

October 31, 2003

15. A Field Study of Energy Efficient Factories

省エネルギー優良工場視察

Mr. Yasuhiko MAEDA

前田 安彦

Senior Projective Manager
Production Related Environmental Group
Manufacturing Department
Residential Air Conditioner
Manufacturing Division
SHIGA PLANT
DAIKIN INDUSTRIES, LTD.

ダイキン工業株式会社
滋賀製作所

主

The DAIKIN logo is rendered in a blue, italicized, sans-serif font. It is positioned above a large, stylized geometric shape that resembles a folded piece of paper or a large 'Z'. This shape is divided into three sections: a black triangle on the left, a light blue parallelogram in the center, and a black triangle on the right. The entire graphic is set against a solid blue background.

DAIKIN

Our Energy Saving Activity
“Aiming for Eco-Friendly and Profit-Making Plant”

DAIKIN Industry, Ltd., Shiga Plant

Introduction of Shiga Plant

Production Base in Japan for Residential Air Conditioner

location

: Kusatsu

Prefecture

Establishment

: November

Site Area

: about 100,000

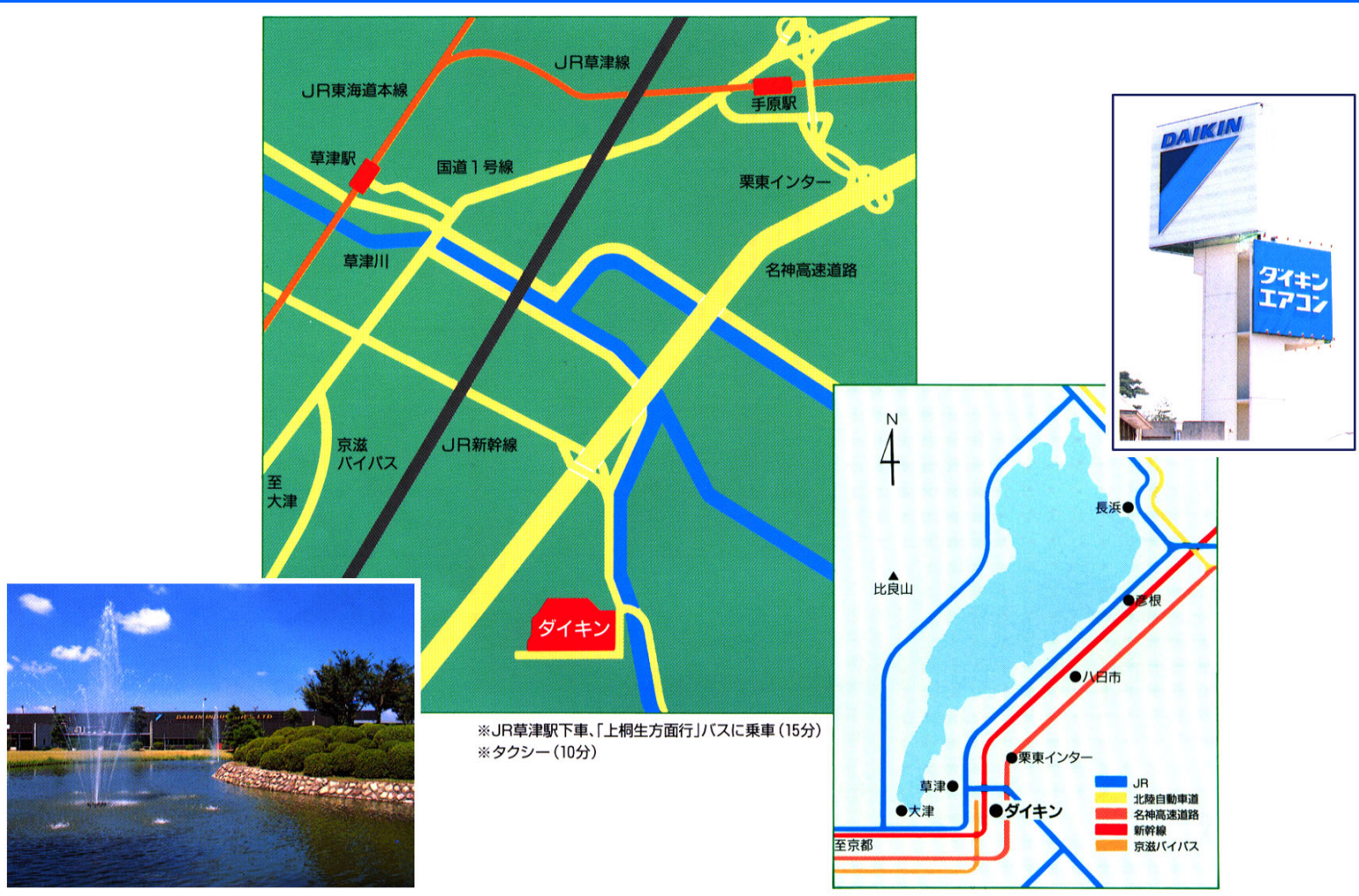
Products

: residential

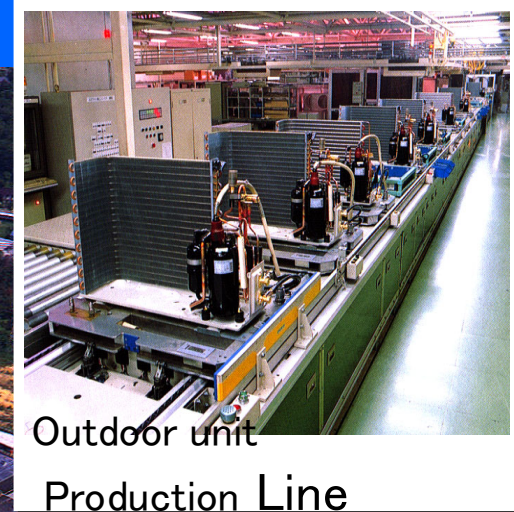
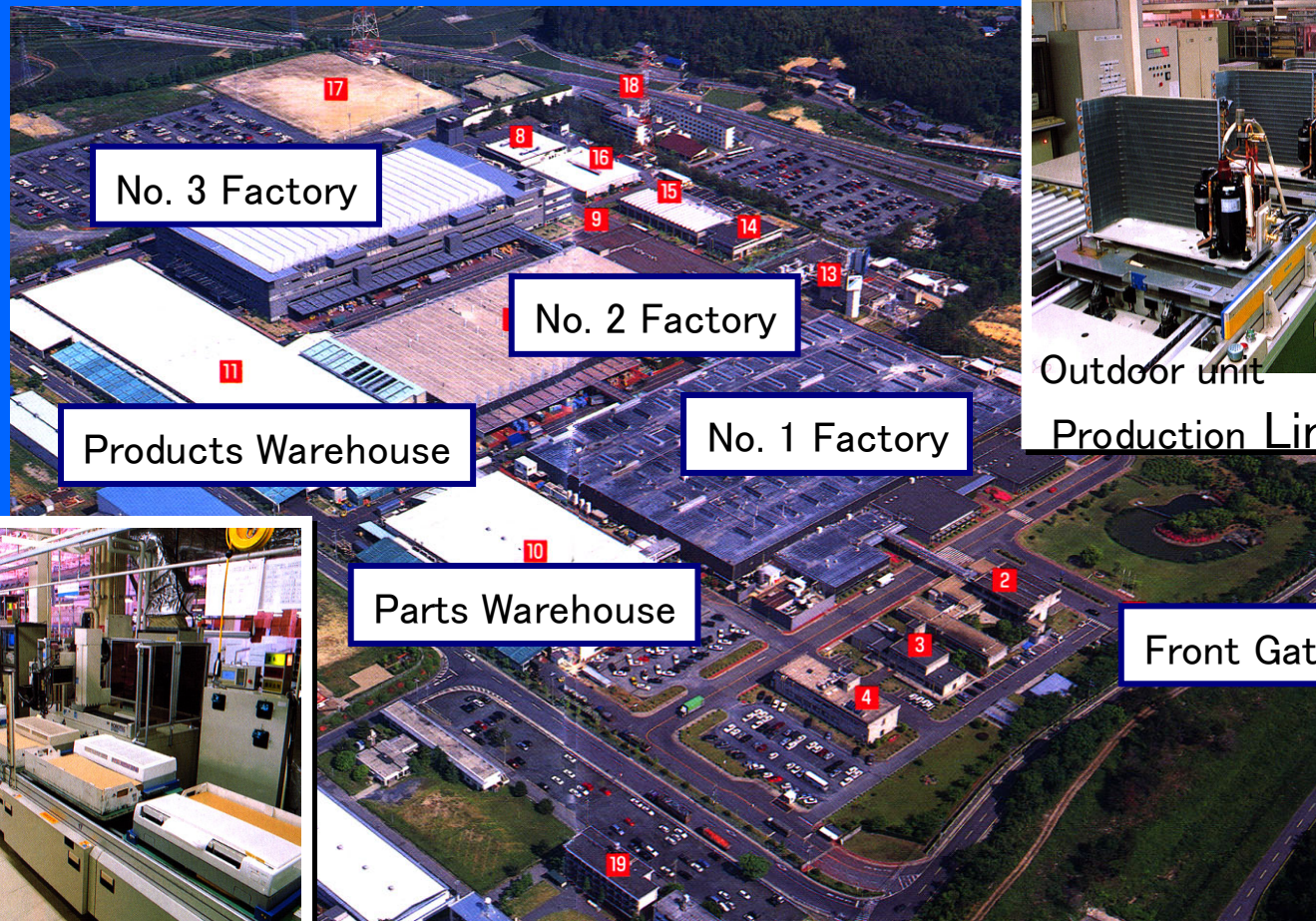
air conditioner

: commercial

air conditioner



Overall View of Shiga Plant



Indoor Unit Production Line

Concept of Shiga Plant

Fine & Amenity

Pursuit of Amenity

Customers

supply of amenity with high satisfaction through
commodities with high standard

Workers

workshop with amenity → supply of commodities of top grade

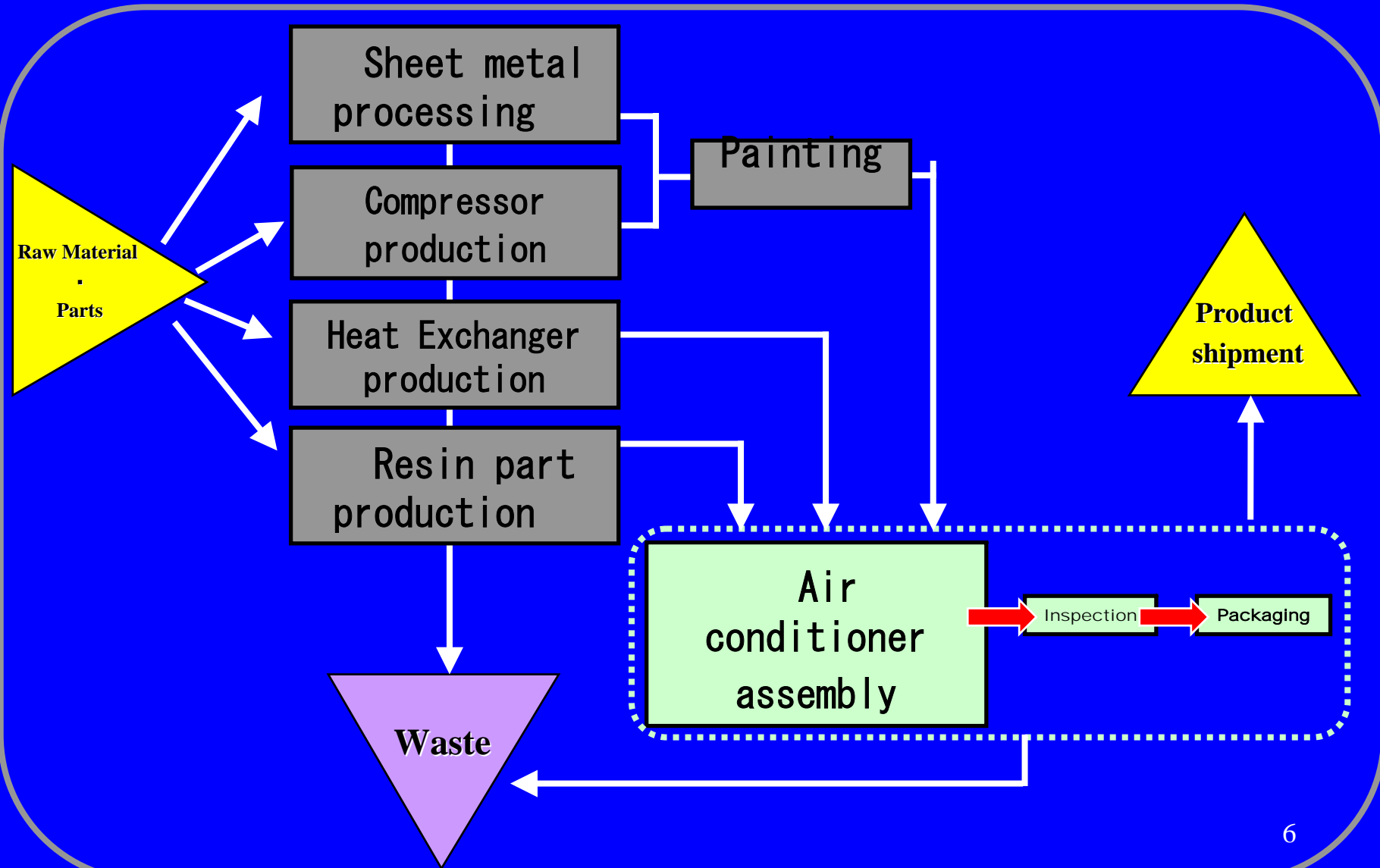
Environmental
Activity

eco- friendly and profit yielding plant

Brief Background of Shiga Plant (focusing on production system/environment and quality matters)

Year	Month	History
1970	11	Start of Shiga Plant operation
1972	2	Becomes a certified factory qualified to affix the JIS mark.
1978	11	Installation of PDS Production System (Production of Daikin System)
1980	11	Industrial standardization and quality control. "Osaka Bureau of Economy, Trade and Industry Director General's Award"
1982	11	" " "National Research Institute President's Prize"
1986	10	" " "Ministry of International Trade and Industry Minister's Award"
1987	2	Excellent energy control factory. "Kinki Bureau of Economy, Trade and Industry Director General's Award"
1990	10	TPM Activity "TPM Business Award of Excellence"
1994	5	ISO9001 Certification Registration
	10	TPM Activity "TPM Business Continuance Award of Excellence"
1996	9	" " "TPM Special Prize Award"
	12	ISO14001 Certification Registration
1997	10	Excellent high pressure gas production plant. "High pressure Gas Safety Institution of Japan Security Association President's Award"
2000	2	Energy Conservation Grand Prize "Agency for Natural Resources and Energy Director General's Award"
		Energy Conservation Air-conditioner with an energy saving inverter "Urru and Sarara"
2001	2	Energy Control Factory of Excellence "Agency for Natural Resources and Energy Director General's Award"
	10	Achievement of Zero-waste Emission
2002	6	High-cycle production system "Production Grand Prize Award"

Production Process Flow



Outline of Energy Usage

Nominated Plant for First-class Energy Management (electricity)

Nominated Plant for Second-class Energy Management (thermal)

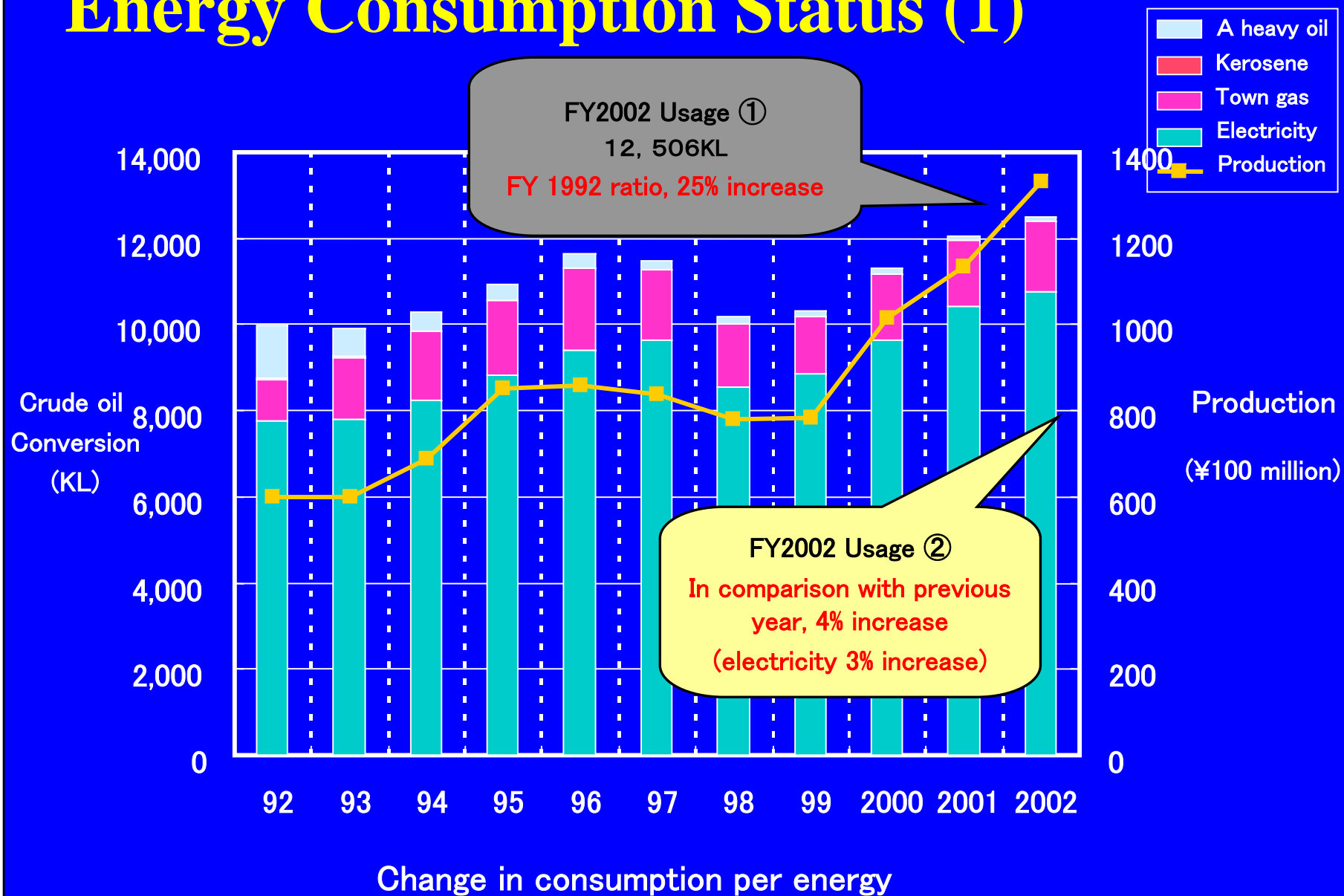
Energy usage per year (FY2002 results)

