

## 2005 Prize of the Chairman of ECCJ

# Challenge to Make Energy Loss “Zero” by Using Knowledge and Ideas of Everybody

Toyota Motor Corporation, Motomachi Plant  
Environment Group, Parts Forming Department

**Keywords: Others (Energy loss, total emission, intensity, concept concerning how to promote energy conservation)**

## Outline of Theme

As of the end of the first half period of FY2004, the actual energy use of this division was far more than the targeted upper limit allotted to the division by Motomachi Plant. The situation was so serious that it seemed not only this division but also Motomachi Plant as a whole was not likely to achieve the yearly target, if things went on as it was.

So, in order to achieve the yearly target by every possible means, about 600 division members centering around the division manager were altogether determined to fight for the energy conservation during the second half period of the fiscal year to achieve the zero energy loss.

## Implementation Period of the said Example

October 2004 – June 2005

- |                                       |                               |                   |
|---------------------------------------|-------------------------------|-------------------|
| ● Project Planning Period             | October 2004                  | Total of 1 month  |
| ● Measures Implementation Period      | November 2004 - February 2005 | Total of 4 months |
| ● Measures Effect Verification Period | March 2005 - June 2005        | Total of 4 months |

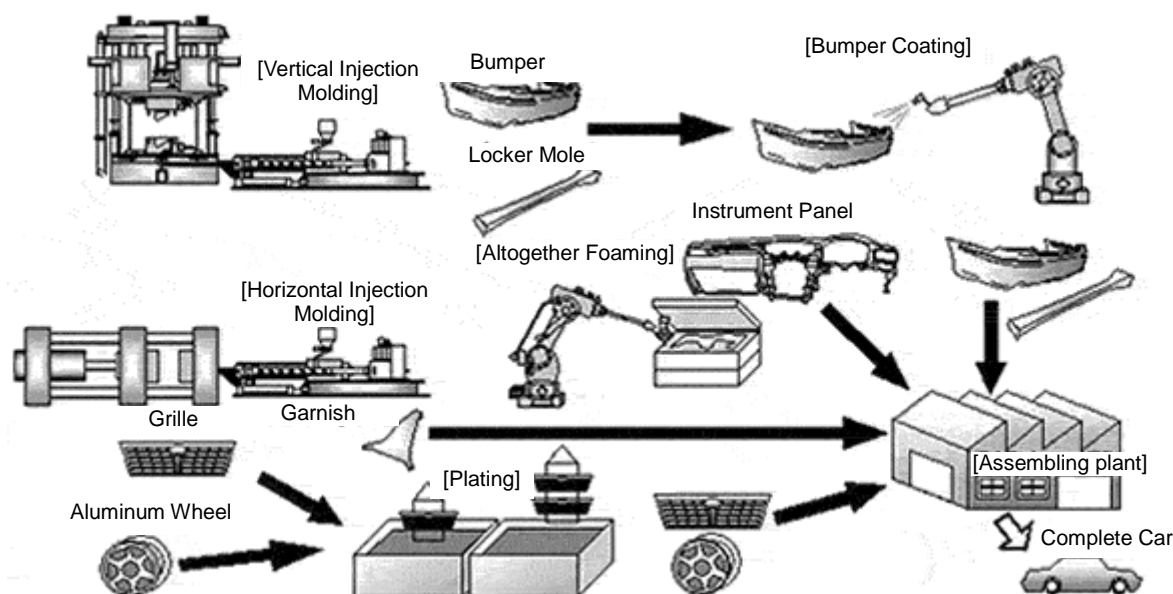
## Outline of the Business Establishment

- Motomachi Plant      Manufacturing of complete cars, including Crown, Mark X, etc.
- No. of Employees:      Approx. 3,000
- This department (Parts Forming Department)

- Items Produced Injection, coating, plating, welding, assembling, etc. for car's interior and exterior parts
- No. of Employees Approx. 600
- Annual Energy Usage Amount (Actual results for fiscal year 2004)
  - Total 29,601 tons (Converted to CO<sub>2</sub>)
- Breakdown
 

