Energy saving / power saving support service

diagnosis casebook

Complimentary Energy Conservation Audit Cases in FY2016

The Energy Conservation Center, Japan

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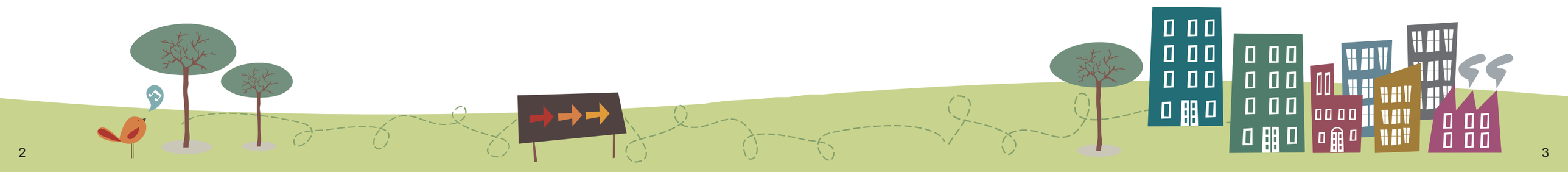


[Tohoku Area]

CASE 1

Audit case of energy conservation/power-saving support services

Case of Japanese Sake Manufacturer

- Industry type: Foodstuffs ■ Products: Japanese sake
- Company name: Ichinokura Co., Ltd.
- No. of employees: Approx. 150

Conducting energy conservation activities such as introduction of the demand monitoring equipment, Ichinokura Co., Ltd. requested for an overall energy conservation audit this time. As a result of the audit, we proposed renewal of the air-conditioning system, adjustment of the boiler air ratios, enhanced thermal insulation of steam piping, introduction of inverters to the aeration blowers, higher-efficiency lighting and guide lights, conveyor operation control by sensors, and so on.

●Effects of the measures (Audit)

Energy consumption (crude oil equivalent)

Reduced by **43** kL/year

Energy cost

Reduced by **2,600,000** yen/year

Proposals requiring no cost (Note) Energy conservation effect is shown in crude oil equivalent.

1. Air-conditioning system: Reduction of standby electric power by shutting off the power during the no-use period of an outdoor unit

The compressor of the outdoor unit is equipped with a crank case heater that is always left energized. We proposed shutting off the power for the outdoor unit during the no-use period of an air-conditioner, thereby saving the power.

Energy Saving: 0.6 kL/year
Cost Saving: 32,000 yen/year
Facility: 25 outdoor units (crank case heater: 40 W/unit)

2. Boiler: Adjustment of the air ratio

Since the air ratios of two boilers are high (1.8 for the No. 1 boiler and 1.6 for the No. 2 boiler), we proposed lowering the ratios to the EC Guideline (1.3) based on the Act on the Rational Use of Energy, thereby reducing heavy oil consumption.

Energy Saving: 10.4 kL/year
Cost Saving: 676,000 yen/year
Facility: 2 boilers (3 t/h/unit, total heavy oil consumption: 318 kL/year)

3. Compressor: Reduction of the discharge pressure

Since one of the compressors (multiple units) has a high discharge pressure, we proposed lowering it (from 0.80 to 0.65 Mpa) to reduce power consumption.

Energy Saving: 1.2 kL/year
Cost Saving: 71,000 yen/year
Facility: 1 compressor (7.5 kW)

Making investments into facilities with higher efficiency (Note) Energy conservation effect is shown in crude oil equivalent.

4. Air-conditioning system: Renewal to the high-efficiency air-conditioner

The air-conditioning system has been used for 20 years after installation and aged. The production of a refrigerant (R22) will be discontinued in 2020 as a global warming preventive measure. Accordingly, we proposed renewing to the latest high-efficiency air-conditioner to conserve energy. This time, we made a calculation on 4 air-conditioners in the office.

Energy Saving: 3.1 kL/year
Cost Saving: 181,000 yen/year
CAPEX: 5,280,000 yen
PP: Upon renewing the aged system
Facility: 4 air-conditioners (cooling/heating capacity: 20/22.3 kW/unit, cooling/heating COP: 2.8/3.0 to 4.2/4.1)

5. Steam piping: Enhanced thermal insulation of the steam piping

We proposed enhancing thermal insulation of the valves and flanges of the steam piping to decrease heat dissipation, thereby reducing the heavy oil consumption of the boilers.

Energy Saving: 3.5 kL/year
Cost Saving: 228,000 yen/year
CAPEX: 540,000 yen **PP:** 2.4 years
Facility: Flange type globe valves (3 pcs. for 100A, 10 pcs. for 80A, and 1 pc. for 65A), flanges (1 pc. for 200A, 5 pcs. for 80A and 5 pcs. for 50A), etc.

6. Wastewater treatment system: Inverted-based aeration blower

Two aeration blowers are always operating, but a wastewater discharge volume decreases during the period of using less water. Accordingly, we proposed introducing an inverter for the blower to reduce an air feed rate on holidays and during the no-use time (frequency setting 60%), thereby promoting energy conservation.
(Note) A further effect is obtained by attaching a DO meter (Dissolved Oxygen) to continuously measure, and controlling an aeration roots blower by an inverter (rotation frequency control by a DO value, lower air volume) so that the DO value will maintain a standard value.

Energy Saving: 11.4 kL/year
Cost Saving: 665,000 yen/year
CAPEX: 500,000 yen **PP:** 0.8 years
Facility: 2 blowers (7.5 kW/unit)

7. Lighting: Renewal to the higher-efficiency lighting and guide lights

We proposed renewing (1) the fluorescent lamps to the low-power consumption (approx. 40% less), long-life (50,000 h.) and inexpensive cold-cathode ones, (2) the downlights (fluorescent lamps) at the entrance to LED lighting, and (3) the fluorescent guide lights to the LEDs, thereby reducing power consumption.

Energy Saving: 5.2 kL/year
Cost Saving: 304,000 yen/year
CAPEX: 4,917,000 yen
PP: Upon renewing the aged system
Facility: Fluorescent lamps, downlights (fluorescent lamps), fluorescent guide lights → Renewal to cold-cathode fluorescent lamps, LED lamps and LED guide lights

Status quo	Renewal plan	Qty.	Money saved (in ¥1,000)	Investment (in ¥1,000)	Payback period (in years)
(1) Fluorescent lamps (36 W/unit)	Cold-cathode fluorescent lamp (22 W/unit)	64	42	384	9.1
(2) Downlights (Compact fluorescent lamps, 13 W/unit)	LED lamps (6.9 W/unit)	17	6	136	22.7
(3) Fluorescent guide lights (15 W/unit)	LED guide lights (2.0 kW/unit)	125	256	4,397	17.2
Fluorescent guide lights (23 W/unit)	LED guide lights (2.7 kW/unit)	16			
Total		222	304	4,917	16.2

8. Lighting: Dimming control of the staircase lighting by a motion detector

We proposed renewing the FLR fluorescent lamps to the Hf fluorescent lamps with motion detector/dimming control function to control the illuminance to 100% when someone passes the staircase and dim to 30% when no one passes, thereby reducing power consumption.

Energy Saving: 0.8 kL/year
Cost Saving: 44,000 yen/year
CAPEX: 504,000 yen **PP:** 11.5 years
Facility: FLR fluorescent lamps (6 units, 85 W/unit) → Renewal to Hf fluorescent lamps with motion detector (6 units, 65 W/unit)

9. Production system: Conveyor operation control by sensors

The conveyors in a canning factory are running even when there is nothing to convey. We proposed installing conveyed goods detection sensors to stop the conveyors when there is nothing to convey, thereby conserving energy.

Energy Saving: 1.9 kL/year
Cost Saving: 108,000 yen/year
CAPEX: 300,000 yen **PP:** 2.8 years
Facility: 30 conveyors (0.25 kW/unit), 10 conveyed goods detection sensors (installed for every 3 conveyors)

10. Transformer: Renewal to higher-efficiency transformers and their integration

We proposed (1) renewing 18-year-old transformers to the high-efficiency ones and (2) integrating 3 transformers into 2 units, thereby reducing transformer losses.

Energy Saving: 5.0 kL/year
Cost Saving: 291,000 yen/year
CAPEX: 3,740,000 yen **PP:** 12.9 years
Facility: (1) Renewal of the transformers (1ø: 1 unit, 200 → 150 kVA), (2) Integration of the transformers (3ø: 3 units, 500 kVA/unit → 2 units, ø500 kVA/unit)

Major efforts in energy conservation activities

1. Adjusting the boiler air ratios for operational improvement
Concerning adjustment of the boiler air ratios, the setting of the operating requirements has been changed for the two boilers. Prior to the audit, they were not properly managed due to high air ratios, but energy conservation effects are now obtained by appropriately lowering air volumes.

2. Utilizing a subsidy to steadily implement an investment-required improvement proposal
Enhanced thermal insulation of the steam piping and energy conservation of lighting by the motion detectors were implemented starting from what can be done. The inverter-based aeration blowers were materialized by initially installing a timer to intermittently operating them. Furthermore, since the air-conditioners, which control the temperature important for brewing, have been installed 20 years and the refrigerant used (R22) will go out of production in 2020, the subsidy was utilized to systematically renew the equipment, realizing energy conservation and stabilizing the product quality. For lighting, the subsidy was utilized to renew the fluorescent lamps and mercury lamps to the LED lamps, starting from those with longer lighting hours.

3. Continuing the energy conservation measures to deliver quality products
After taking the energy conservation audit, an energy management organization was established to positively promote energy conservation activities. Presently, the boilers are being renewed (heavy oil → gas). From now on, high-efficiency equipment will be continually introduced in line with facility improvement.

[Chugoku Area]

CASE 2

Audit case of energy conservation/power-saving support services

Case of Machined Components Manufacturer

- Industry type: Metals
- Products: Machined components
- Company name: Company A ■ No. of employees: 130

Company A has been conducting energy conservation activities such as thinning out/turning off unnecessary lighting fixtures, introducing high-efficiency boilers and utilizing demand monitoring equipment. This time, they requested for an overall energy conservation audit, focusing on the machining facilities. As a result of the audit, we proposed a lower steam pressure fed to the machining line, utilization of inverter-based exhaust fans, thermal insulation of the steam piping and the outer periphery of the industrial furnaces, LED-based lighting in the office and the factory, and so on.

●Effects of the measures (Audit)

Energy consumption (crude oil equivalent)

Reduced by **184** kL/year

Energy cost

Reduced by **14,896,000** yen/year

Proposals requiring no cost (Note) Energy conservation effect is shown in crude oil equivalent.

1. Air-conditioning system: Easing of the air-conditioning setting temperature

The standard cooling/heating setting temperature is 28/18°C, but the setting temperature is not properly controlled for some part of the system. We proposed easing the cooling/heating setting temperature by 1°C (27/21°C → 28/20°C) and strictly observing the standard values, thereby reducing power consumption.

Energy Saving: 10.8 kL/year
Cost Saving: 554,000 yen/year
Facility: Air-conditioners (total power consumption for cooling/heating: approx. 350,000/67,000 kWh/year)

2. Production system: Utilization of the inverter-based exhaust fans

The exhaust fans in the machining line are continuously running at ratings for 24 hours, but an air volume can be reduced during a non-production time. We proposed utilizing the inverters of the exhaust fans in the A- and B-product lines to reduce the air volume to 50% during the non-production time, thereby lowering power consumption. The effects were calculated assuming a production time to be 16 hours/day x 245 days.

Energy Saving: 41.6 kL/year
Cost Saving: 2,137,000 yen/year
Facility: 2 exhaust fans (18.5 and 22 kW)

Making investments into facilities with higher efficiency (Note) Energy conservation effect is shown in crude oil equivalent.

3. Steam-based system: Reduction of the steam pressure fed to the machining line

The steam pressure 0.6 MPa fed to the machining line is high. We proposed attaching a reducing valve to reduce the steam pressure (0.6 → 0.30 MPa, 0.30 MPa less), thereby reducing city gas consumption (by 4.1%).

Energy Saving: 35.3 kL/year
Cost Saving: 3,175,000 yen/year
CAPEX: 500,000 yen **PP:** 0.2 years
Facility: Machining line boiler (13A city gas consumption: 430,000 m³/year)

4. Steam piping: Enhanced thermal insulation of the steam piping

We proposed enhancing thermal insulation of the steam piping of a boiler room and the machining line to reduce futile heat radiation, thereby reducing fuel (city gas) consumption of the boiler.

Energy Saving: 29.6 kL/year
Cost Saving: 2,663,000 yen/year
CAPEX: 500,000 yen **PP:** 0.2 years
Facility: Flange type gate valves (2 pieces for 80A, 8 pcs. for 40A), flanges (10 pcs. for 40A, 182 pcs. for 25A), piping (6 pcs. for 40A), etc.

5. Industrial furnace: Enhanced thermal insulation of the outer periphery of the industrial furnace

(1) The average outer peripheral temperature of a reflow electric furnace is high at 80°C, (2) that of a steam dry furnace is high at 55°C, and (3) that of a refining furnace is high at 75°C. We proposed reducing a radiation heat loss by enhanced thermal insulation of the outer peripheries of the furnaces in (1), (2) and (3), thereby realizing energy conservation.

Energy Saving: 14.5 kL/year
Cost Saving: 862,000 yen/year
CAPEX: 373,000 yen **PP:** 0.4 years
Facility: Reflow furnace, dry furnace and refining furnace

	Avg. outer peripheral temperature (°C)	Qty.	Total furnace surface area (m²)	Money saved (in ¥1,000)	Investment (in ¥1,000)	Payback period (in years)
(1) Reflow electric furnace	80	5	8.6	419	84	0.2
(2) Steam dry furnace	55	1	2.0	286	222	0.8
(3) Refining electric furnace	75	2	6.0	157	67	0.4
Total				862	373	0.4

6. Industrial furnace: Inverter-based dry furnace air feed fan

An air feed fan for the dry furnace (electric fan) throttles an air volume to 30% with a damper. Because a throttle resistance loss results from throttling with the damper, we proposed encouraging energy conservation by the fully opened damper plus inverter-based control.

Energy Saving: 2.0 kL/year
Cost Saving: 101,000 yen/year
CAPEX: 125,000 yen **PP:** 1.2 years
Facility: 1 fan (3.7 kW)

7. Lighting: LED-based lighting in the office and the factory

We proposed renewing the (1) rapid start type fluorescent lamps in the factory and office to the straight-tube LEDs and (2) mercury lamps in the factory to the high-efficiency metal halide lamps, thereby realizing energy conservation.

