November 4, 2003

16. A Field Study of Energy Efficient Factories

省エネルギー優良工場視察

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Araco Corp.
Promotion for Energy Saving

Nov, 2003

ARACO

1. Outline of Araco

Corporate Overview

Confidential

ARACO Corporation

◆Establishment July, 1947

◆Capital 26.6 Million US$

◆Contents (1) Vehicle Operations
(2) Special Purpose Vehicle Operations
(3) Car Interior Operations

ARACO

Confidential

＜ Location ＞

Headquarters

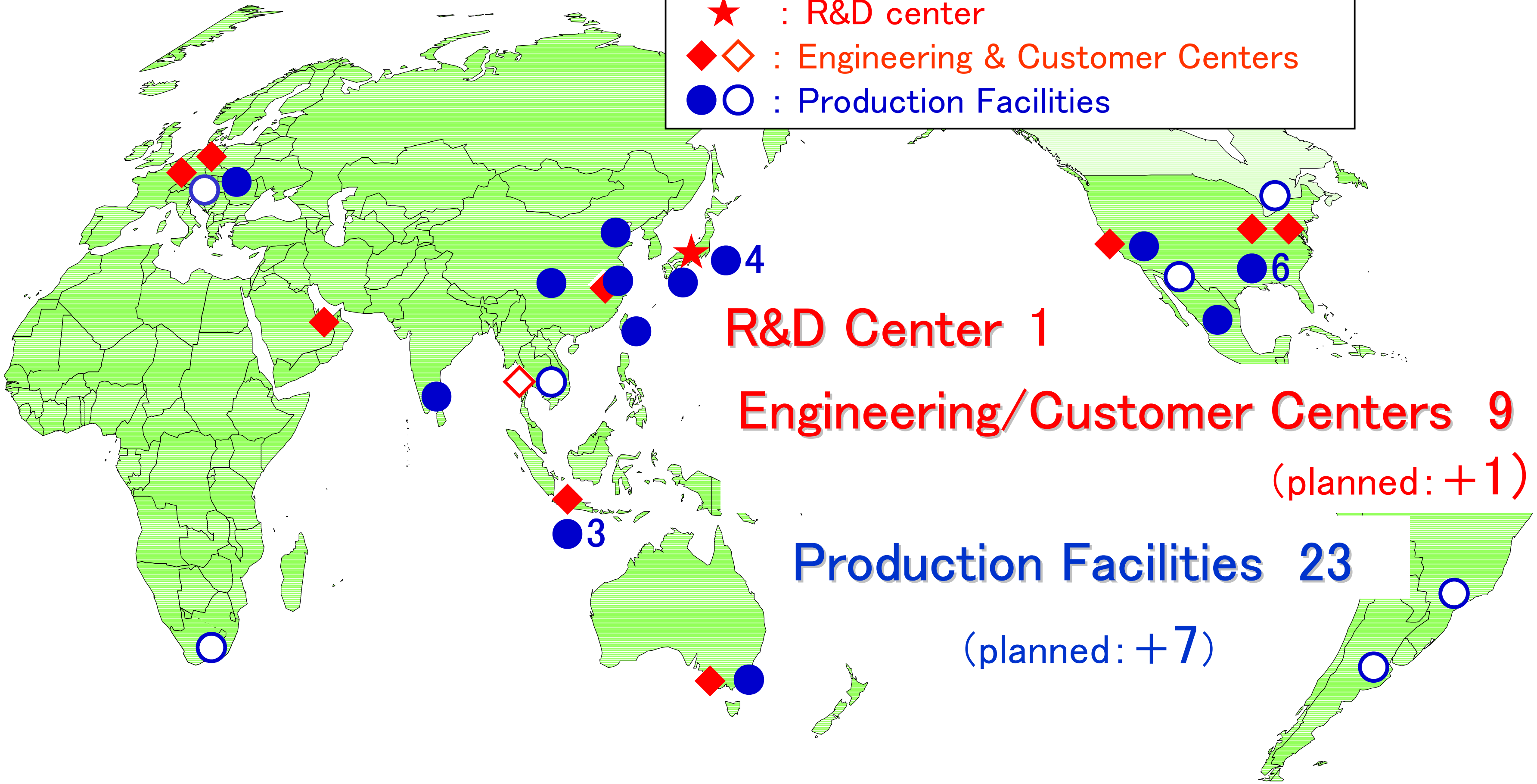
Toyota City, Aichi Prefecture, Japan

Corporate Overview

ARACO

Confidential

< Facilities >



R&D Center 1

Engineering/Customer Centers 9

(planned: +1)

Production Facilities 23

(planned: +7)

Profile of Yoshiwara Plant

Number of Employees : 2,786

Site Space : 290,400㎡

Building Space : 151,700㎡

Corporate Overview

Confidential

< Vehicle Operations >

Araco
COMS

Lexus
LX 470

Toyota
Quick
Delivery Van

Toyota
Land Cruiser 70

Toyota
Land Cruiser 100

Toyota
Coaster

Profile of Sanage Plant

Number of Employees : 2,120

Site Space : 273,200㎡

Building Space : 82,900㎡

Corporate Overview

ARACO

Confidential

< Car Interior Operations >

Seat

Door Trim

Headliner

Sun Visor

Floor Carpet

Package Tray

Main Products: Seats, Door Trim

Capable of being an interior system supplier except I/P

< Special Purpose Vehicle Operations >

FunCargo with swivel seat

◆Electric wheelchair lift

◆Wheelchair with height adjuster

Hi-ACE for the Transport of the Handicapped

◆Fully-automatic slide lift

Corporate Overview

Confidential

＜Vehicle Development ＞

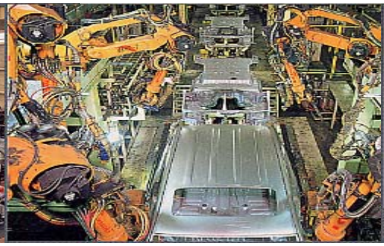
◆Responsible for products from styling and design to final manufacturing.

Styling

Design

Testing

Stamping



Welding

Painting

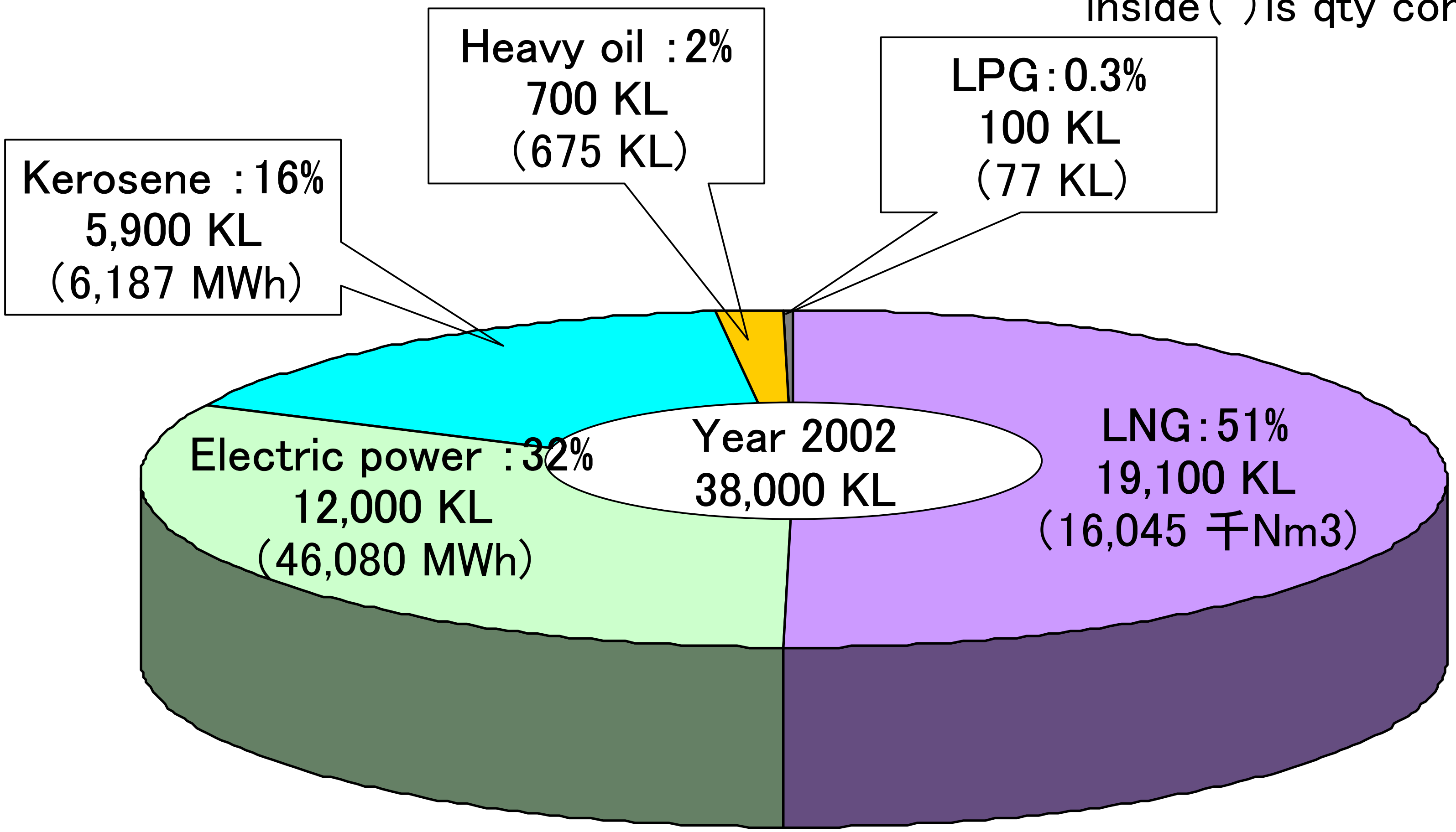
Assembly

Inspection

Outline of Energy Consuming

①Annual Consumed Energy 2002

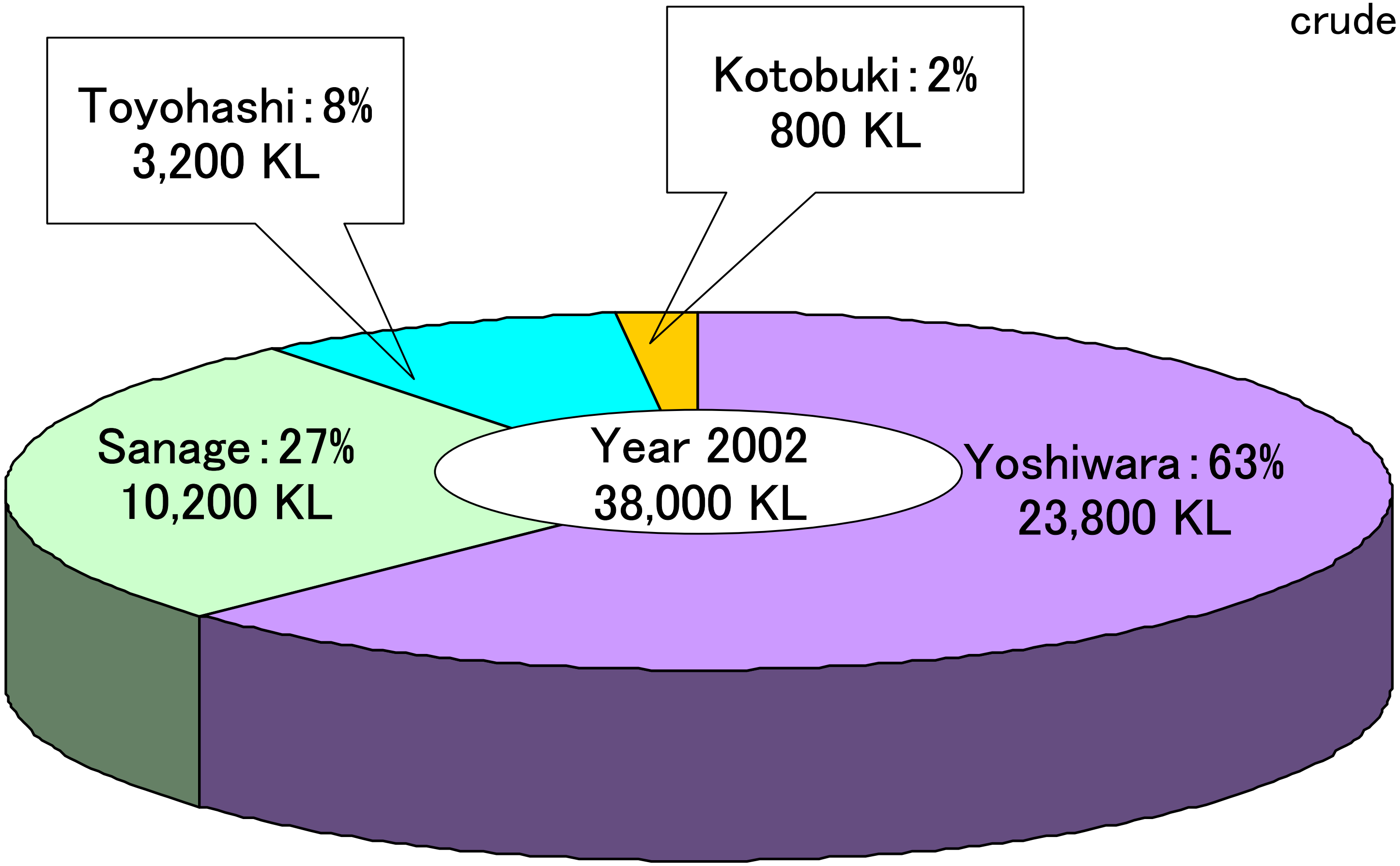
※unit：as of (exchanged to) crude oil
inside( )is qty consumed



Outline of Energy Consuming

②Energy Consumed at Each Plant Year 2002

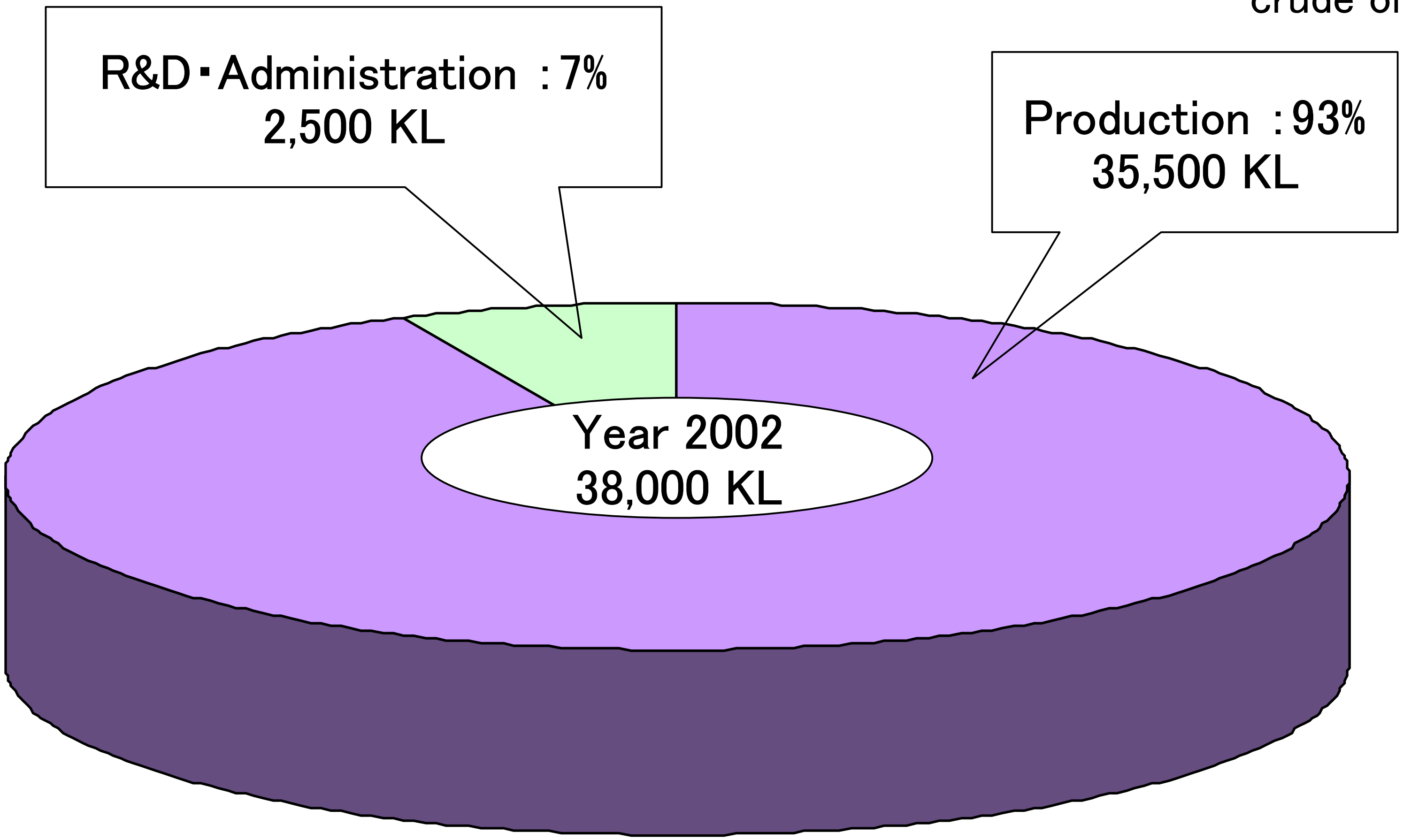
※unit：as of (exchanged to) crude oil



Outline of Energy Consuming

③Energy Consumed at Each Department Year 2002

※unit：as of (exchanged to) crude oil



2. Outline of Energy Saving Action

CO2 Emitted Targeted Qty

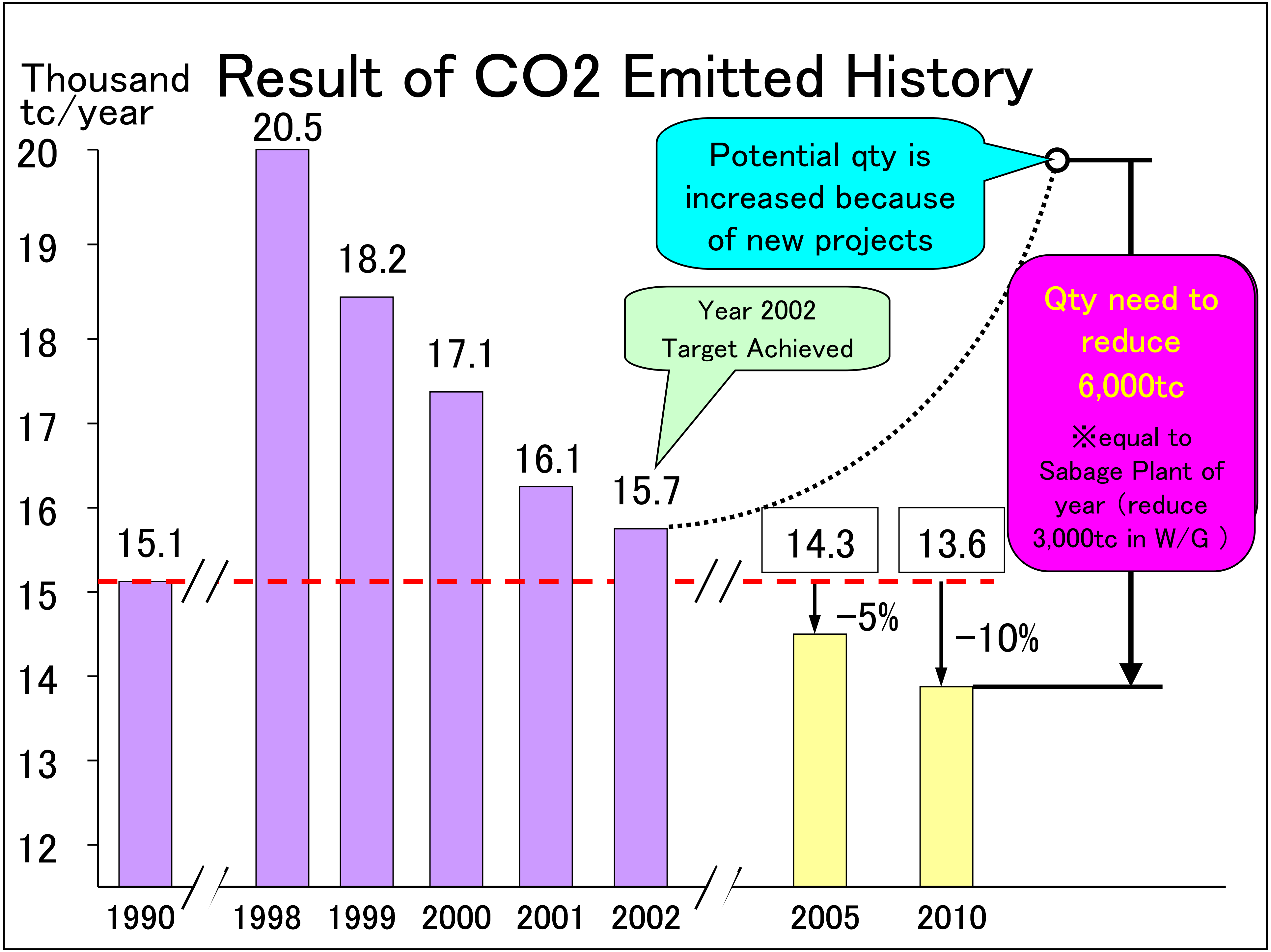
1）Emitted CO2 over company as of the end of year 2005

Level of Year 1990 －5% （14,330tc/Year）

2）Emitted CO2 over company as of the end of year 2010

Level of Year 1990－10% （13,570tc/Year）

※Common target for Toyota group

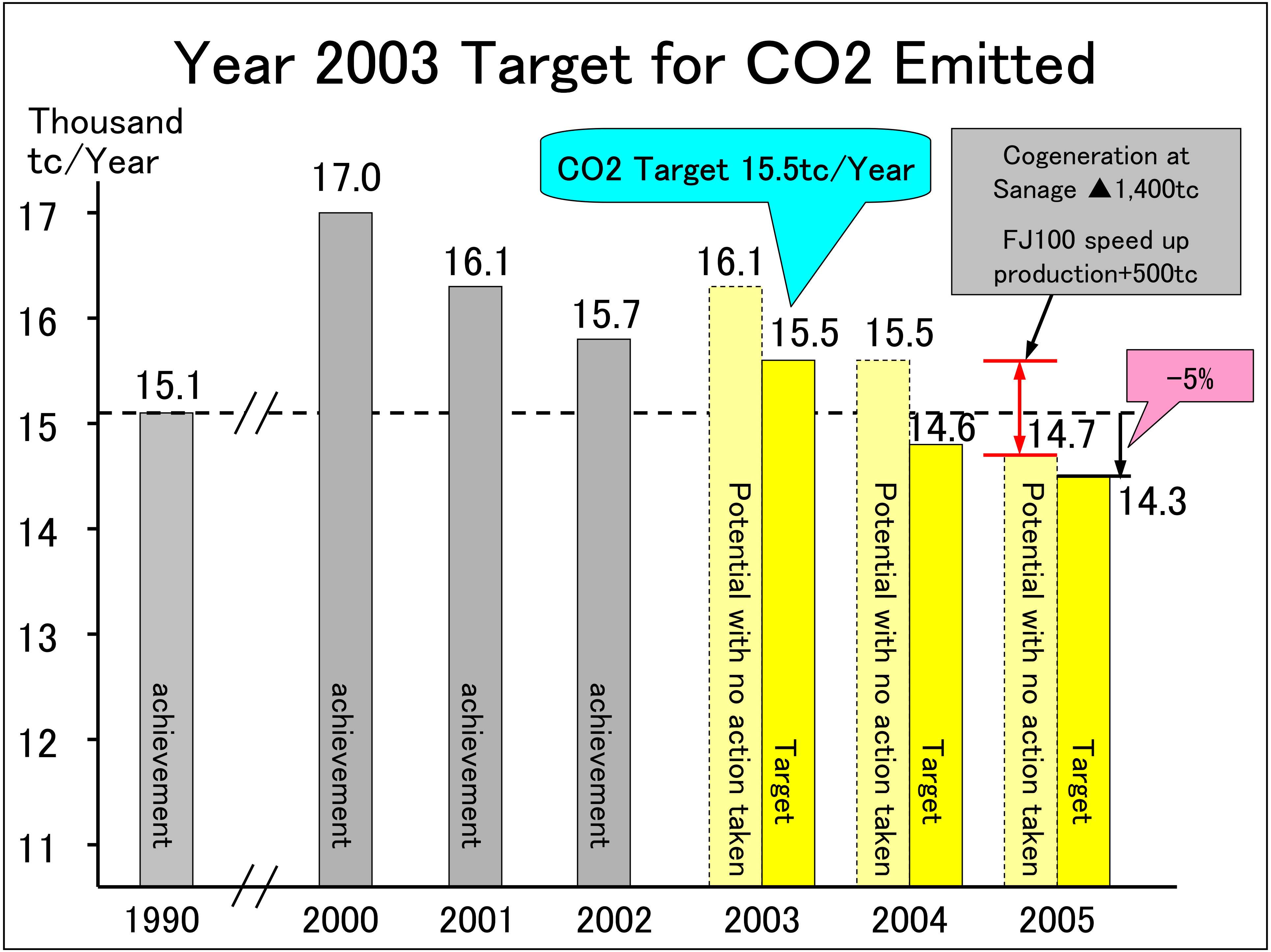

Result of CO2 Emitted History
Thousand tc/year
20
19
18
17
16
15
14
13
12
15.1
20.5
18.2
17.1
16.1
15.7
14.3
13.6
1990
1998
1999
2000
2001
2002
2005
2010
−5%
−10%
Potential qty is increased because of new projects
Year 2002 Target Achieved
Qty need to reduce 6,000tc
※equal to Sabage Plant of year（reduce 3,000tc in W/G ）

Major Promotion till Year 2002

Items	Main Effort for Improvement
CO_2 Emitted Reducing Promotion	1) Change of operation way of equips ・Introduction of cogeneration into Yoshiwara and Sanage plant ・Reduction of loss of not operating equips (Power cut in plants and turning power off of not used equips) 2) Introduction of high efficient equips ・Inverter control of fan, pump & etc. ・Introduction of inverter compressor 3) Energy exchange ・Change of heat source for vacuum forming machine (electric power→steam) 4) Others(Improve productivity &etc.) ・Shortening operating time as production line operation rate improvement ・Equip reduction with intensive production by robots and etc. ・Construction of energy saving building21
Energy Measure	1) Progress watching by energy measure at each process and dept.

