

November 7, 2003

19. A Field Study of Energy Efficient Factories

省エネルギー優良工場視察

Mr. Kazumitsu ISHIGURO

石黒 一満

Senior Productive Officer
CHITOSE PLANT
HOKKAIDO COMPANY
CALBEE FOODS CO., LTD.

カルビー株式会社

北部カンパニー

千歳工場

SPO

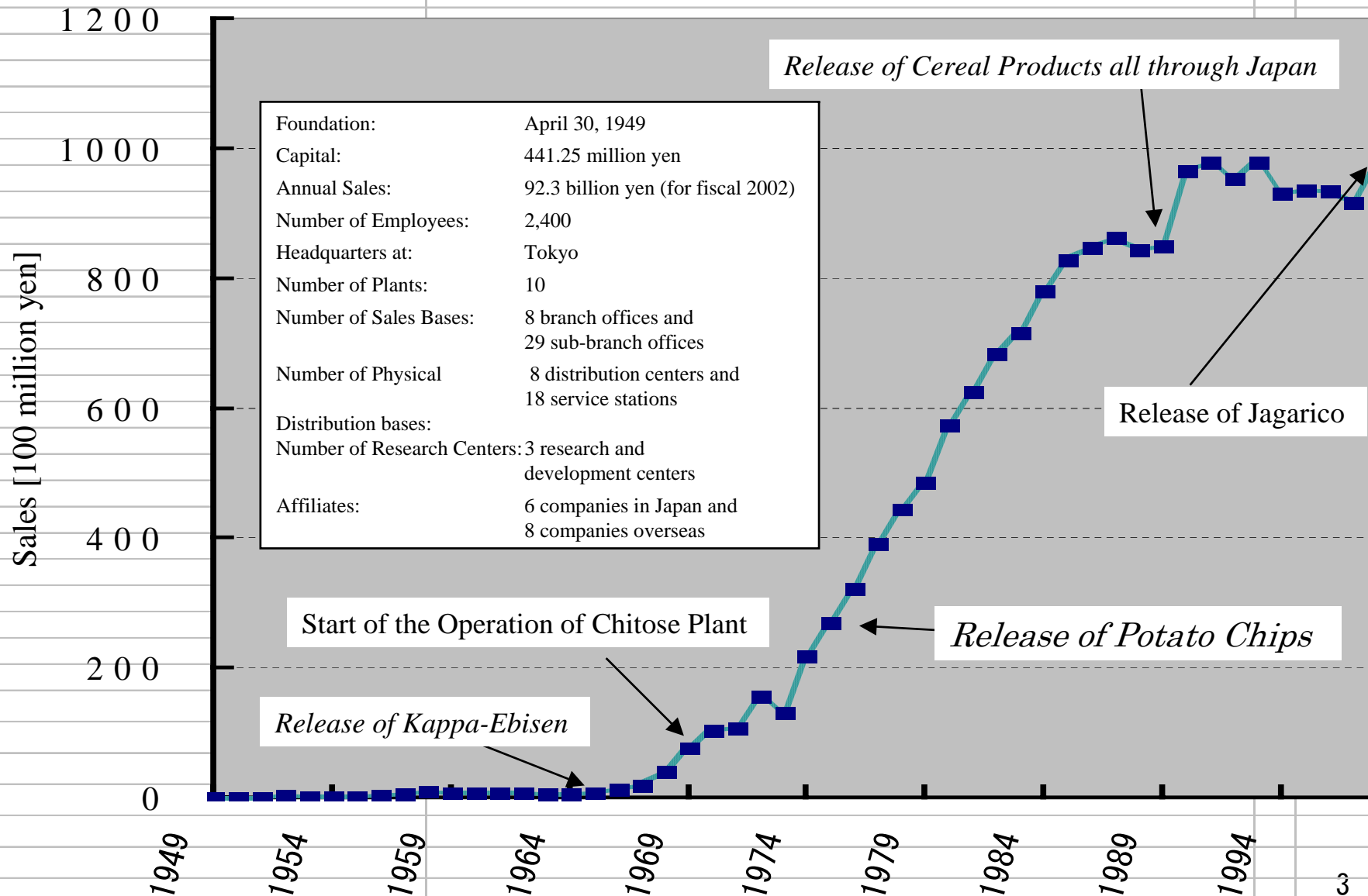


WELCOME TO OUR PLANT

Chitose Plant, Calbee Foods Co., Ltd.

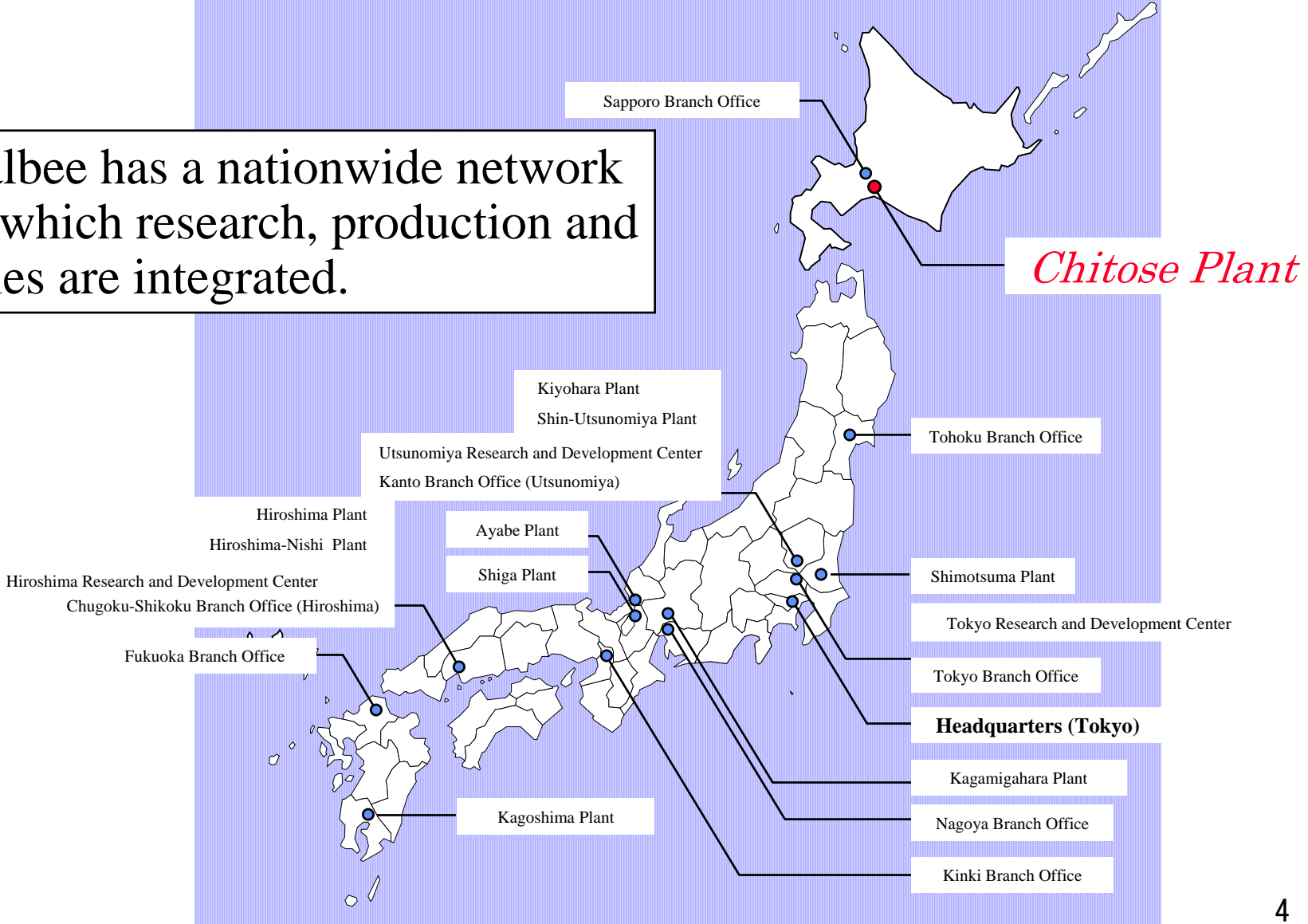
OVERVIEW OF THE COMPANY

Change of Size and Sales of the Company



Business Bases

Calbee has a nationwide network in which research, production and sales are integrated.



Calbee's Business

Concept: "To utilize the food resources grow by the rich nature, taking good care of them and to contribute to the healthy life of people."

