June 2003

JICA Energy Conservation Education Center
Training Seminar Notes

An Example of Factory Energy Conservation Efforts

Gunze, Ltd.
Miyazu Factory
Apparel Divisions Group

Introduction

UNFCCC Kyoto Conference

At the Third Conference of the Parties to the UN Framework Convention on Climate Change (COP3) held in December 1997, Japan's target for reduction of greenhouse gas emissions was set to 6% relative to the 1990 level.

Amendment of Energy Conservation Law

To reduce Japan's emissions of carbon dioxide (CO_2), which is the main greenhouse gas, through an overhaul of the country's approach to energy conservation, the Energy Conservation Law was amended (effective from April 1999).

Gunze's Efforts

In 1997, Gunze, Ltd. drew up a set of basic action guidelines for environmental conservation, in an effort to help realize an affluent society that is compatible with a healthy global environment.

Main Goals of Energy Conservation

1. **Reduction of aggregate energy consumption**
2. **Reduction of aggregate CO_2 emission**
3. **Reduction of energy costs**

Energy conservation requires company-wide action. The awareness of all employees, particularly the energy manager, and the accumulation of small improvements and tactics are the keys to successful energy conservation activities.

Overview of Miyazu Factory

Historical Background

1912: Establishment of Miyazu Factory. Start of yarn manufacturing operations.
1947: Transition to knitted goods business.
1956: Construction of new integrated plant.
1991: Development of TPM; Good Energy Management Factory Award (Electricity) received
1994: Good Energy Management Factory Award (Electricity) received
1995: Class 1 TPM Excellence Award received
1997: Fiftieth anniversary of transition to knitted goods business
1998: TPM Continuity Award received
2002: Introduction of SCM; Acquired ISO 10004 certification
2003: Introduction of TOC-DBR

Land and buildings

Site area : 49,922 m^2

Total building area : 39,093 m^2

Employees (persons)

Male	Female	Total
97	121	218

Production output

Knitting (kg/day)	Dyeing (kg/day)	Sewing (da/day)	Year (1000 da)
6,200	5,400	3,200	819

Overview of Miyazu Factory

Continuous dyeing machines

Main production facilities

Process	Facilities	No. of units
Knitting	Circular knitting machines	114 units
	Seamless knitting machines	12 units
Dyeing	Bleaching equipment; Continuous	1 line
	Batch (clarify)	6 units
	Dyeing machines	34 units
	Drying machines	2 units
	Fabric finishing machines	3 units
Sewing	Automatic cutting machines	7 units
	Sewing machines	130 units
	Setting machines	3 units

Utility facilities

Boiler facilities

Data for fiscal 2002

Capacity	No. of units	Fuel oil consumption
2 t/h	7	Production: 1587 kl/year
		Housekeeping: 55 kl/year