３. Year 2003

Effort of Sanage Plant(Part block)



Year 2003 Target for CO2 Emitted
Thousand tc/Year
17
16
15
14
13
12
11
CO2 Target 15.5tc/Year
Cogeneration at Sanage ▲1,400tc
FJ100 speed up production+500tc
-5%
15.1
17.0
16.1
15.7
16.1
15.5
15.5
14.6
14.7
14.3
achievement
achievement
achievement
achievement
Potential with no action taken
Target
Potential with no action taken
Target
Potential with no action taken
Target
1990
2000
2001
2002
2003
2004
2005

How to Promote

①Reduce fixed energy both on and off time

②Reduce operating energy for process equips

③Improve production efficiency with TPM and TPS promotion

④Set control standard up based on Energy Saving Code

Sample of energy saving improvement ①

・Install skylight on plant roof(38 spots)to take light in order to reduce lighting load by lighting off during daytime

Before Improvement	・Length for lighting on：20 hours(6～2a.m.) [134 lights(Metal halide 250 W)]
After Improvement	・ Length for lighting on：10 hours(16～2a.m.) 10 hours shorter(under fine weather)

<Annual Impact>

Energy Reduced: 62,980kWh

CO2 Reduced: 6. 6tc

Energy Cost Reduced：1,033,000JPY

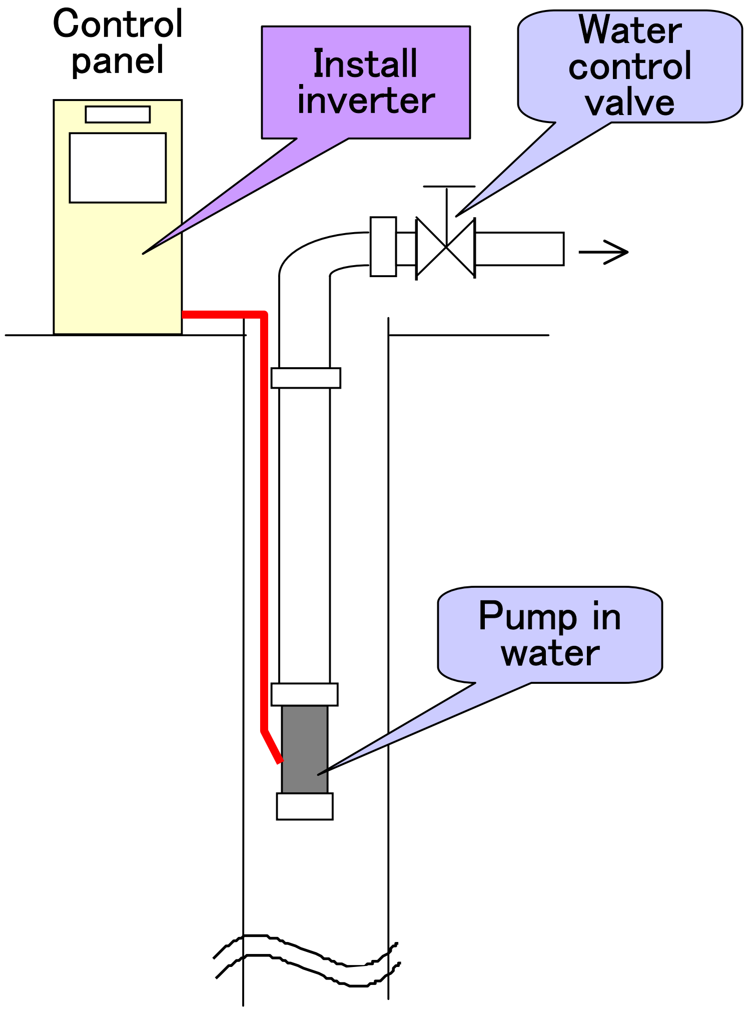
※Assume ¾ of year is good weather

Outdoor

Indoor

Sample of energy saving improvement ②

・ Frequency of all (3)pump in well water in Sanage plant are controlled by inverter to save energy



Before Improvement

・Limit flow size by valve [flow size 40t/h]

After Improvement

・Install inverter and control rotation frequency to adjust flow size

(valve=full open、frequency 60Hz→47Hz)[flow size 40t/h]

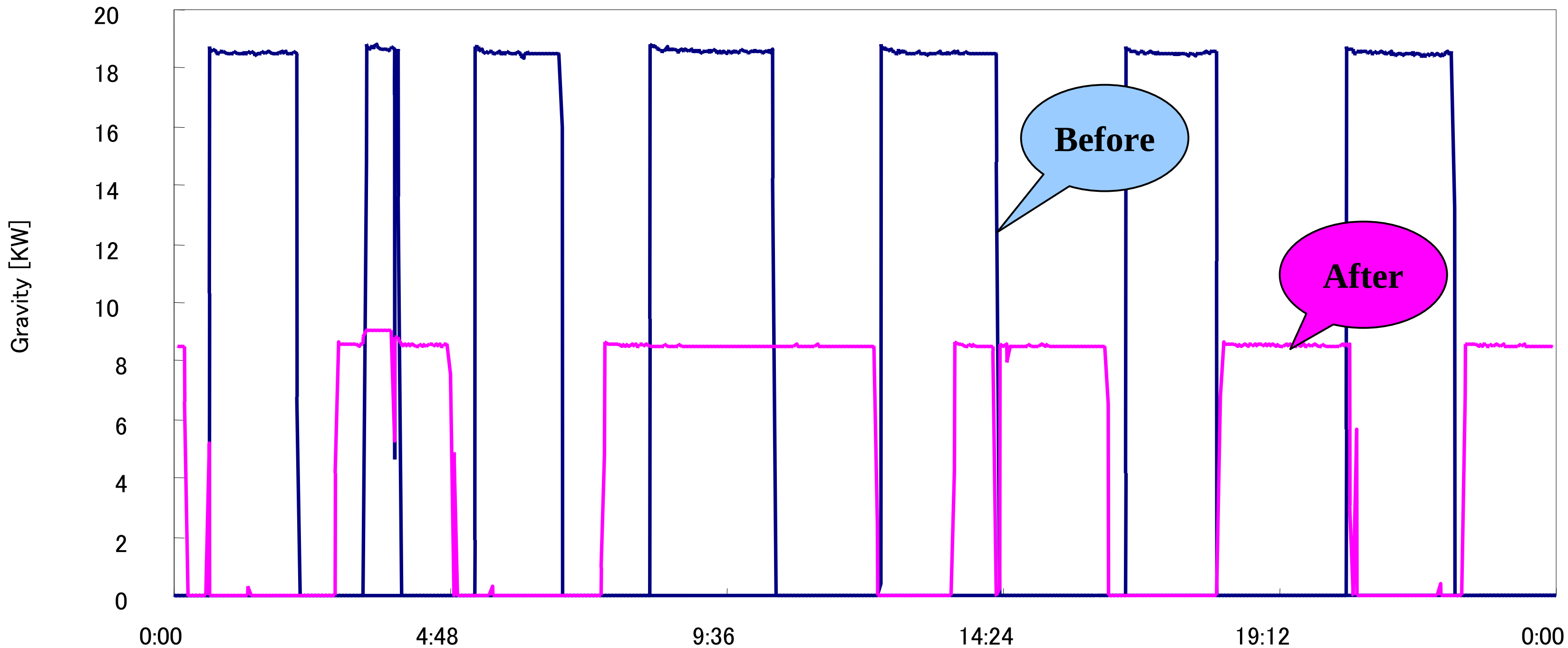


Chart for Energy Consumed at Pump

Before improvement

Qty consumed: 209kWh/pump・day ➡ After improvement Qty consumed: 115kWh/pump・day

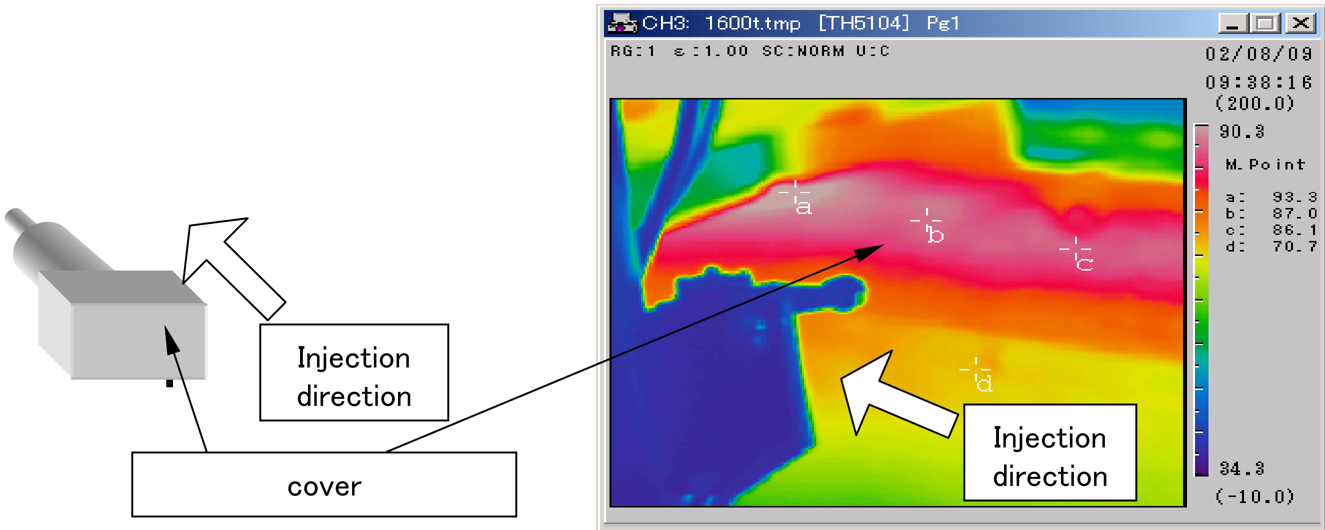
<Annual Impact> Energy Reduced: 101MWh

CO2 Reduced: 18tc

Energy Cost Reduced: 1,441,000 JPY

Sample of energy saving improvement ③

・Apply insulation cover to 1300t injection forming machine heater to reduce waste heat radiation and consumed power.



・Reduce heat radiation loss with insulation of cover

Before Improvement	・Present Temperature ： 93．3 ℃
After Improvement	・Expected Temperature： 50．0℃

※Reduce power consumed by 19%

<Annual Impact> Energy reduced: 6,871kWh

CO_2 reduced: 1．0tc

Energy cost reduced: 102,378 JPY

Construction of R&D Center in Sanage Plant as Save Energy/Environmental Friendly Facility

Araco Corp.
Production Engineering Dept.
Plant Engineering Room

Concept of R & D Center

R&D center is built as core of research and development of automobile interior system.

→

This R&D center is gong to be "Environmental friendly" which is for save energy and environmental friendly as Araco is a company contributing to keep environment.

→

The building is constructed considering following:
① Save energy
② Environmental friendly

Construction Concept

① For Save Energy	1) Introduce high efficient equips 2) Introduce high efficient system 3) Maximize operation of equips 4) Use energy from cogeneration 5) Use natural energy 6) Visualize consumed energy at each division

→

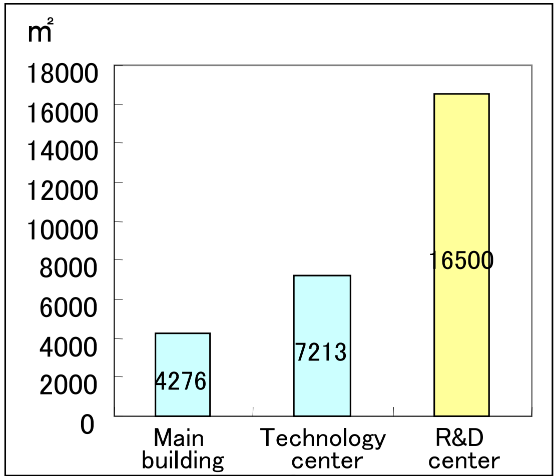
Goal: Time of Completion Exhausted CO2 unit/area is reduced 30%

② For Environmental Fiendly	1) Use actively environmental friendly products being developed in Araco 2) Reduce waste from the building 3) Reduce intake underground water by water recycling

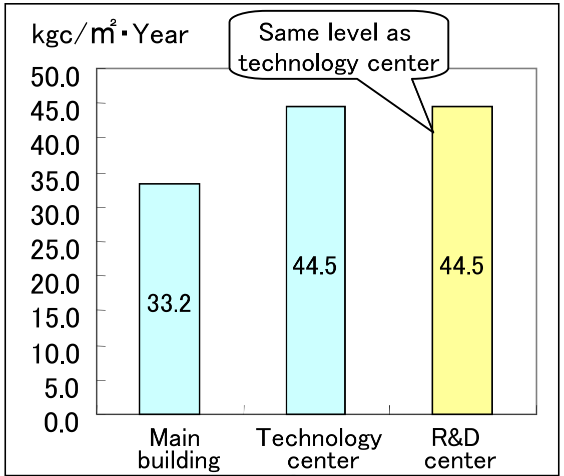
Set up Goal for Exhausted CO_2

Set up exhausted CO_2 goal for R&D center based on previous building's data

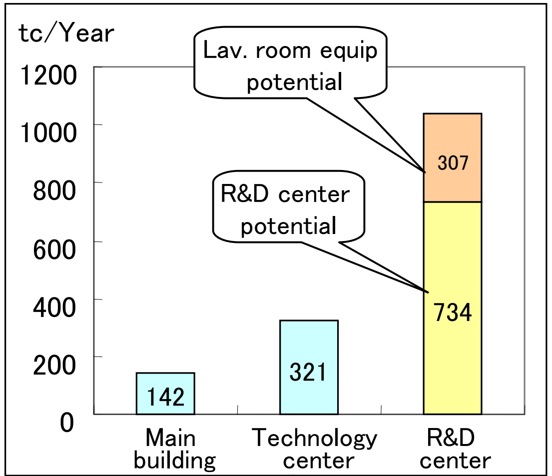
① building area



②Exhausted CO_2 unit/area (1998)



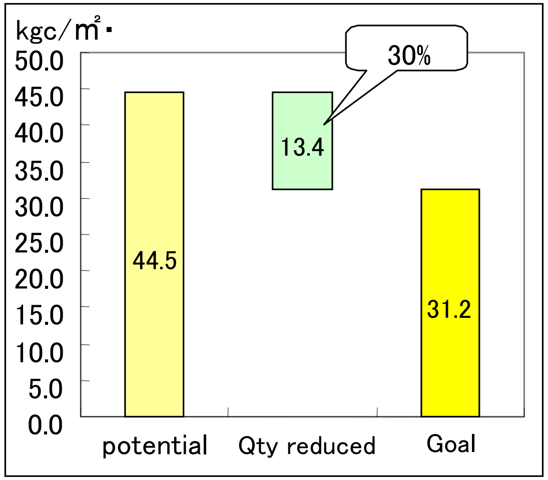
③Exhausted CO_2 (1998)



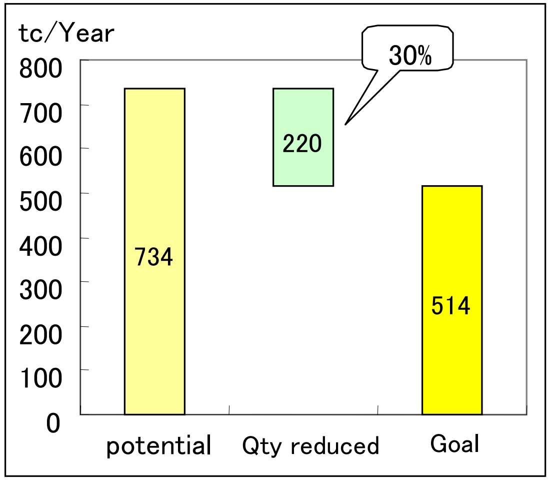
- Assume potential exhausted CO_2 unit/area is same level as technology center(except laboratory equips)
- Set up goal

Reduced qty:
emitted 220tc/Year
in standard unit 13.4kgc/m²・Year

④Exhausted CO_2 unit/area goal



⑤ Exhausted CO_2goal



Save Energy Items List at R&D Center

Cost：thousand JPY/Year
CO2：tc/Year

Category	Division	No.	Objected Items	Detail of Plan	effect		
					Objected Items	Cost	CO2
Introduction of High Efficient Equip	Building	1.	Exterior Wall	Reinforce insulation by spraying insulating material+PC board	Electric Power	532	3.7
		2.	Window	Reinforce insulation with pair glasses	ditto	169	1.2
		3.	Window	Reduce sunshine through from south windows with heat reflex glass	ditto	208	1.5
		4.	Elevator	Improve efficiency by change to inverter	ditto	164	1.1
	Electric Power Equip	5.	Transformer at substation	Improve efficiency with amorphous transformer	ditto	2,305	16.1
		6.	Power Main Line	Reduce loss of power distribution with bus duct main line	ditto	357	2.5
		7.	Electric motor equip	Improve efficiency with high efficient electric motor equip	ditto	920	6.4
	Lighting Equip	8.	Fluorescent	Improve lighting efficiency with high efficient fluorescent lamp	ditto	3,684	25.8
		9.	Fluorescent	Improve lighting efficiency with twin 3type fluorescent down light	ditto	16	0.1
		10.	HID Light	Improve ceiling lighting (HID Light) at laboratory room	ditto	191	1.3
		11.	Leading lighting	Improve lighting efficiency with twin cold negative pole fluorescent lamp	ditto	333	2.3
	Sanitary Equip	12.	Pump	Reduce loss of	ditto	564	3.9
		13.	Air Compressor Equip	Improve efficiency with inverter air compressor	ditto	143	1.0
	Sub Total					9,586	67.1

Category	Division	No.	Objected Items	Detail of Plan	effect: Objected Items	effect: Cost	effect: CO2
High efficient	Electric Power Equip	14.	Distribution Equip	Reduce power distribution loss with 3phase 4-line method power distribution	Electric Power	669	4.7
		15.	electric motor	Reduce wiring loss with 420Velectric motor	ditto	460	3.2
	A/C equip	16.	Refrig. machine	Recover waste heat by recovery of steam drain	LNG	245	2.8
		17.	ditto	Reduce water supply flow size by refrig. machine cooling water big temp. difference	Electric Power	285	2.0
		18.	Hot & cold water	Reduce water supply flow size by air conditioner cooling water big temp. difference	ditto	1,227	8.6
		19.	ditto	Control water supply flow by inverter of warm & cold water 2nd pump	ditto	528	3.7
		20.	ditto	Control air conditioner warm & cold water flow size by 2-part valve	ditto	Included	in No.19
		21.	Administration room air condition equip	Introduce air volume changeable A/C into work room interior zone	ditto	2,716	19.0
		22.	ditto	Respond window side air conditioner load by perimeter air conditioner	ditto	478	3.3
		23.	ditto	A/C by in taken air from outside in non summer season (outdoor air cooling)	ditto	952	6.7
		24.	ventilation	Introduce full heat exchanger for heat exchange between waste air & outdoor air (heat recovery)	ditto	1,435	10.0
		25.	ditto	Keep CO2 density fixed in work room controlling air volume by ventilation fan with inverter	ditto	565	3.9
		26.	A/C equip in laboratory	Control air volume to keep temperature fixed in laboratory ventilation fan with inverter	ditto	990	6.9
		27.	Rest corner	Reduce size of ventilation by introducing air cleaner	ditto	134	0.9
	Sanitary Equip	28.	Water supply equip	Make supplied water pressure appropriate by separating supply pipe	ditto	167	1.2
		29.	ditto	Make water supply pump end pressure(for well water) appropriate by inverter	ditto	206	1.4
		30.	Cooling water equip	Make qty of re-supply water appropriate by control of cooling water conductance	ditto	134	0.1
		31.	ditto	Higher concentration operation by magnetic supply water processing	ditto	134	0.1
		32.	ditto	Cooling water temperature control by inverter of cooling tower fan	ditto	516	3.6
		33.	Lav. equip cooling water	Water flow size control by inverter of cooling water pump for laboratory equip	ditto	781	5.5
		34.	ditto	Flow control by cooling water 2-part valve of laboratorial equip	ditto	Included	in No.33
	Sub Total					12,621	87.7

Category	Division	No.	Objected Items	Detail of Plan	effect: Objected Items	effect: cost	effect: CO2
Most Appropriate Operation	Lighting Equip	35.	Lighting equip	In block lighting and schedule control by central watching	Electric Power	122	0.9
		36.	Window side lighting / work room	Automatic light adjusting in daytime by daylight sensor	ditto	280	2.0
		37.	Lighting/ lavatory & locker room	Automatic lighting on/off system by human detecting sensor	ditto	121	0.8
	A/C equip	38.	A/C heat source	Effective by air conditioner heat source qty control	ditto	878	6.1
		39.	Air conditioner	A/C equip in block & schedule operation by central watching	ditto	586	4.1
		40.	ditto	Automatic operation of ventilation and air cleaner by human detecting sensor	ditto	145	1.0
	Sub Total					2,131	14.9
Use of generated Power	A/C equip	41.	A/C heat source	Heat accumulation of generated power from cogeneration night time by Ice heat energy chilling unit	Electric Power	1,464	10.2
		42.	ditto	Use of waste heat steam of cogeneration to steam absorption refrig. machine for A/C (cooling)	ditto	1,464	10.2
		43.	ditto	Use waste heat steam of cogeneration to steam absorption refrig. machine for heating	LNG	1,650	19.2
	Sub Total					4,577	39.6
Use of Natural Energy	Building	44.	Window	Natural A/C and ventilation in non summer season through window	Electric Power	195	1.4
		45.	Basement	Set “Light Court” beside basement to take light through	ditto	3	0.02
	lighting	46.	Outdoor lighting	Use of hybrid solar light as parking light	ditto	3	0.02
	Sub Total					201	1.4
Visualize	Electric Power	47.	Electric power measure	Electric power measure for unit at each distribution panel	ditto	223	1.6
	Sub Total					223	1.6
Total						29,340	212.3