(1) Contents of Our Business

- ① Production and sales of agricultural and fishery preservable products
- ② Production and sales of confectionery
- ③ Production and sales of frozen food
- ④ Production and sales of other processed foods
- ⑤ Businesses such as warehouse business

Main Products

(1) Snack Products

① Pellet Snack Products

(Kappa-Ebisen, Sapporo Potato)

② Extruded Snack Products

(Saya-Endo, Yaki-Morokoshi)

(2) Potato Chips Products

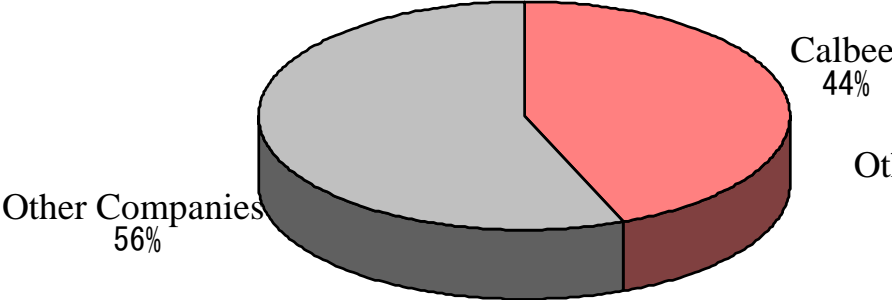
(3) Cereal Products

(4) New-type Snack Products

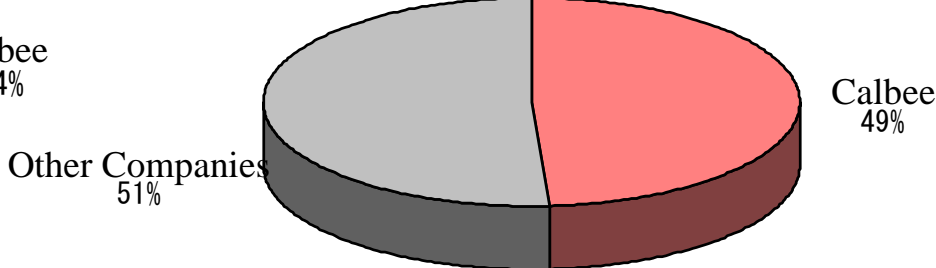
(Japarico)

Market Shares

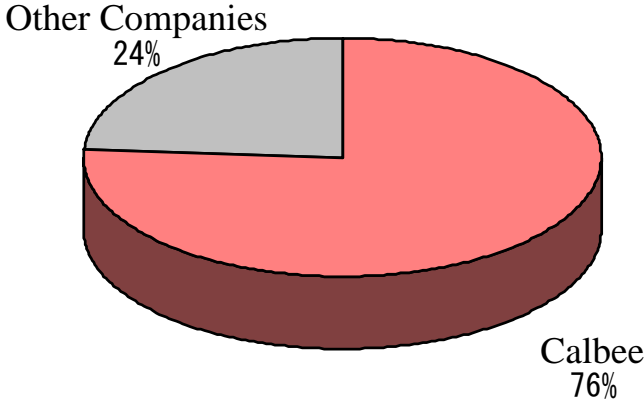
Calbee's Share
in the Snack Product Market



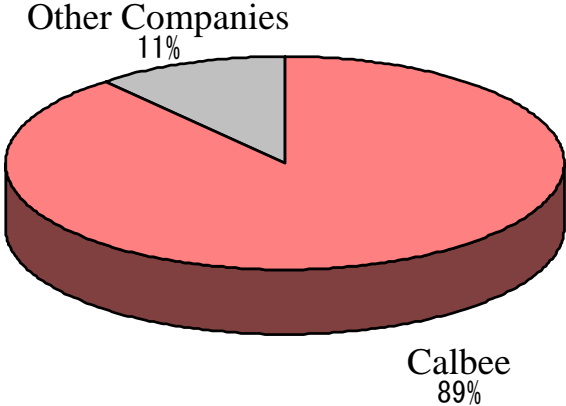
Calbee's Share
in the Snack Product Market in Hokkaido



Calbee's Share
in the Potato Chip Product Market



Calbee's Share
in the Potato Chip Product Market in Hokkaido



From SRI data for fiscal 2001

OVERVIEW OF THE BUSINESS BASE

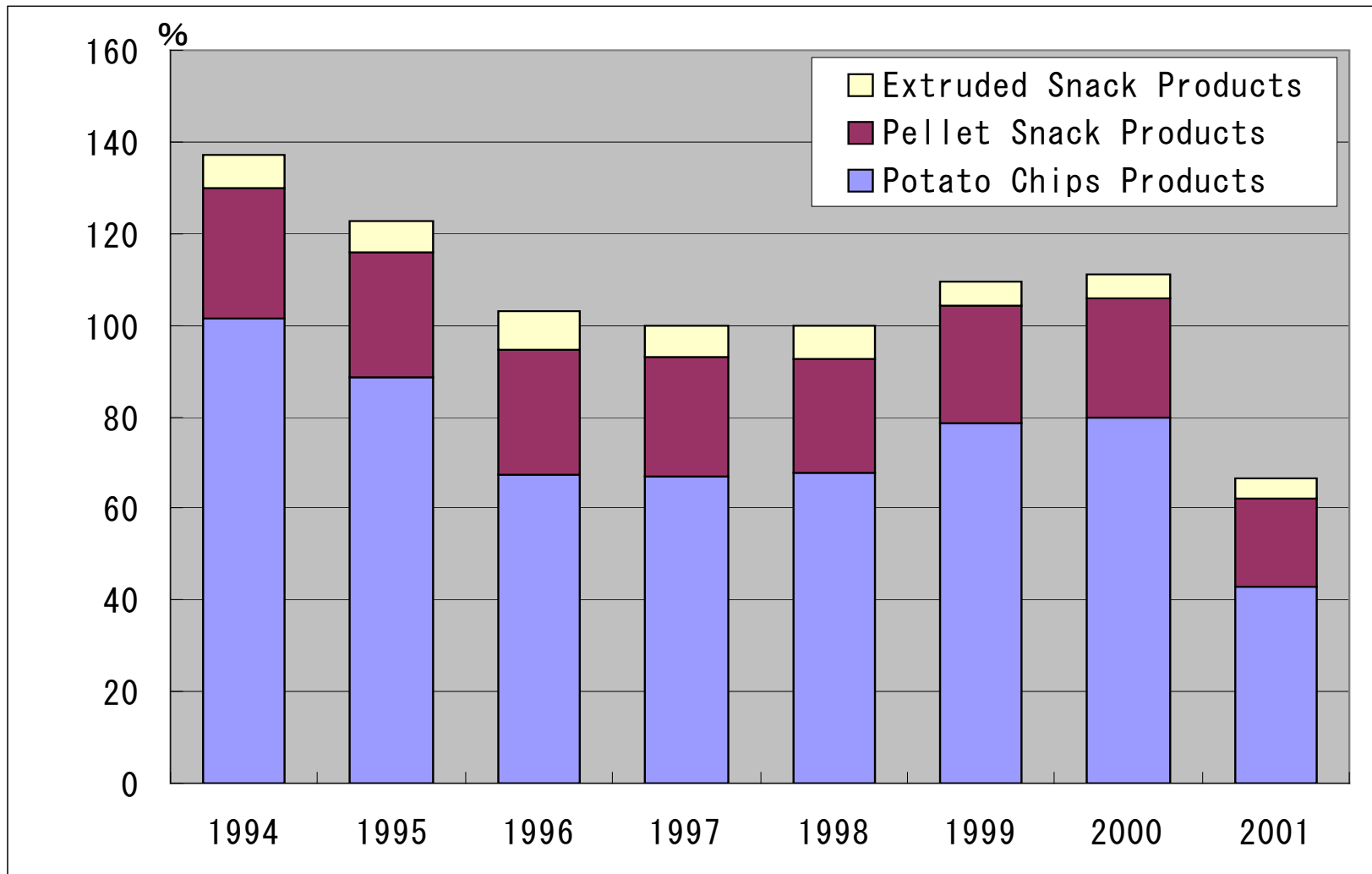
Profile of Chitose Plant

Address:	779-4 Kita-Shinano, Chitose City
Operation Started in:	December 1969
Area of the Premises:	31,540 m ² (9,558 tsubo)
Number of Employees:	117
Average Age:	42 for male, 25 for female
Average Length of Service:	10.3 years (for full-time employees)

With the purpose of establishing a system for production and sales, Chitose Plant was constructed as the third plant of the company following Hiroshima Plant and Utsunomiya Plant.