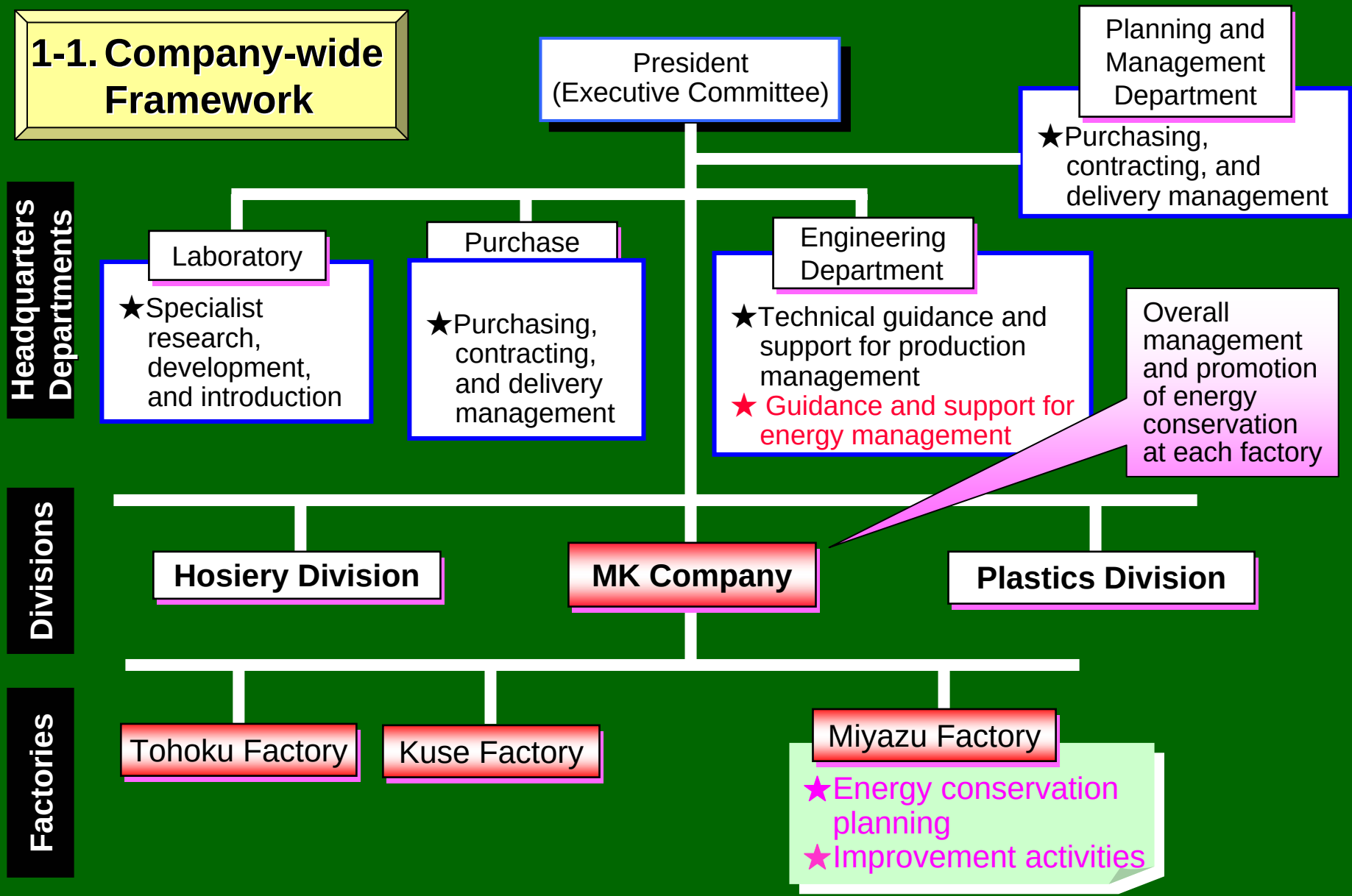
Electrical facilities

Data for fiscal 2000

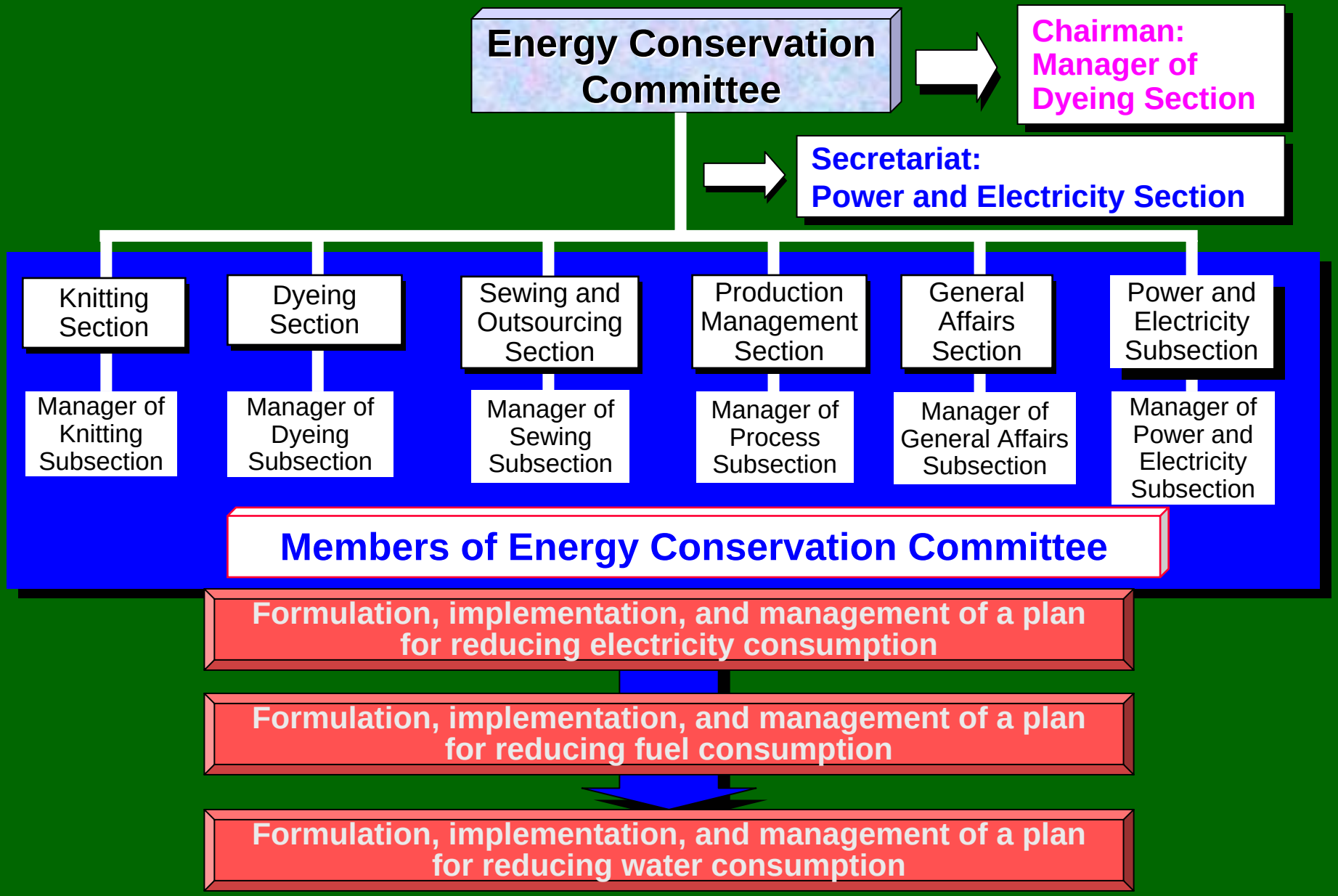
Receiving voltage	Contract demand	Electricity consumption
30 kV	1270 kW	Production: 4534 Mwh/year
6 kV	46 kW	Production: 71 Mwh/year

1. Energy Conservation Organization and Management

1-1. Company-wide Framework



1-2. Framework at Miyazu Factory



2. Energy Conservation Techniques

2-1. Ways to Promote Rationalization of Energy Use

1. Active leadership by management, participation by all employees

1) Management should lead by example to demonstrate its determination
2) Make utmost efforts to motivate employees
3) Conduct activities in organized manner

2. Ascertaining actual energy use

1) Heat energy measurement
2) Electrical energy measurement

3. Setting energy conservation goals

Set clear numerical targets and timelines

Next

2. Energy Conservation Techniques

4. Identifying and examining potential improvements, and proposing improvements

POINT

Potential improvements → Start with those that promise large energy savings and are easy to implement.

1) Consider effects on subsequent work steps, product quality, and yield.
2) Check effects on work environment, practicality, and safety
3) Check environmental impact.

5. Implementing improvement proposals

1) Plan: Specify objectives and methods
2) Do: Educate/train employees and implement the proposal
3) Check: Examine and check the results of implementation
4) Act: If the goals have been achieved, prepare a standard work procedure

6. Assessing results of energy conservation activities

1) Use degree of reduction in energy consumption rate per unit production as assessment criterion
2) Verify expected results and assess economic effects
   → Base assessment on time needed to recoup capital investment (target is usually 3~5 years)

2-2. Steps in Rationalizing Energy Use

STEP 1: Improve energy usage methods and strengthen work management

"Brainstorming" analysis, by all employees, of energy generation and consumption in each department

→ **Improved employee awareness of energy conservation**

Examples: Switching off unnecessary lights and shifting peak loads to off-peak periods

STEP 2: Modification of facilities (small-scale investment)

