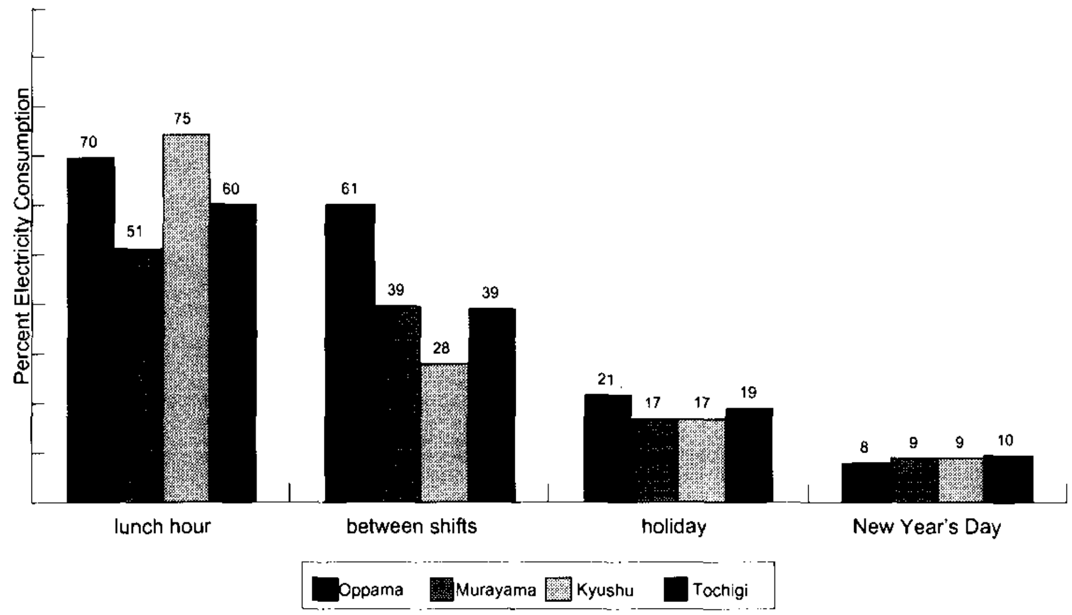


Fig. 6 Percent electricity consumption at downtime

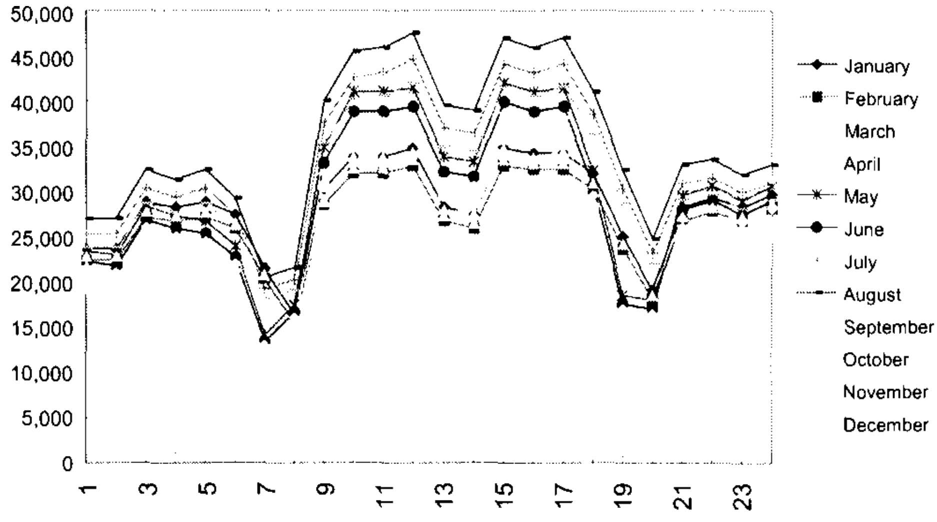


Fig. 7 Daily power load curve

(2) Improvement of existing equipment

There are many approaches to easy identification of energy losses and wasters in existing equipment. Among others, the approach that we call ìthe seven critical points", is effective for divisions and sections at different levels and can be applied to various purposes. The use of effective energy analysis serves effectively to allow workersí attention to be given to the existence of energy wasters.

Measures implemented should also cover energy supply facilities including boilers, compressors and power receiving/distribution equipment.

a) Seven critical points

Checking the facilities from the viewpoints given in Table 12 helps identify various defects at different levels.

Table 12 Seven viewpoints

	Viewpoints	Details
1	Decide	- Illumination and air-conditioning control standards, personnel in charge - Equipment start-up time, shut-down time
2	Stop	- Energy use at downtime - Radiation loss
3	Repair	- Leakage - Equipment failure
4	Lower	- Working pressure - Heating temp., cooling temp.
5	Divide	- Into service control sections - According to working systems
6	Change	- Type of energy used - Material, method, process
7	Recover	- Waste heat - Energy recycling

b) Effective energy analysis

This analyzes an energy consumption pattern focusing on the energy that has worked effectively for product manufacturing. Energy that has not worked for product manufacturing is deemed wasted.

Data shown in Figure 8 were obtained from a study on coating ovens used to dry coatings sprayed on automobiles. Only the energy consumed solely to dry the coatings on automobile bodies is deemed effective. The data indicate that the effective energy account for as small as 1% of the total consumption, and the remainder should be the focus of energy-saving investigation.

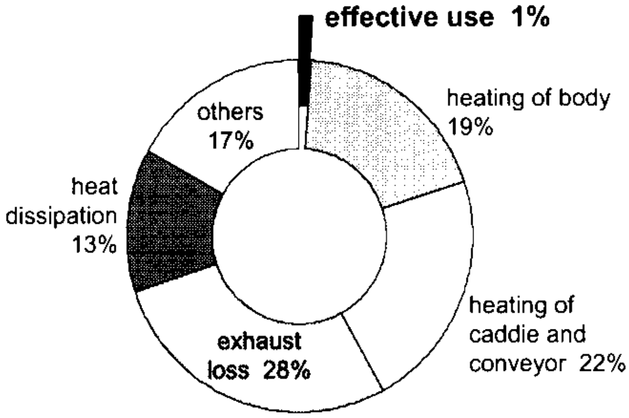


Fig. 8 Results of effective energy analysis

(3) Use of energy-saving type equipment for replacement

There are the following advantages in incorporating energy-saving features in the design of equipment to be newly installed.

1) Double investments arising from maintenance that would be required after installation can be prevented to increase the investment efficiency.
2) Energy-wasting components of equipment can be eliminated, or need not be so high in strength as to resist the excessive energy, enabling the use of small, low-price, high-quality equipment.

The following points are important in replacing existing equipment with energy-saving type one.

1) Engineers should have energy-related knowledge.
2) Database of know-how for energy-saving measures should be available and can be searched easily.
3) A task assignment scheme that requires energy-saving checking has been established.

a) Training of energy-saving engineers

Nissan has established training courses for energy-saving engineers as shown in Table 13 to provide suitable courses for different levels of workers.

Table 13 Engineer training gourses

No.	Course	Trainee	Detail
1	Primary: engineers	New employees	- 2-hour course - relations between energy and tasks
2	Secondary: engineers	3rd-5th year after employment	- 8-hour course - loss analysis, simple thermal rating
3	Energy-saving engineering	Energy-related engineers	- 6-day course - theory and actual facility diagnosis

b) Procedure for energy-saving checking

A procedure has been set up as shown in Figure 9 and the roles to be played by each division have been specified, in order to facilitate the introduction of energy-saving type manufacturing equipment.

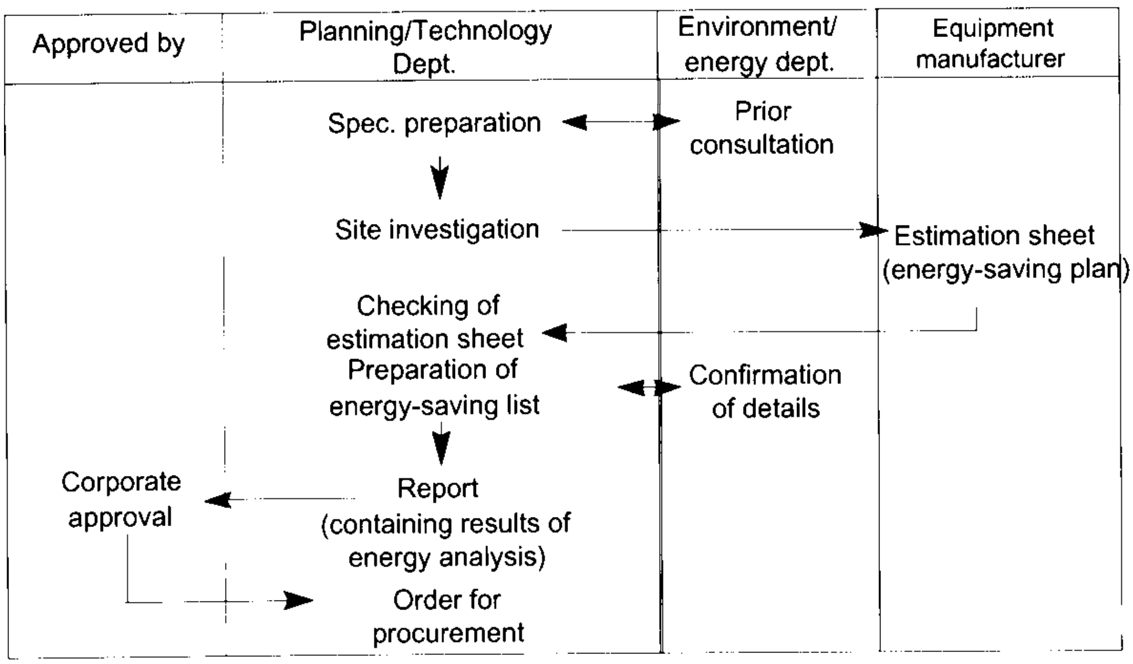
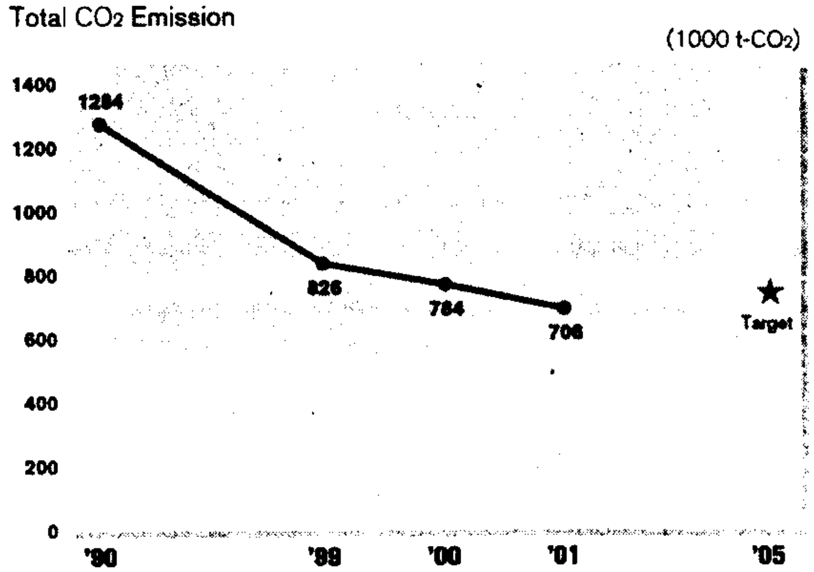


Fig. 9 Procedure of energy-saving checking for new installation

3.4 Effect and future issues

(1) Effect



(2) Future issues

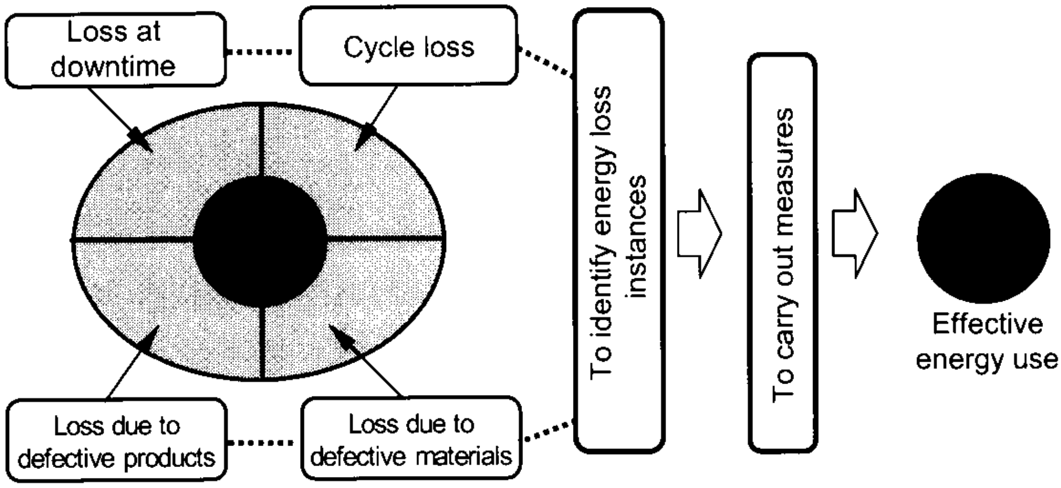
1) To develop automobiles that are friendly to global environment and humans and that serve for control of global warming.
2) To introduce processes, facilities and materials that ebable efficient energy use in manufacturing while making efforts to proviude new products.
3) To implement drastic, creative energy-saving activities based on basic diagnosis and data analysis.

3.5 Comprehensive energy activity

In addition to direct energy-saving measures, there are indirect ones, such as reduction of equipment failures and defective products, that will serve for energy conservation in the long run.

In other instances, causes of equipment failures and defective products may be identified by analysis of energy uses, and elimination of such causes may not only solve the problem but also serve to reduce energy consumption.

Nissanís Comprehensive (Extended) Energy-Saving Activity contains these energy-saving efforts in a variety of fields.



Examples of comprehensive energy-saving activity

Figure 10 indicates that power consumption increases as tools suffer abrasion in some instances. Not only energy consumption but also defective produces will be reduced by managing tools based on quality deterioration point analysis.

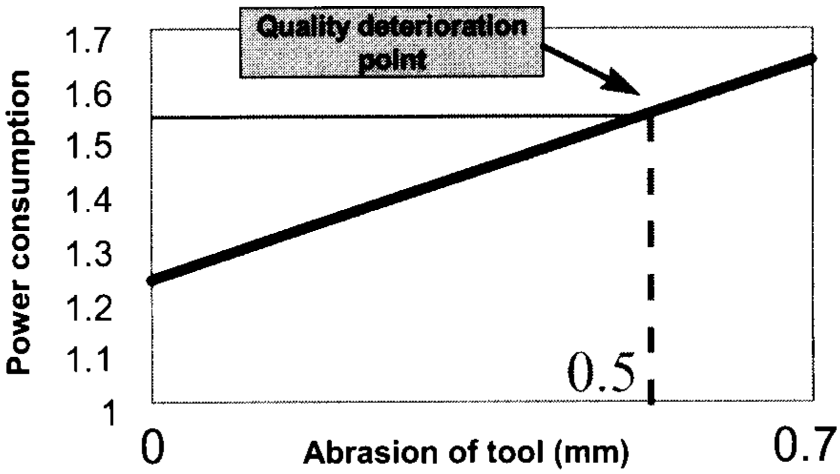


Fig. 10 Relation between tool abrasion and power consumption

Successful Case of Energy Conservation in Murayama Plant of Nissan Motor Co., Ltd.

Case 1

Energy Conservation from Switching to Integrated Body and Bumper Coating for "March"

1. Bumper Production Processes

1-1 Conventional process

Bumpers are produced from a steel sheet by forming and plating, and are mounted onto vehicle bodies in the assembly process.

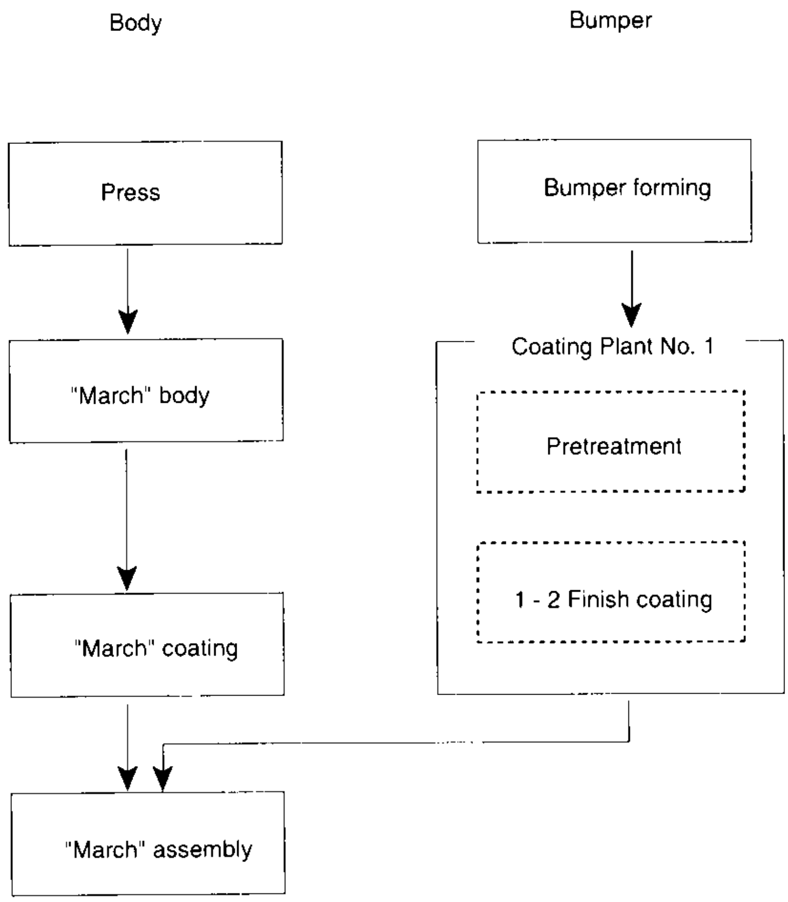
This process is now only used for a small number of models.

1-2 Current mainstream process

Bumpers are produced from a resin by forming. They are then coated, and mounted onto the body in the assembly process.

(advantages: body weight reduction, labor saving and work environment improvements)

2. Production Processes prior to Integrated Body and Bumper Coating

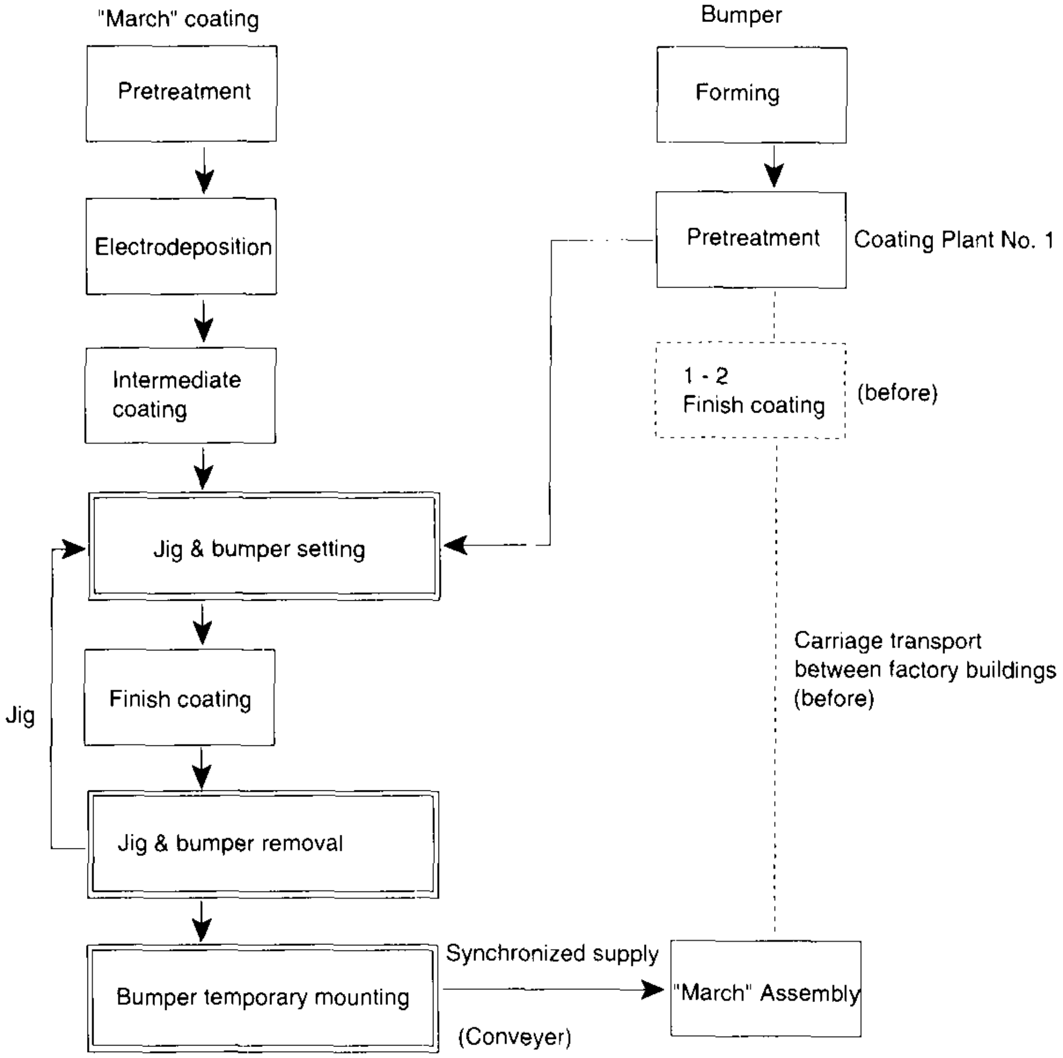


3. Objectives of Integrated Body and Bumper Coating

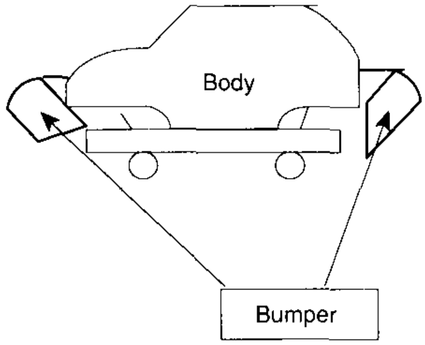
(1) Increased production capacity, reduced man-hour numbers (labor saving), and energy conservation
(2) Easy color-matching between body and bumper
(3) Synchronized bumper supply to assembly process

4. Implementation Details

4-1 Process and layout modifications



4-2 Bumper setting diagram



4-3 Plant modification work

Modification of coating booth, paint supply piping, jigs, etc.

