First Batch of Domestic TOP TENs List

Japan BP List

BP1:Development and Introduction of Human/Environmentally Friendly Equipment with a Focus on Minimizing Power Consumption

1. Practice Overview

CO_2 emissions of labor-intensive assembly plants.

(2011–2012 for overseas plants; 2013 for Japanese plants)

(1) Downsize the volume of plants ▲30%- ▲50%

Reduction in light (LED) and air conditioning energy (while minimizing the line length and hanging of the equipment).

(2) Introduce thorough energy saving equipment ▲40%- ▲56%

Achieved by Karakuri (gimmick)/Oki-Pon/ Motionless/usage of renewable materials.

2.Schematic Diagram

See Figure 1 and 2.

3.Energy Saving

(1)Downsize the volume of plants

(a) Overseas plants; (b) Japanese plants

CO_2 emissions: (a) ▲30% (2000–2011)

(b) ▲50% (2000–2013)

Crude oil equivalent: (a) approx. 11.000 kL equivalent

(b) approx. 11.000 kL equivalent

(2) Introduce thorough energy saving equipment

CO_2 emissions: (a) ▲1% (2000–2011)

(b) ▲14% (2000–2013)

Crude oil equivalent: (a) approx. 1.000 kL equivalent
(b) approx. 280 kL equivalent

4.Innovation Originality

For the introduction of thorough energy saving equip-ment, a Simple Smart Compact for Assembly Innovation (SSCI) team was formed with the aim of developing equip-ment that can be "created/fixed/changed on site." The de-velopment proceeded with the aim that difficult operations are to be thoroughly improved as we, the production engi-neers, create and use the products. We had reduced the load and instances of operation on the basis of manual opera-tions, without power usage. Then, the equipment specifica-tions were made to automate only the parts required for the reduction of man-hours with minimal power. The equipment rigidity was not achieved by targeting the minimum required strength, with reinforcements when tryouts were not successful, ultimately leading to an increase in weight. In-stead, simple/smart measures were taken, such as making the structure of the breakable portion flexible.

5.Transferability Replicability

Equipment development that focused on minimizing power began in 2009, and the introduction of the completed equipment has been implemented in new plants since 2010.

Of the main equipment, 137 have been developed and 70% has so far been completed. For the remainder of the equipment, and with the creation of innovative engineering, we are responsible for more than 70 assembly lines around the world. In order to incorporate them promptly into the current lines and to see the effect, "SSCI Size Expansion" is in progress with the cooperation

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BEST PRACTICE

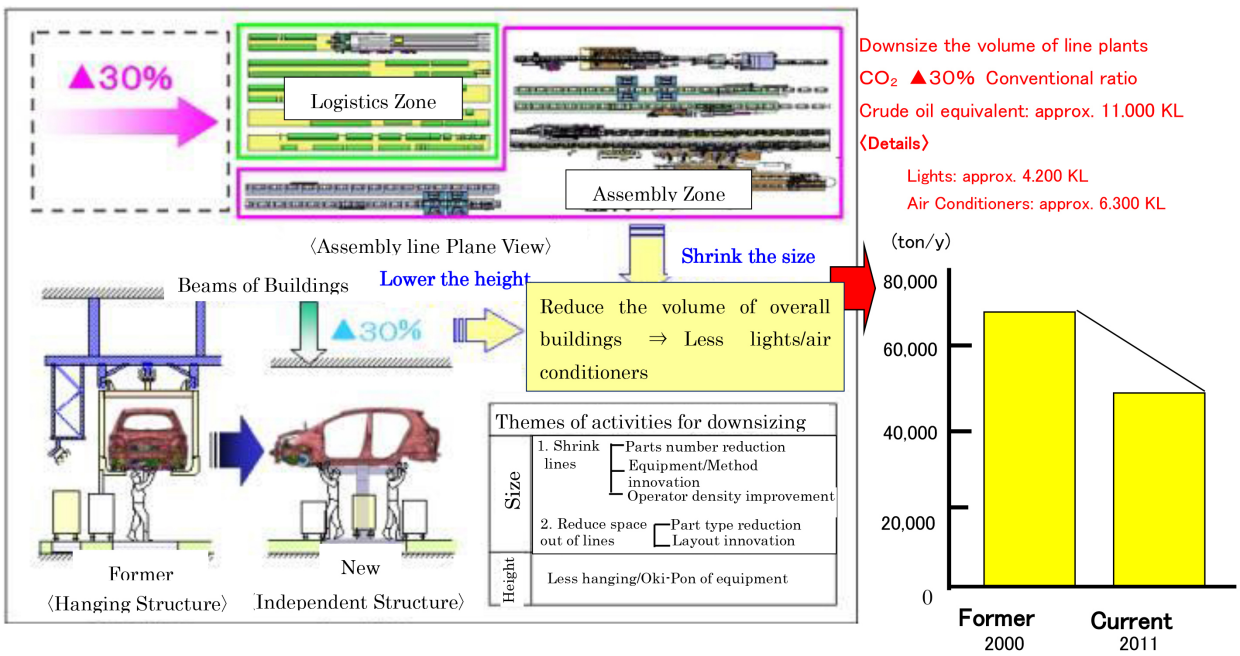

Figure 1 . Downsizing of Assembly Plants

of each assembly plant/equipment manufacturer.

6.Sustainability Continuity

Implementing our own equipment development, having energetic people and members from overseas (sowing), and promoting continuous KAIZEN for energy saving in the future. When assigned to an overseas branch, work as a core power for worldwide development (reaping).

7.Cost Effectiveness

- Cost Effectiveness: ▲30% (compared with the rate of the latest domestic plants).
- Payback Period: 7 y -5.5 y (▲20%)

8.Co-Benefits

Patents, Awards, Publication:

(1) Application of patent/utility model, 21 cases

(2) Awards, six cases *[1]

(3) Newspapers publications, three cases *[2]

(4) Conference presentations nine cases *[3]

(5) Contribution to literature two cases *[4]

(*1. Minister Prize of Economic, Trade and Industry/ Japan Society of Mechanical Engineers etc.; *2. Yomiuri-Shimbun/Nikkei Monozukuri; *3. Japan Society of Precision Engineering/Robotic Society of Japan/Energy Conservation Grand Prize etc.; *4. Robotic Society of Japan/Energy Conservation Grand Prize etc.) ■