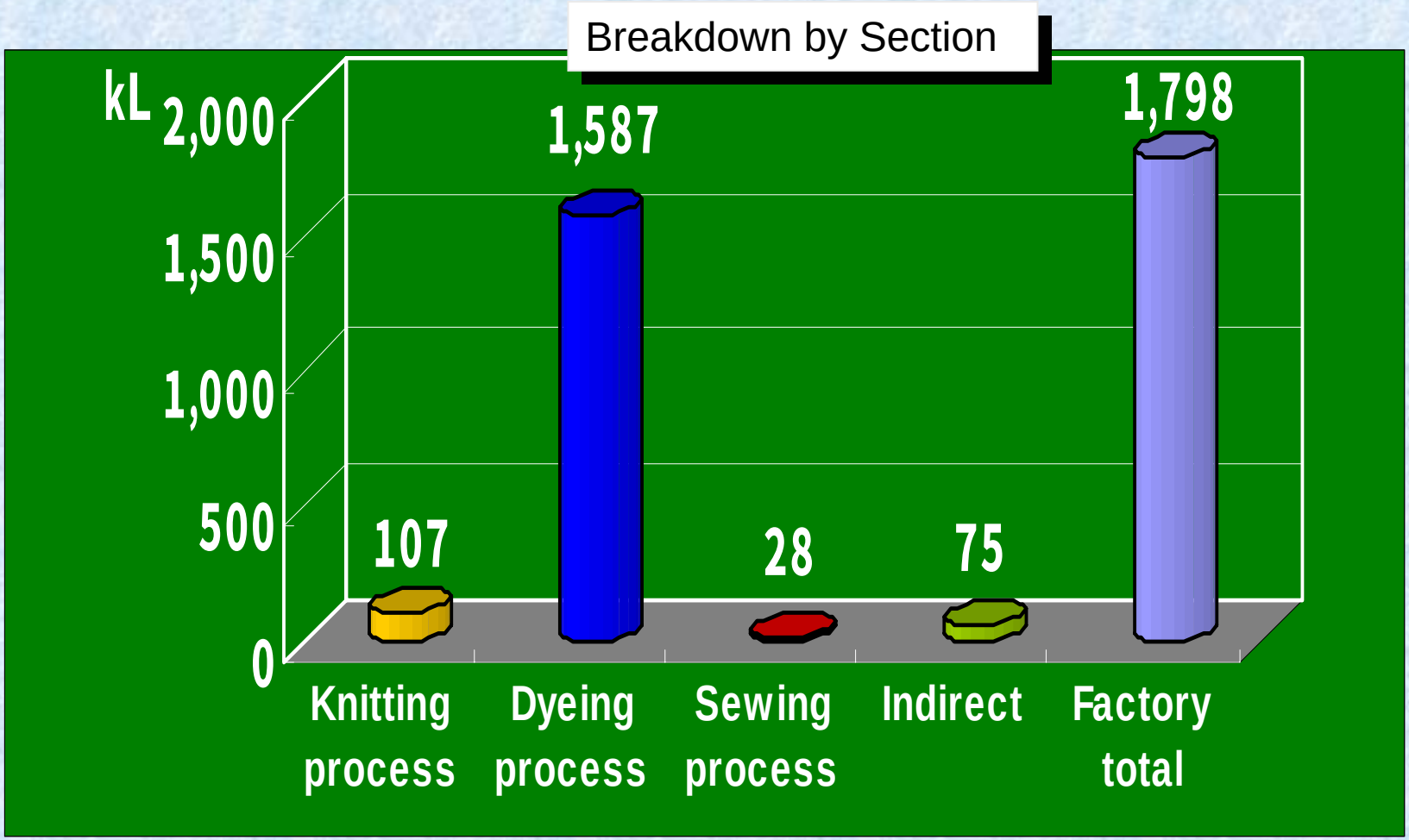
Automation, switching to high-efficiency lamps, installation of waste heat recovery devices, etc.

STEP 3: Upgrading of processes and systems to latest facilities; Transformation of manufacturing processes (development + investment)

3-1. State of Energy Use at Miyazu Factory

Fuel oil consumption

FY 2002



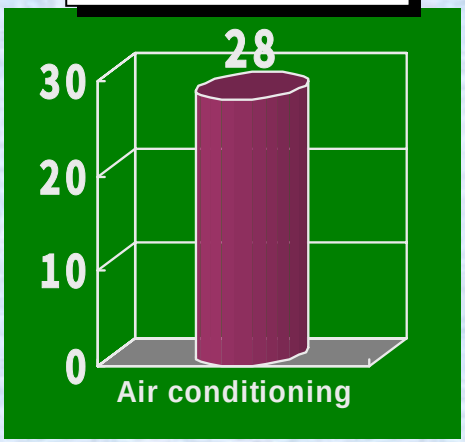
3-2. State of Energy Use at Miyazu Factory

