2005 Prize of Director General of Agency for Natural Resources and Energy

Reduction of unnecessary Power Consumption by Identification and Measurement system of Power Consumption for each Facility

CEO, CIMX Corporation

◎ **Keywords: Rationalization of electromotive power and conversion to heat (Electric power application equipment, electric heating equipment, etc.)**
Rationalization of electromotive power and conversion to heat (Lighting equipment, elevators, office equipment)

◎ Outline of Theme

For small and medium-sized enterprises that are making bloody efforts to reduce cost, electricity expense, which is “unexplained expenditure” because it is unclear when, for what, and how much of it was used, is a heavy burden. By clarifying the use of the electricity, it can be can identified whether electric energy is used in a really valiant way or not. In production factories, the more the production volume, the more energy is consumed. Therefore, we consider that it is more important to identify and zero waste than to control total volume.
To realize this, we have created a system to measure electric power consumption for each electric facility and identify whether it is necessary or not. By visualizing the information obtained from the system and give feedback to all the corporate members, we worked on reduction of unnecessary electric power consumption in daily business operation. As the effect of this project, the standby electricity of manufacturing equipment that was the biggest cause of waste was reduced 48.3% annually compared to the reference month.

◎ Implementation Period of the said Example

April, 2003 - June, 2005

● Project Planning period	April 2003 - March 2004	total of 12 months
● Measures Implementation period	April 2004 - March 2005	total of 12 months
● Measures Effect Verification Period	April 2005 – June	total of 3 months

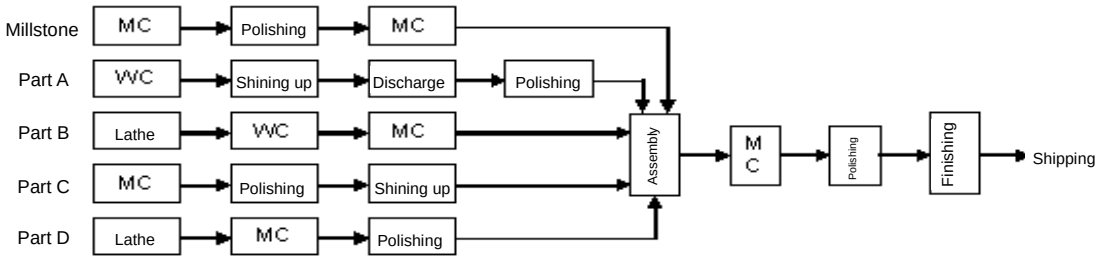
◎ Outline of the Business Establishment

- Production items: die manufacturing, software development
- Number of employees: 48
- Annual energy consumption (Actual record in April 2004 – March 2005)

  Electricity 698,904kWh

◎ Process Flow of Target Facility

In our factory (the die division), NC machine tools are used to manufacture powder metallurgy ultra hard die.



(Note) MC stands for machining center and WC stands for wire cut.

Fig. 1 Manufacturing process

1. Reasons for Theme Selection

In factories, controlling total volume is difficult because energy consumption depends on the production volume. Therefore, we have decided to identify unnecessary and effective energy usage and reduce unnecessary energy use. We considered that energy conservation activity can be promoted without damaging motivation of field workers by identifying waste and reduce only the wasteful part.

2. Understanding and Analysis of Current Situation

(1) Understanding of Current Situation

To identify unnecessary and effective power consumption, we have measured power consumption of each facility (the detail is described later). 80% of all electricity driven facilities (100 facilities) were measured. For each manufacturing facility, it is determined whether it is operating, waiting, or stopped. Standby electricity is identified and defined as unnecessary (Fig. 2). For other facilities, power consumption outside of business hours was identified as unnecessary.