Electricity:	42,441 MWh (16,200 tons)
Steam:	43,400 tons (8,984 tons)
LNG:	1,039 Km <sup>3</sup> (2,451 tons)
Air:	43,786 KNm <sup>3</sup> (1,966 tons)

## Overview of Target Facilities



## 1. Reasons for Theme Selection

As of the end of the first half period of FY2004, the total CO<sub>2</sub> emission (hereinafter, called the total emission) of this department of the year was likely to exceed the actual result of the previous year (Fig. 1), not to mention little prospect of achieving the target. As regards the CO<sub>2</sub> emission per production unit (hereinafter, called the intensity), we could not stop it from increasing since FY2002 (Fig. 2), partly because of the reduction of the production.

So, in order to achieve the target by all means in the second half period of the fiscal year, we,

approximately 600 division members centering around the department manager, altogether started to fight for the energy conservation aiming to make the energy loss zero by deploying the knowledge and ideas of everybody.

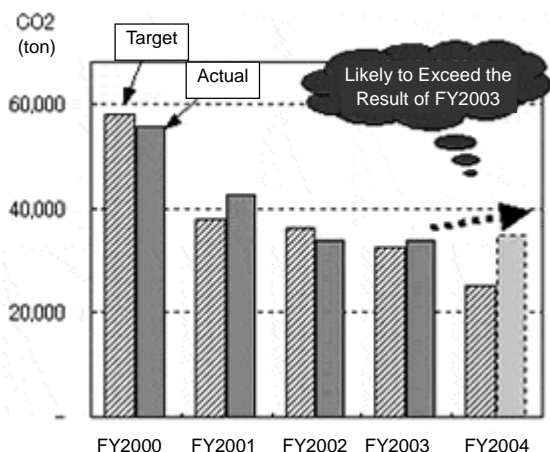


Fig. 1 Total Emission

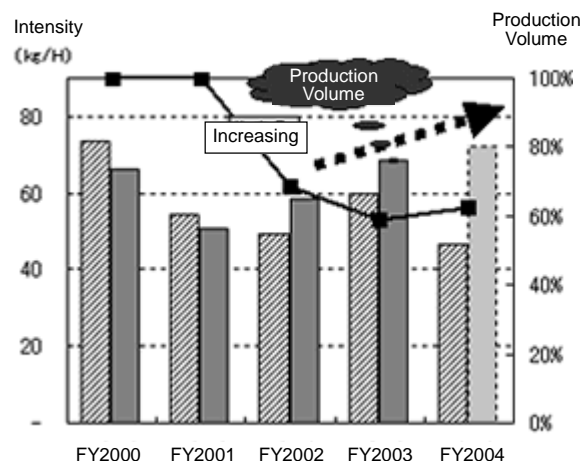


Fig. 2 Intensity

## 2. Understanding of Current Situation and Problems

4 M	Current State	Actual State of Workplace	Problems
People [MAN]	Implemented mainly by managers, section managers and environment staff members.	The actual energy use of critical divisions is not communicated to all employees, so they are not doing energy conservation seriously.	<p>Shortage of energy data by the unit of process and equipment.</p> <p><b>We don't know the energy use amount!</b></p> <p>Unclear energy conservation techniques and measures,</p> <p><b>We don't know how to do it!</b></p>
Equipment (Things) [MACHINE]	All of the equipment are heavy and big.	The equipment and the production conditions cannot be changed so easily because it might affect the product quality. It is not known how much energy is being used.	
Material (Information) [MATERIAL]	Information on actual energy use of each division and section is made available in the next month	Staff members can't know if it is good or bad because the information is about the energy use of the previous month. It is difficult to find out the energy conservation points because the energy use of each process is unknown.	
Method [METHOD]	Energy conservation improvement just for the short-term benefit.	The reason of the improvement is not clear, so it doesn't last long, easily voiding the progress.	

Fig. 3 Clarification of Actual State and Problems of Energy Conservation

### 3. Progress of Activities

#### (1) Target Settings

The targets assigned to each division of Motomachi Plant must be achieved at any cost.

