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18. A Field Study of Energy Efficient Factories

省エネルギー優良工場視察

Mr. Naoyuki NISHII
西井　直之

HOKKAIDO Brewery
SAPPORO BREWERIES LIMITED

サッポロビール株式会社
北海道工場
エンジニアリング部

ESCO: The First in Japan to use Project Financing

SAPPORO BREWERIES LIMITED
HOKKAIDO Brewery
Presenter: Naoyuki Nishii

***Overview**

The ESCO (Energy Service Companies) system, which promotes environmental conservation, has already become widely used in the United States and Europe. Now, a plant in Hokkaido is employing an ESCO's system by introducing this high - efficiency, gas co-generation system that is able to utilize city gas.

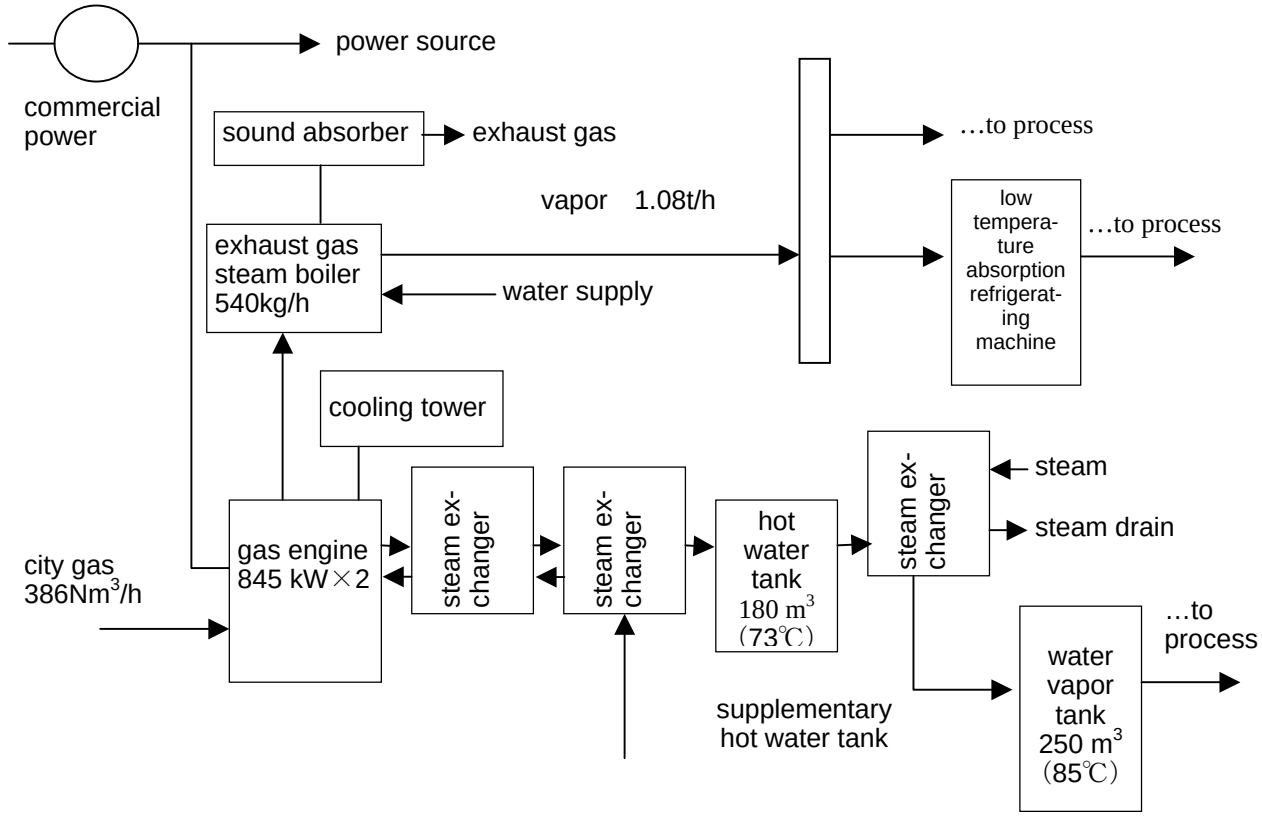
Time table of steps to be implemented **(Oct 2000 – Sep 2002)**