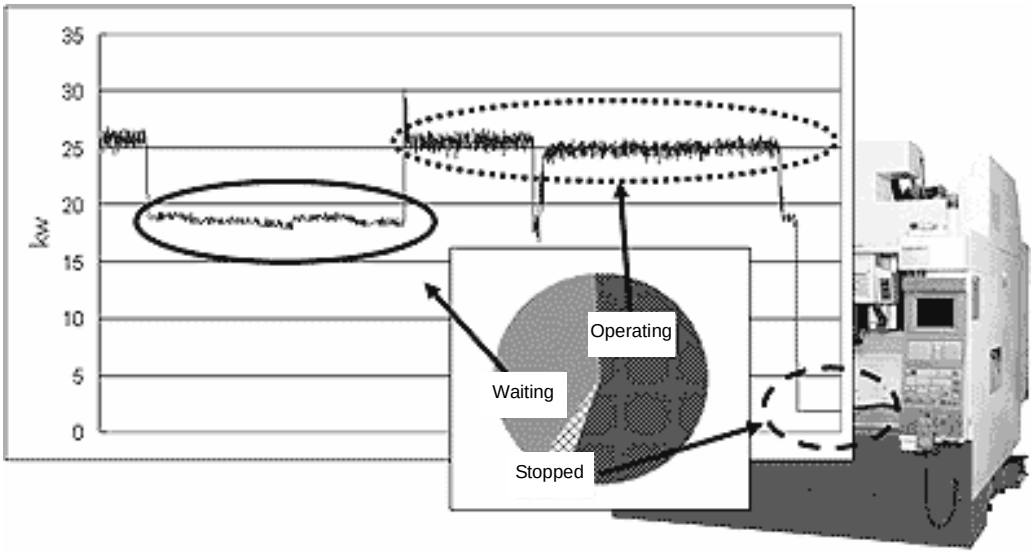


Fig. 2 Image of identification of power consumption by manufacturing equipment

(2) Analysis of Current Situation

The result of the measurement in January, 2004 showed that power consumption that was identified as unnecessary reached 59% of the total, of which standby electricity of manufacturing equipment accounted for 38%, which was overwhelming.

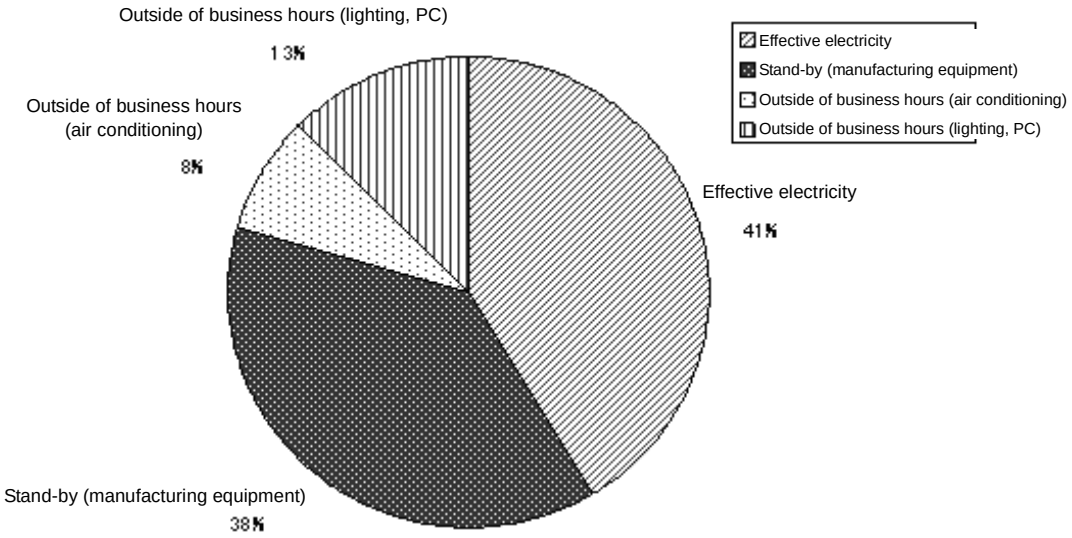


Fig. 3 Result of identifying unnecessary and effective power consumption (January 2004, 100 facilities were measured.)

It was expected that a lot of electricity is consumed as stand-by electricity, and this time, the actual state of each facility became clear, showing that its reduction is an imminent issue. In addition, the analysis indicated that some facilities has very high rate of stand-by electricity while others are not, so it is necessary to analyze trend of each facility group and enforce countermeasures. (Fig. 4) shows the total for each facility group. This shows that wire cut and compressors, which has higher ratio of stand-by electricity, needs measures.