4-4 Execution of trial run

Coating quality: Color matching, color vividness, coat thickness uniformity, dirt, thermal deformation, and adhesion
Equipment: Functions and operating condition
Work efficiency: Work steps involved in bumper setting and removal
Transport: Transport routes and packing style
Safety: Static Electric charge (earthing methods)

5. Implementation effects

Effects of eliminating dedicated "March" bumper coating line
(1 - 2 Finish coating line)

	Energy consumption	Cost
Electricity	1,462 MWh/year	¥15.1 million/year
Gas (LNG)	475,000 m^3/year	¥16.3 million /year
Gas (butane)	158,000 m^3/year	¥3.5 million/year
Total		¥34.9 million/year

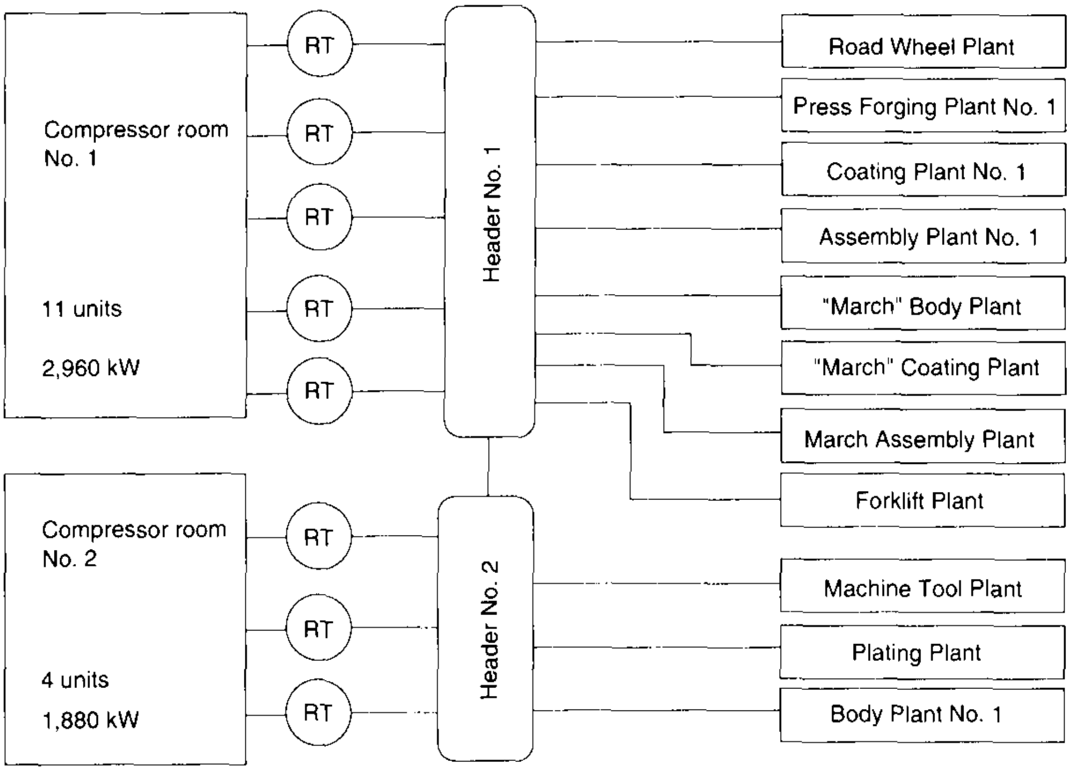
Case 2

Energy Conservation from Compressed Air Pressure Reduction

1. Compressor Equipment Outline

Installed compressor units	15
Combined compressor capacity	4,840 kW
Compressor electricity consumption	13,500 MWh/year

Overall compressed air supply system diagram

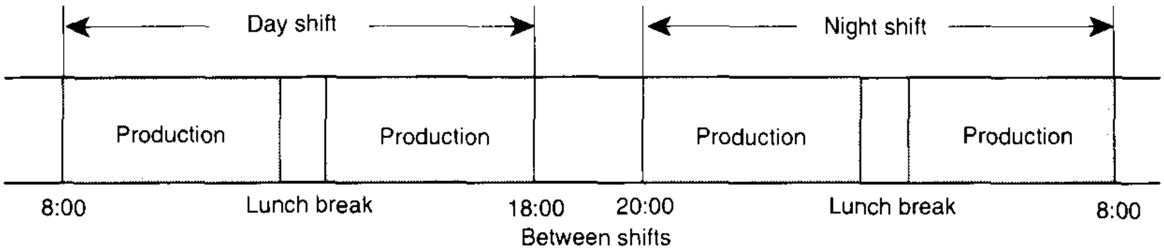


Major usage of compressed air

Machinery operation, jig parts operation, spot welding gun operation, air-driven equipment operation, air-driven tool operation, air blowing, paint spraying and liquid agitation

2. Before improvement

Air supply pressure: 6.4 kg/cm^2 (continuous)



3. Improvement details

Air pressure reduction tests were conducted in two stages and the pressure settings were changed.

(i) 1st Stage: Pressure reduction tests during normal production hours

Although the "March" body production process was the hardest to tackle, an investigation found that there was still room for improvement, and the air supply pressure was successfully reduced by 0.2 kg/cm^2, after conducting repeated tests.

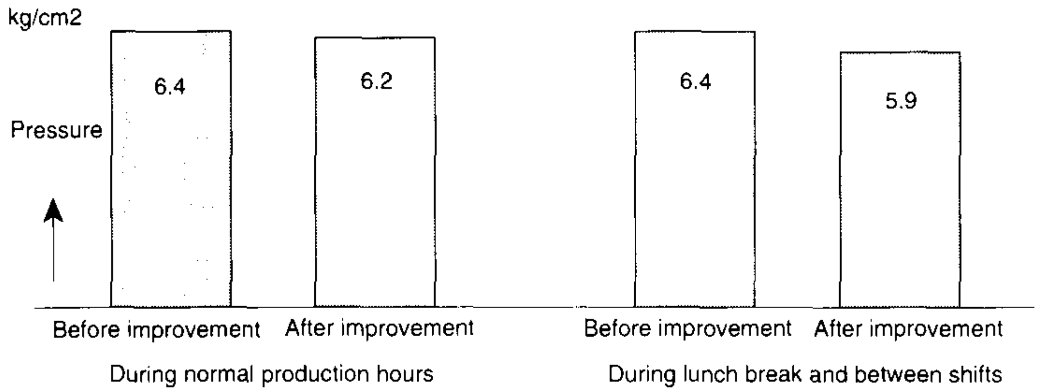
(ii) 2nd Stage: Pressure reduction tests during lunch break and between shifts

As gasoline tank blow forming machines and 5,000-ton transfer press machine were running even during the lunch break and between shifts, repeated tests were conducted to find the lower pressure limit at which there would be no adverse effects on the machines.

During the test period, air cylinder malfunctioning occurred with a blow forming machine and an investigation was conducted. It was found that the problem was due to a pressure drop arising from the insufficient pipe size of the primary-side piping, and the piping was upgraded accordingly.

As a result, the supply pressure was successfully reduced by a further 0.3 kg/cm^2 from the new production hour level.

4. Effects



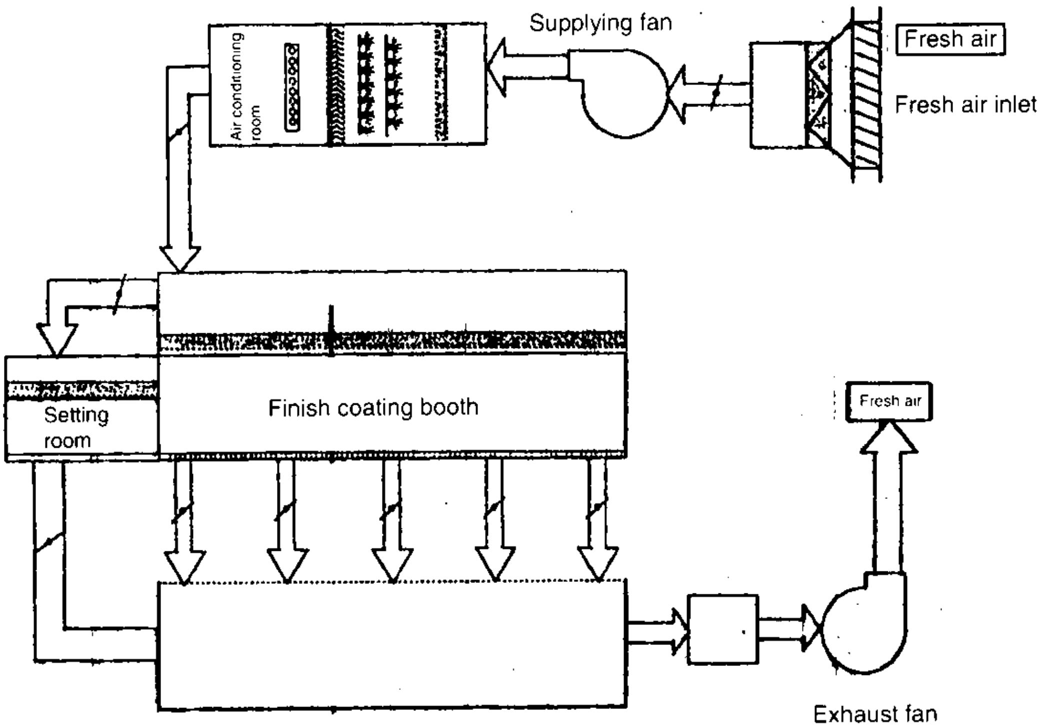
	Unit	Before improvement	After improvement	Savings
Normal production hours	MWh/year million yen/year	7344 74.1	7236 73.0	108 1.1
During lunch break and between shifts	MWh/year million yen/year	1944 19.6	1870 18.9	74 0.7
Total	MWh/year million yen/year	9288 93.7	9106 91.9	182 1.8

Case 3

Energy Conservation from Shutting Down of Finish Coating Booth during Lunch Break

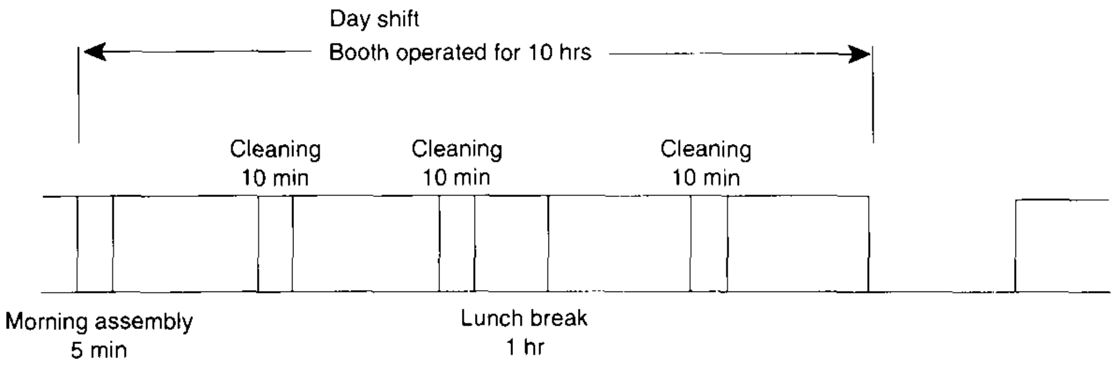
1. Facility outline of finish coating system

Consisting of an air conditioning room, a setting room, and a paint spray room, this equipment carries out finish coating.



2. Before improvement

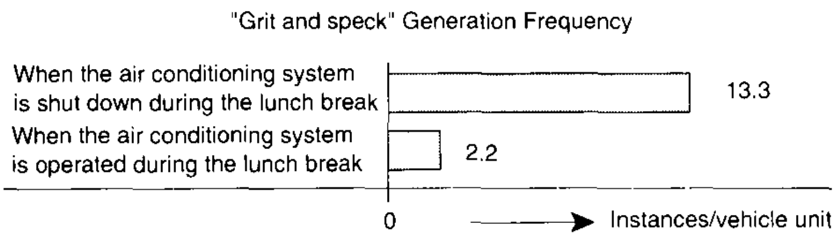
2-1 Operating pattern



During the booth start-up, small dust particles are apt to form due to duct and booth vibration, and these are prone to attach themselves onto the body and generate coating imperfections, called "dirt", as they float around inside the booth.

2-2 "Grit and speck" generation condition

If the booth air conditioning system is shut down during the lunch break, the generation of "grit and specks" increases dramatically, compared to continuous operation. For this reason, the booth air conditioning system is not usually shut down during this period. Nevertheless, it was at the top of the agenda to do so, because of its expected great saving effects, given the large energy consumption associated with the operation of the booth air conditioning system.



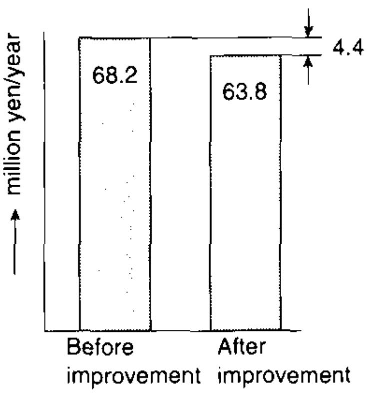
3. Improvement details

(i) The vehicle bodies inside the booth were taken outside during the cleaning time that preceded the lunch break, and those following were left outside the booth entrance. The booth was thus emptied during the lunch break, and "dirt" formation was prevented.

(ii) Since the atmosphere inside the booth needs to be stabilized before production begins, the conditioning system is turned on 15 minutes in advance in summer and 30 minutes in winter.

Summer	Winter	
12:20	12:20	Emptying of the booth starts.
12:30	12:30	The booth air conditioning system is shut down.
13:15	13:00	The booth air conditioning system is restarted.
13:30	13:30	Production begins.

4. Effects



Monetary unit: million yen/year

		Before improvement	After improvement	Savings
Electricity	MWh/year	4608	4310	298
	Cost	46.5	43.5	3.0
Gas	1,000 m^3/year	980	917	63
	Cost	21.7	20.3	1.4
Total cost		68.2	63.8	4.4

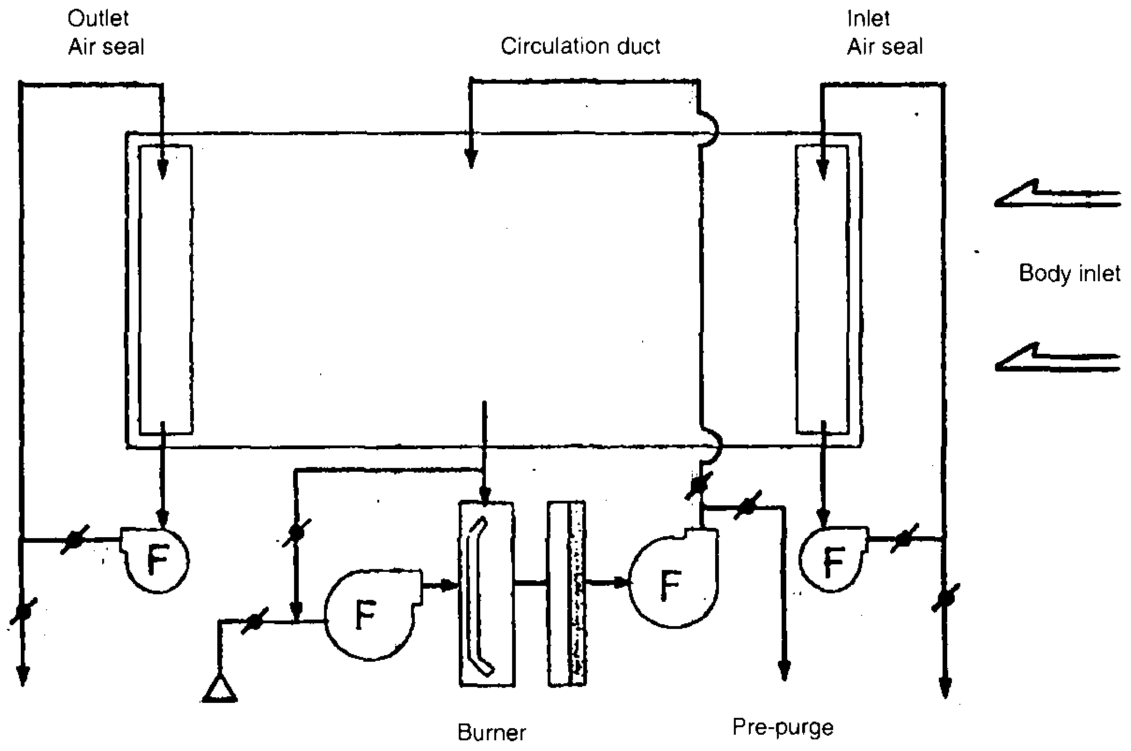
Case 4

Energy Conservation involving Pretreatment Oven Gas

1. Facility Outline of Pretreatment Oven

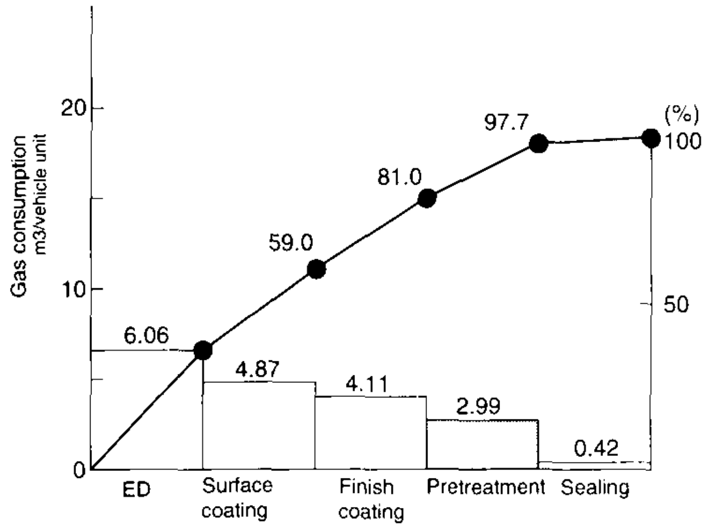
This equipment removes water droplets that have been left on the body during the previous process by evaporation.

Pretreatment oven

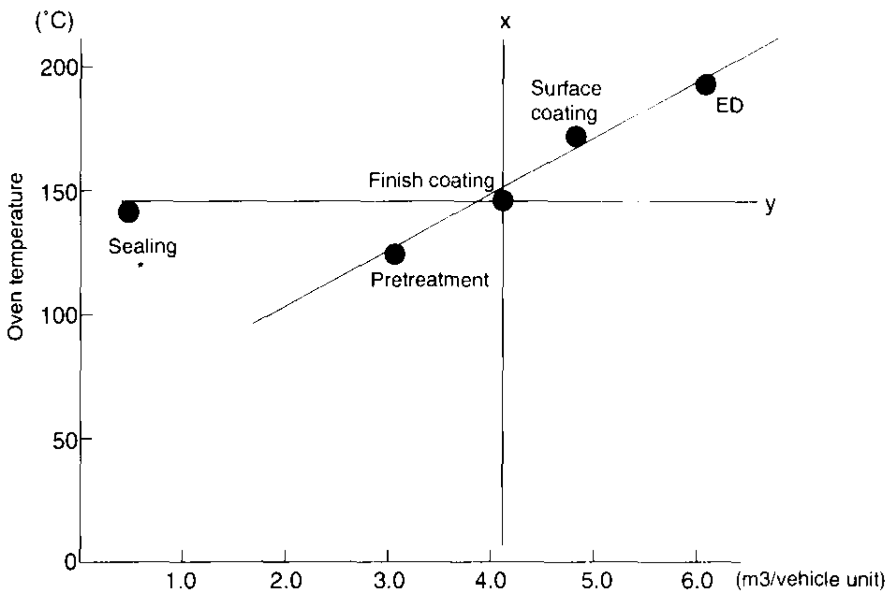


2. Before Improvement

2-1 Gas consumption shares of oven



2-2 Oven setting temperature vs. gas consumption scatter diagram



In the example presented here, gas consumption was reduced by lowering the interior temperature of the pretreatment oven.

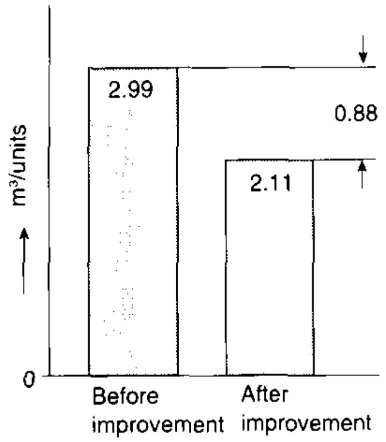
3. Improvement details

A new temperature setting was obtained after determining the lower temperature limit at which product quality was not affected. This was done by conducting tests, in which the oven interior temperature was lowered by 5 °C increments, starting at 125 °C as applicable before the improvement.

Test results

Temperature	Drying performance	ED surface quality	Assessment	Comments
125°C	Drying ◎	ED quality ◎	○	Although water droplets remained on parts of the floor, these posed no problem as they did not affect succeeding processes.
120°C	Drying ◎	ED quality ○	○	
115°C	Drying ○	ED quality ○	○	
110°C	Drying ○	ED quality ○	○	
105°C	Drying ○	ED quality ○	○	
100°C	Drying ○	ED quality ○	◎	Optimum temperature
95°C	Drying △	ED quality ×	×	Unsatisfactory (quality deterioration)

4. Effects



Anualsaving

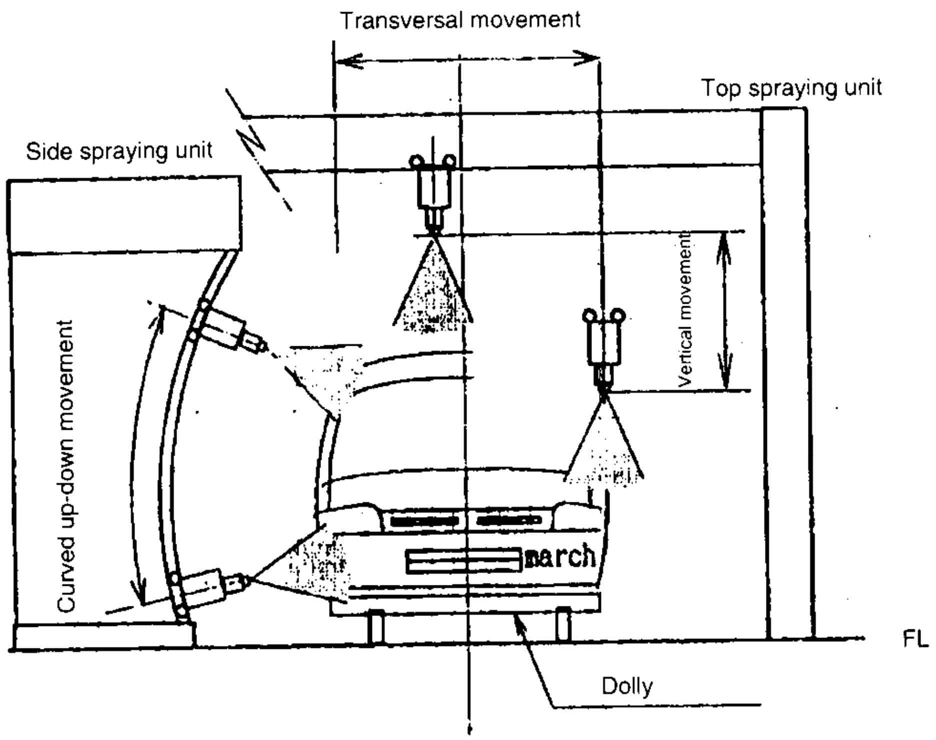
	Before improvement	After improvement	Savings
Gas consumption rate km³/year	412	291	121
Annual cost 1,000 yen/year	9,100	6,400	2,700

Case 5

Energy Conservation involving Automatic Finish Coating Machine

1. Outline of automatic finish coating machine

This equipment automatically carries out paint spraying in the finish coating process. It incorporates top and side spraying units and is of a 3-stage construction.



The energy conservation example presented here involves compressed air supplied to the automatic finish coating machine.