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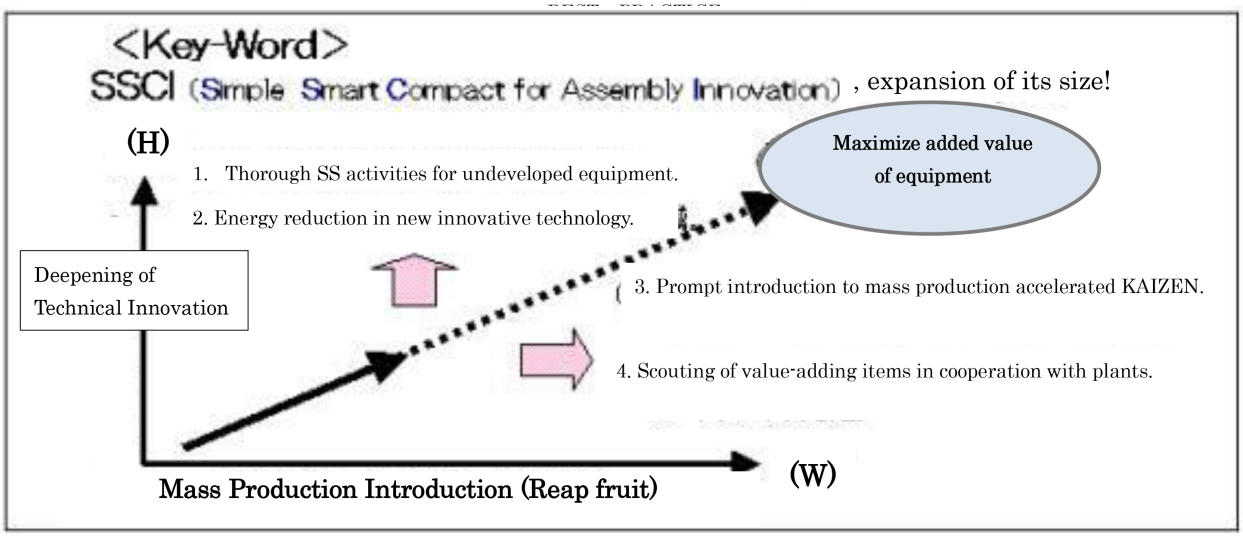


Figure 2 . SSCI Size Expansion Guidance

BP2: New Painting Technology that Simultaneously Reduces Volatile Organic Compounds (VOC) and CO_2 Emissions

1.Details of case

Mazda has been continuously achieving process innovations to solve the conflicting demands of environmental protection, paint quality, and economic efficiency. At present, Mazda has developed the "Aqua-tech Paint System," which a new painting technology that has been practically implemented in mass production. It consists of the following innovations:

(1) High-function waterborne basecoat and 2K clear-coat paint that integrates the functions of primer coating into top coating.

(2) Energy-saving air-conditioning system for the spray booth that controls water evaporation from waterborne basecoat with minimal energy during spray application.

(3) High-efficient flash-off system, that evaporates water from wet paint film with minimal energy, after waterborne basecoat application but before the 2K clear-coat application

(4) Space-saving cartridge system, which is compact and minimizes paint loss during color change.

(5) Pipe cleaning technology, which utilizes solvent-borne paint pipes for waterborne paint.

(6) Design of paint film structure and application technologies that improve paint film smoothness on exterior panels and color matching on internal panels.

2.Diagrams and other illustrations

Refer to Figure 1.

3.Energy conservation performance

- High-function waterborne basecoat and 2K clear-coat paints: 2,000 t/y reductions in CO_2 emissions from primer booth, compared with the 3 Wet-on Paint System, as a result of process shortening.
- Energy-saving air-conditioning system: a 34% reduction in CO_2 emissions when compared with conventional booth air conditioning for waterborne painting.
- High-efficient flash-off system: a 17% reduction in CO_2 emissions when compared with conventional flash-off for waterborne painting.

4.Advanced nature and originality

- Aqua-tech Paint System is further developed with process integration and high-efficient technologies based on the 3 Wet-on Paint System.
- Paints: Adoption of waterborne, instead of solvent-borne, basecoats. Integration of primer functions through

the de-velopment of high-function basecoats and clear-coats.

- Facilities: Minimization of process length and resource consumption, through technology development that max-imizes equipment functions for essential mechanisms, such as water evaporation.

5.Versatility and expandability

- World-leading VOC and CO_2 emission amounts
- Basic paint quality is equal or superior. In addition, paint appearance (gloss and smoothness) is improved.
- Economic efficiency: Vehicle production cost of primer and topcoat was reduced by approximately 18%, compared to conventional solvent-borne paint systems.
- Smooth introduction into existing plants: Conversion was conducted without plant shutdown, through the development of paint and process technologies that assume simultaneous production of solvent-borne and waterborne paint systems.
- This technology can be applied to all other painting indus-tries as a new-generation painting technology that can achieve environmental protection without sacrificing eco-nomic efficiency.

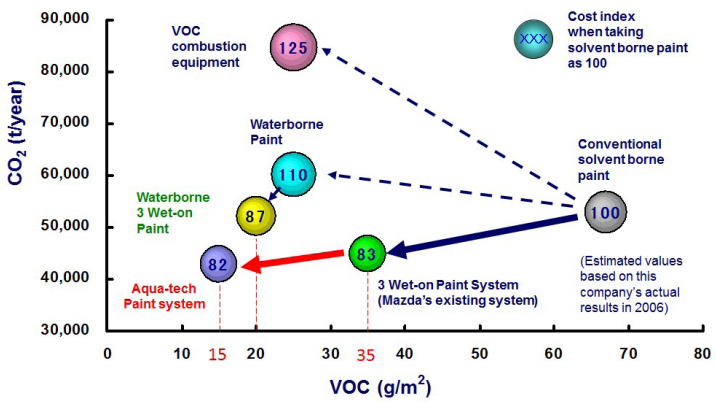


Figure 1

6.Continuity and sustainability

The following activities are under consideration with the relevant departments in the company:

- Implementation of the Aqua-tech Paint System in other domestic and overseas plants.
- Development of the next new painting technology.

7.Investment efficiency

By minimization facility modifications while maximizing existing facility utilization, the introduction into an existing plant (Ujina No.1 Plant) was realized with approximately one tenth of the investment that would have been required for a new waterborne paint plant.

8.Secondary results

Patents, awards and presentations:

(1) Japanese patents: 19; patents outside Japan: 21.

(2) Awards: not applicable.

(3) Newspaper articles: eight articles (Asahi Shimbun, Yomiuri Shimbun, Nikkei, etc.).

(4) Academic lectures: three lectures (The Society of Auto-motive Engineers of Japan, etc.).

(5) Documents and other sources: three articles (Journal of the Society of Automotive Engineers of Japan; Mazda Technical Review).■

BP3: Energy Conservation and Peak Power Containment Promoted by Everybody in the Factory

1.Details of case

As the Panasonic Yamagata Factory expanded the production of lenses as the base for the optical business of the company, drastic increase of CO_2 emission was predicted (production of lenses and CO_2 emissions in 2012 were ex-pected to be 137% and 157%,respectively, of those in 2009). As the mission of Yamagata Factory was to expand the business while preserving environment, the CO_2 Emission-Reduction 3-Year Plan was formulated based on FY2009 actual results. The aim was a final reduction of emissions by 50%.