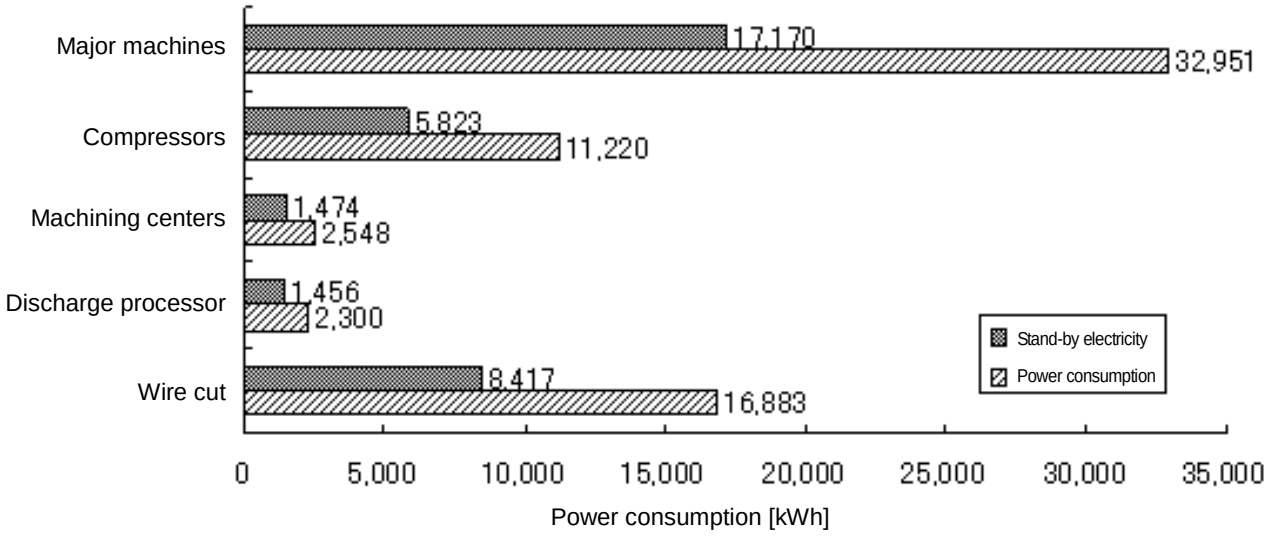


Fig. 4 Power consumption of manufacturing facility groups (January, 2004)

In addition, it was determined to treat each identified power consumption type as follows:

[1] Stand-by electricity of manufacturing equipment (38% of the total)

This does not contribute to production activities, so it can be zeroed theoretically. Our goal is to reduce it by half within one year.

[2] Effective electricity use (41% of the total)

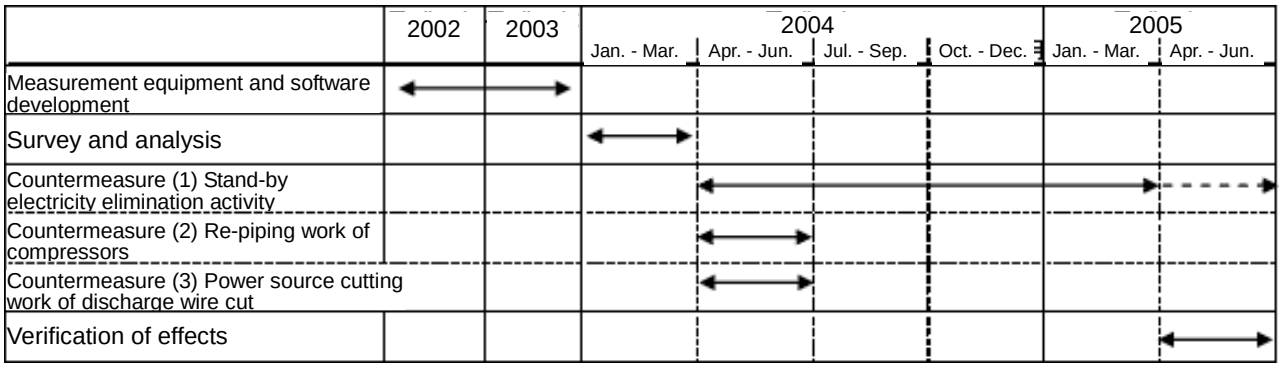
This contributes to production activities, so this is not a target for reduction for now. Effective production and replacement has been performed and will be continued.

[3] Power consumption by air conditioning, office equipment (such as PCs), and lighting outside of business hours

This is essentially unnecessary, but power consumption cannot avoid when production activities go beyond the range of business hours, so this is not a target of reduction for now.