Energy Saving: 50.4 kL/year
Cost Saving: 2,583,000 yen/year
CAPEX: 7,199,000 yen **PP:** 2.8 years
Facility: Fluorescent lamps and mercury lamps → LEDs and metal halide lamps

Status quo	Renewal plan	Lighting hours (h./day)	Qty.	Money saved (in ¥1,000)	Investment (in ¥1,000)	Payback period (in years)
(1) FLR fluorescent lamps (47 W/unit)	Straight-tube LED lamps (25 W/unit)	24	545	2,323	7,135	3.1
FLR fluorescent lamps (115 W/unit)	Straight-tube LED lamps (50 W/unit)		67			
FLR fluorescent lamps (47 W/unit)	Straight-tube LED lamps (25 W/unit)	12	632			
FLR fluorescent lamps (115 W/unit)	Straight-tube LED lamps (50 W/unit)		58			
(2) Mercury lamps (400 W/unit)	Metal halide lamps (400 W/unit)	24	11→6	260	64	0.2
Mercury lamps (400 W/unit)	Metal halide lamps (400 W/unit)	12	16→8			
Total			1,302	2,583	7,199	2.8

8. Demand control: Reduction of demand by enhanced control

We proposed utilizing the present demand monitoring controller to introduce automatic demand load control for an air-conditioning load, etc., thereby reducing maximum power (contract demand) (1,301 to 1,171 kw, 130 kW less). The effects were calculated on the premise of 10% demand reduction from the present contract, including demand reduction (approx. 60 kW) by this energy conservation proposal.

Maximum power: 130 kW less
Cost Saving: 2,821,000 yen/year
CAPEX: 1,000,000 yen **PP:** 0.4 years
Facility: Demand monitoring equipment and automatic demand load controller

Major efforts in energy conservation activities

1. Promoting energy conservation while assessing an effect on the quality and workability
The inverters have been already utilized for seven of the nine exhaust fans in the machining line. For the remaining two, an effect on the working environment and the quality is being assessed. Thermal insulation has been firstly enhanced on the dryers, heaters and steam piping within the range of not affecting the product quality. Thermal insulation of the facilities having an effect on the quality is being carefully carried out.

2. Utilizing a subsidy to realize higher-efficiency air-conditioning and lighting and introduce the EMS
The facilities with large investments were finished by utilizing the “Promotion Project Subsidy for Investments in Energy Conservation and Productivity Revolution of Small- and Medium-sized Businesses” and “Promotion Project for Smart Energy Introduction for Business Offices in Okayama City”. The air-conditioners were renewed to the higher-efficiency ones, the fluorescent lamps and mercury lamps were replaced by LEDs, and the demand controller was introduced to control an air-conditioning load, etc. The renewal will be continued step by step.

3. Energy conservation and environmental activities participated by all the employees
They have learned the concept of extracting the problems and the method of calculating cost-effectiveness through the energy conservation audit, and a field driving force and management (investments) started rolling together, achieving significant results. On the other hand, activities have been going on such as improved work uniforms and reduced industrial waste by thorough sorting, continuing to address new improvement items by the vitalized company and office.

[Kinki Area]

CASE 3

Audit case of energy conservation/power-saving support services

Case of Manufacturer of Surface Treatment Agents and Adhesive Agents

- Industry type: Chemistry
- Products: Chemical treatment agents
- Company name: Company A ■ No. of employees: 50

Company A has been conducting energy conservation activities such as easing an air-conditioning setting temperature, thinning out/turning off unnecessary lighting fixtures, and utilizing the demand monitoring equipment. This time, they requested for an overall energy conservation audit. As a result of the audit, we proposed renewal to high-efficiency air-conditioners, lower steam pressure of the boilers, renewal to a high-efficiency inverter-controlled compressor, LED-based lighting in the office and the factory.

●Effects of the measures (Audit)

Energy consumption (crude oil equivalent)	Energy cost
Reduced by **16** kL/year	Reduced by **1,514,000** yen/year

Proposals requiring no cost (Note) Energy conservation effect is shown in crude oil equivalent.

1. Boiler: Reduction of the steam pressure

Steam is used for reactors, etc. Since a reducing valve is used to reduce a pressure, we proposed lowering the steam pressure (0.70 → 0.60 MPa, 0.1 MPa lower) to reduce bunker-A consumption. (Note) The boiler has been renewed in the year when the audit was conducted to change fuels (bunker A → city gas). The effects were calculated with the bunker A because there are no actual fuel consumption data from the previous year.

Energy Saving: 0.8 kL/year
Cost Saving: 70,000 yen/year
Facility: 2 boilers (0.8 t/h./unit, total bunker-A consumption: 52 kL/year)

2. Compressor: Reduction of the discharge pressure

The factory consumes air for the reactor, dissolver's air cylinder, drum turnover machine, etc. The discharge pressure of the compressor is high at rated 0.69 MPa, seemingly reducible. We proposed lowering the discharge pressure by 0.05 MPa to reduce power consumption.

Energy Saving: 0.3 kL/year
Cost Saving: 28,000 yen/year
Facility: 1 compressor (22.5 kW)

3. Air piping: Air leak prevention

It is difficult to detect a leak from the air piping or know a leak amount, but it is said that the leak amount accounts for 10 to 20% of the air usage of the factory. We proposed decreasing the leak amount from the air piping to reduce the power consumption of the compressor (the effects were calculated on the premise of a 10% leak rate and 80% improvement thereof).

Energy Saving: 0.5 kL/year
Cost Saving: 44,000 yen/year
Facility: 1 compressor (22.5 kW)

4. Demand control: Inhibition of the maximum power by utilizing the demand monitoring equipment

We proposed utilizing the existing demand monitoring equipment to monitor a change of the maxim power, and inhibit the maximum power (210 → 200 kW, 10 kW less) such as by stopping predetermined equipment (air-conditioner) and shifting operation of the production system when the maximum power approaches a setting value.

Maximum power: 10 kW less
Cost Saving: 139,000 yen/year
Facility: Demand monitoring equipment

5. Automatic vending machine: Renewal to high-efficiency automatic vending machines

We proposed renewing automatic vending machines to the latest energy conservation type (peak-shift automatic vending machines) to reduce power consumption (58% less).

Energy Saving: 0.5 kL/year
Cost Saving: 40,000 yen/year
Facility: 2 automatic can/bottle vending machines (total power consumption: 3,300 kWh/year)

Making investments into facilities with higher efficiency (Note) Energy conservation effect is shown in crude oil equivalent.

6. Air-conditioning system: Shielding of outdoor units from solar radiation

There are many air-conditioners and their outdoor units are installed outdoors or on the verandas. We proposed shielding the outdoor units from solar radiation (with a reed blind, etc.) to inhibit a temperature rise of the heat exchanger fins, etc. in summer and decrease a condenser's load, thereby reducing the power consumption for air-conditioning.

Energy Saving: 0.6 kL/year
Cost Saving: 47,000 yen/year
CAPEX: 58,000 yen **PP:** 1.2 years
Facility: 29 electric HP air-conditioners (total rated electric power: 97 kW, cooling/heating COP: 2.3 to 5.0/2.3 to 5.6)

7. Steam piping: Enhanced thermal insulation of the steam piping

We proposed enhancing thermal insulation of the steam piping fed to the reactors, humidifying storerooms, etc. in the factory, using a thermal insulation cover, etc., thereby reducing the bunker-A consumption of the boilers.

Energy Saving: 6.2 kL/year
Cost Saving: 564,000 yen/year
CAPEX: 1,040,000 yen **PP:** 1.8 years
Facility: Flange type globe valves (2 pcs. for 50A), reducing valves (10 pcs. for 50A), and flanges (40 pcs. for 50A)

8. Compressor: Renewal to a high-efficiency inverter-controlled compressor

A constant-rate compressor is used to control loading/unloading, but it consumes the electric power even during unloading. We proposed renewing to an inverter-controlled compressor to reduce power consumption.
(Note) Because the inverter-controlled compressor controls a rotation frequency so as to keep a constant pressure according to a discharge air rate, power consumption decreases as the air rate drops, having an energy conservation effect in a partial load.

Energy Saving: 3.5 kL/year
Cost Saving: 284,000 yen/year
CAPEX: 1,800,000 yen **PP:** 6.3 years
Facility: 1 compressor (22.5 kW)

9. Lighting: LED-based lighting in the office and the factory

We proposed renewing the (1) FLR fluorescent lamps of the office and the (2) mercury lamps of the factory to LED-based lighting to save the electric power.

Energy Saving: 3.3 kL/year
Cost Saving: 272,000 yen/year
CAPEX: 2,220,000 yen **PP:** 8.2 years
Facility: FLR fluorescent lamps and mercury lamps → LED lamps

Status quo	Renewal plan	Qty.	Money saved (in ¥1,000)	Investment (in ¥1,000)	Payback period (in years)
(1) FLR fluorescent lamps (79 W/unit)	Straight-tube LED lamps (40 W/unit)	100	144	1,800	12.5
(2) Mercury lamps (310 W/unit)	LED lamps (79 W/unit)	6	128	420	3.3
Total		106	272	2,220	8.2

10. Tea dispenser: Suspension of automatic tea dispensers during an unnecessary time

The automatic tea dispensers in the cafeteria and the office are continuously operating for 24 hours. We proposed using a schedule timer to turn them off during a nighttime period (8:00 p.m. to 8:00 a.m.) in which there are no users, thereby reducing power consumption.

Energy Saving: 0.3 kL/year
Cost Saving: 26,000 yen/year
CAPEX: 24,000 yen **PP:** 0.9 years
Facility: 2 tea dispensers (total power consumption: 2,400 kWh/year)

Major efforts in energy conservation activities

1. Implementing all the operation improvement proposals as proposed
The operation improvement proposals of "Reduction of the steam pressure" and "Reduction of the discharge pressure of the compressor" were implemented as proposed. "Air leak prevention" is continually inspected by a monthly patrol. The maximum demand has been reduced by promoting "Utilization of the demand monitoring equipment", completely stopping the air-conditioning system at the time of alarm, and adopting a work shift system to avoid simultaneous operation of the large facilities. One of the two automatic vending machine was replaced by an energy conservation type high-efficiency machine.

2. Completed 4 of 5 investment-required improvements and planning to implement the remaining one
"Thermal insulation of the steam piping" was enhanced as proposed. In order to "shield the outdoor units from solar radiation", their self-made solar radiation covers were attached. For "suspension of automatic tea dispensers at night", the dispensers were renewed to those with a timer to automate suspension at night. For "LED-based lighting", 100 fluorescent lamps and 6 mercury lamps were replaced by the LEDs. Since the mercury lamps will go out of production in 2020, the other factories will also replace them by the LEDs. Because "renewal of the compressor" is a costly investment, a public subsidy will be utilized to introduce an inverter-controlled compressor when renewing an aged one.

3. Developing the voluntary improvement activities other than the proposals
The demand was greatly lowered by avoiding simultaneous operation of two raw material kneading rolls based on an on-site idea. The boiler fuel was changed (bunker A to gas) from an environmental viewpoint. The awareness of the employees has been enhanced by putting up an in-house notice, "A wall greening activity has started with bitter gourds, etc. as a heat island preventive measure and a power-saving measure in summer".

Tuning audit implemented

[Kyushu Area]

CASE 4

Audit case of energy conservation/power-saving support services

Case of Plastic Products Manufacturer

- Industry type: Chemistry
- Products: Plastic products
- Company name: Company H ■ No. of employees: Approx. 50

Company H has been conducting energy conservation activities such as easing an air-conditioning setting temperature and thinning out/turning off unnecessary lighting fixtures. This time, they requested for an overall energy conservation audit. As a result of the audit, we proposed enhanced thermal insulation of steam piping, renewal to higher-efficiency lighting, reduction of discharge pressure and enhanced air leak prevention for compressors, utilization of demand monitoring equipment to lower the maximum power, and so on. Six months after the energy conservation audit (December 2014), they took our tuning audit "(1) Measurement of heat radiation from the steam piping system and (2) Measurement of a leak from the air piping" to confirm the current losses and improvement effects.

●Effects of the measures (Audit)

Energy consumption (crude oil equivalent)

Reduced by **42** kL/year

Energy cost

Reduced by **3,561,000** yen/year

Proposals requiring no cost (Note) Energy conservation effect is shown in crude oil equivalent.

1. Boiler: Reduction of fuel consumption by a lower air ratio

When a burner's air ratio is higher than necessary, heat losses by exhaust gas increase. We proposed correcting an air volume to an appropriate value to lower the air ratio (1.35 → 1.30, 0.05 lower), thereby realizing energy conservation.

Energy Saving: 2.4 kL/year
Cost Saving: 200,000 yen/year
Facility: 1 boiler (5 t/h., city gas 13A: 850,000 m^3/year)

2. Compressor: Reduction of a discharge pressure

Five compressors are running. We proposed reducing the discharge pressure of one (37 kW) of them (0.75 → 0.65 MPa, 0.1 MPa lower) to realize energy conservation. If the discharge pressure is reduced for all of them, there is the risk of producing defective products. This time, accordingly, the pressure was reduced for only one of them, to be followed by the rest sequentially (the effects were calculated on one unit).

Energy Saving: 3.0 kL/year
Cost Saving: 202,000 yen/year
Facility: 1 compressor (37 kW)

3. Air piping: Enhanced air leak prevention

We proposed enhancing an air leak prevention to realize energy conservation (the effects were calculated assuming that a 10% air leak rate is improved by 80%).

Energy Saving: 4.1 kL/year
Cost Saving: 277,000 yen/year
Facility: 5 compressors (totally 203 kW)

4. Demand control: Inhibition of the maximum power by utilizing the demand monitoring equipment

Since the maximum power was increased in last December, we proposed enhancing demand control to lower the maximum power (367 → 349 kW, 18 kW less). This proposal includes a contribution of power-saving by renewal to higher-efficiency lighting (8 kW less, Proposal 7).

Maximum power: 18 kW less
Cost Saving: 359,000 yen/year
Facility: Demand monitoring equipment

5. Sanitary equipment: Attachment of a water-saving packing to a faucet

If a packing in a faucet is replaced by a water-saving packing, a flow rate is inhibited when a handle is half-opened, thereby saving water. We proposed attaching the water-saving packings to the faucets in a washroom, etc. to save water.

Energy Saving: –
Cost Saving: 30,000 yen/year
Facility: 10 faucets

Handle opening	Ordinary packing	Water-saving packing
90°	12 L/min.	6 L/min.
Fully open	21 L/min.	21 L/min.

Making investments into facilities with higher efficiency (Note) Energy conservation effect is shown in crude oil equivalent.

6. Steam piping: Enhanced thermal insulation of the steam piping

We proposed enhancing thermal insulation of the piping and valves of a steam piping system to decrease futile heat radiation, thereby reducing fuel (city gas) consumption.