Report of Sample for R&D Center Improvement

No.	save energy－2

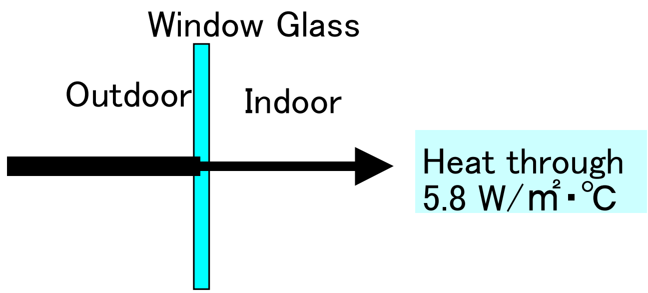
theme	Reinforce insulation with pair glasses
goal・outline	Before: Window is single glass (Heat through flow ratio = Large → heat loss=Large ⇨ Introduce pair glassed (Heat through flow =Small) → Heat loss= Small

Before

・Specification of window

Type	Single glass
Thickness	6mm × 1
Heat through flow	5.8 W/㎡・℃
Size	510 ㎡
Heat loss	2.96 kW/℃

Heat through in summer (section of window)

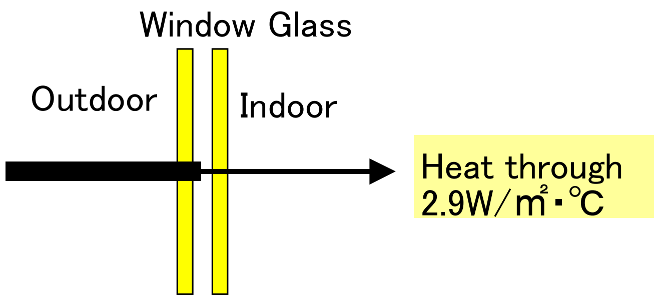


After

・Specification of window

Type	Pair glass
Thickness	6mm × 2
Heat through flow	2.9 W/㎡・℃
Size	510 ㎡
Heat loss	1.48 kW/℃

・ Heat through in summer (section of window)



Objected Matter	Electric Power	Cost Reduced	169 thousand JPY/Year
Energy Reduced	11,348 kWh/Year	CO2 Reduced	1.2 tc/Year

Report of Sample for R&D Center Improvement

No.	save energy－3

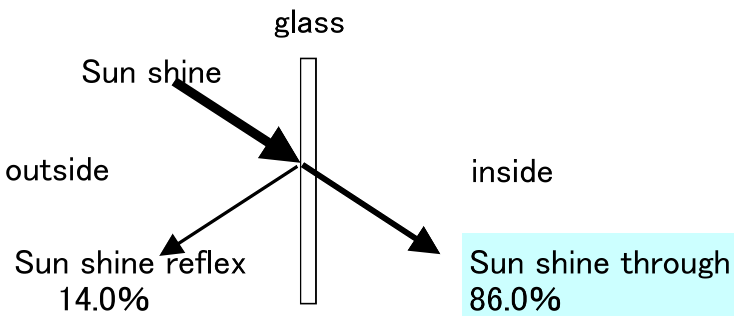
theme	Reduce sunshine through from south windows by heat reflex glass
goal・outline	Before: Normal glass for southern window (Sun shine trough rate → Large) — Introduce pair glass for southern window (Sun shine trough rate →Less)

Before

・Specification of southern window

Type	Normal single glass
Sun shine through rate	86.0 %
Size	250 ㎡
Sun shine through W	64.5 kW

・ Sun shine trough /Summer (section of window)

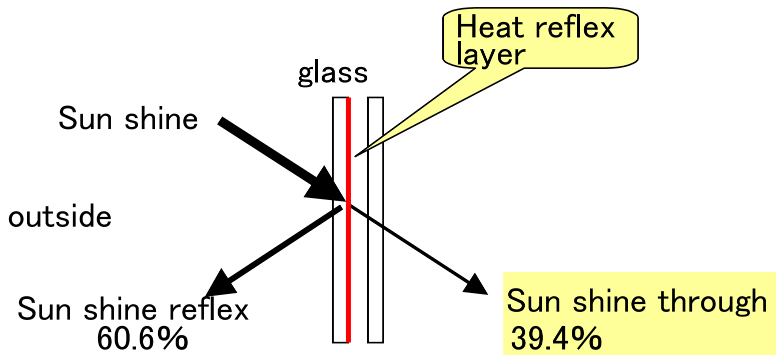


After

・Specification of southern window

Type	Heat reflex pair glass
Sun shine through rate	39.4 %
Size	250 ㎡
Sun shine through W	29.6 kW

・ Sun shine trough /Summer (section of window)



Objected Matter	Electric Power	Reduced Cost	208 thousand JPY/Year
Energy Reduced	13,980 kWh/Year	Reduced CO2	1.5 tc/Year

Report of Sample for R&D Center Improvement

No.	save energy－8

theme	Improve lighting efficiency by high efficient fluorescent（Hf Lamp）
goal・outline	Previous fluorescent light is rapid start lamp of 40W ⇒ Introduce 32W high efficient fluorescent light（Hf lamp）（exchangeable to high output level）→**Lighter and less energy consuming**

Before

・Previous fluorescent light（ex. 2−light type fluorescent light）

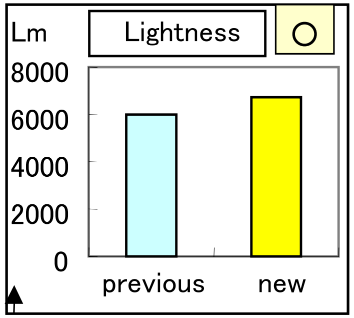
Type of light）	FLR40W×2
Level of lightness）	6,000 Lm
Electric power consumed	85 W
Standard life span	12,000 h
Qty	2,631

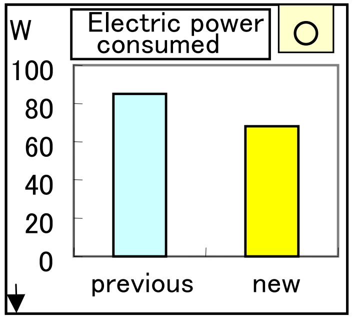
After

・ Hf type fluorescent light（ex.－2light type fluorescent light）

Type of light）	FHF32W×2
Level of lightness）	6,720 ／ 9,460 Lm
Electric power consumed	68 ／ 97 W
Standard life span	12,000 h
Qty	1,037 ／ 932

・ Comparison with previous type（at standard output level）





Objected Matter	Electric Power	Reduced Cost	3,684 thousand JPY/Year
Energy Reduced	247,782 kWh/Year	Reduced CO2	25.8 tc/year

Report of Sample for R&D Center Improvement

No.	save energy―13

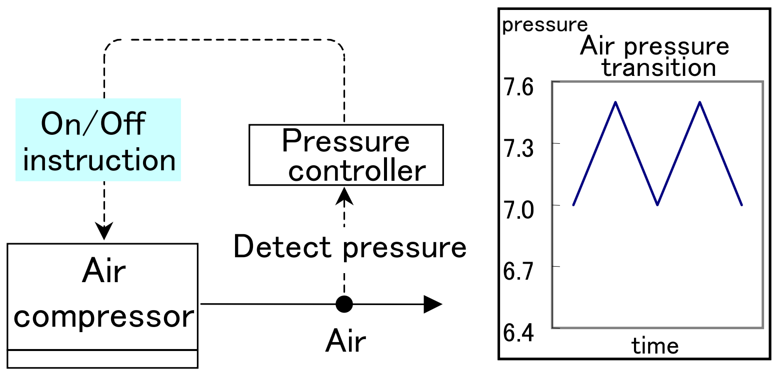
theme	Improve efficiency by inverter air compressor
goal・outline	Previous air compressor is fixed speed →pressure change =Large →Power consumed =Large ⇒ Introduce Inverter driven compressor → pressure change =Less → **Reduce power consumed**

Before

・Air compressor of laboratorial equip.

Corresponding signal of pressure controller「tightness＋On/Off control」 ⇒ Pressure change =Large, Power consumed =Large

・Air pressure control flow

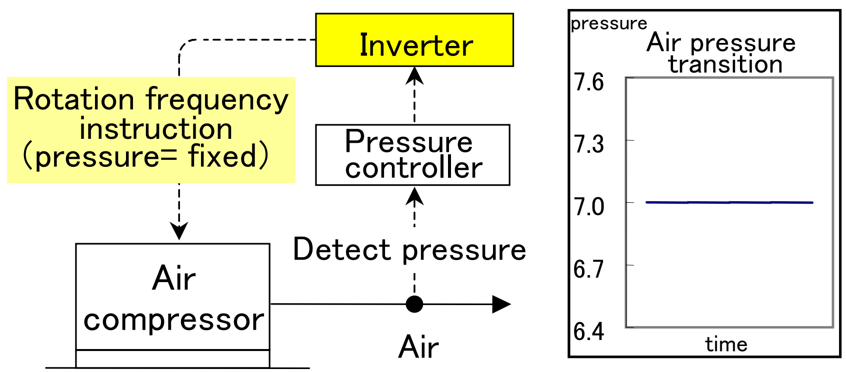


After

Air compressor of laboratorial equip.

Inverter rotating control by signal of pressure controller ⇒ Pressure change =less, Power consumed =less

Air pressure control flow



Objected Matter	Electric Power	Reduced Cost	143 Thousand JPY/year
Energy Reduced	9,600 kWh/Year	Reduced CO2	1.0 tc/year

Report of Sample for R&D Center Improvement

No.	save energy－18

theme	Reduce water supply flow size by refrig. machine cooling water big temperature difference
goal・outline	Previous warm & cold water for air conditioner: Temperature difference between inlet and outlet is 5℃ → Qty of warm & cold water= large ⇒ Change refrig.machine and adjust the difference 8℃ → Reduce qty of warm & cold water →reduce electric power of pump

Before

・General type refrig.machine

temperature of cold water
Inlet 12.0℃
Outlet 7.0℃
Δt= 5.0℃

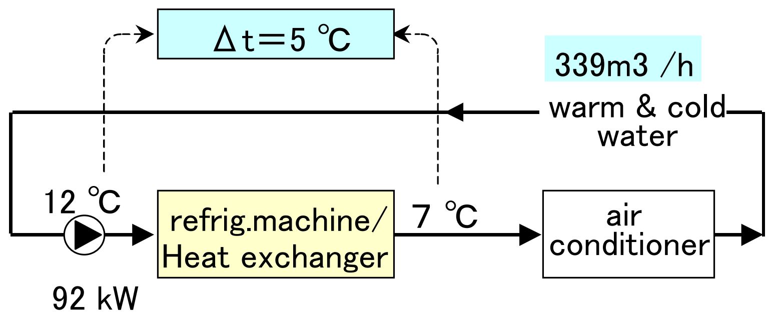
⇒

・qty of cooling water
339m3/h
・pump capacity
92kW

⇒

pump
Electric power = large

・Cold & worm water flow (at cold time)



After

・cold water big temperature difference refrig.machine

temperature of cold water
Inlet 15.0℃
Outlet 7.0℃
Δt= 8.0℃

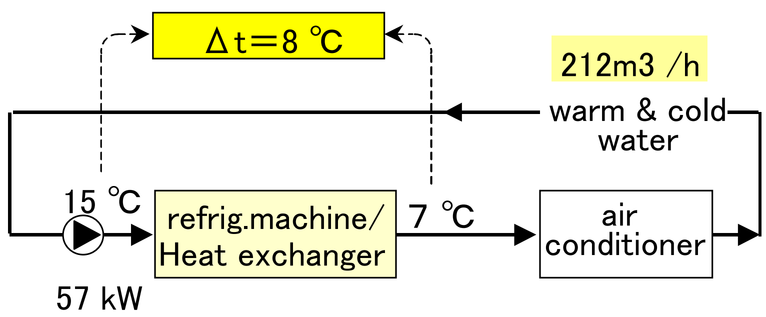
⇒

・qty of cooling water
212m3/h
・pump capacity
57kW

⇒

pump
Electric power = reduce

・warm & cold water flow (at cold time)



Objected Matter	Electric Power	Reduced Cost	1,227 Thousand JPY/year
Energy Reduced	82,512 kWh/Year	Reduced CO2	8.6 tc/year

Report of Sample for R&D Center Improvement

No.	save energy－19

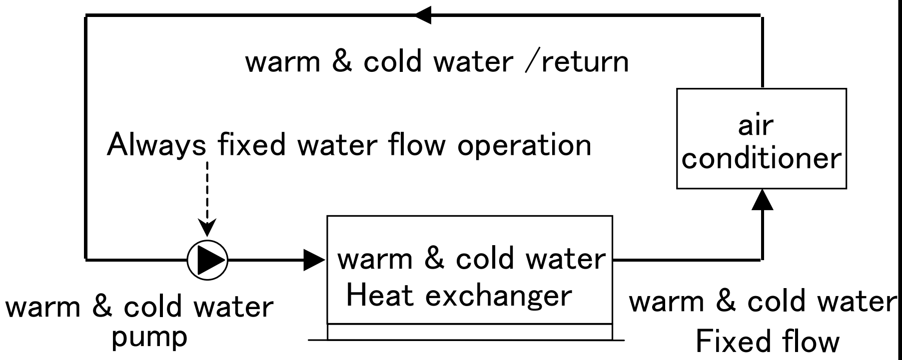
theme	Control water supply flow by inverter of warm and cold water 2nd pump
goal・outline	Previous warm & cold water pump: constantly operated with fixed flow size ⇒ Install inverter into warm & cold water 2nd pump and control water flow corresponding to load size → Reduce power for pump

Before

・Fixed flow warm & cold water equip

warm & cold water equip needs constant fixed water flow ⇨ warm & cold water pump constantly operates with fixed water flow ⇨ pump Electric Power Large

・warm & cold water control flow

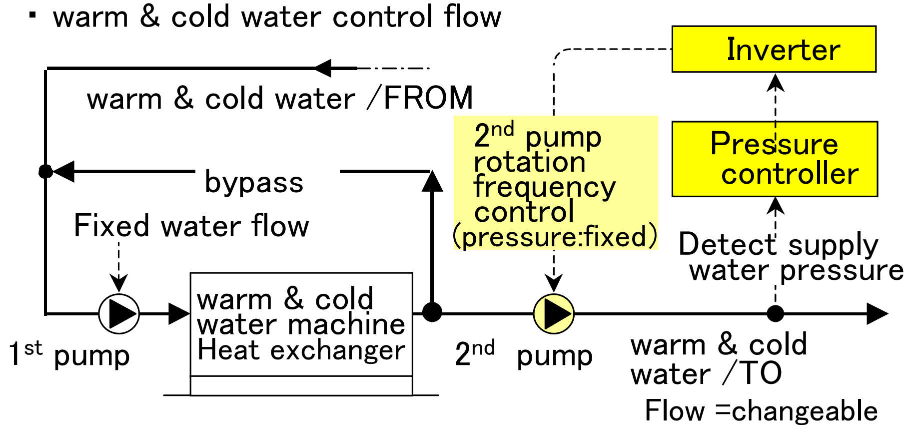


After

・Changeable flow warm & cold water equip

Install 1st pump & 2nd pump ⇨ 1st pump: fixed water flow operation 2nd pump corresponding to load operation ⇨ Reduce power for pump

・warm & cold water control flow



Objected Matter	Electric Power	Reduced Cost	528 thousand JPY/Year
Energy Reduced	35,520 kWh/Year	Reduced CO2	3.7 tc/Year

Report of Sample for R&D Center Improvement

No.	save energy－21

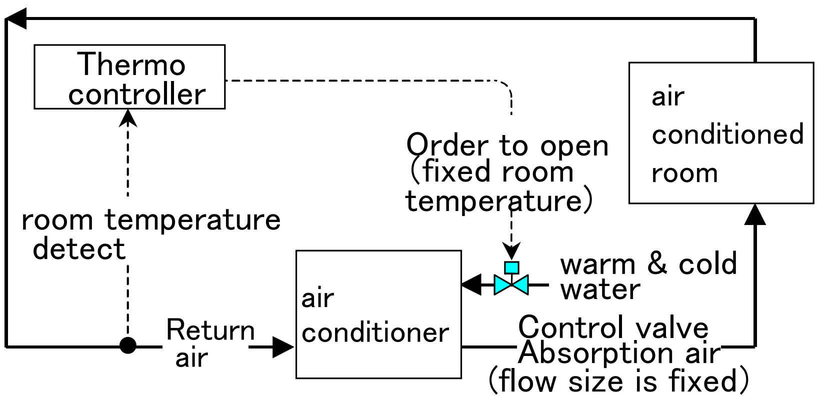
theme	Introduce air volume changeable A/C into work room interior zone
goal・outline	Previous air conditioner:air volume is fixed and room temperature is fixed control →low load operation time = wind flow loss ⇨ Install inverter to air conditioner and do air volume control → Power for fun is reduced

Before

・Fixed air volume type

Detect room (return air temperature) ⇨ warm & cold water valve control (fixed room temperature control) ⇨ air volume of A/C is always fixed ⇨ Power for A/C =Large

・air conditioner air flow

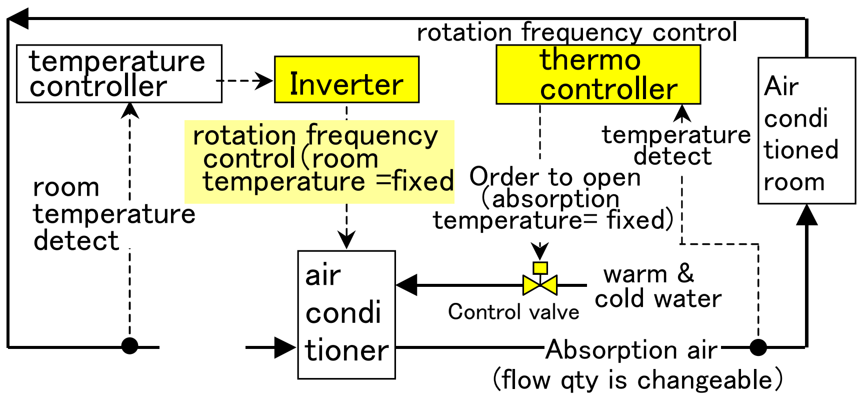


After

・Changeable air volume type

Detect room temperature ⇨ Inverter control of air conditioner fan (room temperature =fixed) ⇨ air volume is changeable depending on load ⇨ Power for A/C =Less

・air conditioner air circling flow



Objected Matter	Electric Power	Reduced Cost	2,716 thousand JPY/Year
Energy Reduced	182,688 kWh/Year	Reduced CO2	19.0 tc/Year

Report of Sample for R&D Center Improvement

No.	save energy－23

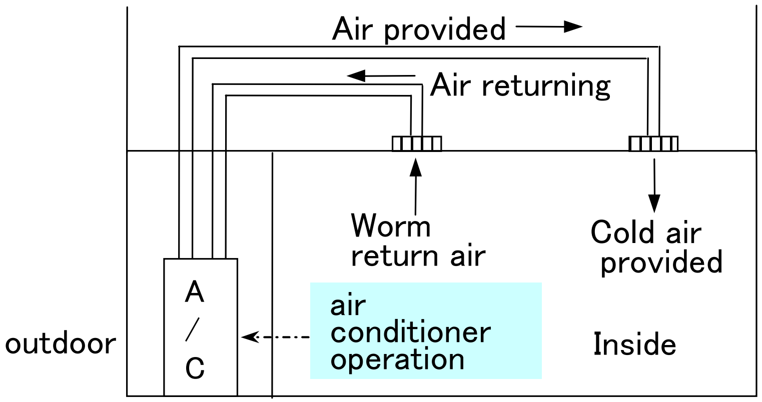
theme	A/C by intaken air from outdoor in non summer season（outdoor air cooling）
goal・outline	Previous A/C: Some rooms are air conditioned (cooling) in non summer season ⇨ When outdoor temperature is lower than that of room A/C by intake air from outdoor →Power for air conditioner is reduced

Before

・A/C in non summer season

A/C is needed because of heat load of OA equip. ⇨ Air conditioner operation ⇨ Consume energy

・Rough sketch of system

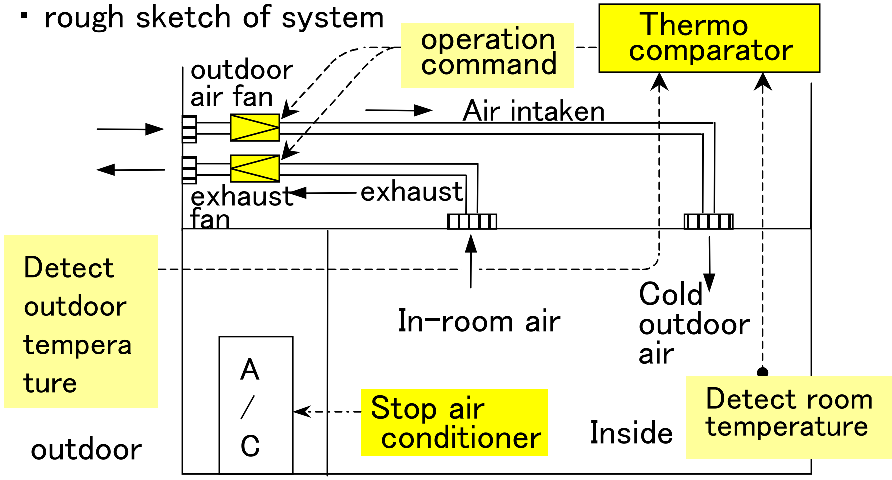


After

・A/C in non summer season

Intake air from outdoor & emit inside air ⇨ Stop air conditioner ⇨ Reduce energy consumed

・rough sketch of system



Objected Matter	Electric Power	Reduced Cost	952 Thousand JPY/year
Energy Reduced	64,000 kWh/Year	Reduced CO2	6.7 tc/year

Report of Sample for R&D Center Improvement

No.	save energy－25

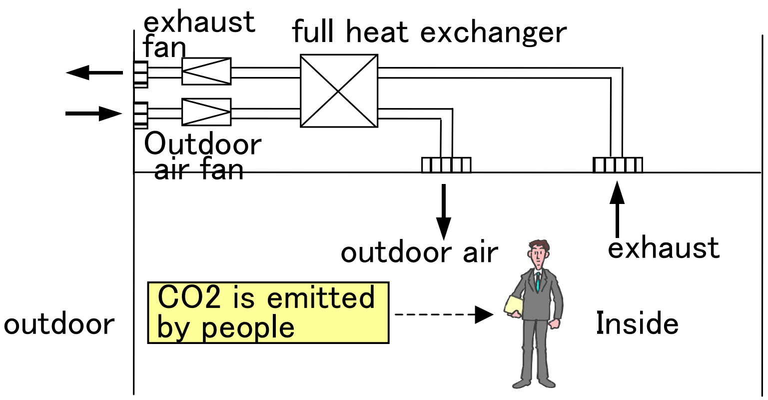
theme	Keep CO_2 density fixed controlling air volume by inverter fan air volume control in work room
goal・outline	Previous ventilation: full load operation → Over ventilation when load is low ⇨ Detect CO_2 density in room → Ventilation fan is inverter controlled (CO_2 density in room is fixed) →Prevent over ventilation

Before

・work room ventilation

ventilation operates with full load ⇨ over ventilation when load is low ⇨ power for ventilation & A/C load increases

・rough sketch of system

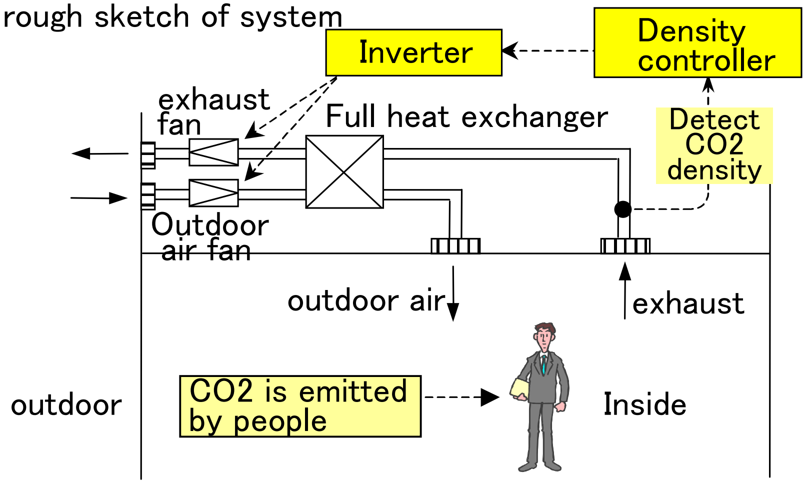


After

・work room ventilation

Detect CO_2 density in room ⇨ Inverter control providing & waste air fan ⇨ Reduce power for A/C by load reduction