3. Progress of Activities

(1) Implementation Structure



(2) Target Settings

We have set January 2004 as the reference. Because power consumption by air conditioning, PCs, and lighting etc. vary depending on business hours, we consider quantification of improvement effect is difficult. Therefore, we selected the stand-by electricity of manufacturing equipment whose unnecessary power consumption accounts for 38% of the total power consumption as the target of the energy conservation activity and set our goal to reduce it by half by March 2005.

(3) Problem Points and Their Investigation

1) Stand-by electricity during non-operation time (due to unawareness of workers)

There was a traditional problem that the variance of production activities and that of power consumption do not match. Until now, we only knew power consumption status of each factory, which means insufficient information. Therefore, it was impossible to understand how much electricity and utility rate was wasted numerically even if non-operated equipment is left on to consume unnecessary stand-by electricity. As a result, many machines were left on.

Especially, there was a pronounce tendency during busy season and overtime work.

2) Waste regarding air compressors

We have investigated the trend of power consumption by air compressors as a time series, and we found that it rarely matches with the operation status of equipment that supply air. Also, when they match, more than necessary power was consumed.

The causes were as follows:

1. Leak due to aging piping
2. Request for air from machines that are not in processing operation (It became clear that discharge wire cutting machine requests air regularly even after finishing processing)
3. Mismatch of compressors and machine groups (Because the piping doe not assume processing conditions, large compressors were operating when only one machine starts working at night).

3) Machine characteristics of discharge wire cut

Due to the machine design, this machine cannot be turned off automatically after processing was finished. Therefore, stand-by electricity was consumed uselessly until a worker turns it off.

4. Details of Measures

(1) Stand-by Electricity during Non-operation Time (due to Unawareness of Workers)

[1] We have developed and attached electricity measurement equipment to 100 electric machines, which account for about 80% of the total power consumption, and started identifying unnecessary and effective power consumption for each facility (Fig. 5).

(Note) We have applied for a patent in the U.S. and Japan.
(Date of application) (Title of application) (Application number)
June 24, 2002 “Production management system in manufacturing industry” Patent application 2002-183353
August 1, 2002 “Operational information collection system for machine tools” Patent application 2002-225099
August 21, 2003 “Electrical information measurement and collection system” Patent application 2003-297610, 11062250 (the U.S.)
October 6, 2003 “Electrical information measurement circuit” Patent application 2003-347321, 11061828 (the U.S.)
April 11, 2005 Diagnostic method for analyzing power consumption of Electrical Equipment 11104244 (the U.S.)

[2] Measurement was performed every minute and daily operation record and standby electricity consumption status were managed using operation status management chart for each machine, which is called Othello Chart (Fig. 6).
[3] This is tallied every month for each machine and record management was thoroughly enforced as information for each equipment group.
[4] Whether reduction of standby electricity is going well or not in each department was identified in reference to the record in January 2004 and it was distributed to workers in writing with payment slips (Fig. 7).
[5] Reduced utility charge was equally distributed to all workers as “energy conservation dividend”.
[6] As a result, we have gained support from families of staff members, which was encouraging in promoting every month’s improvement activities.