Fuel oil consumption

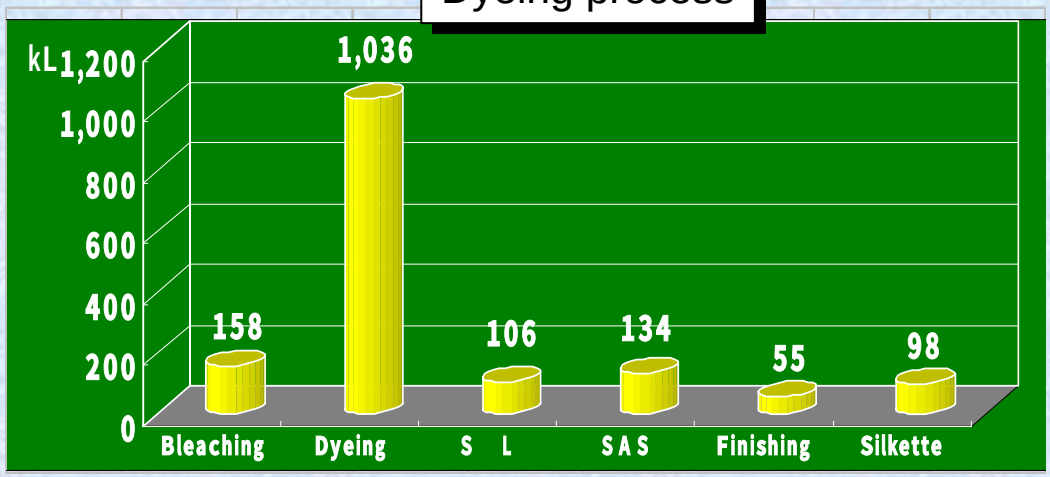
Breakdown by Purpose

FY 2002

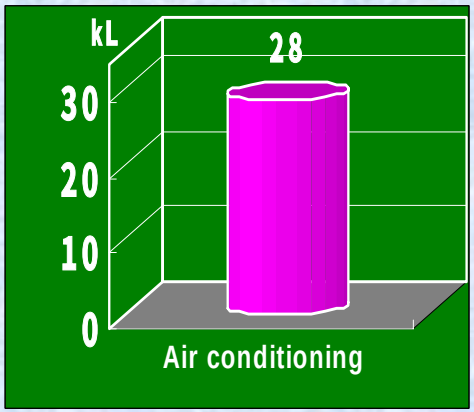
Knitting process



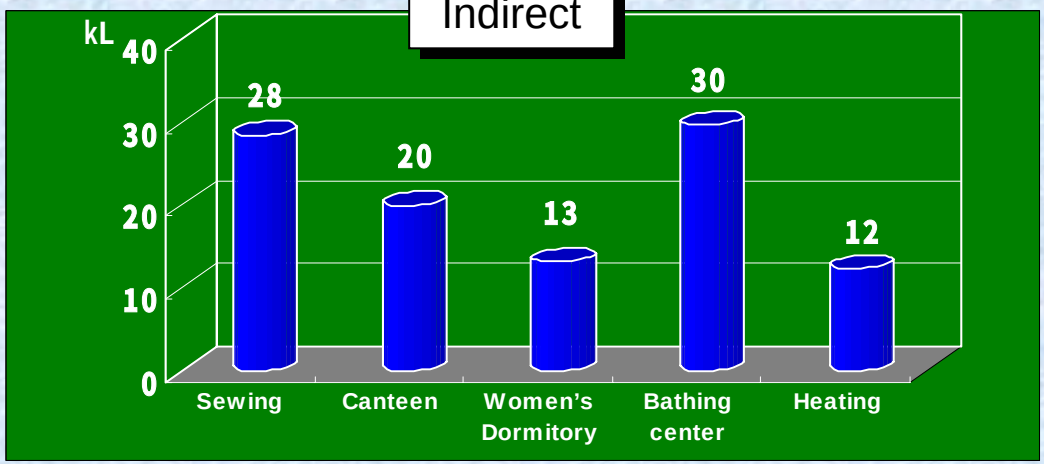
Dyeing process



Sewing process