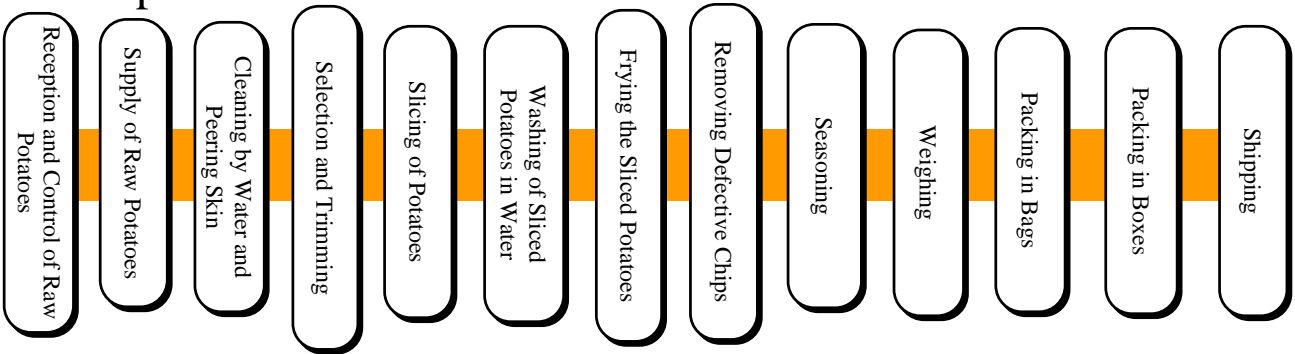
- Dec. 1969: The snack product plant started its operation.
- Nov. 1978: The potato chip product plant started its operation.
- July 1990: The extruder lines were installed.
- Feb. 1992: Northern Physical Distribution Center Opened.
- Oct. 1996: Received the TPM Grand Award.
- Oct. 2000: Received the TPM Continuous Award.
- Sept. 2001: Chitose New Plant started its operation.
- June 2002: Passed the preliminary examination of ISO 9001.
- Aug. 2002: Received the ISO 9001 certification.

Change of Annual Production and Sales

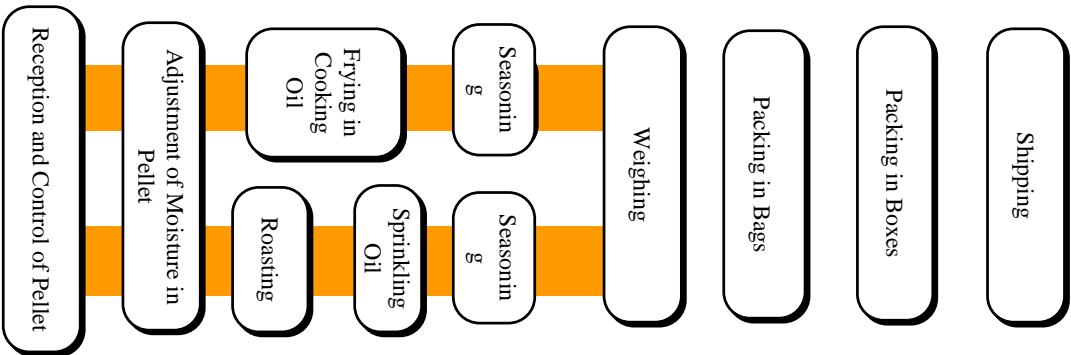


Production Processes

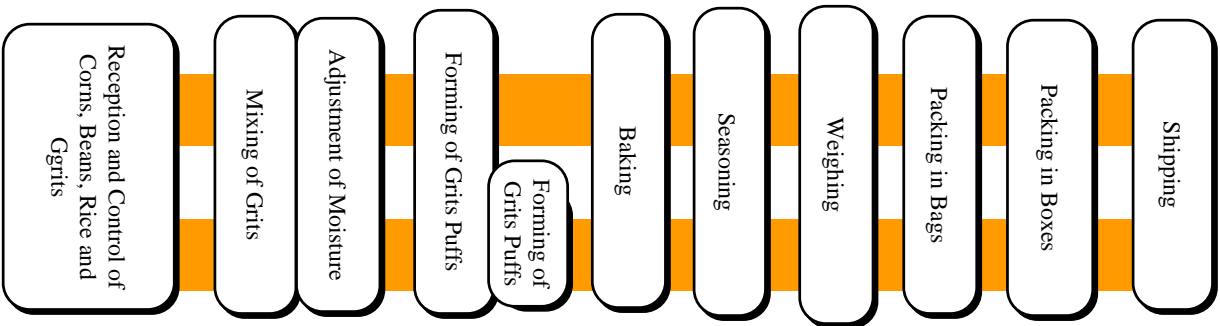
(1) Potato Chip Products



(2) Pellet Snack Products



(3) Extruded Snack Products



INTRODUCTION OF THE NEW PLANT

The Concept of Chitose New Plant

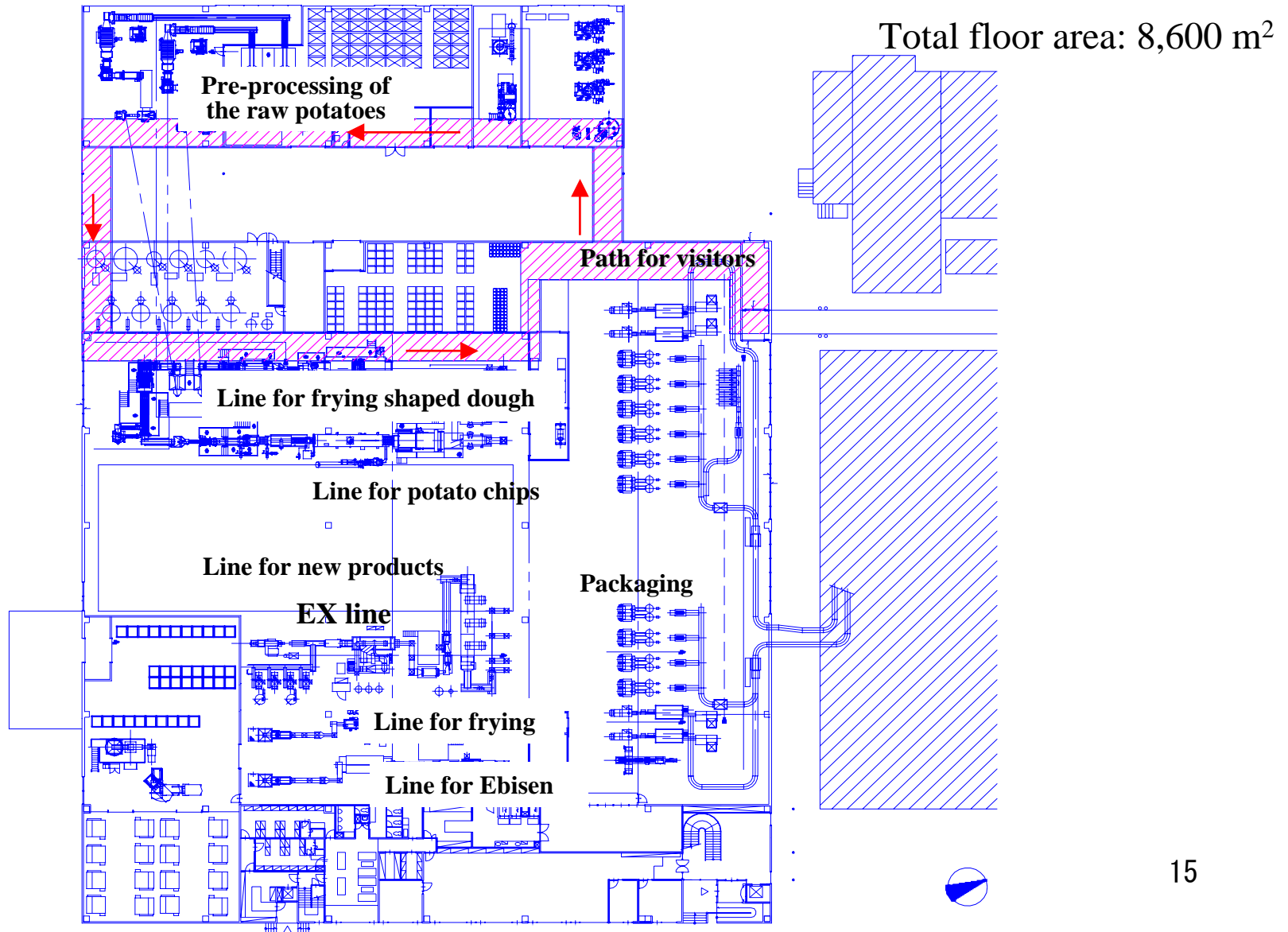
"A 21st-Century-Type Plant Open for
the Local Community and the Customers"
(Achievement of Four "S")

- ① A plant of market-in type (CS)
 - A plant with thorough hygiene control and zero environmental pollution (GS, ES)
- ③ A plant of quality assurance for all the products (CS)
- ④ A plant comfortable and safe to work and lead by the working site (ES)
- ⑤ A plant realizing low-cost operation (SS, GS)

The Items We Would Like to Realize in the New Plant

1. Work-place environment comfortable to work
2. Technical reform
3. Production of small lots of a variety of products
4. Clean energy
5. A plant that can be shown
6. Expansion of business