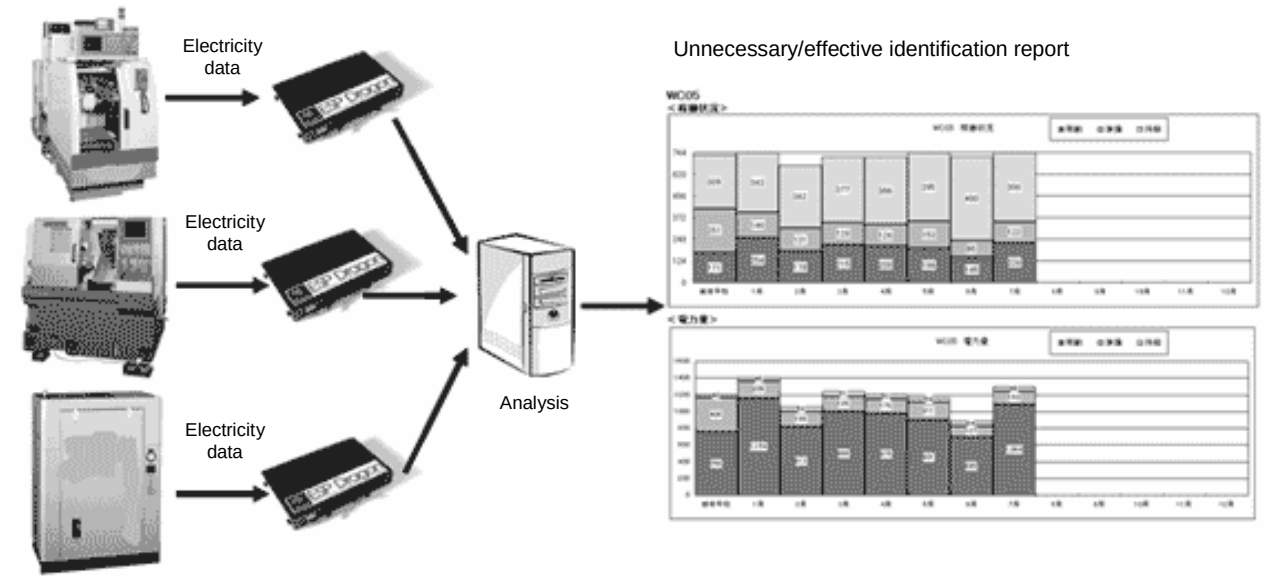


Fig. 5 Image of the system to identify and visualize unnecessary and effective power consumption

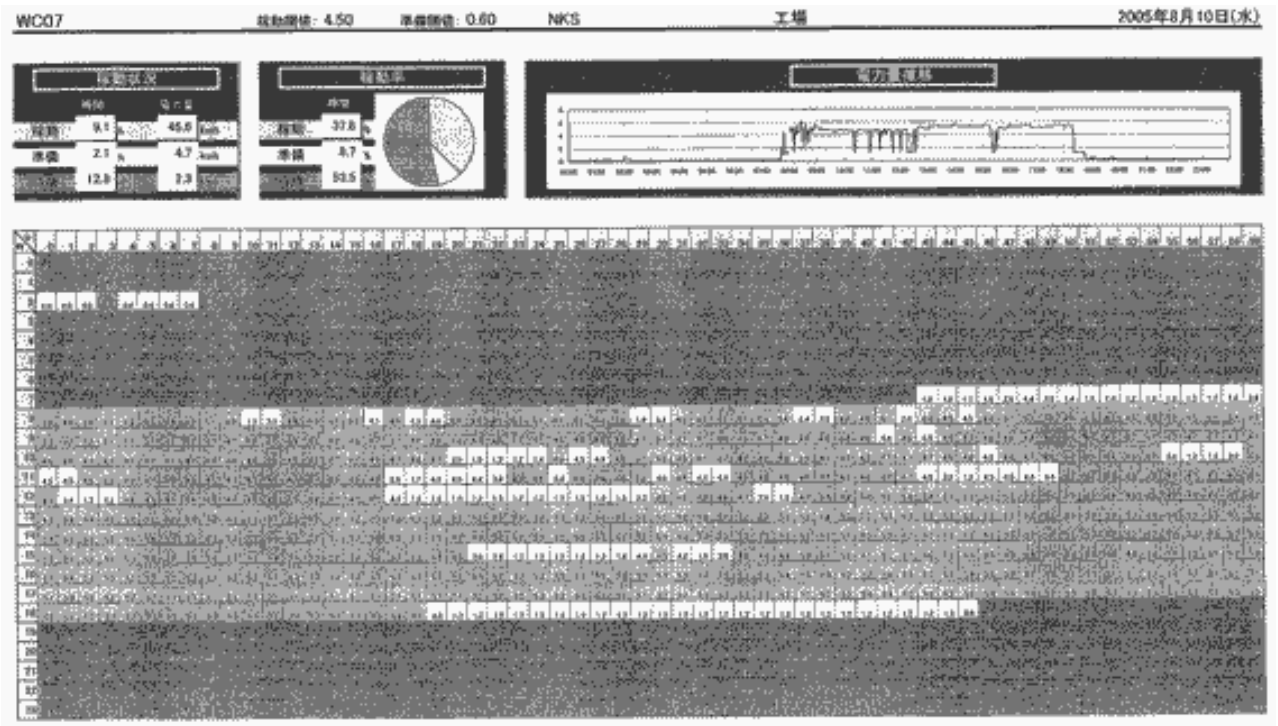


Fig. 6 Othello chart (checking operation status every minute)