Electric power	40,565,000kwh
----------------	---------------

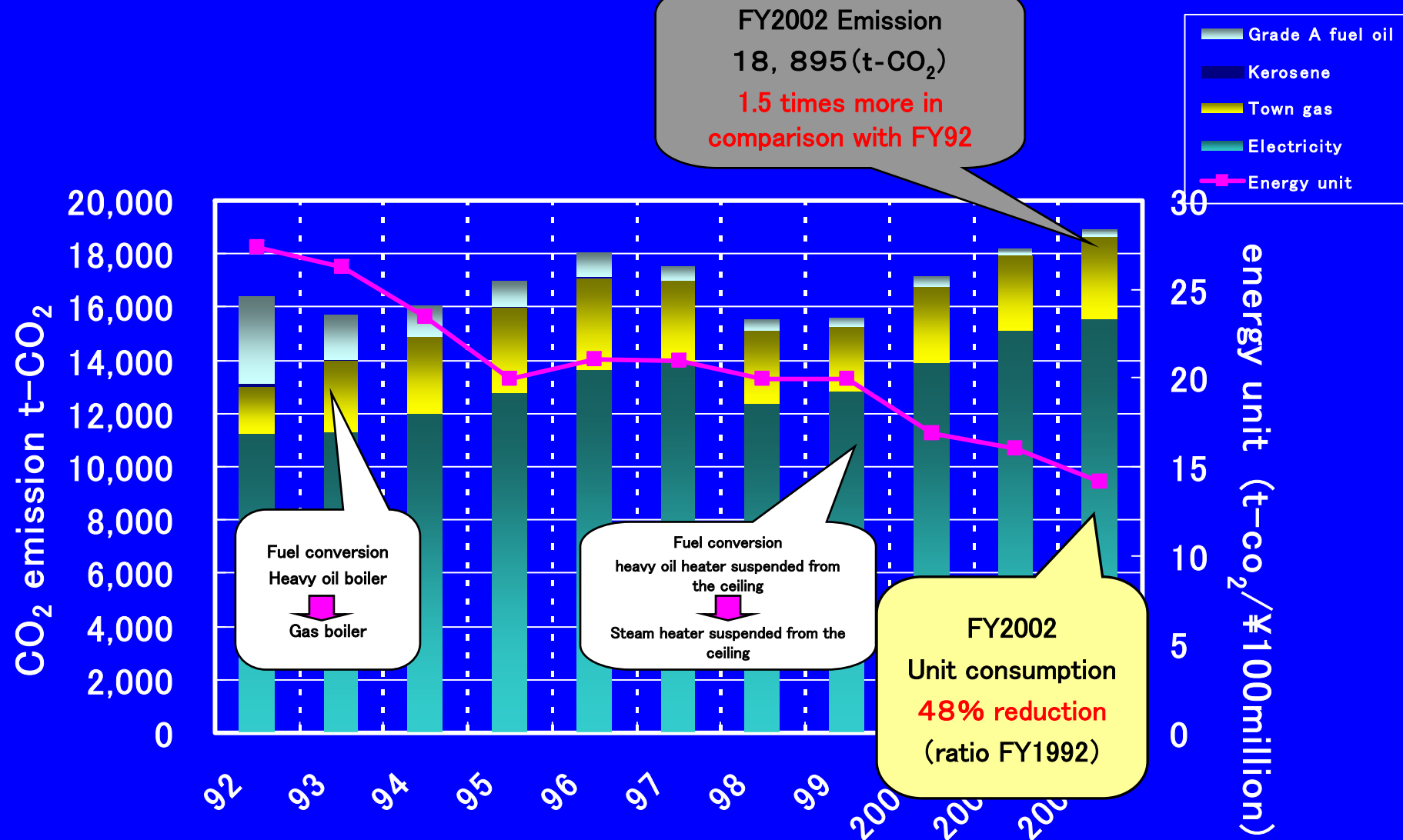
Town gas	1,537,000m ³
----------	-------------------------

Grade A fuel oil	95 KL
------------------	-------

Energy Consumption Status (1)



Status of CO₂ emission



Change in CO₂ emission

Energy Usage Status (2)

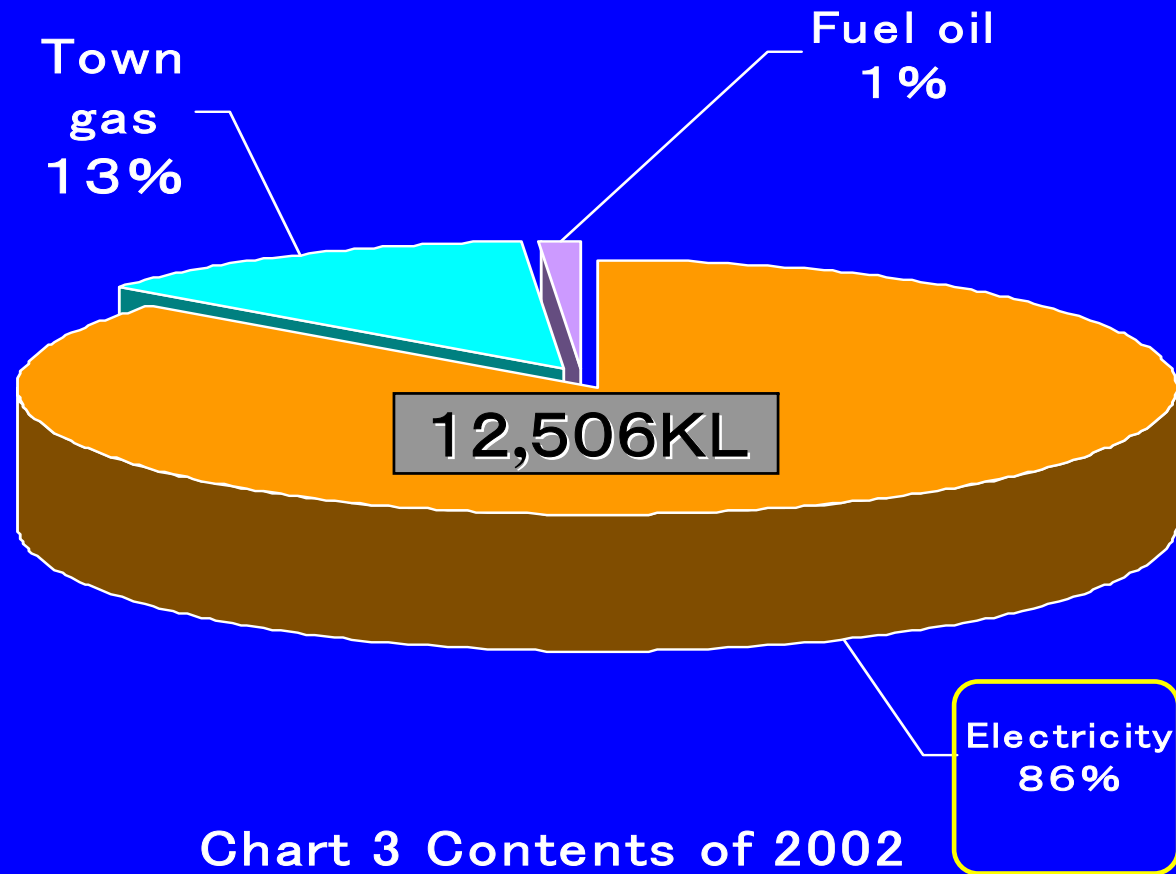


Chart 3 Contents of 2002
consumption per energy

Energy Consumption Status (3)

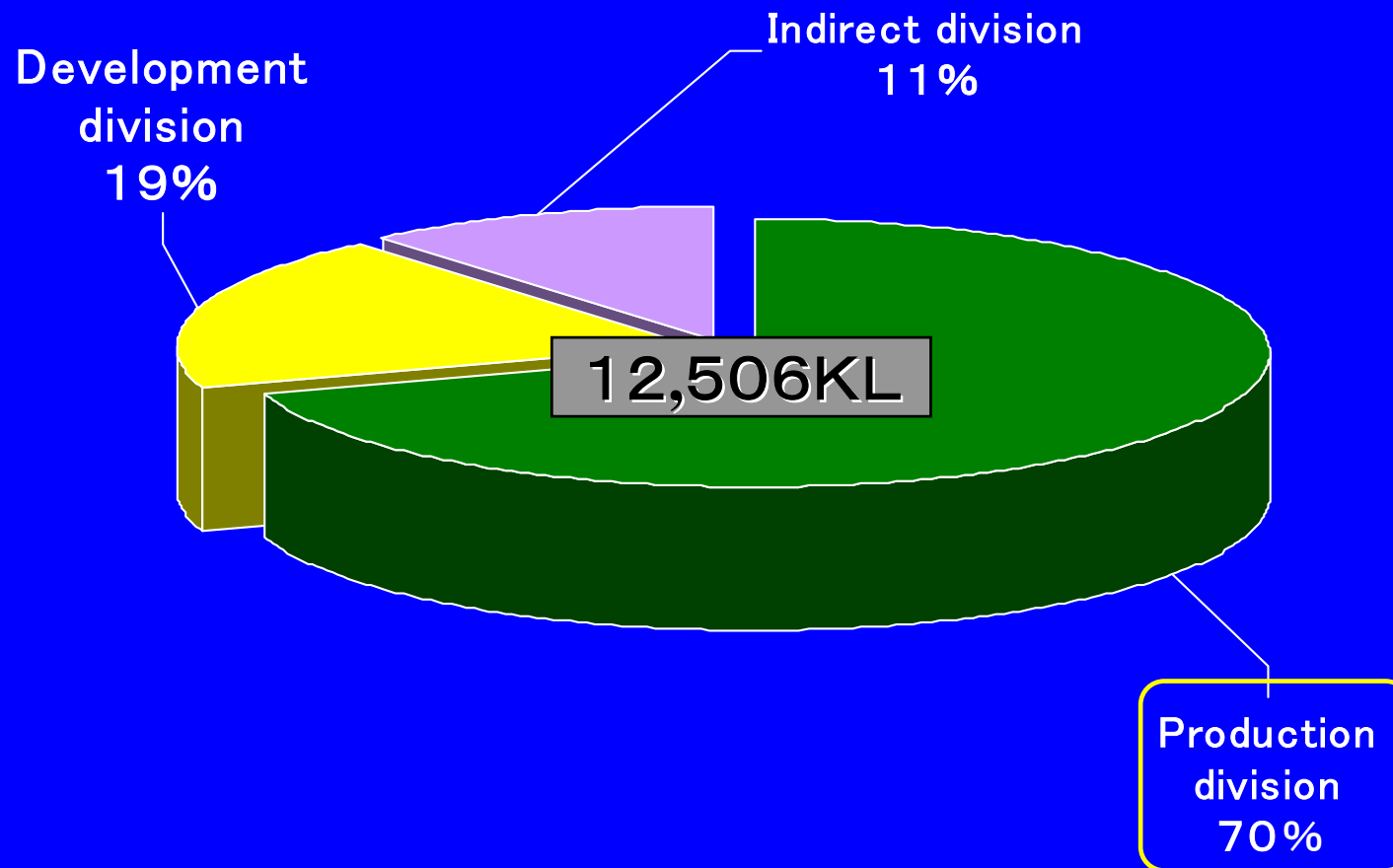


Chart 4 Contents of 2002 consumption per division

Target Actions for Energy Conservation

◆ Company Target

【15% reduction of energy unit for 2000 in comparison with FY1992】

$$\text{Energy unit} = \frac{\text{Energy converted in crude oil (kl)}}{\text{Production on '92 cost base (¥100M)}}$$

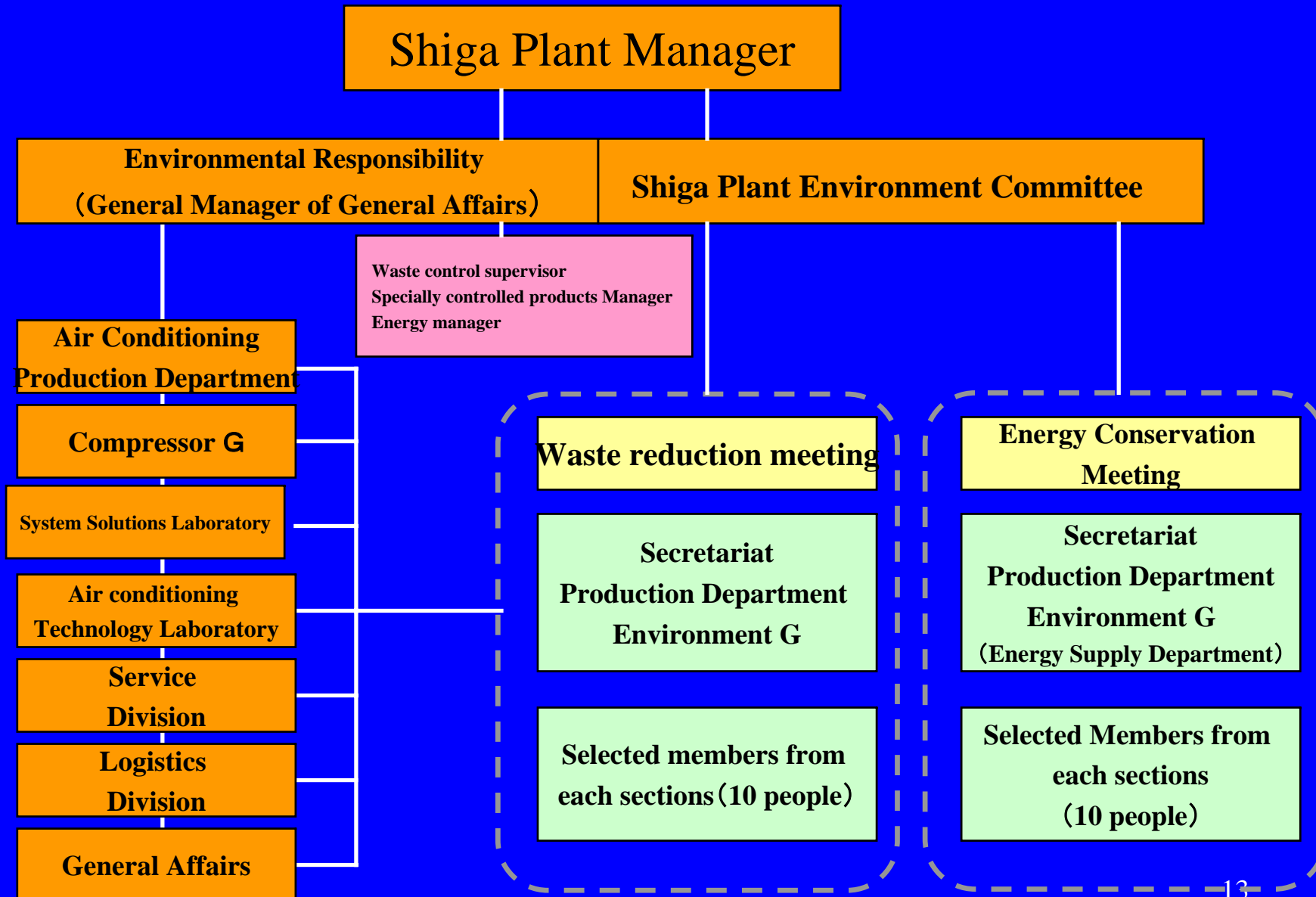
◆ Targets Energy Conservation Law

【over 1% reduction of energy unit in comparison with the previous year】

$$\text{Energy unit} = \frac{\text{Electricity consumption for production (1,000 kwh)}}{\text{No. of products (1,000 sets)}}$$