・rough sketch of system



Objected Matter	Electric Power	Reduced Cost	565 Thousand JPY/year
Energy Reduced	37,980 kWh/Year	Reduced CO_2	3.9 tc/year

Report of Sample for R&D Center Improvement

No.	save energy—32

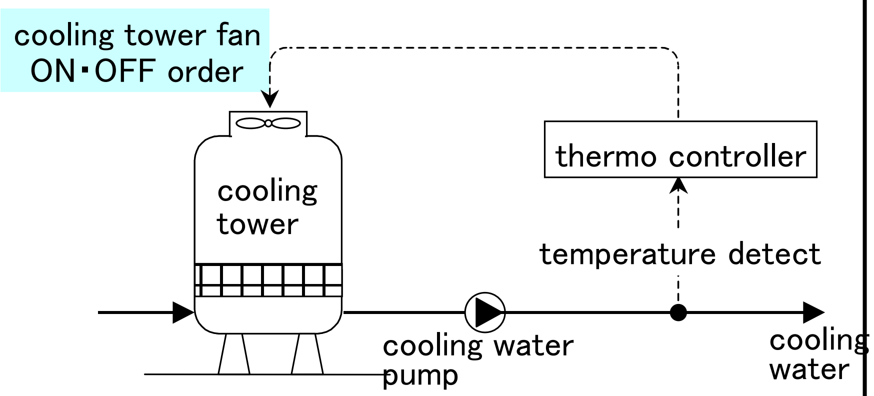
theme	Cooling water temperature control by inverter of cooling tower fan
goal・outline	Previous cooling water(for refrig.machine & laboratory equip): Temperature control is done by On/Off switch of cooling tower fan ⇨ Install inverter to cooling tower fan and control temperature of cooling water by frequency control →Reduce power for fan

Before

・ Control cooling tower fan

cooling water temperature detect ⇨ cooling tower fan ON・OFF control ⇨ Fan Electric Power Large

・ cooling tower fan control flow

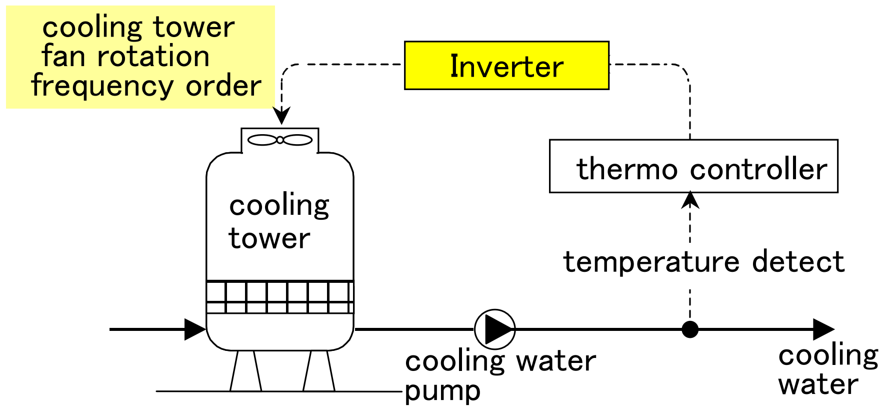


After

・ cooling tower fan control

cooling water temperature detect ⇨ cooling tower fan Inverter control ⇨ Fan Electric Power reduce

・ cooling tower fan control flow



Objected Matter	Electric Power	Reduced Cost	516 Thousand JPY/year
Energy Reduced	34,700 kWh/Year	Reduced CO2	3.6 tc/year

Report of Sample for R&D Center Improvement

No.	save energy－35

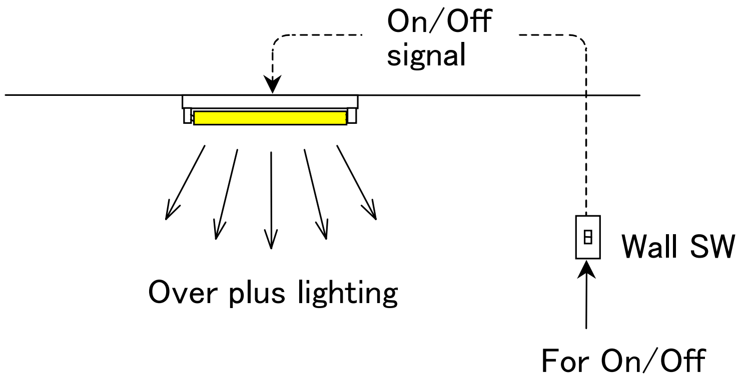
theme	In block lighting and schedule control by central watching
goal · outline	Previous lighting : Turn of/off by hand →cause over plus lighting ⇨ Automatically turn lighting on/off by central watching →prevent over plus lighting

Before

・Work room lighting manual control

Turning lighting On/Off ⇨ Left lighting on after work hour ⇨ Over plus lighting

・Lighting control flow

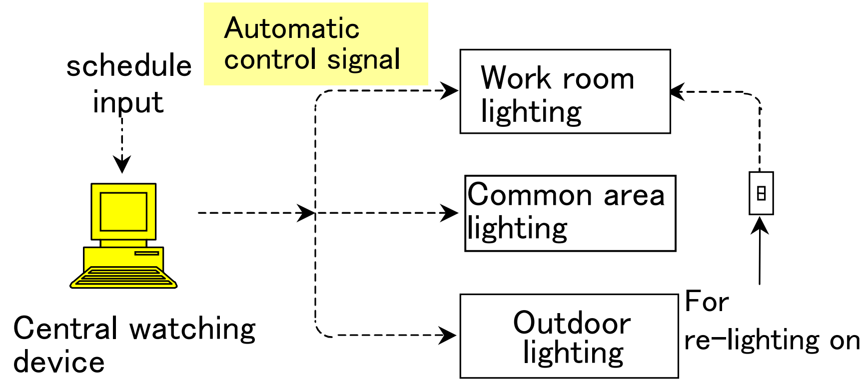


After

・Work room lighting automatic control

All lights are turned off at regular intervals during overtime ⇨ Necessary lights are turned on by hand ⇨ Prevent unnecessary lighting

・Lighting control flow



Objected Matter	Electric Power	Reduced Cost	122 Thousand JPY/year
Energy Reduced	8,182 kWh/Year	Reduced CO2	0.9 tc/year

Report of Sample for R&D Center Improvement

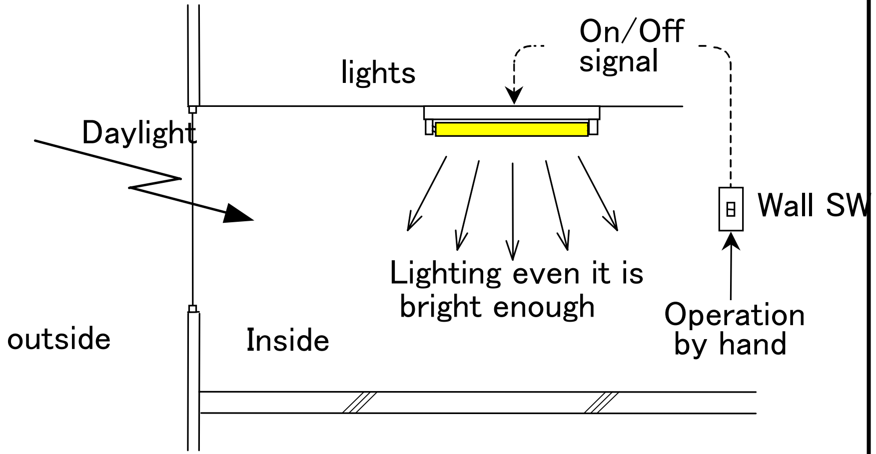
No.	save energy－36

theme	Automatic window side lighting control in work room by daylight sensor
goal・outline	Previous lighting : Lights around windows are light on/off by hand →There are over plus lighting in day time ⇒ Install daylight sensor →Adjust lightness of fluorescents on two-line nearest to windows

Before

・Lightings by windows are operated by hand

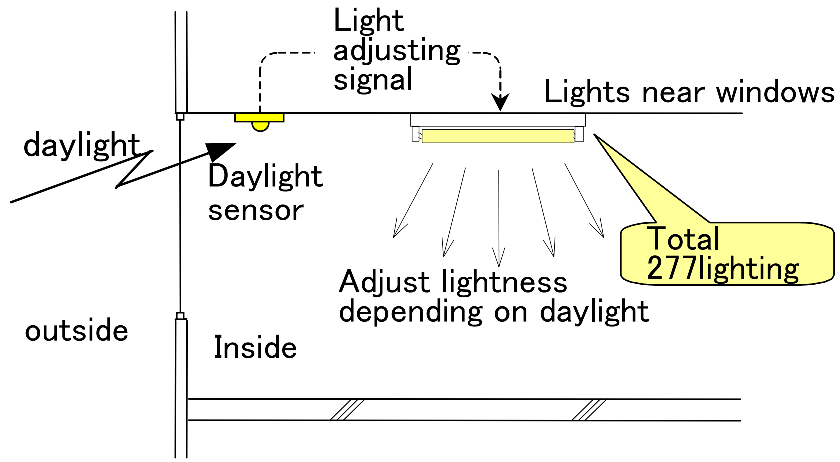
Turning On/Off by hand ⇨ Lighting even it is bright enough ⇨ Power loss



After

・Automatic turning on/off of lights by window

Install daylight sensor ⇨ Adjust lightness (25～100%) of light on two lines nearest windows depending on daylight ⇨ Reduce power



Objected Matter	Electric Power	Reduced Cost	280.1 Thousand JPY/year
Energy Reduced	18,836 kWh/Year	Reduced CO2	2.0 tc/year

Report of Sample for R&D Center Improvement

No. save energy－39

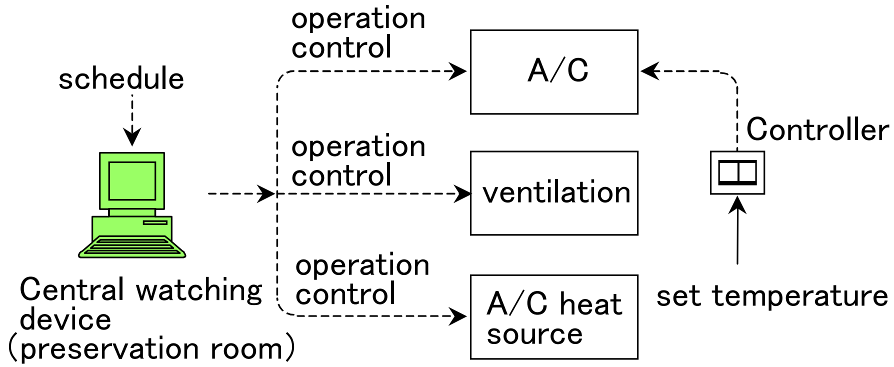
theme	A/C equip in block & scheduling operation by central watching
goal · outline	Previous A/C: operation and temperature than central watching and room condition are preceded and set ⇨ Control A/C temperature by central watching & in-room operation (with limit) → proper control

Before

・A/C equip control

A/C operation by central watching (incapable of in-room control) ⇨ In-room temperature setting ⇨ Proper A/C operation control is difficult

・air condition control flow（work room）

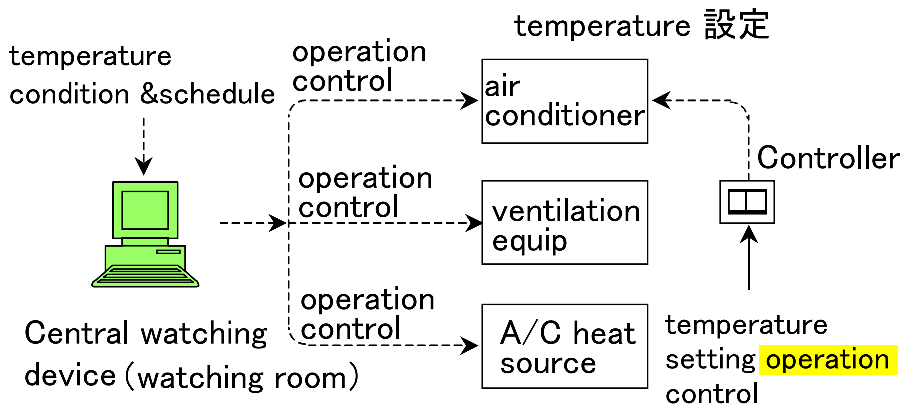


After

・A/C equip control

A/C operation control by central watching (capable of in-room control) ⇨ Control A/C temperature by central watching ⇨ Proper A/C operation control is possible

・A/C control flow（work room）



Objected Matter	Electric Power	Reduced Cost	586 Thousand JPY/year
Energy Reduced	39,382 kWh/Year	Reduced CO2	4.1 tc/year

Report of Sample for R&D Center Improvement

No. save energy－46

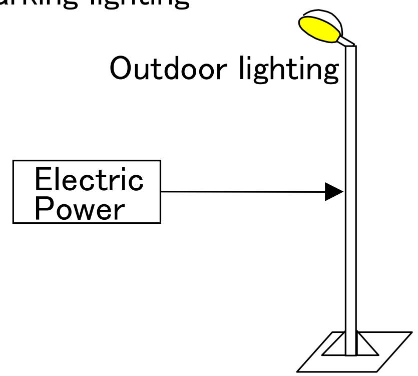
theme	Use of hybrid solar light as parking light
goal・outline	Previous parking light: provided wit commercial (bought) power → CO_2 emitted ⇨ Power provided is generated by natural energy(wind & solar power) →Reduce CO_2 emitted

Before

・Thermal power generation

Burning fossil fuel ⇨ Thermal power generation ＋ CO2 is emitted

・Parking lighting



⇨

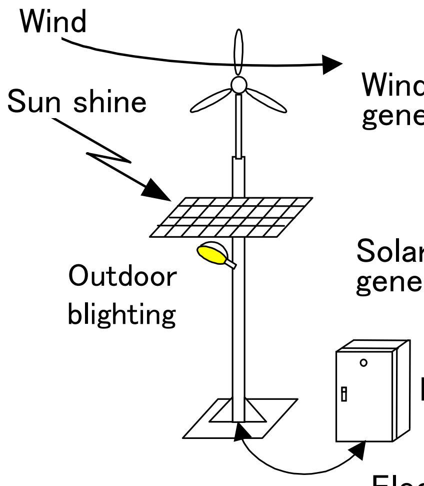
Outdoor light (sodium lamp)

CO2 is emitted

After

・Hybrid solar light

Wind power generation (300W) ＋ Solar power generation (120W) ＋ Battery (6-hour)



Wind power generation ⇨ Outdoor lighting (35W sodium lamp)

Solar power generation ⇨ Reduce CO2 emitted

Objected Matter	Electric Power	Reduced Cost	3.3 Thousand JPY/year
Energy Reduced	219 kWh/Year	Reduced CO2	0.02 tc/year

Report of Sample for R&D Center Improvement

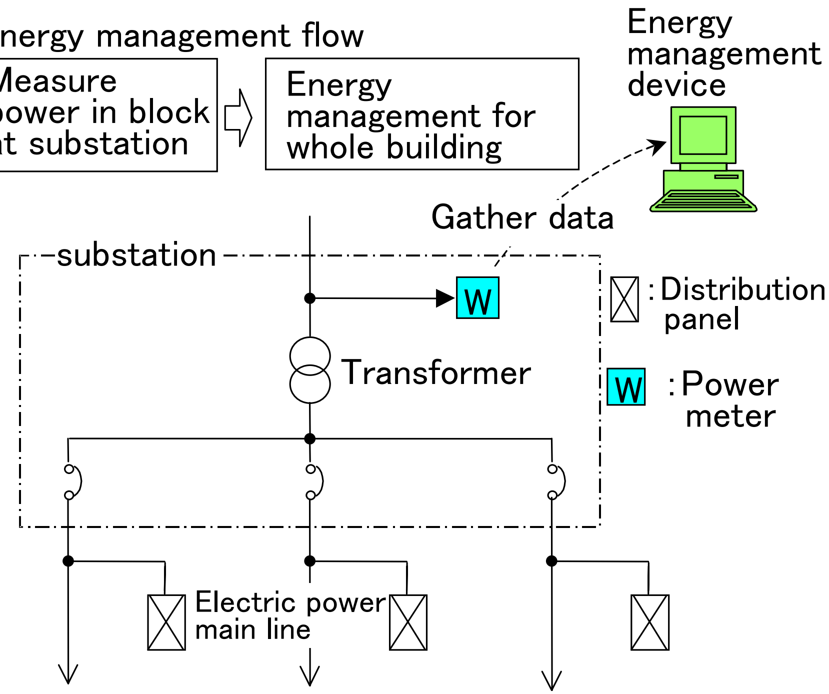
No.	save energy－47

theme	Electric power measure for each unit at each distribution panel
goal・outline	Power consumed in whole building is measured in block→ Impossible to manage power by each unit ⇨ Install power meter to every distribution panel →Gather data to central watching device → Manage energy consumption at each unit

Before

・Energy management flow

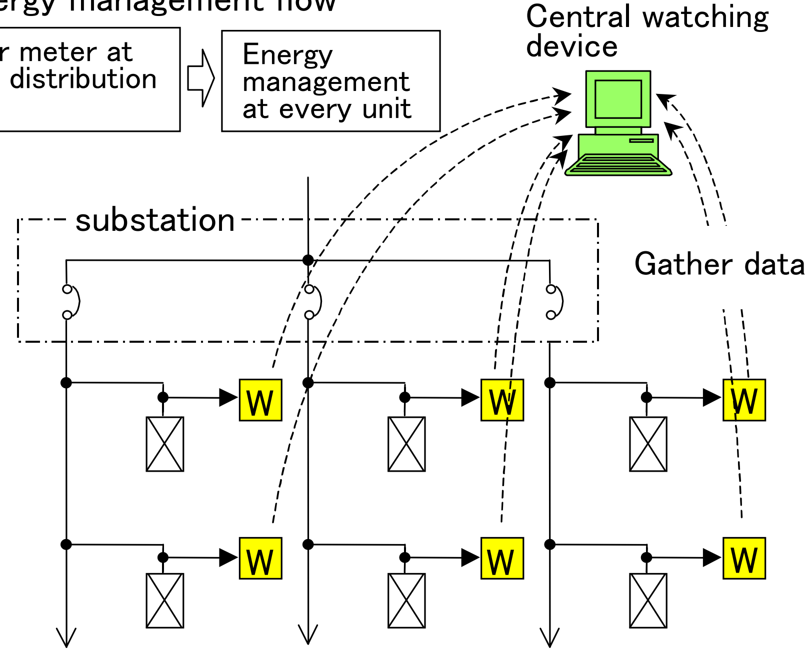
Measure power in block at substation ⇨ Energy management for whole building



After

・Energy management flow

Power meter at every distribution panel ⇨ Energy management at every unit



Objected Matter	Electric Power	Reduced Cost	223 Thousand JPY/year
Energy Reduced	15,000 kWh/Year	Reduced CO2	1.6 tc/year

Emitted CO_2 Reduction Expectation

① Emitted CO_2 Reduction Target

R&D Center during construction
Emitted CO_2 reduction target
220tc/Year

(30% cut compared to emitted CO_2 at Technology Center)

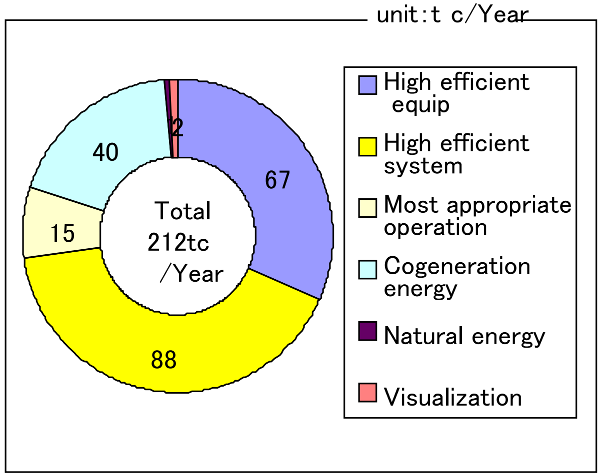
② Result of Reduction Action

Built into items

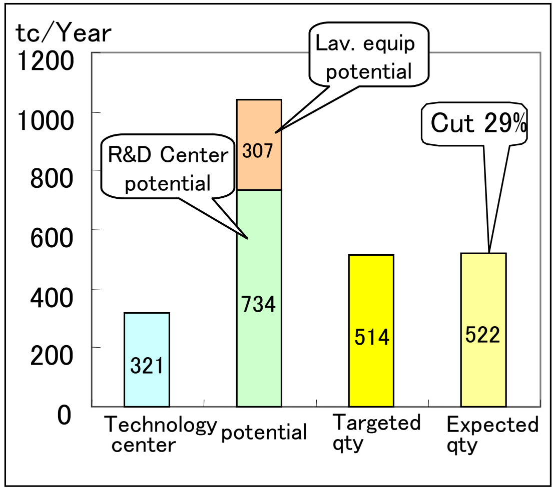
47

Emitted CO_2 reduction effect
212tc/Year

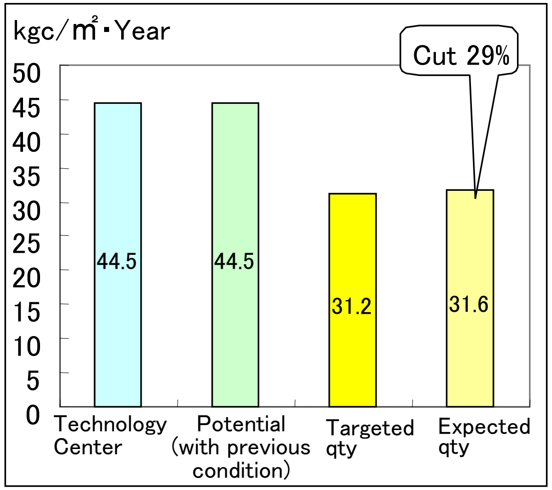
③ Items for Reduction



④ Expected CO_2 Emitted at R&D Center



⑤ Expected CO_2 Emitted Standard in Standard Unit at R&D Center



⑥ Summary of Result & Action in The Future

1) Emitted CO_2 during construction of R&D Center is expected to achieve targeted qty.(29% less than standard unit of technology center.
2) Further cost reduction is targeted by strict control over equip including laboratory operation after start of R&D Center.
3) Examine & evaluate impact of introduced energy saving items

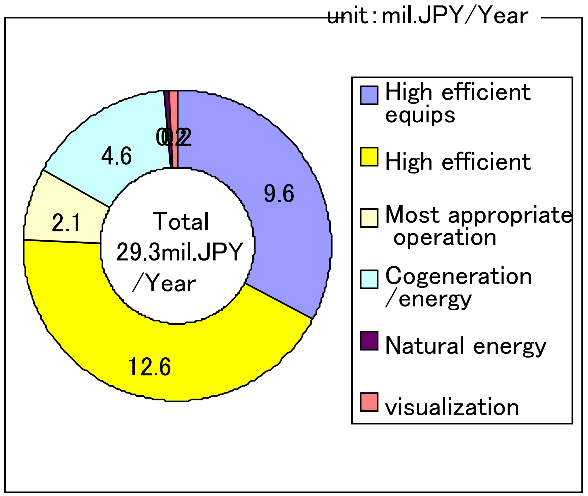
Impact for Energy Cost Improvement Expectation