	Parts Forming Department	Motomachi Plant as a Whole
Total Emission	25,083 tons	144,600 tons
Intensity	46.6 Kg/H	

#### (2) Implementation Structure

Under the initiative of the department manager, the section managers, the technical staff members, the energy conservation staff members and the parts forming department members altogether changed the implementation structure to the structure which could create more energy conservation effects.

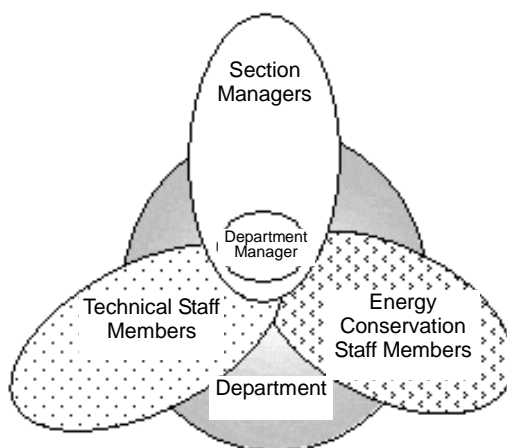


Fig. 4

#### (3) Organization of Energy Conservation Environment

##### 1) Clarification of methods and means of energy conservation

This division had had various processes and equipment mixed (Fig. 5), such as injection, coating, plating, assembling, etc., so it had been difficult to horizontally deploy the improvement for energy conservation. So we clarified a “concept concerning how to promote energy conservation” which we could apply to all sections of the division regardless of the process and equipment they have. And we used it to make the staff members and the group leaders of the workplace understand the activities to make the energy loss zero.

Process	Number of Processes or Equipment
Injection	Injection molders (16 units)
Coating	Bumper coating (process), instrument panel costing, resin coating, electro-deposition coating
Plating	Design plating (2 processes), rust-proof plating (2 processes), functional; plating
Welding	Arc welding (42 cells), vibration molding (2 processes)
Assembling	Bumper, instrument panel, grill, bush press-fitting related work
Drain Treatment	Electro-deposition drain treatment equipment, plating drain treatment equipment

Fig. 5 Outline of This Department's Processes

**[Concept concerning how to promote energy conservation]**

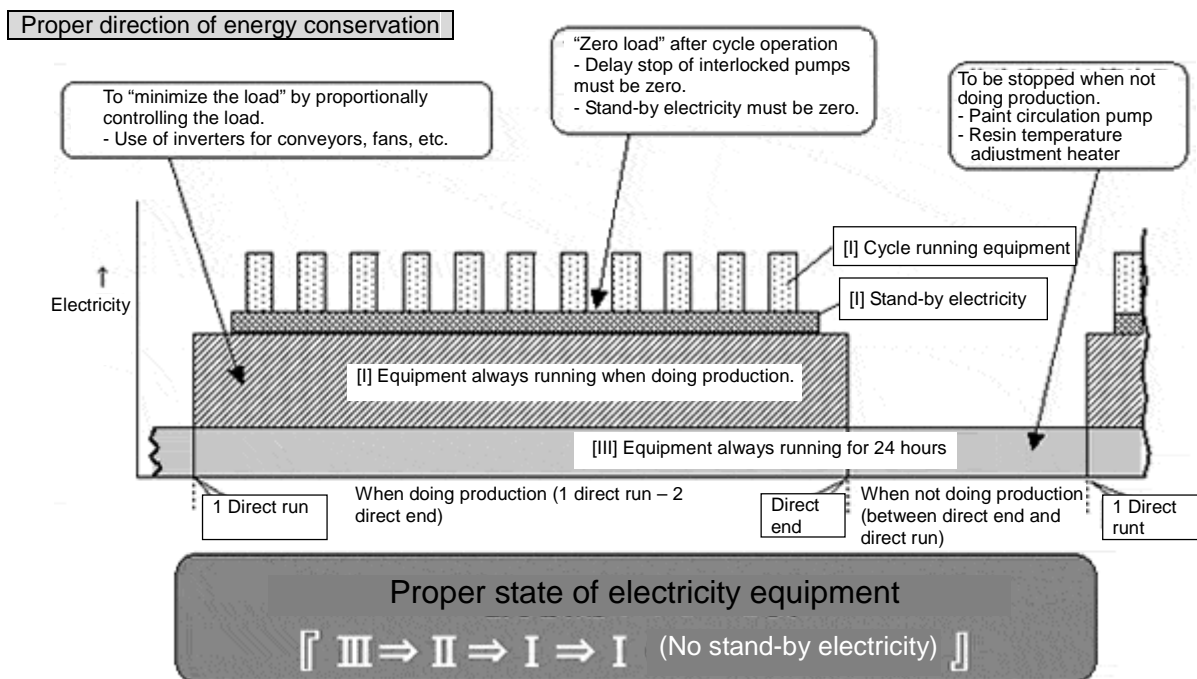
We clarified the energy conservation concept taking the electricity equipment as an example.