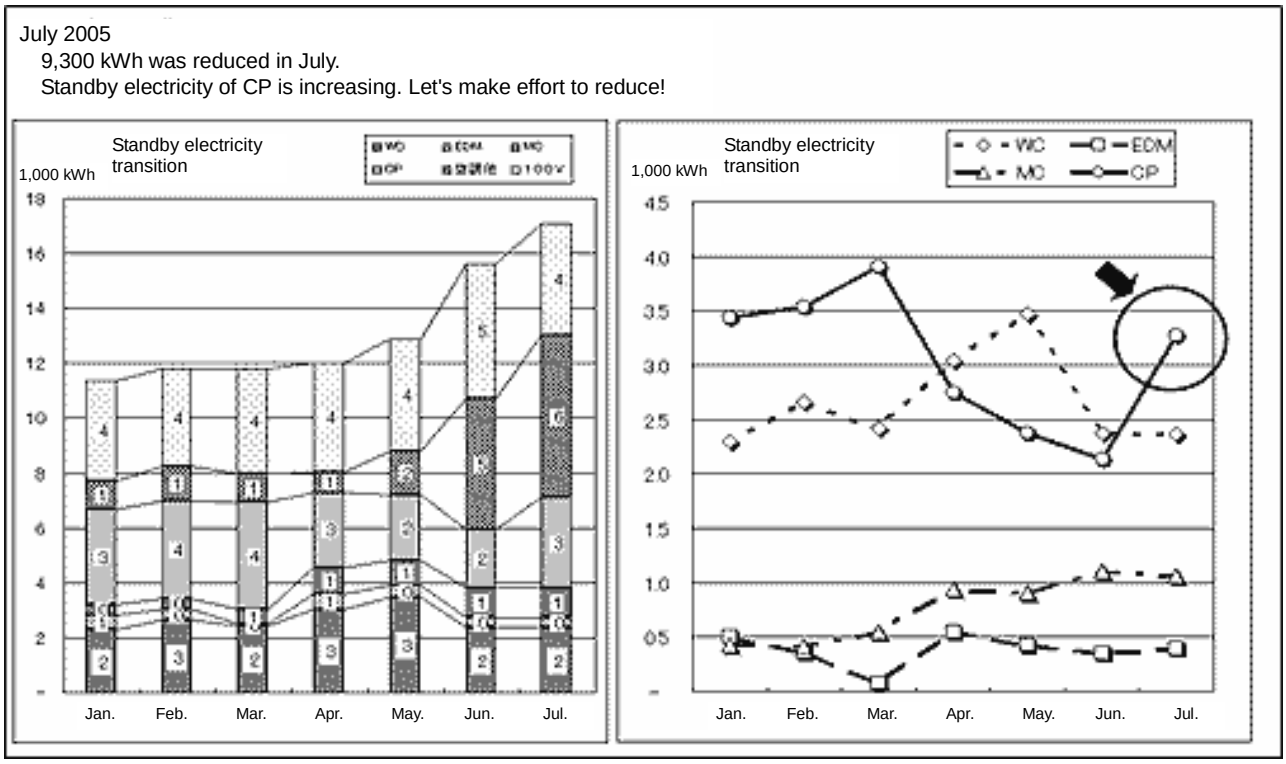


Fig. 7 Report to notify status of stand-by electricity reduction

(2) Waste Regarding Air Compressors

We reviewed the connections of piping and replaced aging pipes with new ones. As a result, we eliminated air leak from piping and minimized air supply to manufacturing equipment that does not request air.

(3) Machine Characteristics of Discharge Wire Cut

We have modified it so that power can be shut off after processing is finished.

5. Effects Achieved after Implementing Measures

As a result of the countermeasures, the standby electricity was reduced 48.3% annually compared to the reference month (Fig. 8) (Fig. 9). In addition, the ratio of standby electricity in total power consumption was improved from 38.2% in the reference month to the annual average of 18.7% (Fig. 10).