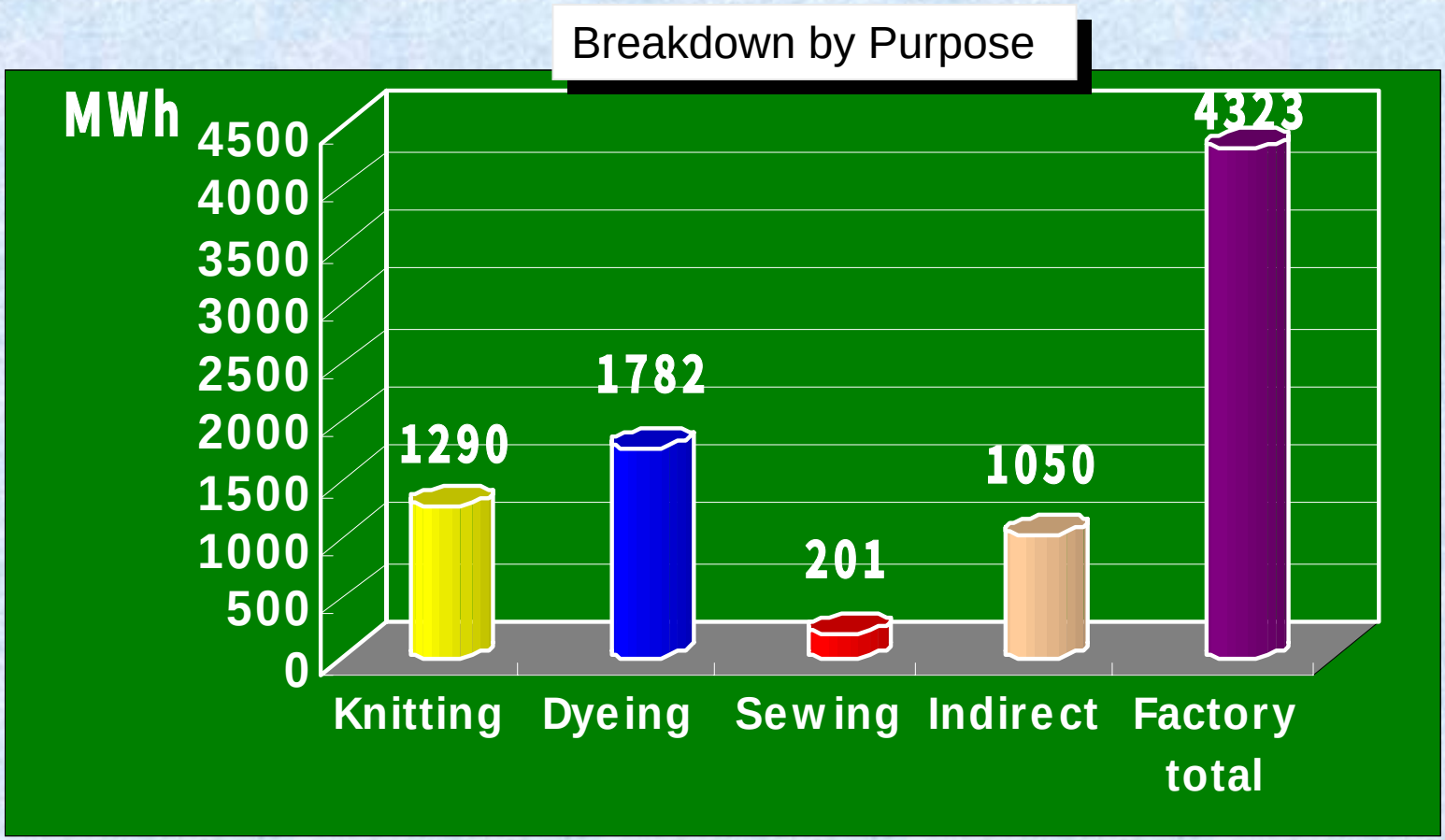
Indirect



3-3. State of Energy Use at Miyazu Factory

Electricity consumption

FY 2002



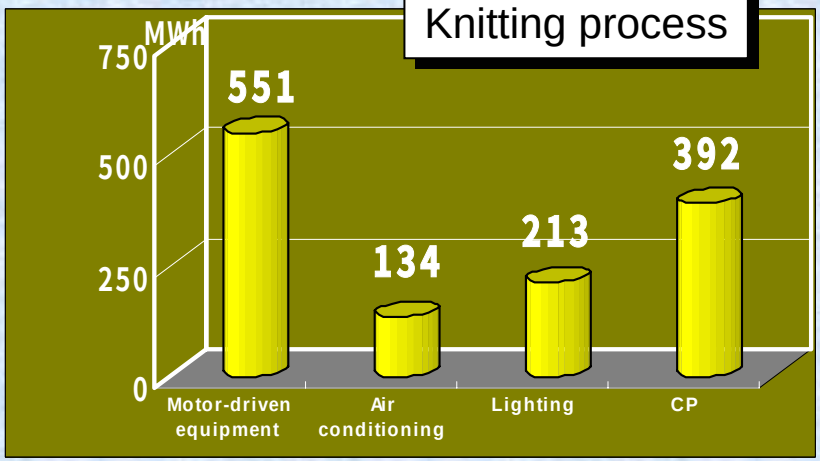
3-4. State of Energy Use at Miyazu Factory