Layout of the Plant



Production of small lots of a variety of products

- Production of small lots of a variety of products in the seasoning process



Air Conditioning System

A Class II Air Conditioning System

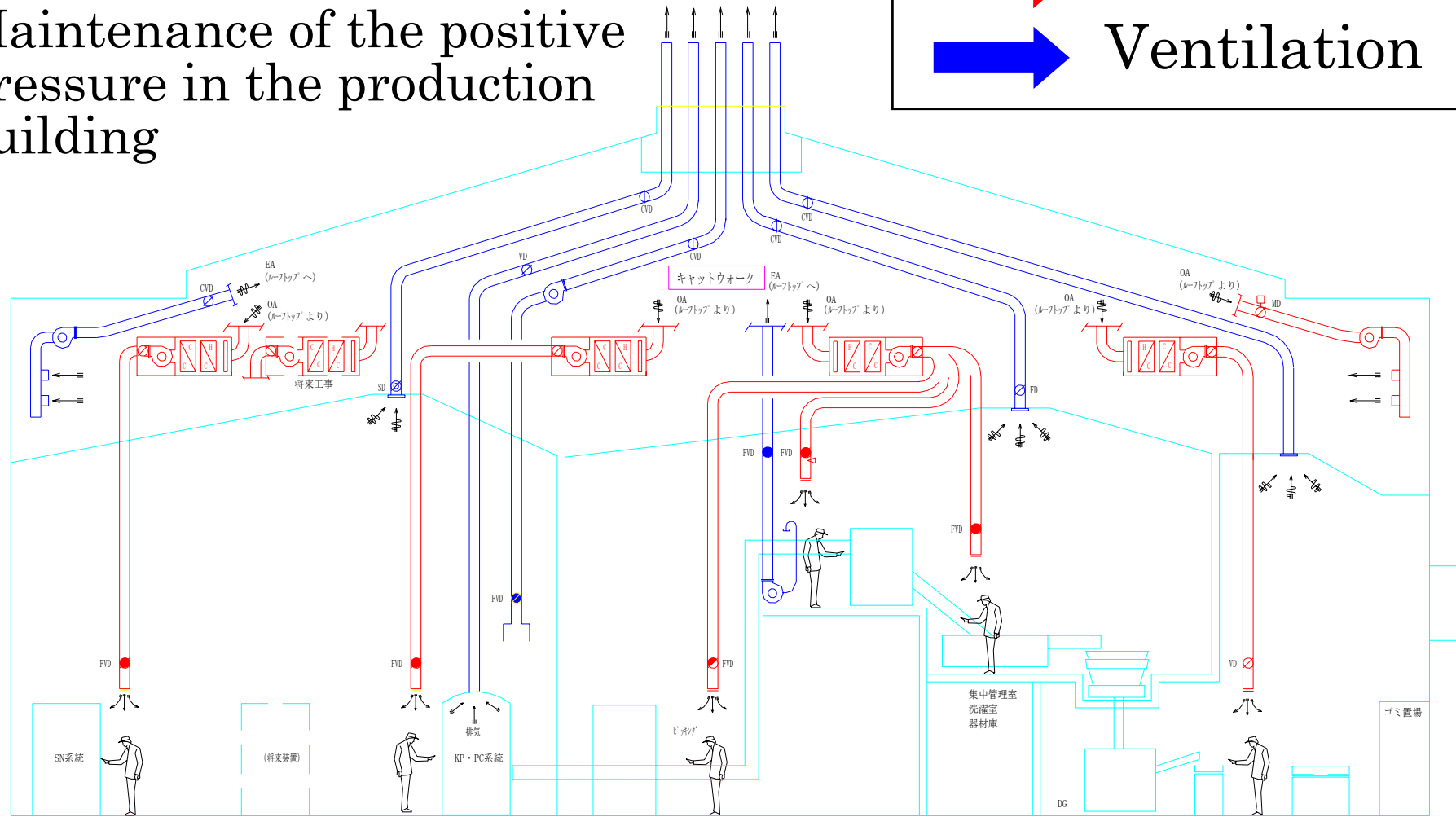
Maintenance of the positive pressure in the production building



Air Supply



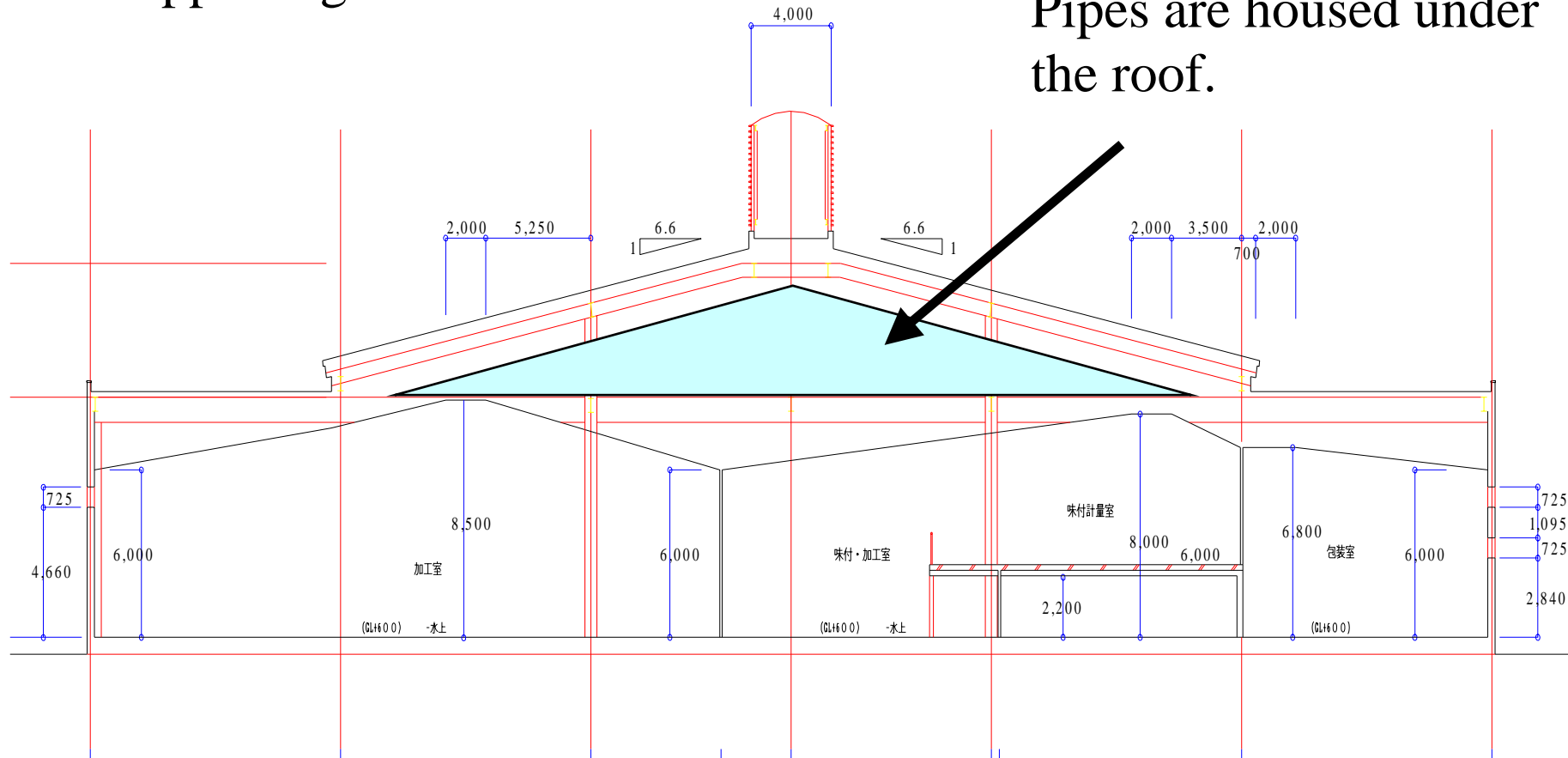
Ventilation



Securing of Space for Piping

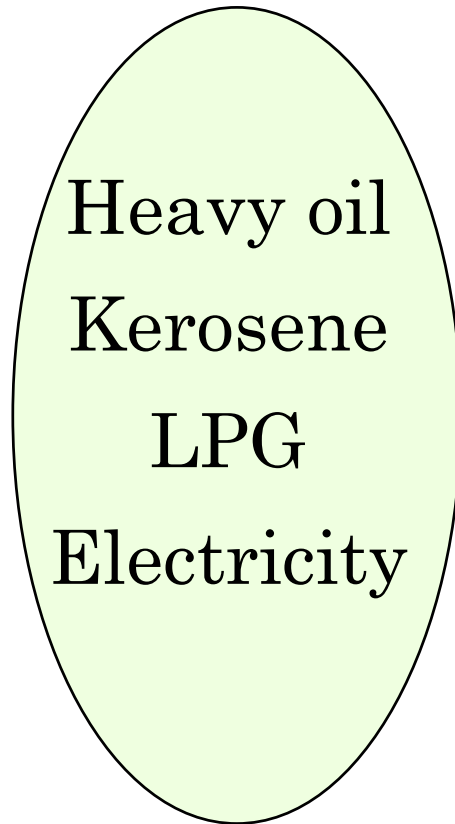
Supporting HACCP

Pipes are housed under the roof.