Yamagata factory started a CO_2 emissions-reduction project not only to implement energy conservation, but also to im-prove production processes and create energy. To achieve these goals, the following objectives were detailed:

(1) Promotion of visualization: analysis and minimization of energy intensity.

(2) Improvement of production process: conservation of energy during vapor deposition, development of ener-gy-saving, lens-forming machines.

(3) Containment of peak power: prevention of increase in the air-conditioning load, improvement of factory air, prevention of increase in lighting, among others.

(4) Energy creation: development of a power generation system with conversion of exhaust-heat to electricity.

2.Diagrams

See Figure 1.

3.Energy conservation performance

Peak electric power

2010:5,800kW

2011:4,600kW [21% reduction]

CO_2 emissions

2010: 15,423 t

2011: 12,865 t

[17% reduction]

[Breakdown of activities]

- Energy conservation of vapor depositors: development of general types, development of standard films—productivity was improved 1.5 times.
- Development of energy-saving lens forming machines—electricity consumption was reduced by 25%.

4.Advanced nature and originality

-Energy creation: development and introduction of a power generation system for converting exhaust-heat to electricity.

5.Versatility and expandability

- Visualization of energy consumption

- Containment of air conditioning load
- Improvement of factory air
- Containment of lighting load
- Introduction of summertime improvement of OA equipment

The nature of the peak-power containment activities is general, so they can be implemented horizontally for other business types.

6.Continuity and sus-tainability

The steps to reduce CO_2, reduce energy-consumption, visualize project achievements and issues, continue cost-reduction activities and sustain improvement were promoted by organizing them in a 3-year plan.

7.Investment efficiency

Unknown

8.Secondary results

- Patents, awards and presentations
- Nothing more, in particular ■

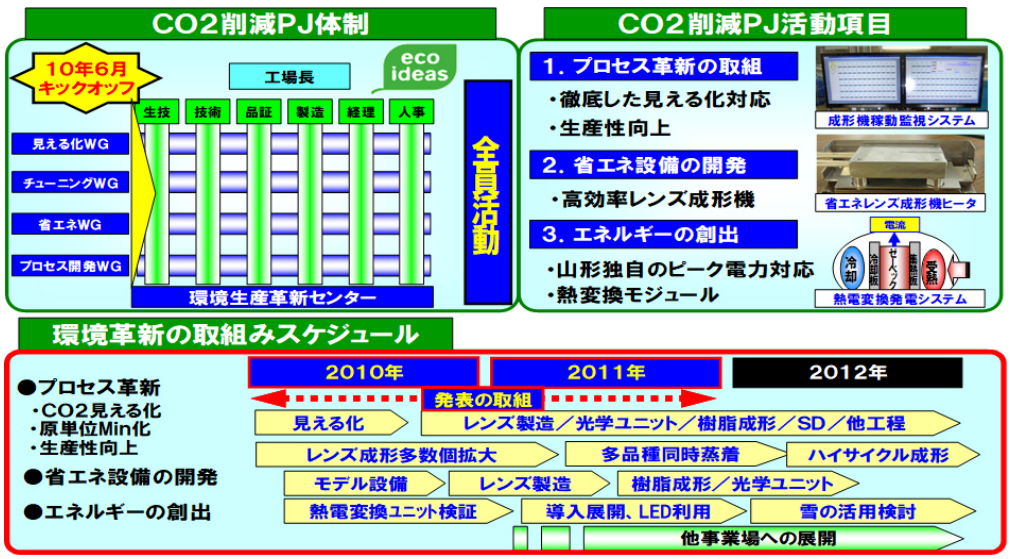


Figure 1

BP4: Low Exergy Utilization System across Multiple Sites

1.Details of case

"Low Exergy Utilization System across Multiple Sites" (hereinafter referred to as 'this project') was developed, installed and initially operated in 2005, which intended to share and utilize low-grade heat (low exergy) in a cascading manner at Fuji Oil Co. and Sumitomo Chemical Co. up to further lower temperature beyond a conventional utilization limit. This project consists of the following three sub-systems: (Photo 1)

(1) Energy sharing system across multiple sites (Fig. 1)
--- Ability to share the low-grade heat (150 oC) and maintain independent operation of each sites, based on Pinch technology (heat utilization methodology).

(2) Integrated energy monitoring system (Fig. 2)
--- Comprehensive analyses and assessments of the optimum operating conditions for whole of sites (area-wide optimization) in conjunction with Energy sharing system across multiple sites mentioned in (1).

(3) Low heat power generation system (Fig. 3)
--- Highly efficient power generation system with highly concentrated ammonia water as a working fluid by using the low-grade heat (115℃) of the overhead vapor from the distillation column in Fuji oil Co.

2.Diagrams

Photo 1 Overview of low exergy utilization system across multiple sites

Fig. 1 Energy sharing system across multiple sites

Fig. 2 Integrated energy monitoring system

Fig. 3 Low heat power generation system

3.Energy Conservation Performance

- Energy conservation amount in annual crude oil equivalent: 10,700 kiloliter (kL). Notes: 38.2 GJ is equivalent to one kL.

- Annual CO_2 emission reduction amount: 28,000 tons-CO_2

(1) In Energy sharing system across multiple sites, the energy conservation amount is 4,900 kL, annual crude oil. This figure was calculated based on boiler fuel reduction amount in Sumitomo Chemical with the booster pump load subtracted.

(2) Outcomes of Integrated energy monitoring system are included in 4,900 kL mentioned in (1), as its operation is integrated with Energy sharing system.

(3) Low heat power generation system generates electric power. The energy conservation amount is 5,800 kL

according to the actual operation data in all year. This energy conservation amount is calculated by subtracting the energy increases from electric power generated. The energy increases are the working fluid circulation pump and the cooling water pump required for the condenser.

4.Advantages and Originality

Supported by New Energy and Industrial Technology De-velopment Organization (NEDO) in FY2000 to FY2002, Chiyoda Corporation developed new Pinch technology (Ar-ea-wide pinch technology) applicable to heavy chemical complexes out of the conventional pinch technology intended for individual site. This project is a case of a new, advanced, and creative energy conservation joint project based on results of applying area-wide pinch technology to the 23 target sites in Chiba heavy chemical complex. Specifically, this project was developed from analyses of low-grade heat utilization in the heavy chemical complex. It is not only Ja-pan's but the world's first system designed to effectively uti-lize discarded low-grade heat across multiple sites beyond the conventional utilization limit.

•Energy sharing system across multiple sites utilizes low-grade heat (150 ºC) discarded in process plants in Fuji Oil and supplies such heat to adjacent Sumitomo Chemical via the new pipelines across two sites. Using the low-grade heat, Sumitomo Chemical heats the boiler feed water to the deaerator of the utility boiler and en-ables to reduce boiler fuel consumption. Usually the power generation at the steam turbine decreases as the low-pressure steam demand for heating the boiler feed water decreases. This system could solve the problem and maintain the power generation amount by installing the new high-pressure feed water preheater.

