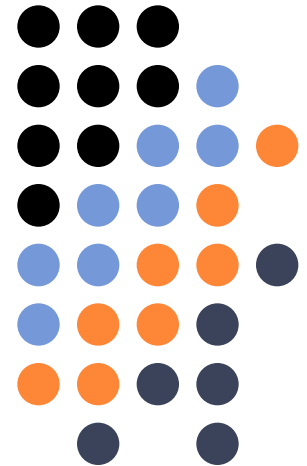


Follow-up Seminar

Energy Saving & Fuel Change

JICA Expert Team

8 July, 2011





Contents

- Review examples of project cases of
 - ◆ Fuel Change
 - ◆ Energy Efficiency
- Objective
 - ◆ Understand the measurement & calculation of energy saving projects

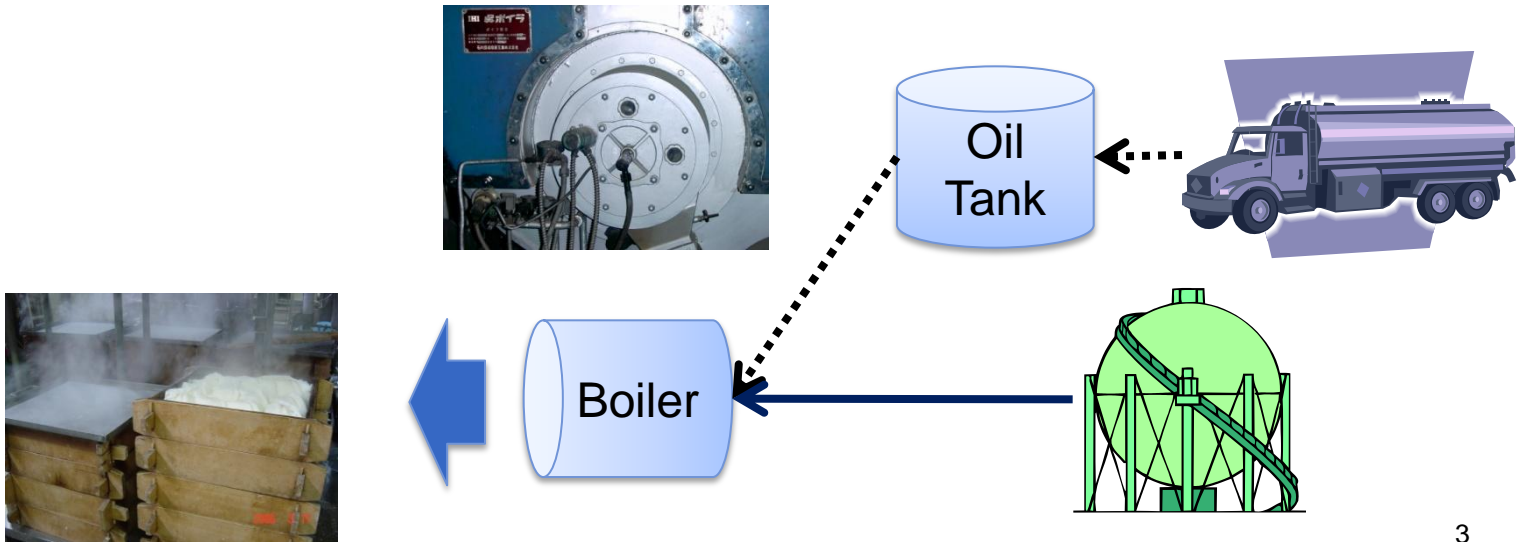


Project A: Boiler Fuel Change

The food factory runs 1.5 t of boiler to provide utility steam of the plant to cook and sterilization.

The boiler runs from 6AM to 6PM including start up time. The facility runs 264 days last year.

The project changes fuel of the boiler from furnace oil to natural gas to save fuel costs. According to the invoice, the facility bought 1,752 kl of furnace oil last year.