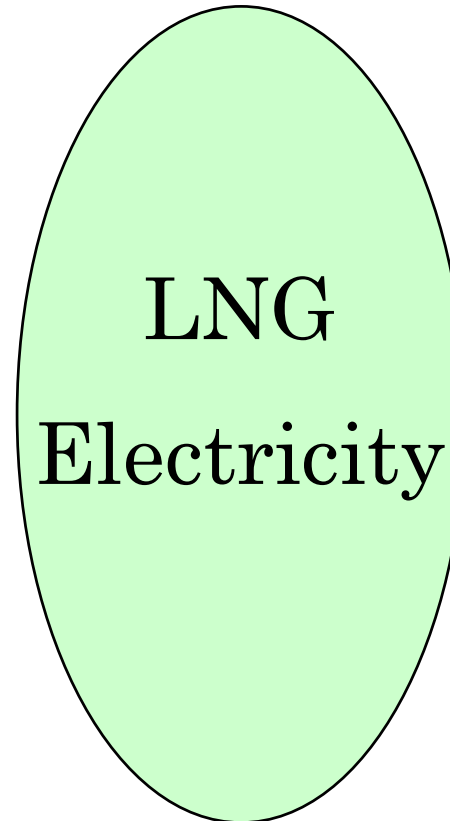


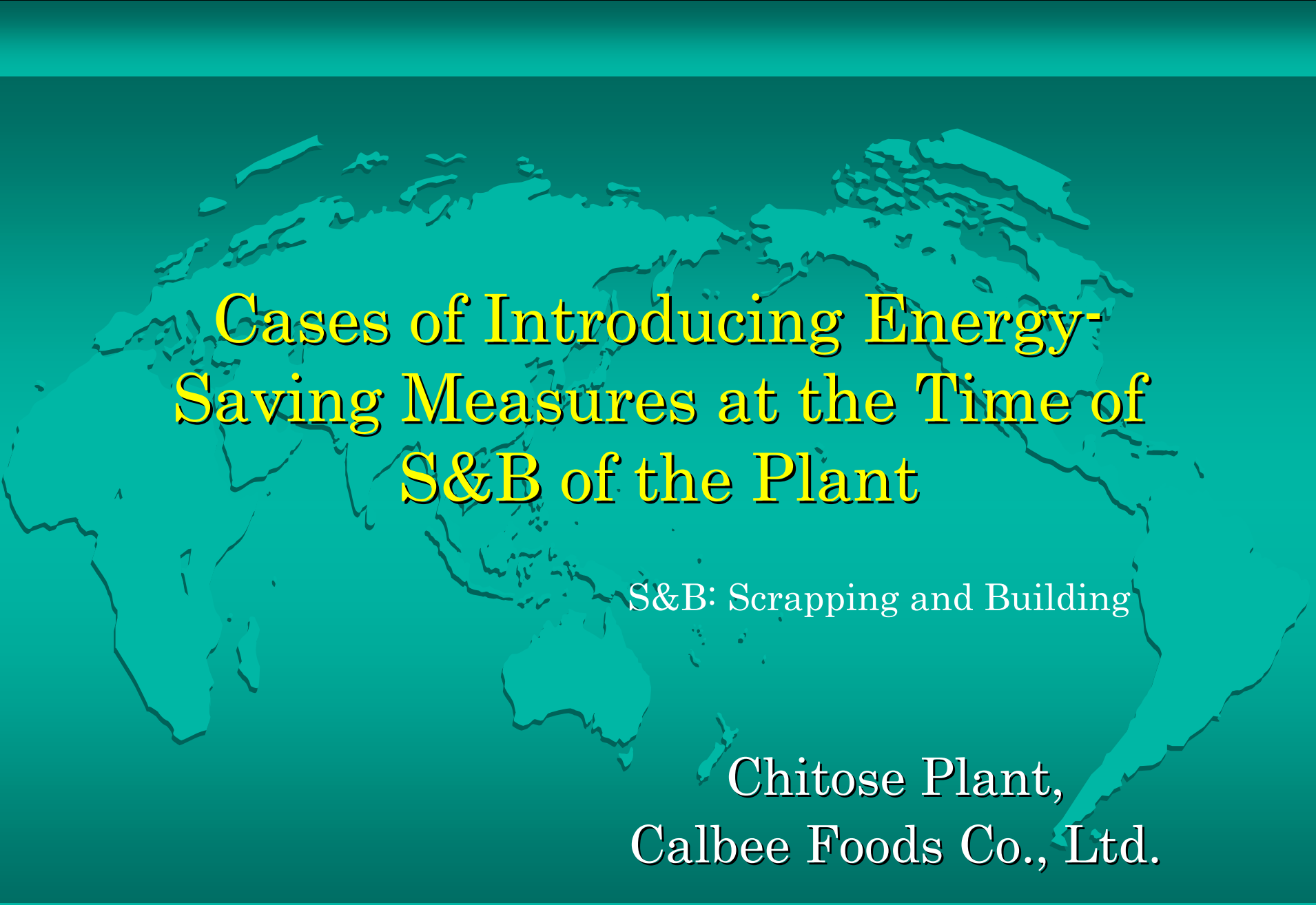
Clean Energy

Old Plant



New Plant





Cases of Introducing Energy-Saving Measures at the Time of S&B of the Plant

S&B: Scrapping and Building

Chitose Plant,
Calbee Foods Co., Ltd.

Shift of Energy at Chitose Plant

Old Plant
2000

New Plant
2002

Heavy Oil: 907,303 L/year

City Gas: 121,816.5 m³/year

Kerosene: 1,067,300 L/year

Kerosene: 42,810 L/year

LPG: 413,288 kg/year

Shifted partially to electricity

Total Amount Converted into Petroleum: 2,478 kL/year

1,488 kL/year

Electricity Consumption: 3,919 Mw/year

3,891 Mw/year

Weight Produced: 6,200 t/year

3,820 t/year

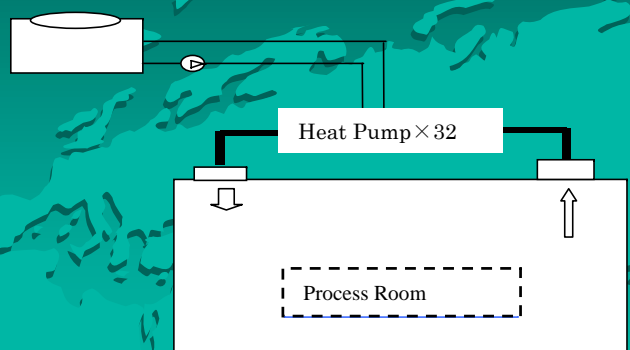
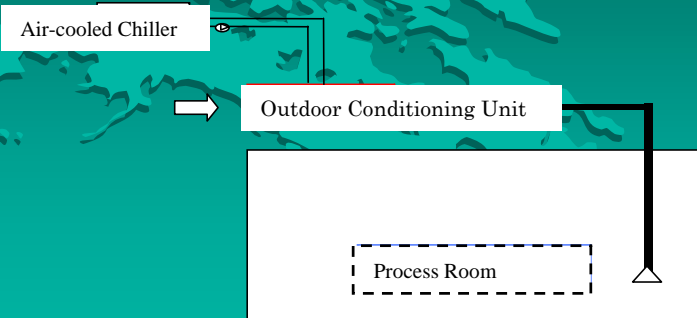
Items Introduced as Energy-Saving Measures

Item	Overview
Electric Equipment	Automatic power factor adjustment of phase-advancing capacitors
Lighting Equipment	General: 40 w → 32 w Plant: 200 V
Air Conditioning Equipment	Reviewing of the air conditioning during night for the air conditioning system using well water for cooling
Power	Installation of inverters
Boiler	Collection of drained steam
Utilization of Wasted Heat	

Comparison of Costs between the Initial Idea and the Reviewed Idea of the Air Conditioning System