* Planning stage	(Oct 2000 - Feb 2001)	5 months
* Implementing the steps	(Mar 2001 - Sep 2001)	7 months
* Confirming the results of the steps	(Oct 2001 – Sep 2002)	12 months (1year)

Summary of the plant

Product list	Beer, Sparkling Beverage
Number of employees	100
Yearly energy usage (in 2001)	
A heavy oil	5,240 KL
electricity	12,900 MWH

Layout of the Facilities



1. Reasons for Selection

Sapporo Breweries has been studying the implementation of the ESCO project together with Hitachi Ltd. a member of the Japan Association of Energy Service Companies (JAESCO), since it was established in October of 1999. ESCO's special characteristics are as follows:

* a decrease in the burden of initial equipment investment costs.
* a guarantee of energy decreases (via performance contract)
* overall improvements according to general consulting
* ESCO shall receive due commission for providing general know-how and other services.

The ESCO businesses shall use both project-financing and shared-savings systems with which each business shall work out plans, procure funds, manage the facilities and assure that a certain amount of energy is saved**.** We decided to pay The ESCO service fee from the achieved energy-saving cost reduction.

When it came time to create the actual plan to introduce the facilities, we decided to collaborate with Hitachi Ltd. Our goal was to produce beer using a method that would both reduce the energy consumption rate and cut back on CO2 emissions. After much consideration, we decided to install a high-efficiency gas co-generation system that uses city gas.

Although nine months elapsed from the end of the smooth construction process to the start of full operation, we were able to attain our initial energy saving target results. Furthermore, as the first to implement this type of system in Japan, ESCO attracted many on-sight observers and attracted the attention of both industry journals and the wider media.

We are going to report on what we have accomplished so far, hoping that this report could help other companies which are considering introducing this ESCO project.

2. The Current Situation: Realization and Analysis

(1) Realization

Performance in 2000	amount of electricity purchased	15,000 MWH
	electricity expenses	¥215,000,000 (approximate)
	amount of fuel purchased	5,000 KL (A crude oil)
	fuel expenses	¥200,000,000 (approximate)

(2.) Analysis

Our yearly electricity consumption is approximately 15,000 MWH, achieved at a cost of about ¥200 - 230 million. In addition, in FY 2000 we replaced LPG with natural gas, and before the conversion fuel expenses had costs of about ¥150 - 200 million.

The purposes for installing the co-generation system include:

* Reducing energy costs
* Our company is aiming to reduce the unit rate of energy. This implementation should contribute to attain this goal. (The company target: to attain a 12% reduction in the energy consumption rate by the year 2010, based on a 1990 benchmark.)
* At the same time, we will contribute to the reduction of the rate of CO2 emissions. (The company target: to attain a 12% reduction in the rate of CO2 emissions by the year 2010, based on a 1990 benchmark.)

3. Process Timetable

(1) Formation

October 1999: The Japan Association of Energy Service Companies (JAESCO) was set up. Its activities started with 16 organizations such as The Energy Conservation Center. Now, the number of members has reached 66. We have spent much deliberation on the feasibility towards implanting the system since then, and as a result of our study, we decided to implement the project in plants in Hokkaido and Sendai.

March 2000: The implementation plan was worked out at the headquarters of Sapporo Breweries.

April 2000: Applied for a grant from the Regional Bureaus of International Trade and Industry (now, the Ministry of Economy, Trade and Industry)

September 2000: Received grant

October 2000 – February 2001: Equipment planning

(2) Setting the Goals

1) The benefit in electricity charges after the change of the electricity contract. (normal time period).

	Usage amount	Before Change	After Change	Benefit from change
		(metered--charges)		
	MWH/ year	¥1000/ year	¥1000/ year	¥1000/ year
Daytime	9,200	78,000	95,000	▲17,000
Nighttime	3,900	33,000	25,000	8,000
Holidays	1,900	17,000	12,000	5,000
Total	15,000	128,000	132,000	▲4,000

A simulation of the night-time and holiday contract, which provides electricity at lower costs. Left as is, the cost would rise by about 4000000 a year, so we study the benefit of operating the co-generation system only during the daytime.