Usage of compressed air supplied to coating machine
(i) Paint atomization
(ii) Generation of spray patterns
(iii) Shaving (prevention of paint dripping)

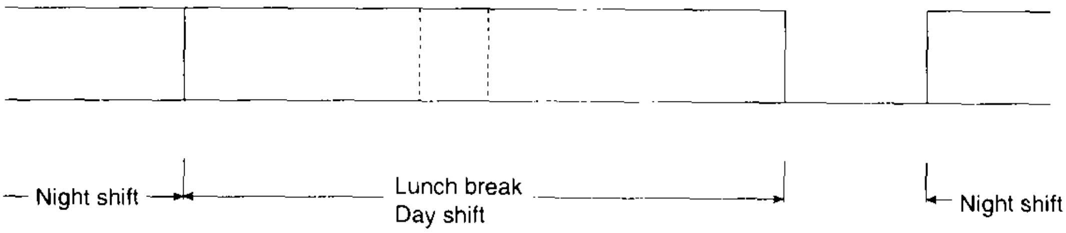
2. Before improvement

Operation pattern

Controlled with start and stop buttons, the operation of the automatic finish coating machine was independent of other equipment, and the pressing of the start button initiated its continuous automatic operation.

When there was no vehicle body inside, it was put into a standby state.

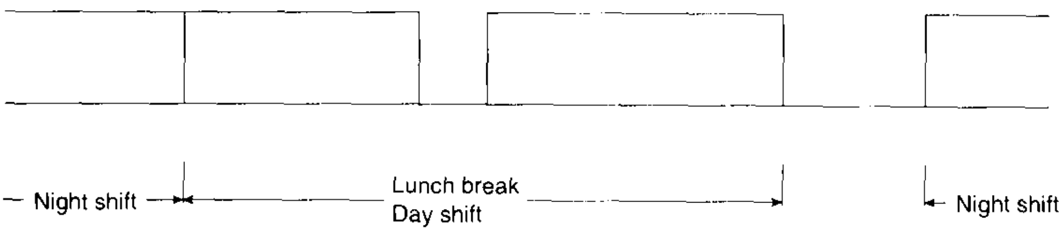
Compressed air was continuously consumed, even during the lunch break, as the machine remained on stand by.



3. Improvement details

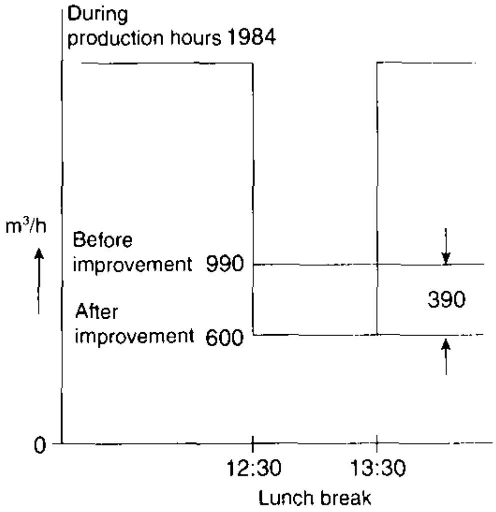
(i) The control circuit was modified with a timer introduced, so that the automatic finish coating machine would be shut down at the beginning of the lunch break.

(ii) However, out of safety considerations, an arrangement was made so that the machine could only be restarted locally via the start button, instead of using a timer control .



4. Effects

Effects of the stoppage of air supply to the automatic finish coating machine during lunch break



Annual savings

	Before improvement	After improvement	Savings
Air consumption 1,000m³/year	475	288	187
Cost 10,00 yen/year	480	290	190

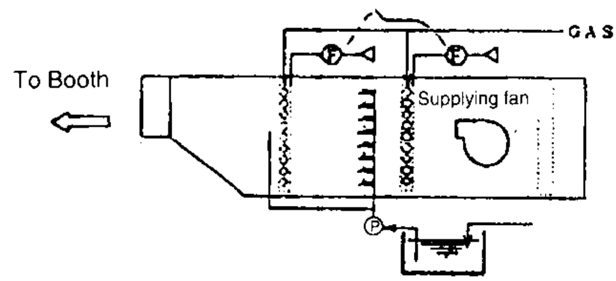
Case 6

Energy Conservation involving Gas Supply to "March" Surface Coating Booth Preburner

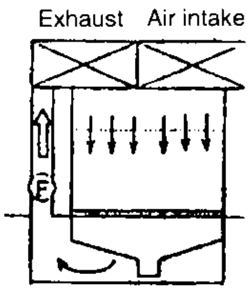
1. Outline of surface coating booth

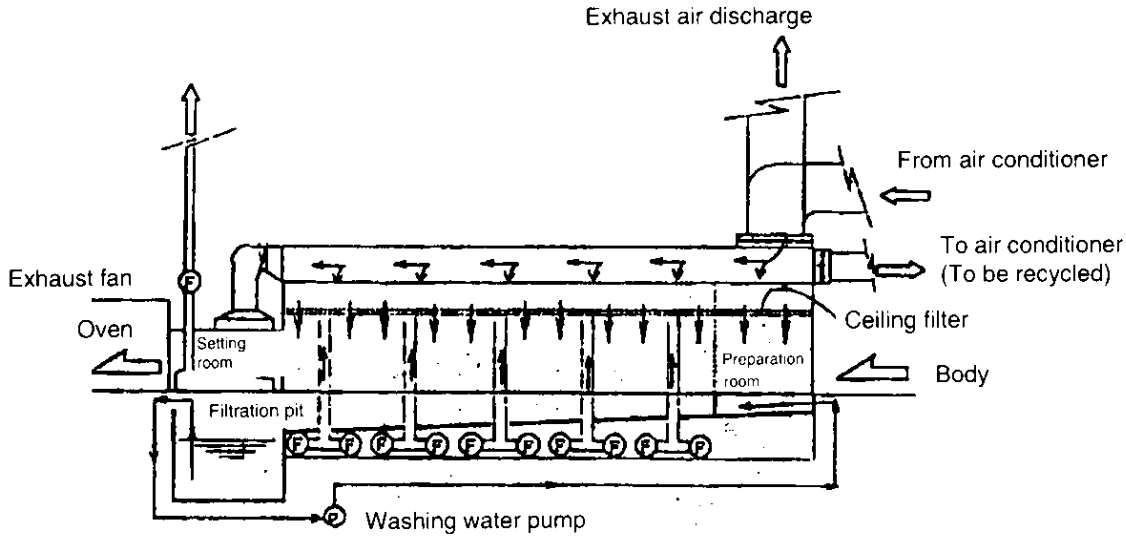
Incorporated in the process that follows pretreatment, the surface coating booth is a piece of equipment that sprays a vehicle body with paint. It consists of an air conditioning room, a preparation room, a spray room and a setting room. The air conditioning room is designed to control the temperature and humidity inside the booth and has a built-in preburner and afterburner, as well as a water spray unit for moistening.

Coating air conditioning room



Booth cross-section



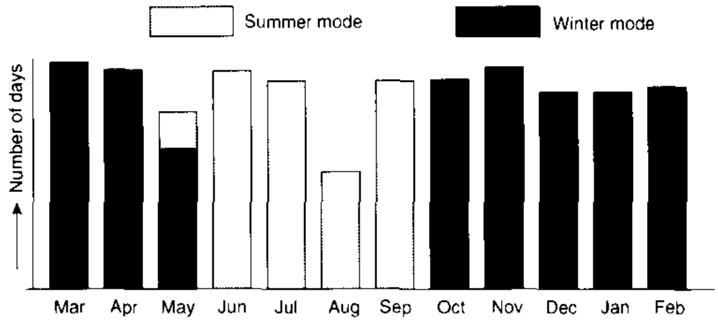


2.Before improvement

The booth air conditioner had a summer/winter changeover switch.

Winter mode: Air conditioner operation was linked to booth operation, with temperature and humidity control provided. It was used during winter and intermediate seasons

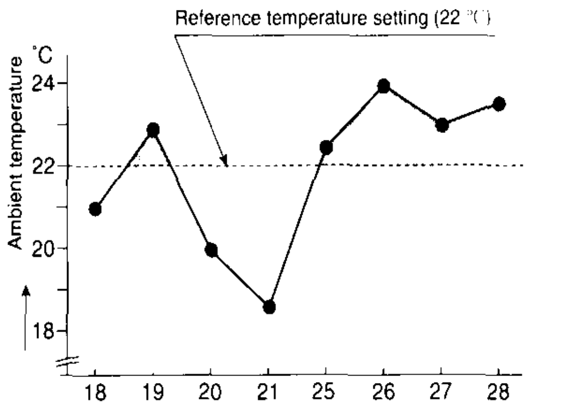
Summer mode: No control was provided over temperature and humidity, so that they were allowed to fluctuate.
It was used during summer and intermediate seasons



The preburner switched to low combustion when the ambient temperature rose to around 22 °C, and continued burning even when the temperature rose further. Improvement measures were taken to eliminate energy loss arising from the low combustion.

3. Improvement details

A circuit that would turn off the burner when the booth interior temperature exceeded the preset value using a thermostat was added.

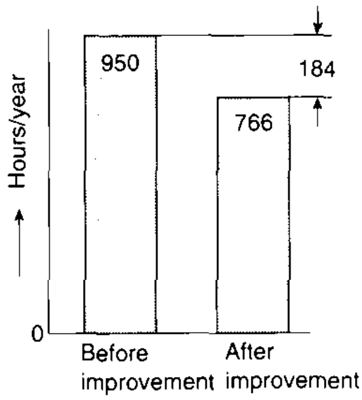


Graph of daily ambient temperature fluctuations (Apr)

Thermostat settings	
Setting 1	22.0 °C Preburner shutdown
Setting 2	20.5 °C Preburner restarting

4. Effects

Gas consumption reduction resulting from reduced preburner combustion hours (184 hrs/year)

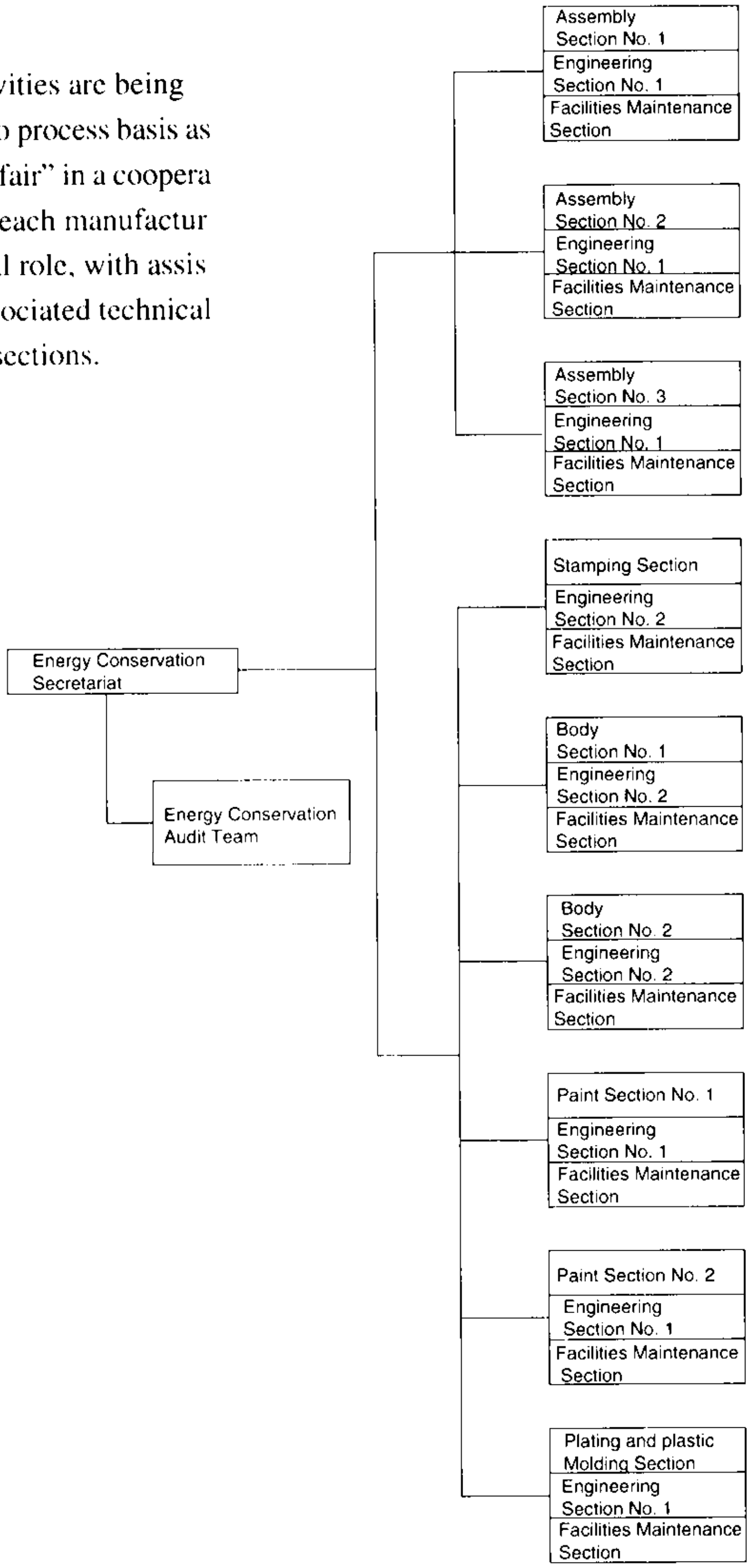


Annual savings

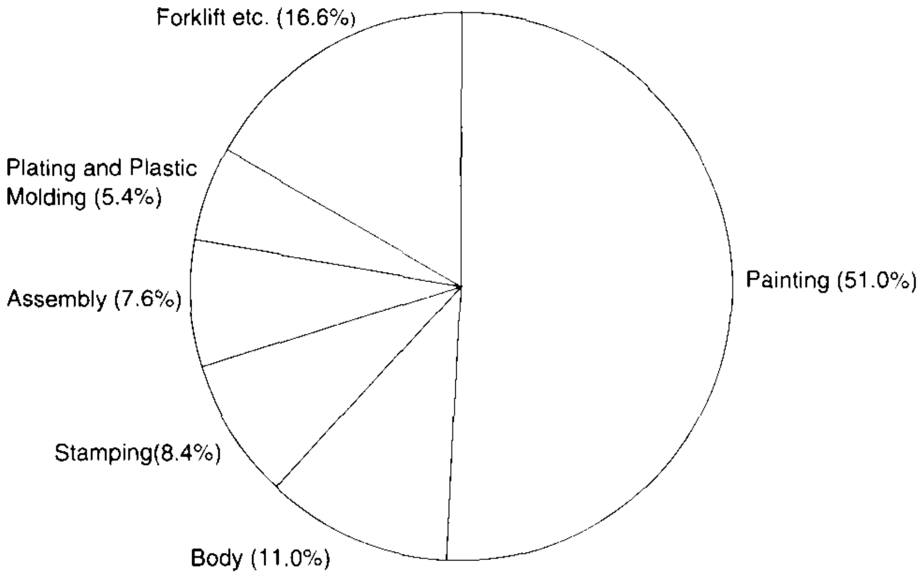
	Before improvement	After improvement	Savings
Gas consumption km^3/year	30	24	6
Cost 1,000 yen/year	660	530	130

Energy Conservation Implementation Organization

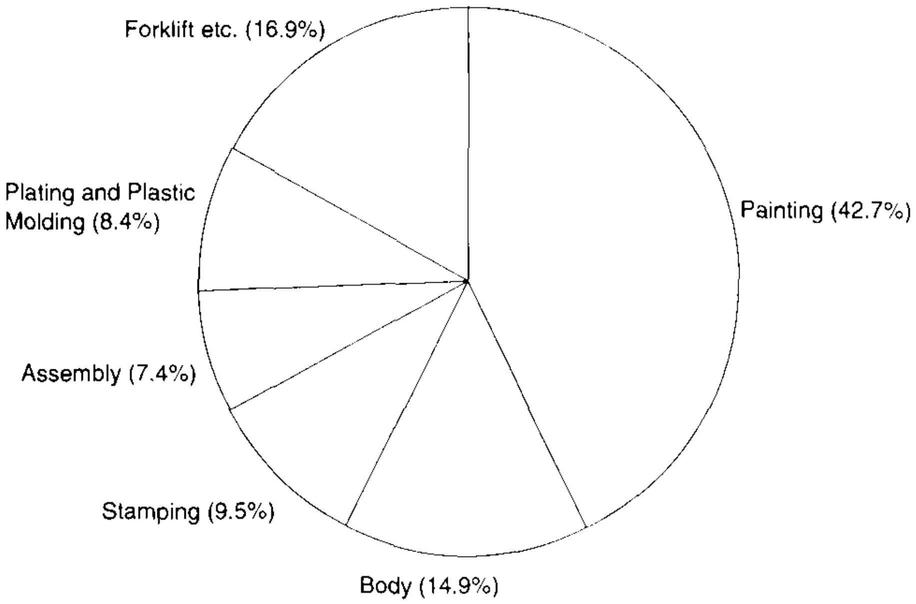
Energy conservation activities are being undertaken on a process to process basis as something of "a family affair" in a cooperative environment, where each manufacturing section plays a central role, with assistance provided by the associated technical service and engineering sections.



% Breakdown of Energy Consumption by Process (calorific content basis)



% Breakdown of Energy Cost by Process

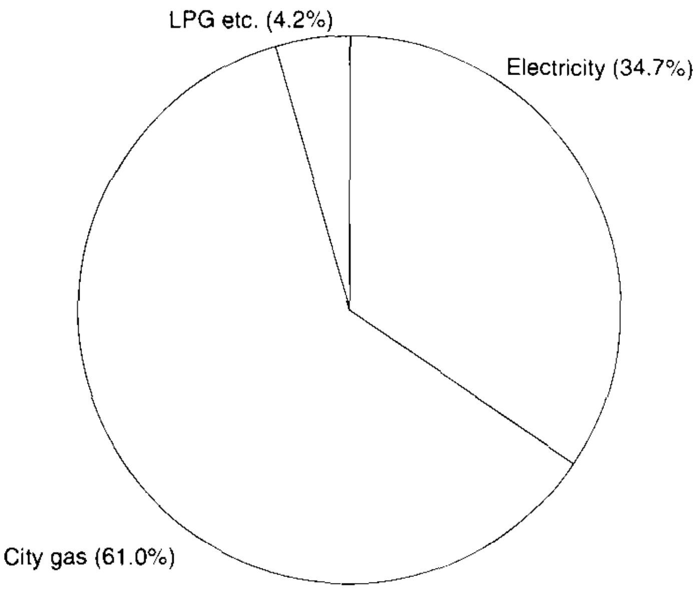


Annual energy Consumption

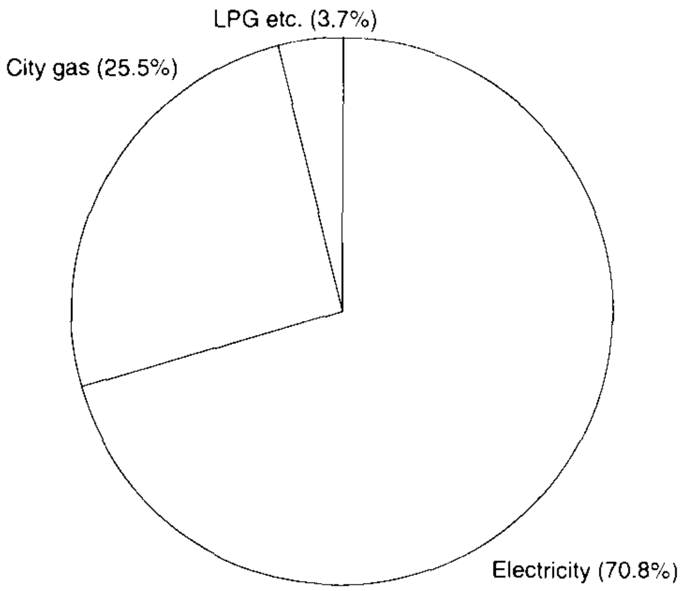
Electricity	119,700 MWh
City gas 13A	8,642,000 m^3
City gas 6A	12,235,000 m^3

Gasoline	541 kl
Kerosene	169 kl
Light oil	73 kl
Heavy fuel oil	54 kl
LPG	446 tons

% Breakdown of Energy Consumption by Source (calorific content basis)



% Breakdown of Energy Cost by Source



Case 7

Energy Saving by Recycling of Bumper Oven Exhaust

1. Reason for selecting the subject

The odor concentration of the exhaust gas from a bumper painting oven exceeded the regulatory level of the offensive odor specified in Tokyo Metropolitan Environmental Pollution Ordinance. So, it was decided to improve the odor concentration and also to decrease the gas consumption.

2. Identification of present situations

2.1 Odor concentration of bumper painting oven

Excerpted from 7 (Offensive Odor), Attached Table 4 (Regulatory Levels To Be Applied to Factories) of Tokyo Metropolitan Environmental Pollution Ordinance.

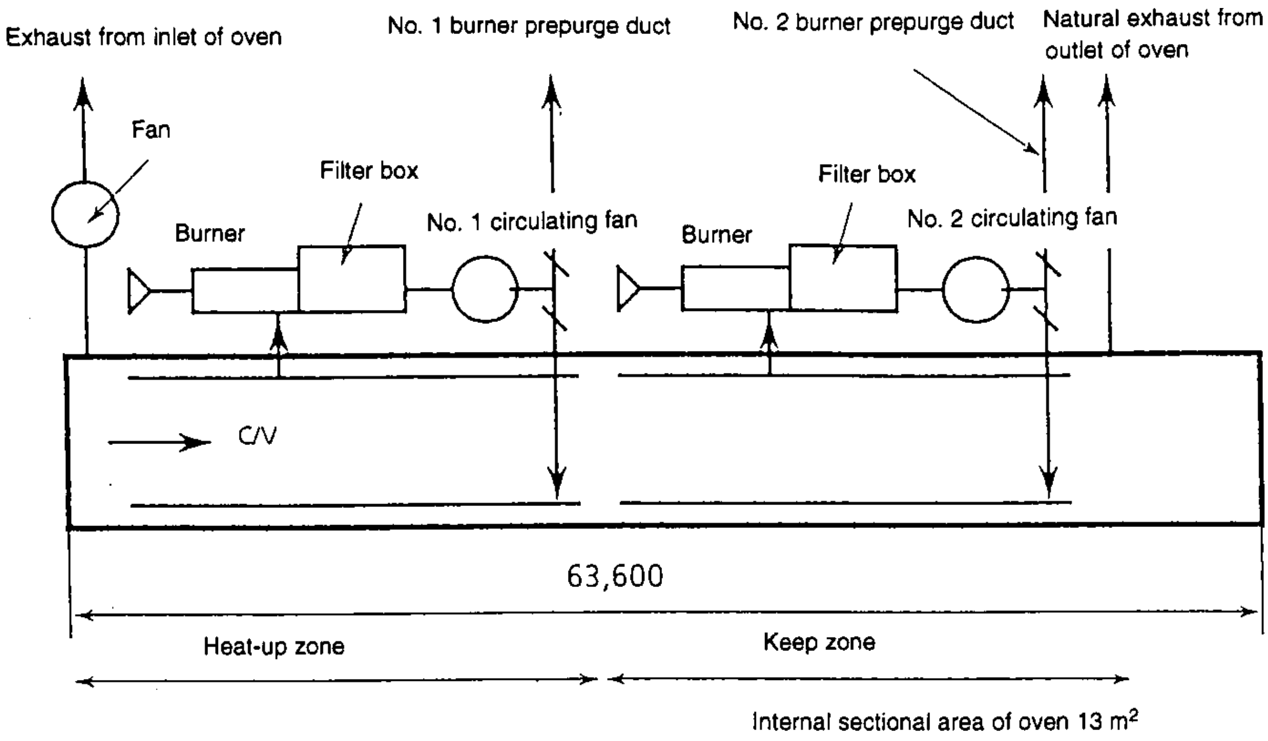
Classification of area		Average concentration of offensive odor discharged from an exhaust port into the atmosphere per working period of time	Bumper painting oven (exhaust gas from the inlet)
Class	Area concerned		
Class 3 area	1. Industrial area 2. Exclusively industrial area 3. Frontage and water area adjacent to commercial area	Offensive odor 1000 (regulatory level)	3000

* An odor concentration refers to a dilution ratio required for letting air with an offensive odor be felt odorless by dilution. (Based on the triangle bag method for odor sensory measurement)

The offensive odor of the exhaust air from the inlet of the bumper painting oven exceeded three times the regulatory level.