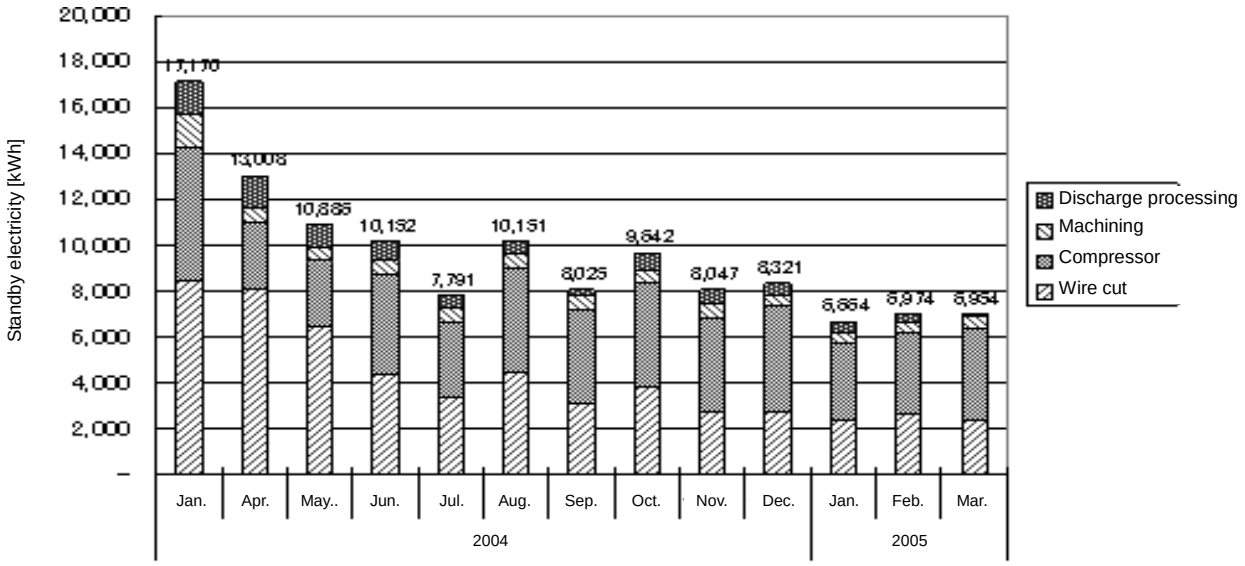


Fig. 8 Transition of standby electricity of manufacturing equipment

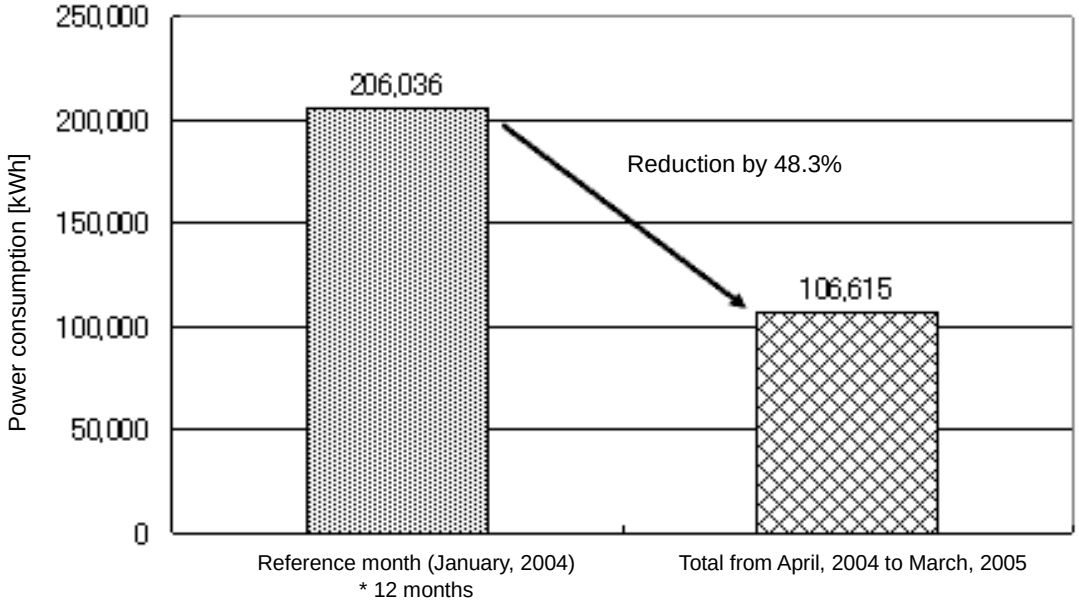


Fig. 9 Summary of standby electricity reduction of manufacturing equipment

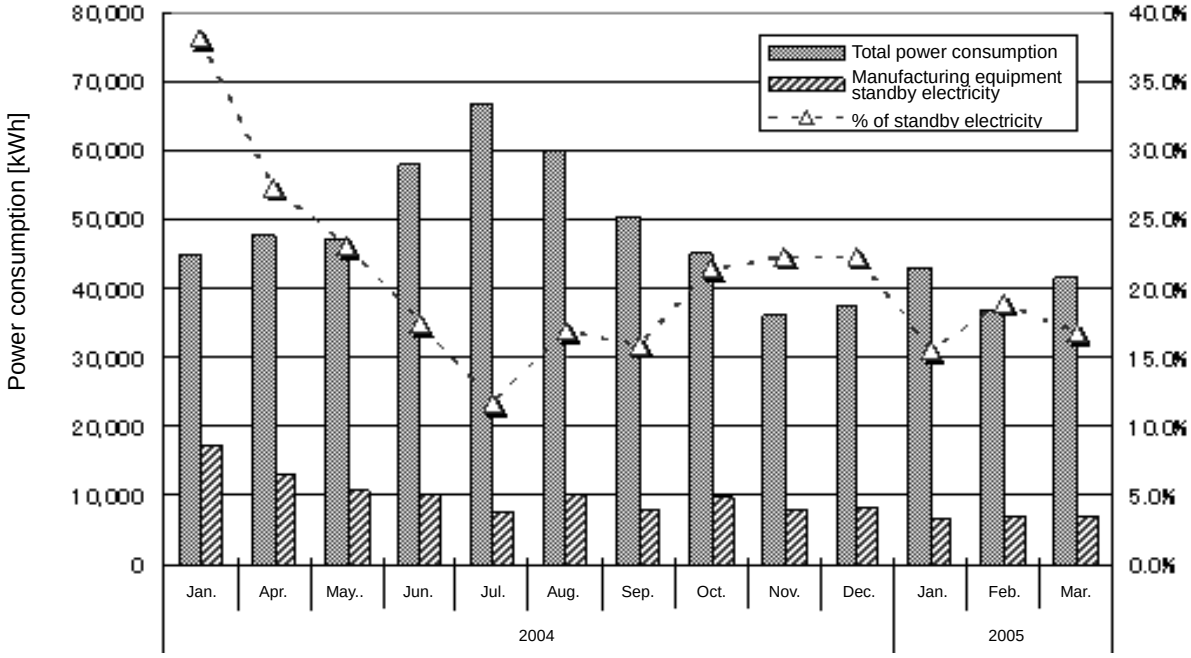


Fig. 10 Transition of ratio of manufacturing equipment standby electricity to the total power consumption

6. Summary

(1) By identifying power consumption in each facility, the points of energy conservation activity became clear.

(2) Especially, it was surprising that the standby electricity of manufacturing equipment is so big.

(3) The energy conservation dividend system changed awareness of staff members and their families, which helped maintaining the energy saving activities.

Mr. A's case

He worked with his family to turn off frequently at home. As a result, he got 2000 yen/month of reduction of power consumption effect. In addition, cooperation with his family members increased conversations and communication between family members was improved.

Mr. B's case

When he went on surfing, he told his friends about the energy conservation dividend and about his wish to protect the environment. He gained a broad approval, and now they make it a habit to pick trash on the beach after they surf.

(4) Traditionally, it was difficult to identify power consumption where night time unattended operation is done such as factories. However, identification became available by the operation determination method developed during this activity (patent pending).

(5) We have devised the Othello chart by operation improvement method. As a result, we have succeeded visualization of operation status and the data became easier to use for work improvement.
(6) The effect of work improvement is 36% in the view point of sales/work hours, which was even greater than the energy conservation effect.

7. Future Plans

(1) The method to identify effective/unnecessary power consumption for each facility proved effective not only for energy saving, but also for increase of productivity, so we would like to promote this method to the entire world.
(2) To promote this method in the future, we plan to start a separate company to develop and sell systems so that everyone can use this mechanism.