2) Calculating the merits of co-generation equipment conversion

Heading		Energy Savings	Energy Cost Reduction	Remarks
Electricity	basic contract	1,610kW	31,000,000 ¥/ yr	
	metered amount days	5,000MWH/ yr	50,000,000 ¥/ yr	
	nights	50MWH/ yr	300,000 ¥/yr	
	holidays	20MWH/ yr	100,000 ¥/ yr	
hot water generation amount		380,000Nm^3/ yr	14,300,000 ¥/ yr	city gas equivalent
steam generation amount		230,000Nm^3/ yr	9,000,000 ¥/ yr	city gas equivalent
GE fuel amount (city gas)		▲1,200,000Nm^3/ yr	▲45,200,000 ¥/ yr	
Interest supplement for the introduction of private power generation equipment		845kWH	▲4,000,000 ¥/ yr	
Total			55,500,000 ¥/ yr	

3) Target results of installed equipment

cost target: ¥55,500,000/ yr - ¥4,000,000/ yr = ¥51,500,000/ yr reduction

numerical target: amount of purchased fuel ▲1,200,000 Nm^3 / yr (increase)

amount of purchased electricity 4,250 MWH / yr reduction

amount of purchased energy 464 KL / yr reduction (crude oil equivalent)

CO_2 Emissions 512 ton-C/ yr

From the above charts 1 and 2, we set the figures above as numerical targets.

4. Problems and their considerations

Certain risks associated with installing the equipment have been foreseen and are categorized below:

1) institutional / legal risk: regulations on working equipment, including more stringent regulation of NOx.
2) tax risk: taxation of specific equipment, etc.
3) nearby resident risk: environmental assessments, noise complaints, etc.
4) risk of not reaching the guaranteed goal
5) risk of an act of God: (fire, snow and other damage)
6) risk of individual contract termination
7) contract risks
8) assessment and investigation risk factors

The basic policy of risk burden is laid out as follows, where ESCO providers enter into basic contracts:

* those that can best avoid a risk shall bear the risk.
* ESCO providers shall not bear secondary losses.
* As for risks beyond the sphere of responsibility (guaranteed categories) of the ESCO provider, both sides shall consult with each other towards continuing the project.

5. contents of the measures

(outline of the equipment)

* 845 kW Mitsubishi gas engine co-generator. (set-up 2) Total generated power capacity, 1,690 KW. Generated output / maximum received energy contact price ratio = 1,690 / 2,500 = 0.68 (holding the capacity for 68% of the electricity demanded.)
* Employs a Mitsubishi gas engine. This is to pursue the benefit of the conversion method and ensure the intake - temperature rise time's output stability.
* The gas engine is driven by natural gas (city gas)
* Energy conversion : gas → electricity + heat (hot water + steam)
* Generating efficiency 38.4% + hot water collection efficiency 25.6% + steam collection efficiency 17.2% = overall heat efficiency 81.2% ; which is the highest aimed for in the world.
* This co-generation program is expected to cover 35% of the Hokkaido plant's annual electricity use and 16.3% of heat it uses.