2.2 Configuration of bumper painting oven

Production of front and rear bumper spoilers of Laurel, Skyline, Precea and Stadea (16,464 pieces were produced in total in October, 1996)



- Capacities of burners and circulating fans

No. 1 burner	No. 2 burner
1,200,000 kcal/h	600,000 kcal/h

No. 1 circulating fan	No. 2 circulating fan
950 m^3/min	1,150 m^3/min

- Energy consumption

  Gas consumption (butane air gas): 62.4 Nm^3/h (lower calorific value 6,450 kcal/Nm^3)
  Power consumption: 16 kW

2.3 Analysis of energy (heat balance)

Heat input (kcal/h)			Heat output (kcal/h)			
Calorific value of gas	402,480	100%	Exhaust gas loss		208,908	51.9%
			Carriage	Works	13,342	3.3
				Dollies	38,430	9.5
				Jigs	27,118	6.7
				Conveyor	24,840	6.2
			Radiation from oven body and ducts		85,560	21.3
			Baking of paint		1,860	0.5
			Others		2,424	0.6
Total	402,480	100%	Total		402,480	100%

Of the heat input of 402, 480 kcal/h, effective heat (for heating works and baking paint) accounted for only 3.8%, and 96.2% of energy had been lost. Among the loss, exhaust gas loss accounted for the largest percentage of 51.9%.

3. Analysis

3.1 Measured intake and exhaust gas volumes of bumper painting oven

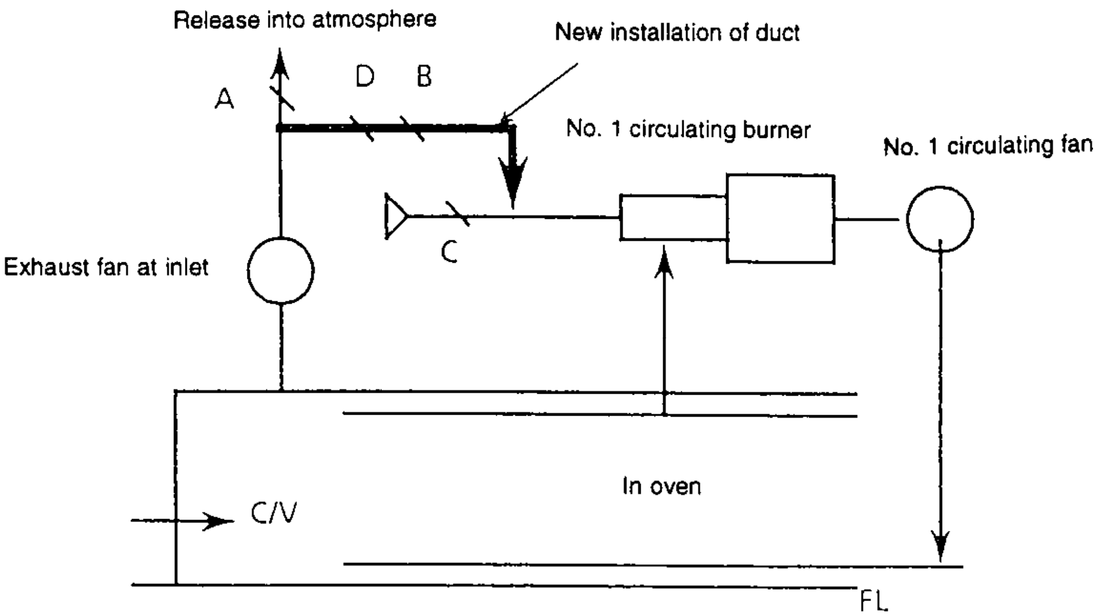
Intake		Sectional area (m^2)	Average gas velocity (m/s)	Average temperature (°C)	Gas volume (Nm^3/h)
Intake of burners	Air from suction opening of No. 1 circulating burner	0.44	0.87	26	1,378
	Air from suction opening of No. 2 circulating burner	0.44	0.77	26	1,220
	Combustion gas (CO_2, H_2O, N_2)				162
Intake at inlet and outlet	Booth intake suction from inlet	13	0.10	25	4,695
	Open air suction from outlet	13	0.06	21	2,856
Total					10,311

Exhaust				
Exhaust from inlet	0.14	14.30	98	5,808
Natural exhaust from outlet	0.14	7.60	62	3,418
Leak of hot gas from No. 1 circulating burner prepurge duct	0.51	0.40	72	636
Leak of hot gas from No. 2 circulating burner prepurge duct	0.51	0.80	116	1,272
Total				11,134

1. In the exhaust gas loss, the exhaust from the inlet amounted to 5,808 Nm^3/h, accounting for 52.2% of the total.
2. The leak from burner prepurge ducts amounted to 1,908 Nm^3/h, accounting for 17.1% of the total.
3. Since the exhaust gas volume of 11,134 Nm^3/h was about 4.1 times the intake gas volume of 2,760 Nm^3/h, the oven was internally kept at negative pressure and soaking could not be achieved in the oven. Furthermore, the dust of open air was sucked in.

4. Improvement plan and implementation

		Quality	Investment	Energy	Term of construction	Maintenance	Result
To decrease the odor concentration	Removal of offensive odor by installation of deodorizing equipment	O	× 30 million yen	× 6 million yen	× A large number of consecutive holidays are necessary.	O	×
	Re-utilization of the exhaust gas from inlet as air for combustion	O	O 2 million yen	O	O Saturday and Sunday only are necessary.	× Generation of resin	O



1. A duct was connected between the inlet and the air suction opening of the burner blower.
2. Selector dampers A, B and C were installed to allow the selection of either fresh air or the exhaust gas from the inlet.
3. A damper D was installed for adjusting the suction volume of the exhaust gas from the inlet.
4. As a measure for preventing the resin generated in the oven when the oven is stopped, a command to select the damper for introducing fresh air into the oven is issued when the oven is stopped, for replacing the internal atmosphere.

5. Confirmation of Effects

5.1 Gas consumption decrease effect

Before improvement:

$1{,}378\ Nm^3/h \times 0.31\ kcal/Nm^3\ °C \times (26-0)°C = 11{,}106\ kcal/h$......(a)

After improvement (with the gas volume adjusting damper opened 100%)

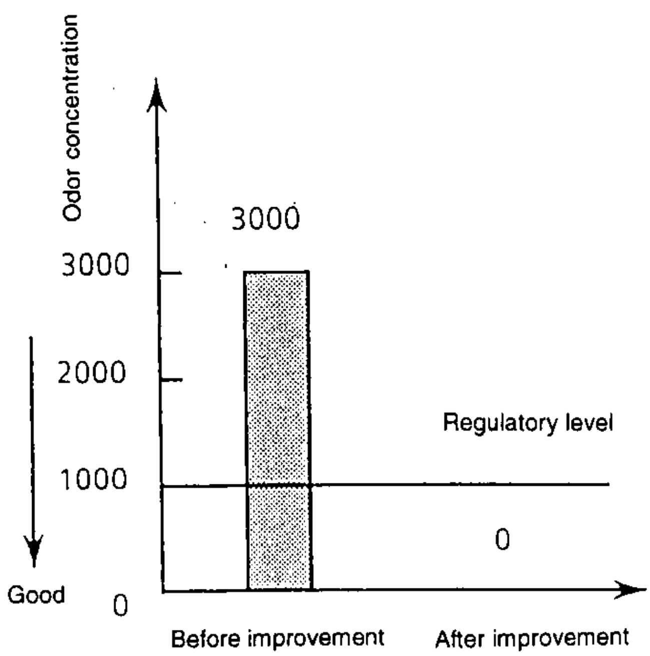
$5{,}808\ Nm^3/h \times 0.31\ kcal/Nm^3\ °C \times (98-0)°C = 176{,}447\ kcal/h$......(b)

$((a)-(b))/6{,}450\ kcal/Nm^3 = 25.6\ Nm^3/h$

Annual effect:

$25.6\ Nm^3/h \times 16\ h/day \times 20\ days/month \times 12\ months/year \times 25\ yen/Nm^3$

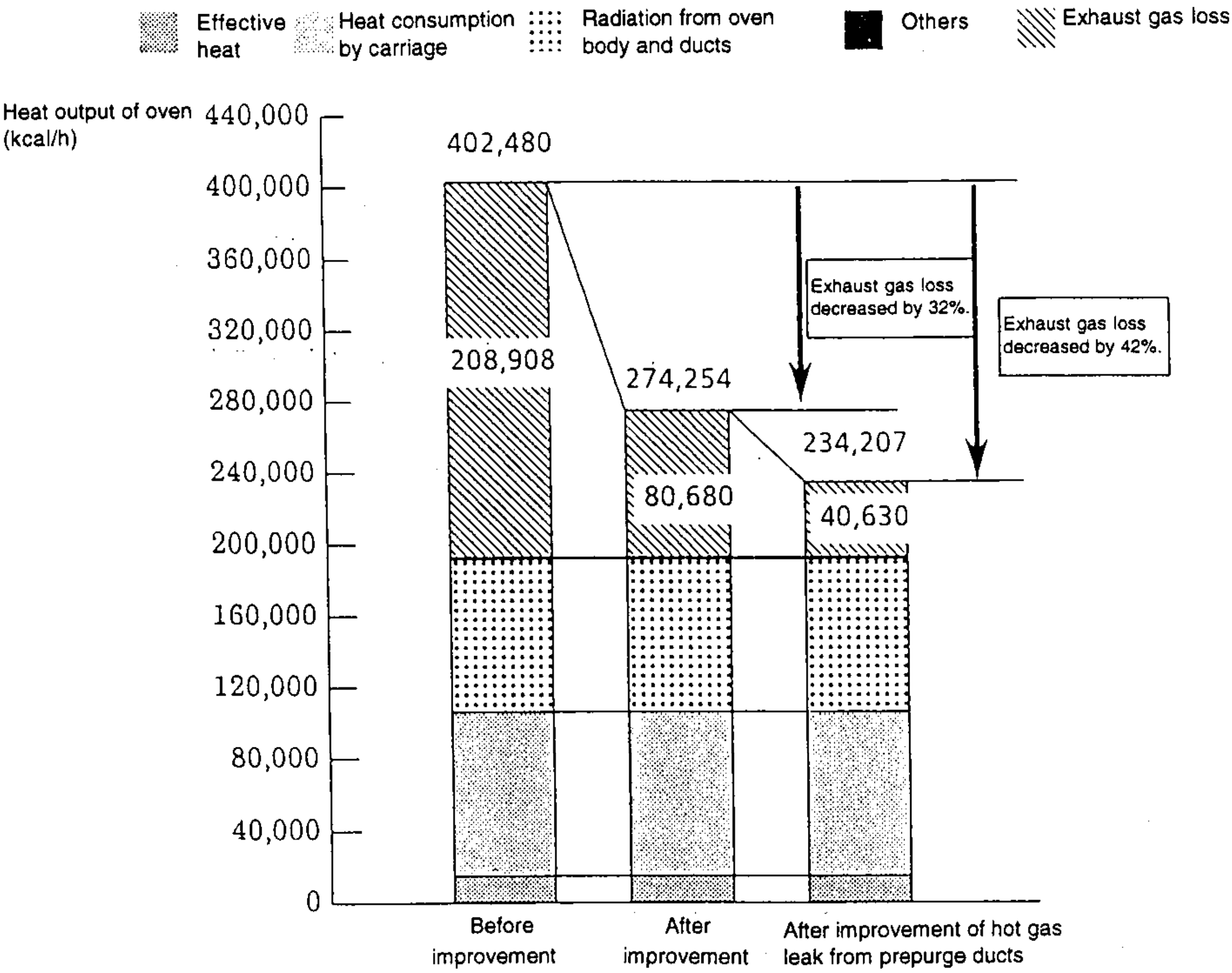
$= 2{,}458{,}000$ yen/year



Odor Concentration Lowering Effect

By re-utilizing the exhaust gas from the inlet as air for combustion, the odor concentration could be lowered to zero. As a side effect, it was found that the gas consumption could also be decreased by 2,458,000 yen per year.

5.2 Changes of heat output before and after improvement



Heat efficiency 3. 8% → 5.5% → 6.5%

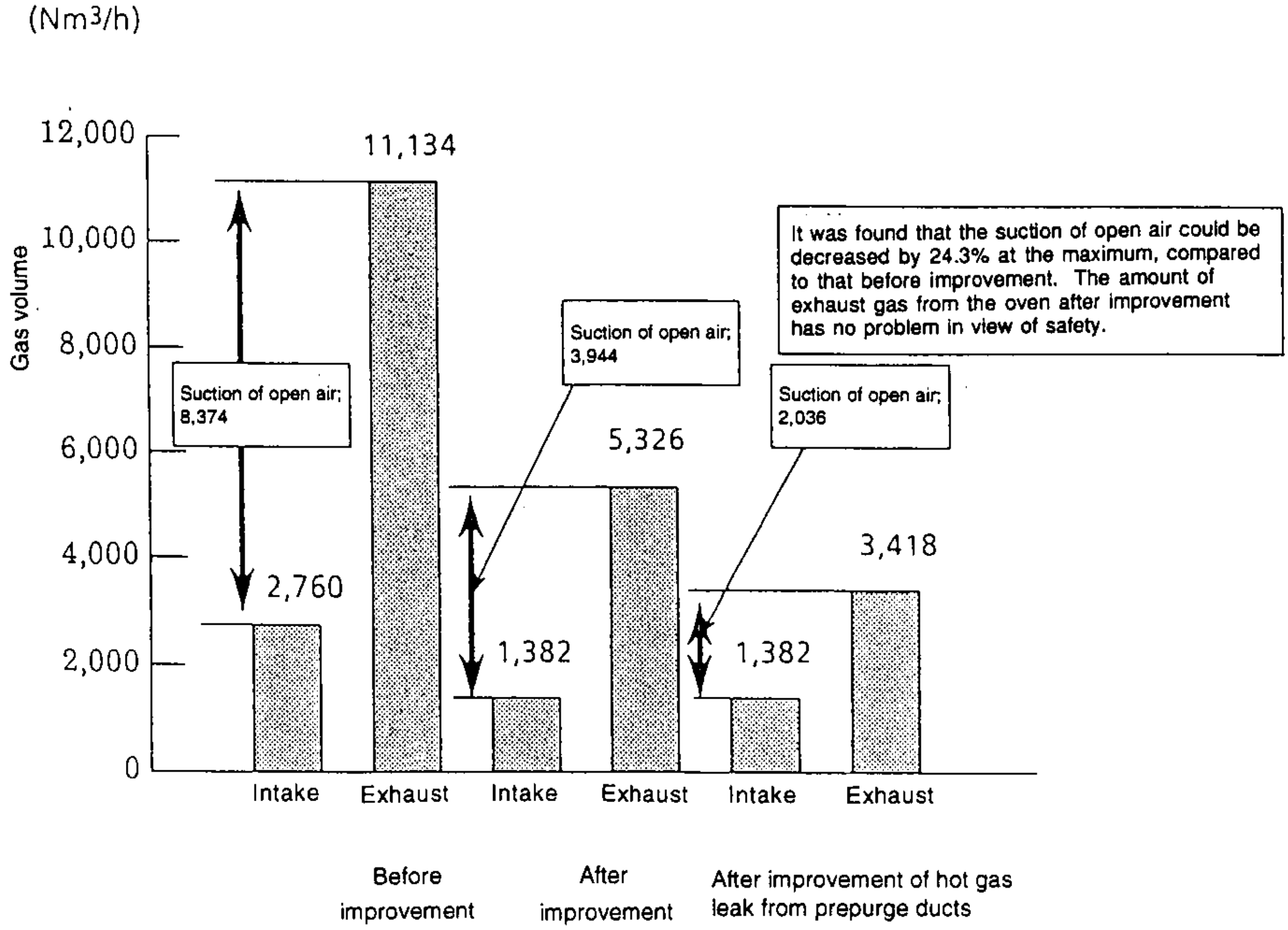
It was found that heat output could be decreased by 42% at the maximum, compared to that before improvement.

5.3 Changes of intake and exhaust balance

Minimum required amount of carrier air per kg of solvent corresponding to 30% of lower explosion limit (LEL) (in the case of toluene): 67.6 Nm^3/kg

Necessary amount of ventilation:
67.6 $Nm^3/kg \times 38.8\ kg/h = 2{,}623\ Nm^3/h < 3{,}418\ Nm^3/h$

Hence, safety is secured even if the amount of exhaust gas is decreased.



It was found that the suction of open air could be decreased by 24.3% at the maximum, compared to that before improvement. The amount of exhaust gas from the oven after improvement has no problem in view of safety.

6. Having Attended the Energy Saving Engineer Course

(1) Having attended the Energy Saving Engineer Course, I can now discuss energy saving based on data.

(2) I could master special techniques for rational use of energy.

Case 8

1. Energy saving case

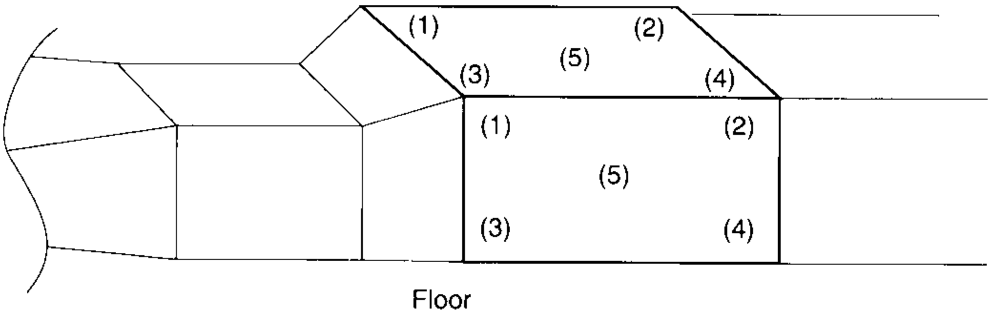
1.1 Subject: Decrease of city gas by reinforced heat insulation of burning furnace

1.2 Shop: Third painting

1.3 Name of step or equipment: L304 line convective burning furnace

1.4 Conventional situation

The average surface temperature of the outer wall of the burning furnace was as high as 69.5°C.



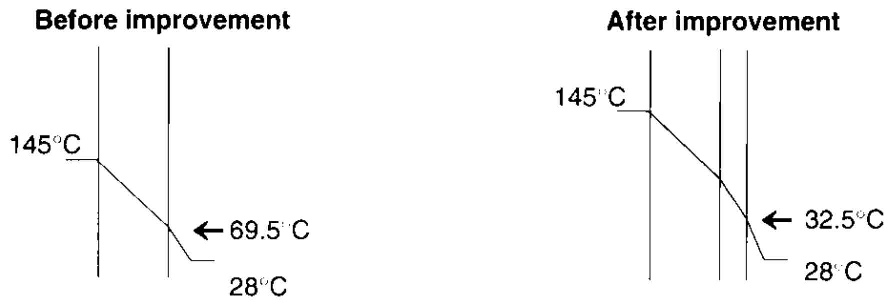
Measured temperatures in °C

Measured surface	Top surface	Bottom surface
(1)	68	66
(2)	73	73
(3)	67	66
(4)	73	68
(5)	70	71
Average	70.2	68.8
Area	4 (m^2)	4 (m^2)

1.5 Details of improvement

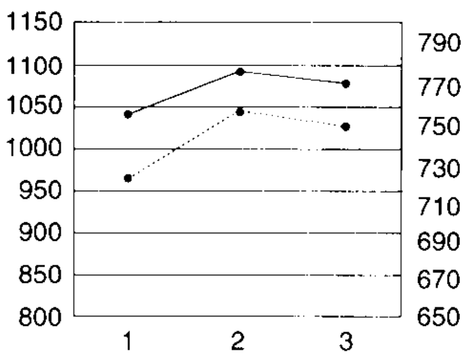
A heat insulating paint was applied to the surfaces of the furnace body. Compared to the heat insulation by generally used glass wool, the cost was lower, and the heating insulation capability was higher.

(1) Estimation of radiation heat quantity



By lowering the heat transmission coefficient, the surface temperature declined.
69.5°C → 32.5°C
Δt = 37.0°C

(2) Decrease of gas consumption



The effect was obtained based on the ratio to the gas consumption of the dark red step operated under the same conditions to avoid the influence of production fluctuation on the Sunday of one week after the date of improvement.

(3) Comparison between heat insulating paint and glass wool

Item	Paint, 3 mm	Glass wool, 50 mm
Heat quantity	25,000 kcal/h	←
Work cost	¥30,000	¥200,000

The effect was almost equivalent, but the work cost was about 1/7.

1.6 Effect

Decrease of city gas consumption…40 m^3/day

40 (m^3/day) × 244 (days/year) × 33 (yen/m^3) = 322,000 (yen/year)

Value: Improvement cost .... 3,750 (yen/m^2)

Effect .... 40,250 (yen/m^2)

Case 9

1. Energy saving case

1.1 Subject: Lights-out of general lighting at Assembling Shop of Second Factory

1.2 Shop: T43

1.3 Name of step or equipment: Lighting

1.4 Conventional situation

Illuminance values of lighting at Assembling Shop of Second Factory were measured, and many places were found to exceed the standard illuminance.

Standard illuminance: 500 lx

	0–1	1–2	2–3	3–4	4–5	5–
K–J	225 40	630 470	250 250	325 280	355 355	
J–I	65 5	75 30	500 480	580 550	900 800	
I–H		15 5	450 400	420 400	400 330	
H–G		40 0	640 640	60 40	780 530	

Measured illuminances

Upper values: General lighting plus local lighting in lx

Lower values: Local lighting without general lighting in lx

1.5 Details of improvement

The illuminances at respective places were measured together with the person in charge of energy conservation, and the lights corresponding to excessive illumination and those of unnecessary places were turned off.

(1) Notices of lights-out (to indicate that the lights-out are for energy conservation).

(2) The wirings at the places of lights-out were removed.
Number of lights turned off: 896 110W lights

1.6 Effect

12. 0.11kW × 892 lights × 20 days/month × 9 hours/day × 10 yen/kW = 176,616 yen/month

Case 10

1. Energy conservation case report

1.1 Decrease of electric energy by installation of calendar timers for exhaust fans

(1) Objective: To automatically stop the exhaust fans after shutdown of molding line operation, for decrease of energy.

(2) The exhaust fans were turned off manually when the generation of exhaust gas stopped after shutdown of line operation. However, turning them off was often forgotten to consume waste energy. So, calendar timers were installed for automatically stopping the fans for decrease of electric energy.