Chart5 Energy Conservation Activity Targets

Organization



Target and Results of Voluntary plan

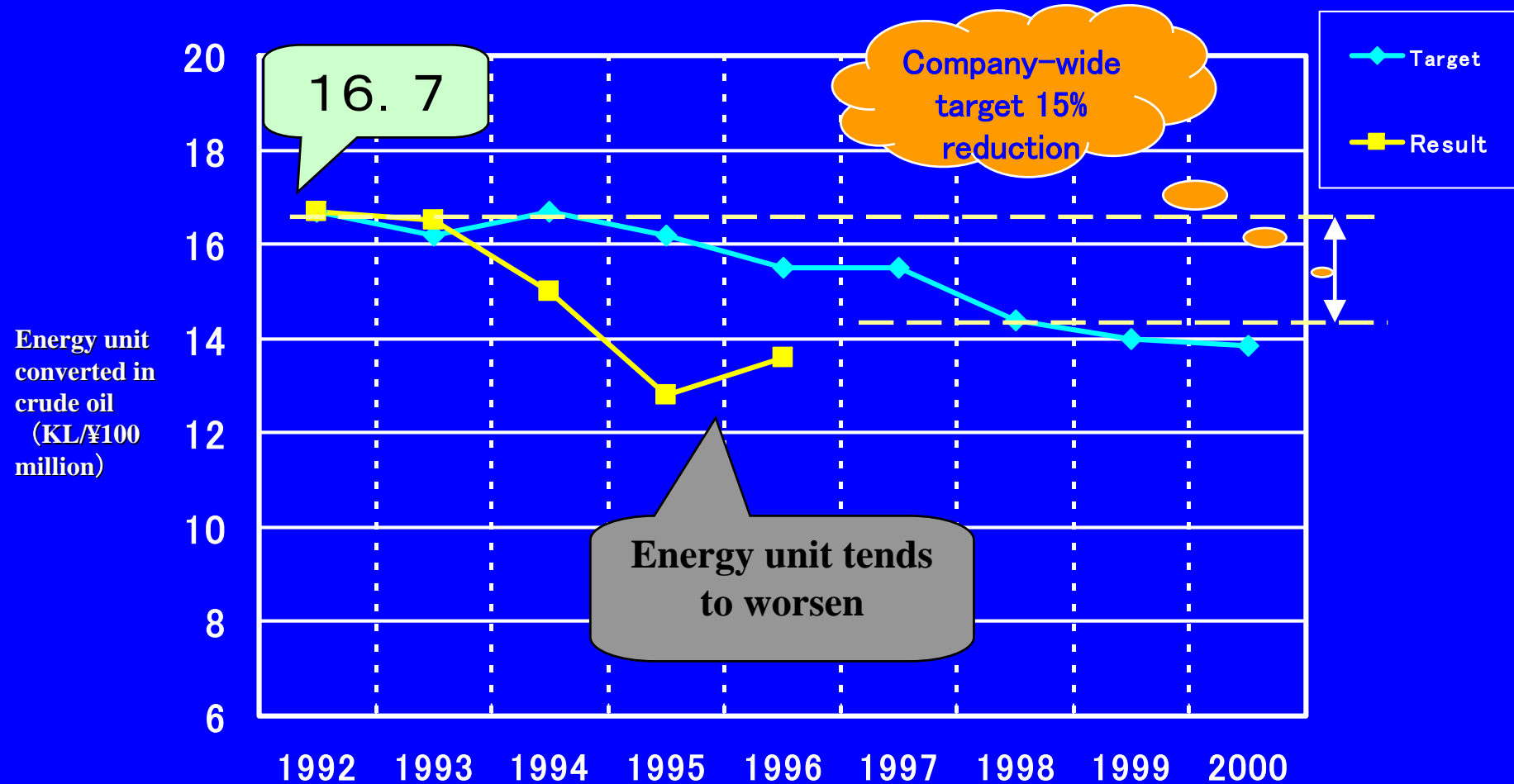


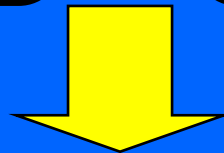
Chart8 Change in energy unit

Change of Basic Concept of Energy Saving Activity

◆ Energy saving activity on old concept

enlightening and stingy
energy saving activity

superficial
energy saving activity



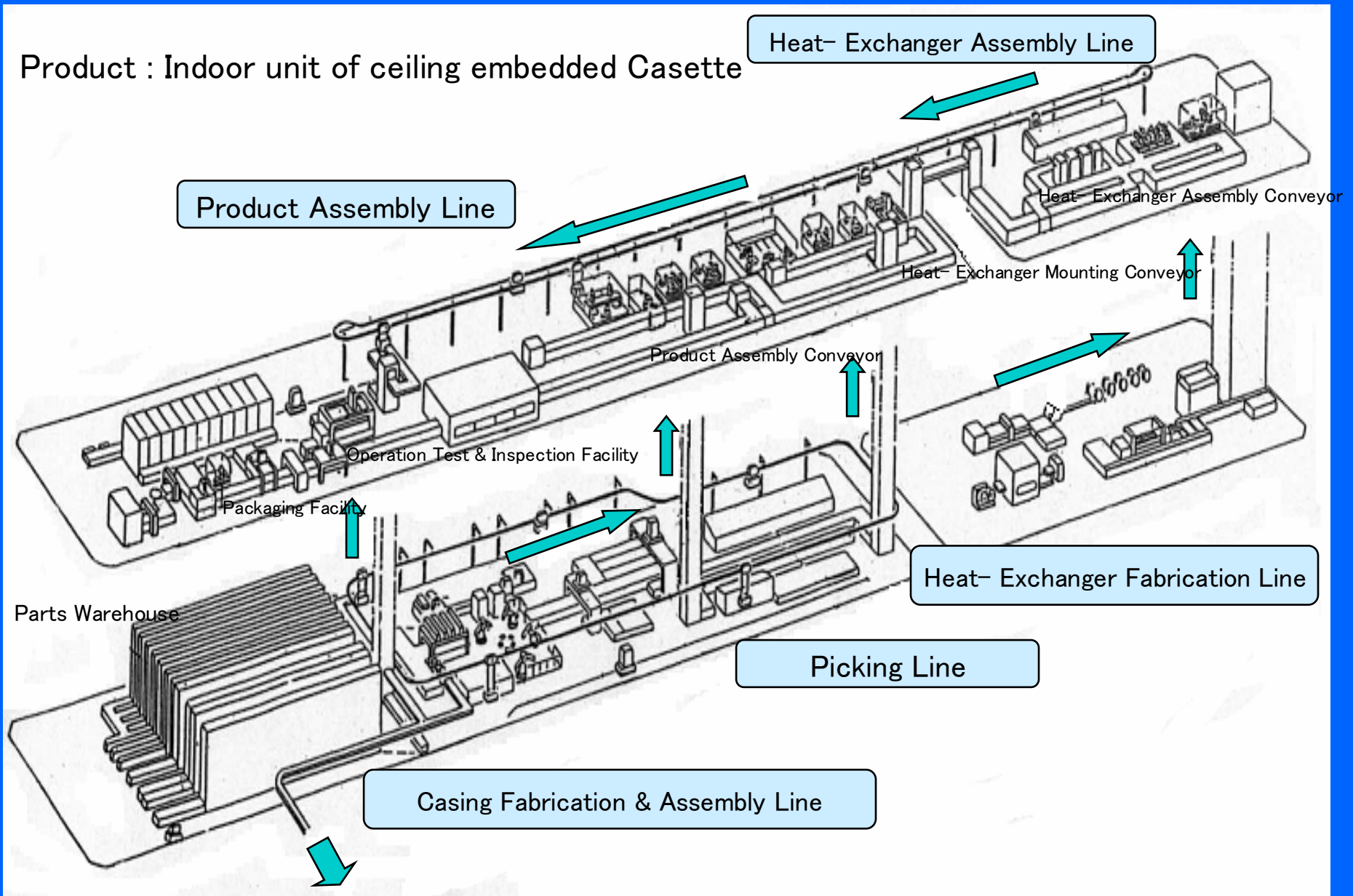
◆ Energy saving activity on new concept

efficiency- oriented
energy saving activity

analytical
energy saving activity

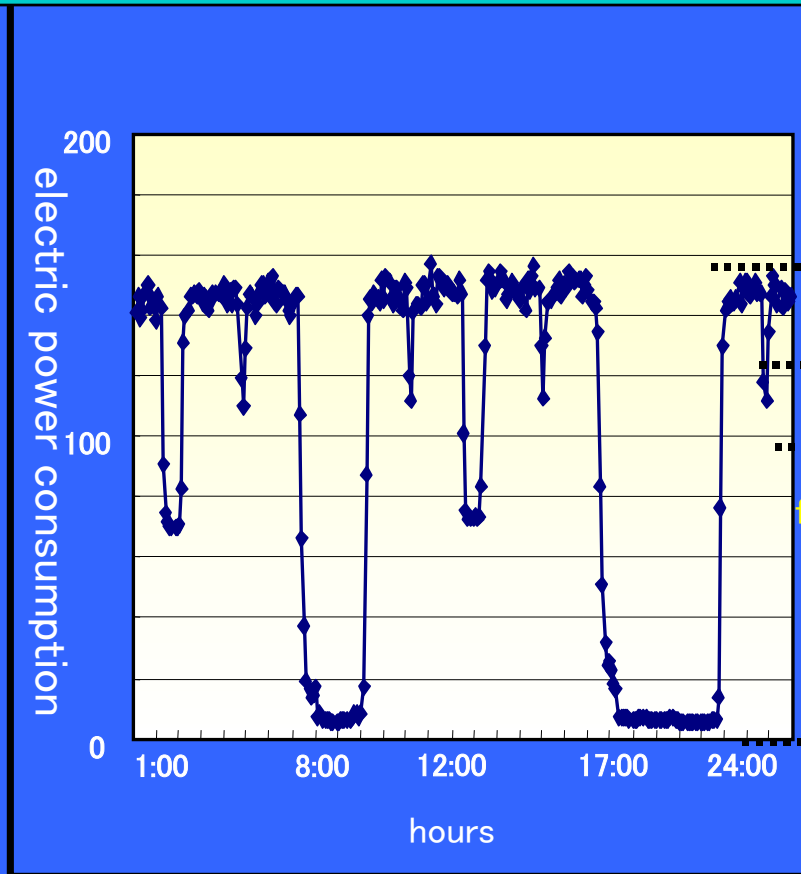
Energy Analysis Line

Product : Indoor unit of ceiling embedded Casette



Energy Analysis on New Concept (1)

Transition of Electric Power Consumption along
Operating Time for Product Assembly Line



Test Analysis of Product Assembly Line

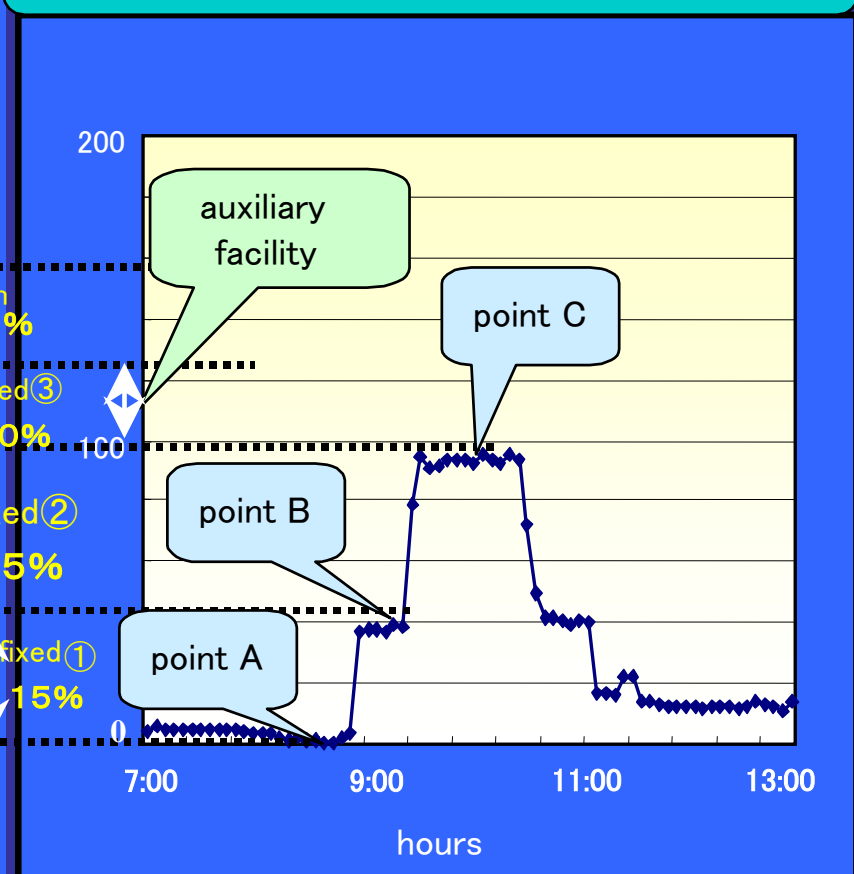


Fig. 9 Analysis of Electric Power Consumption

Energy Analysis on New Concept (2)

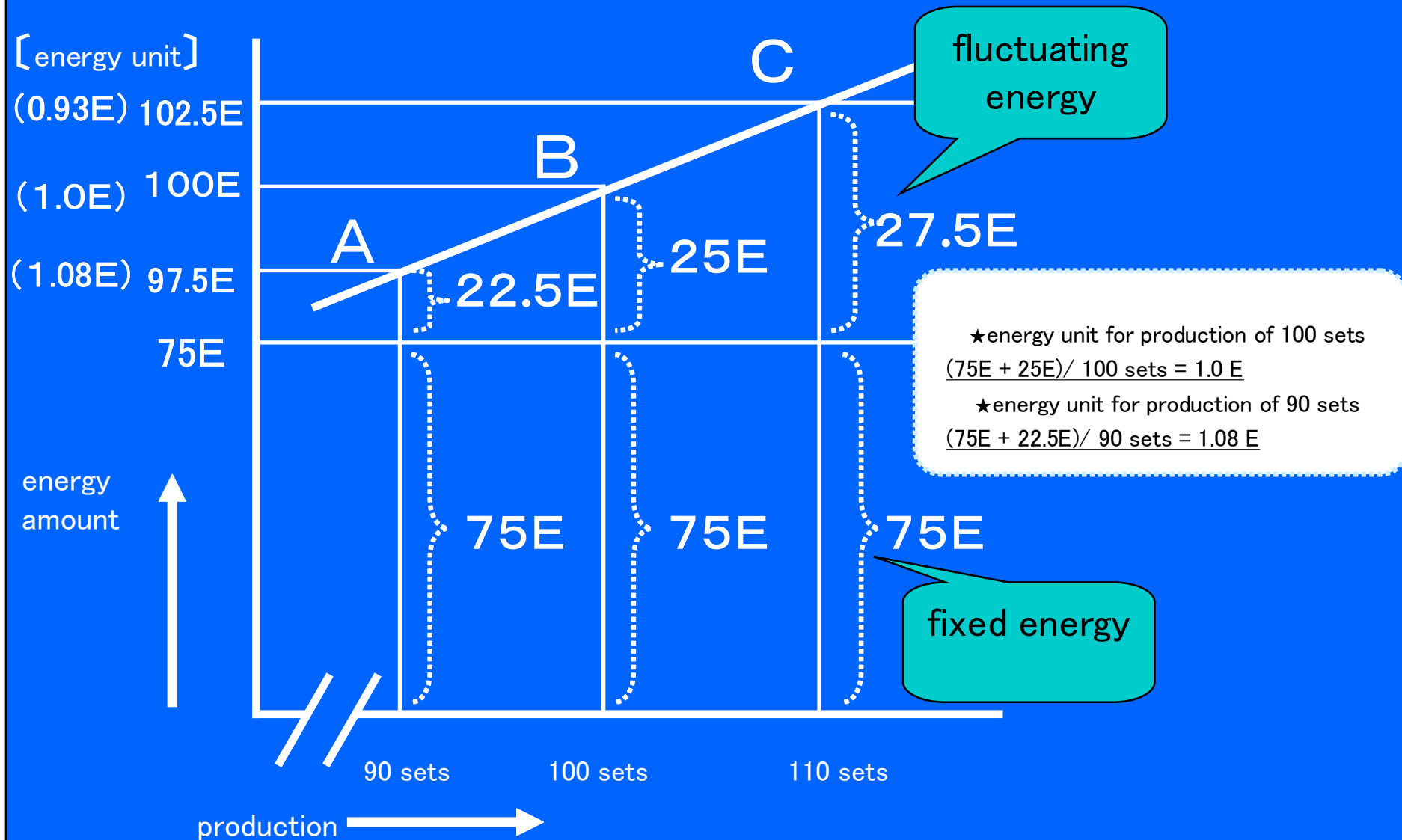







































Fig. 10 Influence of Fixed Energy to Energy Unit

Classification of Energy Saving

Saving Method	category	Saving Items	
Elimination of energy waste	Cons- umption	lighting	<ul style="list-style-type: none"> · removing idle fluorescent and mercury lamps · turning off when not needed
		air- conditioning	<ul style="list-style-type: none"> · strict control of setting temperatures (28 °C for cooling and 20 °C for heating)
		turning off idle equipment and at breaks	<ul style="list-style-type: none"> · assured management of on- and off- time of power supply for the line facilities by clarifying the persons in charge
	Supply	optimum transformer operation	<ul style="list-style-type: none"> · repairing air- leakage through the energy saving patrol · repairing water- leakage through the Energy saving patrol
Maintenance of function (aggravation due to negligence)	Cons- umption	leakage prevention	<ul style="list-style-type: none"> · repairing air leakage by energy- saving patrol · repairing water leakage by energy- saving patrol
		cleaning and overhauling	<ul style="list-style-type: none"> · cleaning air- filters for air- conditioners and other systems · washing the heat- exchangers for air- conditioners
		thermal insulation	<ul style="list-style-type: none"> · repairing abrasion and gaps
Improvement of facility (energy efficiency, etc.)	Cons- umption	Replacement with energy- saving type	<ul style="list-style-type: none"> · changing fluorescent lamps to Energy saving type (40 W → 36 W)
		Introduction of energy- saving Equipment	<ul style="list-style-type: none"> · introducing “Ecoeyes” to utilize midnight power (peak- shift) · installing water- spray (“Enecut”) to air- conditioner outdoor equipment (condenser)
		changing control method	<ul style="list-style-type: none"> · prevention of idling (changing to the circuit to shut down the system when not fabricating) from fixed energy to variable energy
		changing testing method (fixed → proportional)	<ul style="list-style-type: none"> · prevention of idling (use of timer) · changing the control method of calorie meter
		increasing system efficiency	<ul style="list-style-type: none"> · increasing the efficiency of air- conditioning for F6 line
		utilization of natural energy	<ul style="list-style-type: none"> · changing to air- conditioning system for A1 & A2 lines by introducing external air
	Supply	introduction of energy- saving equipment	<ul style="list-style-type: none"> · changing to high- efficiency motors (for such cooling water pumps as compressors and dry air in the plant)
		optimization of energy supply method	<ul style="list-style-type: none"> · stoppage of supply system by using timer in line with the line shut- down · optimum operation in accordance with the load of cooling- water pump in the plant
		supply voltage structuring energy	<ul style="list-style-type: none"> · decreasing supply voltage for lighting circuit (4%)
			<ul style="list-style-type: none"> · introducing D-BISP for monitor of energy & air- conditioning
Enlightenment of Energy Conservation		enhancement of employees' Energy Conservation awareness	<ul style="list-style-type: none"> · broadcasting for PR of Energy saving · publishing bulletins for PR of Energy saving