Energy Saving: 18.6 kL/year
Cost Saving: 1,545,000 yen/year
CAPEX: 644,000 yen **PP:** 0.4 years
Facility: Flange type globe valves (11 pcs. for 65A), flanges (12 pcs. for 150A) and piping (44 m for 65A)

7. Lighting: Renewal to higher-efficiency lighting

We proposed (1) renewing the FLR fluorescent lamps in the factory and the office to the high-efficiency LED lamps, (2) replacing the FLR fluorescent lamps in a molding line, boiler room, etc. by the Hf fluorescent lamps, and (3) replacing the mercury lamps used in the factory and warehouse building and as outside lights by the high-efficiency ceramic metal halide lamps, thereby reducing power consumption.

Energy Saving: 13.6 kL/year
Cost Saving: 922,000 yen/year
CAPEX: 6,500,000 yen **PP:** 7.0 years
Facility: FLR fluorescent lamps → (LED lamps and Hf fluorescent lamps), Mercury lamps → Ceramic metal halide lamps

Status quo	Renewal plan	Qty.	Lighting hours (h./year)	Money saved (in ¥1,000)	Investment (in ¥1,000)	Payback period (in years)
(1) FLR fluorescent lamps (40 W/2-lamp type, 85 W/unit)	Straight-tube LED lamps (55 W/unit)	100	4,878	256	3,500	13.7
(2) FLR fluorescent lamps (40 W/2-lamp type, 85 W/unit)	Hf fluorescent lamps (65 W/unit)	100	4,878	171	1,200	7.0
(3) Mercury lamps (415 W/unit)	Ceramic metal halide lamps (208 W/unit)	40	3,415	495	1,800	3.6
Total		240		922	6,500	7.0

8. Lighting: LED guide lights

Conventional guide lights (fluorescent lamps) are inefficient because they use a copper or iron type ballast. We proposed renewing to high-efficiency LED guide lights to realize energy conservation.

Energy Saving: 0.4 kL/year
Cost Saving: 26,000 yen/year
CAPEX: 325,000 yen **PP:** 12.5 years
Facility: Fluorescent guide lights → LED guide lights

Before renewal	After renewal	Qty.
Guide lights: Fluorescent lamps (15 W/unit)	LEDs (2.0 W/unit)	5
Guide lights: Fluorescent lamps (23 W/unit)	LEDs (2.7 W/unit)	5

Results of tuning audit

1. Topics	(1) Measurement of heat radiation from the steam piping, valves and flanges (Proposal 6) (2) Identification of the compressed air leaking spots and measurement of a leak amount (Proposal 3)
2. Target facilities	(1) Steam piping in the factory, (2) Air piping in the factory
3. Results	(1) Heat radiation from non-heat-retained parts of the steam piping system: 73.3 kL/year in crude oil equivalent (approx. 7.5% of fuel consumption), Saved amount of money, approx. 5,700,000 yen/year (2) Leak amount from the air piping: 7.8 kL/year in crude oil equivalent (5.2% leak rate), Saved amount of money, approx. 530,000 yen

Major efforts in energy conservation activities

1. Measures for the leak from the air piping and heat radiation from the steam piping in response to the results of the tuning audit

As a result of the tuning audit, it was found out that the air piping had 87 air leak spots, resulting in an air leak amount of 77 Nm^3/h. The leak spots were immediately repaired. It was also found out that heat radiation from the steam piping accounted for approx. 7.5% of fuel consumption. Renewal of the piping, enhancement of thermal insulation, etc. are planned in line with renewal of a molding machine (steam-based) in the next term.

2. Improving four items in line with operation and investments (except for those associated with the tuning audit)

"Reduction of the compressor's discharge pressure" and "Reduction of fuel consumption by the lower air ratio" were conducted in consultation with the relevant manufacturers. Concerning "Replacement of the Hf mercury lamps by the ceramic metal halide lamps", a subsidy was utilized to renew many of them. The energy for the outside lights (mercury lamps) having short lighting hours was saved by shorting the lighting hours with a timer. Other fluorescent lamps and guide lights are also being renewed to LED lamps.

3. Developing the voluntary improvement activities other than the proposals

After taking the energy conservation audit, a company-wide energy conservation promotion system was built, including a management level, to systematically address energy conservation such as making a medium-/long-term plan for energy conservation investments; the compressors have been already renewed to the inverter-based one.

[Tokai Area]

CASE 5

Audit case of energy conservation/power-saving support services

Case of Manufacturer of Various Automated Systems

- Industry type: Machinery
- Products: Development, design and construction of various automated systems, and provision of technical service
- Company name: Maruyoshi Co., Ltd. ■ No. of employees: Approx. 50

Maruyoshi Co., Ltd. has been taking energy conservation measures such as thinning out/turning off unnecessary lighting fixtures and renewing to high-efficiency lighting. This time, they requested for an overall energy conservation audit, focusing on air-conditioning and demand reduction. As a result of the audit, we proposed easing of the setting temperature of air-conditioners, lowering of a cooling load by affixing light-shielding sheets to the windows expose to strong solar radiation, replacement of fluorescent lamps by LED lamps, reduction of the maximum power by introducing a demand monitoring controller, and so on.

●Effects of the measures (Audit)

Energy consumption (crude oil equivalent)	Energy cost
Reduced by **3.4** kL/year	Reduced by **456,000** yen/year

Proposals requiring no cost (Note) Energy conservation effect is shown in crude oil equivalent.

1. Air-conditioning system: Easing of the setting temperature of air-conditioning

We proposed easing the cooling/heating setting temperature (25/22°C) in the office and the factory to a government-recommended value (28/20°C) to reduce power consumption.

Energy Saving: 1.9 kL/year
Cost Saving: 180,000 yen/year
Facility: 10 air-conditioners (totally 81 kW, cooling/heating power consumption: 16,000/20,000 kWh/year)

2. OA equipment: Utilization of the sleep mode of the PC

Half the energy of the PC is consumed by the display. We proposed turning off the power of the display and setting the PC to the sleep mode when leaving your seat, thereby reducing power consumption.

Energy Saving: 0.1 kL/year
Cost Saving: 10,000 yen/year
Facility: 12 desktop PCs, 3 notebook PCs

Making investments into facilities with higher efficiency (Note) Energy conservation effect is shown in crude oil equivalent.

3. Air-conditioning system: Lowering of the cooling load by affixing the light-shielding sheets to the windows

We proposed affixing the detachable light-shielding sheets to the windows exposed to strong solar radiation (factory: approx. 23 m^2 without blind, office: approx. 16 m^2 with blind) to lower the cooling load, thereby reducing power consumption.

Energy Saving: 0.2 kL/year
Cost Saving: 20,000 yen/year
CAPEX: 39,000 yen **PP:** 2.0 years
Facility: 10 air-conditioners (totally 81 kW, cooling/heating power consumption: 16,000/20,000 kWh/year)

4. Lighting: Renewal of the fluorescent lamps to the LED lamps

We proposed renewing the fluorescent lamps of the ceiling of the factory and office to the LED lamps to reduce power consumption.

Before renewal	After renewal	Qty.
FLR fluorescent lamps (85 W/unit)	Straight-tube LED lamps (40 W/unit)	45
FLR fluorescent lamps (43 W/unit)	Straight-tube LED lamps (20 W/unit)	17

Energy Saving: 1.2 kL/year
Cost Saving: 118,000 yen/year
CAPEX: 846,000 yen **PP:** 7.2 years
Facility: FLR fluorescent lamps → Straight-tube LED lamps

5. Demand control: Reduction of the maximum power by introducing the demand monitoring equipment

We proposed introducing the demand monitoring equipment with a monitor to (1) automatically stop predetermined equipment (machining center, etc.) to reduce the maximum power (contract demand) when it is expected to exceed a demand target value (55 → 45 kW, 40 kW less) and (2) set the demand target value for each season by “visualization” of the energy usage status, thereby reducing power consumption throughout the year.

Maximum power: 18 kW less
Cost Saving: 128,000 yen/year
CAPEX: 400,000 yen **PP:** 3.1 years
Facility: Demand monitoring equipment

Major efforts in energy conservation activities

1. Immediate implementation of operational improvement
All the employees cooperated to immediately ease the temperature setting of the air-conditioners and reduce the standby power of the PCs.

2. Energy conservation by investment in the systems
As a solar radiation control measure, the light-shielding sheets were affixed to the west windows to improve cooling effectiveness, bringing it home to ease the temperature setting of the air-conditioners. Utilization of a subsidy is being planned to renew the fluorescent lamps to the LED lamps.

3. Promoting a maximum power reduction measure
The demand monitoring equipment was introduced to put demand control into practice according to a prepared preferential list of stopping the equipment. Demand analysis was started for further improvement.

[Chugoku Area]

CASE 6

Audit case of energy conservation/power-saving support services

Case of Manufacturer of Optical Films, Liquid Crystal Films and Electronic Parts

- Industry type: Electric and electronic devices
- Products: Optical films, liquid crystal films and electronic parts
- Company name: TEC Corporation ■ No. of employees: Approx. 80

TEC Corporation has been conducting energy conservation activities such as thinning out/turning off unnecessary lighting fixtures and introducing demand monitoring equipment. This time, they requested for an overall energy conservation audit, focusing on air-conditioners, etc. As a result of the audit, we proposed renewal to higher-efficiency packaged air-conditioners, inverter-based air-conditioning equipment, reduction of the discharge pressure and the feed pressure to pneumatic equipment for compressors, reduction of the maximum power by introducing an automatic demand load controller, and so on.

●Effects of the measures (Audit)

Energy consumption (crude oil equivalent)

Reduced by **102** kL/year

Energy cost

Reduced by **6,619,000** yen/year

Proposals requiring no cost (Note) Energy conservation effect is shown in crude oil equivalent.

1. Air piping: Enhanced air leak prevention from the air piping

Aged air piping and pneumatic systems were seen here and there. Air leak inspection is conducted, but there is generally a 10 to 20% air leak. We proposed enhancing an air leak control measure to realize energy conservation (the effects are calculated on the premise of a 10% leak rate and 80% improvement thereof).

Energy Saving: 9.0 kL/year
Cost Saving: 489,000 yen/year
Facility: 5 compressors (totally 67 kW)

Making investments into facilities with higher efficiency (Note) Energy conservation effect is shown in crude oil equivalent.

2. Air-conditioning system: Renewal of the packaged air-conditioners

We proposed renewing the aged cooling/heating packaged air-conditioners in Building A to the higher-efficiency ones to reduce power consumption.

Energy Saving: 23.0 kL/year
Cost Saving: 1,253,000 yen/year
CAPEX: 6,000,000 yen **PP:** 4.8 years
Facility: 3 air-conditioners (total capacity: 154 kW, cooling/heating COP: 2.1/2.4 → 4.2/4.2)

3. Air-conditioning system: Inverted based AHU fans

A fan for an air handling unit (AHU) is continuously running at ratings throughout the year. Since a thermal load drops at night and on holidays (non-production time), we proposed fully opening a damper and introduce an inverter (20% less air volume by lowering a motor speed), thereby realizing energy conservation.

Energy Saving: 18.2 kL/year
Cost Saving: 988,000 yen/year
CAPEX: 675,000 yen **PP:** 0.7 years
Facility: 3 fans (15 kW/unit)

4. Air-conditioning system: Inverter-based cooling water pump

A cooling water pump for a chiller is continuously running. We proposed introducing an inverter to lower a flow rate during a low-load intermediate period and at night (50% less), thereby realizing energy conservation.

Energy Saving: 11.8 kL/year
Cost Saving: 644,000 yen/year
CAPEX: 165,000 yen **PP:** 0.3 years
Facility: 1 pump (11 kW)

5. Air-conditioning system: Introduction of an energy conservation belt for an AHU fan

The fan for the air handling unit (AHU) has a high motor capacity. We accordingly proposed remodeling the pulley of the existing system and introducing an energy conservation belt, thereby reducing power consumption (approx. 5% less).
(Note) Since a V-belt with inside notches (energy conservation belt) reduces a "bending stress" when it is coiled around the pulley, it decreases losses caused by bending and improves power transmission efficiency from a motor to the drive side, saving the power.

Energy Saving: 4.1 kL/year
Cost Saving: 225,000 yen/year
CAPEX: 400,000 yen **PP:** 1.8 years
Facility: 3 fans (15 kW/unit)

6. Air-conditioning system: Energy conservation by sprinkling water on the roof

The roof of the clean room in Building C is lined with a heat-insulating material, but the rest of the roof is not. We proposed sprinkling water on the roof (reutilizing wastewater from a chiller) to reduce intrusion of heat through the roof (15% less), thereby reducing power consumption for air-conditioning.

Energy Saving: 0.6 kL/year
Cost Saving: 34,000 yen/year
CAPEX: 50,000 yen **PP:** 1.5 years
Facility: Roof area (200 m²), air-conditioner (COP: 3.0)

7. Compressor, pneumatic equipment: Lower discharge pressure of the compressor and lower feed pressure to the pneumatic equipment

(1) Lower the discharge pressure of the compressor gradually, while checking the air-based system (0.63 to 0.65 MPa → 0.5 MPa, 0.1 MPa less). (2) Since the air pressure of the pneumatic equipment is high, feed the air at an appropriate pressure (air blow: 0.6 → 0.4 MPa) by a reducing valve. We proposed adopting the measures (1) and (2) to realize energy conservation.

Energy Saving: 21.3 kL/year
Cost Saving: 1,161,000 yen/year
CAPEX: 150,000 yen **PP:** 0.1 years
Facility: 5 compressors (totally 67 kW), 10 reducing valves

Item	Money saved (in ¥1,000)	Investment (in ¥1,000)	Payback period (in years)
(1) Lower discharge pressure of the compressor (0.1 MPa less)	550	-	-
(2) Lower feed pressure to the pneumatic equipment (0.06 to 0.2 MPa less)	611	15	0.2
Total	1,161	15	-

8. Compressor: Utilization of the exhaust heat from the compressors for heating

The exhaust heat from the compressors is discharged outside through the duct piping. We proposed utilizing this exhaust heat for heating in Building C to decrease an air-conditioning load, thereby realizing energy conservation.

Energy Saving: 4.9 kL/year
Cost Saving: 268,000 yen/year
CAPEX: 300,000 yen **PP:** 1.1 years
Facility: 5 compressors (totally 67 kW), air-conditioner (capacity: 6 kW, COP: 3.0)

9. Lighting: Replacement of the fluorescent lamps by the LEDs

We proposed renewing the fluorescent lamps in a factory to higher-efficiency, longer-life LED lamps to realize energy conservation. It is expected to reduce replacement work of ceiling lighting owing to the longer-life (40,000 h.) LED lamps, but this is not included in the effects.