•Integrated energy monitoring system features a 2-level structure. The level 1 calculates the individual optimal operating condition for each site. The level 2 calculates the area-wide optimal operating conditions for whole of sites. And the level 2 collects the minimum required data from the level 1 and provides the solution result to the operators as an operation guide. The 2-level structure enables to achieve the following three important func-tions. i) secrecy, ii) expandability, iii) robustness. In ad-dition, this system enables to calculate the allocation for each site in the energy conservation amount secured at both sites by Energy sharing system. (Patent No. 4389577; Integrated energy optimization method at multiple facilities)

•Low heat power generation system is the world's first developed system in the refinery field. This system makes use of the low-grade heat (115 oC) in the over-head vapor from the distillation column in Fuji Oil Co. Conventionally such heat was discarded to the atmos-phere by air-fin coolers. But it became a heat source for this system and was exchanged with the highly con-centrated ammonia water to produce the high pressure ammonia vapor at 3 MPaG by the newly developed heat exchanger. The vapor drives the power generation tur-bine to generate 4 MW in electricity. (K. Matsuda, Low heat power generation system, Applied Thermal Engi-neering 70 (2014) 1056-1061)

5.Versatility and Expandability

Conventionally, it was believed that the individual site

in heavy chemical complexes had no more opportunity for energy conservation. Based on the result by area-wide pinch technology targeted on Chiba heavy chemical complex, however, it was found that there still was large energy conservation potential if the heavy chemical complex shared energy as if they were a single entity. This project of Chiba heavy chemical complex developed by area-wide pinch technology led to a turning point on a policy, the concept of "Promotion of Energy Conservation by Collaboration of Multiple Actors" appeared in the Basic Energy Plan formulated by Ministry of Economy, Trade and Industry in October 2003. With governmental support, similar systems have been actively introduced into many domestic heavy chemical complexes. Chiyoda Corporation applied area-wide pinch technology to five of the ten major domestic heavy chemical complexes and found out each of them still had a large energy conservation potential. Subsequently, based on the effects of this project introduced in Chiba complex, energy conservation joint projects across the sites have been expanded to Mizushima and Kashima heavy chemical complexes. In addition, area-wide pinch technology analysis has been applied to large-scale ironworks, which confirmed large energy conservation potential and identified several energy conservation measures.

6.Continuity and Sus-tainability

Area-wide pinch technology was applied to analyze the following areas:

(1)Domestic heavy chemical complexes

- Chiba heavy chemical complex
- Kashima heavy chemical complex
- Mizushima heavy chemical complex
- Ube heavy chemical complex
- Oita heavy chemical complex

(2)Overseas heavy chemical complexes

- Map Ta Phut heavy chemical complex, Thailand

7.Investment Efficiency

(1)Investment amount: Undisclosed

(2) Recovery period for facility introduction

A simple payback period is approx. 5 years for (a) Energy sharing system across multiple sites and (b) Integrated en-ergy monitoring system, and approx. 8 years for (c) Low heat power generation system. Nowadays economic evaluation has been greatly improved due to the subsequent increase of energy prices for crude oil and electric power.

8.Secondary Effects

(1)Environmental Effect

Based on the results by area-wide pinch technology, large energy conservation potential was confirmed in each heavy chemical complex.

For instance;

1) Chiba heavy chemical complex: 640,000 kL

2) Mizushima Heavy chemical complex: 1,210,000 kL

3) Map Ta Phut heavy chemical complex in Thailand: 880,000 kL

Figures amount up to 20 to 30% of the total energy consumption of each heavy chemical complex. It was found out that a large amount of energy conservation could be achieved by introducing a similar energy conservation project.

This project was implemented by the two sites in Chiba

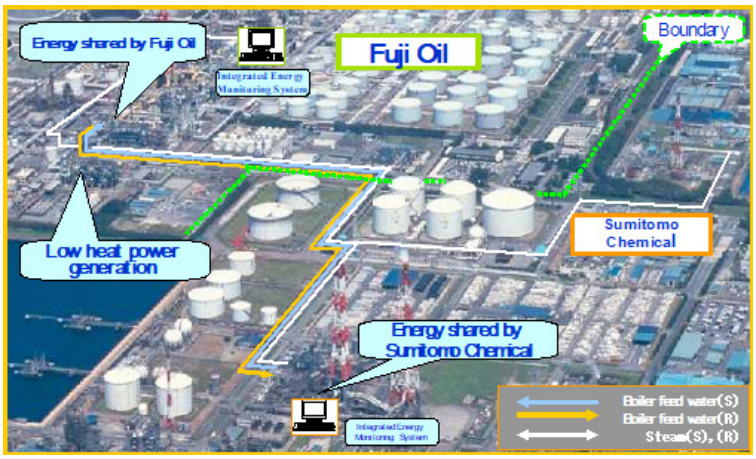


Photo 1 Overview of Low Exergy Utilization System across Multiple Sites

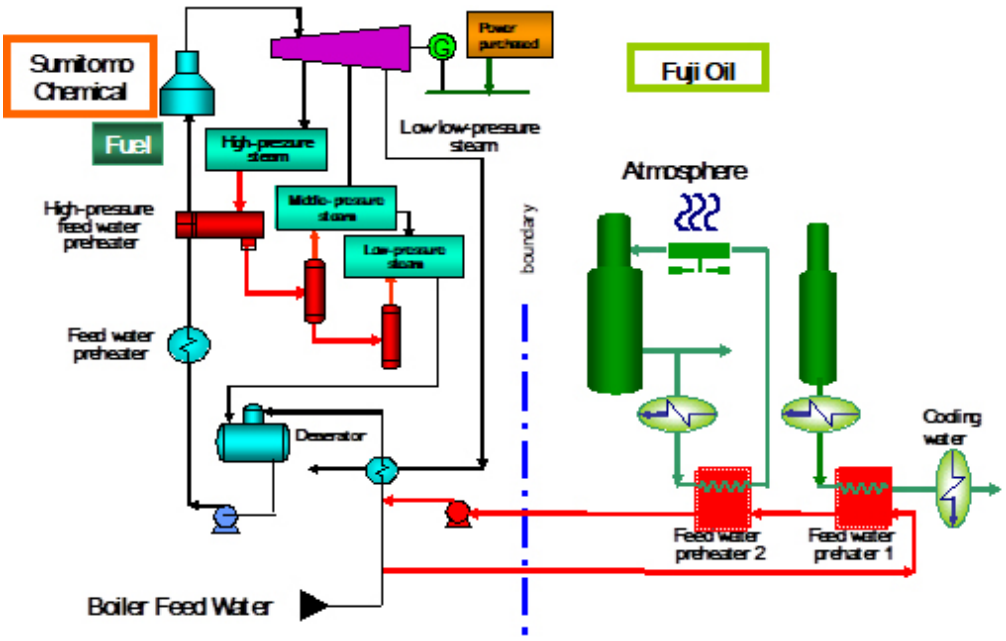


Fig. 1 Energy sharing system across multiple sites

heavy chemical complex, and its energy conservation amount is 10,700 kL (annual CO_2 emission reduction amount equiva-lent to 28,000 tons). It is now clear from this project that a huge amount of energy conservation (CO_2 reduction) can be expected if similar projects are introduced into other sites of the heavy chemical complexes.