**Classification of electricity equipment**

We classified the electricity equipment into 3 groups according to the running system and investigated each group's electricity consumption per hour.

		Classification	Example	Electricity Consumption per Hour [KWH]
Electricity Equipment	I	Cycle running equipment	Robot	$\alpha$
		Stand-by electricity	$\uparrow$	$\delta$
	II	Equipment always running when doing production	Conveyor, fan	$\beta$
III	Equipment always running for 24 hours	Stirring pump	$\gamma$	

The use of the electricity when doing the production and when not doing the production is illustrated below to explain the methods and means of the energy conservation.

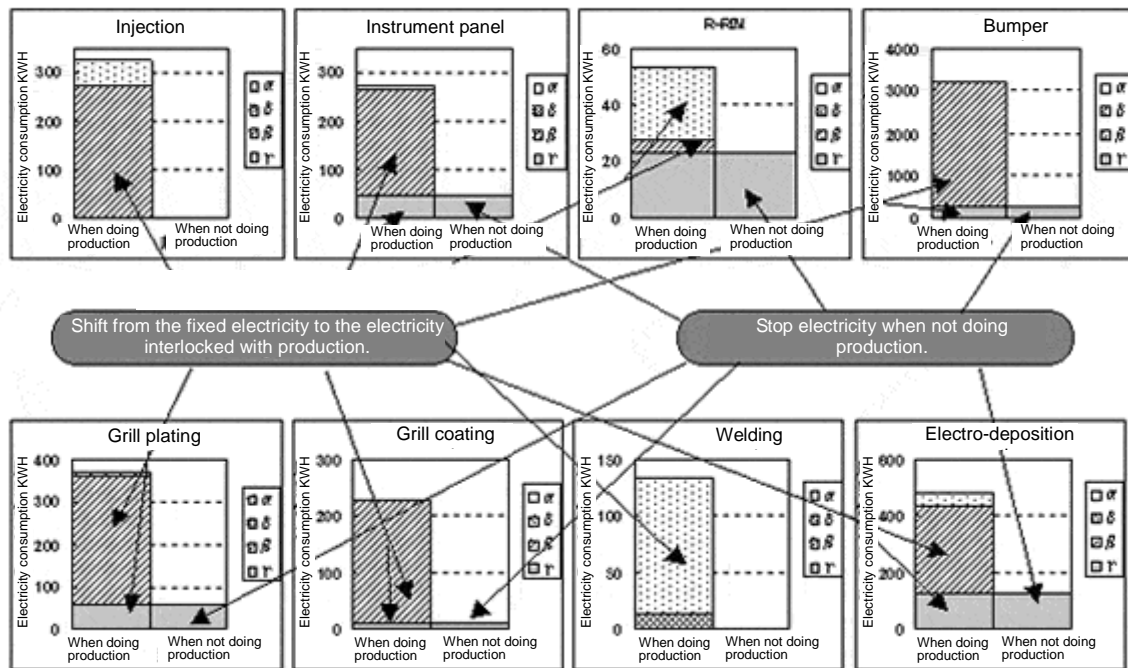


- Note :
- [1] The equipment always running for 24 hours is stopped when not doing production (III – II).
  - [2] The equipment always running when doing production is changed to the cycle run equipment (II – I).
  - [3] To get rid of the stand-by electricity of the cycle run equipment.