Energy Saving: 8.7 kL/year
Cost Saving: 472,000 yen/year
CAPEX: 2,490,000 yen **PP:** 5.3 years
Facility: Hf fluorescent lamps → Straight-tube LED lamps

Status quo	Renewal plan	Rated life (h.)	Qty.	Money saved (in ¥1,000)	Investment (in ¥1,000)	Payback period (in years)
(1) Hf fluorescent lamps (40-W 2-lamp type, 86 W/unit)	Straight-tube LED lamps (40 W/unit)	12,000	153	272	1,530	5.6
(2) Hf fluorescent lamps (110-W 2-lamp type, 230 W/unit)	Straight-tube LED lamps (101 W/unit)	→40,000	48	201	960	4.8
Total			201	473	2,490	5.3

10. Demand control: Reduction of the maximum power by an automatic demand load controller

We proposed utilizing a demand monitoring controller to control the air-conditioners, AHU fans, etc. through the automatic demand load controller, thereby reducing the maximum power (contract demand: 500 → 450 kW, 50 kW less). This proposal includes contributions to power-saving (approx. 43 kW) by replacement of the fluorescent lamps by the LEDs (13 kW, Proposal 9), renewal of the air-conditioners (10 kW, Proposal 2), improvement of the compressors (12 kW, Proposal 7), and so on.

Maximum power: 50 kW less
Cost Saving: 1,085,000 yen/year
CAPEX: 1,000,000 yen **PP:** 0.9 years
Facility: Automatic demand load controller

Major efforts in energy conservation activities

1. Promoting the higher-efficiency air-conditioning related system

To promote energy conservation, the greatest challenge was to realize the higher-efficiency of the air-conditioning related system, which accounted for 70% of the energy used by the business establishment. Utilizing the FY2014 Subsidy for Introduction of Energy Conservation Facilities for Local Factories, Small- and Medium-sized Businesses and other means, considerable energy conservation related to the air-conditioning system was realized by renewal of the air-conditioning chiller bodies and packaged air-conditioners, introduction of outdoor air-conditioners for reducing ventilation losses, and introduction of an inverter system for the air handling unit (AHU) fans and chiller cooling water pumps. In addition, thorough energy conservation was realized by changing heater-based heating of the air-conditioning system to the heat pump-based heating method, and changing a humidification system from steam to direct spray.

2. Replacing the fluorescent lamps by the LEDs to greatly reduce lighting power consumption

Utilizing the same subsidy, the lighting fixtures of the entire building were renewed to the LEDs, halving lighting power consumption.

3. Further energy conservation activities

Utilizing the introduced EMS, an optimum control method is being built, aiming at demand control which does not inhibit production and quality. It is also planned to take measures for the compressed air, which uses the second largest energy.

[Chugoku Area]

CASE 7

Audit case of energy conservation/power-saving support services

Case of Manufacturer of Household Rice Cookers, etc.

- Industry type: Electric and electronic devices
- Products: Household rice cookers, etc.
- Company name: Ketaka Electric Co., Ltd. ■ No. of employees: Approx. 280

Addressing energy conservation as part of management reform activities, Ketaka Electric Co., Ltd. has been taking various energy conservation measures in parallel with the activities such as preparing a list of energy-consuming devices and improving the wiring diagrams. This time, they requested for an overall energy conservation audit in order to upgrade the energy conservation activities. As a result of the audit, we proposed thermal insulation of the cylinders of the injection molding machines, introduction of inverters for hydraulic pumps, introduction of compressor numbers control, reduction of an air-conditioning area, and so on.

●Effects of the measures (Audit)

Energy consumption (crude oil equivalent)	Energy cost
Reduced by **66** kL/year	Reduced by **5,579,000** yen/year

Proposals requiring no cost (Note) Energy conservation effect is shown in crude oil equivalent.

1. Air-conditioning system: Appropriate setting temperature

We proposed managing an air-conditioning setting temperature control value (28°C in summer and 20°C in winter) in a reliable manner to reduce power consumption (the effects were calculated when the setting temperature is eased by 1°C).

Energy Saving: 4.0 kL/year
Cost Saving: 229,000 yen/year
Facility: 31 air-conditioners (total rated power consumption: 200 kW)

2. Air-conditioning system: Thorough cleaning of the filters of the indoor units

Many filters of the air-conditioners were found clogged. We proposed cleaning them periodically to reduce power consumption.

Energy Saving: 1.8 kL/year
Cost Saving: 103,000 yen/year
Facility: 31 air-conditioners (total rated power consumption: 200 kW)

3. Compressor: Lower discharge pressure

We proposed lowering a discharge pressure by 0.1 MPa (0.75 → 0.65 MPa) through periodic cleaning of the filters, looping of air piping, and so on, to reduce the power consumption of the compressors.

Energy Saving: 8.9 kL/year
Cost Saving: 505,000 yen/year
Facility: 10 compressors (totally 137 kW)

4. Air piping: Air leak prevention

We proposed inspecting and repairing an air leak from the air piping to reduce the power consumption of the compressors (the effects were calculated assuming that a 10% air leak rate is improved by 80%).

Energy Saving: 6.4 kL/year
Cost Saving: 364,000 yen /year
Facility: 10 compressors (totally 137 kW)

5. Lighting: Thinning out of ceiling lighting

Task ambient lighting is used in an assembly factory, but ceiling lighting is excessive. We proposed thinning out lighting (30% less) to lower illuminance adequately, thereby reducing power consumption.

Energy Saving: 5.5 kL/year
Cost Saving: 315,000 yen /year
Facility: Fluorescent lamps (40 W/unit, 866 → 606 units)

Making investments into facilities with higher efficiency (Note) Energy conservation effect is shown in crude oil equivalent.

6. Air-conditioning system: Reduction of the target area for air-conditioning

There are multiple assembly lines of different work shifts on the factory floor and the conditioned air flows into the areas of the suspended assembly lines. We proposed installing partitions with sheets, etc. to lower the air-conditioning load of the operating lines, thereby reducing power consumption.

Energy Saving: 1.4 kL/year
Cost Saving: 79,000 yen/year
CAPEX: 200,000 yen **PP:** 2.5 years
Facility: Air-conditioner (totally 64 kW), air-conditioning area (approx. 960 → 480 m²)

7. Compressor: Introduction of numbers control

Five compressors keep running all the time under a low load of approx. 50%. We proposed controlling the number of compressors operated according to the required load to increase efficiency, thereby reducing power consumption and decreasing the contract demand (10 kW less).

Energy Saving: 2.4 kL/year
Cost Saving: 324,000 yen/year
CAPEX: 900,000 yen **PP:** 2.8 years
Facility: 5 compressors (totally 63 kW)

8. Production system: Introduction of the inverters for the hydraulic pumps

The hydraulic pumps for processing machinery always run at a constant speed. During pressure maintenance and standby, the discharged oil from the pump returns to a tank from a relief valve. We proposed introducing the inverters for the hydraulic pumps to decrease a discharge oil rate during pressure maintenance and standby, thereby reducing power consumption.

Energy Saving: 3.5 kL/year
Cost Saving: 200,000 yen/year
CAPEX: 1,200,000 yen **PP:** 6 years
Facility: 2 hydraulic pumps (21 kW)

9. Production system: Thermal insulation of the cylinders of the injection molding machines

We proposed attaching a heat-retaining cover to the heater (220°C) installed on the cylinder surface of the injection molding machines to reduce the power consumption of the heater. An indoor environment is also improved by less radiation from the heater.

Energy Saving: 28.6 kL/year
Cost Saving: 1,621,000 yen/year
CAPEX: 2,000,000 yen **PP:** 1.2 years
Facility: 13 units (total surface area: 12.35 m²)

10. Lighting: Replacement of the mercury lamps by the metal halide lamps

We proposed renewing the mercury lamps in the factory to the high-efficiency metal halide lamps to reduce power consumption.

Energy Saving: 3.2 kL/year
Cost Saving: 180,000 yen/year
CAPEX: 560,000 yen **PP:** 3.1 years
Facility: 56 mercury lamps (300 W/unit) → 56 metal halide lamps (200 W/unit)

11. Demand control: Reduction of the maximum power by installing the watt-hour meters

We proposed installing the watt-hour meters for the 20-kW or higher facilities and the compressors to understand and analyze actual power usage, thereby reducing the maximum power and decreasing the contract demand (869 → 780 kW, 89 kW less).

Maximum power: 89 kW less
Cost Saving: 1,659,000 yen/year
CAPEX: 1,250,000 yen **PP:** 0.8 years
Facility: 25 watt-hour meters

Major efforts in energy conservation activities

1. Presenting the on-going waste and the results of efforts to improve the awareness of the employees ― Make haste to implement energy conservation activities

After the audit, the first implemented activity was to present “on-going waste” to the employees to make them understand that “the effects result from actions”. Aiming at “reduction of the standby power”, the waste of power usage on holidays was notified and it was encouraged to turn off the circuit breakers when leaving the office/factory for weekends. As a result, the power usage on holidays has been halved compared with before, awakening the employees’ awareness that “they can do it.”

2. Starting to build an energy conservation promotion structure and cultivate human resources to continue the activities

The scope of electric power management per department was clarified and an “energy conservation committee” was set up for auditing electric power, implementing improvements, presenting monthly reports, and so on. Utilizing a subsidy, 82 watt-hour meters and a data collection system were introduced to “visualize” the power usage status for each facility, making daily management and confirmation easier.

3. Energy conservation measures with investments which utilized a subsidy and were implemented systematically

Approx. 30% energy conservation was achieved by utilizing a subsidy to renew the injection molding machines. Making use of a surplus production capacity generated by high productivity of the new injection molding machines, further energy conservation effects were obtained by shifting production to the new facility.

[Hokkaido Area]

CASE 8

Audit case of energy conservation/power-saving support services

Case of Printing Company

- Industry type: Printing ■ Products: Prints
- Company name: iword Co., Ltd., Ishikari Factory
- No. of employees: Approx. 270

iword Co., Ltd., Ishikari Factory has been taking various energy conservation measures such as thinning out/turning off unnecessary lighting fixtures and stopping unnecessary devices. This time, they requested for an overall energy conservation audit, focusing on air-conditioning and lighting. As a result of the audit, we proposed suspension of night-time intake of the outside air, renewal to high-efficiency absorption type water coolers/heaters, replacement of the lighting fixtures with the LED lamps, turning off lighting based on subdivided lighting segments, renewal of the vacuum heaters, and so on.

●Effects of the measures (Audit)

Energy consumption (crude oil equivalent)

Reduced by **49** kL/year

Energy cost

Reduced by **4,231,000** yen/year

Proposals requiring no cost (Note) Energy conservation effect is shown in crude oil equivalent.

1. Compressor: Cleaning of the compressor's filter

A contaminated filter adds to a suction resistance, increasing the power. We proposed cleaning a suction filter periodically to reduce pressure losses, thereby reducing power consumption (the effects were calculated assuming that the compressor is constantly operated at a load of 80%).

Energy Saving: 0.2 kL/year
Cost Saving: 16,000 yen/year
Facility: 1 compressor (37 kW)

Making investments into facilities with higher efficiency (Note) Energy conservation effect is shown in crude oil equivalent.

2. Air-conditioning system: Suspension of night-time intake of the outside air

Air-conditioning energy is wasted in summer and winter, if an outside air intake volume is higher than necessary. We proposed suspending intake of the outside air (outside air intake volume: 17,300 m^3/h.) from the midnight to the early morning (11:00 p.m. to 5:00 a.m., 2 months in summer and 5 months in winter), during which no problems seem to happen, to realize energy conservation.

Energy Saving: 11.6 kL/year
Cost Saving: 967,000 yen/year
CAPEX: 500,000 yen **PP:** 0.5 years
Facility: 2 absorption type water coolers/heater (LPG, cooling/heating COP: 0.9/0.8)

3. Air-conditioning system: Renewal to the high-efficiency absorption type water coolers/heaters

Introduced 17 years ago, the gas absorption water cooler/heater has been aging. We proposed renewing it to the latest high-efficiency gas absorption water cooler/heater to realize energy conservation.

Energy Saving: 9.1 kL/year
Cost Saving: 754,000 yen/year
CAPEX: 24,000,000 yen
PP: Upon renewing the aged system
Facility: Absorption type water cooler/heater (LPG consumption: 70 t/year, cooling/heating capacity: 422/494 kW, cooling/heating COP: 0.8/0.8 →1.2/0.84)

4. Water heating system: Renewal of a vacuum water heater

Installed 17 years ago, the vacuum water heater may have deteriorated in its efficiency. We proposed renewing to the high-efficiency model to reduce fuel consumption. Currently, one unit is in operation. In view of the heating load status and the capacity of the cooler/heater, however, it is also necessary to consider the idea of installing 2 half-capacity units.

Energy Saving: 5.4 kL/year
Cost Saving: 448,000 yen/year
CAPEX: – **PP:** Upon renewing the aged system
Facility: 1 vacuum water heater (LPG consumption: 37 t/year, boiler efficiency: 80 → 90%)

5. Lighting: Renewal of lighting to the LED lamps and turning off based on subdivided lighting segments

We proposed renewing the fluorescent lamps in the factory and the metal halide lamps on the ceiling of a cargo-handling room to LED lamps, and turning off unnecessary lamps based on the subdivided lighting segments of the bookbinding factory and the cargo-handling room, thereby realizing energy conservation. However, the effects have not been calculated on the subdivided lighting segments of the fluorescent lamps.

Energy Saving: 19.3 kL/year
Cost Saving: 1,374,000 yen/year
CAPEX: 15,260,000 yen **PP:** 11.1 years
Facility: FLR fluorescent lamps and metal halide lamps → LED lamps

Status quo	Renewal plan	Lighting hours (h./day)	Qty.	Money saved (in ¥1,000)	Investment (in ¥1,000)	Payback period (in years)
(1) FLR fluorescent lamps (225 W/unit)	LED lamps (118 W/unit)	2,570	241	1,213	14,460	11.9
(2) Metal halide lamps (414 W/unit)	LED lamps (119 W/unit)	1,365→1,108	24	161	800	5.0
Total			265	1,374	15,260	11.1

6. Transformer: Integration of the transformers and renewal to higher efficiency

(1) Of the 5 power transformers, integrate 3 low-load units into one. (2) Renew an electric light transformer (1 unit: 1ø, 300 kVA) to the latest high-efficiency small transformer (1 unit: 1ø, 100 kVA) because a demand factor is low. We proposed reducing transformer losses by (1) and (2) to realize energy conservation.