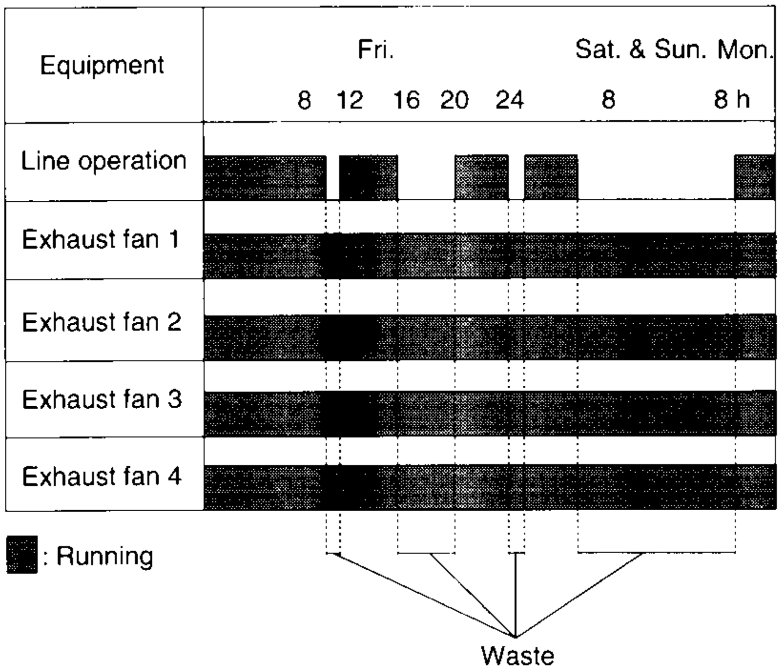
1.2 Items concerned

☐ Energy saving
☒ Energy decrease
☐ Production equipment
☒ Non-production equipment
☐ During operation
☒ During non-operation (lunch time, duty interval, holiday)

☒ Electricity
☐ Air
☐ Fuel oil
☐ Steam
Other (   )

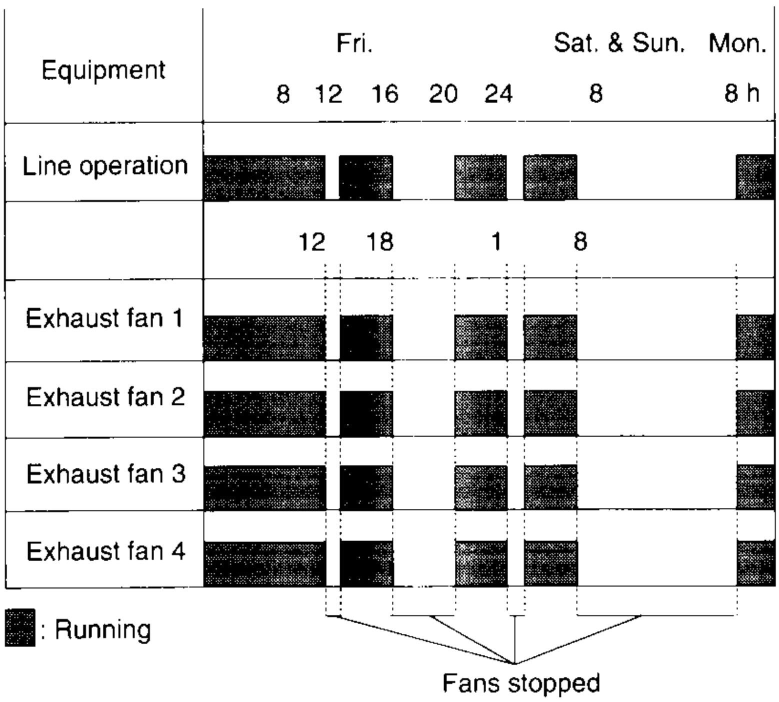
1.3 Comparison

(1) Conventional situation



Since the exhaust gas was generated still after shutdown of line operation, the fans were operated for preservation of working environment. So, turning them off was often forgotten.

(2) Improvement



1) Calendar timers were installed for exhaust fans, for automatically turning them off. (They are started manually.)
2) Basically the fans are turned off in synchronization with line operation. (Time lags are set to suit the conditions of the places where exhaust gas is generated.)

1.4 Effect

(1) Conventional situation

Energy quantity before improvement	425 MWh/year
Decreased energy quantity	103 MWh/year

(2) Improvement

Energy quantity after improvement	322 MWh/year
Effect as crude oil	27 kL/year

1.5 Future problems

Change of time for overwork and holiday work

Case 11

1. Energy conservation case report

1.1 Decrease of electric energy by installing a temperature controller for a cooling tower fan for intermittent operation

(1) Objective: To automatically start and stop a cooling fan depending on the temperature of cooling water, for achieving energy saving.

(2) Outline: The cooling tower fan was manually started and stopped, and operated normally since the cooling water is supplied to a wide range of many apparatuses such as core making machines, molding hydraulic units and gate folding presses. A temperature controller was installed to automatically start and stop the fan depending on the temperature of cooling water, for decreasing electric energy.

1.2 Items concerned

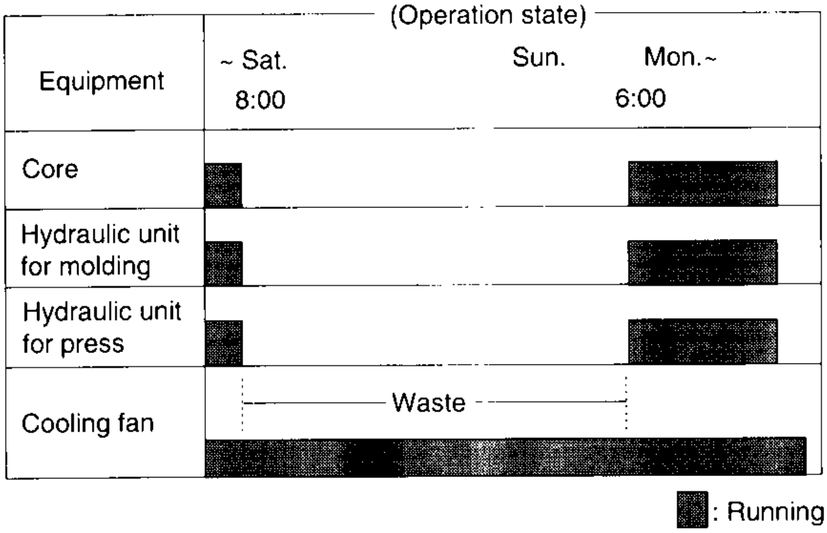
- ◙ Energy saving
- ☐ Energy decrease
- ☐ Production equipment
- ☐ Non-production equipment
- ☐ During operation
- ☐ During non-operation (lunch time, duty interval, holiday)

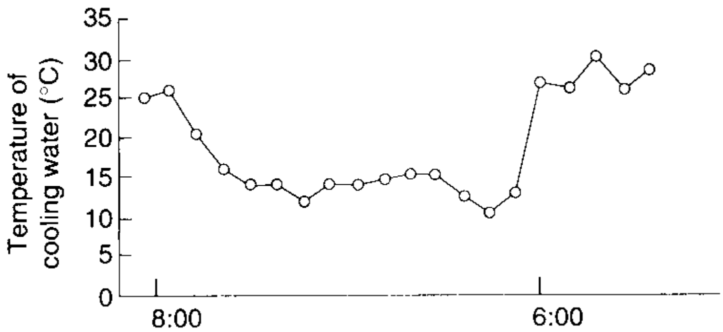
- ☐ Electricity
- ☐ Air
- ☐ Fuel oil
- ☐ Steam

Other (   )

1.3 Comparison

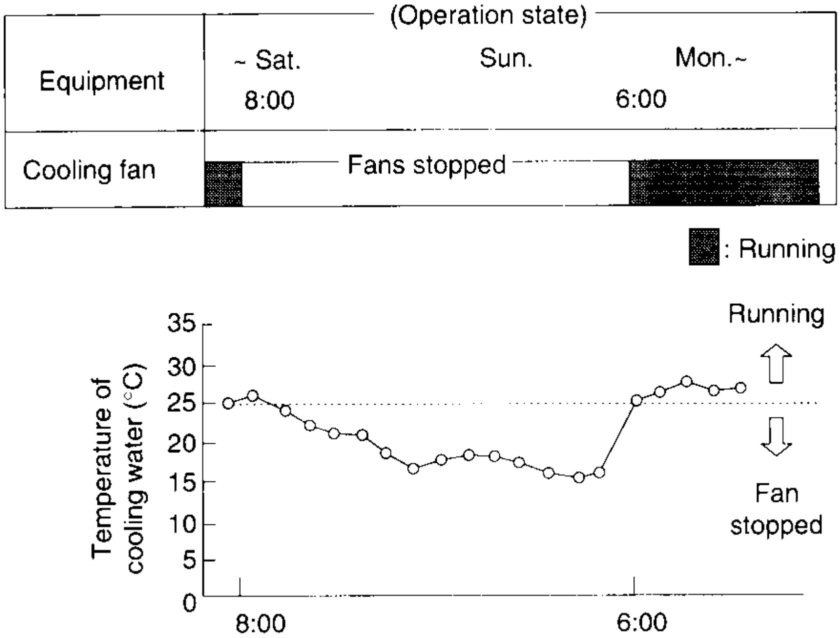
(1) Conventional situation





The fan was normally operated to consume electric power irrespective of the line operation state and the cooling water temperature.

(2) Improvement



A temperature controller was installed for operating the fan as follows, for energy saving.
At temperatures of 25°C and lower, the fan stops.
At temperatures of 25°C and higher, the fan starts.

1.4 Effect

(1) Conventional situation

Energy quantity before improvement	26 MWh/year
Decreased energy quantity	10 MWh/year

(2) Improvement

Energy quantity after improvement	16 MWh/year
Effect as crude oil	3 kL/year

1.5 Future problems

Optimization of cooling water temperature

Case 12

1. Energy conservation case report

1.1 Stopping paint recovering and circulating pumps while no paint is sprayed at intermediate and top coating booths.

(1) Objective: To decrease the power consumption of paint recovering and circulating pumps.

(2) Outline: During lunch time and maintenance, paint recovering and circulating pumps are stopped.

1.2 Items concerned

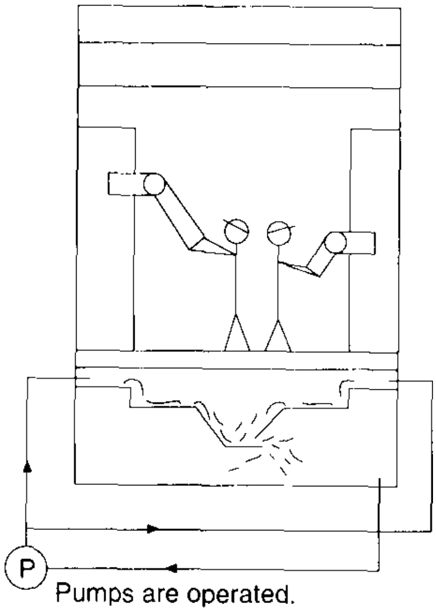
☐ Energy saving
☒ Energy decrease
☒ Production equipment
☐ Non-production equipment
☐ During operation
☒ During non-operation (lunch time, duty interval, holiday)

☒ Electricity
☐ Air
☐ Fuel oil
☐ Steam
Other ( )

1.3 Comparison

(1) Conventional situation

(Conventional practice)

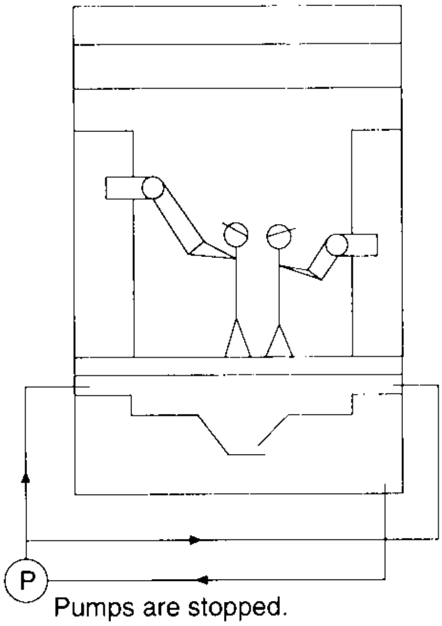


Point of view

Even during lunch time and maintenance when no paint was sprayed, circulating water was kept flowing.

(2) Improvement

(Present practice)



Action

The circulating pump operation circuits were modified to stop the circulating pumps when no paint is sprayed (when the booth operation is halved).

1.4 Effect

(1) Conventional situation

Energy quantity before improvement	1,584,000 kWh/year 1)
Decreased energy quantity 1) – 2)	86,000 kWh/year

(2) Improvement

Energy quantity after improvement	1,498,000 kWh/year 2)
Effect as crude oil	22.4 kL/year

1.5 Future problems

*The effect shall be expressed in terms of year in principle.

Case 13

1. Energy conservation case report

1.1 Energy saving operation of air conditioners while no paint is sprayed at intermediate and top coating booths

(1) Objective: To decrease air conditioning energy.

(2) Outline: The air conditioning temperature and humidity during lunch time and maintenance are changed.

1.2 Items concerned

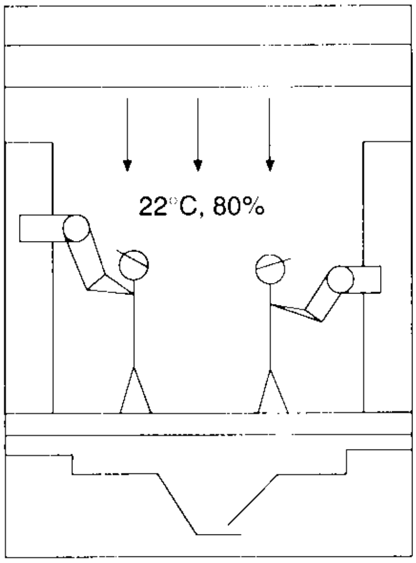
☑ Energy saving
☐ Energy decrease
☑ Production equipment
☐ Non-production equipment
☐ During operation
☑ During non-operation (lunch time, duty interval, holiday)

☐ Electricity
☐ Air
☑ Fuel oil
☐ Steam
Other (   )

1.3 Comparison

(1) Conventional situation

ex. Winter



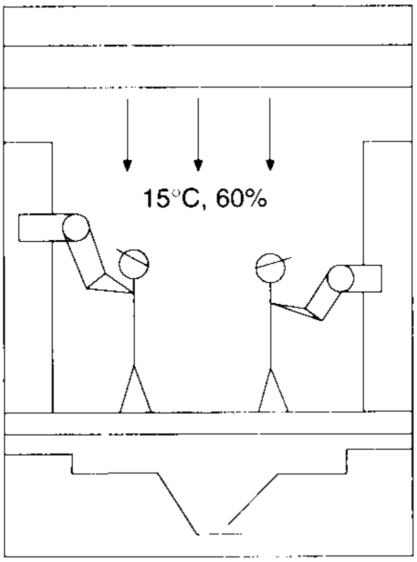
Point of view

Even during lunch time and maintenance when no paint was sprayed, air conditioners were operated under the same conditions as those during spraying.

1) Summer: 28°C, 80%
2) Spring/autumn: 24°C, 80%
3) Winter: 22°C, 80%

(2) Improvement

ex. Winter



Action

Energy saving mode was added.

Energy saving operation during halved operation

1) Summer: Washer only is operated (22 ~ 30°C, 70 ~ 90%)

2) Spring/autumn: Washer only is operated (15 ~ 22°C, 70 ~ 90%)

3) Winter: 15°C, 80% (prevention of dew condensation)

1.4 Effect

(1) Conventional situation

Energy quantity before improvement	638 kL/year 1)
Decreased energy quantity 1) – 2)	56.5 kL/year

(2) Improvement

Energy quantity after improvement	581.5 kL/year 2)
Effect as crude oil	59.3 kL/year

1.5 Future problems

*The effect shall be expressed in terms of year in principle.

Case 14

1. Energy conservation case report

1.1 Efficient operation of electrodeposition water washing pumps (sequential start and stop)

(1) Objective: To stop the operation of electrodeposition water washing pumps during shut-down of line operation, for decreasing power consumption.

(2) Outline: Conventionally, even when the electrodeposition water washing step was devoid of any car during hot time and lunch time, the electrodeposition water washing pumps were operated. So, it was decided to automatically stop the operation of water washing pumps when there is no car, and to start the pumps sequentially when the body is carried in, for decreasing power consumption.

1.2 Items concerned

- ☑ Energy saving
- ☐ Energy decrease
- ☑ Production equipment
- ☐ Non-production equipment
- ☐ During operation
- ☑ During non-operation (lunch time, duty interval, holiday)

- ☑ Electricity
- ☐ Air
- ☐ Fuel oil
- ☐ Steam
- Other (   )

1.3 Comparison

(1) Conventional situation

The water washing pumps were started and stopped in anticipation of the time when the body was carried into and out of the water washing step.

During hot time in the daytime and lunch time, the pumps were not started or stopped since the workers' rest time was different from the time zone during which the water washing step became devoid of any car.

Water washing pumps were operated also while the water washing step was devoid of any car. ...... 20 hours/day

Electrodeposition water washing pump: 5.5 kW × 4 units

(2) Improvement

The car body carried into the electrodeposition water washing step is automatically detected, to sequentially start and stop the water washing pumps.

The improvement could shorten the operation time to 16 hours per day.

[Remark] Change of circuit

1.4 Effect

(1) Conventional situation

Energy quantity before improvement	110,880 kW/year 1)
Decreased energy quantity 1) – 2)	22,176 kW/year

(2) Improvement

Energy quantity after improvement	88,704 kW/year 2)
Effect as crude oil	5,766 L/year

1.5 Future problems

*The effect shall be expressed in terms of year in principle.

Case 15

1. Energy conservation case report

1.1 Energy saving operation of electrodeposition circulating pumps on holidays

(1) Objective: To review the operation frequency of the electrodeposition paint circulating pumps during non-operation of line, for decreasing power consumption.

(2) Outline: The electrodeposition paint circulating pumps were fully operated during line operation and during line non-operation. The rotating speeds of the electrodeposition paint circulating pumps were reviewed to secure the minimum circulation frequency not to cause the settlement of electrodeposition paint, for decreasing power consumption.

1.2 Items concerned

☐ Energy saving
☐ Energy decrease
☐ Production equipment
☐ Non-production equipment
☐ During operation
☐ During non-operation (lunch time, duty interval, holiday)

☐ Electricity
☐ Air
☐ Fuel oil
☐ Steam
Other ( )

1.3 Comparison

(1) Conventional situation

The electrodeposition paint circulating pumps were fully operated also on holidays.
Electrodeposition point: Anionic electrodeposition paint
Paint circulation frequency: 9.4 times/h (including draft stirring)

Rating and power consumption of motors

Pump	Rating	Electric power [kW]
1	19 kW	18.6
2	↑	19.8
3	↑	19.9
4	↑	20.4
5	↑	20.2
For filtration	15 kW	13.5
Total		112.4

(2) Improvement

A voltage-to-frequency converter (inverter) was added to the primary side of each motor, to modify the system for ensuring that the rotating speed of the motor can be changed to achieve a predetermined flow rate, for lowering the rotating speed of each circulating pump during line operation and during line non-operation such as holidays and duty intervals, thereby decreasing power consumption.

Item	Conventional conditions	Targets	
		During line operation	During line non-operation
Circulation frequency	9.4 times/h	7.0 times/h	4.7 times/h
Power consumption	112.4 kW	53.2 kW	42 kW

Item	Before improvement	After improvement	Effect
During line operation	112.4 kW	30.3 kW	82.1 kW
During line non-operation	112.4 kW	19.1 kW	93.3 kW
Annual	984.6 MWh	211.9 MWh	772.7 MWh

[Remark] Voltage-to-frequency converters (inverters) were added.

1.4 Effect

(1) Conventional situation

Energy quantity before improvement	984.6 MW/year 1)
Decreased energy quantity 1) – 2)	772.7 MW/year

(2) Improvement

Energy quantity after improvement	211.9 MW/year 2)
Effect as crude oil	200,902 L/year

1.5 Future problems

*The effect shall be expressed in terms of year in principle.

Case 16

1. Energy saving digest

1.1 Theme

End pressure controller (II) of air supply pressure

1.2 Kind of energy

Compressed air

1.3 Apparatus concerned

Second power low pressure compressor

1.4 Practice period

April, 1992 ~

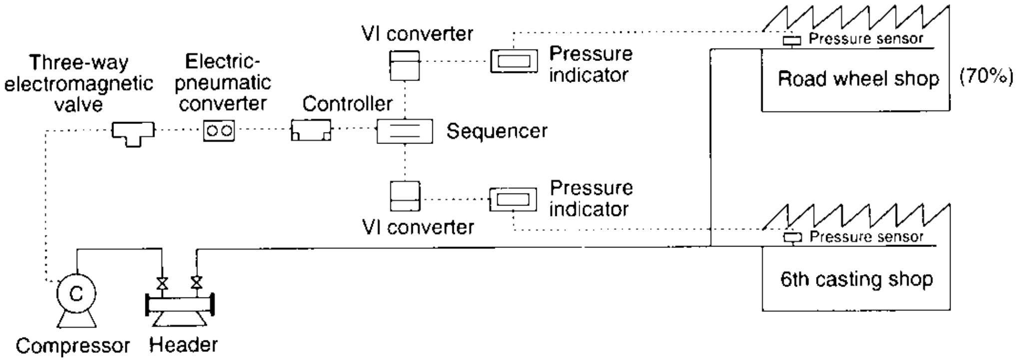
1.5 Outline of apparatus

(1) Conventional system

For controlling the low pressure air, the pressure of the air supply header was detected, and the unloader of the compressor was controlled to keep the air supply pressure constant. According to this method, even if the load at the end had declined to raise the end pressure, the air supply pressure was constant. So, excess pressure occurred.

(2) Improved system

To control the end pressure, low pressure portions in the range from the casting division to the assembling division are detected for controlling the unloader of the compressor, to keep the end pressure constant. At present, the end pressures are detected at the road wheel shop and the 6th casting shop.



(3) Feature

The end control (I) covered the high pressure system, and the pressure was controlled by letting the air go to the low pressure system. In the present improvement, since the end pressure is controlled by the unloader of a compressor, this idea can also be applied to similar other compressors.

1.6 Effects

The decrease in the shaft power of the low pressure compressor and in the quantity of air leak due to the decrease of average air supply pressure by 0.4 kg/cm^2 was estimated to be 20 million yen/year.