① Impact for Energy Cost Improvement

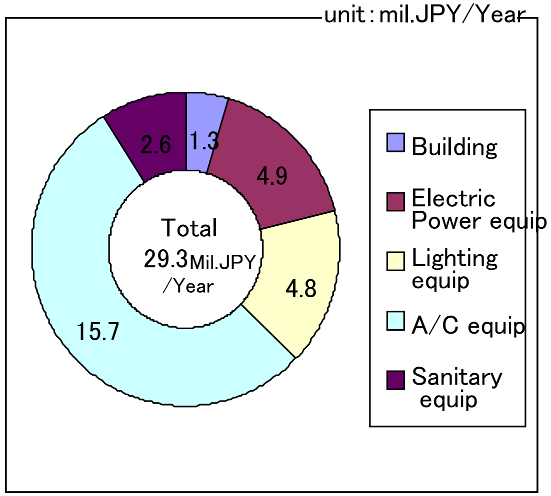
Built in saving energy items
47

Impact for energy cost improvement
29.3 Mil. JPY/Year

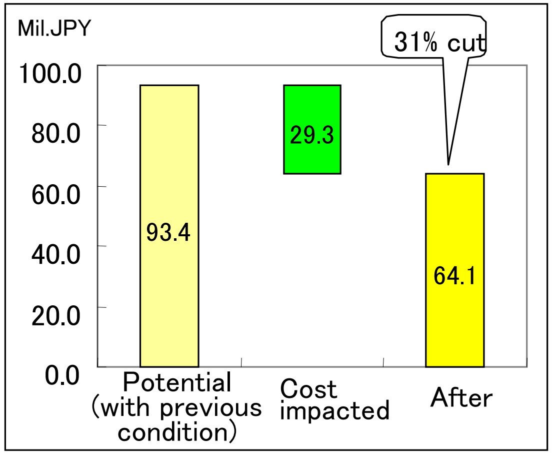
②Division for Improved Items



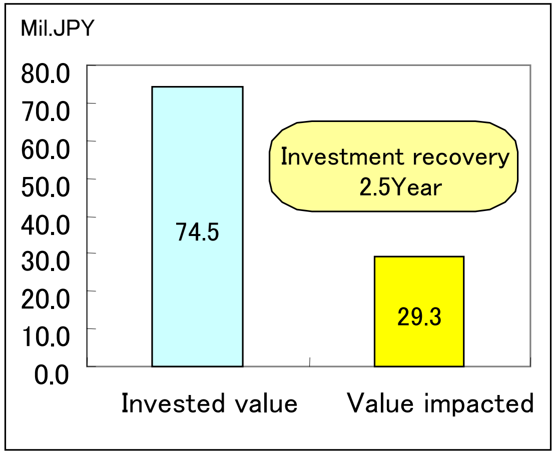
③ Improved items Division



④ R&D Center Energy Cost Expectation



⑤ Impact for Investment



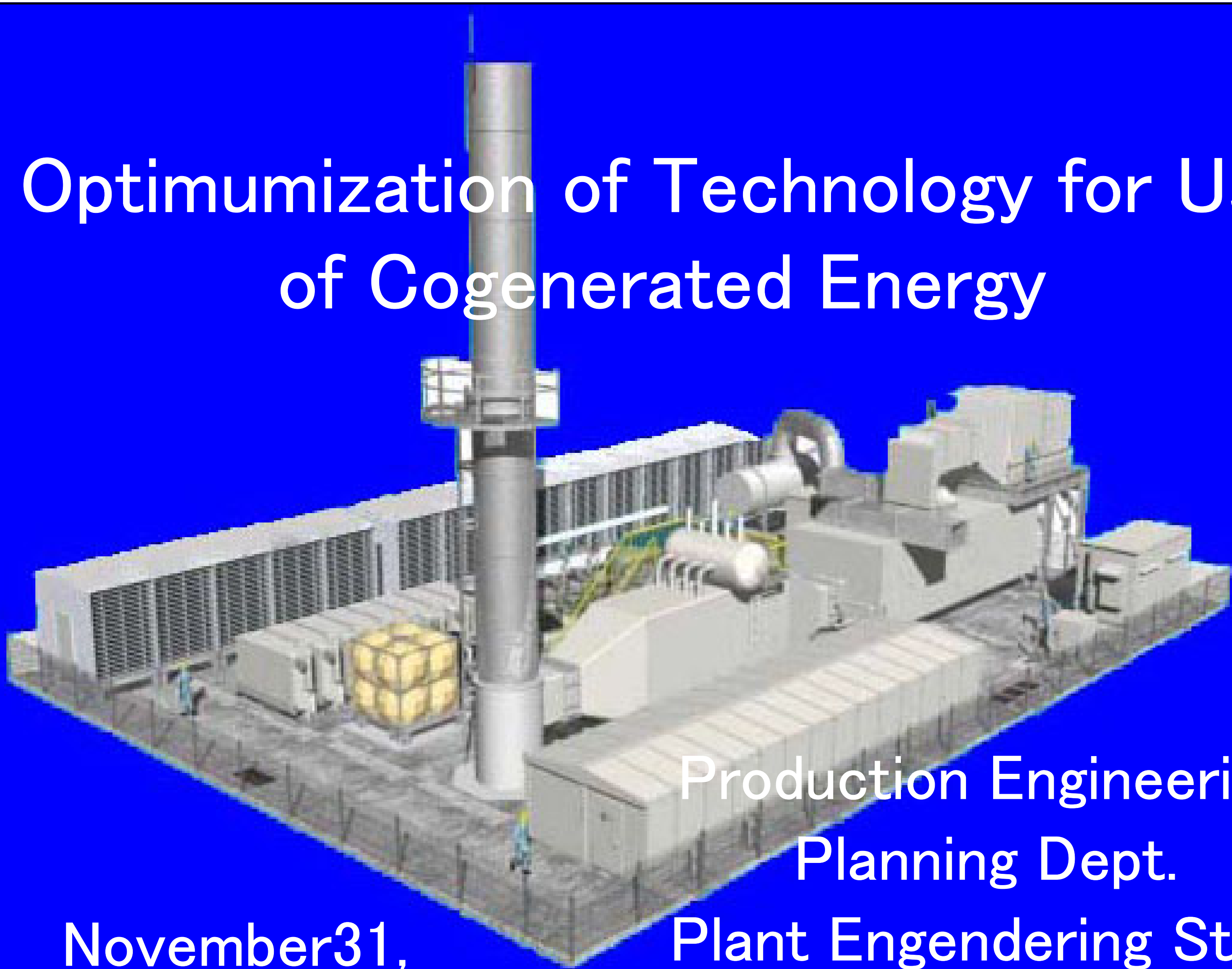
⑥ Summary of Result & Action in The Future

1) Energy cost during construction of R&D Center is expected to cut by 31% compare to potential (in previous condition).
.(investment recovery=2.5 years

2) Further cost reduction is targeted by strict control over equip including laboratory operation after start of R&D Center.

3) Examine & evaluate impact of introduced energy saving items

Optimumization of Technology for Use of Cogenerated Energy



Production Engineering Planning Dept.
Plant Engendering Staff
Kouji Tukamoto

November31, 2002

1. Outline of Theme

2. Production Process Flow for Objected Equips

Necessary Energy : Power, Air, Steam & LNG

Material forming → Vacuum forming → Assembly → Production

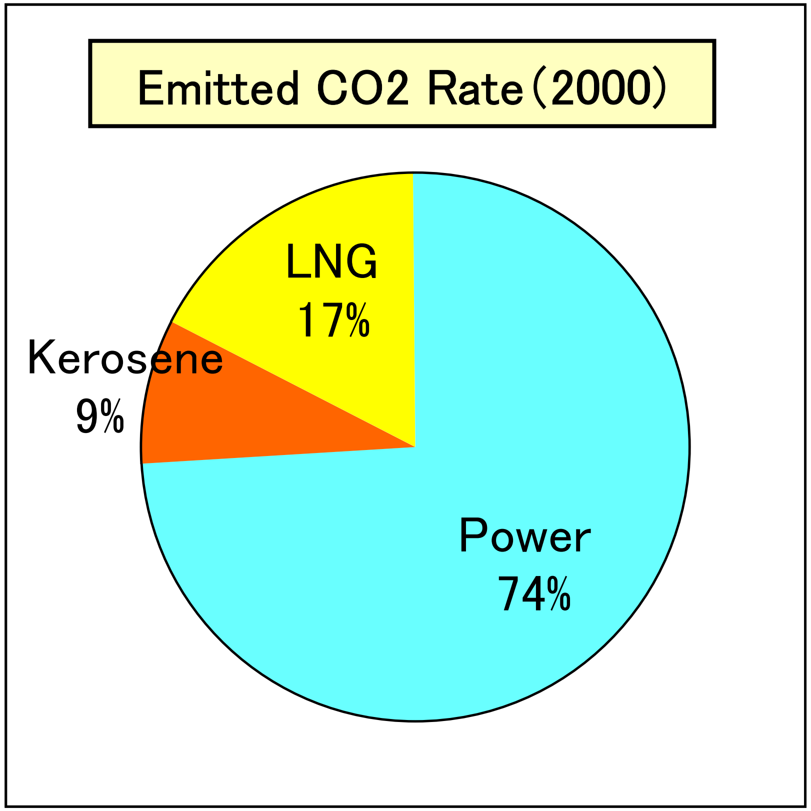
2. Production Process Flow for Objected Equips

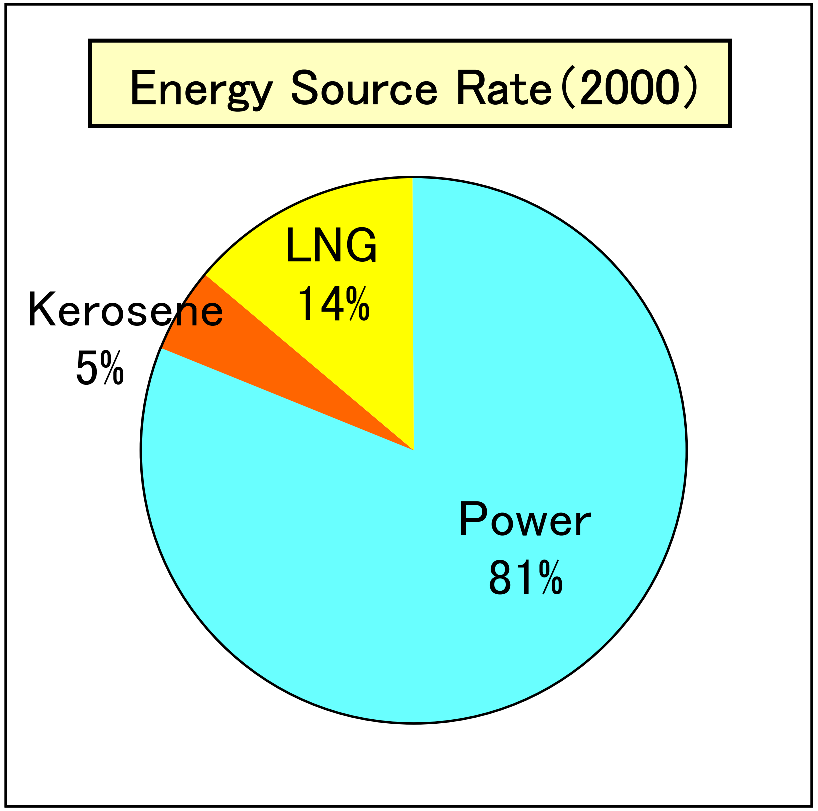
Necessary energy : Power , Air & Steam

Flame	Press Process	Forming Process			
Pad	Forming Process		Assembly Process	→	Production
Cover	Cutting Process	Sewing Process			

3. Reason for Selecting This Theme

5. Before Promotion: Energy Proportion



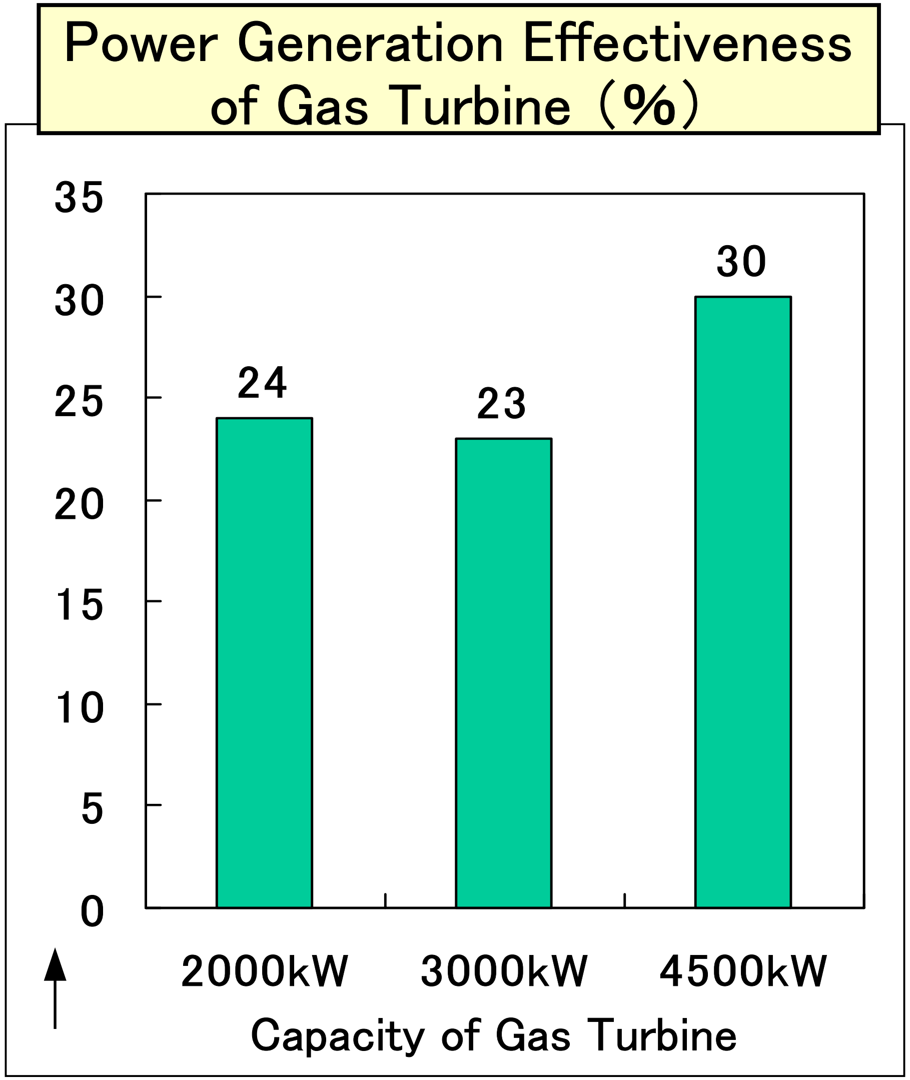


① Rate for power is highest
② Rate for LNG･Kerosene is low

→

Usage of heat energy of power is a few

Selection of Capacity for Gas Turbine at Sanage Plant

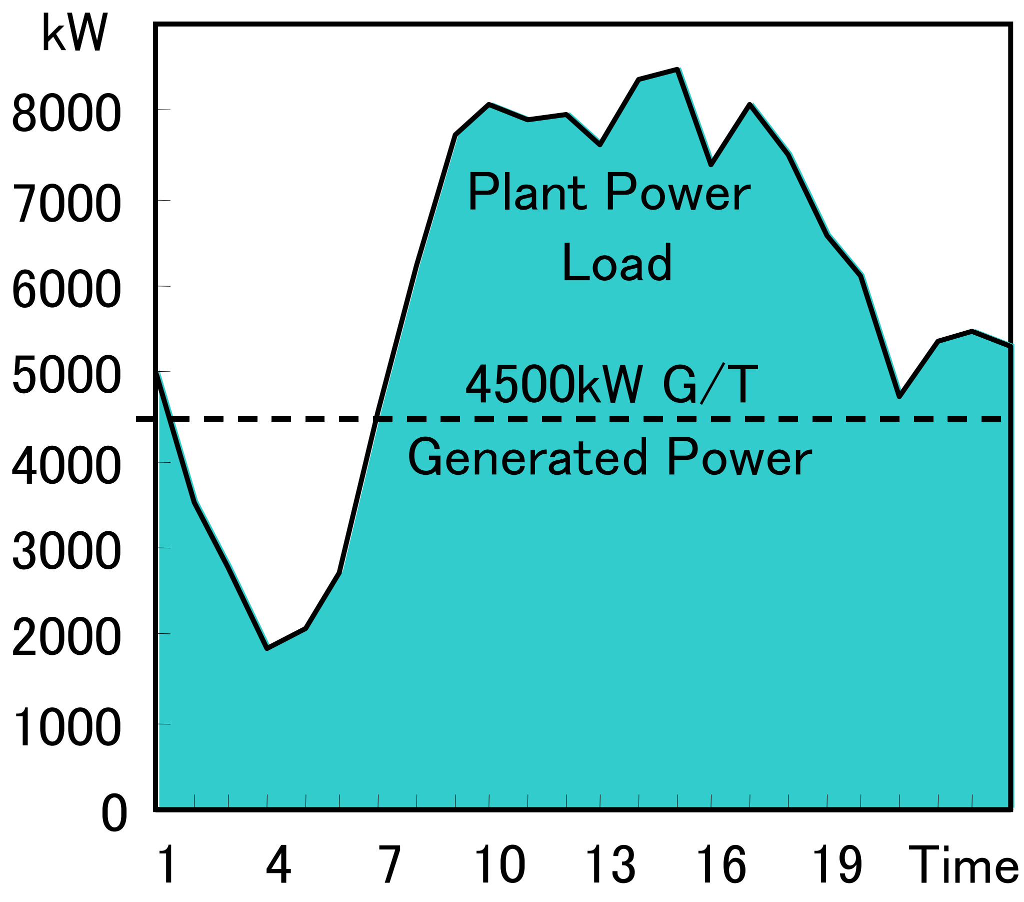


Gas turbine of 2000, 3000kW are low effective for power generation
(Impractical to save energy)

4500kW is selected as power generation effectiveness is focused on

Sanage Plant before Promotion: Energy Load (Year 2000)

Daytime Power Load in Sanage Plant



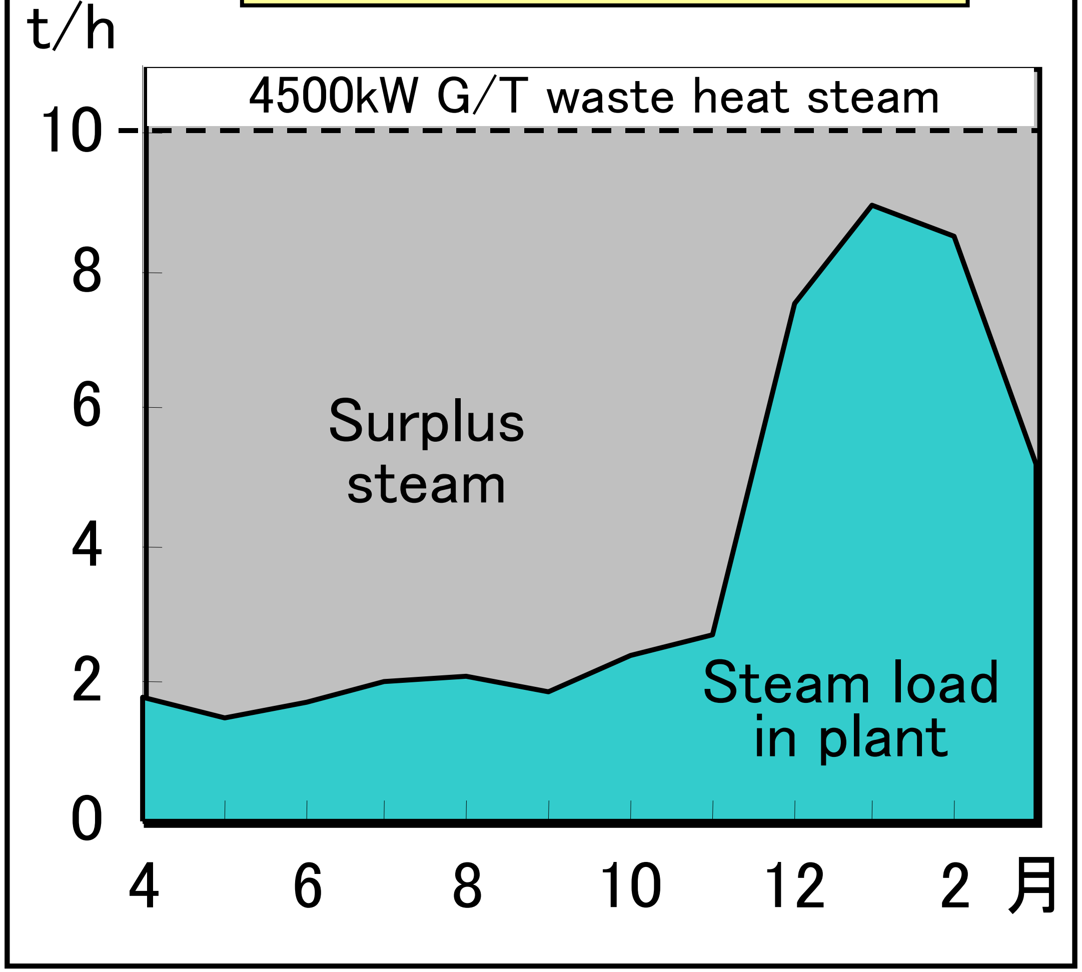
Simulation at 4500kW G/T is done

Full load operation is possible except midnight

Efficient operation is possible (Use of generated power at midnight is to be examined)

Sanage Plant before Promotion: Energy Load (Year 2000)

Annual Steam Load at Sanage Plant



Simulation at 4500kW G/T is done

Surplus steam is generated over year

↓

Impossible for efficient operation

↓

Efficient use of Surplus steam is needed

6. Analysis of Present Situation

7. Constitution for Promotion & Schedule

Step for Countermeasures Practice	Unit in charge	Schedule (Actual)				
		Year 1999	Year 2000	Year 2001	Year 2002	Year 2003
Overall planning	Plant engineering staff					
Training for equip operation management	Sanage plant maintenance staff					
Investigation for present situation (Energy use in plant)	Sanage Manufacturing dept.					
Setting energy saving measures into R&D center	Technical administration dept.					
Practicing measures (Installa-tion & improvement of equips)	Plant engineering staff					
Equip operation & management training	Sanage plant maintenance staff					
Confirmation of result of promotion	Plant engineering staff					

8. Setting up Target

1) Target for Reduction of Emitted CO_2

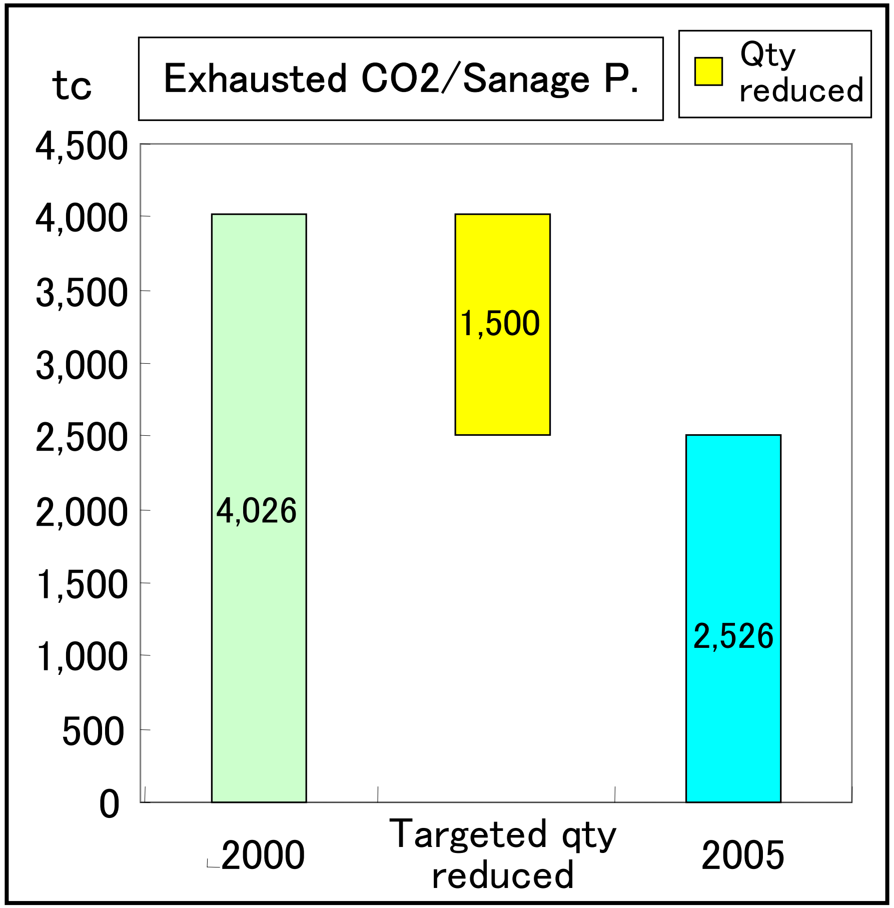
① Target for CO_2 /over company	② Target for Cogeneration & new energy	③ Target for Cogeneration /Sanage plant
Target for reduction of emitted CO_2 till year 2010 over company ↓ 『 6,140tc/Year 』	Target for reduction by introduction of cogeneration & new energy ↓ 『 3,000tc/Year 』	Target for reduction by introduction of cogeneration at Sanage plant ↓ 『 1,500tc/Year 』