(2)Human resource Development

In Japan, for the purpose of spreading the concept for energy conservation by sharing and effectively utilizing low-grade heat across multiple sites in the heavy chemical complexes, this has been announced at many occasions

in technical seminars and academic conferences, sponsored by public institutions such as New Energy and Industrial Technology Development Organization (NEDO), Society of Chemical Engineers, Japan (SCEJ), and Japan Society of Mechanical Engineers (JSME). With the support of NEDO, this project has also been announced overseas, in countries such as Thailand, Indonesia, China, Taiwan, Finland, and Czech.

Each country had strong interest and was eager to introduce area-wide pinch technology. Consequently, Map Ta Phut heavy chemical complex in Thailand was selected as the next target site followed by the Japanese heavy chemical complexes. Its application has been already materialized, supported by NEDO.

(3) Social Recognition

1)Awarded with "Agency for Natural Resources and Energy Director-General's Award" at Superior Energy-Saving Machines Commendation Ceremony of the Japan Ma-chinery Federation. (FY2006)

2)Awarded with "Special Award for Energy Conservation Grand Prize" of Ministry of Economy, Trade and Industry. (FY2011)

3)Posted on NEDO webpage "NEDO PROJECT SUCCESS STORIES" as a successful case of a NEDO project. (FY2014)

(4)Safety and Sanitation

This project has been improving the record for accident-free and stable operation since operation commencement in 2005.■

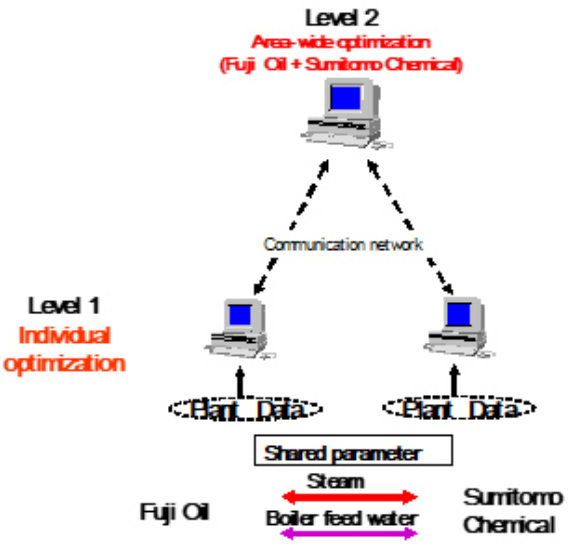


Fig. 2 Integrated energy monitoring system

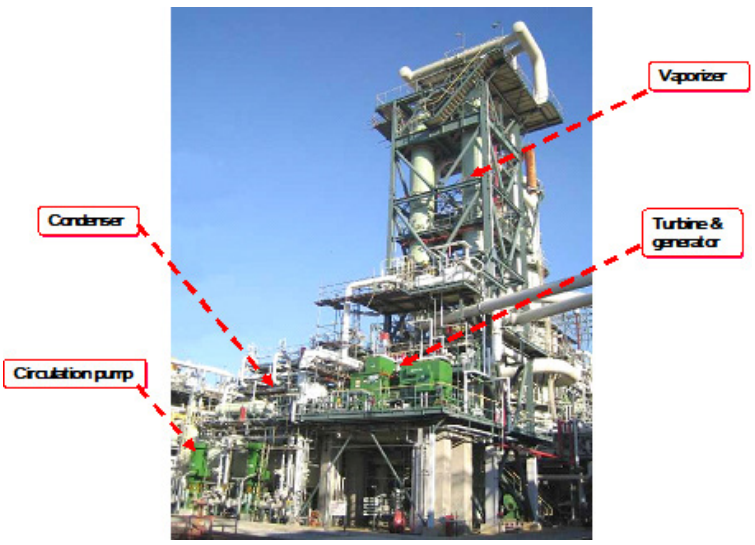


Fig. 3 Low heat power generation system

BP5: Reduction in Steam Loss from 100,000 Steam Traps

1.Details of case

Reduction in energy loss from steam leaks (hereafter steam loss) is one of the main pillars of energy conservation activities. The proper maintenance and management of steam traps is especially important from this viewpoint. Our company has long been managing this on its own.

However, in addition to the fact that the judgment standards and confirmation methods, which primarily relied on the five senses of the operator to determine whether the trap function is normal, were unclear, the enormous number of units (100,000 from seven refineries) limited our ability to achieve proper maintenance.

Thus, we planned to build, in collaboration with TLV Co., Ltd., an effective and sustainable program for maintenance and management that would allow us to comprehensively and accurately audit the traps of each refinery every year, feed the audit results into a database, and repair/replace traps based on analysis of this database.

As Figure 1 shows, the clarity and continuity of our work procedures have been enhanced by the newly crafted maintenance and management program, which is now based on an annual work cycle comprised of "6 steps" recommended by TLV in BPSTM (Best Practice of Steam Trap Management). In implementing each step, the head office, each refinery, and TLV reviewed the past characteristics and issues, together with new ideas, and built an efficient and sustainable program.(See Figure 1.)

2.Energy conservation performance

- Energy conservation amount in annual crude oil equivalent: ▲18,000 kL
- Annual CO_2 emission reduction amount:

▲46,000 t-CO_2.

As you can see from the leak failure rates of major refineries (Muroran, Mizushima) and the example trends of steam loss volume shown in Figure 2, the failed trap rate has been steadily declining every year as a result of the development of this program at each refinery since 2005. It is now assumed that the

total steam loss from all seven refineries was reduced by approximately 37 tons per hour by 2008.(See Figure 2.)

3.Advanced nature and originality

For building this program, we sought opinions from internal experts and operators and a trap manufacturer (TLV) on the issues of, and possible improvements to, existing mainte-nance and management, and adopted ideas from new viewpoints outside of the existing framework so that the program would work efficiently and sustainably. The following are the major ideas:

(1) Validation of audit technique (accuracy of inspection de-vice, skill level of inspector).

(2) Outsourcing of inspection work (consignment of man-power tasks).

(3) Efficient audit work (improved efficiency, labor savings by taking advantage of management tools such as use of IT technology).