Table of Energy Conservation Methods

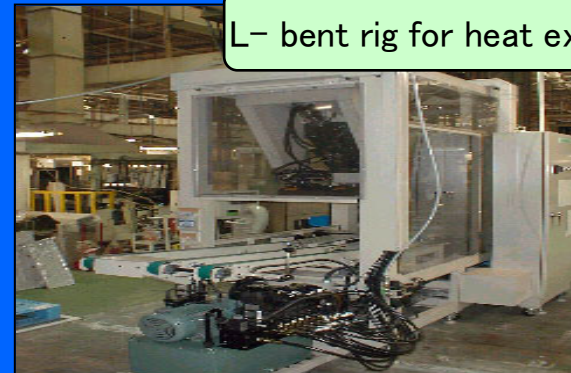
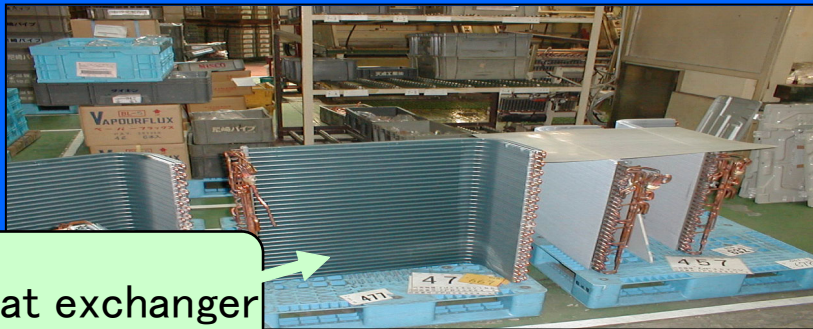
Energy Conservation Plan

Deletion method	User	Action items	FY1997	FY1998	FY1999	FY2000
Waste removal	Consumer	lighting Air conditioning Turning off idle equipment and at breaks	  	  		
	Supplier	Optimization of transformer operation				
Function maintenance (Worsens if left unattended)	Consumer	Leakage prevention Cleaning, overhauling thermal insulation	  			
Facility improvement (Energy efficiency etc)	Consumer	Replacement to energy conserving version				
		Installation of energy conserving machine				
		change in controlling method (fixed to proportional)				
		change in testing method (fixed to proportional)				
		Increased system efficiency				
		Utilization of natural energy				
	Supplier	Installation of energy conserving machine				
		Optimization of energy supplying method				
		Supply voltage				
		Construction of energy control				
Energy conservation enhancement activity		Employees to be conscious of energy conservation				

Energy Consumption Activity Plan

Improvement Case (1)

Cycle Stop of Hydraulic Pump for L- Bent Rig for Heat Exchanger

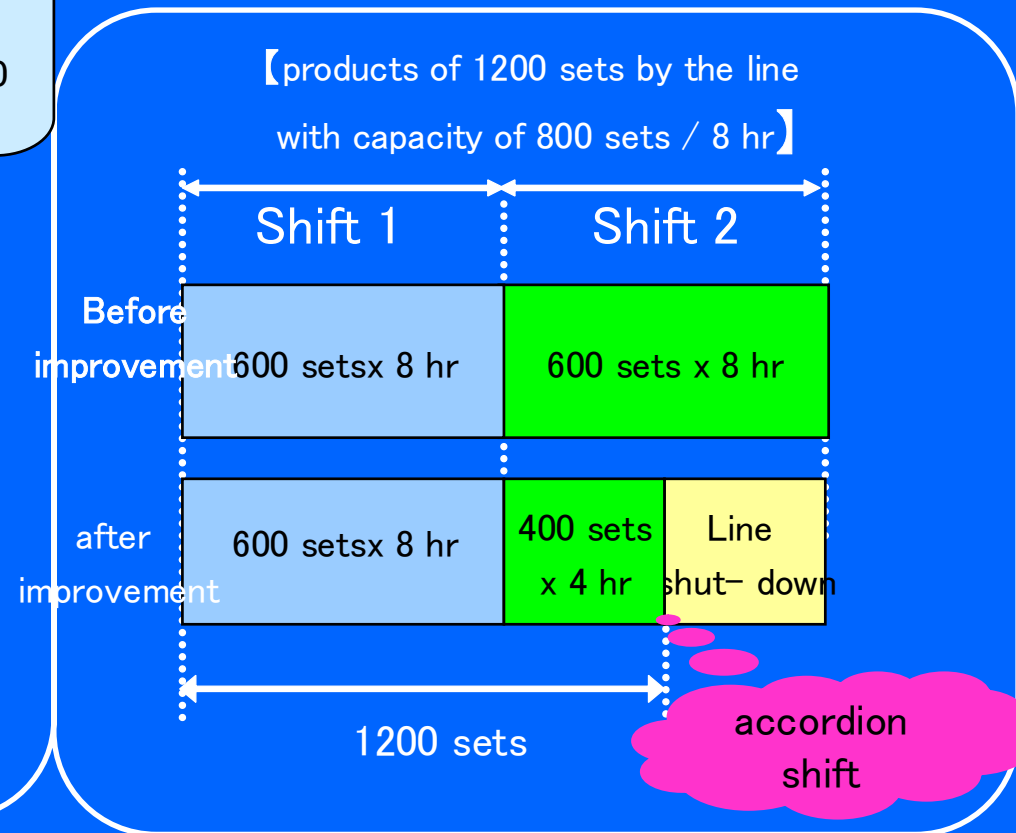
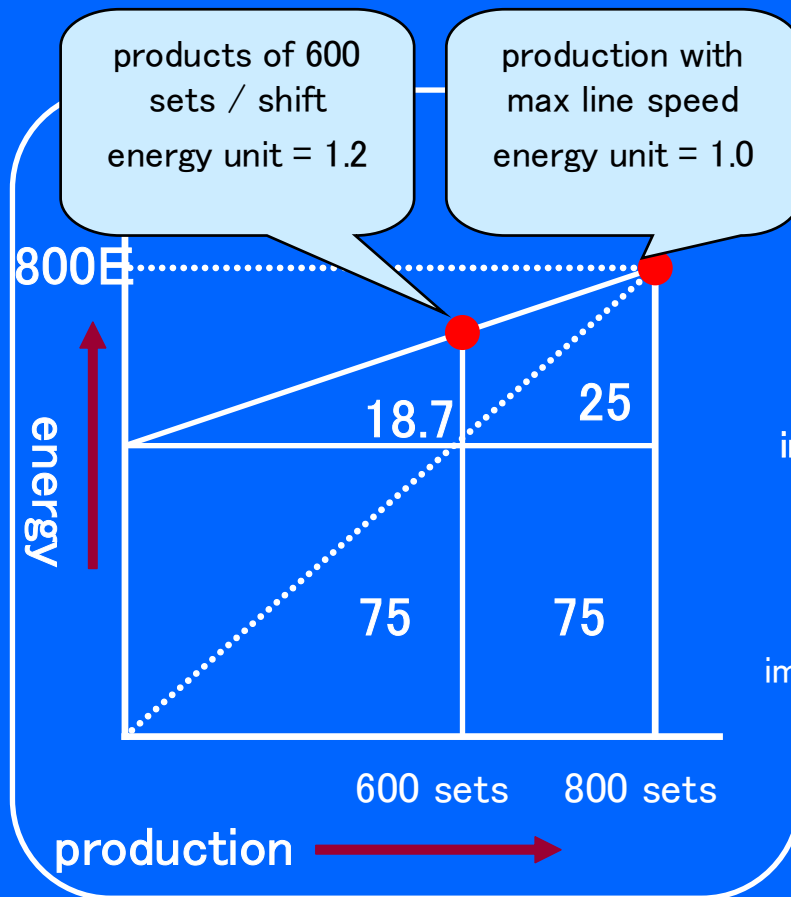


	Fixed Energy	Required Measure	Measure Taken
1	idle operation of hydraulic pump	changing circuit to automatic stop of hydraulic pump	adding “circuit check” to inspection table
2	consumption of 100 W during breaks	clarifying switch to turn off	specifying person in charge on the panel
3	consumption of 500 W at standby	clarifying the timing to turn- on power source for standby	specifying person in charge on the panel

effect : cost reduction of ¥ 305,000 / year

Improvement Case (2)

Measure for MAX Energy Efficiency by MAX Line Speed



effect : cost reduction of ¥ 1,770,000 / year

Case study of improvement (3)

Tag

To control the power source of ON-OFF time for the line equipment

Preparation of an instruction sheet

- ① To indicate the names of a section and a group in charge of management and the name of a power board
- ② To divide the persons in charge into Group A and Group B and write the names of the leader and sub-leader of each group
- ③ To indicate the time to turn the switch ON and OFF
- ④ To control the tags by color for each ON-OFF operation

Power Board of equipment

Group 5 of the 2nd Manufacturing Section

Name of power board: F6 Line Fin Press

Persons in charge Group A – Leader: Akira Katabuchi

Sub-leader: Kojiro Maeda

Group B – Leader: Yoshihiko Sakai

Sub-leader: Tomoya Tanaka

	Daytime	Night
Time to switch on	08:35	21:35
Time to switch off	17:20	05:20

Result : ▲¥820,000/year

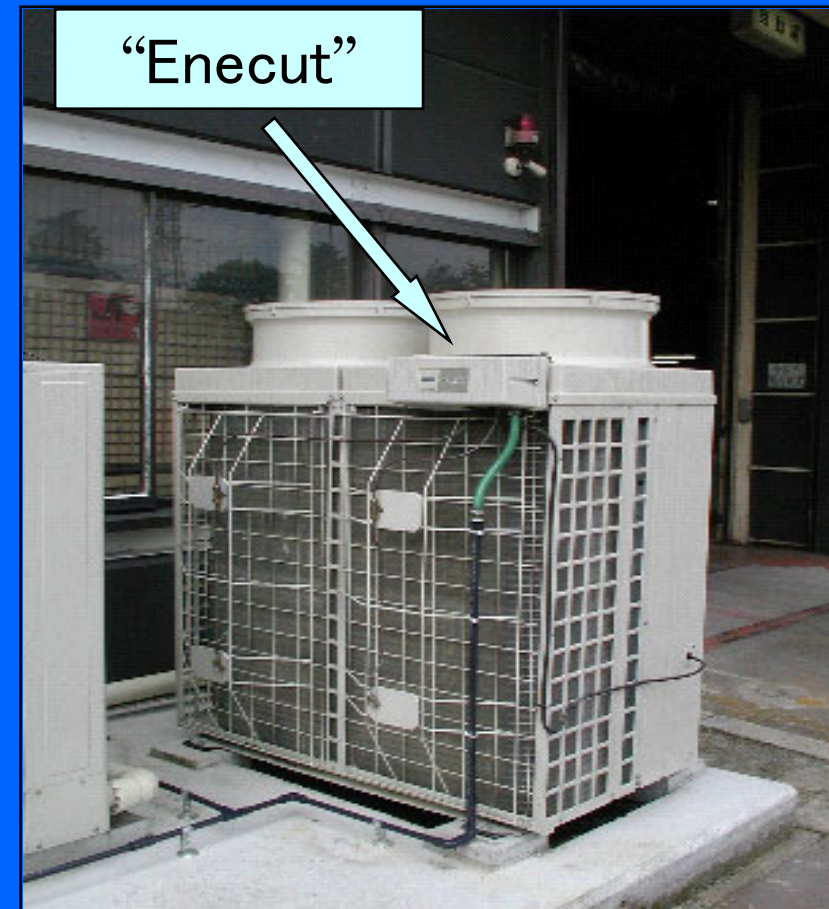
Improvement Case (3)

Installation of Air- Conditioner “Enecut”

Number of Installation	
No. 1 Factory	17 sets
No. 2 Factory	10 sets
No. 3 Factory	21 sets
Others	9 sets
Total	57 sets

Energy Saving Effects

- about 13 % reduction of power consumption per set
 - about 20 % cost reduction including demand decrease effect
- Effect – 1 : cost reduction of ¥ 444,000 / year (reduced electric power)
- Effect – 2 : cost reduction of ¥ 649,000 / year (reduced demand on electric power)



Case of No. 1 Factory

Case study of improvement (5)

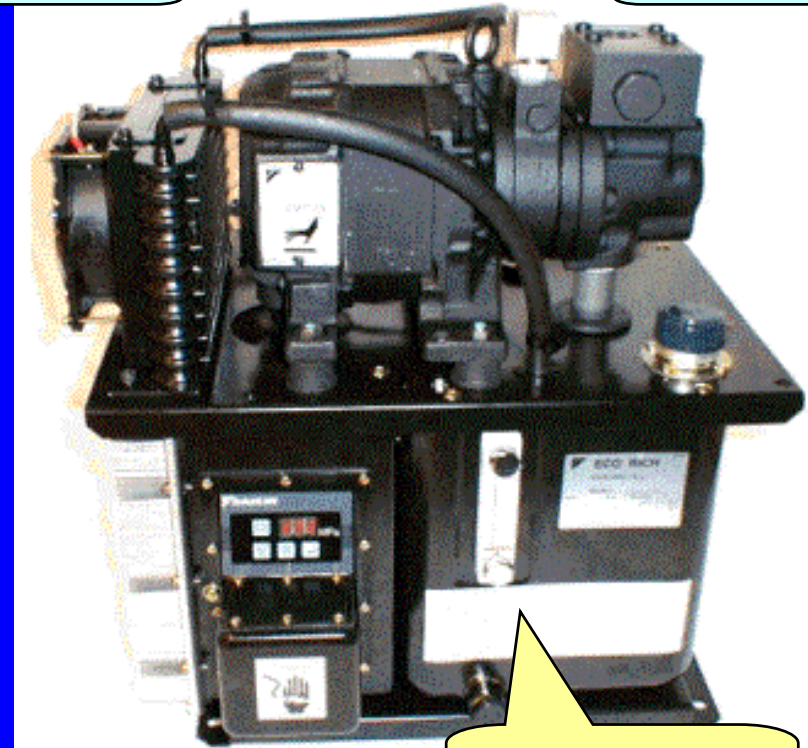
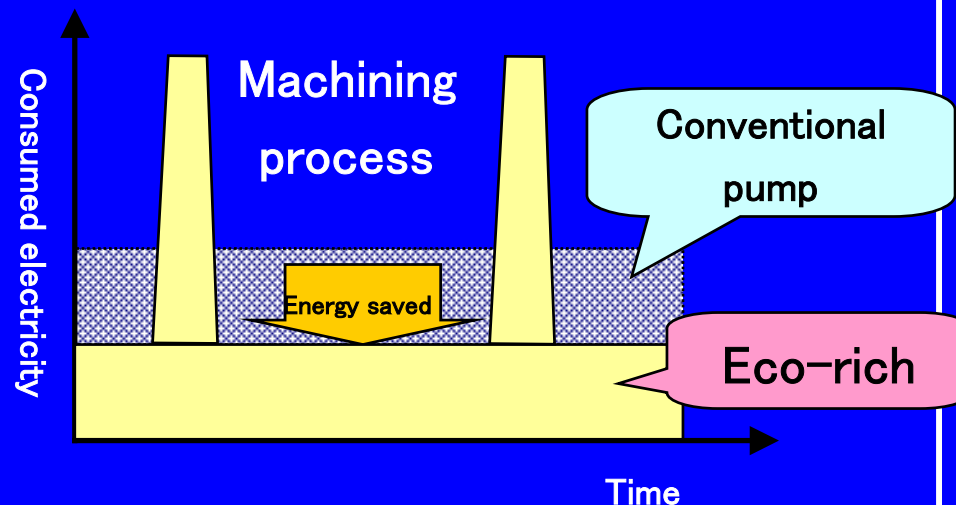
Awards

To install the Eco-rich, a hydraulic pump

- Technical Development Prize of the Japan Hydraulics and Pneumatics Society
- President's Prize of the Japan Machinery Federation

Hybrid hydraulic pumping system

- To supply the quantity of flow in accordance with loaded condition as required
- Number installed: 8 units (machining line)