Electricity consumption

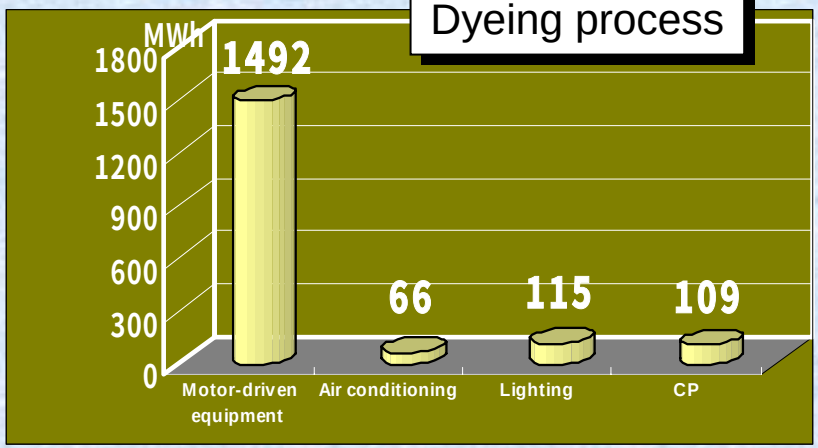
Breakdown by Purpose

FY 2002

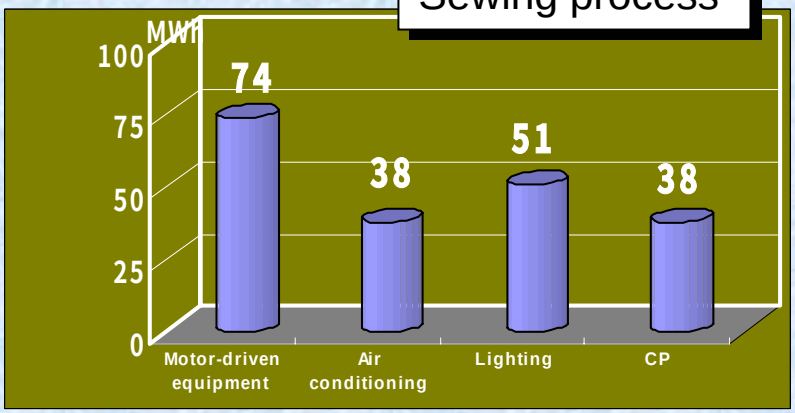
Knitting process



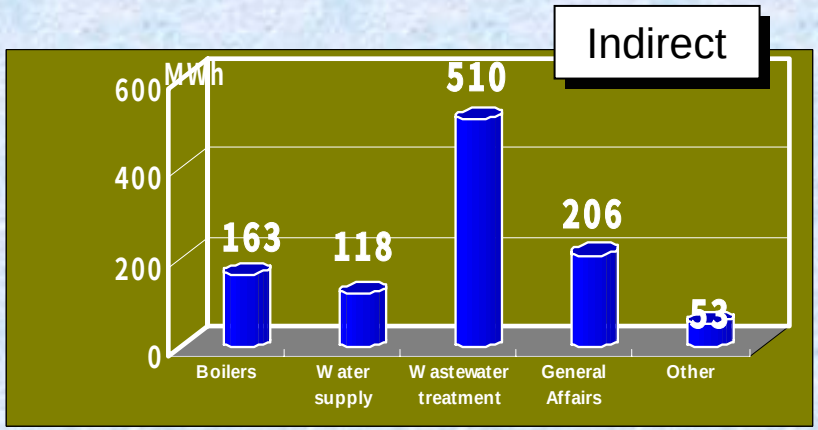
Dyeing process



Sewing process



Indirect



4-1. Areas of Attention in Energy Conservation

Heat consuming facilities 1

	Area of attention	Actual improvement
Waste heat reduction	Waste heat from boilers Waste heat from heat consuming equipment Waste heat from steam traps	◆Development of automatic boiler control (ABC) techniques ◆Humidity-based control of dryers ◆Reduction of exhaust steam/air from heat consuming equipment ◆Selection of optimal traps for heat consuming equipment
Reduction of heat loss	Heat loss from heat consuming equipment Heat loss from steam pipes Other	◆Strengthening of boiler heat insulation ◆Review of boiler steam supply pressure ◆Strengthening of heat insulation for dryer interior walls ◆Strengthening of heat insulation for all bleaching and dyeing facilities ◆Reduction of steam delivery pressure for each process ◆Strengthening of heat insulation for main steam pipes ◆Heat insulation of warm-water pipes and pumps ◆Heat insulation of fuel oil tanks

4-2. Areas of Attention in Energy Conservation

Heat consuming facilities 2

Area of attention		Actual improvement
Reduction of heat use	Improvement of bath ratios	◆Bath ratio reduction for dyeing machines, fluorescent brightener/softener baths, continuous H_2O_2 baths, etc. (reduction of bath ratios for in-tank treatment) ◆Introduction of jet dyeing machines ◆Introduction of continuous bleaching machines (GSB)
	Introduction of high-efficiency equipment	
Waste heat recovery	Condensate recovery	◆Heat exchange with dyeing process effluent ◆Heat recovery from dryer exhaust ◆Heat exchange with recovered $NaClO_2$ solution ◆Re-use of continuous H_2O_2 bath effluent ◆Re-use of dryer drainage as boiler feed water ◆Re-use of drainage from knitting and sewing process air-conditioner heaters for humidification
Heat source modification	Well water cooling	◆Re-use of CAM waste heat for air conditioning ◆Use of compressor cooling water for humidification ◆Cascading of continuous blow-down heat exchangers ◆Adoption of kerosene boiler for bathing center ◆Adoption of small-capacity once-through boilers (control based on number in operation)
	Condensate re-use	
	Other	

4-3. Areas of Attention in Energy Conservation

Electrical facilities 1

	Area of attention	Actual improvement