Energy Saving: 3.3 kL/year
Cost Saving: 234,000 yen/year
CAPEX: 1,350,000 yen **PP:** 5.8 years
Facility: Integration of the power transformers (3 units: totally 1,000 kVA→ 1 unit: 500 kVA), renewal of the electric light transformer (1 unit: 1ø, 300 kVA → 1 unit: 1ø, 100 kVA)

Status quo	Renewal plan	Money saved (in ¥1,000)	Investment (in ¥1,000)	Payback period (in years)
(1) 3 power transformers (3ø, 200 kVA x 1,300 kVA x 1,500 kVA x 1)	Integrated into 1 unit (3ø, 500 kVA)	167	450	2.7
(2) 1 electric light transformer (1ø, 300 kVA)	Renewed to 1 unit (1ø, 100 kVA)	67	900	13.4
Total		234	1,350	5.8

7. Demand control: Introduction of the demand monitoring equipment

We proposed introducing the demand monitoring equipment with a monitor to "visualize" the energy usage status, and inhibiting the maximum demand power by suspending predetermined devices or lowering the rotating speed of a printing machine, thereby decreasing the contract demand (1,215 → 1,190 kW, 25 kW less), when the maximum power is finely monitored on its change and comes close to a setting value. In addition, we proposed setting a target value for each season to reduce power consumption throughout the year.

Maximum power: 25 kW less
Cost Saving: 438,000 yen/year
CAPEX: 400,000 yen **PP:** 0.9 years
Facility: Demand monitoring equipment

Major efforts in energy conservation activities

1. Promoting the energy conservation measures, including utilization of the capital investment promotion tax system for productivity enhancement

Two air-cooled chiller units were newly installed, which fall under the category of the advanced facilities (latest models, productivity enhancement) in the capital investment promotion tax system for productivity enhancement. Together with this, a series of energy conservation measures were taken such as improving the ventilation system of the factory, integrating the transformers as proposed in the energy conservation audit, and introducing the demand monitoring equipment.

2. Other energy conservation measures

The fluorescent lamps in the factory were renewed to the LED lamps to not only conserve energy, but prevent the insects.

3. Further recognizing the necessity of energy conservation in the wake of the energy conservation audit

Reliable demand control has been enabled by introduction of the demand monitoring equipment, leading to an enhanced energy conservation management structure.

Tuning audit implemented

[Hokkaido Area]

CASE 9

Audit case of energy conservation/power-saving support services

Case of Manufacturer of Wooden Musical Instrument Members and Wood

- Industry type: Wood and wooden products manufacturing industry
- Products: Wooden musical instrument members, wood, etc.
- Company name: Kitami Mokuzai Co., Ltd. ■ No. of employees: Approx. 120

Kitami Mokuzai Co., Ltd. has been conducting energy conservation activities such as introducing the demand monitoring equipment and turning off unnecessary lighting fixtures. This time, they requested for an overall energy conservation audit. As a result of the audit, we proposed lowering a compressor's discharge pressure, thermal insulation of the steam piping, and renewal to high-efficiency lighting and high-efficiency transformers. Approximately 2 years after the energy conservation audit (Oct. 2015), they took our tuning audit "Lower discharge pressure of the compressor" to tune two of three compressors and confirm their tuning method and energy conservation effects.

●Effects of the measures (Audit)

Energy consumption (crude oil equivalent)

Reduced by **65** kL/year

Energy cost

Reduced by **1,601,000** yen/year

Proposals requiring no cost (Note) Energy conservation effect is shown in crude oil equivalent.

1. Compressor: Lower discharge pressure

The discharge pressure (0.69 MPa) is higher than the pressure required (0.4 to 0.5 MPa) for an air cylinder, etc. We proposed lowering the discharge pressure by about 0.1 MPa to reduce the power consumption of the compressors (9% less).

Energy Saving: 4.5 kL/year
Cost Saving: 323,000 yen/year
Facility: 20 compressors (totally 103 kW)

Making investments into facilities with higher efficiency (Note) Energy conservation effect is shown in crude oil equivalent.

2. Steam piping: Enhanced thermal insulation of the steam piping (Reduction of waste wood for boiler fuel)

We proposed enhancing thermal insulation of the steam piping and the valves to inhibit radiation losses, thereby reducing a purchase volume of waste wood for boiler fuel (104 t/year less, 4.1% less).

Energy Saving: 45.6 kL/year
Cost Saving: 256,000 yen/year
CAPEX: 900,000 yen **PP:** 3.5 years
Facility: Flange type globe valves (10 pcs. for 50 A, 51 pcs. for 32A), flanges (4 pcs. for 200A, 98 pcs. for 50A), piping (7 m for 32A), etc.

3. Lighting: Renewal to high-efficiency lighting

We proposed renewing the (1) ceiling mercury lamps to the ceramic metal halide lamps, (2) outside mercury lamps to the high-pressure sodium lamps, and (3) FLR fluorescent lamps to the Hf fluorescent lamps, thereby reducing energy conservation.

Energy Saving: 3.3 kl/year
Cost Saving: 236,000 yen/year
CAPEX: 1,848,000 yen **PP:** 7.8 years
Facility: FLR fluorescent lamps → (LED lamps, Hf fluorescent lamps), mercury lamps → ceramic metal halide lamps

Status quo	Renewal plan	Qty.	Money saved (in ¥1,000)	Investment (in ¥1,000)	Payback period (in years)
(1) Mercury lamps (415 W/unit)	Ceramic metal halide lamps (208 W/unit)	7	63	228	3.6
(2) Mercury lamps (310 W/unit)	High-pressure sodium lamps (195 W/unit)	6	56	130	2.3
(3) FLR fluorescent lamps (40-W 2-lamp type, 85 W/unit)	Hf fluorescent lamps (32-W 2-lamp type, 65 W/unit)	149	117	1,490	12.7
Total		162	236	1,848	7.8

4. Transformer: Renewal to the high-efficiency transformers

We proposed renewing the aged transformers in a power-receiving cubicle to the high-efficiency amorphous transformers to reduce power losses.

Energy Saving: 11.0 kl/year
Cost Saving: 786,000 yen/year
CAPEX: – **PP:** –
Facility: Transformers (3ø: 8 units, totally 1,425 kVA, 1ø: 6 units, totally 200 kVA) → Transformers (3ø: 3 units, totally 1,500 kVA, 1ø: 2 units, totally 200 kVA)

Results of tuning audit

1. Topics	Lower discharge pressure of the compressors (Proposal 1)
2. Target facilities	Compressors (15 kW x 3 units, discharge pressure: 0.69 MPa), 3 of 20 compressors
3. Results	A discharge pressure setting value was lowered (0.69 → 0.59 MPa) on two of three compressors, and no problems were confirmed. Energy conservation effect, No. 1 unit: Power reduced by 7.5%, No. 2 unit: Power reduced by 5.0%, No 3 unit: Reserved Reason for the reserving one unit: Impossible in the present situation because the pressure drops greatly when blowing the air to remove polishing abrasive grains, resulting in unstable operation of other pneumatic devices. A possible measure is to branch the piping for air blow from the low-pressure compressor to feed the air.
4. Expected results	No. 1 unit: 48,000 yen/year, No. 2 unit: 46,000 yen/year

Major efforts in energy conservation activities

1. Energy conservation by lowering the setting pressure of the air compressors (including the tuning audit activities)

After the audit, 5 of 20 units were suspended by rationalization to realize energy conservation. The tuning audit was conducted on 3 of 4 screw type units, whose output exceeds 15 kW. Based on actual values such as the air pressure and compressor power, the pressure was lowered by 0.1 MPa on 2 units to realize energy conservation. An additional measure is being considered as to a system showing an instantaneous decompression by air blow.

2. Energy conservation by renewal to the high-efficiency high-voltage power-receiving system and the high-efficiency lighting system

The power-receiving system was renewed to the high-efficiency type. For the lighting system, 12 ceiling mercury lamps, 6 outside mercury lamps and 33 fluorescent lamps with relatively long lighting hours were renewed to the LEDs. In addition, the fluorescent lamp pull switches were installed at the 256 positions so as to manually turn off the unnecessary fluorescent lamps, thereby realizing thorough energy conservation.

3. Promoting energy conservation of the waste wood-fired boiler

According to the audit, thermal insulation of the steam piping and the valves of the waste wood-fired boiler was systematically implemented, reducing the fuel consumption of the boiler by a little more than 7% from the previous year.

[Shikoku Area]

CASE10

Audit case of energy conservation/power-saving support services

Case of Stockings Manufacturer

- Industry type: Textile industry ■ Products: Stockings
- Company name: Kagawa Seamless Co., Ltd.
- No. of employees: 160 in the main office/factory, 48 in the Dokigawa Factory

Kagawa Seamless Co., Ltd. requested for an energy conservation audit, focusing on the air-conditioners and lighting in the main office/factory, and we proposed enhancing utilization of outside air cooling, controlling the number of compressors, renewing to high-efficiency lighting, and so on. Three years later, they requested for another energy conservation audit, focusing on waste heat recovery and the air-conditioners in the Dokigawa Factory, and we proposed heating of boiler feed water by waste heat recovery from steam drain and hot wastewater, renewal of the air-conditioners, renewal of the compressors, inverter-based aeration blowers, and so on.

●Effects of the measures (Audit)

Energy consumption (crude oil equivalent)

Reduced by **147** kL/year

Energy cost

Reduced by **9,301,000** yen/year

Proposals requiring no cost (Note) Energy conservation effect is shown in crude oil equivalent.

1. Air-conditioning system (Main office): Enhanced utilization of outside air cooling in the intermediate period

Because a formulation room has high indoor heat generation, it is cooled except for January and February. On the other hand, an outside air inlet valve is fully closed in summer, fully opened in January and February, and manually adjusted as to its opening in the intermediate period. We proposed increasing an outside air inlet volume in the intermediate period to lower a cooling load.

Energy Saving: 5.0 kL/year
Cost Saving: 276,000 yen/year
Facility: Air-conditioner (COP: 4.3, capacity: 447 kW)

Making investments into facilities with higher efficiency (Note) Energy conservation effect is shown in crude oil equivalent.

2. Air-conditioning system (Main office): Renewal to the high-efficiency refrigerators

Of the two air-conditioning refrigerators in the formulation room, we proposed renewing one of them with lower COP to the high-efficiency type to reduce power consumption.

Energy Saving: 26.7 kL/year
Cost Saving: 1,471,000 yen/year
CAPEX: 8,000,000 yen **PP:** 5.4 years
Facility: Refrigerators (119 kW, COP: 2.9 → 6.0)

3. Air-conditioning system (Dokigawa): Renewal to a high-efficiency packaged air-conditioner

Installed 28 years ago, a packaged air-conditioner for Rooms A and B has aged. Heating is done with steam, but the thermal efficiency of steam is lower than that of a heat pump (HP). We proposed renewing to the latest high-efficiency packaged cooling/heating air-conditioner to realize energy conservation. Power consumption increases because of steam heating through the electric heat pump, but there will be no fuel (LPG) consumption, resulting in energy conservation as a whole.

Energy Saving: 3.5 kL/year
Cost Saving: 232,000 yen/year (431,000 yen/year less for LPG, 199,000 yen/year more for electric power)
CAPEX: 3,000,000 yen **PP:** 12.9 years
Facility: 1 air-conditioner (capacity: 52 kW, cooling COP: 2.9, boiler steam used for heating) → 1 air-conditioner (capacity: 52 kW, cooling/heating COP: 3.3/3.4)

4. Boiler (Dokigawa): Heating of boiler feed water by recovering the waste heat from overflowing hot water

Well water is heated by the waste heat of hot wastewater from a dyeing machine and stored in a hot water tank to be reused by a heater for the dyeing machine, but surplus water is discharged (overflow). We proposed utilizing this overflowing hot water to heat boiler feed water (27 → 43°C) to reduce the boiler fuel (1.9% less).

Energy Saving: 12.7 kL/year
Cost Saving: 915,000 yen/year
CAPEX: 1,000,000 yen **PP:** 1.1 years
Facility: 3 boilers (2.5 t/h./unit)

5. Steam-based system (Dokigawa): Heating of boiler feed water by recovering the waste heat from the steam drain

We proposed recovering the waste heat from the steam drain of the dyeing machine to heat boiler feed water (27 → 49°C), thereby reducing the boiler fuel (2.4% less). In this case, wastewater is fed to a wastewater treatment system after waste heat recovery to prevent a dye from contaminating boiler feed water when opening the heater.

Energy Saving: 16.1 kL/year
Cost Saving: 1,167,000 yen/year
CAPEX: 5,000,000 yen **PP:** 4.3 years
Facility: 3 boilers (2.5 t/h./unit)

6. Compressor (Main office): Numbers control

As an air source for automatic sewing machines, automatic knitting machines, and so on, four constant-speed compressors are used to feed air. Since the sewing machines stop at night, air consumption decreases, resulting in unloading operation. We proposed controlling the number of compressors to automatically stop the compressors at night, thereby reducing energy consumption.

Energy Saving: 31.8 kL/year
Cost Saving: 1,754,000 yen/year
CAPEX: 500,000 yen **PP:** 0.3 years
Facility: 5 compressors (totally 37 kW/unit)

7. Compressor (Dokigawa): Renewal to an inverter-controlled screw compressor

One screw compressor and two reciprocating compressors are estimated to have aged because they were introduced approx. 30 years ago. We proposed renewing to the latest high-efficiency inverter-controlled screw compressor to reduce power consumption. After renewal, the existing machine will be used a spare unit.
(Note) A conventional suction valve throttling compressor does not reduce much power consumption because if an air volume decreases and a discharge pressure increases, it throttles the suction valve to control the pressure. Since the inverter-controlled type controls a rotation frequency so as to maintain the constant discharge pressure according to a flow rate, power consumption decreases according to the flow rate, having greater energy conservation effects than the conventional type.

Energy Saving: 3.5 kL/year
Cost Saving: 276,000 yen/year
CAPEX: 2,000,000 yen **PP:** 7.2 years
Facility: 1 screw compressor (22 kW, loading/unloading control), 2 reciprocating compressors (7.5 kW/unit, on/off control) → 1 inverter-controlled screw compressor (22 kW)

8. Wastewater treatment system (Dokigawa): Inverted-based aeration blowers

Two aeration blowers at a wastewater treatment plant are continuously operating for 24 hours by turns regardless of a treatment volume. We proposed introducing inverters to operate the blowers according to the treatment volume (working days) (lower air volume on holidays: 30% less), thereby reducing power consumption.
(Note) Substantial energy conservation is expected by continuously measuring the DO (Dissolved Oxygen) value of contaminated water in an aeration tank and controlling the rotation frequency of the blowers based on that numerical value.

Energy Saving: 4.4 kL/year
Cost Saving: 355,000 yen/year
CAPEX: 300,000 yen **PP:** 0.8 years
Facility: 2 roots blowers (15 kW/unit)

9. Production system (Dokigawa): Introduction of a heat pump into a feed water heater by waste heat recovery

A heater for the dyeing machine heats feed water (well water → 45°C) with overflowing hot water. We proposed introducing a heat pump (HP) into this feed water heater to further heat hot water (45 → 60°C), thereby reducing steam consumption for heating.