2) Target for Energy Reduction –as exchanged to crude oil qty–

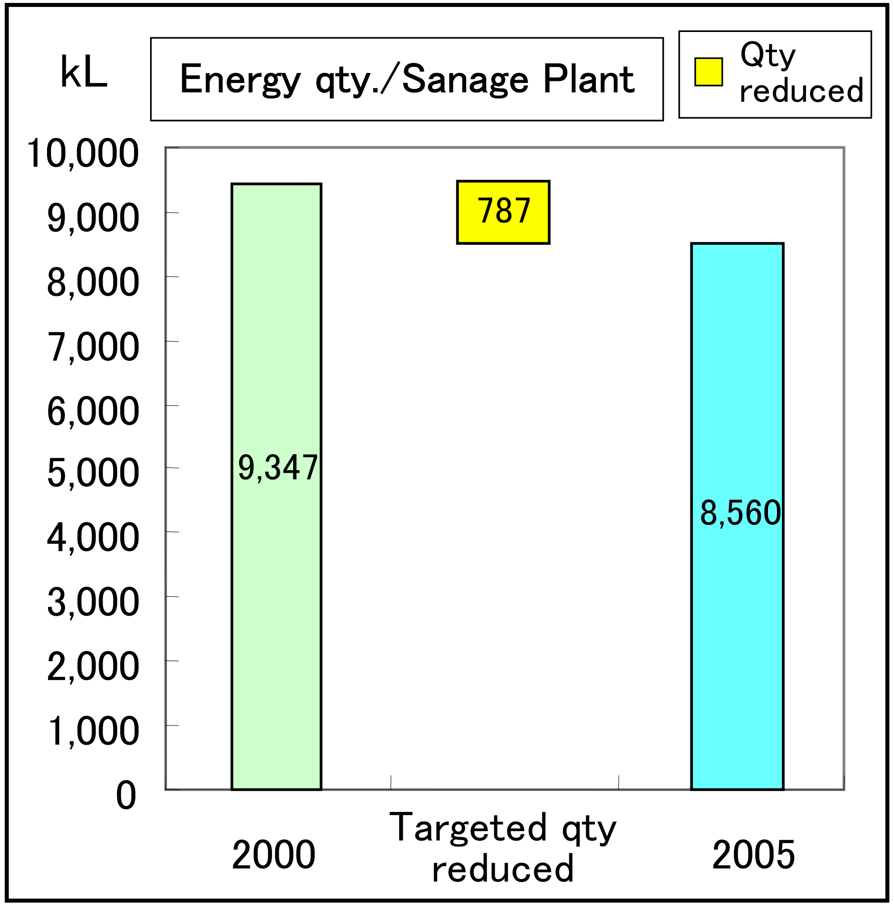
① Application for subsidy	② Condition for subsidy	③ Target for this time
Applying for "Model project for rationalized facility introduction using leading energy"	Condition to acquire the subsidy is Energy reduction (exchanged to qty of crude oil)	Target for reduced energy as crude oil (exchanged to qty of crude oil) ↓ 『 787kL/Year 』

3) Summary of Target

①Targeted reduction on exhausted CO2 1,500tc /Year (2005～)



②Targeted reduction on Energy qty. 787kL /Year (2002～2004)



9. Basic Policy of This Subject

10. Sampling of Subject & Examination of Countermeasure

Basic Policy
Ⅰ. Improving Effectiveness of Cogeneration

No	Subjects for Energy Saving	Countermeasures
1	Selection of method to reduce gas turbine NOx	Lean burn gas turbine
2	Selection for most appropriate fuel for gas turbine	Dual fuel gas turbine
3	Effective use of cogenerated power during night	Ice heat storage

Subject Ⅰ-1 Selection of Method to Reduce Gas Turbine NOx

Subject

Improve efficiency of gas turbine

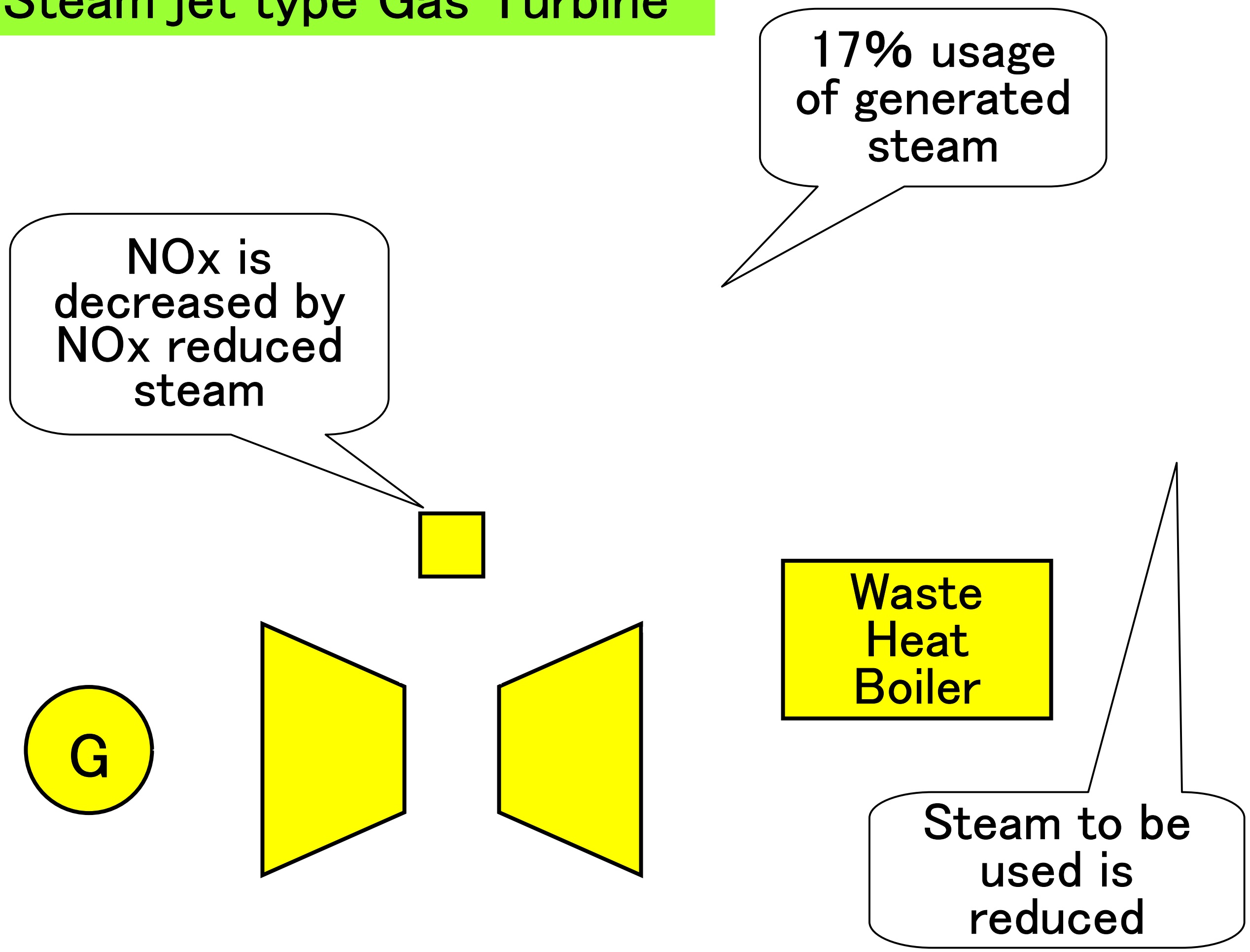
↓

Examine more effective means to reduce NOx

Subject Ⅰ-1 Selection of Method to Reduce Gas Turbine NOx

Examination for Steam Jet Type Gas Turbine(NOxReduced)

1) Steam jet type Gas Turbine



Use steam to reduce NOx in exhausted gas

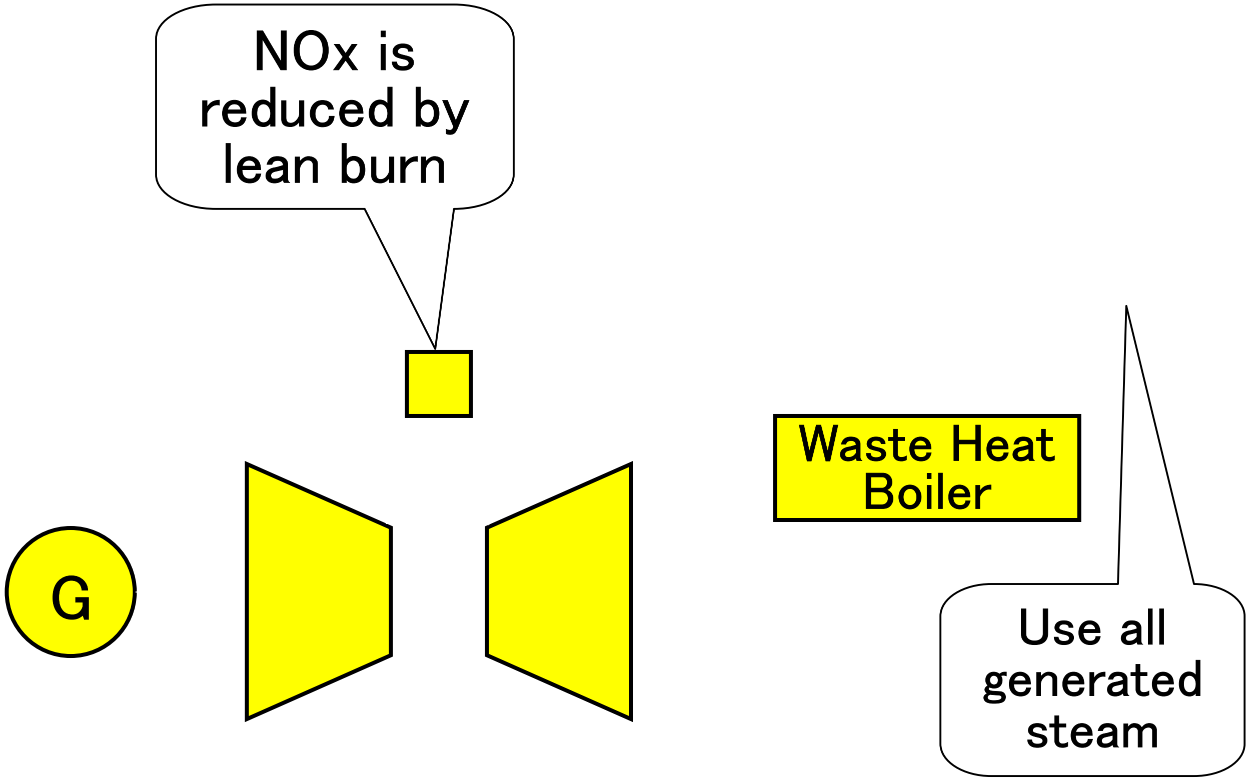
↓

Usable steam at production is reduced

Subject Ⅰ-1 Selection of Method to Reduce Gas Turbine NOx

Examination for Lean Burn Type Gas Turbine (NOxReduced)

2) Lean Burn Type Gas Turbine



NOx in exhausted gas is reduced by lean burn

↓

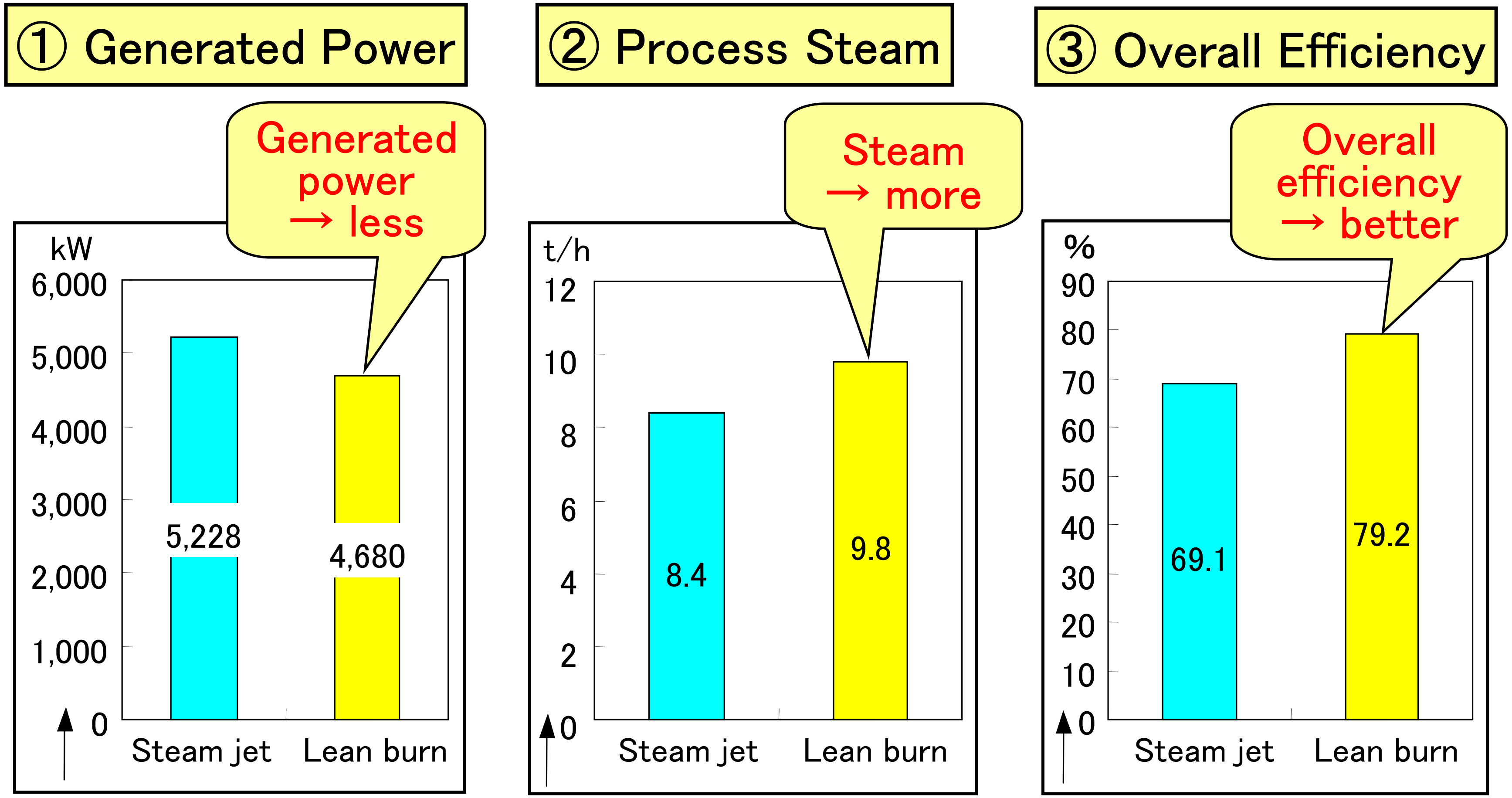
Steam to reduce NOx is not needed

↓

Usable steam at production is increased

Subject Ⅰ-1 Selection of Method to Reduce Gas Turbine NOx

3) Comparison of performance



Measure Ⅰ-1 Lean Burn Gas Turbine

Result of Examination

Focus on comprehensive efficiency and adopt lean burn gas turbine

Effect

Improve comprehensive efficiency
(Steam usable is increased)

↓

Increased steam is used for another countermeasure

Subject Ⅰ-2 Selection for Most Appropriate Fuel for Gas Turbine

Subject

Maximize effect of gas turbine

↓

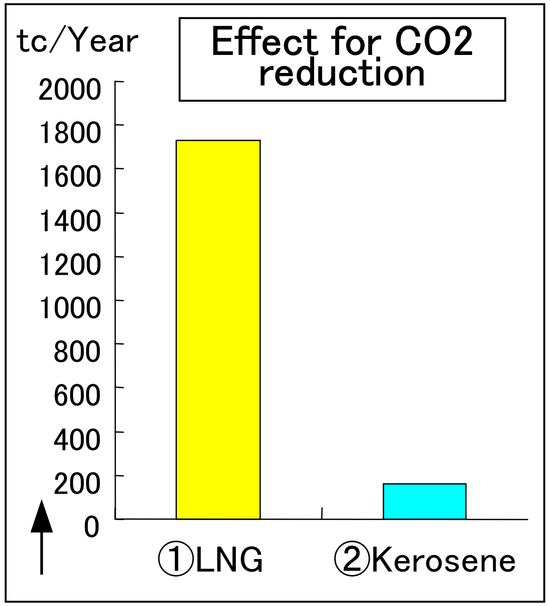
Examine more effective fuel of Gas Turbine

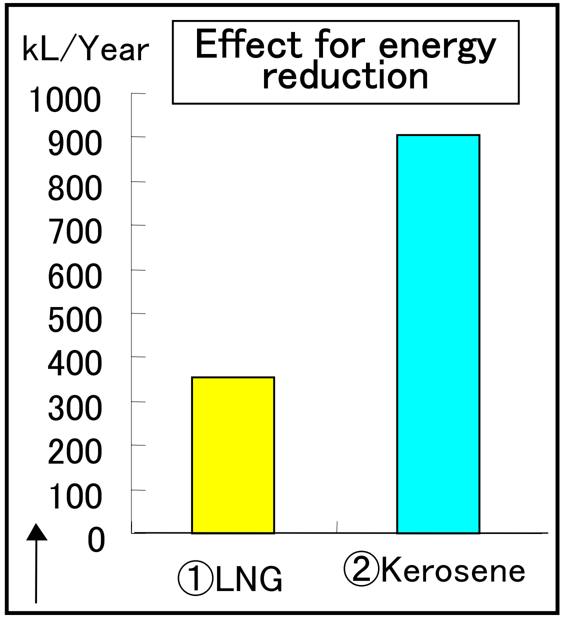
Subject Ⅰ-2 Selection for Most Appropriate Fuel for Gas Turbine

Comparison of Performance of Fuel

Type of Fuel	Effect for CO2 Reduction	Effect for Energy (Cost) Reduction
① LNG	Large	Middle
② Kerosene	Small	Large

There would be big difference depends on the type of Gas turbine Fuel



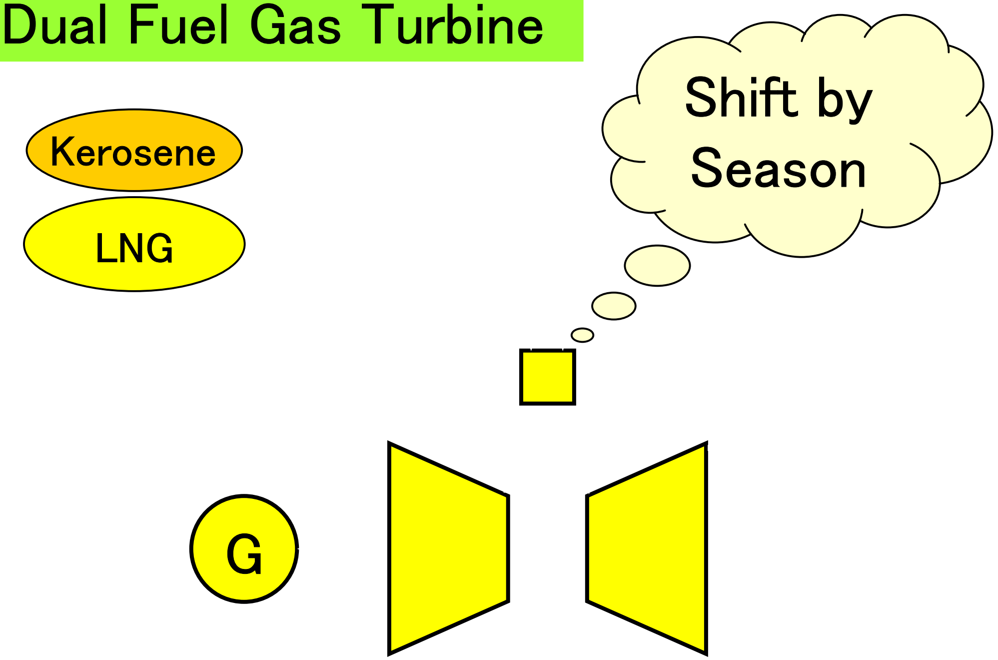


Introduce dual fuel to maximize effectiveness of cogeneration
① LNG Fuel
② Kerosene Fuel

Subject I -2 Selection for Most Appropriate Fuel for Gas Turbine

Dual fuel gas turbine → Shift type of fuel for gas turbine by season

Dual Fuel Gas Turbine



Shifting fuel type during high-load operation with is possible → Reliability of gas turbine is increased

Selection for G/T Fuel

1) ～2004
Focus on reduction of energy quantity & cost
→ Mainly operate with kerosene fuel（Kerosene：LNG＝9months：3months）

2) 2005～
Focus on reduction of exhausted CO2 to achieve the targeted Qty
→ Operate with LNG Fuel

Measure Ⅰ-2 Dual Fuel Gas Turbine

Effect

Maximize effect of cogeneration
(Energy cost /qty & CO_2)

Reduced QTY

① CO_2 Effect ⇒ 1,153 tc／Year
② Effect for Energy ⇒ 272 kL／Year

Subject Ⅰ-3 Effective Use of Cogenerated Power during Night

Problem

Midnight power load decreases

↓

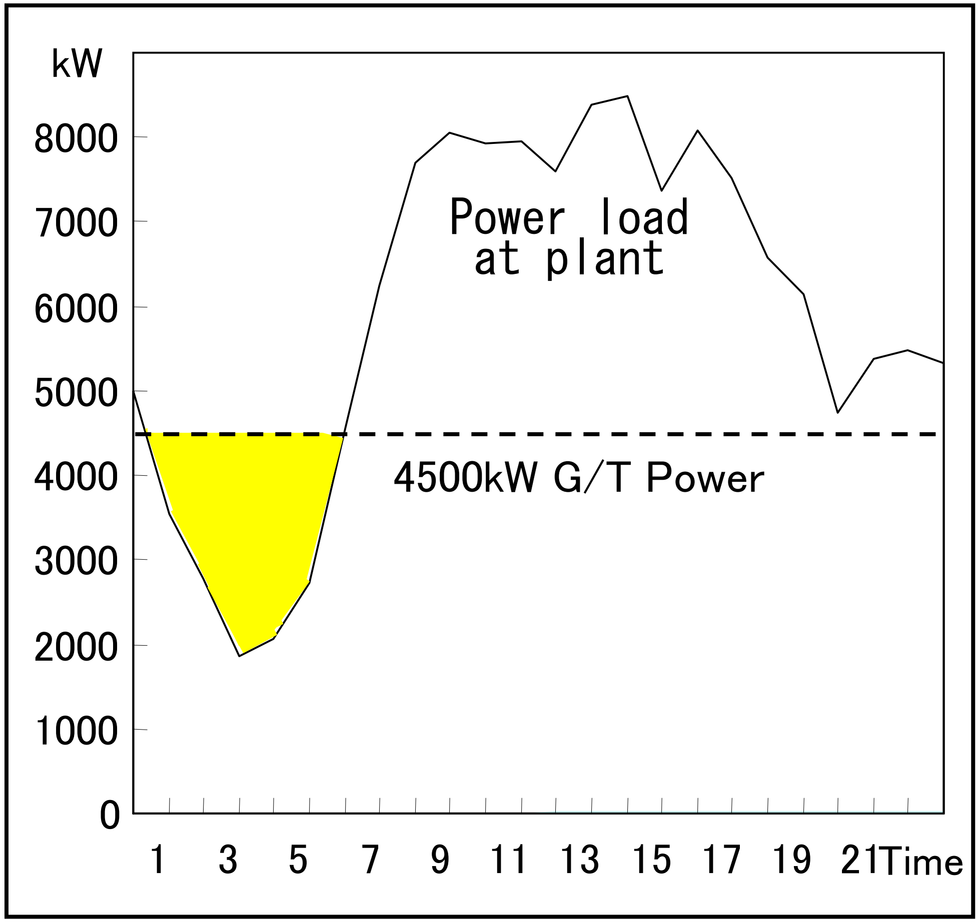
Low load operation of cogeneration
(Low efficiency)