Power receiving and transform-ing facilities	Optimization of transformer capacities Peak demand control Appropriate deployment of shunt capacitors	◆Improvement of transformer load factors through consolidation of low-load circuits ◆Stoppage of non-essential transformers on holidays and at night ◆Computer control of peak demand ◆Reduction of power loss through automatic power factor control
Power distribution facilities	Optimization of distribution voltages Balancing of loads between phases Improvement of power distribution system	◆Improvement of load efficiency by optimizing supply voltages ◆Balancing of loads between phases for single-phase, three-wire system ◆Reduction of distribution power loss by optimizing conductor sizes and installing shunt capacitors
Production facilities	Optimization of equipment capacity Making operations continuous and automatic Process integration	◆Operation of circulation fans at optimum air flows ◆Humidity-based control of exhaust fans ◆Improvement of fabric moisture content ratio ◆Development of GSB bleaching equipment ◆RPM control of pumps in accordance with load ◆Constant-pressure control of pumps ◆Integration of softening and drying processes ◆Integration of fluorescent brightening and H_2O_2 bleaching processes

4-4. Areas of Attention in Energy Conservation

Electrical facilities 2

	Area of attention	Actual improvement
Utility facilities	Optimization of transformer capacities	◆Improvement of transformer load factors through consolidation of low-load circuits ◆Stoppage of non-essential transformers on holidays and at night ◆Computer control of peak demand ◆Reduction of power loss through automatic power factor control ◆Improvement of load efficiency by optimizing supply voltages ◆Balancing of loads between phases for single-phase, three-wire system ◆Reduction of distribution power loss by optimizing conductor sizes and installing shunt capacitors ◆Inverter control of lighting equipment
	Peak demand control	
	Appropriate deployment of shunt capacitors	
	Optimization of distribution voltages	
	Balancing of loads between phases	
	Improvement of power distribution system	
Production facilities	Optimization of equipment capacity	◆Operation of circulation fans at optimum air flows ◆Humidity-based control of exhaust fans ◆Improvement of fabric moisture content ratio ◆Development of GSB bleaching equipment ◆RPM control of pumps in accordance with load ◆Constant-pressure control of pumps ◆Integration of softening and drying processes ◆Integration of fluorescent brightening and H_2O_2 bleaching processes
	Making operations continuous and automatic	
	Process integration	