Actual effect = 26 million yen/year

Case 17

1. Energy saving digest

1.1 Theme

Remote control of unit heater

1.2 Kind of energy

Steam

1.3 Apparatus concerned

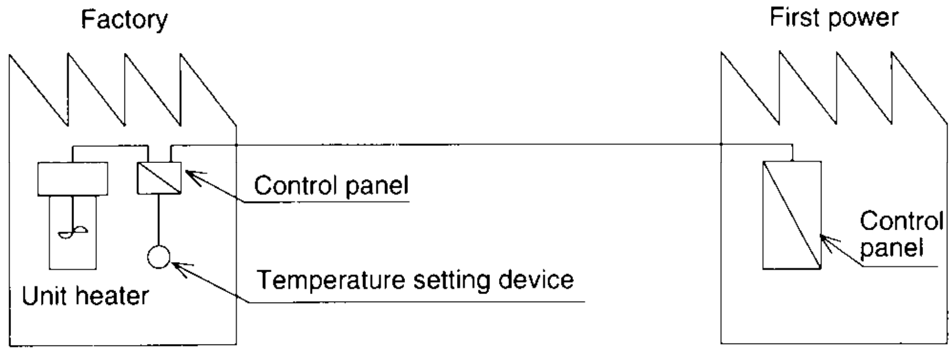
Unit heater (First Axle 27th Line)

1.4 Practice period

September, 1992

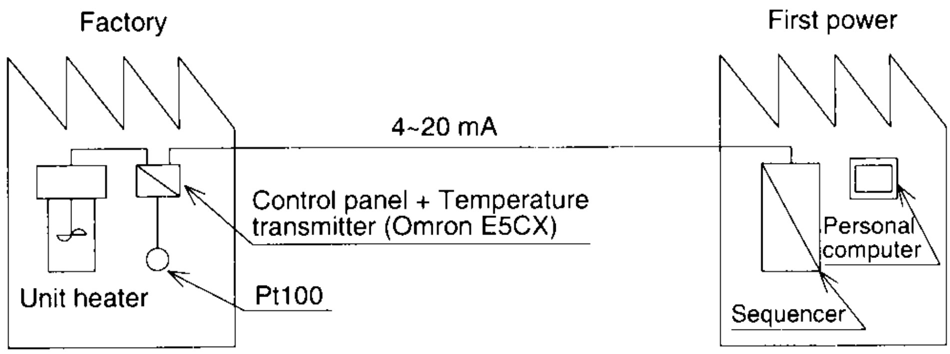
1.5 Outline of apparatus

(1) Conventional system



From the First Power monitor room, a command for automatically operating the unit heater was given to the field panel, and the unit heater was started and stopped by the temperature setting device.

(2) Improved system



The unit heater is started and stopped by the sequencer from First Power.

(3) Features

1) The field temperature is transmitted to First Power by the temperature transmitter, and the unit heater is started and stopped by the sequencer based on the temperature set by the personal computer.

2) The operation status, temperature and operation time in the unit heater area of each factory are displayed as graphics on the personal computer and the operation time is printed out.

1.6 Effects

(1) Temperature control has been remarkably improved. Estimated energy saving effect: 20 million yen/year (actual effect: 25 million yen/year).

1) The platinum resistance temperature sensing element sequencer used improves the temperature accuracy.

2) Changing the temperature setting is not necessary any more.

(2) Since the temperature in each factory can be known, the timing for actuating the air conditioner valve can be severely controlled.

(3) The temperature in the field can be known at a glance on the personal computer, even without measuring it.

Case 18

1. Individual improvement sheet

1.1 Improvement theme

Decrease of energy of washing machine (YW2610)

1.2 Classification

Trouble
Preliminary arrangement
Halt
Speed
Failure
Rise
(Energy)
Tool or mold
Safety
Working convenience
Other

1.2 Reasons for taking up the theme

(1) Since dripping in the air blow tank was poor, water drops remained.

(2) For drying products, hot air blow was used.

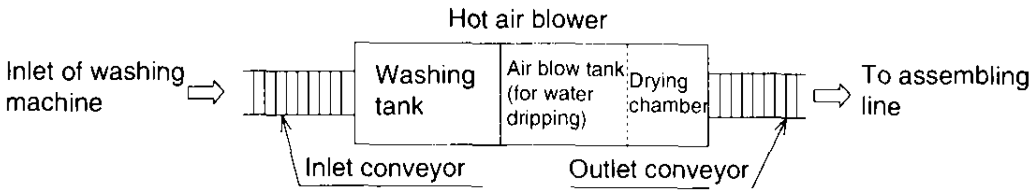
1.3 Targets of improvement

By March, 1997,

(1) air consumption to be decreased by 20%.

(2) electric power consumption to be decreased by 20%.

1.4 Outline of equipment (line)



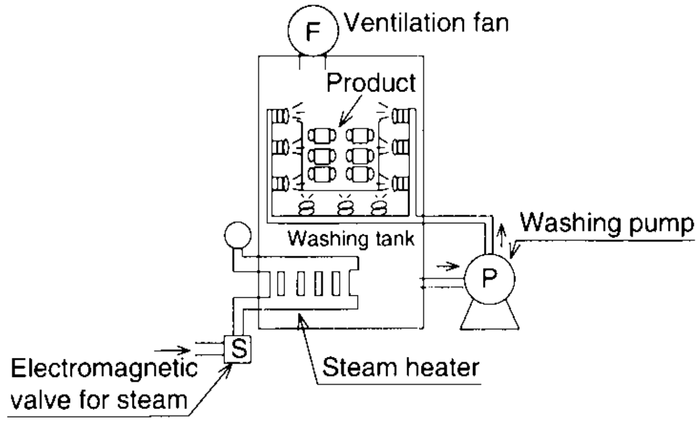
YW2610 washing machine

1.5 Identification and analysis of situation

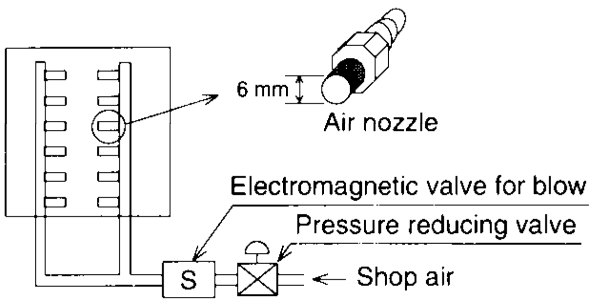
(1) Outline of washing tank

1) The washing solution was heated to 70 ~ 80°C by a steam heater.

2) The washing solution was pressure-fed by a 3.5 kW washing pump, to be sprayed to products.



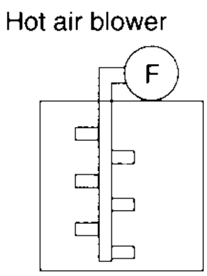
(2) Outline of air blow tank



1) Twelve copper pipes with an inner diameter of 6 mm were used for air blowing.

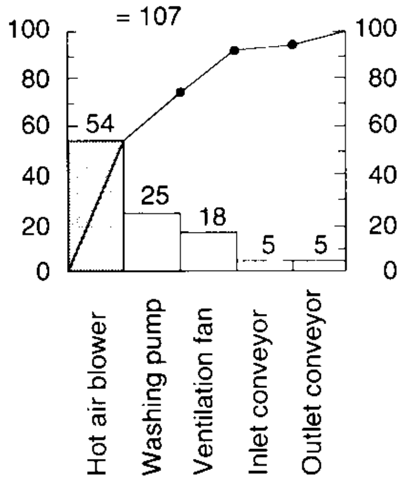
2) Air blow was effected while products stopped.

(3) Outline of drying chamber

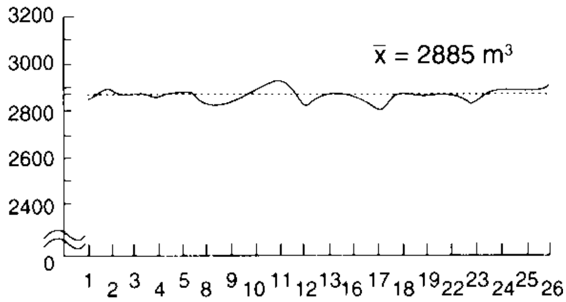


A 7.5 kW hot air blower was used for drying the surfaces of products.

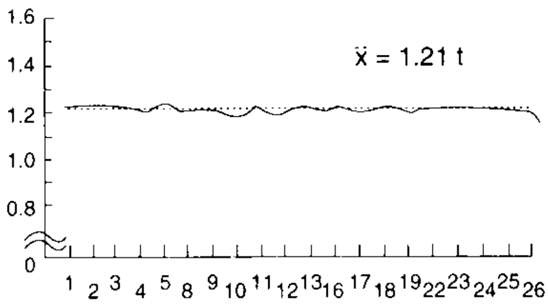
(4) Much water remained.



Pareto diagram of electric power consumption per day



Graph of air consumption per day



Graph of steam consumption per day

1.6 Details of main improvements

(1) Improvements for raising air temperature

1) Air piping is kept in contact with the steam piping used for the washing tank.

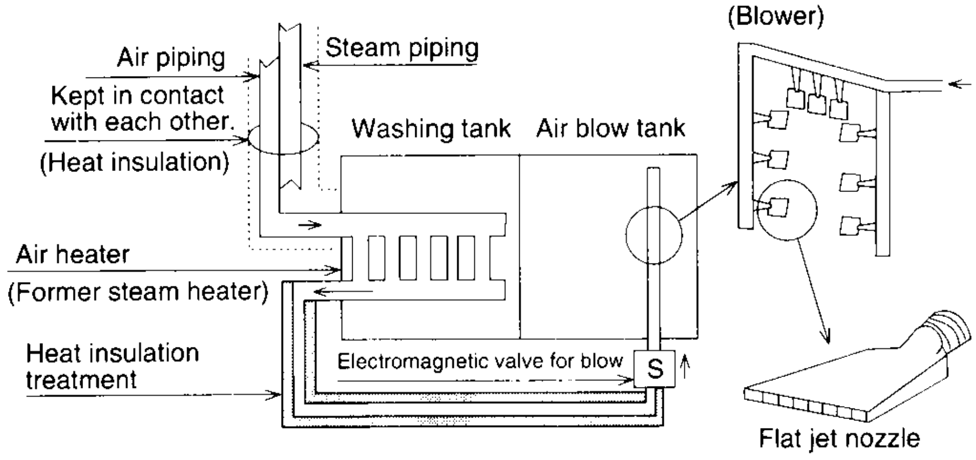
2) The steam heater which had been used for the washing tank is used as an air heater.

(2) Improvements for air blower

1) A gate type air blower is adopted.

2) Air blow is executed while products move.

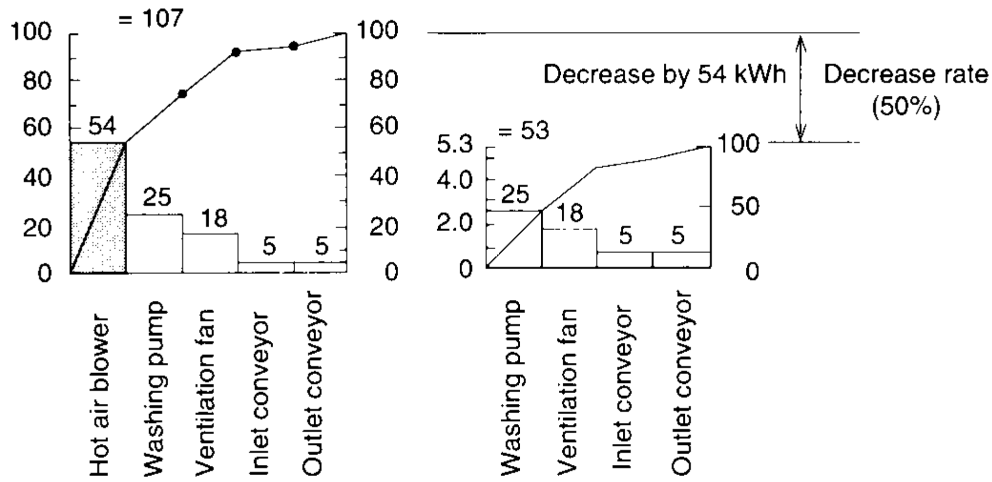
3) The air blow nozzle was changed to a low noise energy saving type nozzle.



Discontinuance of hot air blower

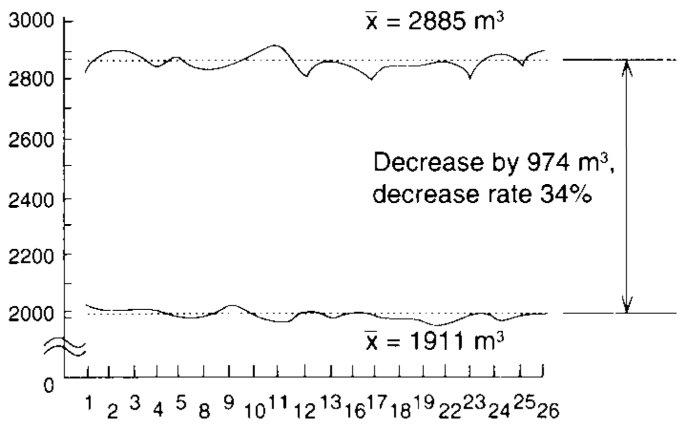
1.7 Effects of improvement

(1) Electric power consumption decrease effect



Pareto diagram of electric power consumption per day

(2) Air decrease effect



Graph of air consumption per day

(3) Calculation of effects in amount of money

1) Electric power: 54 kWh × 244 days × 9 yen/kWh = 119,000 yen/year

2) Air: 974 m^3 × 244 days × 1.2 yen/m^3 = 285,000 yen/year

1.8 Sustaining of effects

For sustaining, improving and expanding the effects					
What	Where	Who	When	Why	How
Working Standard	In the field	S42	December 10	Standardization	By revision
Equipment Inspection Standard	In the field	S42	December 15	Sustaining of function	By revision
Prevalent use of improved nozzle	All sites	S24	From January, 1997	For expansion of effects	By changing the nozzle.

1.9 Future problems

(1) To promote the prevalent adoption of the improvements in similar equipment.

(2) To review the air blowing equipment for possible adoption of the improved nozzle.

Case 19

1. Thermal efficiency improvement achieved by using new boilers in Second Area

One 30 t/h water tube boiler was replaced by ten 2 t/h small once-through boilers. The thermal efficiency improvement achieved in this case is described below.

(1) The 30 t/h water tube boiler was operated at a peak thermal efficiency of about 85%, but at an average thermal efficiency of 80%, due to low load, shutdown loss, etc.

(2) Since many 2 t/h small once-through boilers have been installed, the number of boilers operated can be controlled to suit the load, to allow each boiler to be operated always at a thermal efficiency of 95%. So, irrespective of the load, a high efficiency can be kept. The boiler room of the Second Area has an accumulator and the boilers are protected from any sudden change of load. However, considering the loss due to shutdown, etc. as 5%, the average thermal efficiency is assumed to be 90% for calculation.

(3) Effect of thermal efficiency improvement

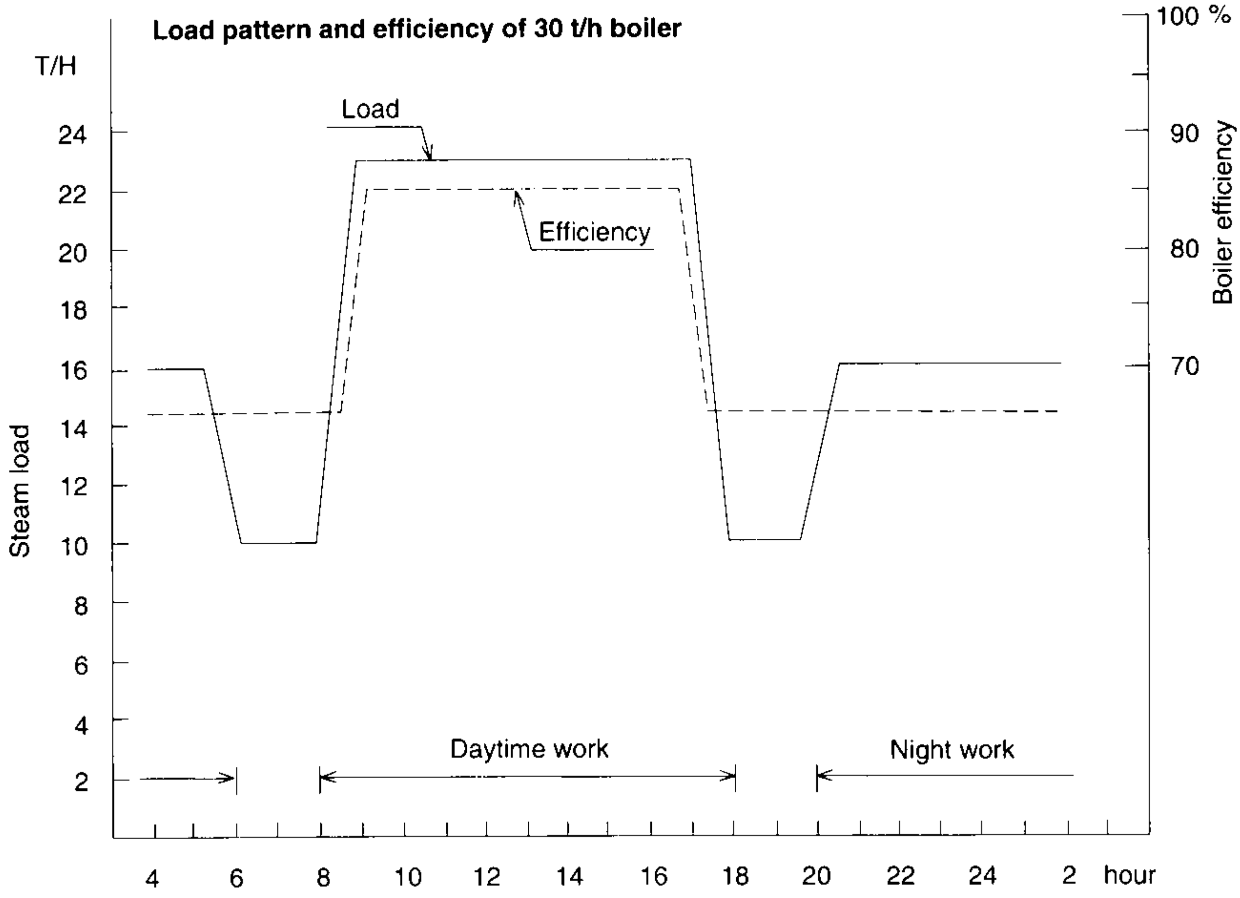
1) Thermal efficiency improvement

$(1392178 - 1392178 \times 0.8/0.9) \times 25/1000 = 3{,}867{,}000$ yen/year

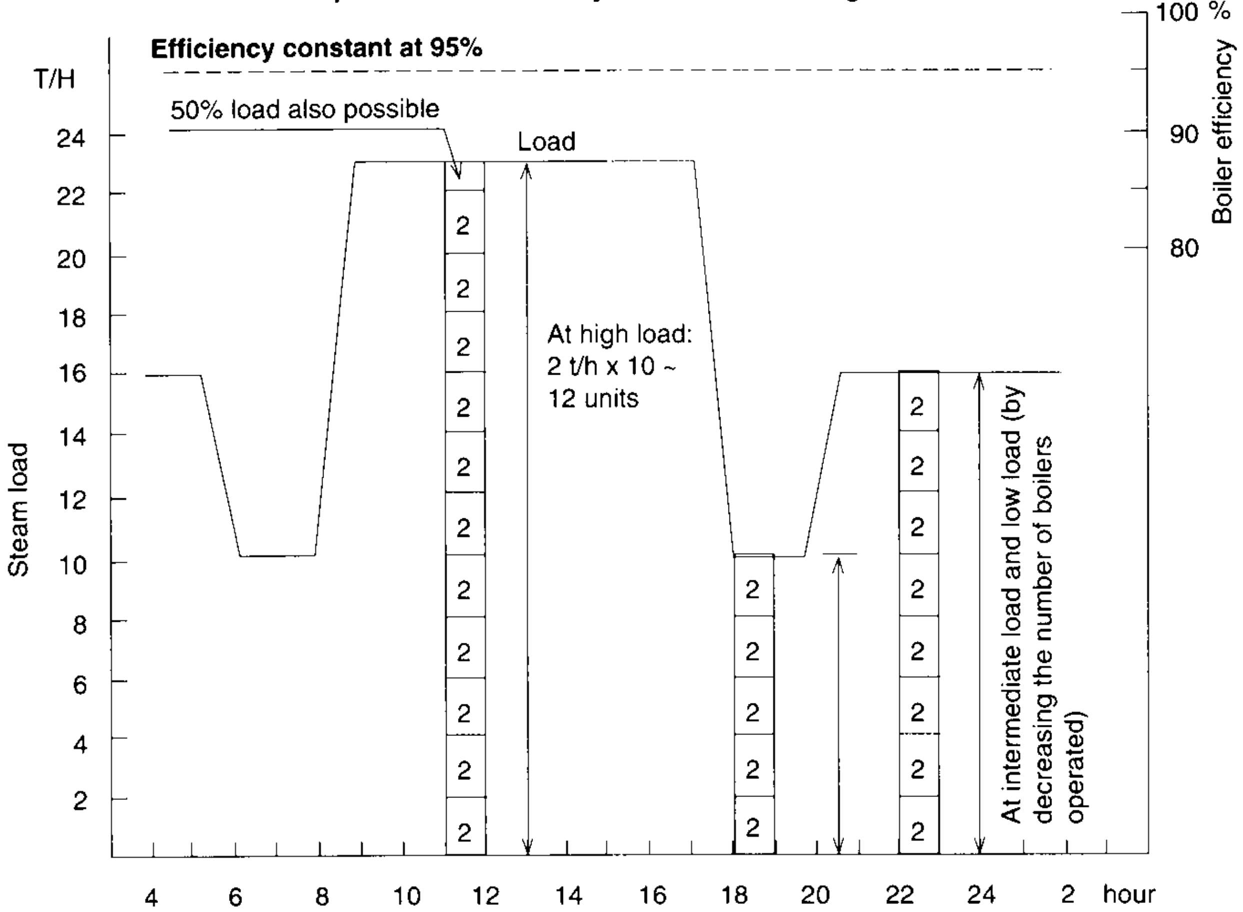
2) Due to change to city gas

$1392178 \times 0.8/0.9 \times 25 - 1001243 \times 39.5 = -8{,}612{,}000$ yen/year

Comparison of a large boiler and many small boilers in operation



Load pattern and efficiency of 2 t/h once-through boilers



Reference 1

1. Standard values as businesses' criteria under Energy Conservation Law

1.1 Regulatory levels for rationalization

Attached Table 4-1A Regulatory excess air factors of boilers (during combustion at a certain load in stable state after periodical inspection)

Boiler capacity (amount of evaporation)	Oil firing	Gas firing
30 tons or more per hour	1.1 ~ 1.25	1.1 ~ 1.2
10 tons to less than 30 tons per hour	1.15 ~ 1.3	←
5 tons to less than 10 tons per hour	1.2 ~ 1.3	←
Less than 5 tons per hour	1.2 ~ 1.3	←

Attached Table 4-2A Regulatory excess air factors of industrial furnaces (during combustion at almost the rated load after inspection or repair) (at exhaust outlet of furnace)

Kind of furnace *[1]	Oil firing		Gas firing	
	Continuous type	Intermittent type	Continuous type	Intermittent type
Casting melting furnace	1.3	1.4	1.25	1.35
Billet heater	1.25	—	1.2	—
Metal heating furnace	1.25	1.35	1.25	1.35
Heat treatment furnace	1.25	1.3	1.2	1.25
Drying furnace *[2]	1.3	1.5	1.25	1.45

*[1]. Cupola is not included.

*[2]. Burner portion only.

Attached Table 4-3A Regulatory furnace wall outer surface temperatures of industrial furnaces (average temperatures in the steady state at an open air temperature of 20°C)

Furnace temperature	Furnace wall outer surface temperature (°C)		
	Ceiling	Lateral side wall	Bottom
1,300°C or higher	140	120	180
1,100°C to lower than 1,300°C	125	110	145
900°C to lower than 1,100°C	110	95	120
Lower than 900°C	90	80	100

*[1]. Cupola is not included.