(4) Introduction of the database management system (con-tinuous data updates and data analysis every year).

(5) Selection of the best trap model is critical to the safe operation of equipment and for the prevention of re-peated failures.

4.Versatility and expandability

In industries with large-scale facilities that use high volumes of steam for heating via piping and tanks, etc., large numbers of traps are installed causing many users to struggle with maintenance and management. In addition, in small and medium-sized factories and large buildings, steam is used for heating. Therefore, energy-conservation activities include periodic surveys and maintenance of traps.

In our case, the energy-saving effect for 100,000 traps is 18,000 kL/year (crude oil equivalent) and the economic advantage is around 1 billion yen (fuel cost assumed as 58,000 yen/kL). On the other hand, the cost spent on audits and repairs was around 900 million yen, proving it is eco-nomically sound. Also, by introducing ideas that make the maintenance and management program viable, it is also possible to continue to keep the steam loss to a minimum from now on.

Though this activity does not introduce state-of-the-art en-ergy-saving technology, it is a steady energy conservation activity that is sure to produce beneficial results. As a proverb says: "a penny saved is a penny earned."We think this ac-tivity is worth trying in other companies and industries. TLV is actually deploying this program as the 'BPSTM: Best Prac-tice of Steam Trap Management®" Program in major oil re-fining, petrochemical, and steel companies as well as in small and medium-sized plants in Japan, and has steadily achieved reductions in the leak failure rates and steam losses in 91 facilities. Additionally, TLV is proceeding to im-plement this program in countries outside of Japan, and is planning to implement a wider range of energy conservation activities. The results are as shown below.

* Actual implementation results as of 2014

(The figures show the steam loss reduction amounts and

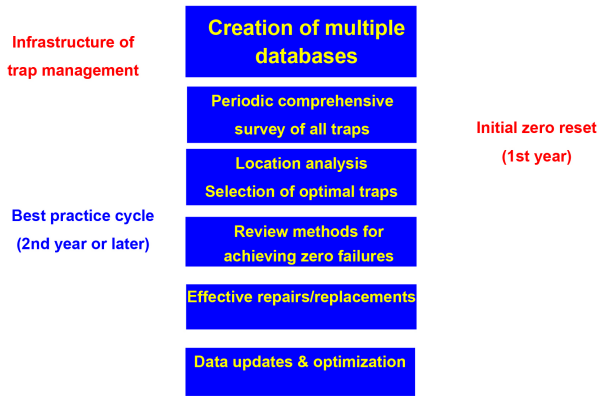
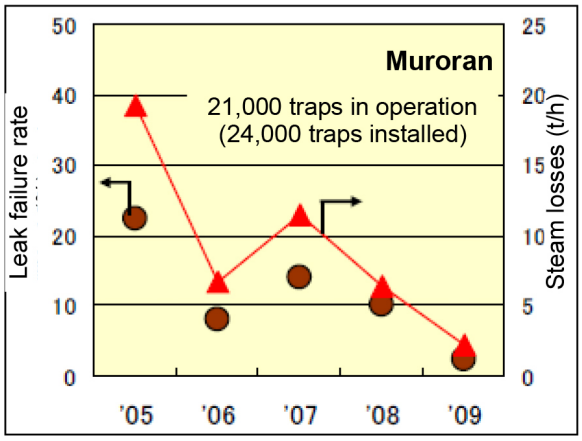


Fig. 1



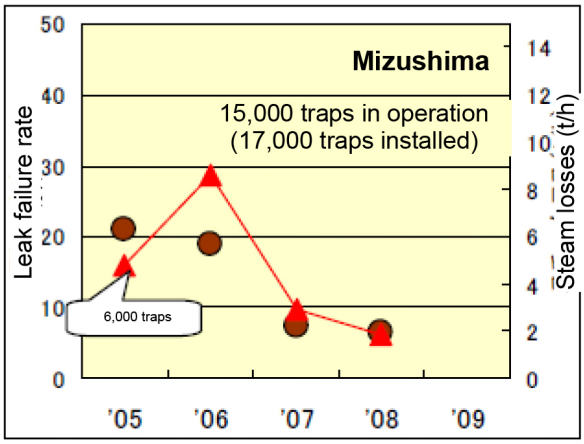


Fig. 2

CO_2 reduction amounts.)

(1) In Japan: 91 facilities, realizing reductions of 918,000 t/year and 134,000 t-CO_2/year

(2) Outside Japan: 18 facilities, realizing reductions of 175,000 t/year and 26,000 t-CO_2/year

5.Continuity and sus-tainability

This activity was launched at each refinery in 2005. We have been trying to tackle the existing issues related to maintenance management with new ideas, and have established an effective and sustainable program, which is now being sustained and managed.

Encouraged by the effects gained from trap activities, we have discovered overlooked energy losses, such as steam loss from unnoticed places and ineffective operations resulting from failures, and this has lead to enhanced voluntary energy conservation activities.

In Muroran's case, to promote energy conservation by reducing steam losses, and implementing "5S" by improving the clouded environment around leak locations, a "Steam Cloud Search Group"was formed, which conducted voluntary activities to search for leak locations and do repair work.

This also resulted in an increase in employee motivation, leading to improved knowledge of steam and pursuit of energy conservation. There are some refineries that are actively participating in the steam-specialized energy conservation and technical surveys

conducted by TLV.

Through these activities, executives at our company (head office) are not only promoting energy conservation activities but are also supporting each refinery with: labor-savings in operations through use of IT, establishment of the program, education of personnel, set up of the systems, technical support, and securing the budget for these efforts. In addition, the results of these activities are disclosed internally and externally (making it visible), thereby, motivating the employees in terms of energy conservation activities and contributing to continuity and sustainability.

6.Investment efficiency

Refer to"the energy-saving effect for 100,000 traps"described in 6. "Versatility and expandability".

7.Secondary results

Refer to "Actual implementation results as of 2014"described in 6. "Versatility and expandability," for CO_2 reduction amounts. ■

BP6: Energy Just In Time (JIT) Activities

1.Details of case

(1) Supply JIT (model activity: optimal supply of industrial air)

Improvements were implemented with the following steps in order to adapt the energy JIT to the concepts of supplying; when necessary (at an appropriate time), only as much as is needed (in an appropriate quantity), where necessary (at an appropriate site), and what is necessary (appropriate material), etc.

STEP1: Required amount of air and production site location are recorded in the registry and energy map.

STEP2: Timing of when the air is needed is understood from the signboard information generated from the production side.

STEP3: Air supply schedule and estimated amounts are calculated according to the signboard information and energy register.

STEP4: Pneumatic equipment, which matches the estimated air amount, is chosen from the equipment performance curve.

Thus, “necessary air supply operation when necessary with the highest efficiency” is realized.