Energy Saving: 7.1 kL/year
Cost Saving: 661,000 yen/year
CAPEX: 7,500,000 yen **PP:** 11.3 years
Facility: Heat pump (heating capacity: 65 kW, COP: 3.9)

10. Lighting (Main office): Renewal to high-efficiency lighting (LEDs)

We proposed renewing the fluorescent lamps in the formulation room to high-efficiency LED lighting to reduce power consumption. Heat generation decreases along with energy conservation of the lighting fixtures, lowering an air-conditioning load.

Energy Saving: 20.8 kL/year
Cost Saving: 1,151,000 yen/year
CAPEX: 6,000,000 yen **PP:** 5.2 years
Facility: 236 fluorescent lamps (88 W/unit) → 236 LED lamps (46 W/unit)

Major efforts in energy conservation activities

1. Addressing energy conservation in the main office/factory

Conventional activities have included introduction of the inverters into the pumps and the fans, and introduction of the demand monitoring equipment. Along with the proposals in the energy conservation audit, the 236 fluorescent lamps in the formulation room have been replaced by the LED lamps, and “Enhanced utilization of outside air cooling in the intermediate period” and “Renewal to the high-efficiency refrigerators” are examined. In addition, the pull switches (string) have been attached to the lighting fixtures to frequently turn off unnecessary ones. The fans are also effectively utilized to lower a feeling temperature during cooling and stir the air during heating.

2. Addressing energy conservation in the Dokigawa Factory

Conventional activities have included renewal to the high-efficiency boilers, introduction of the waste heat recovery equipment, and so on. In response to the proposal “Renewal to the high-efficiency packaged air-conditioner (PAC)”, the PAC has been renewed to obtain energy conservation effects. In addition, the production processes have been reviewed and improved to not only reduce water and steam consumptions, but enhance manufacturability.

[Hokkaido Area]

CASE11

Audit case of energy conservation/power-saving support services

Case of Hot Spring Hotel

- Industry type: Service industry
- Products: Hot spring hotel
- Company name: Manseikaku Hotels Co., Ltd
- No. of guests: 600

The hotel run by Manseikaku Hotels Co., Ltd. has been conducting the energy conservation activities such as thinning out/turning off unnecessary lighting fixtures, renewing to high-efficiency lighting, and introducing and utilizing the demand monitoring equipment. This time, they requested for an overall energy conservation audit. As a result of the audit, we proposed an inverter-based cold/hot water pump for air-conditioning, cleaning of the heat exchangers of the air-conditioning indoor units for the guest rooms, lower air ratio of vacuum water heaters, enhanced thermal insulation of the hot water piping, and so on.

●Effects of the measures (Audit)

Energy consumption (crude oil equivalent)	Energy cost
Reduced by **70** kL/year	Reduced by **4,985,000** yen/year

Proposals requiring no cost (Note) Energy conservation effect is shown in crude oil equivalent.

1. Hot water system: Lower air ratio of the vacuum water heaters

Two vacuum water heaters are alternately operating to supply hot water. Since both of them have a high air ratio, we proposed adjusting it to the standard value provided by the Act on the Rational Use of Energy (1.9 → 1.3) to realize energy conservation.

Energy Saving: 12.8 kL/year
Cost Saving: 1,019,000 yen/year
Facility: 2 vacuum water heaters (total bunker-A consumption: 360 kl/year)

2. Automatic vending machine: Renewal to the high-efficiency automatic vending machines

We proposed renewing automatic vending machines of beverages (canned and bottled) to the high-efficiency ones to reduce energy consumption (36% less).

Energy Saving: 3.2 kL/year
Cost Saving: 213,000 yen/year
Facility: 39 air-conditioners (total power consumption: 35,000 kWh/year)

Making investments into facilities with higher efficiency (Note) Energy conservation effect is shown in crude oil equivalent.

3. Air-conditioning system: Inverter-based cold/hot water pump

A cold/hot water pump for air-conditioning a banquet hall is adjusting a flow rate by throttling with a valve. We proposed fully opening the valve and controlling the pump with an inverter (lower a rotation frequency to the required flow rate) to reduce power consumption. In this case, as it is necessary to generate a pressure for an actual pump head, and so on, the effects were calculated under the condition that the pump head is lowered to 1/2.

Energy Saving: 32.7 kL/year
Cost Saving: 2,160,000 yen/year
CAPEX: 2,500,000 yen **PP:** 1.2 years
Facility: 1 pump (30 kW)

4. Air-conditioning system: Cleaning of the heat exchangers of the air-conditioning indoor units for the guest rooms

The heat exchangers of the air-conditioning indoor units (FCU: Fan Coil Units) for the guest rooms are contaminated here and there. We proposed recovering heat exchange efficiency by cleaning to reduce fuel consumption. The effects were calculated assuming a 5% energy conservation rate by cleaning.

Energy Saving: 9.1 kL/year
Cost Saving: 729,000 yen/year
CAPEX: 3,180,000 yen **PP:** 4.4 years
Facility: Indoor units (FCU: 318 units, total heat quantity of cooling/heating: 550/960 kW)

5. Air-conditioning system: Installation of the curtains over the window glasses of a restaurant and a lounge

In a restaurant and a lounge, heating is suspended at night during the winter (outside the business hours), and the heat is radiated and lost from the window glasses due to a high room temperature. Because an overnight radiation amount cools down a building and is added to a heating load next day, we proposed installing the curtains over the window glasses to prevent lowering of the room temperature, thereby reducing bunker-A consumption for heating.

Energy Saving: 0.7 kL/year
Cost Saving: 52,000 yen/year
CAPEX: 1,000,000 yen
PP: Upon renewing the aged system
Facility: Window glasses (area: 225 m^2, room temperature at night: 22°C, outside air: 1°C)

6. Air-conditioning system: Adoption of an energy conservation belt for an air-conditioning fan

Since an air-conditioner's fan in a main kitchen is continuously running throughout the year, we proposed replacing it by an energy conservation belt to reduce power consumption. The effects do not include reduction of maintenance expenses due to enhanced durability.
(Note) Because a V-belt with inside notches (energy conservation belt) reduces a "bending stress" when it is coiled around a pulley, it decreases losses by bending and improves power transmission efficiency from a motor to the drive side, saving the power.

Energy Saving: 0.4 kL/year
Cost Saving: 25,000 yen/year
CAPEX: 17,000 yen **PP:** 0.4 years
Facility: 1 exhaust fan (22 kW)

7. Hot water swimming pool: Reduction of heat dissipation from the surface of a hot water swimming pool

We proposed installing simple heat-retaining sheets on the water surface of a hot water swimming pool at night during the winter to inhibit evaporation of the water content and lowering a water temperature, thereby reducing the fuel consumption of a boiler. Specific measures include spreading foaming resin sheets, insulating boards, etc. on the surface of the indoor swimming pool.

Energy Saving: 4.1 kL/year
Cost Saving: 330,000 yen /year
CAPEX: 200,000 yen **PP:** 0.6 years
Facility: Hot water swimming pool (surface area: 100 m^2, water temperature: 31°C, ambient temperature: 28°C)

8. Hot water piping: Enhanced thermal insulation of a hot water piping system

We proposed enhancing thermal insulation of a hot water piping system in a machine room to decrease radiation losses, thereby reducing the bunker-A consumption of the hot water boiler.

Energy Saving: 1.9 kL/year
Cost Saving: 151,000 yen/year
CAPEX: 380,000 yen **PP:** 2.5 years
Facility: Flange type globe valves (3 pcs. for 150A), flanges (3 pcs. for 150A, 14 pcs. for 80A, 6 pcs. for 65A), piping (1 m for 80A, 1 m for 50A), and so on

9. Lighting: Renewal of the fluorescent guide lights to the LED lamps

The fluorescent guide lights consume less power, but has high annual power consumption because they are left turned on for 24 hours. We proposed replacing them by the high-efficiency LED guide lights to reduce power consumption.

Energy Saving: 1.8 kL/year
Cost Saving: 121,000 yen/year
CAPEX: 1,368,000 yen **PP:** 11.3 years
Facility: 40 fluorescent guide lights (23 W/unit) → 40 LED guide lights (2.7 W/unit)

10. Electric outlet load: Power-off of the guest-room refrigerators when the rooms are not occupied

We proposed installing the electric outlets with switch to turn off the indoor small refrigerators when the rooms are not occupied, thereby reducing power consumption resulting from futile operation.

Energy Saving: 2.8 kL/year
Cost Saving: 185,000 yen/year
CAPEX: 10,000 yen **PP:** 0.1 years
Facility: 320 small refrigerators (17 kWh/month/unit)

Major efforts in energy conservation activities

1. Implementing all two operational improvement proposals
The air ratio of the vacuum water heaters was adjusted and two automatic vending machines were integrated into one high-efficiency model.

2. Utilizing a subsidy to implement the proposed investment-required improvements, obtaining substantial energy conservation effects
The proposal "Inverter-based cold/hot water pump" was expanded to all 12 units by utilizing the 2014 Subsidy for Introduction of Energy Conservation Facilities for Local Factories, Small- and Medium-sized Businesses, obtaining substantial effects. "Cleaning of the heat exchangers of the air-conditioning indoor units for the guest rooms", "closing of the gaps of the restaurant and lounge doors (prevention of entry of the outside air)" and "enhanced thermal insulation of the hot water piping" were also implemented. "Renewal of the guide lights to the LED lamps" is being sequentially implemented, beginning with the burnt-out ones.

3. Developing the improvement activities other than the proposals
A cold/hot water generator was renewed by adopting a combination of a hot spring heat-based heat pump (heating) and a cooling tower (cooling), intended for utilization of the hot spring heat, and utilizing the 2014 Subsidy for Introduction of Energy Conservation Facilities for Local Factories, Small- and Medium-sized Businesses, including primary heating of hot water feed by the hot spring heat, thereby greatly reducing the fuel heavy oil.

[Tohoku Area]

CASE12

Audit case of energy conservation/power-saving support services

Case of Hot Spring Hotel

- Industry type: Service industry ■ Products: Hot spring hotel
- Company name: Tendo Hotel Co., Ltd.
- No. of guests: Approx. 210 on weekdays and 300 on holidays

Tendo Hotel Co., Ltd. has been conducting the energy conservation activities such as suspending the air-conditioners during the intermediate period, replacing the lighting fixtures by the LEDs, and educating the employees about energy conservation. This time, they requested for an overall energy conservation audit. As a result of the audit, we proposed water-saving in the washrooms and bathrooms, inverter-based pumps for an air-conditioning system, adjustment of a boiler's air ratio, reduction of the maximum power by introduction of the demand monitoring equipment, and so on.

●Effects of the measures (Audit)

Energy consumption (crude oil equivalent)	Energy cost
Reduced by **65** kL/year	Reduced by **6,650,000** yen/year

Proposals requiring no cost (Note) Energy conservation effect is shown in crude oil equivalent.

1. Freezer/refrigerator: Consolidation of the prefabricated refrigerators and freezers for kitchen

Many refrigerators and freezers are installed for kitchen use, but the utilization factors of individual units seem low and there is room for consolidation of the numbers. The refrigerators and freezers consume the power not only for the compressors, but for ancillary facilities such as frozen door preventive heaters, defrosting heaters and internal lighting. We proposed consolidating the number of working units to realize energy conservation.

Energy Saving: 1.5 kL/year
Cost Saving: 101,000 yen/year
Facility: Reduction of the refrigerators and freezers (3 units, 2.2 kW/unit)

2. Sanitary system: Adjustment of the hot water volume in the washrooms

Since a face-washing hot water discharge rate is high, we proposed (1) using a stop cock for a hand-washing faucet to reduce by 75% and (2) introducing a super water-saving shower to save water and reduce the bunker-A consumption of the boiler.

Energy Saving: 22.2 kL/year
Cost Saving: 2,806,000 yen/year
Facility: Hot water reduced by 3,300 m^3/year, hand-washing water reduced by 2,200 m^3/year

3. Lighting: Power-saving of the fluorescent lamps

We proposed replacing the FLR fluorescent lamps in the backyard such as an office and a kitchen by the power-saving fluorescent lamps to reduce power consumption.

Energy Saving: 0.7 kL/year
Cost Saving: 49,000 yen/year
Facility: 180 FLR fluorescent lamps (40 W/unit) → 180 fluorescent lamps (36 W/unit)

Making investments into facilities with higher efficiency (Note) Energy conservation effect is shown in crude oil equivalent.

4. Air-conditioning system: Renewal to a high-efficiency inverter-controlled freezing machine

Installed about 28 years ago, a water-cooled chiller has aged. We proposed renewing it to a high-efficiency inverter-controlled freezing machine to reduce power consumption.

Energy Saving: 4.9 kL/year
Cost Saving: 329,000 yen/year
CAPEX: 27,650,000 yen
PP: Upon renewing the aged system
Facility: 1 water-cooled chiller (cooling capacity: 247 kW, COP: 4.1 →5.1)

5. Air-conditioning system: Inverter-based secondary hot water pumps

Two secondary hot water pumps (No. 2 and No. 3) in the new building have an excessive capacity and are operated by throttling with a valve. (35% for No. 2 and 70% for No. 3). We proposed fully opening the valve and control them with inverters (lower flow rate by controlling a motor speed) to reduce power consumption.

Energy Saving: 4.2 kL/year
Cost Saving: 283,000 yen/year
CAPEX: 600,000 yen **PP:** 2.1 years
Facility: 2 pumps (11 kW, 3.7 kW)

6. Boiler: Reduction of fuel consumption by lowering the air ratio

The air ratio of individual boilers has not been measured and understood, but are estimated high. We proposed adjusting it (1.8 → 1.3) to reduce bunker-A consumption.

Energy Saving: 7.2 kL/year
Cost Saving: 550,000 yen/year
CAPEX: 400,000 yen **PP:** 0.7 years
Facility: 4 boilers (0.9 t/h./unit, total heavy oil consumption: 176 kl/year)

7. Steam piping: Enhanced thermal insulation of the steam piping

We proposed enhancing thermal insulation of the steam piping and valves to reduce the heavy oil consumption of the boilers (feasible by thermal insulation work by the employees).

Energy Saving: 3.3 kL/year
Cost Saving: 250,000 yen/year
CAPEX: 1,300,000 yen **PP:** 5.2 years
Facility: Flange type globe valves (15 pcs. for 80A), flanges (50 pcs. for 100A, 50 pcs. for 65A)

8. Water heating system: Introduction of exclusive small pumps for midnight use into a bathtub filtration system

Two bathtub filtration pumps (5.5 kW/unit) are running. Since contamination is less at midnight, we proposed installing exclusive small filtration pumps and switching them over with a timer to reduce power consumption. Since the number of filtration pumps is added to, they will be a backup in the case of failure.
(Note) It is also possible to detect free residual chlorine concentration in bathtub water to control the filtration pump with an inverter, allowing further energy conservation.