Subject

Examine effective use of
Cogenerated Power during night

Subject Ⅰ-3 Effective Use of Cogenerated Power during Night

1) Daytime power load at Sanage plant



Midnight power load decreases and cogeneration is operated with low load (efficiency declined)

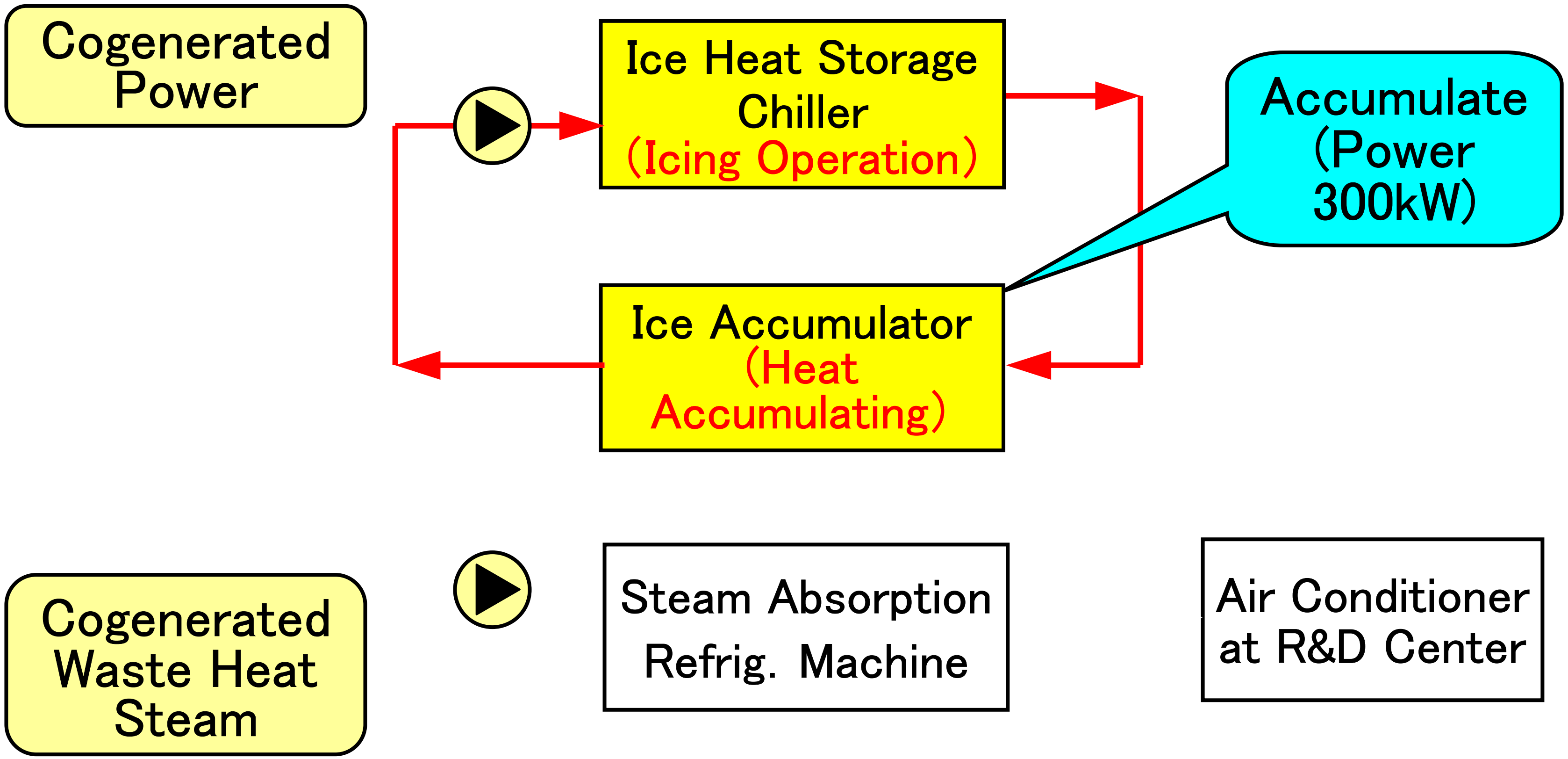
Set ice heat energy chilling unit as air conditioner's heat source at R&D Center

Use generated power of cogeneration (Steam turbine) to accumulate heat in storage

Subject Ⅰ-3 Effective Use of Cogenerated Power during Night

Cold energy is stored in ice accumulator using power from cogeneration (steam turbine) during night

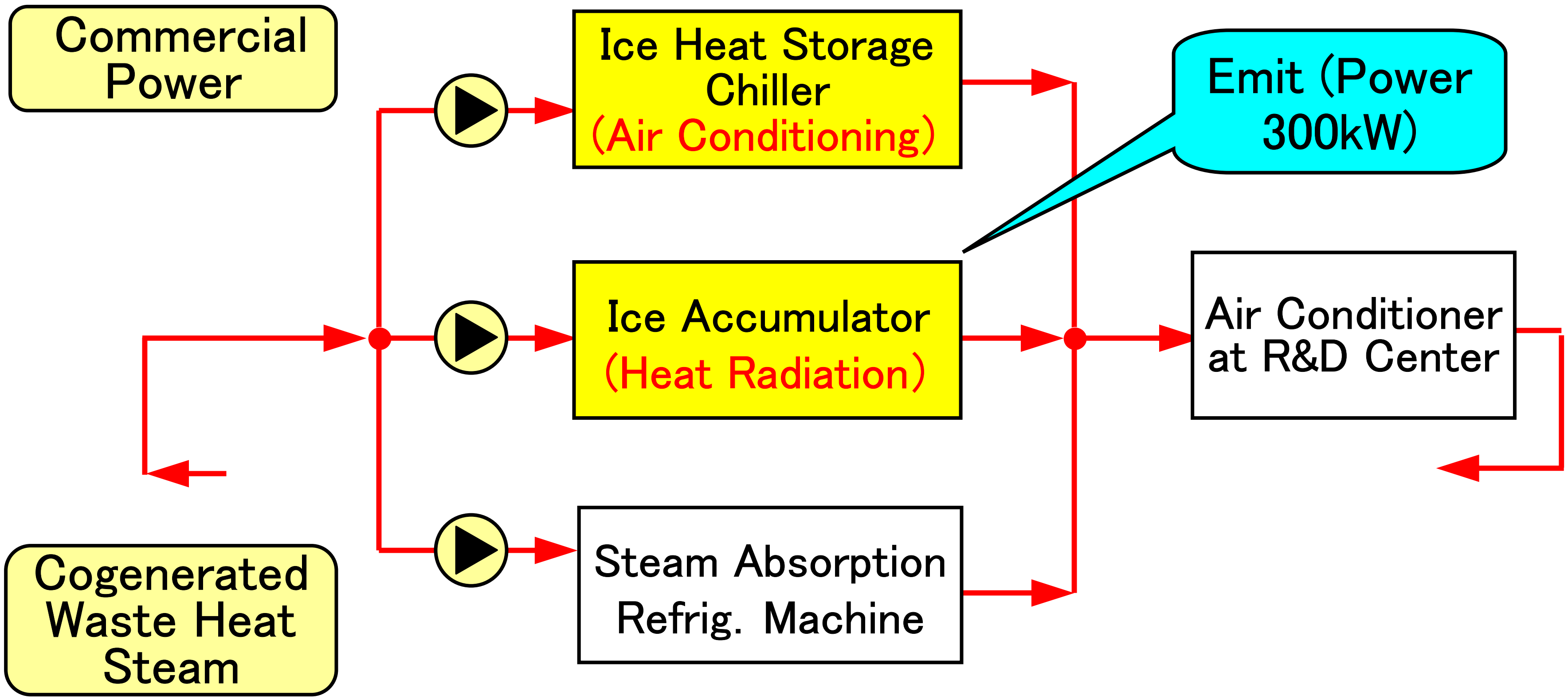
2) Heat source flow in R&D center (during night)



Subject Ⅰ-3 Effective Use of Cogenerated Power during Night

Daytime/ Mainly air-conditioning by heat radiation of ice accumulator and steam driven absorption refrigerating machine

3) R&D Center Heat Source (Daytime)



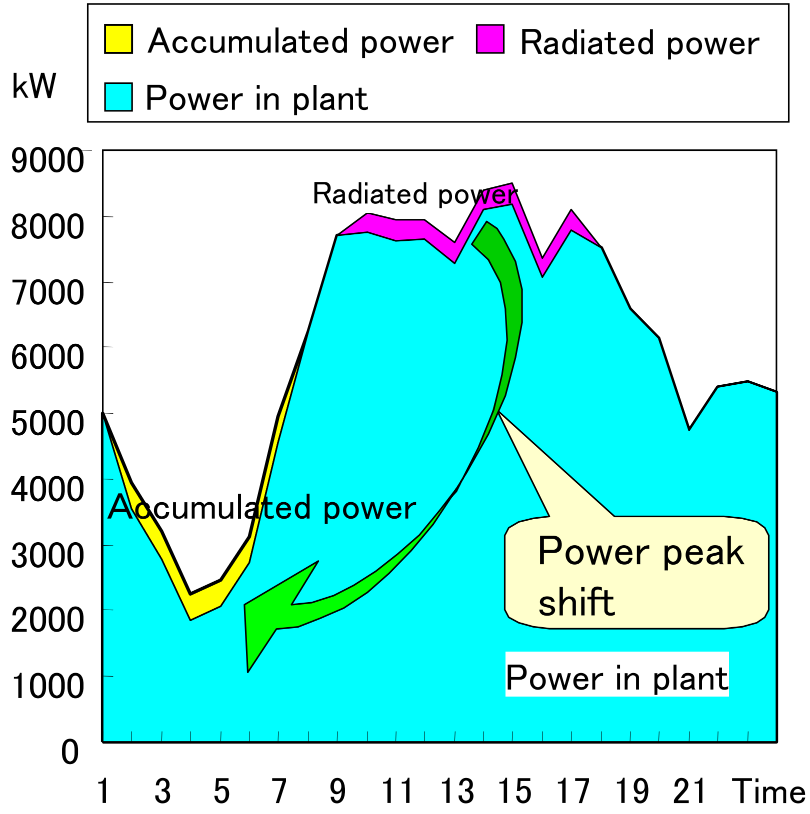
Subject Ⅰ-3 Effective Use of Cogenerated Power during Night

① Shifting day time power peak

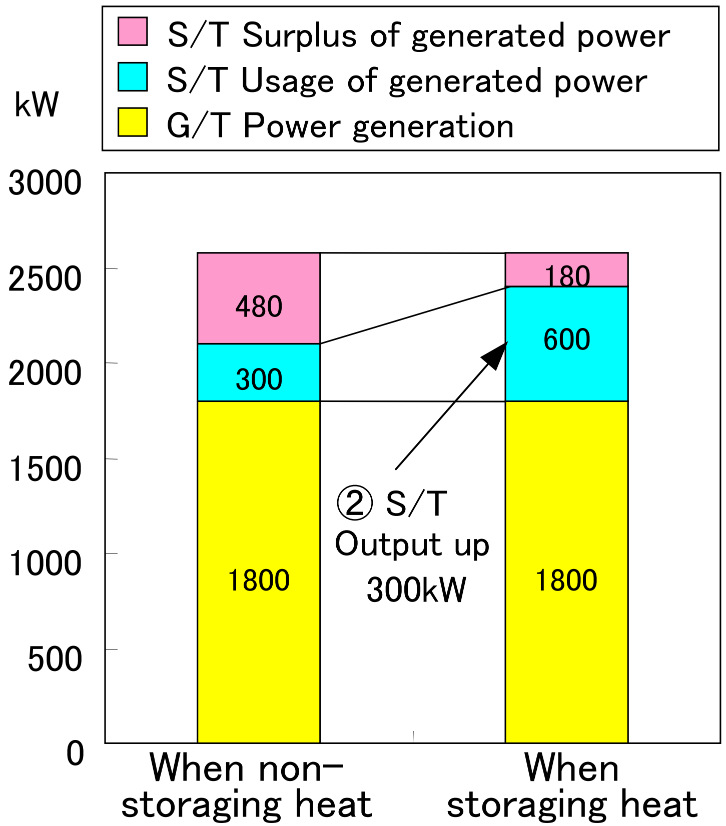
➡

② Increasing effectiveness of cogeneration (steam turbine) at midnight

4) Day Power Load Curb (Heat Accumulating Effect)



5) Cogenerated Power during Midnight



Measure Ⅰ-3 Ice Heat Storage

Effect

① Shifting day time power peak
② Increasing effectiveness of cogeneration at midnight (steam turbine)

Reduced QTY

① Effect for CO_2 ⇒ 16 tc／Year
② Effect for energy ⇒ 53 kL／Year

Basic Policy
Ⅱ. Effective Use of Energy from Cogeneration

No	Subjects for Energy Saving	Countermeasures
4	Effective use of surplus waste heat steam	Combined circle
5	Effective use of waste heat steam	Cascade use of waste heat steam
6	Effective use of waste heat hot water	Recovery of hot water heat
7	Countermeasure for power demand in summer	Control power demand

Subject Ⅱ-4 Effective Use of Surplus Waste Heat Steam

Problem

Surplus heat waste is generated depending on the season or time

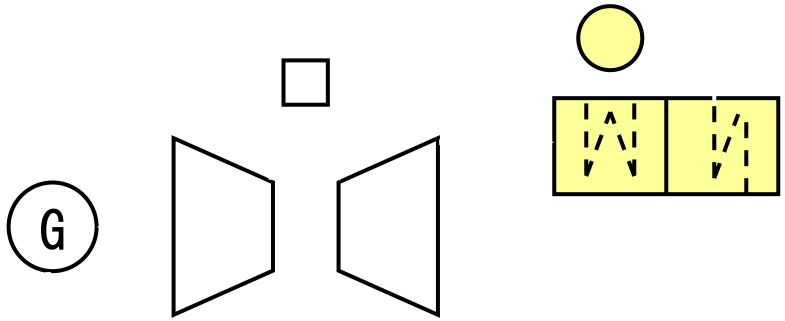
Subject

Surplus steam has to be used effectively

Subject Ⅱ−4 Effective Use of Surplus Waste Heat Steam

General type cogeneration installed into Yoshiwara plant

1) General Type Cogeneration



Surplus steam is radiated

Energy loss occurs

Power Load

Steam Load

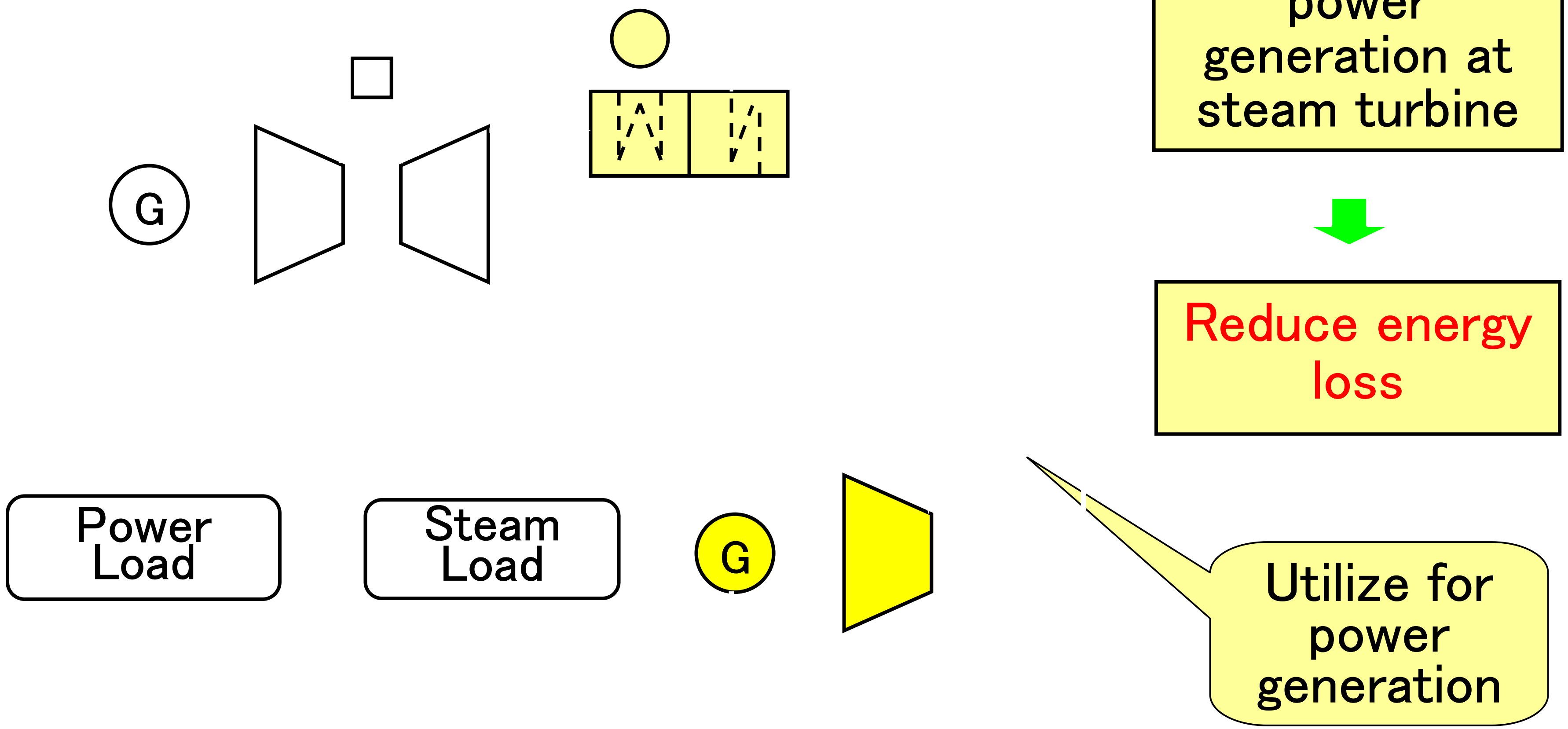
Steam Radiation

Energy loss

Subject Ⅱ−4 Effective Use of Surplus Waste Heat Steam

Utilize surplus steam applying co−generation of combined circle

2) Combined Cogeneration



Surplus steam is used for power generation at steam turbine

Reduce energy loss

Measure Ⅱ-4 Combined Circle

Effect

Prevent decreasing efficiency using surplus waste heat steam effectively

Reduced QTY

① Effect for CO_2 ⇒ 384 tc／Year

② Effect for Energy ⇒ 91 tc／Year

Basic Energy Saving Policy
Ⅲ. Energy Exchange for Plant Equips

No	Subjects for Energy Saving	Countermeasures
8	Energy change of electric chiller for air conditioner	Energy change to waste heat steam
9	Energy change of electric heating	Energy change to waste heat steam

Ⅳ. Improve Energy Efficiency of Plant Equips

No	Subjects for Energy Saving	Countermeasures
10	Use of hot water as heat source for refrig. machine	Genelink refrig. machine
11	Effective use of cold water	Effective use of cold water of genelinlk refrig. machine
12	Effective use of cooling tower in off season	Use cooling tower for refrig. machine as for steam turbine
13	Reduction of steam in winter	Reduction of air curtain steam
14	Improving effectiveness of gas compressor with low load	Gas compressor energy saving operation
15	Reduction of loss of transformer	Amorphous transformer
16	Pursuing most appropriate operation of equips	Most effective operation supporting system

Subject Ⅳ-10 Use of Hot Water as Heat Source for Refrigerating Machine

Problem

Steam consumed by steam absorption refrigerator is much

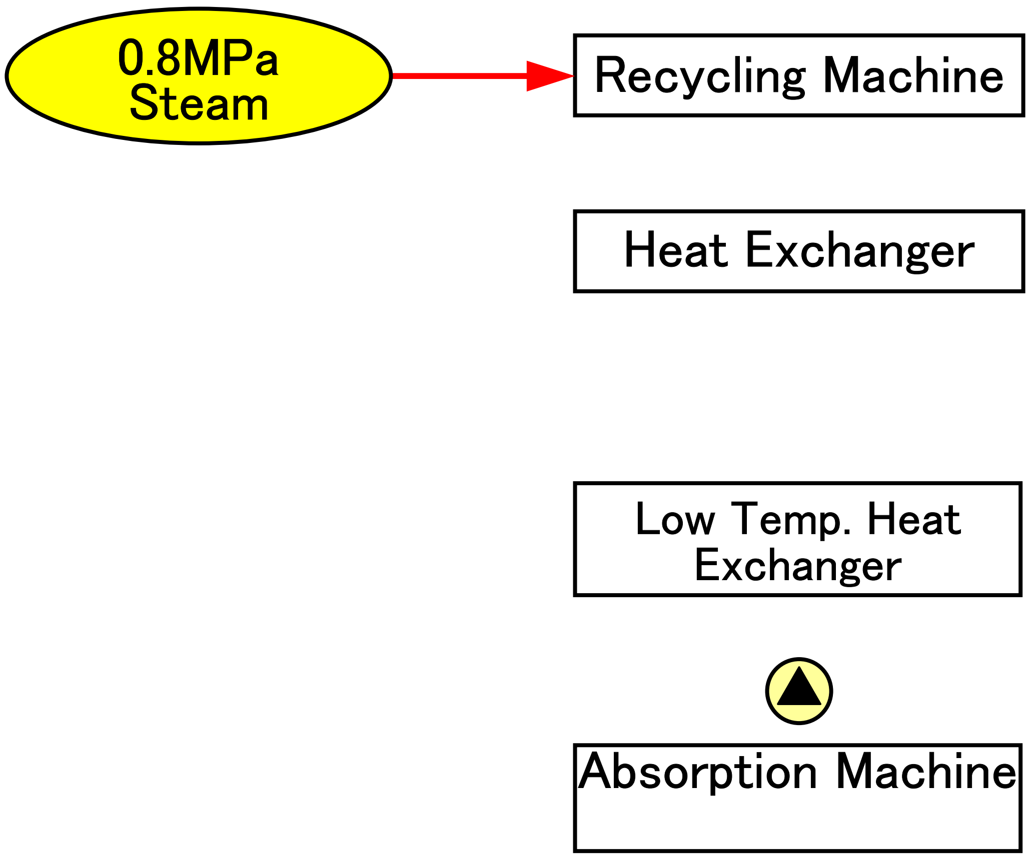
Subject

Reduce consumed steam by use of waste heat hot water

Subject Ⅳ-10 Use of Hot Water as Heat Source for Refrigerating Machine

Steam is used for general type refrig. machine as heat source

1) General type of refrig. machine: Absorption flow



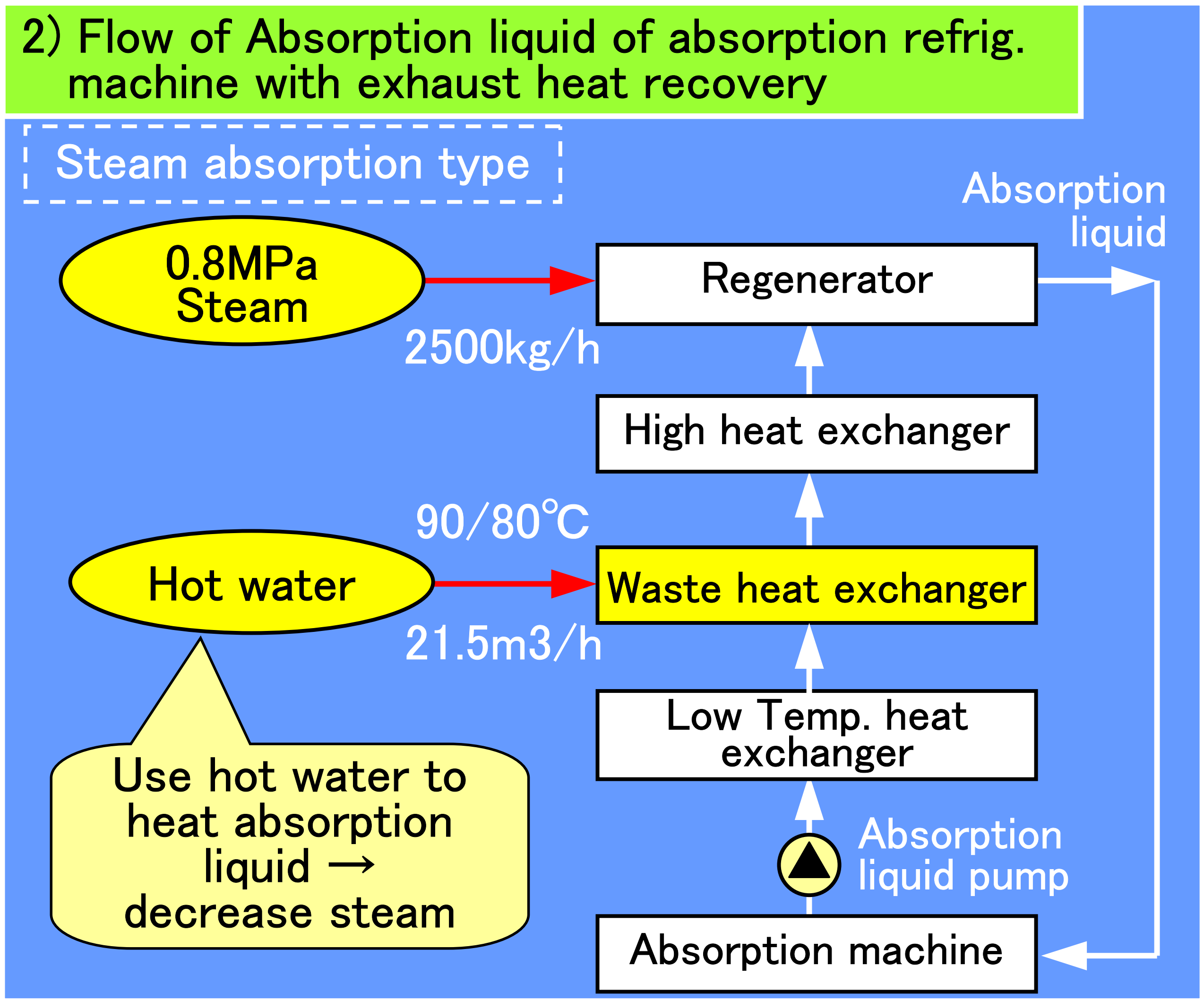
General Type
Refrig. Machine:
Capacity＝
2110kW
(600USRT)