(2) Production JIT (model activity: idling stop of system)

An automatic system for energy reduction at times of no-production was developed. Whereby, if the work or the handling of a current process becomes faulty, due to issues with previous process, etc., then the power supply to the equipment of the current process is automatically cut. When work for the current process becomes unnecessary, as the previous process is restored, the power supply is automatically restored.

2.Energy conservation performance

(1) Supply JIT (model activity: optimal supply of industrial air)

Intensity at the time of low load:

▲7% (9.9→10.6 m^3/kWh)

Electric energy of the pneumatic equipment:

▲2% (Air supply pressure: 480→470 kPa)

(2) Production JIT (model activity: idling stop of system)

Electricity reduction during the lunch break: ▲50%

Standby electricity during automatic operation:

▲70%

Daily power consumption: ▲approx. 7%

3.Advanced nature and originality

(1) Supply JIT (model activity: optimal supply of industrial air)

Besides traditional quantitative control using air pipe terminal pressure, a new pneumatic equipment control system was developed and standardized. It “calculates the air quantity requested by the factory by acquiring the production infor-mation then choosing and operating efficient pneumatic equipment that is the most suitable for the air amount cal-culated” (patent pending).

(2) Production JIT (model activity: Idling stop of system)

The “idling stop of system” was developed and standardized. It automatically shuts down the power supply of the standby power equipment when production is disabled, due to breakdown, etc., and automatically restores the power when it becomes necessary through the acquisition of the opera-tional information of the preceding and subsequent pro-cesses (patent pending).

4.Versatility and ex-pandability

(1) Supply JIT (model activity: optimal supply of industrial air)

The air JIT system has been implemented throughout the company since 2010, while establishing JIT tools such as the "energy signboard," "energy registry," "energy map," and the "optimal operation control" so that it can also be implemented in other workplaces.

(2) Production JIT (model activity: idling stop of system)

For the idling stop, the “application manuals” of the existing systems were prepared and distributed throughout the company. The idling stop for new systems was incorporated into the “design standard (DMS) for internal production systems” so that it is reflected in the design at the implementation stage.

5.Continuity and sustainability

Denso started the model demonstrations in FY2009. By verifying their effect, documenting the implementation method as manuals, and repeating explanatory meetings, the activities have been implemented in all of the Energy Workshops as an important energy conservation measure in the company. Furthermore, the Environment Committee considers energy JIT as one of the important energy conservation measures for development, and has implemented it in Group companies in Japan and overseas.

6.Investment efficiency

(1) Supply JIT (model activity: optimal supply of industrial air)

Investment amount of 52.92 million JPY; investment recovery for 2.8 y.

(2) Production JIT (model activity: idling stop of system)

Investment amount of 530,000 JPY; investment

recovery for 3.5 y.

7.Secondary results

Estimation of the effects when implemented throughout the company:

(1) 170 million JPY/y (electric energy for pneumatic equip-ment: ▲9%)

(2) 1.4 billion JPY/y (electric energy consumed in the pro-duction line: ▲7%)

Patents, awards, and presentations

(1) Patent application: Application No. PN134438 (submitted on September 21, 2010)

Presentations: (a) presented at the traveling lecture program of the Energy Conservation Center, Japan, Tokai-Hokuriku branch (80 attendees); and (b) presented at Nikkei (Febru-ary 4, 2010), and Nikkei Sangyo Shimbun (March 23, 2010)

(2) Patent application: Application No. PN137669 (submitted on November 30, 2010)

Presentation: the Mid-Japan Economist (March 23, 2010) ■

BP7: Integrating LNG Cold Energy into an Ethylene Plant

1.Details of case

Osaka Gas, a gas supplier, vaporizes LNG at the Senboku LNG Terminal (hereinafter referred to as "Senboku") adjacent to the Mitsui Chemicals Osaka Works and supplies it to six prefectures in the Kinki region as city gas. LNG is a -160 ºC cryogenic fluid and has considerable cold energy availa-ble for cooling substances. Its effective use helps energy conservation and CO_2 emission reduction. Some plants in the precincts of the Mitsui Chemicals and Osaka Petro-chemical Industries input energy, such as electric power and steam, in order to generate cold energy through the refrig-erators, and utilize it for separation, etc. during product manufacture. At present, the world's first large-scale energy conservation process has been introduced, which is capable of receiving LNG into the ethylene plant from Senboku I, making use of LNG cold energy in the most effective manner in the factory and greatly reducing the energy required for the refrigerators.

2.Diagrams and other illustrations

See Figure1.

3.Energy conservation performance

Test operations started in September 2010 and full-scale operations in January 2011, confirming the following substantial energy conservation effects:

- A 6% reduction in energy intensity at the ethylene plant of Osaka Petrochemical Industries.
- Total reduced crude oil equivalent energy of 13,000 kL/y at four factories, with a reduction rate of 1.4%.

4.Advanced nature and originality

- Realizes remarkable energy conservation at the ethylene plant by utilizing the capability of cascading the LNG cold energy in a phased manner within a wide temperature range from -100 to 20 ºC.
- Establishes a new process capable of high energy conservation performance with high operational stability, while continuously securing the required amount of cold energy by combining the LNG cold energy, refrigeration compressor, and expandor, even when the LNG supply volume to the ethylene plant fluctuates.
- First example of the utilization of LNG cold energy on a

large scale at an ethylene plant in the world.

- Collaborative program comprehensively combining energy ranging over different types of industries, such as the gas and petrochemical industries, in an industrial complex.

- Realizes 100% LNG cold energy utilization at Senboku I (on a throughput basis) and improves exergy efficiency of the entire terminal by 14%.

5.Versatility and expandability

- Utilization of LNG cold energy has been attracting attention owing to higher environmental awareness and increased LNG introduction.

- Even when the LNG supply volume fluctuates, this process has high operational stability allowing the continuous operation of the ethylene plant by the combined use of a refrigeration compressor. It is widely applicable when making use of LNG cold energy as an alternative to a refrigerator at chemical plants, etc.

- This is a collaborative program comprehensively combining energy, for the gas and petrochemical industries, and a model case for business collaboration in other regional industrial complexes. It is expected that the application of this technology in Japan and overseas will develop large-scale energy conservation in the future.

6.Continuity and sus-tainability

- Improvements to increase LNG cold energy usage will be examined to pursue further increases in energy conserva-tion.

7.Investment efficiency

Unknown

8.Secondary results

Patents, awards received and publications:

(1) Press releases: Nikkan Kogyo Shimbun and eight other cases.

(2) Official announcements: Kyodo press release and four other examples.