Energy Saving: 2.2 kL/year
Cost Saving: 151,000 yen/year
CAPEX: 240,000 yen **PP:** 1.6 years
Facility: Two pumps (2.2 kW/unit) added to the existing two pumps (5.5 kW/unit)

9. Sanitary system: Replacement of the shower heads in the bathrooms by the water-saving type

We proposed changing the shower heads in the bathrooms from the conventional type to the water-saving type to save water and reduce bunker-A consumption.

Energy Saving: 6.0 kL/year
Cost Saving: 810,000 yen/year
CAPEX: 2,800,000 yen **PP:** 3.5 years
Facility: 40 shower heads

10. Lighting: Introduction of the motion detectors for lighting in the restrooms

There are many lighting fixtures in the restrooms in the public areas, but effective lighting control cannot be easily done by manual flashing. We proposed installing the motion detectors to turn off lighting when there is nobody, thereby reducing power consumption.

Energy Saving: 0.6 kL/year
Cost Saving: 39,000 yen/year
CAPEX: 176,000 yen **PP:** 4.5 years
Facility: 8 restrooms, fluorescent lamps (27 W/unit: 14 units, 12 W/unit: 8 units), 8 motion detectors (1 master device + 2 slave devices/location)

11. Lighting: Replacement of the fluorescent guide lights by the LED lamps

We proposed renewing the fluorescent guide lights to the LED lamps with low power consumption to reduce power consumption.
(Note) When renewing to the LED guide lights, it is necessary to notify to a competent fire station in advance.

Category	Power consumption (W)		Qty.	
	Fluorescent lamp	LED	Fluorescent lamp	LED
(1) Class-A guide lights (40 W)	49	10.5	22	48
(2) Class-A guide lights (35 W)	44	10.5	26	
(3) Class-B guide lights (Class BH)	25	3.6	90	91
(4) Class-C guide lights (20 W)	25	2.0	1	1
(5) Class-C guide lights (10 W)	13	2.0	57	56
Total			196	196

Energy Saving: 9.7 kL/year
Cost Saving: 654,000 yen/year
CAPEX: 8,500,000 yen **PP:** 13 years
Facility: Fluorescent guide lights → LED guide lights

12. Demand control: Introduction of the demand monitoring equipment

We proposed introducing the demand monitoring equipment to monitor the change of the maxim power, and suspending operation of the premeditated systems when the maximum power approaches a setting value, thereby inhibiting the maximum power (contract demand: 720 → 693 kW, 27 kW less). The systems to be suspended include kitchen equipment (convection oven, dish washing machine), sauna, change of the defrosting time of the freezers and refrigerators, electric water heaters, and so on.

Maximum power: 27 kW less
Cost Saving: 437,000 yen/year
CAPEX: 400,000 yen **PP:** 0.9 years
Facility: Demand monitoring equipment

13. Electric outlet load: Power-off of the guest-room refrigerators when the rooms are not occupied

The refrigerators are installed in the guest rooms. They are left turned on all the time, consuming the standby power. We proposed utilizing extension cords with switch, etc. to turn off the power when the rooms are not occupied, thereby realizing energy conservation.

Energy Saving: 2.8 kL/year
Cost Saving: 191,000 yen/year
CAPEX: 116,000 yen **PP:** 0.6 years
Facility: 116 small refrigerators (180 kWh/unit·year)

Major efforts in energy conservation activities

1. Implementing the management proposals requiring no investments in advance
"Adjustment of the hot water volume in the washrooms" has been put into practice and is being promoted because it brings about great effects. For "Power-saving of the fluorescent lamps", the employees have been voluntarily replacing the burnt-out fluorescent lamps by the power-saving type.

2. Implementing easily practicable investment-required proposals in advance
The deteriorated bathroom faucets were renewed according to the proposal. When this was done, 20 shower heads were replaced by the latest water-saving type capable of lowering a water rate without changing a pressure, thereby substantially reducing water-heating energy.

3. Utilizing a subsidy to replace the guide lights by the LED lamps
The Subsidy for Eco-Renovation Promotion Model Project in Yamagata Prefecture was utilized to replace all fluorescent guide lights by the LED lamps, which had been left turned on all the time.

[Tohoku Area]

CASE13

Audit case of energy conservation/power-saving support services

Case of General Welfare Facilities

- Industry type: Social welfare and nursing care
- Products: General welfare facilities
- Company name: Social welfare corporation, Kagayakinokai, Ikiikinosato
- No. of users: 500

Ikiikinosato has been taking the energy conservation measures such as thinning out/turning off unnecessary lighting fixtures and changing a cooling/heating setting temperature. This time, they requested for an overall energy conservation audit, focusing on reduction of a boiler fuel. As a result of the audit, we proposed the lower air ratio of a cold/hot water generator for air-conditioning, a measure to control heat radiation from the surface of the baths and a swimming pool when they are not in use, enhanced thermal insulation of hot water piping and a tank, power-saving of an antifreeze heater, integration of transformers, and so on.

●Effects of the measures (Audit)

Energy consumption (crude oil equivalent)	Energy cost
Reduced by **87** kL/year	Reduced by **8,767,000** yen/year

Proposals requiring no cost (Note) Energy conservation effect is shown in crude oil equivalent.

1. Air-conditioning system: Reduction of fuel consumption (LPG) by the lower air ratio

We proposed lowering the air ratio of the cold/hot water generator for air-conditioning (1.60 → 1.30) to decrease heat losses by an exhaust gas, thereby realizing energy consumption.

Energy Saving: 2.5 kL/year
Cost Saving: 236,000 yen/year
Facility: 2 absorption type cold/hot water generators (cooling/heating capacity: 633/736 kW/unit, LPG consumption: 100 t/year)

2. Air-conditioning system: Power-off of the air-conditioners during their non-operating period

Since the air-conditioners are left turned on all the time, the crank case heaters consume the standby power when air-conditioning is not used (4 months/year). We proposed turning off the circuit breakers during that period to realize energy conservation.
(Note) The crank case heater is a facility to prevent mixture of a refrigerant and a lubricant and does not need to be energized when the air-conditioners are not operating. Its manufacturer recommends turning on the main power a couple of hours before using the air-conditioners.

Energy Saving: 1.1 kL/year
Cost Saving: 83,000 yen/year
Facility: 50 air-conditioners (crank case heater: 30 W/unit)

3. Plumbing equipment: Power-saving of the antifreeze heater

We proposed (1) adjusting the setting temperature of the piping antifreeze panel heater for a fire-fighting system (20 → 5°C) and (2) removing the power wiring of the incorporated antifreeze heater of an electric valve because there is no fear of freezing of the piping (hot water) of a filtration pump, thereby reducing power-saving.

Energy Saving: 0.8 kL/year
Cost Saving: 58,000 yen/year
Facility: 1 panel heater (1.0 kW/unit), 4 electric valves (15 W/unit)

4. Demand control: Utilization of the demand monitoring equipment

A possible cause for higher maximum power (demand) is heater operation for the vaporizers (3 LPG vaporizers, totally 78 kW) and the tableware storages (2 units, totally 27 kW). We proposed utilizing the demand monitoring equipment to monitor the change of the maximum power, and stop the predetermined devices (vaporizers, etc.) to inhibit the maximum power (221 → 180 kW, 41 kW less) when it approaches a setting value.

Maximum power: 41 kW less
Cost Saving: 685,000 yen/year
Facility: Demand monitoring equipment

5. Automatic vending machine: Renewal to the energy conservation type

Specified as the specially designated secondary device of the Act on the Rational Use of Energy, the automatic beverage vending machines have enhanced the energy conservation performance year after year. We proposed renewing them to the energy conservation type to reduce power consumption.

Energy Saving: 0.3 kL/year
Cost Saving: 24,000 yen/year
Facility: 2 automatic vending machines (totally 3,020 → 1,754 kW/year)

Making investments into facilities with higher efficiency (Note) Energy conservation effect is shown in crude oil equivalent.

6. Water heating system: Enhanced thermal insulation of the valves, flanges and a filtration tank

We proposed enhancing thermal insulation of the valves and the flanges of the hot water feed/heating piping, and the filtration tank to decrease heat dissipation, thereby realizing energy conservation.

Energy Saving: 9.2 kL/year
Cost Saving: 866,000 yen/year
CAPEX: 413,000 yen **PP:** 0.5 years
Facility: Flange type gate valves (10 pcs. for 80A, 10 pcs. for 65A, 20 pcs. for 50A), flanges (20 pcs. for 80A, 20 pcs. 65A, 40 pcs. for 50 A), 1 filtration tank (ø1.5 m, 3.0 m high)

7. Water heating system: Inverter-based hot spring circulation pump

Since the valve of a hot spring circulation pump is narrowed, a required flow rate is lower than the rated flow rate of the equipment. Accordingly, we proposed fully opening the valve and controlling the pump by an inverter to adjust the flow rate, thereby reducing power consumption.

Energy Saving: 0.9 kL/year
Cost Saving: 70,000 yen/year
CAPEX: 70,000 yen **PP:** 1.0 year
Facility: 1 pump (2.2 kW)

8. Other facilities: Measure to control heat radiation from the surface of the baths and the swimming pool when they are not in use

We proposed covering the water surface with a simple heat-retaining sheet (3-layer bubble wrap, foamed polyethylene sheet, etc.) to inhibit moisture evaporation and a water temperature fall during a time period (14 h./day x 365 days) when the indoor baths, outdoor bath and hot water swimming pool are not used, thereby reducing boiler fuel consumption.

Energy Saving: 68.6 kL/year
Cost Saving: 6,459,000 yen/year
CAPEX: 2,900,000 yen **PP:** 0.4 years
Facility: 2 indoor baths (total surface area: 101 m², 40°C), outdoor bath (23 m², 40°C), hot water swimming pool (approx. 200 m², 30°C)

9. Lighting: Higher-efficiency mercury lamps

We proposed renewing the outside mercury lamps (lighting hours: 3.5 h./day x 365 days) to the high-efficiency ceramic metal halide lamps (with an exclusive stabilizer) to realize energy conservation.

Energy Saving: 0.3 kL/year
Cost Saving: 26,000 yen/year
CAPEX: 350,000 yen **PP:** 13.5 years
Facility: 7 mercury lamps (400 W/unit) → 7 ceramic metal halide lamps (250 W/unit, with stabilizer)

10. Transformer: Integration of the transformers in two electrical rooms

Five transformers in two electrical rooms are lightly loaded. We proposed integrating them into two transformers in the first electrical room (suspension of 3 units and removal of the primary-side wiring) to decrease transformer losses, thereby realizing energy conservation. In this case, cabling is required from the first to the second electrical room.

Energy Saving: 3.5 kL/year
Cost Saving: 260,000 yen/year
CAPEX: 1,000,000 yen **PP:** 3.8 years
Facility: 3ø transformers (2 units,300 kVA + 200 kVA → 1 unit, 300 kVA), 1ø transformer (3 units, 200 kVA/unit → 1 unit)

	Status quo	Renewal plan
1st electrical room	3ø transformer (1 unit: 300 kVA) 1ø transformer (2 units: 200 kVA/unit)	Integrate into; - 3ø transformer (1 unit: 300 kVA) - 1ø transformer (1 unit: 200 kVA) in the 1st electrical room.
2nd electrical room	3ø transformer (1 unit: 200 kVA) 1ø transformer (1 nit: 200 kVA)	

Major efforts in energy conservation activities

1. Implementing four operational improvement proposals requiring no investments
Energy conservation activities were immediately put into practice for operational improvement, such as lowering the air ratio of the cold/hot water generators for air-conditioning and the gas type water boiler, suspending surplus antifreeze heaters, renewing to the energy-conserving automatic vending machines, and utilizing the existing demand monitoring equipment to inhibit the maximum power.

2. Implementing two relatively easy investment improvement proposals for management
Thermal insulation of the valves and flanges for the hot water piping, and the filtration tank was enhanced, and the mercury lamps for the indoor hot water swimming pool were renewed to the high-efficiency lighting fixtures to obtain the energy conservation effects.

3. Enhancing the energy conservation management structure and promoting their own measures
Having understood the necessity of the management structure after the audit, an organizational structure was established with a managing director at the top plus mangers and their subordinates to continuously promote energy conservation. In addition, a water-saving tool was introduced, small humidifiers were renewed to large ones (mist fans), and one vaporizer was suspended as their voluntary measures to realize energy conservation. Also, it is planned to renew two hot water boilers by utilizing the Promotion Project Subsidy for Investments in Energy Conservation and Productivity Revolution of Small- and Medium-sized Businesses of the FY2015 supplementary budget.

[Chugoku Area]

CASE14

Audit case of energy conservation/power-saving support services

Case of Welfare Center and Culture Center

- Industry type: Public ■ Products: Welfare center, culture center
- Company name: Company K
- Total floor area: 4,056 m² for the welfare center A, 6,700 m² for the culture center B

Company K has been taking the energy conservation measures such as thinning out unnecessary lighting fixtures and suspending unnecessary air-conditioning at the welfare center A and culture center B which are the designated administrator facilities. This time, they requested for an overall energy conservation audit, focusing on air-conditioning and lighting. As a result of the audit, we proposed easing the setting temperature of air-conditioning, controlling an air-handling unit for air-conditioning and a pump through an inverter, lowering an outside air inlet volume, renewing to high-efficiency lighting, and so on.

●Effects of the measures (Audit)

A.

Energy consumption (crude oil equivalent)	Energy cost
Reduced by **20** kL/year	Reduced by **2,441,000** yen/year

B.

Energy consumption (crude oil equivalent)	Energy cost
Reduced by **36** kL/year	Reduced by **4,039,000** yen/year

Proposals requiring no cost (Note) Energy conservation effect is shown in crude oil equivalent.

1. Air-conditioning system (Culture center): Lower outside air inlet volume for an atrium and a hot water swimming pool

(1) Since a CO_2 concentration (490 ppm) in the atrium is low and the outside air inlet volume is too high, lower the outside air inlet volume to a control value (900 ppm). (2) The CO_2 concentration of the hot water swimming pool has not been measured. Lower the outside air inlet volume to the required volume at the CO_2 concentration control value (900 ppm) obtained from the number of users at the peak time. We proposed reducing power consumption for air-conditioning by taking the measures (1) and (2).

Energy Saving: 7.3 kL/year
Cost Saving: 806,000 yen/year
Facility: Air-conditioner (cooling/heating COP: 2.6/3.3)

Item	Energy conservation effect	Cost reduction
(1) Lower outside air inlet volume for the atrium	17,073 kWh/year	487,000 yen/year
(2) Lower outside air inlet volume for the hot water swimming pool	11,210 kWh/year	319,000 yen/year
Total	28,283 kWh/year	806,000 yen/year

2. Air-conditioning system (Welfare center): Easing of the setting temperature of air-conditioning

We proposed easing the setting temperature of (1) a GHP air-conditioner for a public area and (2) an EHP air-conditioner for tenants (cooling/heating: 24/24°C → 26/22°C) to realize energy conservation.