Attached Table 4-4A Regulatory exhaust gas temperatures of boilers (at a load factor of 100% at an inlet air temperature of 20°C after periodical inspection)

Amount of evaporation	Waste gas temperature (°C)	
	Oil firing	Gas firing
30 tons or more per hour	200	170
10 tons to less than 30 tons per hour	200	170
5 tons to less than 10 tons per hour	220	200
Less than 5 tons per hour	250	220

Attached Table 4-5A Regulatory waste heat recovery rates of industrial furnaces (during combustion at almost the rated load)

Exhaust gas temperature (°C)	Capacity class	Waste heat recovery rate (%)
Lower than 500	A · B	25
500 to lower than 600	A · B	25
600 to lower than 700	A	35
	B	30
	C	25
700 to lower than 800	A	35
	B	30
	C	25
800 to lower than 900	A	40
	B	30
	C	25
900 to lower than 1,000	A	45
	B	30
	C	25
1,000 or higher	A	45
	B	30
	C	30

(1) The exhaust gas temperature refers to the temperature at the furnace outlet and at the recuperator inlet.

(2) Capacity classes are as follows:

A: 84,000 MJ or more per hour

B: 21,000 MJ to less than 84,000 MJ per hour

C: 840 MJ to less than 21,000 MJ per hour

Attached Table 4-6 Apparatuses to be improved in power factor

Name of apparatus to be improved in power factor	Capacity (kW)
Squirrel cage induction motor	75
Wound rotor induction motor	100
Induction furnace	50
Vacuum melting furnace	50
Induction heater	50
Arc furnace	—
Flash butt welding machine	10
Arc welding machine (excluding portable type)	10
Rectifier	10,000

1.2 Target levels for rationalization

Attached Table 4-1B Target excess air factors of boilers (during combustion at a certain load in stable state after periodical inspection)

Boiler capacity (amount of evaporation)	Oil firing	Gas firing
30 tons or more per hour	1.05 ~ 1.15	←
10 tons to less than 30 tons per hour	1.15 ~ 1.25	←
5 tons to less than 10 tons per hour	1.15 ~ 1.3	1.15 ~ 1.25
Less than 5 tons per hour	1.15 ~ 1.3	1.15 ~ 1.25

Attached Table 4-2B Target excess air factors of industrial furnaces (during combustion at almost the rated load after inspection or repair) (at exhaust outlet of furnace)

Kind of furnace *[1]	Oil firing		Gas firing	
	Continuous type	Intermittent type	Continuous type	Intermittent type
Casting melting furnace	1.05 ~ 1.25	1.05 ~ 1.3	1.05 ~ 1.2	1.05 ~ 1.25
Billet heater	1.05 ~ 1.2	—	1.05 ~ 1.15	—
Metal heating furnace	1.05 ~ 1.2	1.05 ~ 1.3	1.05 ~ 1.15	1.05 ~ 1.3
Heat treatment furnace	1.05 ~ 1.2	1.05 ~ 1.3	1.05 ~ 1.15	1.05 ~ 1.25
Drying furnace *[2]	1.05 ~ 1.3	1.05 ~ 1.5	1.05 ~ 1.25	1.05 ~ 1.45

*[1]. Cupola is not included.

*[2]. Burner portion only.

Attached Table 4-3B Target furnace wall outer surface temperatures of industrial furnaces (average temperatures in the steady state at an open air temperature of 20°C)

Furnace temperature	Furnace wall outer surface temperature (°C)		
	Ceiling	Lateral side wall	Bottom
1,300°C or higher	120	110	160
1,100°C to lower than 1,300°C	110	100	135
900°C to lower than 1,100°C	100	90	110
Lower than 900°C	80	70	90

*[1]. Cupola is not included.

Attached Table 4-4B Target exhaust gas temperatures of boilers (at a load factor of 100% at an inlet air temperature of 20°C after periodical inspection)

Amount of evaporation	Waste gas temperature (°C)	
	Oil firing	Gas firing
30 tons or more per hour	160	140
10 tons to less than 30 tons per hour	160	140
5 tons to less than 10 tons per hour	180	260
Less than 5 tons per hour	200	180

Attached Table 4-5B Target waste heat recovery rates of industrial furnaces (during combustion at almost the rated load)

Exhaust gas temperature (°C)	Capacity class	Waste heat recovery rate (%)	Waste gas temperature (°C)	temperature (°C)
Lower than 500	A · B	35	275	190
500 to lower than 600	A · B	35	335	230
600 to lower than 700	A	40	365	305
	B	35	400	270
	C	30	435	230
700 to lower than 800	A	40	420	350
	B	35	460	310
	C	30	505	265
800 to lower than 900	A	45	435	440
	B	40	480	395
	C	35	525	345
900 to lower than 1,000	A	55	385	595
	B	45	485	490
	C	40	535	440
1,000 or higher	A	55	—	—
	B	45	—	—
	C	40	—	—

(1) The exhaust gas temperature refers to the temperature at the furnace outlet and at the recuperator inlet.

(2) Capacity classes are as follows:

A: 84,000 MJ or more per hour

B: 21,000 MJ to less than 84,000 MJ per hour

C: 840 MJ to less than 21,000 MJ per hour

Energy Conservation Guidebook

In Japan, Energy Conservation Month is observed in February every year to increase energy conservation awareness and further spread concrete energy conservation activities throughout the country.
During Energy Conservation Month, Nissan Motor undertakes special promotional events at its factories and other business sites. Using Energy Conservation Month as a lever, let's further our energy conservation efforts by taking a closer look at energy consumption in our factory.

* Aiming for Japan's No. 1 factory

Amid a continued severe business environment, active energy conservation programs are being implemented by Nissan and many other companies as part of their cost cutting efforts. To emerge as a winner from the fierce corporate competition, it is necessary to tackle cost cutting more vigorously than your competitors.

* Each employee's great ideas and steady efforts can bring about great saving effects. Aiming to make our factory Japan's No. 1, let's elevate our energy conservation activities to the highest standards as well.

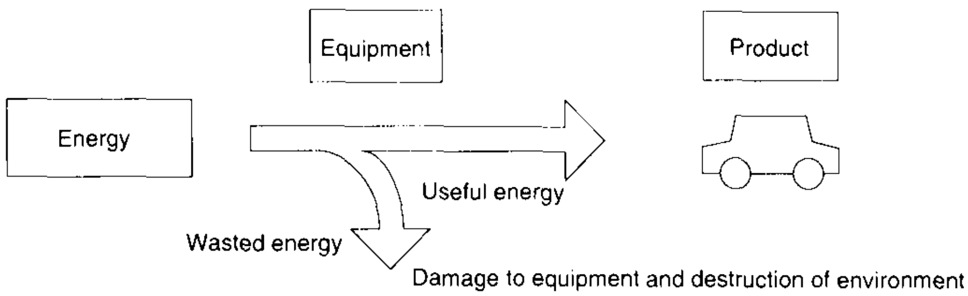
* To be No. 1 in Japan's energy conservation drive, we must tackle the issue at its heart, challenging the limits with smart thinking and inventiveness, rather than mindlessly resorting to superficial measures.

Energy Conservation as Main Pillar of Cost Cutting Efforts

* In Murayama District, energy costs totaled as much as ¥2.3 billion in fiscal 1993, emerging as a major target for cost cutting efforts.

Improve Efficiency by Eliminating Waste

(Let's get as close to theoretical energy consumption limits as possible.)



Please look for new energy conservation methods.

* It is the energy consuming section that plays the major part in energy conservation activity, with support provided by the technical service and engineering sections associated with the process concerned.
Please look for new ways of saving energy, using Energy Conservation Month as a springboard to further our activities into fiscal 1995.

Energy Conservation Implementation Procedure

(1) Energy conservation audit

(Have a good grasp of the amount of energy being consumed.)
Do you know how much energy is being used?

(2) Setting targets

(Let's set energy consumption reduction targets.)
Ambitious but realistic targets will lead to great results.

(3) Planning and evaluation of improvement measures

(Give your idea a concrete shape.)
Fully examine its effects on the product quality, expected benefits and associated investment costs.

(4) Working out and putting it into action improvement measure implementation programs

(Make sure you draw up a proper plan.)
Implement the program in accordance with a sensible schedule and under close cooperation with other sections concerned

(5) Checking improvement effects and standardization

(Carry out comparisons on an energy consumption rate per unit production basis.)
Utilize the results of energy consumption rate per unit production comparisons and improvement measure implementation as MP data.

Focuses of Energy Conservation

1) STOP

• Why is this equipment necessary?
• Can we eliminate this step?

Examples:

(i) Can we stop or cut back on air blowing?

(ii) Can the number of steps in washing processes be reduced?

2) SUSPEND

• Is any equipment running idly?

Examples:

(i) Are there any louver fans running 24 hours a day?
(It not only wastes electricity, but also warm air.)

(ii) Is there any equipment running idly during the lunch break and between shifts?
Are there any machines running 24 hours day?
(Is there a way of detecting vehicle bodies to control them automatically?)

3) REDUCE

• Why is this amount necessary?

• Can we reduce operating pressures, temperature settings and operating hours?

Examples:

(i) Can we reduce air pressure?

(ii) Can we reduce hot water temperatures or booth temperatures?

(iii) Can we reduce drying durations?

4) REPAIR

• Are there any losses caused by machine faults?

Examples:

(i) Are there any air leaks from couplers?

(ii) Are there any water leaks from half-open taps?

(iii) Are there any overflows from tanks or cooling towers?

5) RECOVER

• Where is energy being wasted?

• Can any waste energy be recovered and reused?

Examples:

(i) Can we use heated exhaust air from combustion facilities (ovens) or ducts (waste heat recovery)?

(ii) Is there any clean water being drained away?

6) SUBSTITUTE

- Can we use cheaper energy sources?

Examples:

(i) Can we switch from electric heaters to gas heaters?

Electricity	1 kWh (¥10) = 860 kcal	¥11.6/1,000 kcal
Gas	1 m^3 (¥23) = 6,500 kcal	¥3.5/1,000 kcal

(ii) Can we change machine operation priorities to operate higher efficiency ones first?

* Check the above 6 points (3 R's & 3 S's) and use your ingenuity.

Of course, these examples do not cover everything. Try to look at things around you from a different angle, and give a little thought to what happens if your routine work is done using a different method or different work steps.

You may find unexpected energy conservation ideas. Please give us a hand.

Examples of Estimating Energy Conservation Benefits

<Electricity> When lights and machines are switched off for one hour a day

Item		Electricity consumed	Calculation formula	Annual savings
Lights	Single 40 W-lamp fluorescent	40 (W)	0.04 kW * 1 lamp * 1 hour/ day * 244 (days/year) * 10 (yen/kWh) =	97 yen/fixture
	Double 40 W-lamp fluorescent	80 (W)	0.04 kW * 2 lamps * 1 hour/day * 244 (days/year) * 10 (yen/kWh) =	195
	Double 110 W-lamp fluorescent	220 (W)	0.11 kW * 2 lamps * 1 hour/ day * 244 (days/year) * 10 (yen/kWh) =	536
	300 W	300 (W)	0.3 kW * 1 lamp * 1 hour/day * 244 (days/year) * 10 (yen/kWh) =	732
	250 W sodium	250 (W)	0.25 kW * 1 lamp * 1 hour/ day * 244 (days/year) * 10 (yen/kWh) =	610
	400 W mercury	400 (W)	0.4 kW * 1 lamp * 1 hour/ day * 244 (days/year) * 10 (yen/kWh) =	976
	700 W mercury	700 (W)	0.7 kW * 1 lamp * 1 hour/ day * 244 (days/year) * 10 (yen/kWh) =	1,708
	1,000 W mercury	1,000 (W)	1.00 kW * 1 lamp * 1 hour/ day * 244 (days/year) * 10 (yen/kWh) =	2,440
Motors	0.75 kW fan	750 (W)	0.75 kW * 1.00 (LF) * 1 * 1 * 244 * 10 =	1,830
	0.75 kW pump	562.5 (W)	0.75 kW * 0.75 (LF) * 1 * 1 * 244 * 10 =	1,372
	0.75 kW pump	375 (W)	0.75 * 0.50 (LF) * 1 * 1 * 244 * 10 =	915
Heater	1 kW electric heater	1,000 (W)	1.00 kW * 1 unit * 1 (hour/day) * 244 (day/year) * 10 (yen/kWh) =	2,440

Utilize these for overall estimates.

(For more accurate estimates, carry out measurements.)

<Steam>

What is the hourly energy consumption of a ceiling-mounted unit heater (square-shaped)?

(75,000 (kcal/h*unit) * 0.8)/500 (kcal/kg) = 120 (kg/h)

0.12 (t/h) * 2,600 (yen/t) = 312 (yen/h)

By turning it off for one hour a day per season, a saving of ¥31,200 can be achieved.

<Air>

Air leaks from bolted Joints and couplers
* Carry out calculations using the following figures — although there are some variations depending on the size.

Item	Air pressure	Leakage volume
Small leak	5.0(kg/cm^2)	1.2(Nm^3/H)
Medium leak	5.0(kg/cm^2)	2.8(Nm^3/H)
Large leak	5.0(kg/cm^2)	5.6(Nm^3/H)

Saving effect calculation example for small air leak

Operating pressure (gauge pressure)	5.0 (kg/cm^2)
Leakage duration (per day)	18 (hours/day)
Days of operation (per year)	244 (days/year)
Unit cost of air	1.0 (yen/Nm^3)

1.2 (Nm^3/h) * 18 (h/d) * 244 (d/y) * 1.0 (yen/Nm^3) = 5,270 (yen/y)

<Gas>

When butane air gas baking is reduced by an hour a day
(at a gas flow rate of 50 (Nm^3/h))

50 (Nm^3/h) * 1 (h/d) * 244 (d/y) * 23 (yen/Nm^3) = 280,600 (yen)

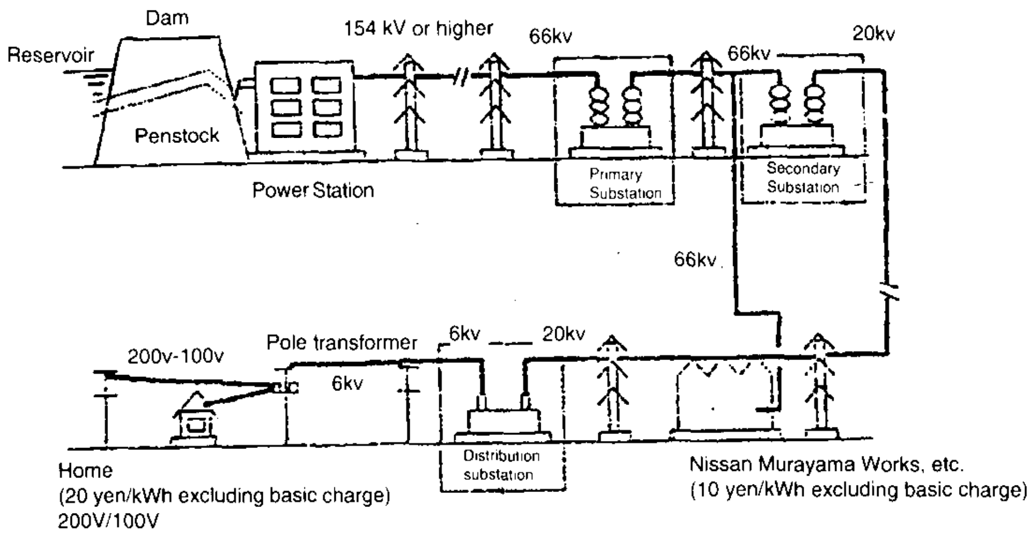
<Water>

When water trickle-flows from a tap:
Loss per minute is 213 (cc)
Loss per year is 110,500 (l)

This will incur the following costs:
Water supply cost 110.5 (m^3/y) * 13 (yen/Nm^3) = 1,436 (yen/y)
Sewerage cost 110.5 (m^3/y) * 203 (yen/Nm^3) = 22,431 (yen/y)
Thus, water leaks not only increase water supply costs but also sewerage costs, with the increase in the latter actually greater than the former.

<Reference>

Electricity Supply Process — from Generation to Delivery



As can be seen from the above diagram, electricity passes through various electrical equipment and power transmission lines before being delivered to consumers. This forces the electric power company (e.g. Tokyo Electric Power Co., Ltd.) to spend enormous amounts of money to cover equipment, construction and operation/maintenance costs, which are subsequently passed onto consumers in the form of electricity rates.
As electricity supply to homes involve extra facilities, electricity rates for homes are about 1.5 times higher than factories.

Calculation of Electricity Costs

Electricity rates include a component called a basic charge, which also applies to other utility rates, such as telephone and water supply.

Basic charges in electricity supply are determined in accordance with the maximum power demand. For a home, the basic rate is based on the maximum current setting (15 A or 20 A) of a circuit breaker, called a current limiter, which is also an expression of maximum power demand, as a current limiter automatically turns itself off when the electric current, and thus electric power, flowing through it exceeds the predetermined limit.

In that event, people can continue using electricity in the home simply by turning off the power switches of a couple of appliances and then turning the current limiter back on. At factories, however, this is not acceptable, as it means shutting down some of the production machines.

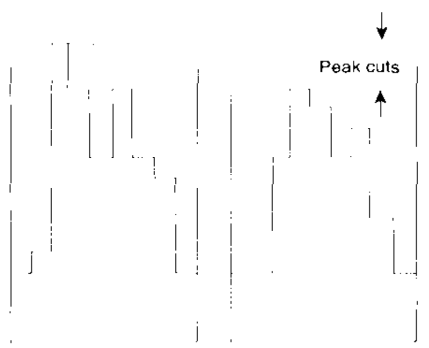
Therefore, an excess power demand surcharge (a kind of fine) is paid to the power company, instead of allowing the power supply to be cut off.

However, if this is repeated often, the power company issues a recommendation for an increase in the contract demand.

To keep contract demand low, it is necessary to avoid short bursts of intensive electricity use and use electricity evenly day and night.

← Electricity rate →	
Basic charge (fixed contract component)	Meter charge

The greater the proportion of the basic charge, the higher the price of electricity per kWh.



Fellow employees

Let's take a closer look at our energy use and find ways of improving it.

Successful Case of Energy Conservation in Tochigi Plant of Nissan Motor Co., Ltd.

Computation of Energy conservation Effect – Electricity

① Power consumption of the electric appliance

Appliance	Power used (kW)	per hour
Personal computer	0.1	¥1.3
Word processor	0.05	¥0.65
Copier	1.0	¥13.0
Television	0.05	¥0.65
Hot water pot	0.6	¥7.8
·Refrigerator	Wattage x load 0.5	
Electronic oven	1.0	¥13.0
·Electric heater	0.5 (500w)	¥6.5
Unit heater	2.2	¥28.6
Spot cooler	1.5	¥19.5
Electric fan	0.2	¥2.6

· With respect to the electric heater and refrigerator, power consumption varies according to the wattage. Obtain an hourly fee by the following equation.

$$\frac{\text{Rating wattage}}{1000} \times ¥13/\text{kWh} = \text{Fee per hour}$$

· Compute the amount of energy consumption for your work unit (per one machine).

· Amount used per hour x Hours used per day x No. of days worked – Amount used per year

· For your information, power is consumed at the rate of 10% of the total power as stand-by power if left plugged in. It is recommended to unplug any electric appliance as much as possible.

② In case when a lamp is turned off for a certain number of hours per day (per lamp)

Item		Power consumed (W)	Annual effect (¥/year)
Lighting	1 bulb of 40W	43	136
	2 bulbs of 40W each	85	270
	2 bulbs of 110W each	230	730
	Eye-lamp of 300W	300	952
	Sodium lamp of 250W	273	866
	Fluorescent tube of 400W	424	1,345
	Fluorescent tube of 700W	745	2,362
	Fluorescent tube of 1,000W	1,060	3,362
Electric heater of 1kW		1,000	3,172

Equation

Power consumed x No. of lamps x hours lit per year x unit price = Annual effect

・ Use the above table to compute the effect of your energy conservation efforts.

Computation of Energy conservation Effect – Air

① **Air leak**

◎ A leak from the joint or screw cap

・ You can compute leakage based upon the following values, although there are some differences in size and etc.

Item	Air Pressure	Air Leakage
Leak (small)	5 kg / cm^2	1.2 Nm^3 / h
Leak (medium)	5 kg / cm^2	2.8 Nm^3 / h
Leak (large)	5 kg / cm^2	5.6 Nm^3 / h

・A hypothetical situation of an air leak — Leak (small)

Pressure used (gauge pressure)	5 kg/cm^2
Hours of leak (per day)	18 hours
No. of hours worked (per year)	244 days
Unit price of air (N m^3 / h)	¥1.2/Nm^3

Equation for the effect of the above air leak

1. 2 Nm^3 x 18 hours x 244 days x ¥1.2/Nm^3 = ¥6,300/year

・ Carry out a computation for a large or medium air leak as well.

Leakage per pressure (per hour)

Delivery pressure	6 kg / cm^2	5 kg / cm^2	4 kg / cm^2
Actual air leakage (per 1 mm^2)	2.51 Nm^3	2.2 Nm^3	1.89 Nm^3
Delivery pressure	3 kg/cm^2	2 kg/cm^2	1 kg/cm^2
Actual air leakage (per 1 mm^2)	1.58 Nm^3	1.2 Nm^3	0.81 Nm^3

Formula

Value in the above table x Hours of leak x Hours worked x Unit price of air

↘ ↙

Change the figures depending upon the leak..

② **When you flatten the end of an air blow nozzle ....**

(As an example, the core CB-line air-blow equipment in the MF2 Factory)

Volume of air-brow before taking the measure	240 Nm^3/h
Volume of air-blow after taking the measure	165 Nm^3/h
Hours of air blow per product	6 seconds/unit
Core C/B production amount	2,720 pieces/day

Equation

$$(240 - 165)\ Nm^3 \times \frac{6\ \text{seconds/pieces} \times 2720\ \text{pieces/day}}{3600\ \text{seconds}} \times 244\ \text{days/year} \times ¥1.2/Nm^3 = ¥99,600/\text{year}$$

Flow rates by changing the shape of the airgun point

For the copper pipe of 8 mm (inner diameter 6mm)

	Shape	Flow rate (Root 5 kg/cm^2)	Wind velocity (Point 60 cm)	Noise (Side 1m)
1	O Circle	53 m^3/h (3.3K)	23 m/s	91.1 dB (A)
2	7 mm, 9mm	53 m^3/h (3.3K)	23 m/s	91.7 dB (A)
3	5 mm, 10 mm	53 m^3/h (3.4K)	23 m/s	91.4 dB (A)
4	4 mm, 10.5 mm	45 m^3/h (3.7K)	25 m/s	90.3 dB (A)
5	3 mm, 10.5 mm	37 m^3/h (4.0K)	25 m/s	88.4 dB (A)

Formula

Flow-rate shown in the above x No. of hours worked x No. of days worked x Unit price of air

Change the figures depending upon the situation.

Computation of Energy conservation Effect – Steam

① **Steam leak**

◎ A leak from the joint or screw cap

・ Carry out a computation based upon the following values although there are some differences in size and etc.

Item	Leaking conditions	Steam pressure	Amount
Leak (small)	Oozing	5 kg/cm^2	¥10/h
Leak (medium)	Spurting	5 kg/cm^2	¥20/h
Leak (large)	Dripping	5 kg/cm^2	¥40/h

・ A computation example of effect from a steam leak — Leak (small)

Hours of leak (per day) — 18 hours

Days worked (per year) — 244 days

Equation

18 hours x ¥10/h x 244 days/year = ¥43.900/year

Note: A large leak means a substantial amount of leakage. In case of a large leak, there will be computational errors. Get advice from the M24 Energy conservation Consulting Group.