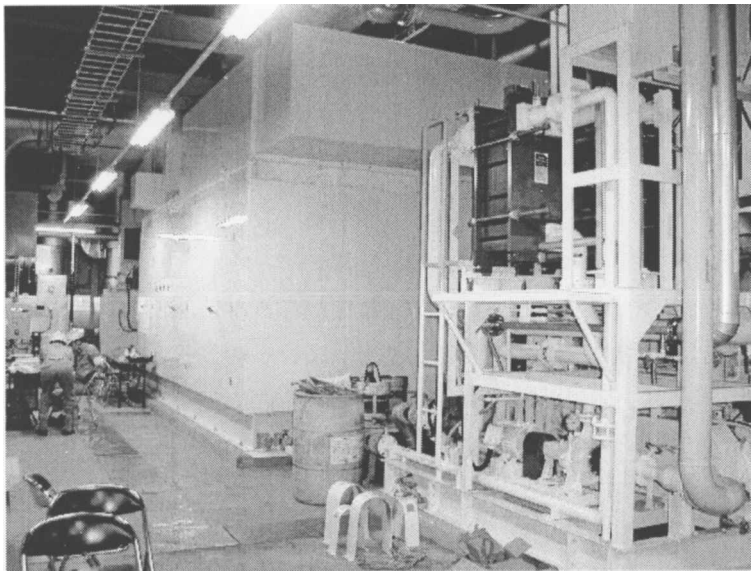


Fig. 1 outside picture gas engine and enclosure

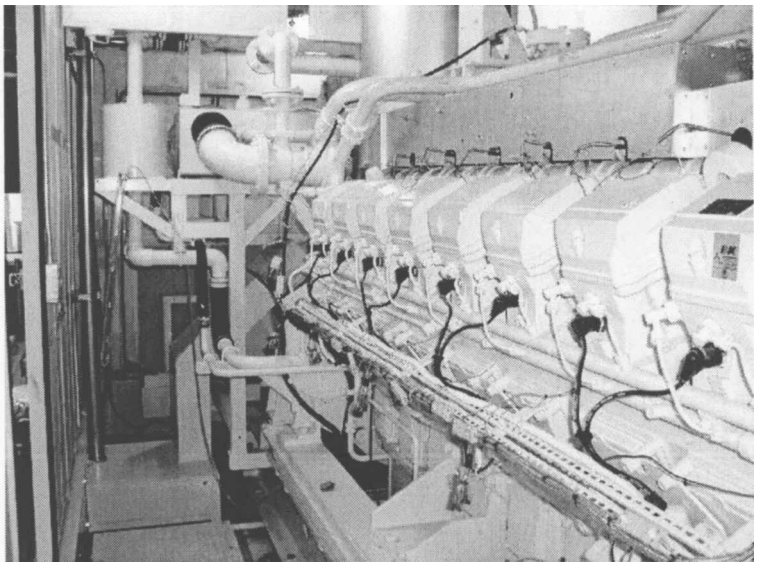


Fig.2 a 16 cylinder gas engine

(operation set up)

* Primarily DSS operating (Daily Start Stop) : During daytime hours (8:00 - 22:00) two machines operate 6100 hours in one year.
* Different electricity rates vary depending on day and night usage.
  That is, in the afternoon the co-generator runs, thereby cutting down on purchased electricity. In the nighttime, inexpensive electricity is purchased.