(3) Document contributions: Ministry of Economy, Trade and Industry, “Chemical Vision Study Group” and two other cases. ■

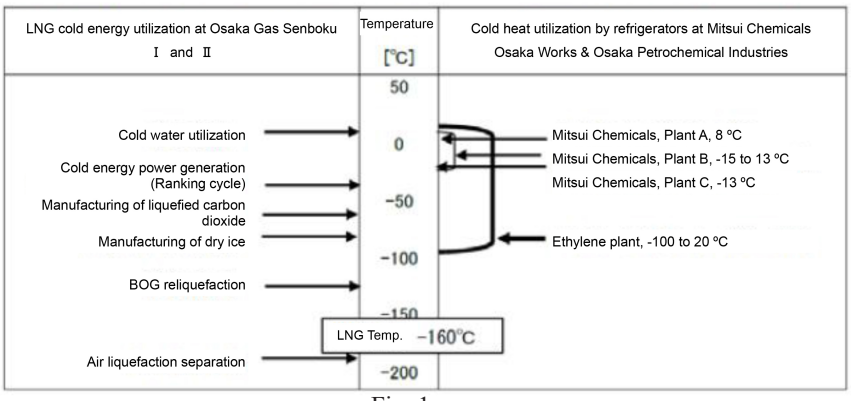


Fig. 1

BP8: Electricity-saving Measures by Coca-Cola: Development and Popularization of Peak Shift Vending Machines

1.Details of case

In response to the decreased electric power supply after the Great East Japan Earthquake in 2011, a Power-saving Project Team was formed. By formulating power-saving measures that included halting cooling operations using three-group rotation and comprehensively implementing power-saving measures over a short period targeting ap-proximately 350,000 vending machines, reductions in elec-tric power consumption exceeding the government targets were achieved.

In order to further develop and continually promote the concept of “reduced electric power consumption during daytime in summer when electric power is insufficient,” Co-ca-Cola (Japan) developed a "Peak Shift Vending Machine" jointly with Fuji Electric, Japan's largest vending machine manufacturer.

Aimed at wide and quick popularization of this new vending machine in the market, an installation target of 25,000 units was determined for the current fiscal year(2013FY). Through strengthened cooperation with bottling companies, devel-opment and application of a variety of sales tools, and im-plementation of unique communication strategies and public relations activities in terms of society and consumers, the installation target was achieved ahead of the plan (by late September). In addition, a public awareness rate of 35% was achieved, with the media exposure also reaching an amount equivalent to 1.3 billion yen, indicating a widening circle of awareness.

2.Diagrams

See Figure1&2.

3.Energy conservation performance

● Actual energy conservation results realized for each vending machine

- The annual electric power consumption has been reduced to approximately one-third over the past 10

years.

- In addition, the introduction of the Peak Shift Vending Machine has reduced the electric power consumption by more than 10% compared to the vending machine previously used by Coca-Cola (FY2012 machine).

● Total electric power consumption by the vending machines in the market

- 40% reduction over a 10-year period (reduction of more than 1 billion kWh over a 10-year period)

● Energy conservation merits of Peak Shift Vending Machines

- For summer, when the electricity demand is generally high, 16 hours of daytime electric power consumption for cooling have been reduced to zero, i.e., the daytime electric power consumption has been reduced by 95%

4.Technological advancement and originality

-In order to reduce the daytime electric power consumption for cooling to zero, all the products in the vending machine are cooled and utilized as cold storage materials.

-Improvements in terms of airtightness and efficient utilization of vacuum heat insulating materials in the vending machines have enabled cooling effect to be maintained over longer time periods.

5.Versatility and expandability

-Technology disclosure commenced against the main vending machine manufacturers.

Market share to be expanded to 30% by 2020.

In 2014, production has been started by all four vending machine manufacturers in Japan, and they are trying to popularize it as a new energy-saving measure.

-Promoting awareness and education on the peak shift concept through positive public relations activities.

-A"47 Prefecture Electricity-saving Awareness Survey"was carried out targeting the whole of Japan, and the results were released to the public.

6.Continuity and sustainability

- Implemented planned promotion of the Peak Shift Vending Machine functions as “standard functions.”

7.Investment efficiency

Unknown

8.Secondary results

Patents, awards, and presentations:

(1) Patents: 1 patent (Joint application with Fuji Electric)

(2) Presentations (Television): Total 19 media including NHK

(3) Presentations (News Agencies): Total 8 media including Kyodo News

(4) Presentations (National Newspapers): Total 8 media including Asahi Shimbun

(5) Presentations (English Newspapers): Total 3 media including The Japan Times

(6) Magazines and Trade Journals: Total 88 media including The Economist and Energy Conservation

(7) WEB: Total 744 media including NHK ONLINE

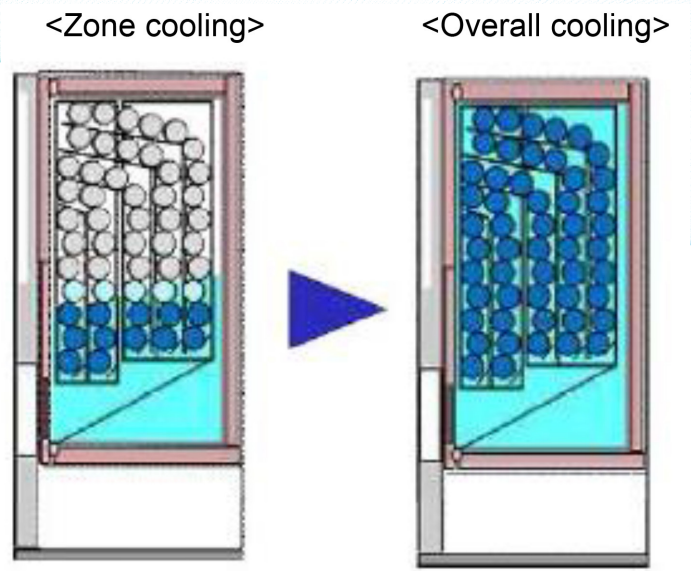

<Zone cooling>
<Overall cooling>

Fig. 1

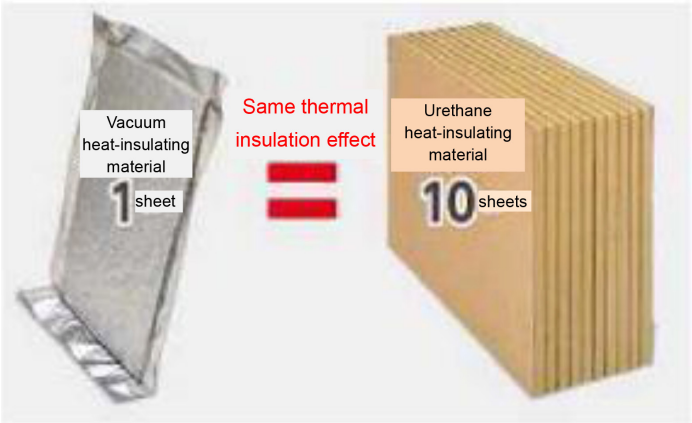

Vacuum heat-insulating material
1 sheet
Same thermal insulation effect
Urethane heat-insulating material
10 sheets

Fig. 2