・ Is there not any uninsulated piping in steam piping?

The following effect can be expected from insulating piping

・

◎ Computation of effect: Energy conservation effect from insulation per 1m

(Size 20A operation)

Formula

$$\frac{\text{(Heat dissipation from uninsulated piping – Heat dissipation from insulated piping) x length (m)}}{\text{Equivalent value of steam volume}}$$

$$\text{x Hours air-supplied x Unit price of steam} \quad \frac{(111-26) \times 1\text{ m}}{500\text{ kcal/kg}} \times 6{,}100\text{h/year} \times ¥2.2\text{/kg}$$

= ¥2,281/year

A Digest of Energy conservation Items

Item No.1
Created by: Sakurai
Created on: May 25, 2001

The Name of Theme

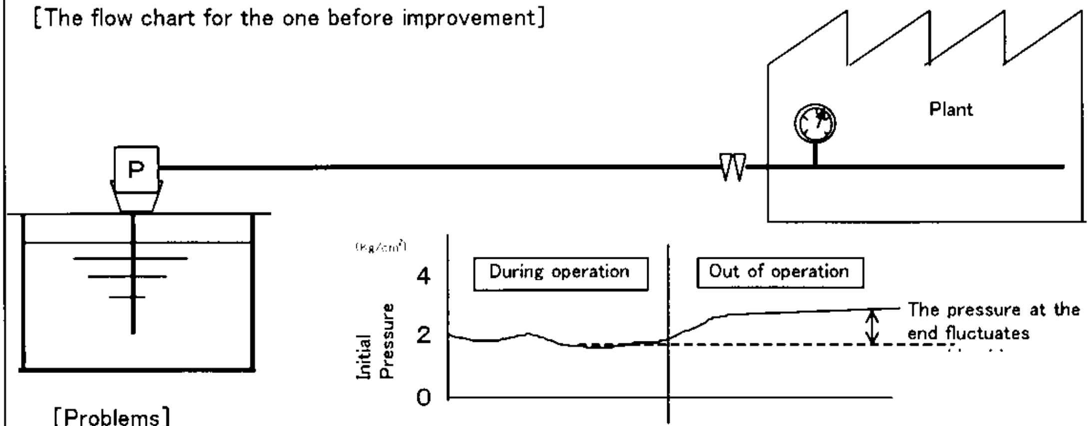
The control of the pressure at the end of water-conveying pump

Classification of Energy	Targeted Facility	Time to Conduct
Electricity	Water-conveying pump for city water	1995

Details of the

1) The conventional system

[The flow chart for the one before improvement]



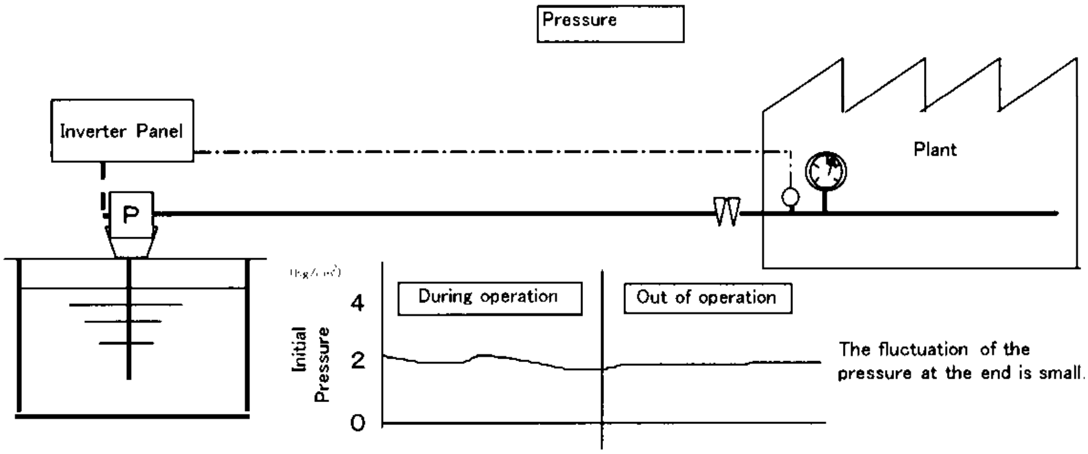
[Problems]

・The pump sent water constantly regardless of the amount of consumption on the plant side and the variation of the water-conveying pressure was considerable.

・When the amount of consumption got lower between the shifts or during holidays, the pressure at the end got higher and the water-conveying pressure becamee excessive.

2) The Improved System

[The flow chart for the one after improvement]



The signal representing the water-conveying pressure at the entrance of the plant was fed back to make the pressure stable at the predetermined pressure by controlling the rotation rate using the inverter, and the electric power for the

3) The features of the improvement	4) The Amount Invested
・By detecting the pressure at the end, the water conveying pressure can be quickly controlled and the pressure fluctuation range could be made smaller. ・By controlling the pressure at the end located on the site where the water was used, the excessive water pressure was avoided.	¥500,000

5) The Effect of This Improvement	6) Presentations for Outside and Prizes
The electricity consumption was reduced by 20~30% in case with a 15 kW motor.	

A Digest of Energy conservation Items

Item No.2
Created by: Sakurai
Created on: May 25, 2001

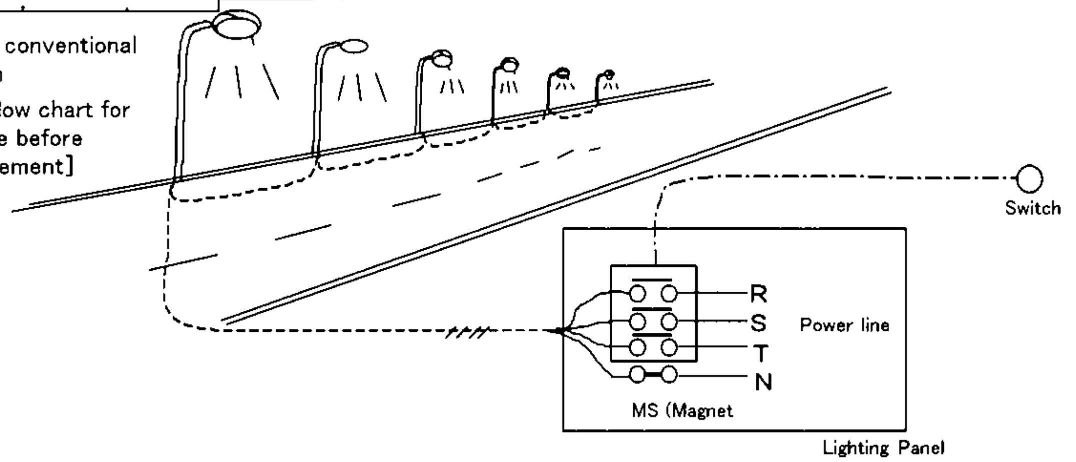
The Name of Theme

Reducing the Power Consumption for Lighting the Street-lamps on the Site to One Third

Classification of Energy	Targeted Facility	Time to Conduct
Electricity	The street-lamps along the road on the site	1990

The Details of the

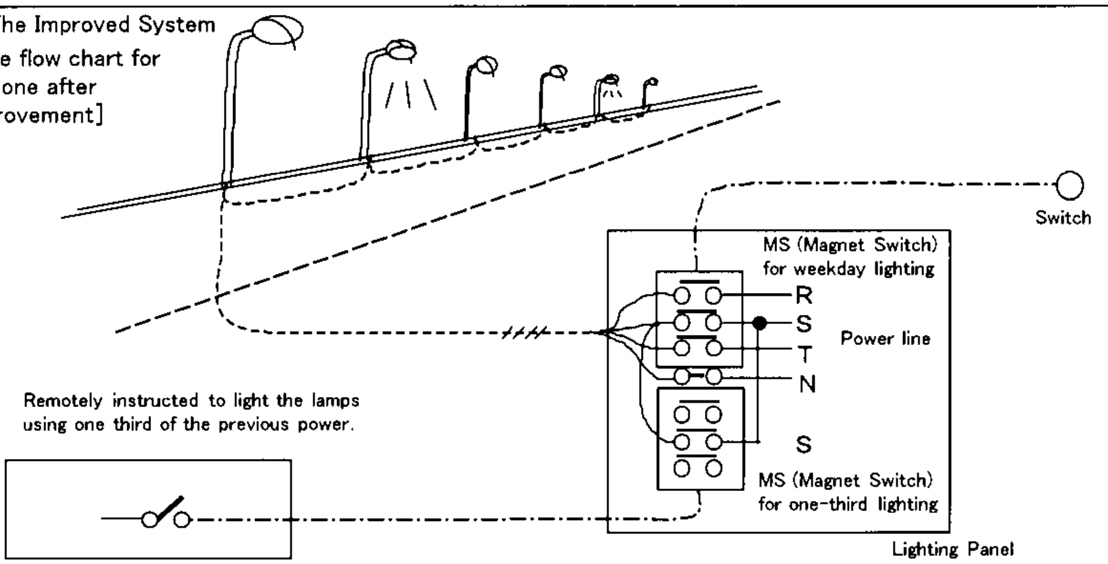
1) The conventional system
[The flow chart for the one before improvement]



[Problems]

The street-lamps on the site were all lit controlled by the automatic switch regardless of the day of the week. It was waste of energy to light them during the time when no person walks around such as the night of a holiday.

2) The Improved System
[The flow chart for the one after improvement]



A magnetic switch to light the lamps with one third of the previous power was added and was remotely instructed to light the lamps to reduce the power consumption to one third.

3) The features of the improvement

・Only one phase among the three phases in the power line was made transmitted to light the lamps with one third of the ordinary power.
・This was conducted during the time with few people walking such as the night of a holiday and during a long vacation.

4) The Amount Invested

5) The Effect of This Improvement

The reduced electric power: ¥800,000/year

6) Presentations for Outside and Prizes

A Digest of Energy conservation Items

Item No.3
Created by: Kikuchi
Created on: May 25, 2001

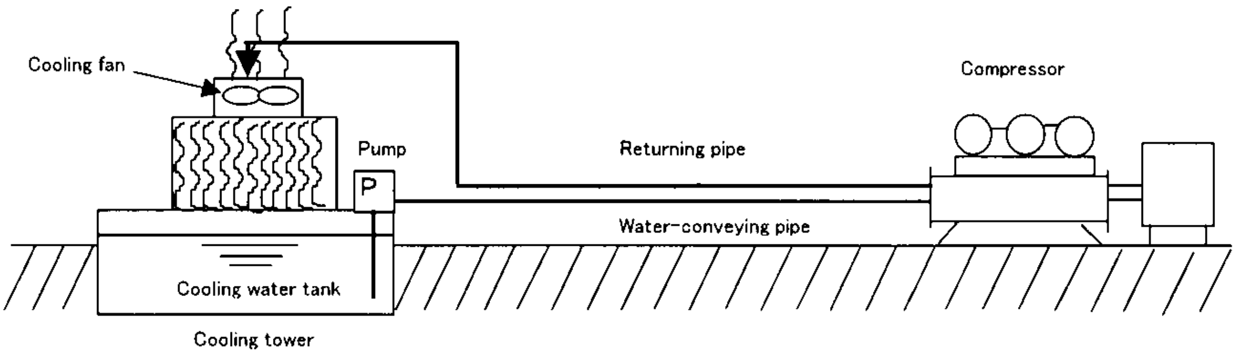
The Name of Theme

The Control of the Water Temperature of Cooling Tower Fan

Classification of Energy	Targeted Facility	Time to Conduct
Electricity	The cooling tower for cooling water for compressor	1988

The Details of the Improvement

1) The conventional system
[The flow chart for the one before improvement]

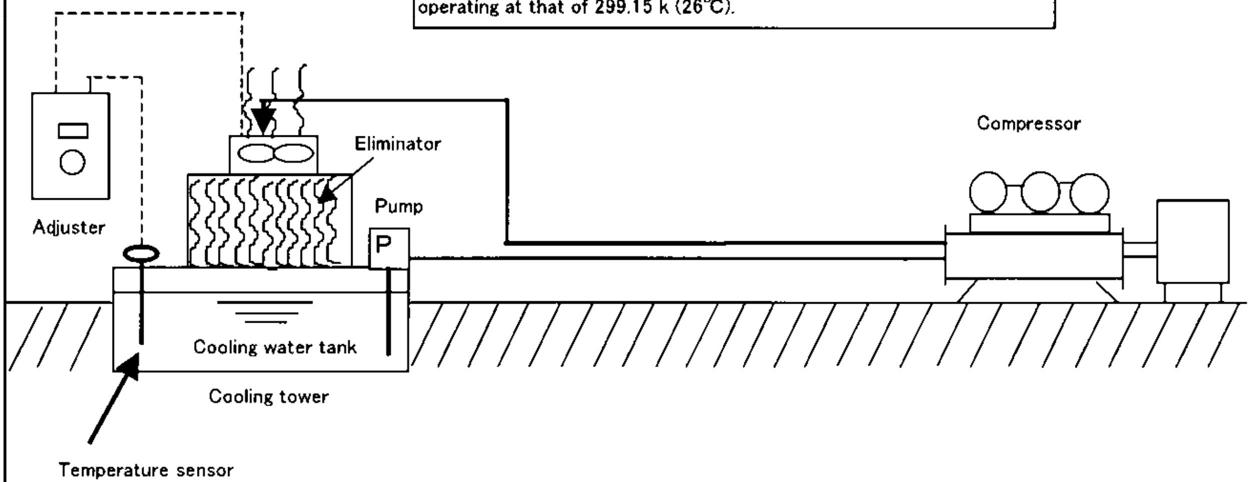


[Problems]

There were outdoor cooling towers equipped to cool down the cooling water for the compressors. However, the cooling fans were operating continuously regardless of the load (temperature) the cooling water had.

2) The Improved System
[The flow chart for the one after improvement]

Temperature sensors were equipped in cooling water tanks to improve the temperature control such that the cooling fans would start operating at the water temperature of 301.15 k (28°C) and would stop operating at that of 299.15 k (26°C).



3) The features of the improvement

・During the time when the number of operating compressors got fewer than usual such as between the shifts or on a holiday, or in winter time, when the cooling water was cooled sufficiently by only falling down to the eliminators, the operation of the cooling fans was controlled by temperature-controlled turning on and off to reduce the power consumption.

4) The Amount Invested

The cost for the parts for the control system: ¥50,000

5) The Effect of This Improvement

When four 11 kW motors and four 7.5 kW motors were used: ¥1,000,000/year~¥2,000,000/year

6) Presentations for Outside and Prizes

A Digest of Energy conservation Items

Item No.5
Created by: Kikuchi
Created on: May 25, 2001

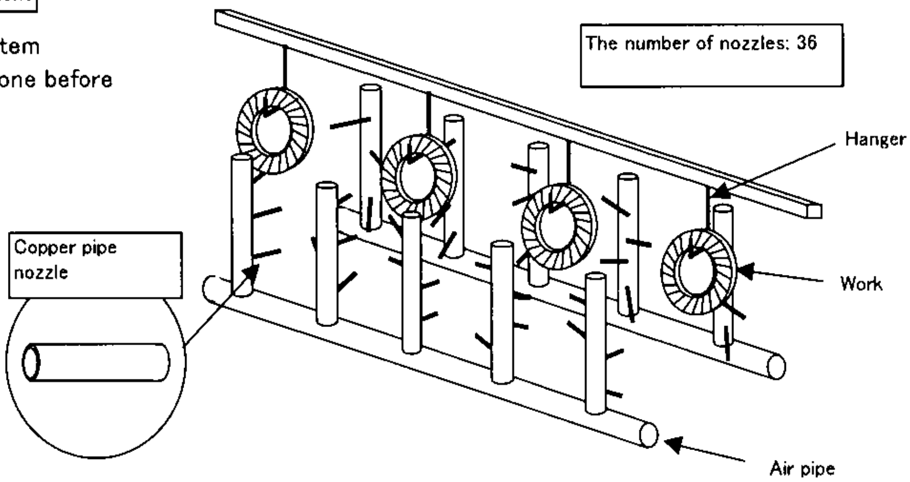
The Name of Theme

Reduction of the Blowing Air of Parts Washing Machine

Classification of Energy	Targeted Facility	Time to Conduct
Compressed air	Parts Washing Machine for Car Shafts	1995

The Details of the Improvement

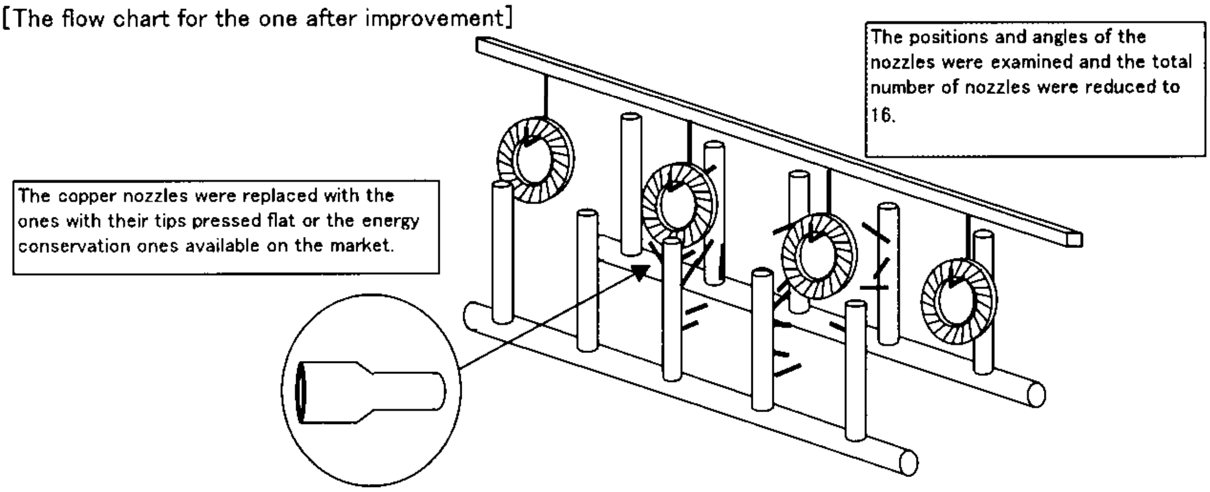
1) The conventional system
[The flow chart for the one before improvement]



[Problems]

In the conventional air blowing system, there were many copper pipes of 6 mm to 10 mm arranged. The positions and angles some of them were not properly set to the works and the air blowing efficiency was not satisfying.

2) The Improved System
[The flow chart for the one after improvement]



3) The features of the improvement

1) The positions and angles of the air blowing nozzles were examined and the instantaneous air flow was reduced by reducing the number of nozzles.
2) The instantaneous air flow was reduced by introducing the nozzles with their tips pressed flat and the energy conservation nozzles available on the market.

4) The Amount Invested

・For pressing the nozzles tips, just working was necessary.
・A energy conservation nozzle cost ¥1,500~¥2,500

5) The Effect of This Improvement

The amount of air for blowing was reduced by 30%~50%.
It differed according to the size of the equipment but, in our case, ¥500,000/year~¥1,000,000/year.

6) Presentations for Outside and Prizes

A Digest of Energy conservation Items

Item No.10
Created by: Sakurai
Created on: May 25, 2001

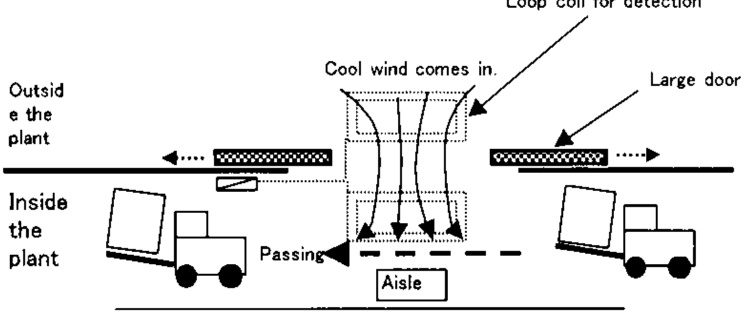
The Name of Theme

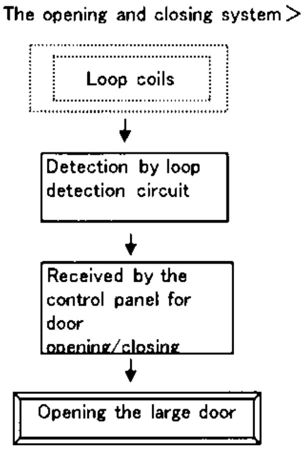
Prevention of Unnecessary Opening and Closing of the Large Doors (Automatic) by Double Detection System

Classification of	Targeted Facility	Time to Conduct
Steam	The large doors on the aisles in the	1992

The Details of the

1) The Conventional System
[The flow chart for the one before improvement]

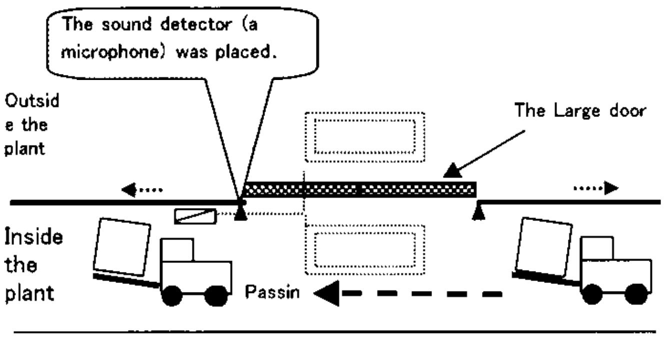


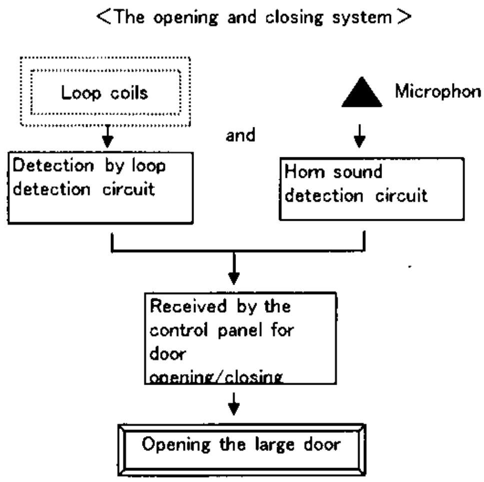


[Problems]

The large door of the plant was opened and closed by detecting the forklifts and vehicles with the loop coils that were buried in and out of the door and used to detect metals. However, when the vehicles that were not to pass through the opened door passed by the door, the door was also opened and, especially in the wintertime, the cold atmosphere came into the plant and worsened the heating efficiency.

2) The Improved System
[The flow chart for the one after improvement]





The circuit was changed and a sound detection sensor was placed to open the door by the double detection with loop coils and a microphone for the horn sound of vehicles, then, the unnecessary openings and closings were avoided.

3) The features of the improvement

・Attention was paid to the volume of horns of forklifts and vehicles and the sound detector was set not to open with small sound.
・The door was made not open by the vehicles passing by the door and the people working near by all welcomed it.

4) The Amount Invested

The cost for construction and the parts: ¥150,000

5) The Effect of This Improvement

To raise the temperature of the incoming cold air (1~5℃ in winter time) up to the temperature of the heated atmosphere inside the plant, 13℃, about ¥150,000~¥300,000/year of steam was necessary for one large door.
(The heating cost saved: ¥150,000~¥300,000/year/door.)

6) Presentations for Outside and Prizes