Energy Saving: 5.6 kL/year
Cost Saving: 487,000 yen/year
Facility: GHP air-conditioner (city gas consumption: 12,000 m³/year), EHP air-conditioner (power consumption: 57,000 kWh/year)

3. Air-conditioning system (Welfare center): Delayed air-conditioner start time at the front entrance

Two indoor units for the front entrance are activated 1 hour earlier than other 6 outdoor units. We proposed delaying their start time to the same time as the other units to reduce fuel consumption and power consumption for the GHP.

Energy Saving: 2.4 kL/year
Cost Saving: 224,000 yen/year
Facility: GHP air-conditioner (city gas consumption during cooling/heating: 44.3/43.8 m³/h.)

4. Ventilation system (Welfare center): Change of the exhaust fan setting temperature of an elevator machine room

The Enforcement Order of the Building Standards Act and the JIS "Inspection Standards for Elevators" stipulate that the temperature of the machine room should be maintained at 40°C or lower as a rule. We proposed easing the exhaust fan setting temperature 20°C (during the audit) to 35°C to save the power.

Energy Saving: 0.4 kL/year
Cost Saving: 33,000 yen/year
Facility: Fluorescent lamps (4 units, 40 W paired lamps/unit)

5. Lighting (Welfare center): Thinning out of lighting of the corridor in the public area

Lighting of the corridor in the public area has been already thinned out, but illuminance was 150 to 250 lx at the time of audit (3rd floor), brighter than the JIS illuminance standard 100 lx. We proposed thinning out lighting on the 3rd and 4th floors to realize energy conservation.

Making investments into facilities with higher efficiency (Note) Energy conservation effect is shown in crude oil equivalent.

6. Air-conditioning system (Welfare center): Power-saving by installing the sunshades for the outdoor units

The outdoor units for the air-conditioners are installed on the west side of the 1st and 2nd floors and on the rooftop, and subjected to the direct sunshine. We proposed making shades for the outdoor units with "reed screens", etc. to block solar insolation, thereby lowering the temperature of the outdoor units (condensers) to save the power.

Energy Saving: 0.8 kL/year
Cost Saving: 64,000 yen/year
CAPEX: 400,000 yen **PP:** 6.3 years
Facility: 10 air-conditioners (compressors: 65 kW in total)

7. Air-conditioning system, hot water swimming pool (Culture center): Inverter-based AHU, cold/hot water pump, etc.

(1) The fans of the air-handling units (AHUs) for air-conditioning throttles damper opening to 50% to adjust an air volume. The secondary cold/hot water pump for air-conditioning and the secondary hot water pumps throttle the discharge valves to about 30% opening. By fully opening the damper and introducing an inverter, accordingly, reduce the motor speed to lower the air volume/flow rate. (2) A water circulation pump for the swimming pool keeps running at a constant speed at night after business hours. Introduce an inverter to lower the pump rotation frequency during the less contaminating nighttime, thereby reducing a circulation water rate (70% less). We proposed saving the power by taking the measures (1) and (2).

Energy Saving: 20.7 kL/year
Cost Saving: 2,300,000 yen/year
CAPEX: 2,138,000 yen **PP:** 0.9 years
Facility: 4 AHU fans (totally 37 kW), 1 cold/hot water pump (5.5 kW), 2 secondary hot water pumps (2.2 kW/unit), 3 circulation pumps (totally 10.5 kW)

8. Hot water swimming pool (Culture center): Improvement of a jacuzzi pump operating method and water-saving of showers

(1) A jacuzzi pump is continuously running while the hot water swimming pool is utilized, but the utilization frequency of the pump seems low. We proposed running it only during usage of the jacuzzi to reduce power consumption. Specifically, have users turn on the start switch of the jacuzzi pump and use a timer to stop the pump automatically, or install a motion detector at the upper part of the jacuzzi to run the pump automatically. (2) We proposed replacing the conventional shower heads in a shower room with the water-saving type to save water and reduce the power consumption of a hot water heat pump chiller.

Energy Saving: 1.7 kL/year
Cost Saving: 302,000 yen/year
CAPEX: 270,000 yen **PP:** 0.9 years
Facility: 1 pump (2.2 kW), 8 shower heads

9. Lighting (Culture center, welfare center): Renewal to high-efficiency lighting

(1) We proposed renewing the (1) downlights in the restrooms (incandescent lamps), (2) mercury lamps in a gymnastic meeting room, (3) multi-halogen lamps in the atrium, and (4) fluorescent guide lights to the high-efficiency models to reduce power consumption.

Energy Saving: 6.0 kL/year
Cost Saving: 526,000 yen/year
CAPEX: 1,957,000 yen **PP:** 3.7 years
Facility: Incandescent lamps → LED lamps; Mercury lamps, halogen lamps → Ceramic halide lamps; Fluorescent guide lights → LED guide lights

Status quo	Renewal plan	Lighting hours (h./year)	Qty.	Money saved (in 1,000 yen)	Investment (in 1,000 yen)	Payback period (in years)
(1) Downlights (incandescent lamps, 40 W/unit)	LED lamps (5.2 W/unit)	4,485	20	66	50	0.8
(2) Mercury lamps (300 W/unit)	Ceramic halide lamps (190 W/unit)	828	20→15	55	675	12.3
(3) Multi-halogen lamps (430 W/unit)	Ceramic halide lamps (250 W/unit)	3,926	8	161	280	1.7
(4) Fluorescent guide lights (98 W/unit)	LED guide lights (3.5 W/unit)	8,760	11	244	952	3.9
Fluorescent guide lights (49 W/unit)	LED guide lights (3.5 W/unit)		6			
Total			45	526	1,957	3.7

10. Demand control (Welfare center): Introduction of the demand monitoring equipment

We proposed introducing the demand monitoring equipment to monitor changes of the maximum power, and suspend the air-conditioning system or thin out lighting as set in advance when approaching a setting value, thereby inhibiting the maximum demand power (142 → 130 kW, 12 kW less).

Maximum power: 12 kW less
Cost Saving: 253,000 yen/year
CAPEX: 400,000 yen **PP:** 1.6 years
Facility: Demand monitoring equipment

Major efforts in energy conservation activities

1. Purpose of utilizing the complimentary energy conservation audit at the public facilities

Under the stern financial circumstances, Company K has been making efforts for efficient management of the designated administrator facilities. In the meantime, they have utilized the complimentary energy conservation audit system to consider the energy conservation measures for the welfare center A and the culture center B, and steadily implemented them, focusing on the operational improvement proposals requiring no investments.

2. Implementing the investment-required improvements

On the other hand, the investment-required improvements cannot be easily implemented by the designated administrator alone. Eyeing utilization of a national subsidy system, they have been deliberating with the related parties so as to implement them in a municipal mid-term plan. They have already renewed to high-efficiency lighting.

Tuning audit implemented

[Kanto Area]

CASE15

Audit case of energy conservation/power-saving support services

Case of City Gas Manufacturing and Supply Company

- Industry type: Other manufacturing
- Products: City gas
- Company name: Company A
- No. of employees: Approx. 200 on weekdays and approx. 30 on holidays

Company A has been conducting the energy conservation activities such as thinning out/turning off unnecessary lighting fixtures and renewing them to high-efficiency ones at the main office building. This time, they requested for an overall energy conservation audit, including an absorption type water cooler/heater. As a result of the audit, we proposed easing a cooling start time and a cooling setting temperature, easing the cold water temperature of the absorption type water cooler/heater, utilizing an inverter for a cooling water pump, replacing mercury lamps and guide lamps by high-efficiency lamps, turning off lighting thoroughly outside the business hours, and so on. Half a year after the energy conservation audit (Dec. 2014), they had our tuning audit to measure various data and confirmed a tuning method and energy conservation effect as to “full opening of the flow rate control valve of the cooling water pump and tuning by inverter control”.

●Effects of the measures (Audit)

Energy consumption (crude oil equivalent)	Energy cost
Reduced by **5** kL/year	Reduced by **404,000** yen/year

Proposals requiring no cost (Note) Energy conservation effect is shown in crude oil equivalent.

1. Air-conditioning system: Easing of a cooling start-up time

It is estimated that cooling starts at 6:00 a.m. during summer. We proposed delaying the start-up time by one hour to realize energy conservation because there is an enough time before the working hours.

Energy Saving: 1.7 kL/year
Cost Saving: 143,000 yen/year
Facility: 5 GHP air-conditioners (total capacity: 256 kW, cooling COP: 1.2)

2. Air-conditioning system: Easing of the cooling setting temperature (GHP)

We proposed easing the cooling setting temperature of a new building by 1°C (26 → 27°C on the average) to realize energy conservation.

Energy Saving: 1.2 kL/year
Cost Saving: 101,000 yen/year
Facility: 5 GHP air-conditioners (total capacity: 256 kW, cooling COP: 1.2)

3. Air-conditioning system: Easing of the cold water temperature of the absorption type water cooler/heater

Because a load is low during a cooling period (June, half of September, and October) except during the maximum load, we proposed raising the cold water temperature from the water cooler/heater (7 → 9°C) to enhance the efficiency of the water cooler/heater, thereby improving fuel (city gas 13A) consumption efficiency.

Energy Saving: 0.4 kL/year
Cost Saving: 37,000 yen/year
Facility: Absorption type water cooler/heater (city gas consumption during the target period: 6,500 m³/year)

4. Air-conditioning system: Utilization of the inverter for the cooling water pump

The discharge valve of the cooling water pump (CWP-1) is opened approximately 50%. We proposed fully opening the valve and adjusting inverter setting (already installed, lower pump rotation frequency) to reduce pump power.

Energy Saving: 0.5 kL/year
Cost Saving: 51,000 yen/year
Facility: 1 pump (5.5 kW)

5. Lighting: Thinning out of lighting

The illuminance (1,100 to 1,200 lx) of the 2nd and 3rd office floors of the new building is high, leaving room for reduction with respect to the JIS standard (750 lx). We proposed thinning out lighting to reduce the lighting power.

Energy Saving: 0.4 kL/year
Cost Saving: 39,000 yen/year
Facility: Hf fluorescent lamps (65 W/unit, 46 →37 units)

6. Lighting: Thorough lights out outside the business hours

A power monitor tells that lighting of the 2nd and 3rd floors of the new building has been turned on from an early time before the business hours. We proposed turning it off outside the business hours to reduce the lighting power except when it is inevitable.

Energy Saving: 0.04 kL/year
Cost Saving: 4,000 yen/year
Facility: Hf fluorescent lamps (10 units, lighting hours outside the business hours: 65 W/unit x 1 h./day)

Making investments into facilities with higher efficiency (Note) Energy conservation effect is shown in crude oil equivalent.

7. Lighting: Renewal of the mercury lamps of a parking lot to the high-efficiency lamps

We proposed renewing the outdoor mercury lamps of the parking lot to high-efficiency ceramic metal halide lamps to reduce the lighting power.

Energy Saving: 0.2 kL/year
Cost Saving: 15,000 yen/year
CAPEX: 90,000 yen **PP:** 6.0 years
Facility: Mercury lamps (2 units, 210 W/unit) → Ceramic metal halide lamps (2 units, 128 W/unit)

8. Lighting: Renewal of the guide lights to the LED lamps

The guide lights of the new building are all LED lamps, but those of the main building are almost fluorescent lamps. We proposed replacing the guide lights by the LED lamps at the timing of their renewal to reduce power consumption. When renewing to the LED guide lights, it is necessary to notify a competent fire station in advance.

Energy Saving: 0.2 kL/year
Cost Saving: 14,000 yen/year
CAPEX: 130,000 yen **PP:** 9.3 years
Facility: Fluorescent guide lights → LED guide lights

Before renewal	After renewal	Qty.
Guide lights: Fluorescent lamps (15 W/unit)	LED lamps (2.0 W/unit)	2
Guide lights: Fluorescent lamps (23 W/unit)	LED lamps (2.7 W/unit)	2

Results of tuning audit

1. Topics	Tuning by fully opening the flow rate control valve of the cooling water pump and adjusting the inverter (Proposal 4)
2. Target facilities	Gas-fired absorption type water cooler/heater (cooling/heating: 352/329 kW), cooling water pump (1 unit, 5.5 kW)
3. Results	We confirmed the methods for measuring the cooling water inlet/outlet pressure of the water cooler/heater, cooling water volume and pump power. We confirmed the effects of full opening of the valve and inverter adjustment (48 Hz) under the equivalent conditions to conventional throttling of the discharge valve (50% opening). Power consumption: 8.8% less, Crude oil equivalent: 0.2 kL/year, Effects: 21,000 yen/year We confirmed the effects, assuming that an inverter frequency is 48 Hz during summer (same as the above) and 35 Hz during the intermediate period when the outside temperature is low (cooling water volume: 30% less than the summer). Power consumption: 38% less, Crude oil equivalent: 1.0 kL/year, Effects: 91,000 yen/year

Major efforts in energy conservation activities

1. Utilizing the inverter to realize energy conservation (including the tuning audit activities)

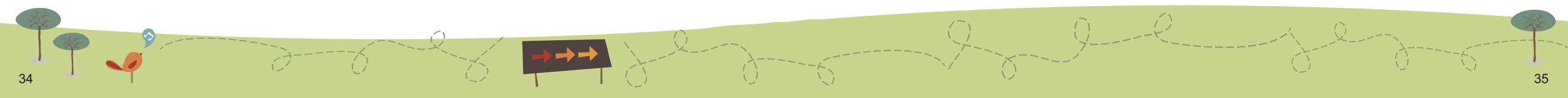
In order to utilize the inverter for the cooling water pump as proposed, they had a tuning audit after the energy conservation audit to learn a method to collect the data for preparing the relationship diagrams of “frequency vs. flow chart” and “frequency vs. electric power”. After that, they voluntarily applied it to not only the measured cooling water pump, but a cold/hot water circulation pump to obtain more energy conservation effect.

2. Implementing the six operational improvement proposals requiring and not requiring investments (other than those related to the tuning audit)

For the improvement proposals not requiring investments, they implemented “easing of the cooling setting temperature (26 → 28°C)” and “easing of the cold water temperature of the absorption type water cooler/heater (7 → 9°C)”. For the improvement proposals requiring investments, they invested in the sensors, LEDs and LEDs with sensor to respond to the proposals, “thinning out of lighting” and “thorough lights out outside the business hours”. For the “mercury lamps of the parking lot” and “guide lights”, they are renewing them to the LED lamps successively.

3. Developing the voluntary improvement activities other than the proposals

They have utilized the waste heat by cogeneration, renewed the air-conditioners and introduced solar power generation (subsidy utilized) to realize 15% energy conservation across the building.



Complimentary Energy Conservation Audit Cases in FY2016

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