## 2) Focusing on energy conservation points

We clarified the energy conservation points by visualizing the type of the electricity use of each process.

Type of electricity use and energy conservation points



3) Energy data to be disclosed next day

Using the raw energy data managed by the plant, we visualized the electricity amount used per day (Fig. 6) and the minimum electricity amount per hour when there is no production (Fig. 7). It encouraged the employees to do energy conservation (organization of PDCA base).

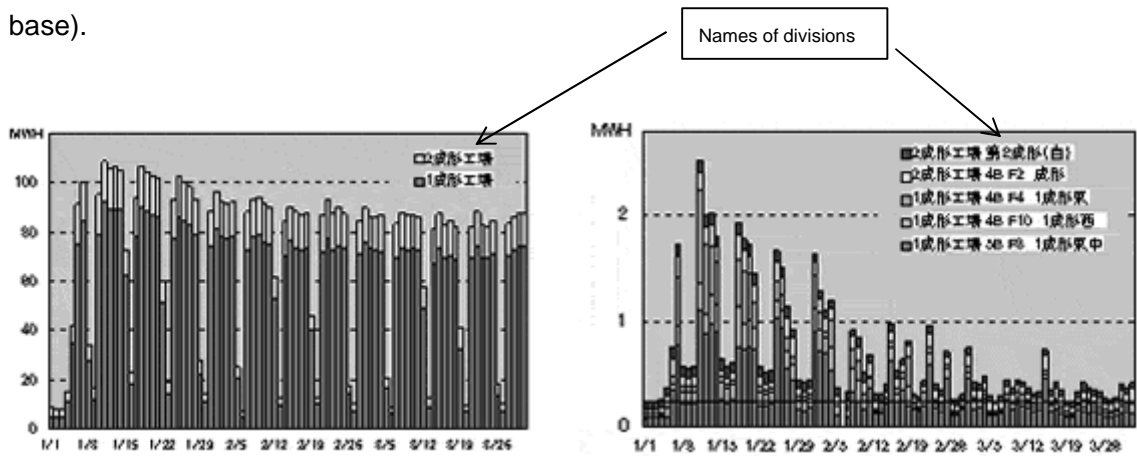


Fig. 6 Electricity Amount Used a Day

Fig. 7 Use of Minimum Electricity when not Doing Production

## 4. Implementation of Energy Conservation Improvement

### 1) Clarification and implementation of energy conservation measures

We implemented the improvement based on the “concept concerning how to promote energy conservation” in all processes.

Measures	No. of Cases	Total Emission [CO <sub>2</sub> ton/year]
To shift from the fixed electricity to the electricity interlocked with production	15	1,038
To stop electricity when not doing production	39	2,164
Total	54	3,202

(Breakdown of improvement)

Stop	#	Measures Implemented	Electricity	Steam	LNG	Air	Reduction Amount, Ton/year
Always Stopped	1	Stop compressor for injecting R-RIM	●				82
	2	Stop chiller for adjusting injection mold temperature	●				75
	3	Reduce half of pumps for sending hilled and hot water for injection AB	●				28
	4	Stop heater for adjusting 1 coating temperature	●				14
	5	Stop chiller for 6 booth air conditioning	●				9
	6	Stop chiller for 308 air conditioning	●				6
Sub Total							213
生産集約による	1	Aluminum plating	●	●			85
Interlocked with Production	#	Measures Implemented	Electricity	Steam	LNG	Air	Reduction Amount, Ton/year
Interlocked with Production	1	Make instrument panel line drying equipment small			●		836
	2	Interlock aluminum dust collector with grinding machine			●		3
	3	Interlock with thrush line exhaust fan fluid floor furnace			●		1
Sub Total							840
Intermittent Operation	1	Operate sand filter every two days	●				94
	2	Intermittent operation of RRIM material circulation pump	●				84
	3	Intermittent operation of heater for altogether foaming vacuum molder	●				7
	4	Intermittent operation of hydraulic pump for altogether foaming W/J	●				6
	5	Intermittent operation of agitator for RRIM storage tank	●				2
	6	Intermittent operation of exhaust fan for altogether foaming vacuum molder	●				2
	7	Intermittent operation of hydraulic pump for altogether foaming injector	●				1
	8	Change to intermittent operation of underground pit fan	●				1
	9	Intermittent operation of A-2 pulverizer	●				1
	10	Intermittent operation of injection B-3 pulverizer	●				1
	11	Operate plastic paint storage fan only when there is goods coming in	●				0
	12	Intermittent operation of agitation pump for RRIM material	●				0
Sub Total							198
Total							1,038