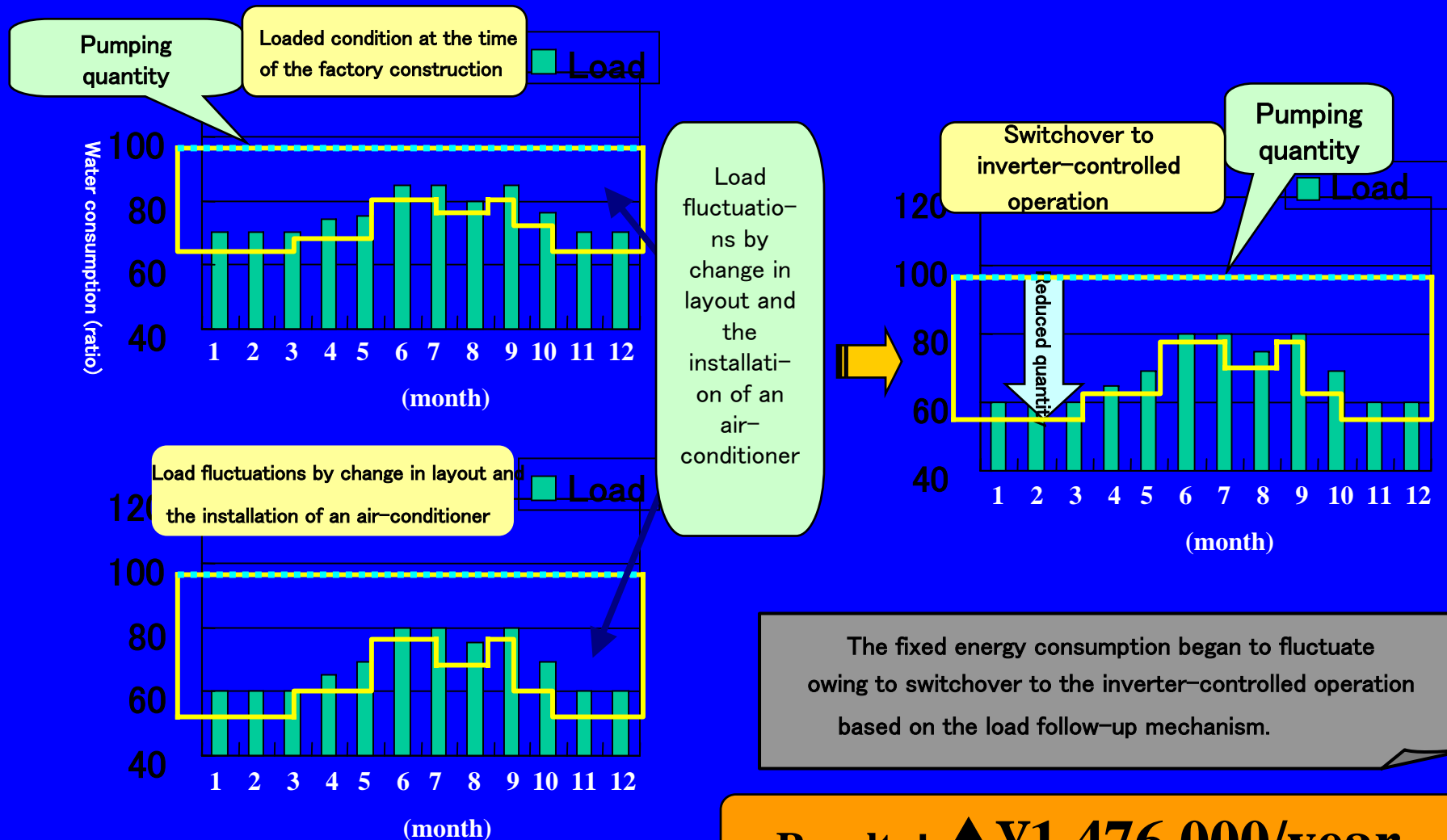


Eco-rich

Result : ▲¥128,000/year

Case study of improvement (6)

To optimize the operation of cooling-water pumps of No. 1 factory



Result : ▲¥1,476,000/year

Case study of improvement (7)

To raise the efficiency of a heat exchanger drying method

Before (improvement)

Drying method: “Lean rack method”

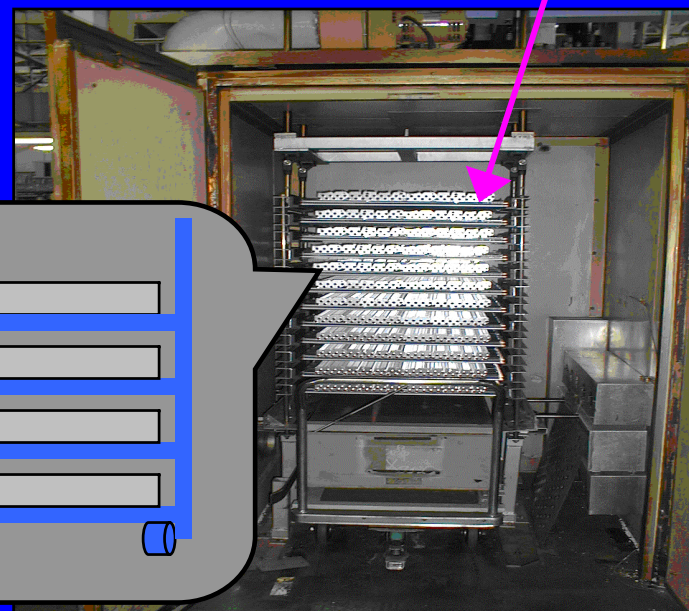
24 units/15 minutes (Set temperature: 120°C)



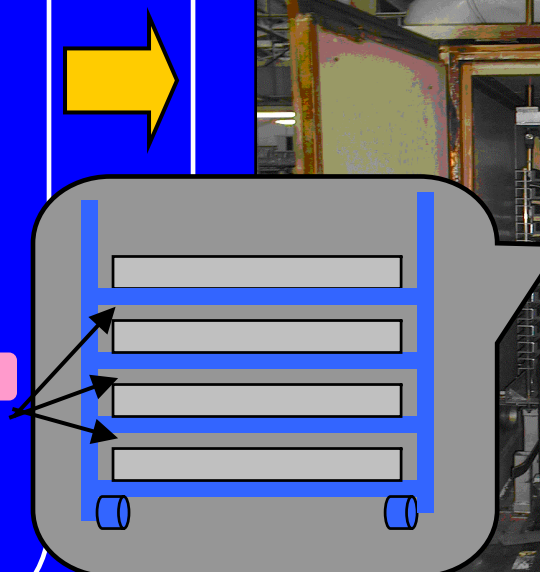
After (improvement)

Drying method: “Parallel cross method”

48 units/15 minutes (Set temperature: 120°C)



To dry heat exchangers with higher efficiency by lifting the heat exchanger using a in house made device and creating a gap between heat exchangers



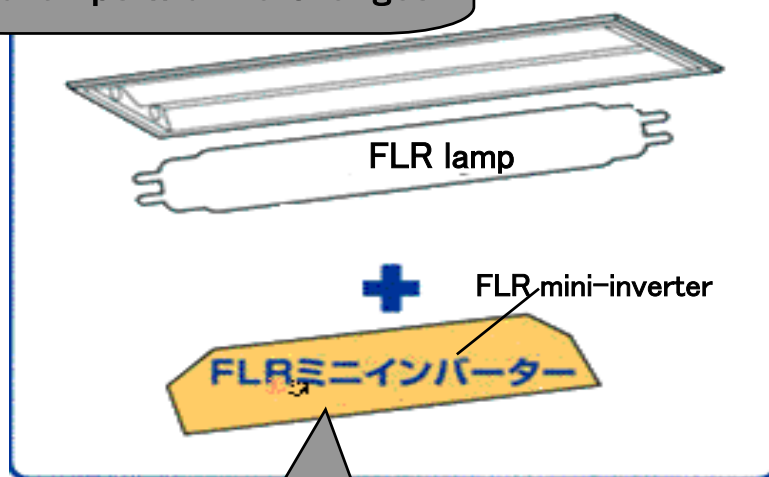
Result : ▲¥870,000/year

Case study of improvement (8)

To change the stabilizer of lighting equipment to an inverter-controlled stabilizer

Energy could be saved approximately by 25% just by switching the copper stabilizer to the inverter-controlled stabilizer without changing the existing lighting system.

Use the lighting equipment and lamps with no changes



To change the stabilizer only

To change 400 units with two FLR40W lamps



※Stabilizer newly installed:
Mini-inverter 40W type for FLR

Result : ▲¥708,000/year

Improvement Case (4)

Enlightenment Activity

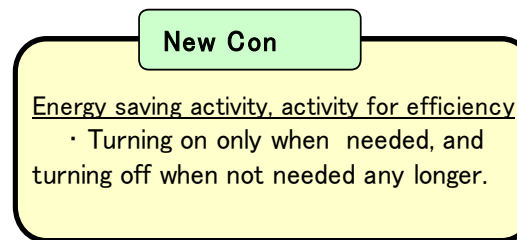
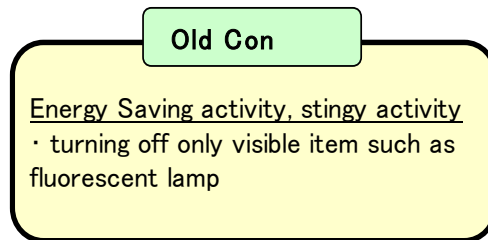


Fig. 16 Renovation of Energy Saving Awareness

Facility for No. 1 Peak- Cut	
set temperature	cooling : 28 °C heating : 20 °C
person in charge	John
Cooperate for prevention of global warming !	

Fig. 17 Set Temperature Specification Label for Air-Con

省エネPR報

省エネ分科会

★あなたは知っていますか？

Bセで使われているエネルギー費用は
〔 6億円／年 〕

製品1台作るのに必要なエネルギー費用
〔 700円／台 〕

事務所で使われるエネルギー費用は
〔 72, 000円／人・年 〕

★意外と高いと感じられたでしょうか？

省エネルギーは
あなたの手から！！

Fig18 Publishing PR for Energy Saving

省エネパトロール	
発行12年 9月27日	
発行部門	○省エネルギー分科会
指摘場所	1工場A1ライン
指摘事項	
エアードライバー本体より エアー漏れ	
処置担当者 ダイキン 太郎	
対策内容	完了日
エアードライバー本体交換	9月27日

Fig.19 Indication for Correction by Energy Saving patr

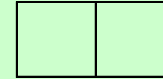
省エネエコ活動表		総務課 タイヤン太郎											
省エネエコ活動項目	9/1	2	3	4	5	6	7	8	9	10	11	12	13
不使用パソコンの電源を切った (1点/1台)		2				2							
不要電灯の消灯 (1点/1台)			1						1				
エアコンのフィルター掃除 (6点/1台)						6							
エアコンの設定温度チェック (2点/1台)													
不要エアコンの電源を切った (5点/1台)												5	
目標達成までの残点数	30	28	27		19				18	18	13		

Fig.20 Eco-Activity for Energy Saving

Broadcasting for PR of Energy Saving

Feb. 3 1998

Energy Saving Sub- Committee



★broadcasting is given for PR of Energy Saving.

For the purpose of enhancing awareness of Energy saving, broadcasting is given for PR of Energy Saving.

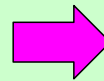
1. Contents of Broadcasting

Let's promote Energy saving for the sake of the global environment by beginning with what you can.

- Turn off the lights not in use at lunch times and breaks .
- Set office and meeting rooms temperature as specified.
- Turn on light only when you need one, and turn off as soon as you don't need any longer.

Old Concept

Save energy with the stingy-minded activity.



New Concept

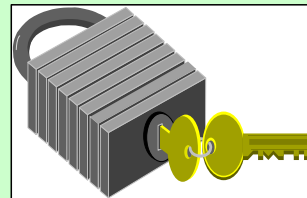
You may use when you need, but use at the maximum efficiency.

2.] Broadcasting Starting : on November 1, 2001

Hours : 12 noon for Workshops
12:20 pm for Offices

You can start Energy Conservation by yourself !

Switch on when you need, and switch off when you don't need any longer.



If you change your concept, you can solve the problem.

[Next bulletin scheduled on March 12, 2001]

Energy Saving on PR

June 30 1997

Energy Saving Sub-
Committee

name	name
------	------

★Do you know that ... ?

Energy cost at our factory is
¥ 600 million / year .

Energy cost required for making one product is
¥ 700.

Energy cost at our offices is
¥ 72,000 / person x year

★More than you expected ?

You can start Energy Saving on by yourself !

Switch on when you need, and switch off when you
don't need any longer



Power consumption in summer sky rocketing !
[Next bulletin scheduled on July 9, 2001]

Eco- Activity for Energy Saving

Enlightenment
Activity

Eco- Activity Table for Energy Saving						General Affair Section (target 30point)			
John Daikin									
Eco- Activity Item	4/1	4/2	4/3	4/4	4/5	～	4/28	4/29	4/30
Turning off lights not in use (1 point each)		2			2				
Turning off desk- top computer not in use (1 point each)	3		1				1		5
Cleaning filter of air- conditioner (6 points each)				6				6	
Turning off air- conditioner not in use (5 points each)			2					4	
Balance point for target	27	25	22	16	14	～	15	5	0

Set Temperature Specification Label for Air- Conditioner & Patrol for Energy Saving

Enlightenment Activity

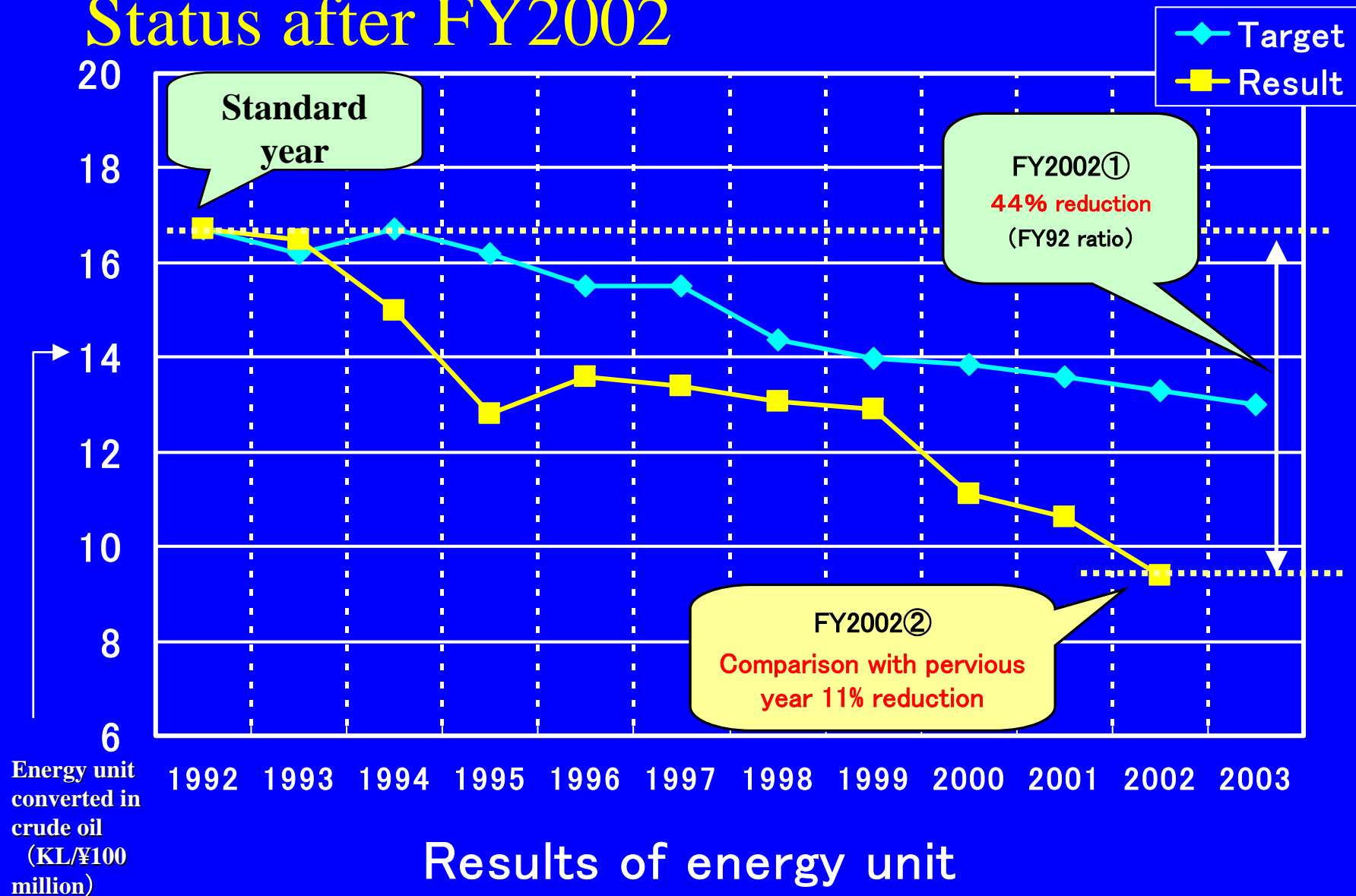
Facility for No. 1 Peak- Cut	
set temperature	cooling : 28 °C heating : 20 °C
person in charge	John Daikin
Thank you for your cooperation prevention of Global Warming !	