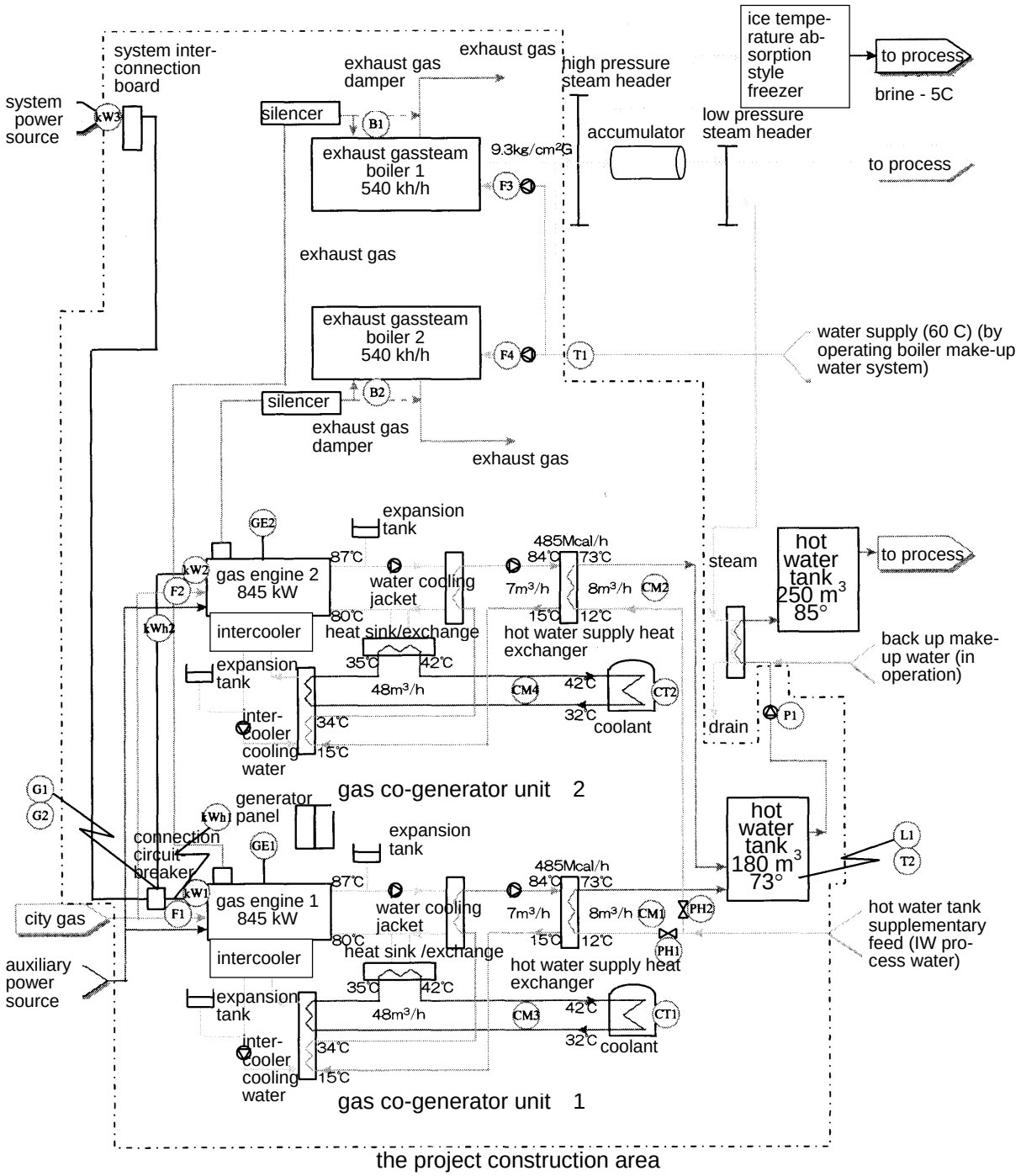


Fig.3 Flow Sheet

5. Results after implementation (October 2001 - Sep 2002)

1) Amount Evaluation

	12 months operation	Target value	Attainment level
Energy reduction	612.5 kL / yr	464 kL / yr	132.0%
CO2 emission reduction	479 ton-C / yr	512ton - C / yr	93.6%

2) Operation Time (for this company guarantee list)

	12 months operation	Guaranteed value	Attainment level
Operation time	6,001.1 h/ yr	6,100 +/-100hr/ yr	100.0%

3) Energy Evaluation

	12 months operation	Target value	Attainment level
Reduction-effect Planned value	¥53,404,000/ yr	¥51,500,000/ yr	103.8%
Attained value	¥50,119,000/ yr		

Because the price of gas rose up a bit from when the plan was formed, the value was ¥3,000,000 lower than expected.

6. Summary

We succeeded in operating the facilities at full swing in about 2 years since first starting the plan. At that time, the ESCO project itself was not fully understood, and we had many troubles. However, we fully owe our ESCO provider, Hitachi Ltd. and others for helping us succeed in this project. After one year of full operation, and the result as planned was obtained. Although there were some small general problems with the facilities, they were quickly dealt with in each case. Our company could conserve energy, and even cut costs, without a large initial investment. Through the grant, despite encountering several obstacles, we now feel a strong sense of reward.

7. Beyond the Plan

There are still 9 years ahead of us in our contract. Although we will pay attention to the current operating conditions, we anticipate observing that we will always clear our initial targets throughout the 10-year period.