**2) Case example of improvement: “To reduce the fixed electricity (β)”**

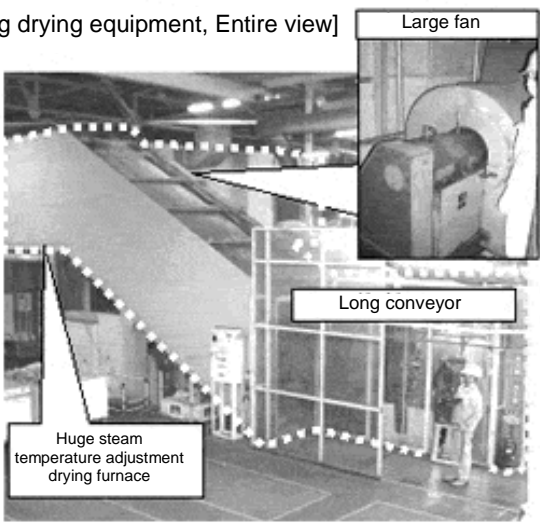
Case example of energy conservation improvement

Classification: Electricity Industrial steam Air conditioning steam LNG

**[Subject]**  
 To make coating line and drying equipment for instrument panels smaller

**[Before improvement]**  
 This drying equipment uses the idling equipment (implantation line).  
 Production number: 25 products/day (As of February, 2005)  
 2 direct production following the previous process.  
 Drying condition: 60 x 5 minutes to be kept.  
 60 x 10 minutes, through.

[Existing drying equipment, Entire view]



<b>Energy used</b>	Using steam
Drying furnace temperature adjustment: Steam	AM5 : 30~AM2:00
	Standard: 40A <b>kgf/cm<sup>2</sup></b>
Circulation fan: Electricity	}
Standard: 6.50 KW	
Conveyor: Electricity	
Standard: 0.75 KW	Operation: 15H/day

**[Critical point]**  
 Isn't the existing drying furnace too big that it is out of the proportion to the number of the products produced?

**[After improvement]**  
 Batch system (1 unit) drying furnace was made. All of the existing equipment were stopped!

[Small drying furnace. Entire view]      [State in the furnace]      [Small heater and fan]

[Furnace unit, contracted to 1/20]      [Drying one by one]      [Heater & fan]

The drying condition 60 x 5 minutes is kept by the timer.

**Energy used**  
 Drying furnace temperature adjustment: Electricity Standard: 9 KW  
 Circulation fan: Electricity Standard: 90 W  
 Operation: 5H/day

**[Effect]**

Steam ▲4,010 ton/year	➔	CO <sub>2</sub> reduction 836 ton/year
Electricity ▲15,192 KWH/year		

**3) Case example of improvement: “To be interlocked with production (β -> α)”**

Case example of energy conservation improvement

Classification: Electricity Industrial steam Air conditioning steam LNG

**[Subject]**  
 Intermittent operation of the altogether foam injector's hydraulic pump

**[Before improvement]**  
 The altogether foam injector's hydraulic pump is used to run the injection head.  
 (Problem)  
 It is operated all the time when the injection head is working.