[Set Temperature Specification
Label for Air- Conditioner]

Patrol for Energy Saving	
Issued by	Energy Saving Sub- Committee
Place assigned	No.1 Factory A1 Line
Indication	air leakage from air driver for assembly
Date of Counter- Action	Sept 7, 2001 / John Daikin

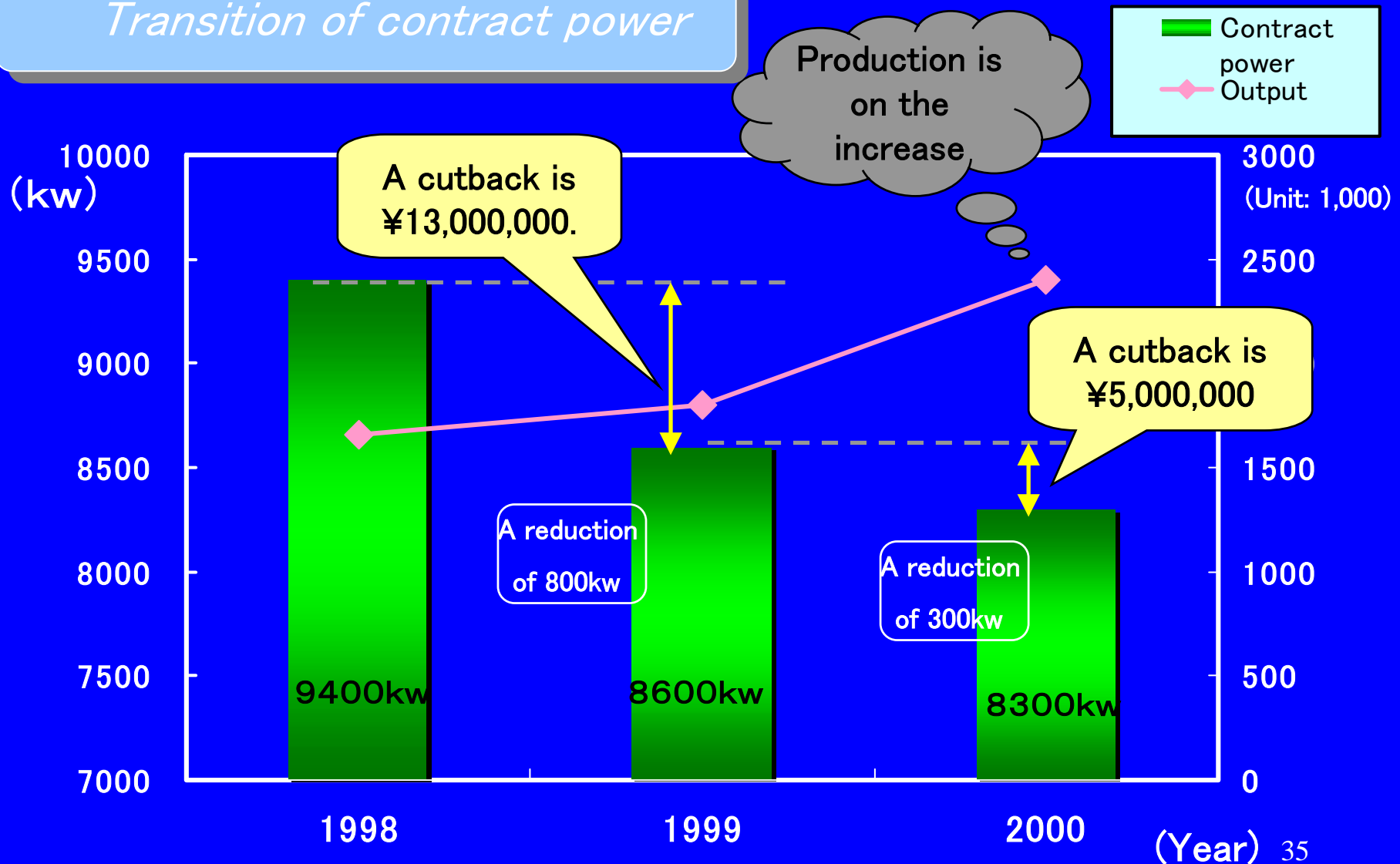
[Indication for Correction by Energy
Saving Patrol]

Status after FY2002



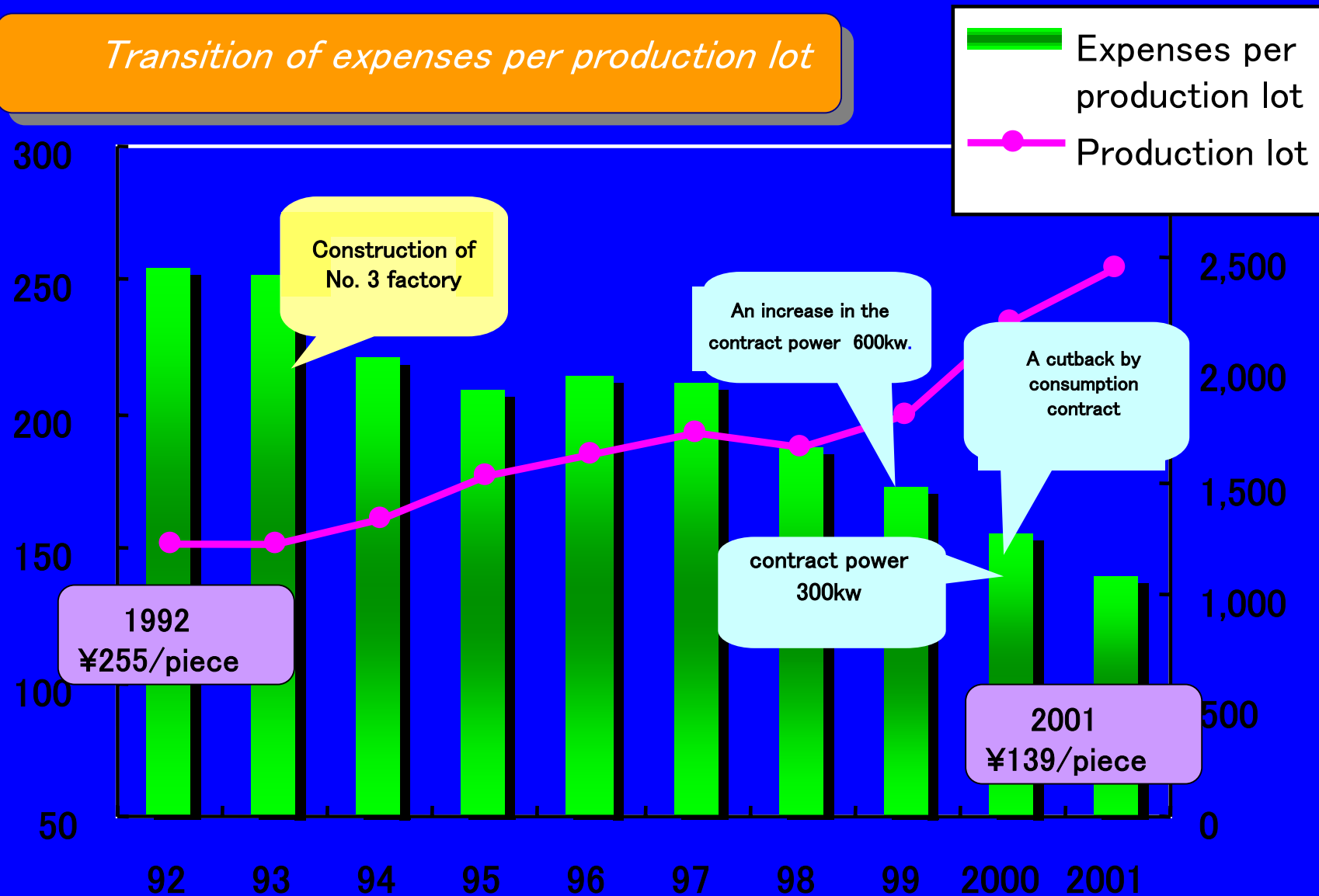
Effect of the countermeasure (2)

Transition of contract power



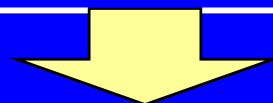
Effect of the countermeasure (3)

Transition of expenses per production lot



Effect of the countermeasure (4)

Fiscal year	Components and contents of countermeasure	Result	
		Reduced quantity (KL)	Reduced amount (In thousand yen)
1998	Direct Section: To stop the cycle of hydraulic pumps of each manufacturing facility Indirect Section: To wash regularly the heat exchanger of a freezer for testing Supply Section: To operate the number of units according to the load of a specially high transformer	Total 952	Total 32,805
1999	Direct Section: To change the air-conditioning method of F6 line Indirect Section: To operate efficiently each testing equipment by installing a timer Supply Section: To reduce the contract power (800kw)	Total 726	Total 50,285
2000	Direct Section: To cut back energy by raising the efficiency of line operation Indirect Section: To operate testing equipment efficiently by cutting down its operation time Supply Section: To reduce the contract power (300kw)	Total 620	Total 45,125
Grand total		2,298	128,215



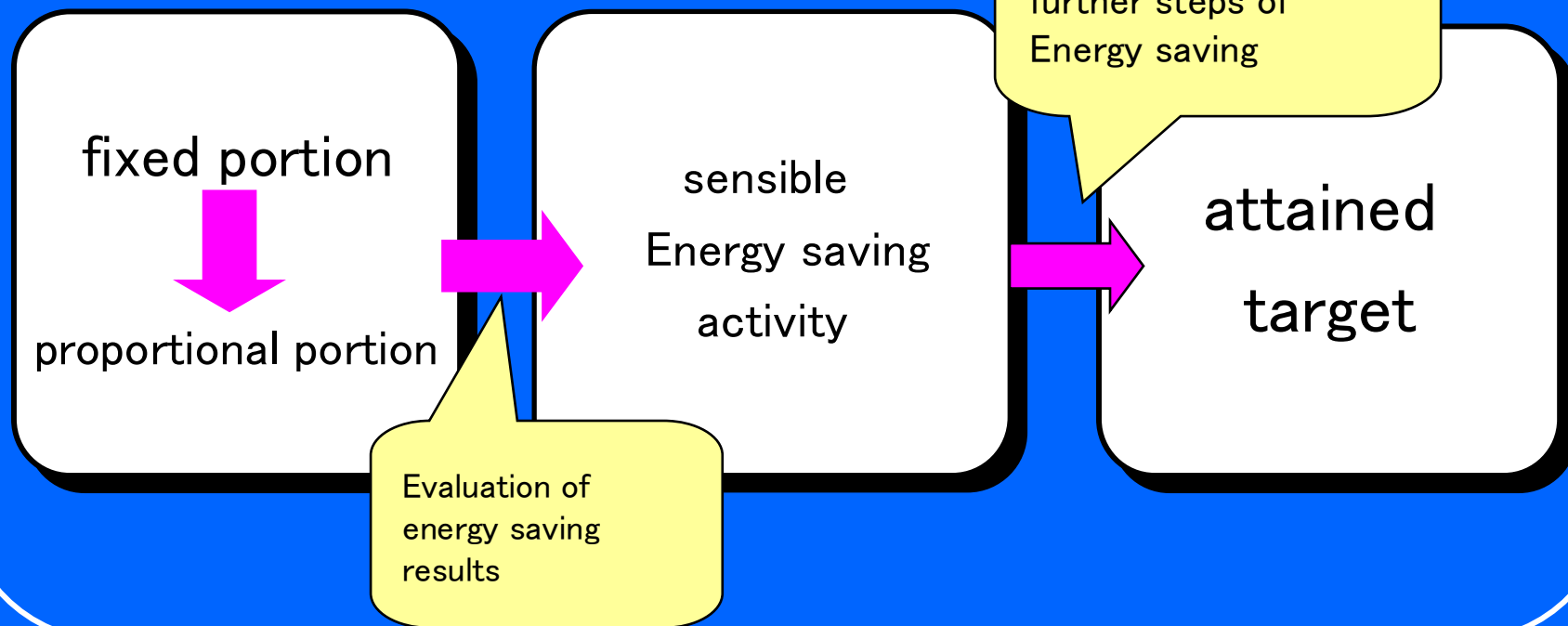
FY2000

- A factory excelling in energy management
 - Awarded the “Director-General’s Prize of the Agency of Natural Resource and Energy”
- National Competition of Model Cases in Energy Saving
 - Awarded the “President’s Prize of the Energy Conservation Center”

Conclusion

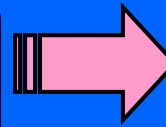
Energy Saving Activity on New Concept

changing consumption structure



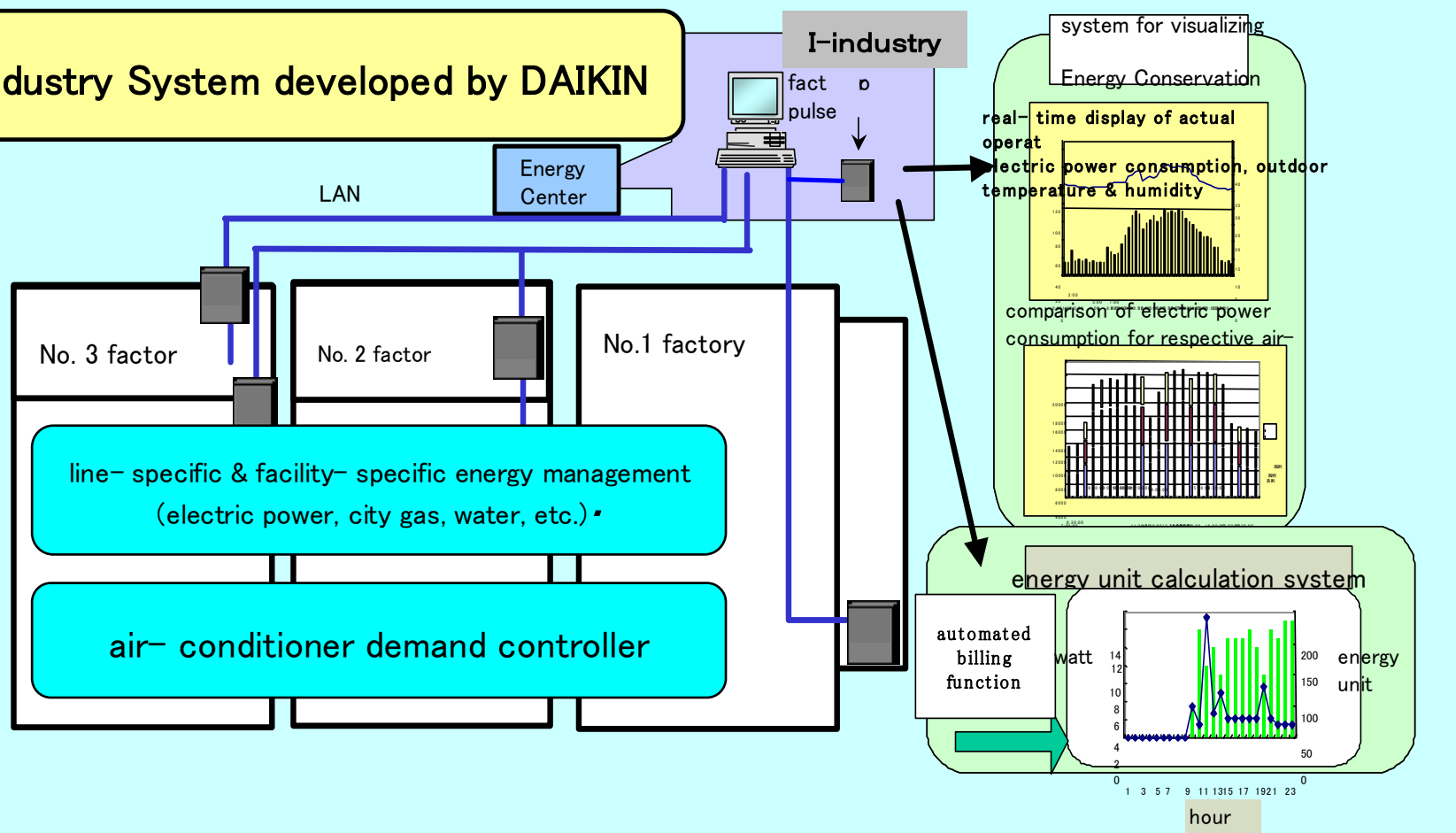
Future Plan

structuring real-time
energy management system



promoting further
energy saving

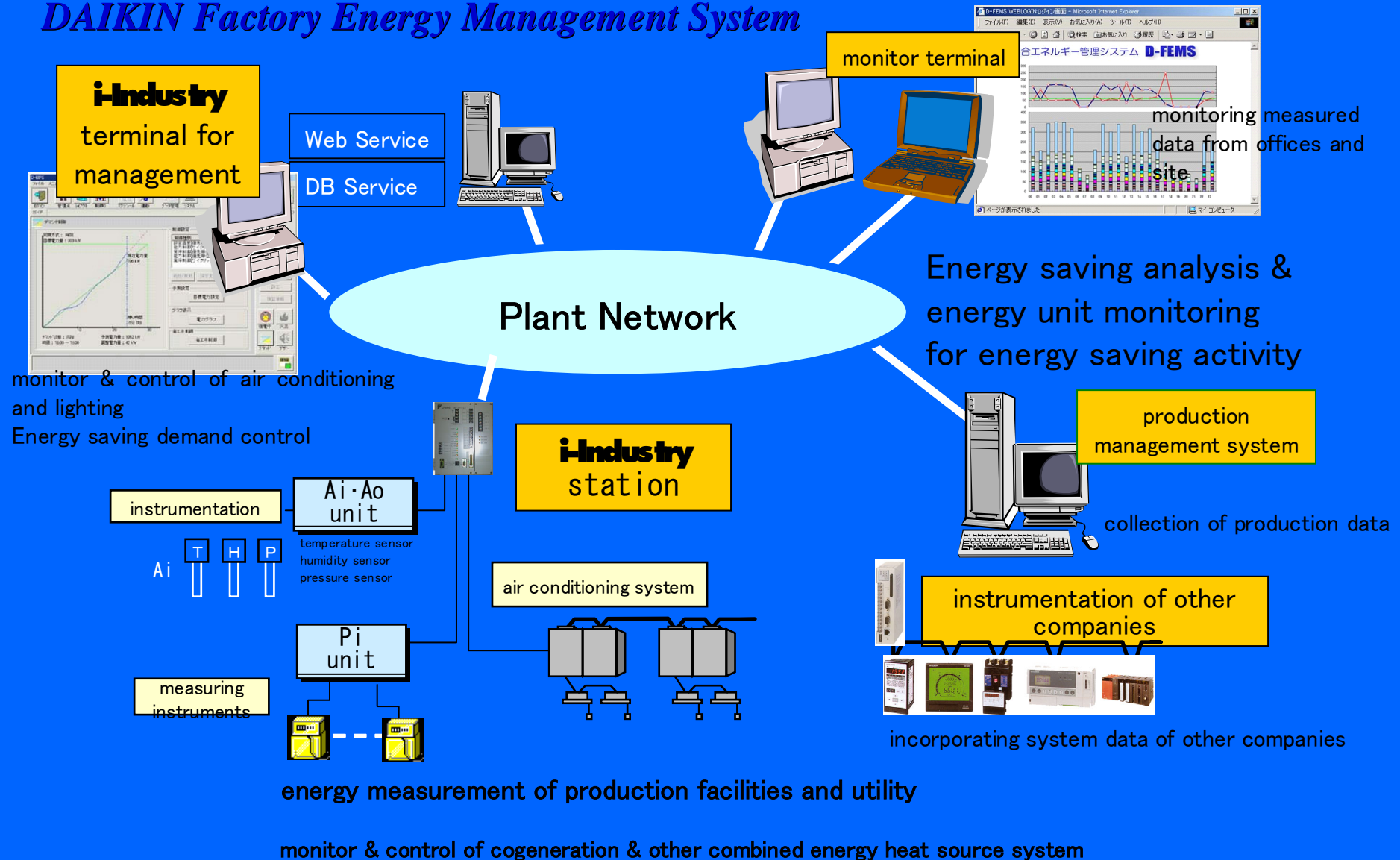
i-Industry System developed by DAIKIN





total energy management system for factories
supplying the total solution regarding Energy Conservation