↓

Steam
Consumed
＝ 2700kg/h

Subject Ⅳ-10 Use of Hot Water as Heat Source for Refrigerating Machine

Genelink refrig. machine → Use hot water to heat absorption liquid



Absorption refrig. machine with exhaust heat recovery:
Capacity＝ 2110kW (600USRT)

Steam consumed ＝ 2500kg/h

Steam consumed Decreased 7%

Measure Ⅳ-10 Genelink Refrig. Machine

Effect

Effective use of low temperature waste heat

⬇

Reduce steam consumed at genelink refrigerating machine

Reduced QTY

① Effect for CO_2 ⇒ 39 tc／Year

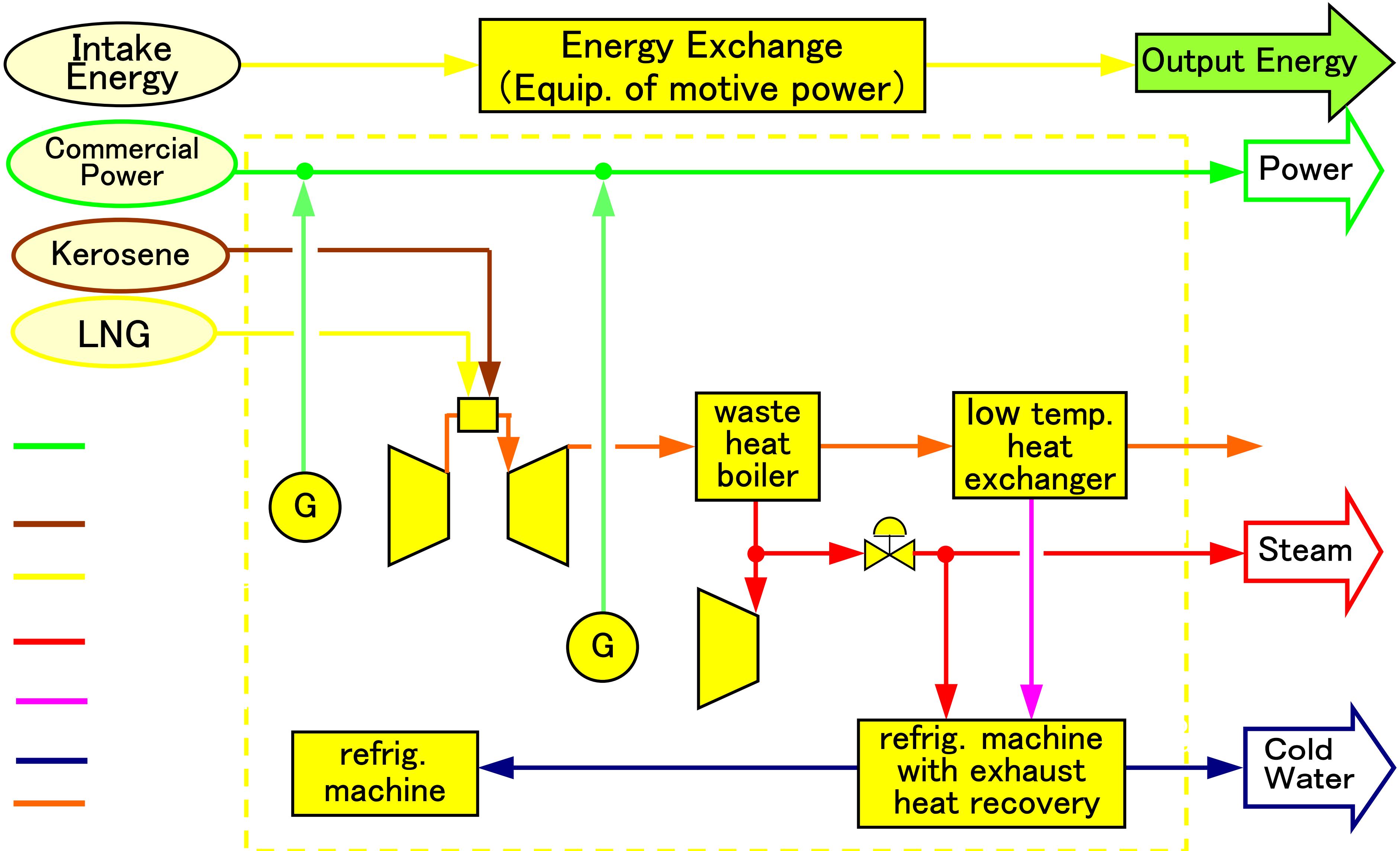
② Effect for Energy ⇒ 70 kL／Year

11. Summary of Measure

1) Introduced New Facilities

Type of Facility	Name of Facility	Heat Source	Total Capacity	Qty	Remarks
Cogene-ration	Gas turbine	Kerosene LNG	4,680 kW 4,170 kW	1	intake air temp. 15℃
	Steam turbine	2.0MPa Steam	1,800 kW	1	max. steam qty. 10t/h
	Waste heat boiler	Waste heat	10 t/h	1	
	Low temp. heat exchanger	Waste heat	500 kW	1	
	Genelink refrig. machine	0.8MPaSteam ,Hot water	600USRT	1	fans are changed to inverter
	Most Effective Supporting System			1	
Refrig. Machine	2nd Plant	0.8MPa Steam	300USRT	1	fans & pumps are changed to inverter
	5th Plant	0.8MPa Steam	450USRT	1	ditto
	R&D Center	0.8MPa Steam	280USRT	1	ditto
Ice heat Chiller	R&D Center	Electric Power	1,308 kW	4	

3) Introduced Cogeneration System Flow



12. Summary of Effect

1) Quantity

※Impact for CO_2 (tc): Year 2005、Impact as crude oil (kL): Year 2002

Basic guideline for energy saving	Countermeasures	Annual impact for reduction: CO_2	Annual impact for reduction: Crude oil
Ⅰ Improve efficiency of cogeneration	1,2 Lean burn type、dual fuel gas turbine	1,153	272
	3 Ice accumulation	16	53
Ⅱ Effective use of energy from cogeneration	4 Combined cycle gas turbine	384	91
	5,6 Cascade use of heat & steam	23	43
	8 Power demand control	Cost impact	
Ⅲ Energy exchange	8,9 Energy exchange of dry furnace & etc.	15	72
Ⅳ Improve energy efficiency of plant equips	10～12 Use of hot water at genelink & etc.	43	80
	13 Reduce steam for air curtain	87	159
	14,15 Energy saving operation of gas comp.	9	23
Total		1,730	793

2) Day Power Load at Sanage P. after Promotion (Year 2002)

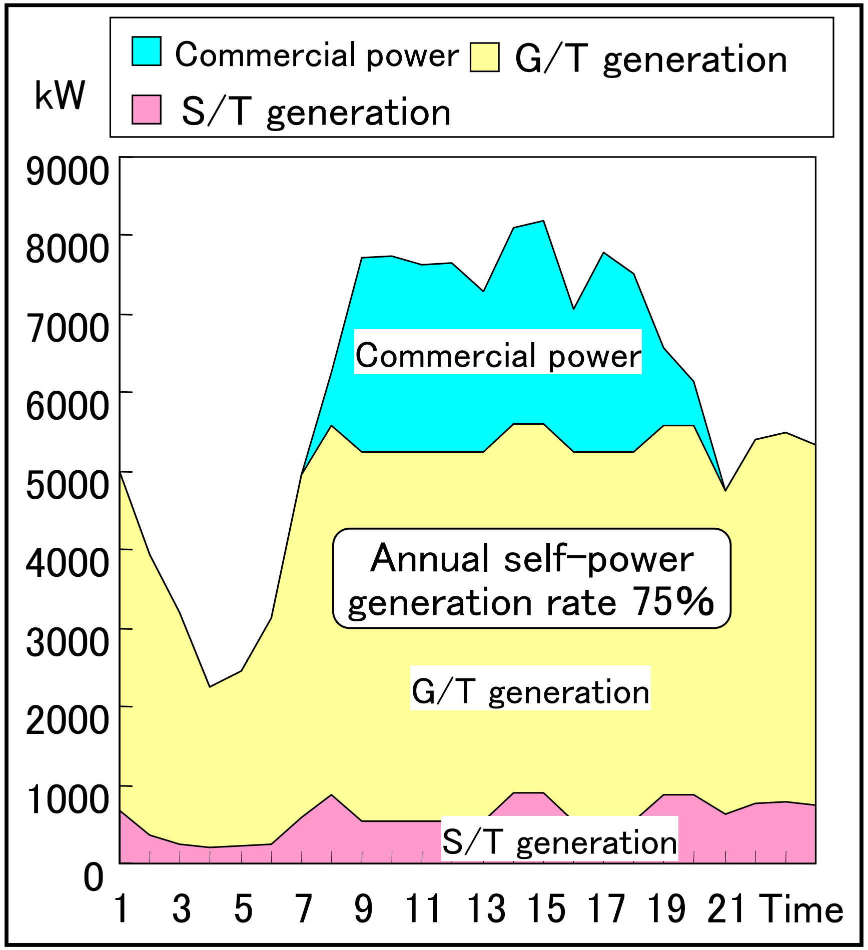
Condition for Power Generation

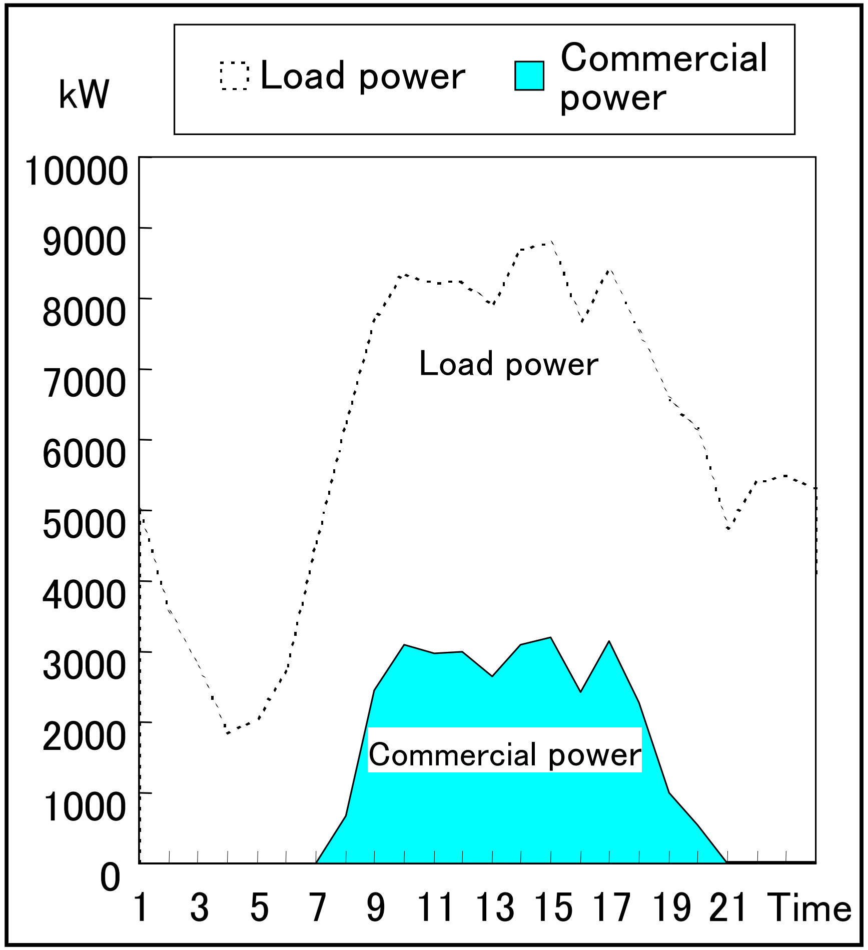
S/T: Base power generation

G/T: Controlling capacity generation

Condition for Commercial Power

Commercial(bought) power is reduced by cogeneration

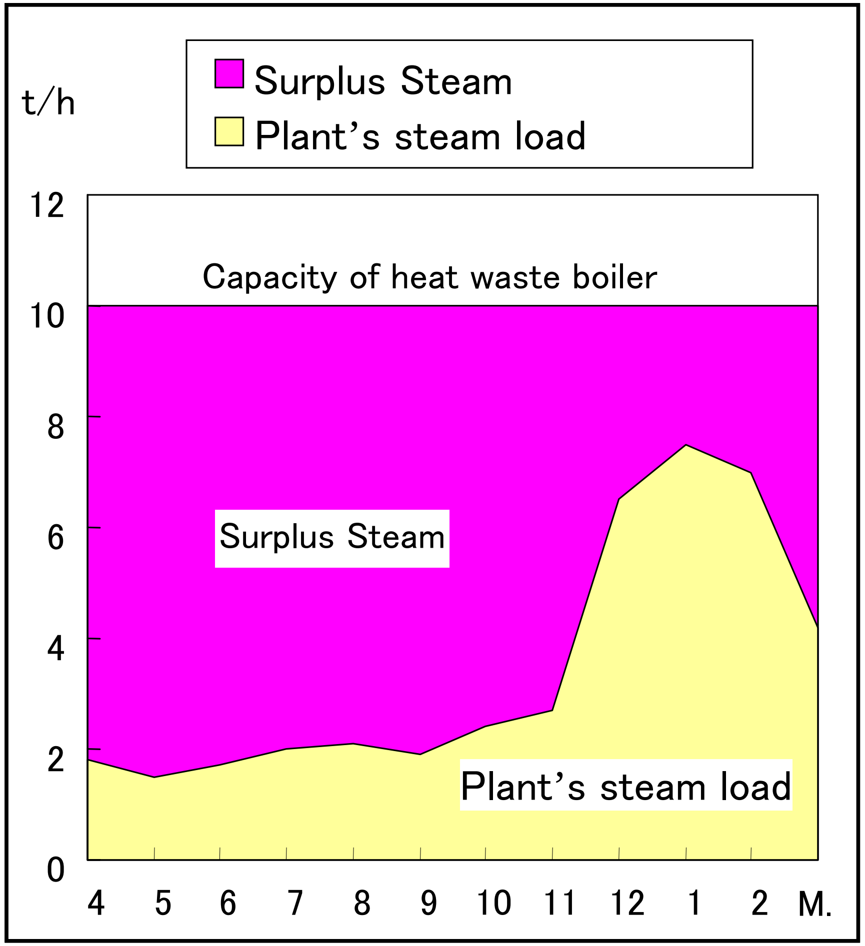




3) Annual Steam Load at Sanage P. after Introduction (2002)

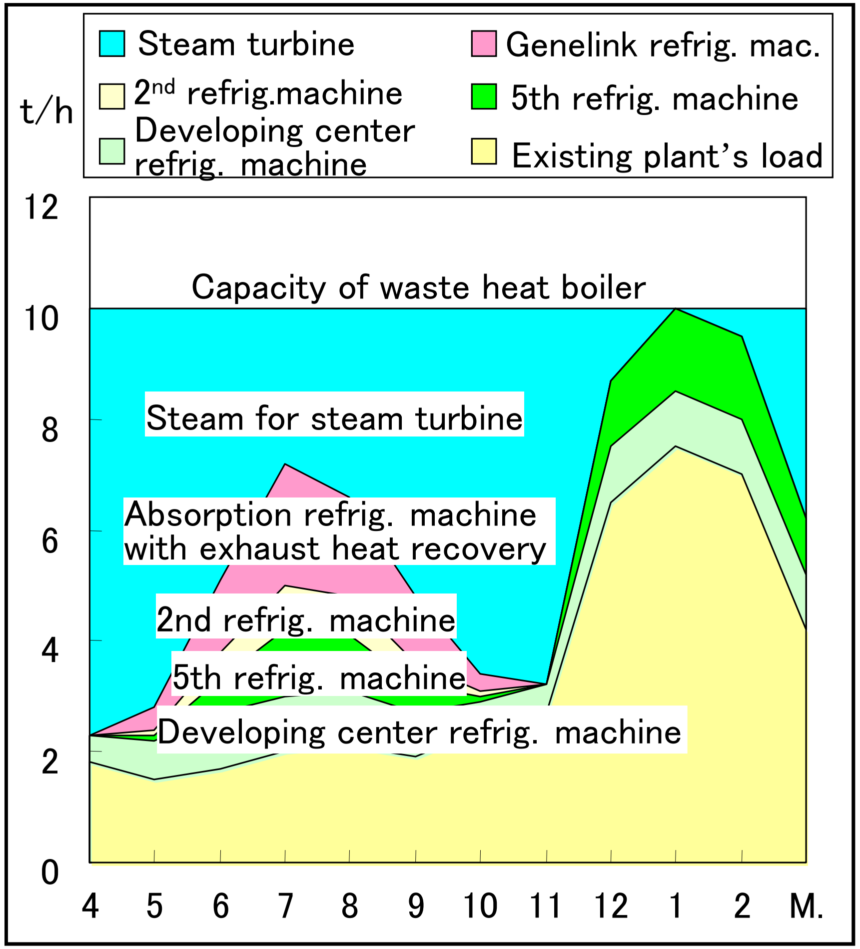
Before Improvement/annual steam load

Plant's steam is less than capacity of cogeneration waste heat boiler



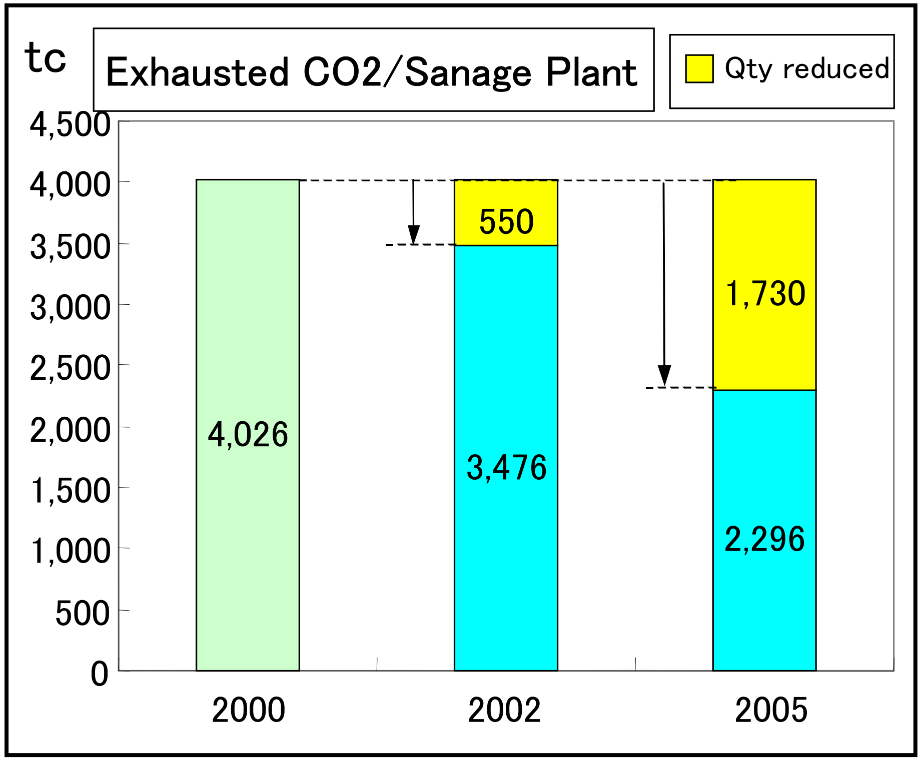
After Improvement/annual steam load

Energy is replaced to steam as steam load equip. is set/changed



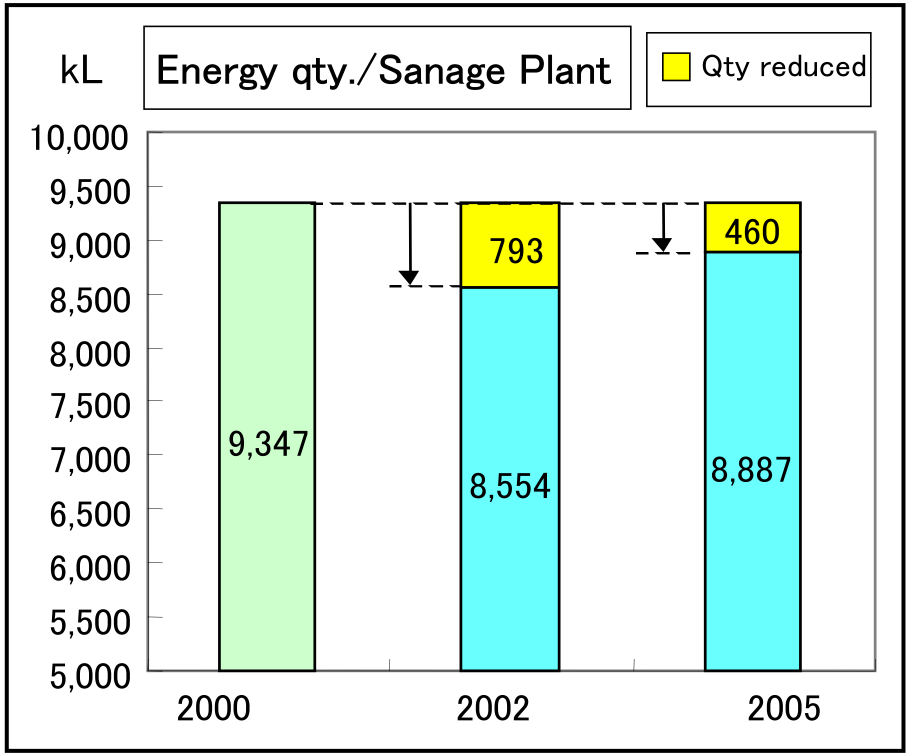
4) Energy Transition after Promotion

①Targeted reduction on exhausted CO2
1,500tc /Year （2005～）



2005～: targeted reduction on exhausted CO2
1,500tc /year is expected

②Targeted reduction on Energy qty.
787kL /Year （2002～2004）



2002～2004: targeted reduction on Energy qty.
787kL /year is expected

13. Summary

We have successfully achieved following :

① Full use of cogeneration system's ability which was not considered to make big effect at the beginning.

② Shorter recovery period for the investment obtaining subsidy from NEDO

③ Accumulation of energy saving know-how

14. Plan After Now

① All the planed equipments have started operation since April, 2002. We are grasping conditions of the operation and manage it so that we can achieve better effect.

② We are planning further save energy improvement including cogeneration in small size plant.

Thank You For Listening