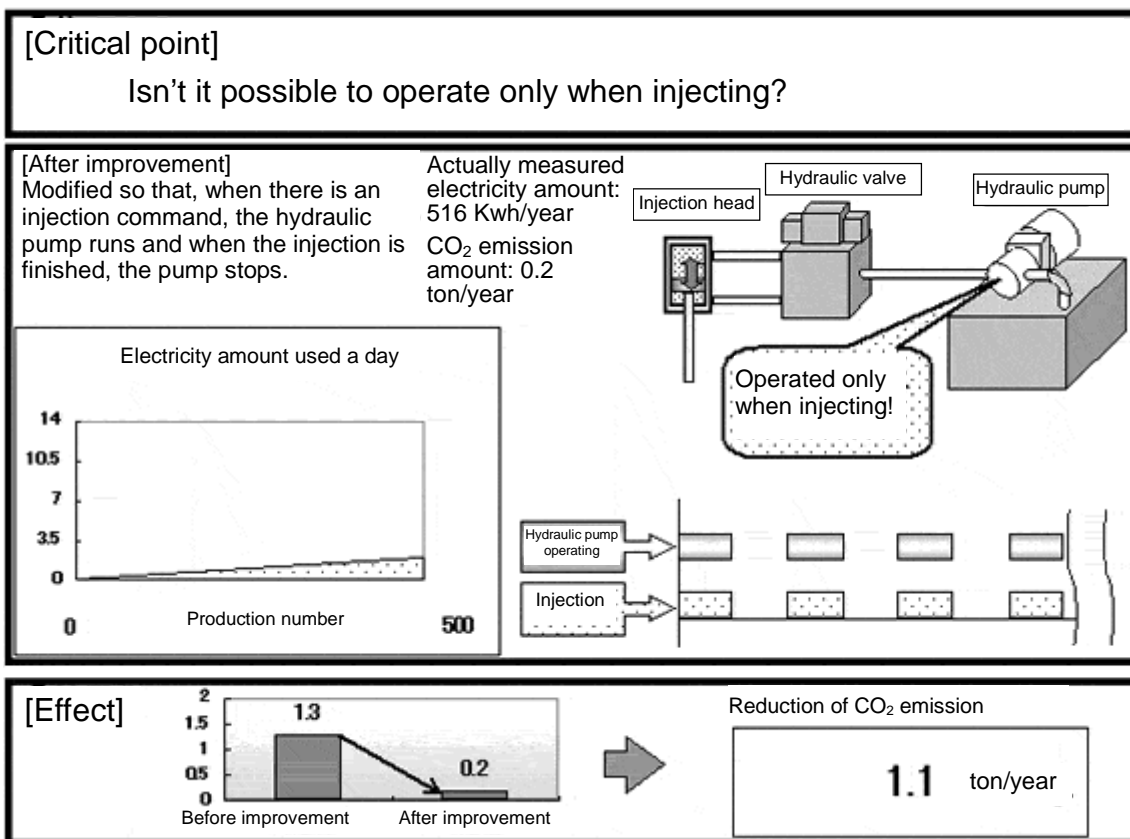
Actually measured electricity amount 3440 Kwh/year  
 CO<sub>2</sub> emission amount 1.3 ton/year

Electricity amount used a day

14	10.5	7	3.5	0
Fixed portion 2 Kwh/day				
0	Production number			500

Hydraulic pump operating  
 Injection

**[Critical point]**  
 Isn't it possible to operate only when injecting?



## 5. Effects

### 1) Total emission, intensity

In the second half period (October to March), we could not recover the portion which we had not achieved in the first half period (April to September). So, through the FY2004, we could not achieve both targets of the total emission and the intensity. However, in FY2005 as of the end of the first quarterly period, we achieved the reduction of approx. 1,700 tons in the total emission and the reduction of 10.2 Kg/H in the total intensity, both compared with the achievement of the previous year, thanks to the energy conservation effects realized in and carried over from the previous year and new energy conservation proposals. Judging from the production plan from now on, it is possible to achieve both targets of the year (Fig. 8, Fig. 9).