DAIKIN Factory Energy Management System



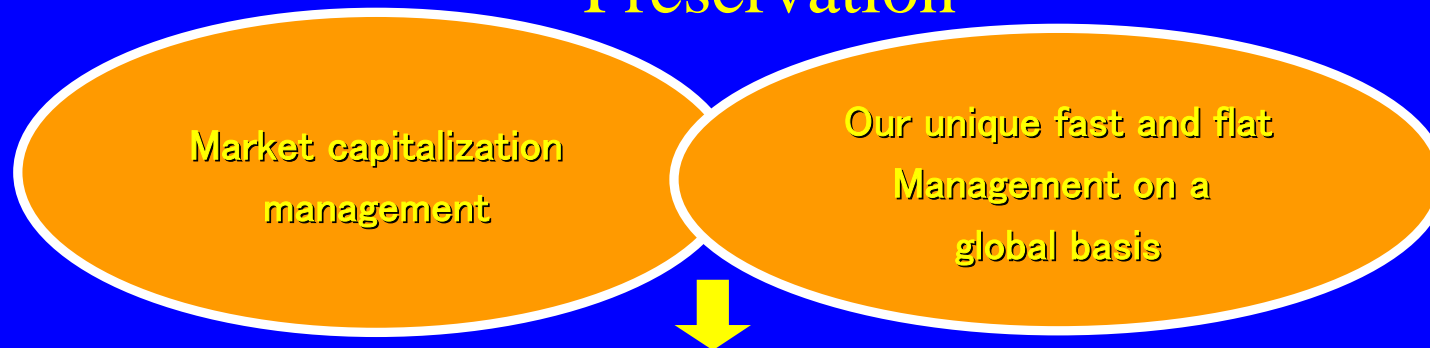
DAIKIN



Our Waste Reduction Activity
“Recycling resources-from sludge to tissue paper”

Daikin Industries, Ltd. Shiga Plant

Outline of Management Regarding Environment Preservation



Daikin's goal

To become a Global and Truly First-class Company

Realizing a dynamic company which attracts people, capital and information

Have a robust financial structure and earnings.

Our main businesses of air-conditioning And flurochemicals are ranked number one or two globally

Have corporate principles and Transparency respected globally

World-class corporate culture and climate



Concept of Creating a Company

Fine

&

Amenity

Pursuing Amenity

customers

**provides amenity with high satisfaction
and high quality**

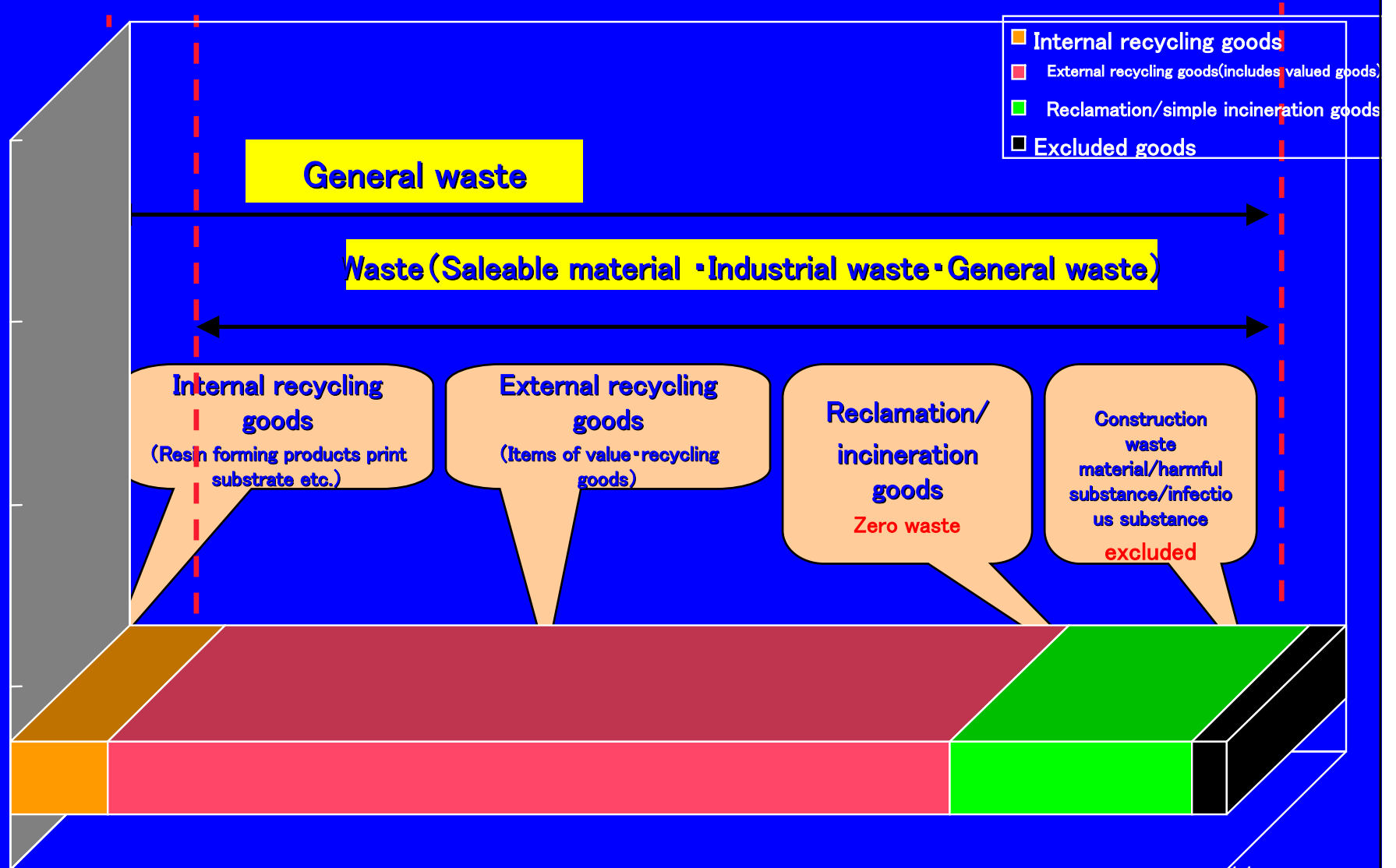
workers

Comfortable working place → provides the best product

**environmental
activity**

**Continuous engagement which is friendly to
the environment**

Definition of Waste



Definition of Recycling

Material Recycle

Saleable
goods

Raw
material

Fuel

Thermal Recycle

Those with heat recovery by
attached
facilities during incineration

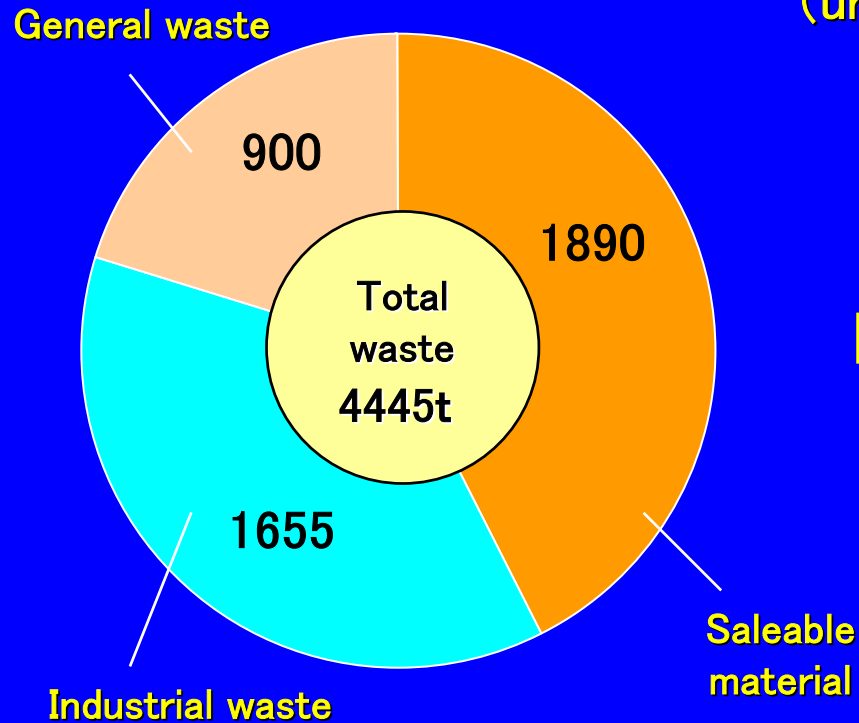
Recycle Excluded

1. Construction waste
2. Infectious medical waste
3. Special harmful industrial waste

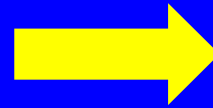
4. Simple reclamation
5. Simple incineration

Change in Total Waste (1992-2002)

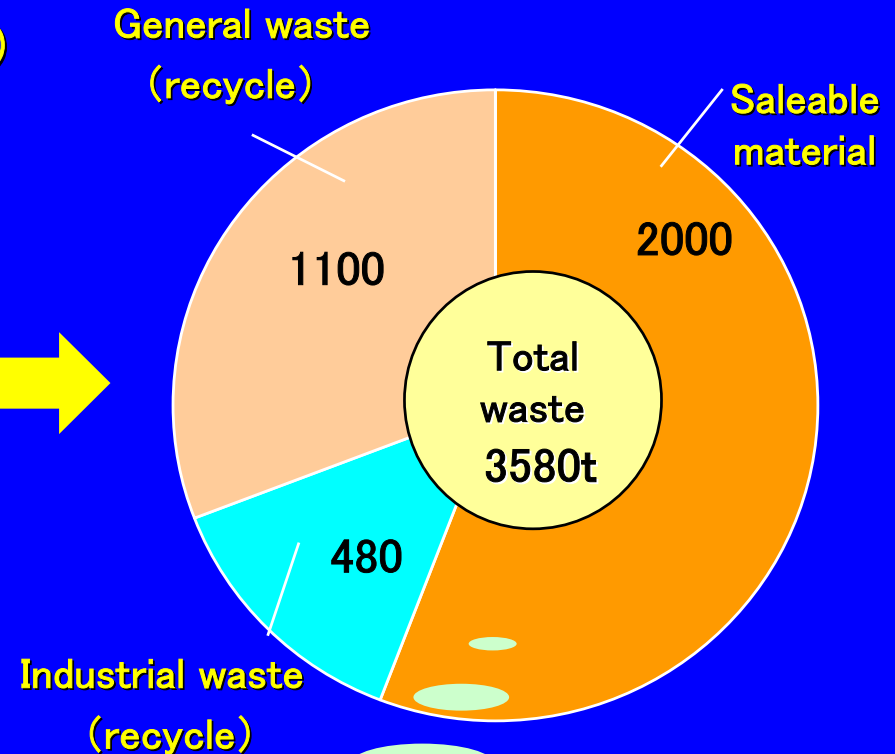
1992



(unit t)