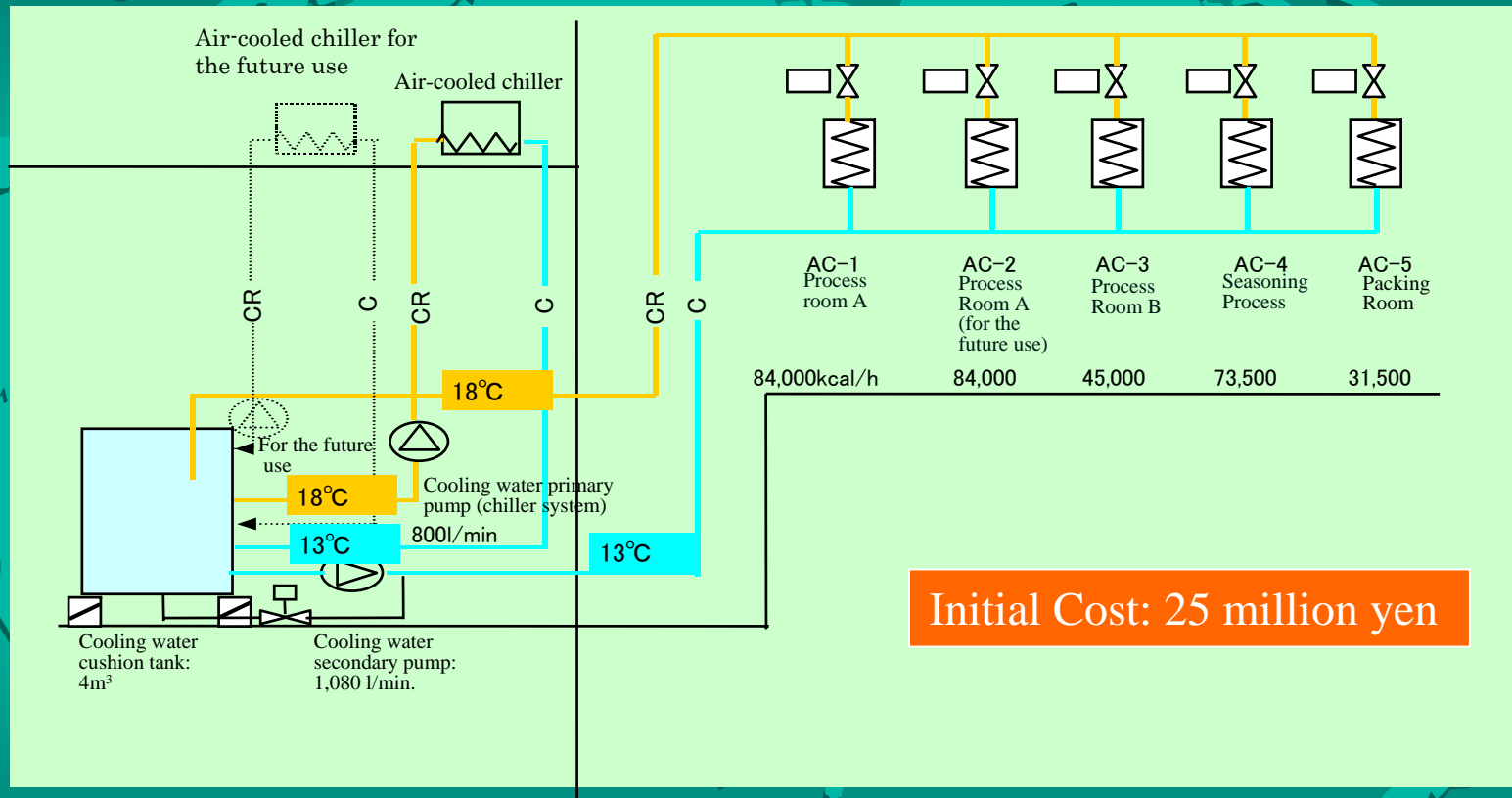
Initial Idea for Design		Reviewed Idea after Consideration	
<ul style="list-style-type: none"> • Cooking Tower • Heat Source Water Pump • Water Heat Source Heat Pump • Water Heat Source Heat Pump Total: 	<p>23.9 kw</p> <p>22 kw</p> <p>17.8 kw × 22 units</p> <p>4.35 kw × 10 units</p> <p>481 kw</p>	<ul style="list-style-type: none"> ① Well Water Equipment <ul style="list-style-type: none"> • Plate heat exchanger (water-water) • Well water primary pump • Well water secondary pump ② Cooling Equipment <ul style="list-style-type: none"> • Air-cooled chiller • Cooling water primary pump • Cooling water primary pump • Cooling water primary pump ③ Outdoor conditioning unit <ul style="list-style-type: none"> • Process Room A • Process Room B • Seasoning Process Room • Packing Room 	<p>187,500 kcal/h (12°C/17°C)</p> <p>2.2 kw</p> <p>2.2 kw</p> <p>30 kw</p> <p>2.2 kw</p> <p>5.5 kw</p> <p>5.5 kw</p> <p>18.5 kw</p> <p>7.5 kw</p> <p>15 kw</p> <p>7.5 kw</p> <p>Total: 90.6 kw</p>
Electric Capacity: Rated Capacity	4,811 kw	Total Electric Capacity: Rated Capacity	90.6 kw
Electricity Consumption:	3.5 months × 25 days/month × 12 hours/day × 481 kw = 505,050 kwh	Electricity Consumption:	3.5 months × 25 days/month × 12 hours/day × 90.6 kw = 95,130 kwh
Electricity Charge:	When 14 yen/kwh, 505,050 kwh × 14 yen/h = 7,070,700 yen/season	Electricity Charge:	When 14 yen/kwh, 95,130 kwh × 14 yen/h = 1,331,820 yen/season
A cost of about 5,7 million yen could be reduced by limiting the area to be air-conditioned.			

Review on the Air Conditioning System 1

Initial Idea for Design		Reviewed Idea after Consideration	
Working area (process rooms, seasoning process rooms and packing rooms) are air-conditioned by water heat source heat pumps.		Spot-air-conditioning is carried out by outdoor conditioning unit with chillers using well water + air cooling as the heat sources	
Whole the room is air-conditioned.		Only the spots where workers work are air-conditioned.	
			
· Cooking Tower	23.9 kw	① Well Water Equipment · Plate heat exchanger (water-water)	187,500 kcal/h (12°C/17°C)
· Heat Source Water Pump	22 kw	· Well water primary pump	2.2 kw
· Water Heat Source Heat Pump	17.8 kw × 22 units	· Well water secondary pump	2.2 kw
· Water Heat Source Heat Pump	4.35 kw × 10 units	② Cooling Equipment · Air-cooled chiller	30 kw
Total:	481 kw	· Cooling water primary pump	2.2 kw
		· Cooling water primary pump	5.5 kw
		· Cooling water primary pump	5.5 kw
		③ Outdoor conditioning unit · Process Room A	18.5 kw
		· Process Room B	7.5 kw
		· Seasoning Process Room	15 kw
		· Packing Room	7.5 kw
Electric Capacity: Rated Capacity	4,811 kw	Total Electric Capacity: Rated Capacity	90.6 kw
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A cost of about 5,7 million yen can be saved by limiting the area to be air-conditioned.			

Overview of the Introduced Air-conditioning System 1

Unit of the Type of Air-cooled Chilling



Air-cooled chiller: Model 120RT, 288,000 kcal/h (18°C/13°C)