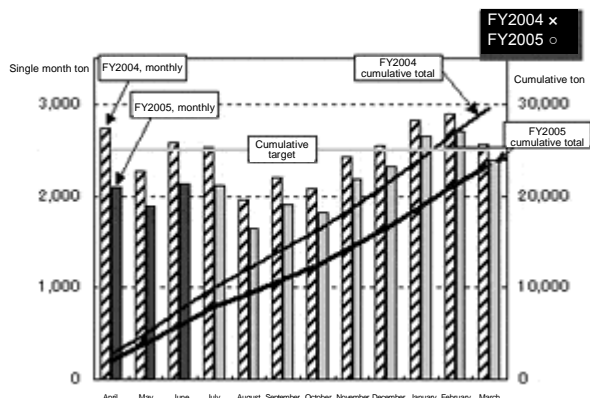


Fig. 8 Total Emission

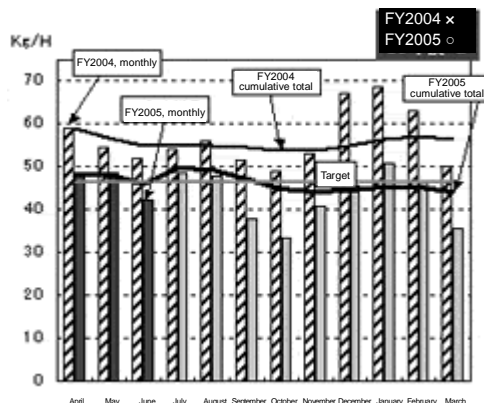


Fig. 9 Intensity

## 2) Proposed quantity of energy conservation

As the “concept concerning how to promote energy conservation” spread in the division, the proposed quantity of energy conservation increased since November. Especially in February and March, a lot of big improvements were made by modifying the equipment (Fig. 10).

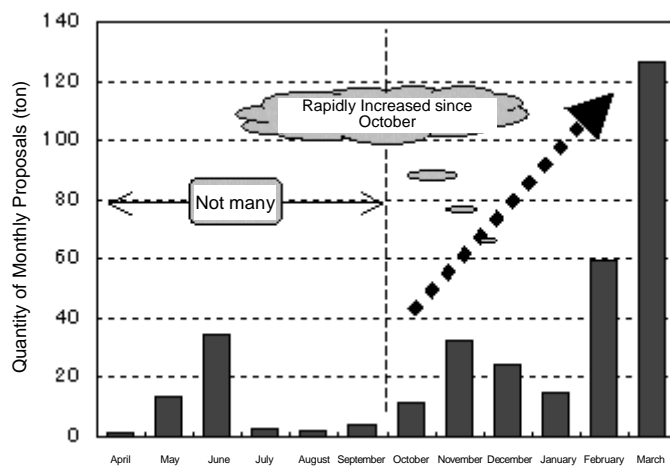


Fig. 10 Proposed Quantity of Energy Conservation

## 3) Horizontal deployment

We chose the SS (simple and slim) multiple equipment as the new equipment aiming at the zero energy loss (Fig. 11).

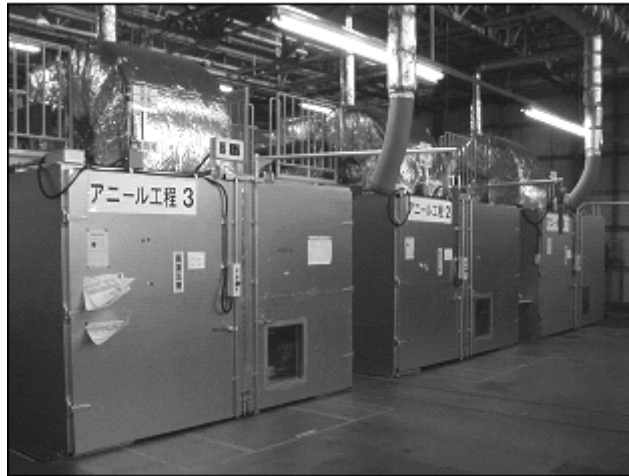


Fig. 11 Example of Horizontal Deployment

## 6. Summary

- (1) In the energy conservation activities implemented in this short period of time, we realized anew that the most important thing in doing the energy conservation was the awareness and the way of thinking of each employee concerning the energy conservation.
- (2) We introduced this division's "concept concerning how to promote energy conservation" to other divisions of Motomachi Plant. We hope that other divisions could use it when studying the important points of energy conservation, even if their work is different from ours.