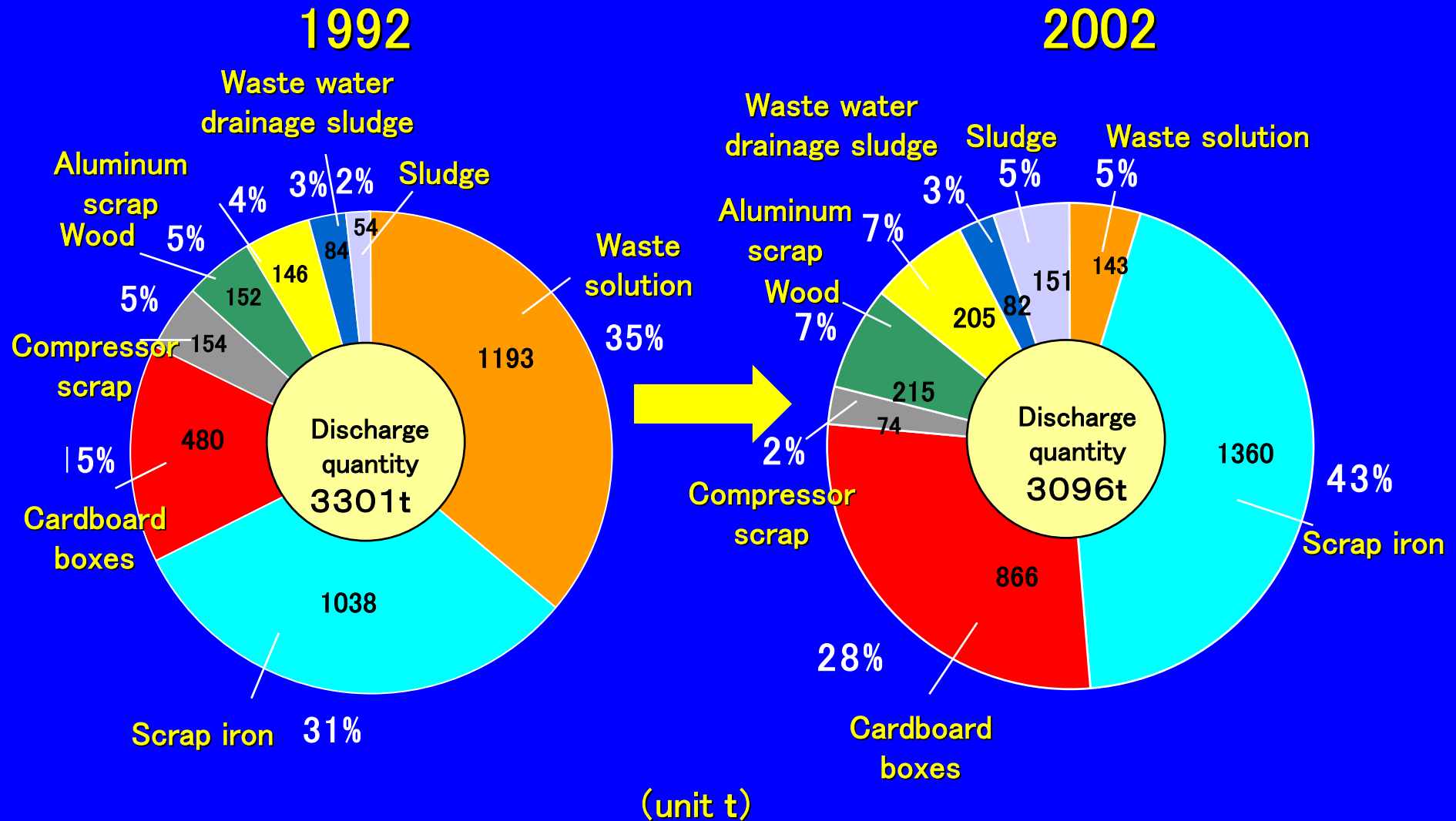


2002

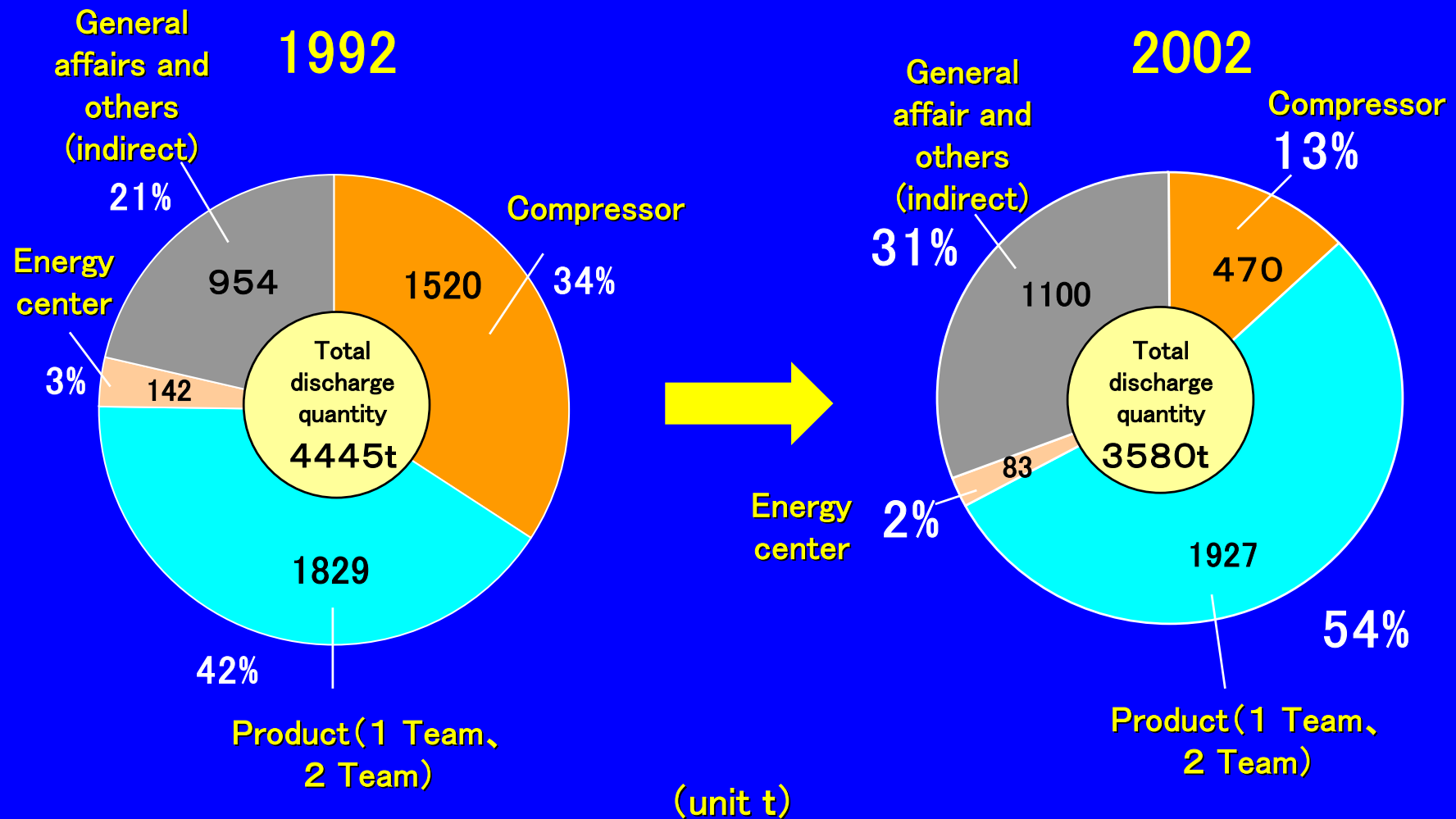


FY1992 ratio▲20%
(▲865t)

Main Waste Emission Amount per Item (1992-2002)

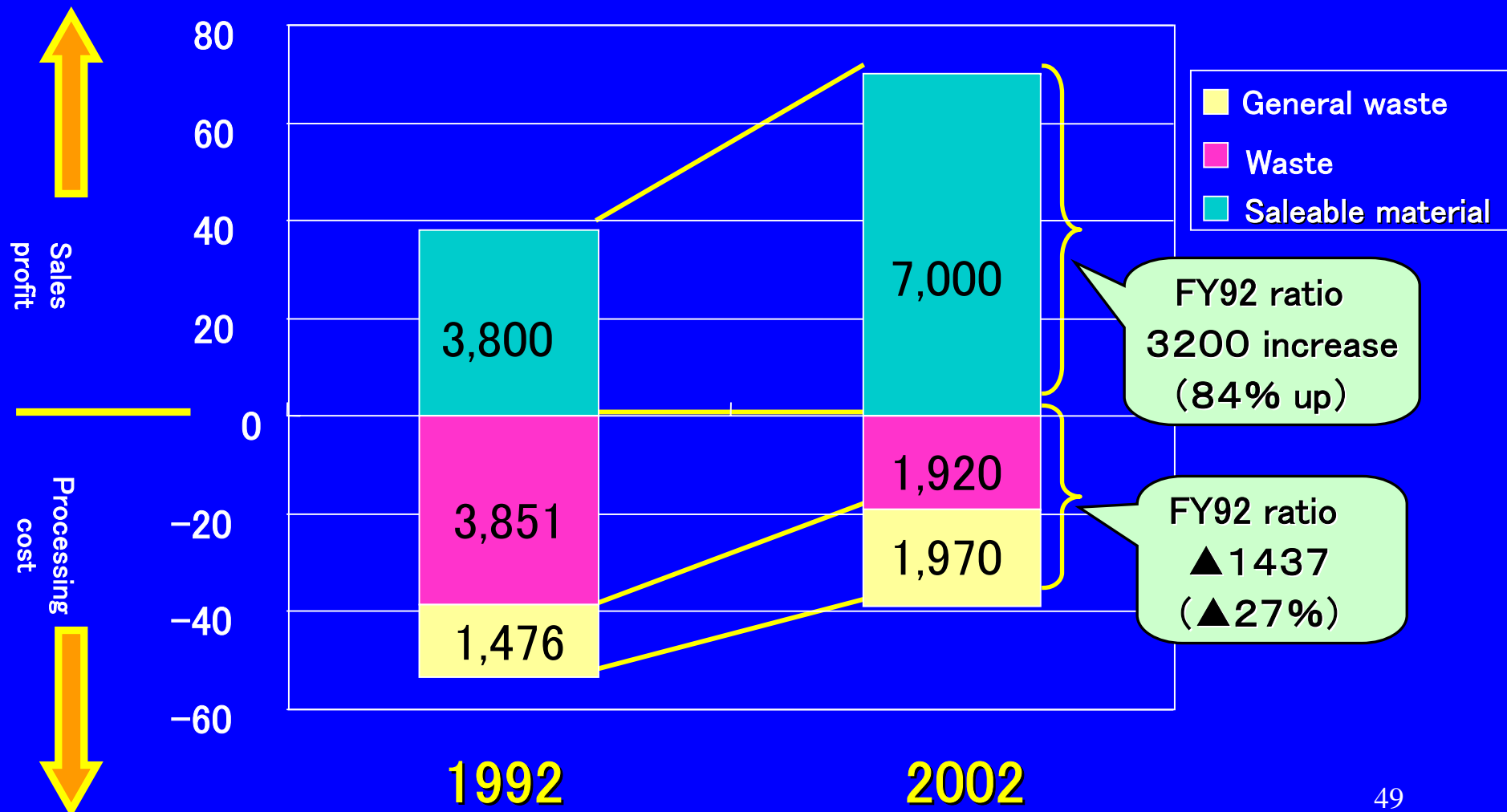


Waste Emission Amount per Division (1992-2002)

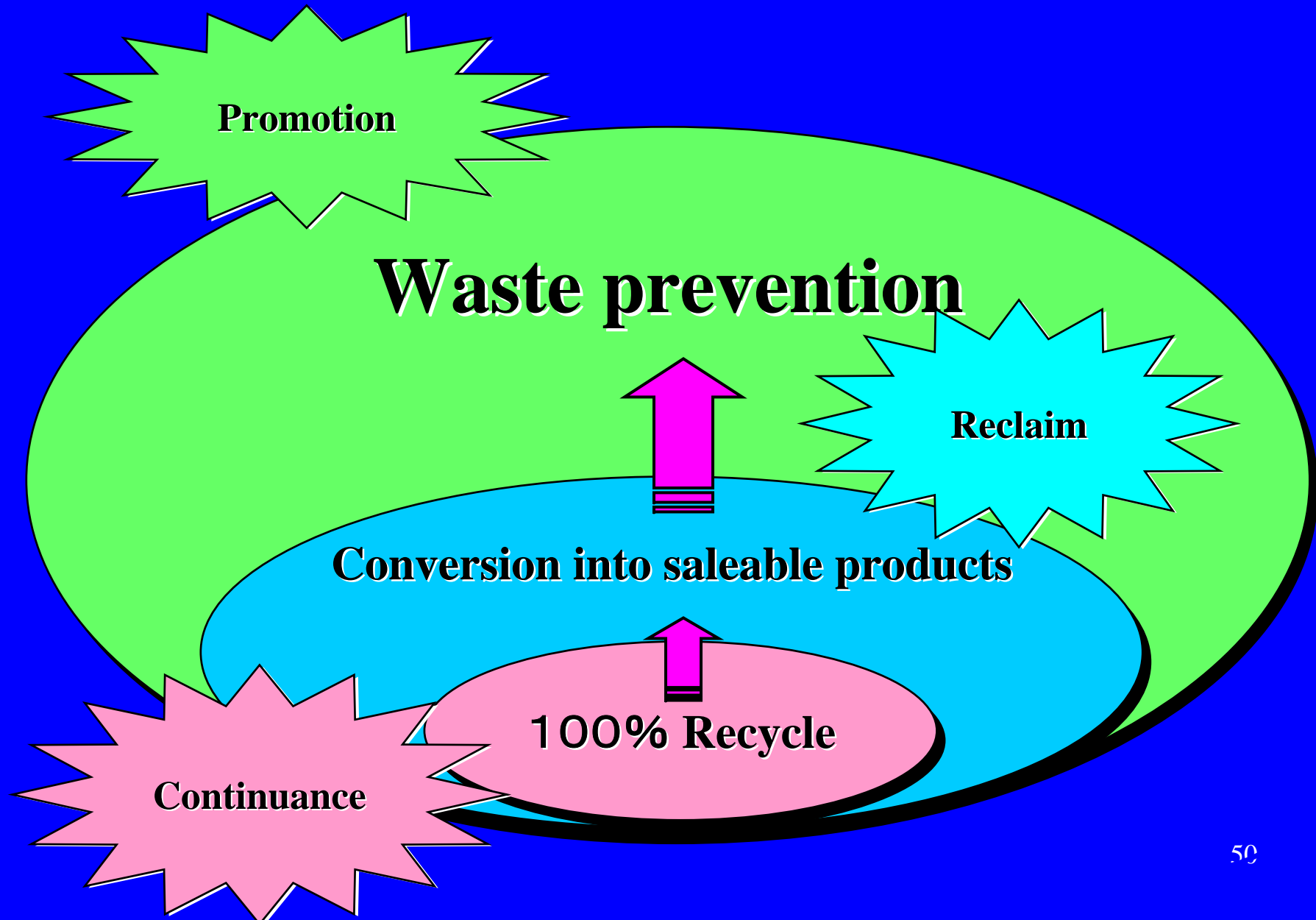


Change in Waste Processing Cost (1992-2002)

Unit ¥M



Concept of Waste Reduction Activity



Efforts in Recycling

Recycling means “Effective use of limited resources”.

To find a dealer who is “near, low cost and safe”

- ① **Total sorting by everyone at the department.**
Abolition of dustbins and installation of recycling boxes.
- ② **Search a nearby collector with low risk and low processing cost.**
- ③ **Effort when emitting so as to satisfy collecting standard.**
(dewatering of grinding scrap)
- ④ **Internal Manifest System which raises sorting and cost conscious.**

Efforts in Conversion into Saleable Products

To turn “waste to be saleable resources”

Effective use of limited resources and recycling of materials to produce usable and salable products repeatedly.

- ① Grasping precious metal content and to become effective resources by element analysis of electric parts.
- ② To become effective resource by sorting waste plastic per types and grinding internally.
- ③ Re-commercialization of wood pallets.

Efforts in Waste Prevention

Waste prevention→“do not bring in or generate waste”

Efforts involving all departments and affiliated companies

- ① Promotion of reusing parts delivery boxes.
- ② Long-life measure against compressor production process grinding solution
- ③ Condensing waste solution at compressor production process.
- ④ Yield improvement of sheet metal material and aluminum material
- ⑤ Reusing waste cloth and gloves by cleaning.
- ⑥ Tackling reduction of sludge that occur at waste water processing

Example of Recycling Improvement (3)

Improved emission method so as to obey collecting standard. (grinding scrap)

Before improvement



Grinding scrap of casting and stone was emitted, inclusive of grinding lubricant



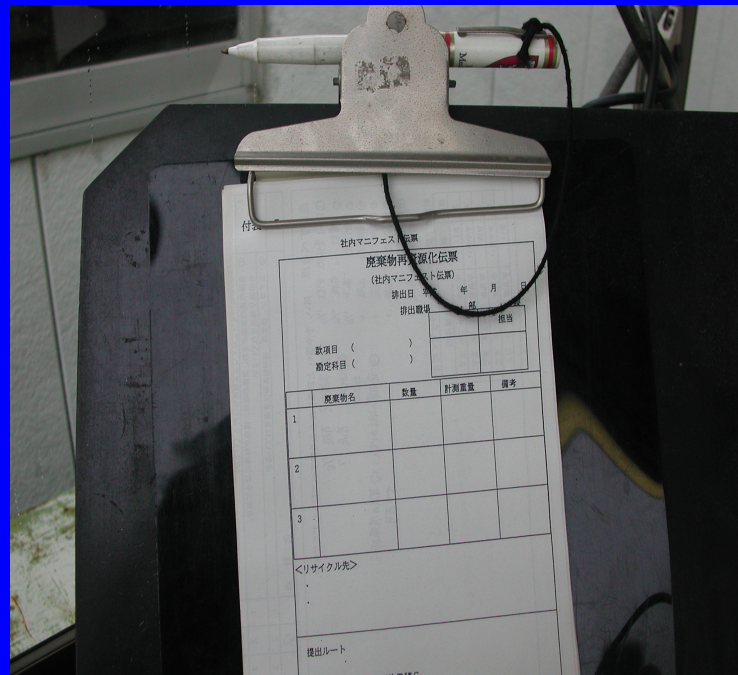
After improvement



Installed a grinding lubricant converger and now emitted after grinding lubricant has been collected.

Example of Recycling Improvement (4)

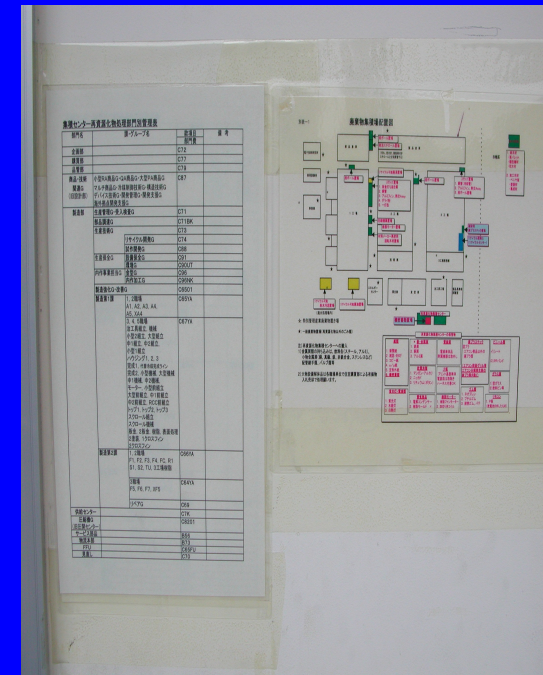
Internal Manifest System which raises sorting and cost conscious



Internal manifest
order



Resource collecting
center



Waste collecting location
map and control chart per
processing department

Example of Conversion into Saleable Material Improvement (2)

Items to become saleable by a further sorting of waste plastic and internal grinding

Before improvement



Mixed emission of plastic



After improvement



After sorting at recycling location,
proceeds to grinding process.



Reduced to power by plastic
grinding machine

Example of Conversion into Saleable Material Improvement (2)

Reusing part delivery boxes

Before improvement



Cardboard case



A pallet must be underneath cardboard case.



After improvement



Domestic (Plastic reusing boxes)



Overseas (Reusable pallet made of metal)

Example of Waste Prevention Improvement (4)

Yield improvement of sheet metal and aluminum material

Before improvement



Scrap Width 5mm

After improvement



Scrap Width 3~2mm

Example of Waste Prevention Improvement (5)

Reusing waste cloth/protection gloves by cleaning

Before Improvement



Waste occurrence amount
60t/year



After Improvement



Waste occurrence amount
1/6
10t/year

Summary of Waste Reduction Activity

Recycle
100% action

- Search on-site recycling dealers that are near inexpensive and safe
- Achievement and continuance of sorting activity by everyone
- Preparation for items to be saleable based on material recycling
- 100% recycling and contribute to lower cost.

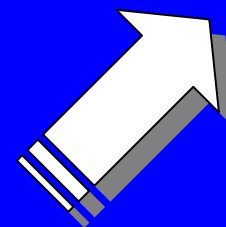
Action for items to
become saleable

- Change for action to enable continuance as a company
- Traditional waste to be of value as well (further searching dealers and sorting)
- FY92 ratio, ¥3.2 M increase in selling profit

Action for waste
prevention

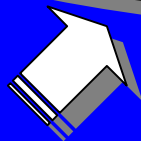
- Emission and processing cost can both be reduced at the same time.
- Effective action unnecessary of recycling energy.
- FY92 ratio, 865t of emission reduced.
- FY92 ratio, ¥1.4 M processing cost reduced.

Future Activity Plan



2001~

- Continued recycling engagement
- Conversion to valued goods engagement, based on material recycling
 - internationally as well
- For reduction in total discharge quantity, engagement in occurrence control from engineering development stage.
- ISO 14001 Daikin nationally unified certification (next spring-plan)
- Target Nikkei Environmental Management Ranking within 10th place for 3 consecutive years



1992~2001

- Engagement targeting only industrial waste
- Zero waste emission=100% recycle

DAIKIN