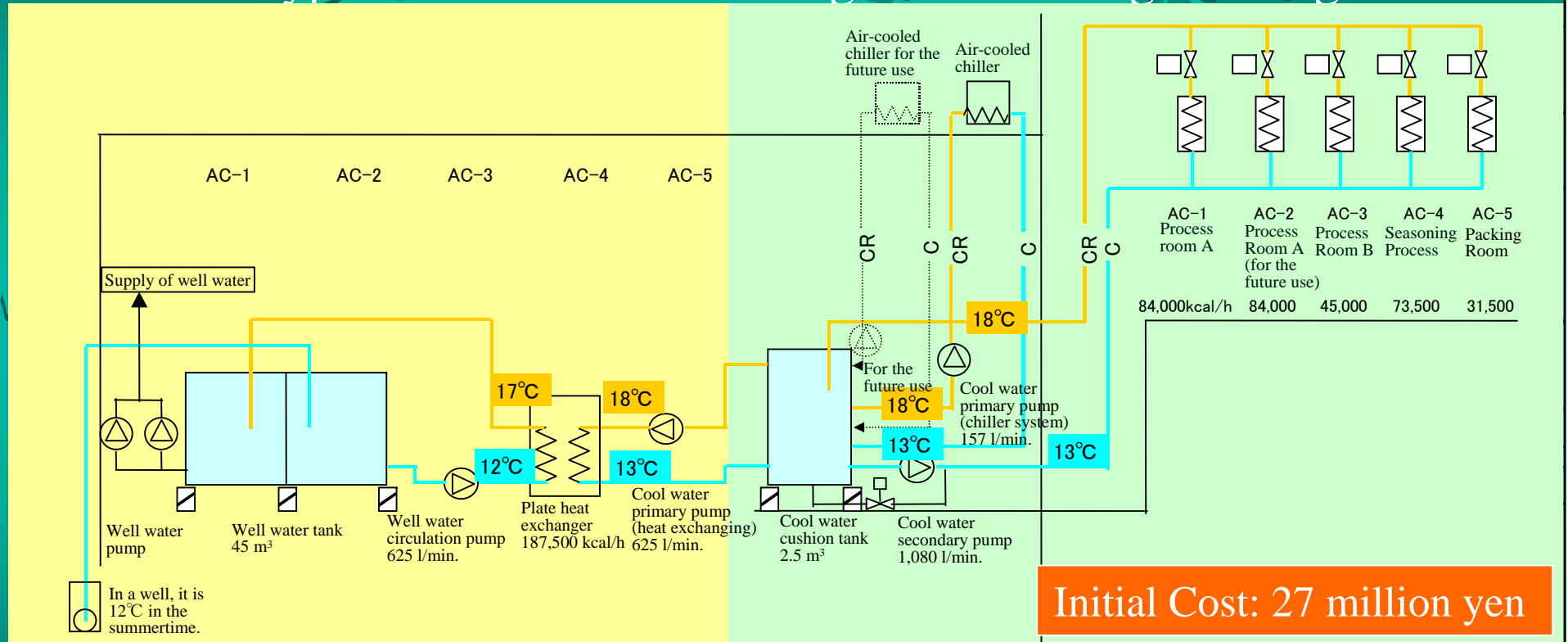
90 kw

Cooling water primary pump: 304 l/min × 5.5 kw

Cooling water primary pump: 1,060 l/min × 5.5 kw

•Overview of the Introduced Air-conditioning System 2 (Energy-Saving by Using the Heat of Well Water)

Unit of the Type of Well-Water Cooling + Air-cooling Chilling



① Equipment for Well Water
 Plate heat exchanger (water-water) 187,500 kcal/h
 Well water primary pump 625 l/min. × 2.2 kw (12°C/17°C)
 Well water secondary pump 625 l/min. × 2.2 kw

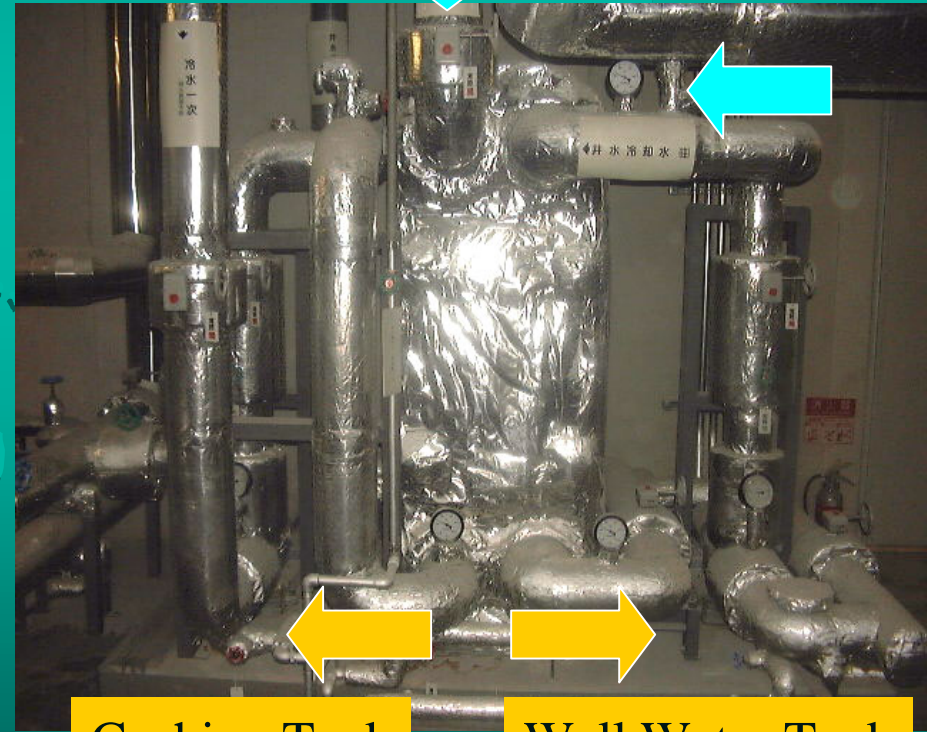
② Cooling Equipment
 Air-cooled chiller Model 40 RT 91,160 kcal/h 30 kw
 Cool water primary pump 304 l/min. × 2.2 kw (12°C/17°C)
 Cool water primary pump 1,060 l/min. × 5.5 kw

Overview of the Introduced Air-conditioning System 3 (Energy-Saving by Using the Heat of Well Water)

Plate Heat Exchanger

Cushion Tank

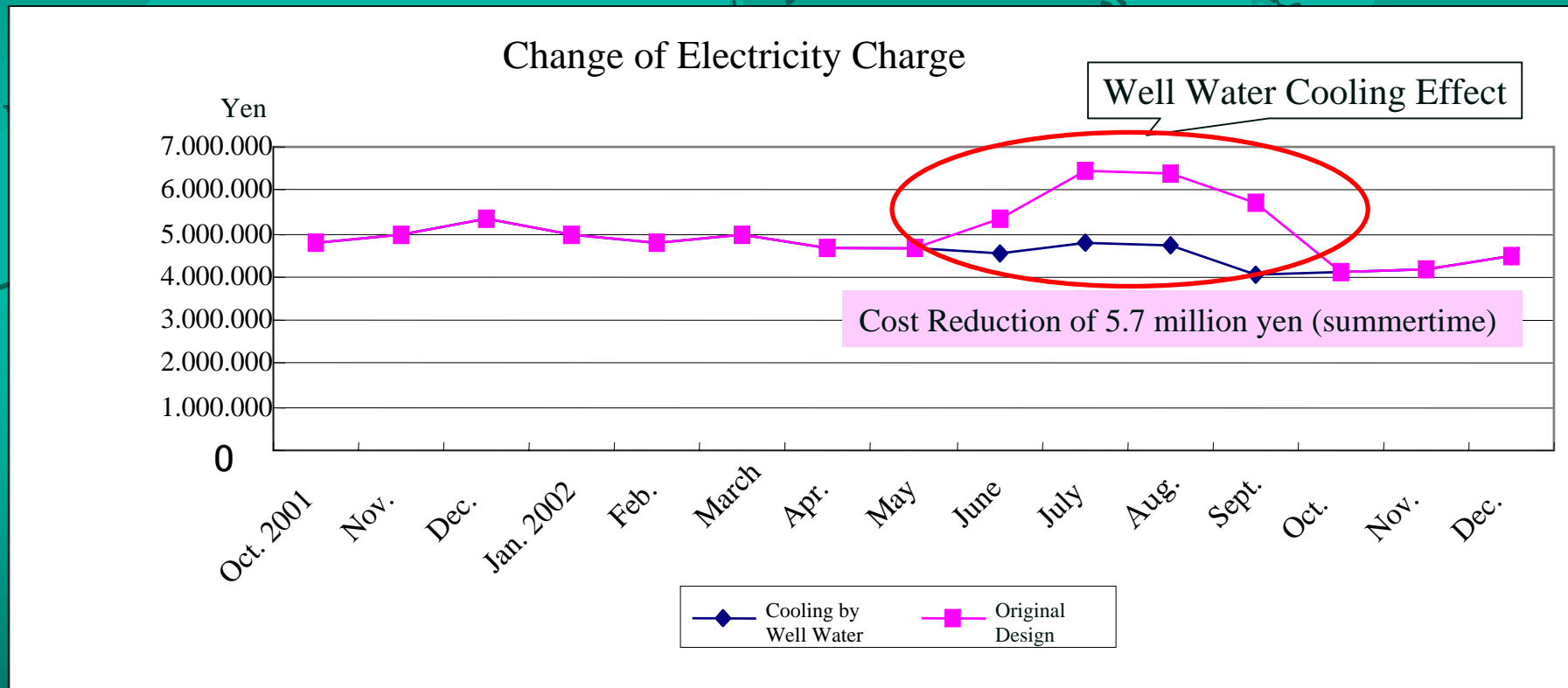
Well Water Tank



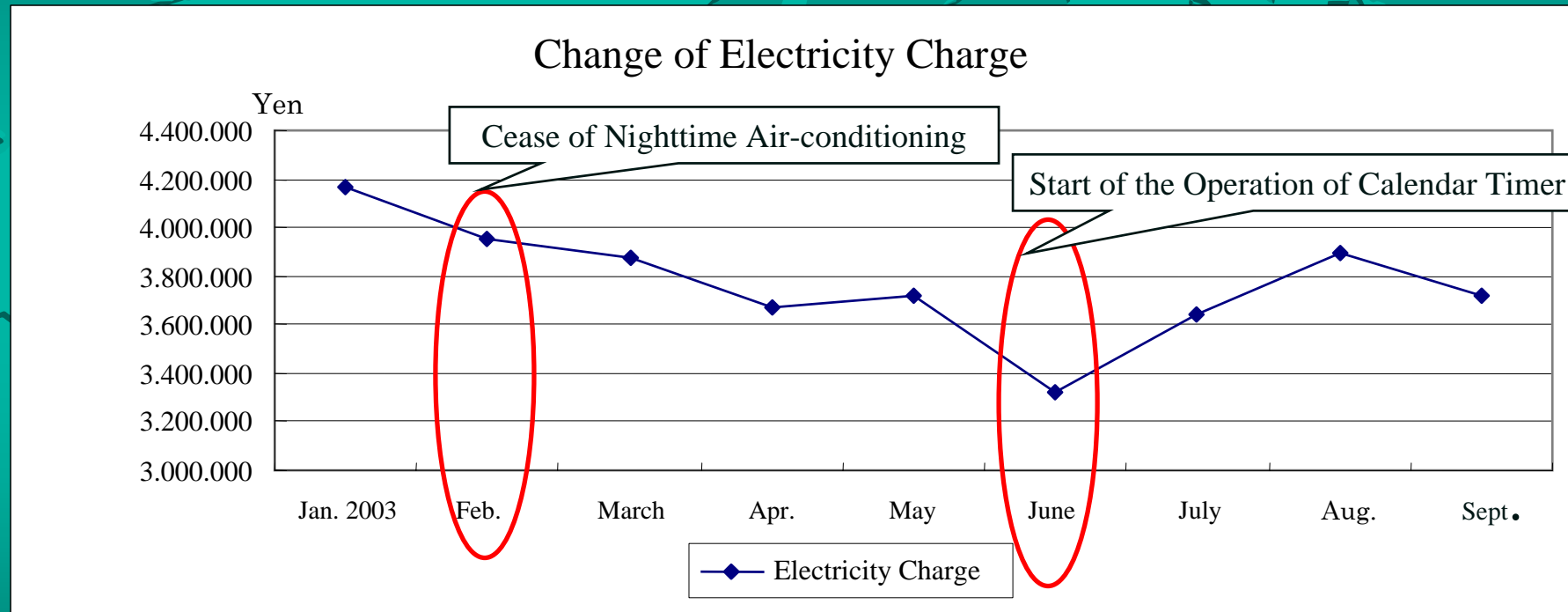
Cushion Tank

Well Water Tank

Effect Of the Introduction of Cooling by Well Water



Effect of Implementation of the Measures after Starting Operation



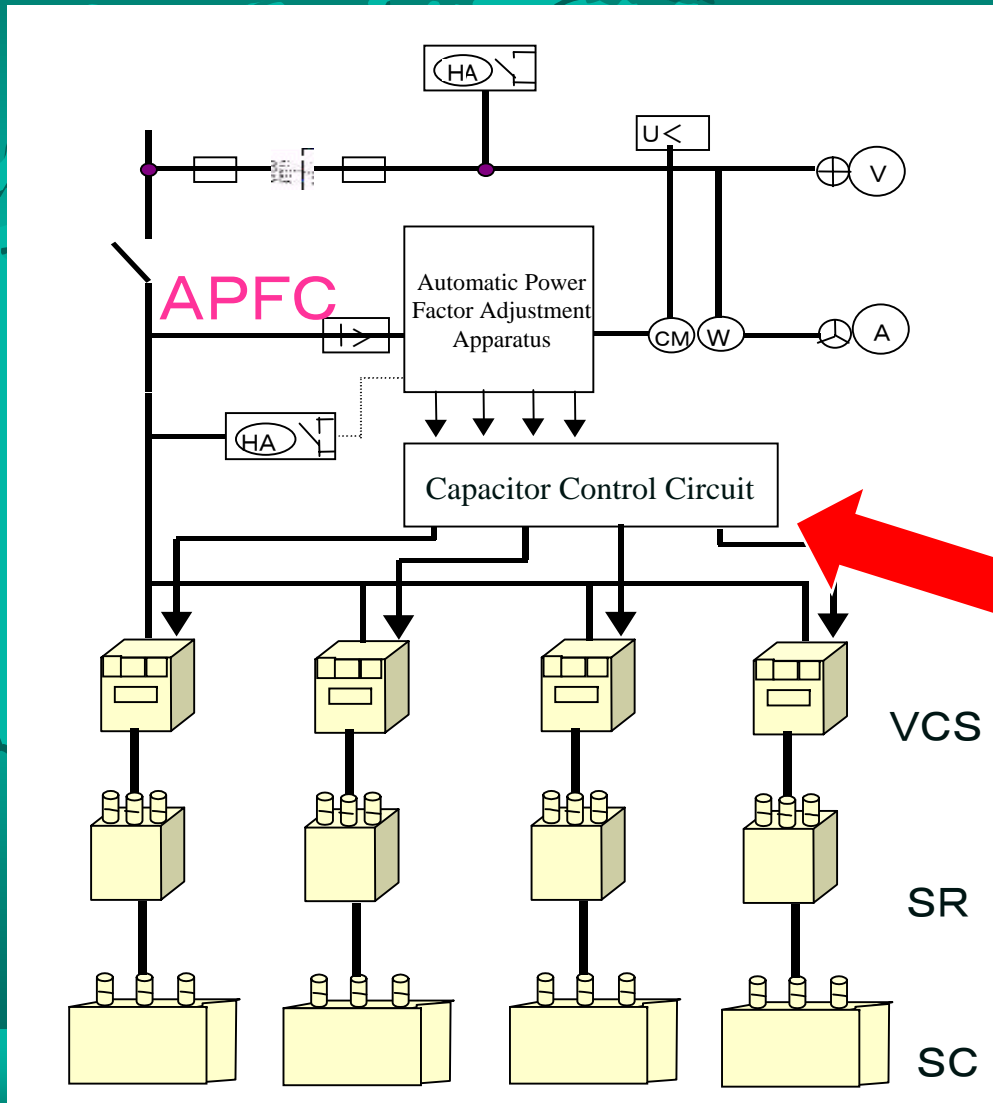
Measures for Introduction of Equipment for Receiving and Transforming the Electric Power

- Automatic power factor adjustment of phase-advancing capacitors

Improvement of the power factor by automatic power factor adjustment of phase-advancing capacitors



Overview of Automatic Power Factor Adjustment of Phase-Advancing Capacitors



- AC Voltage Meter
- AC Ampere Meter
- Watt Meter
- Power Factor Meter
- Over-current Relay
- Under-voltage Relay
- Automatic Power Factor Adjuster
- Adjuster
- Over-current Meter Relay

ON and OFF of phase-advancing capacitors are controlled in response to the load

Effect by the Introduction of Phase-Advancing Capacitors

Reduction of power loss and increase of equipment capacity are facilitated by improving the power factor.

At the same time, decrease of the minimum charge by the power-factor discount is also facilitated.

The electricity charge calculated with the decrease of the minimum charge by the power factor discount is calculated by the following equation.

Electricity Charge = [minimum charge] + [charge for power]

The Minimum Charge = (Contracted Amount of Power \times unit charge [yen]/kWh) \times 1 - (Power Factor % - 85)/1

Charge for Power = (Amount of Power Consumed \times Unit Charge/kWh)

Amount of Power Contracted: 1,000 kw

Unit Charge [yen]: 1,870 yen/kwh

Power Factor: 90% \rightarrow 99%

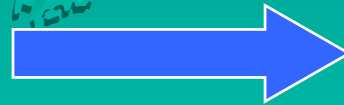
Before the Improvement: 1,777,000 yen/month

After the Improvement: 1,627,000 yen/month

Cost Reduction of 150,000 yen/month.

Energy-Saving Measures Related to Motive Power (Introduction of Inverters)

Old Plant
Inverters 10 units
Motive Power Load Total 75 kw



New Plant
Inverters 110 units
Motive Power Load Total 750 kw

Rated Frequency: 50 Hz

Inverters in the New Plant: Driving at 40 Hz in average

$$750 \text{ kw} \times 8.26 \text{ yen/kwh} \times 6 \text{ hours} \times 5 \text{ days} \times 25 \text{ days} = 4,646,000 \text{ yen/month}$$

$$4,646 \text{ yen/month} \times 40/50 = 3,717,000 \text{ yen/month}$$

Cost Reduction of 929,000 yen/month

Tasks Remained for the Future

1. Effective utilization of the wasted heat discharged to the atmosphere from the production equipment
2. Effective utilization of the wasted heat from the boilers
3. Control of combustion in the combustion equipment
4. Collection of drained steam