Project A: Boiler Fuel Change

Calculate CO2 Emissions of before and after the project

Items	Value	Unit
Emission Factor		
Furnace Oil	3.084	tCO2/kl
Natural Gas	2.108	kgCO2/Nm3
Heat Value		
Furnace oil	39.85	GJ/kl
Natural Gas	46.10	MJ/Nm3

Project A: Calculation Steps



1. CO2 Emissions from furnace oil consumption

$$\begin{aligned} & 1,752 \text{ (kl)} \times 3.084 \text{ (tCO}_2\text{/kl)} \\ & = 5,403.17 \text{ (tCO}_2\text{)} \end{aligned}$$

2. Amount of Natural Gas required to alternate Furnace Oil.

2-1. Heat energy supplied by furnace oil.

$$\begin{aligned} & 1,752 \text{ (kl)} \times 39.85 \text{ (GJ/kl)} \\ & = 69,817.2 \text{ (GJ)} \end{aligned}$$

2-2. Required natural gas to supply same heat energy as furnace oil.

$$\begin{aligned} & 69,817.2 \text{ (GJ)} \div 46.10 \text{ (MJ/Nm}^3\text{)} \\ & = 69,817.2 \times 10^3 \text{ (MJ)} \div 46.10 \text{ (MJ/Nm}^3\text{)} \\ & = 1,514.47 \times 10^3 \text{ (Nm}^3\text{)} \end{aligned}$$

2-3. CO2 emissions from natural gas consumption

$$\begin{aligned} & 1,514.47 \times 10^3 \text{ (Nm}^3\text{)} \times 2.108 \text{ (kgCO}_2\text{/Nm}^3\text{)} \\ & = 3,192.50 \times 10^3 \text{ (kgCO}_2\text{)} \\ & = 3,192.50 \text{ (tCO}_2\text{)} \end{aligned}$$

3. Reduction Amount

$$5,403.17 \text{ (tCO}_2\text{)} - 3,192.50 \text{ (tCO}_2\text{)} = 2,210.67 \text{ (tCO}_2\text{)}$$



Project B: LED Lighting Application

Light Emitting Diode (LED) is a lighting devices to alternate traditional lamps.

LED gives more concentrated lighting than conventional lighting and needs less electricity to provide the same luminance. Project replace old halogen lamps in factory and warehouse space to LED.

The factory and warehouse operates is the same working hours, starts at 6AM and close at 6PM with 264 working days a year. Emission coefficient of electricity is 0.686 tCO₂/MWh.

Elec. Power of Hg lamp	400	W
Number of Hg lamp	137	Units

Elec. Power of LED lamp	118	W
Number of LED	83	Units



Project B: Calculation Steps



1. Calculate Hg lump's electricity consumption & CO2 Emissions.

$$\begin{aligned} & 400 \text{ (W/unit)} \times 137 \text{ (units)} \times 12 \text{ (hours/day)} \times 264 \text{ (days)} \\ & = 173,606,400 \text{ (Wh/year)} \\ & = 173,606.4 \text{ (kWh/year)} \\ & 173,606.4 \text{ (kWh/year)} \times 0.686 \text{ (tCO}_2\text{/MWh)} \\ & = 173.61 \text{ (MWh/yaer)} \times 0.686 \text{ (tCO}_2\text{/MWh)} \\ & = 119.1 \text{ (tCO}_2\text{/year)} \end{aligned}$$

2. Calculate LED lump's electricity consumption & CO2 Emissions

$$\begin{aligned} & 118 \text{ (W/unit)} \times 83 \text{ (units)} \times 12 \text{ (hours/day)} \times 264 \text{ (days)} \\ & = 31,027,392 \text{ (Wh/year)} \\ & = 31,027.4 \text{ (kWh/year)} \\ & 31,027.4 \text{ (kWh/year)} \times 0.686 \text{ (tCO}_2\text{/MWh)} \\ & = 31.03 \text{ (MWh/year)} \times 0.686 \text{ (tCO}_2\text{/MWh)} \\ & = 21.29 \text{ (tCO}_2\text{/year)} \end{aligned}$$

3. Calculate reductions and savings.

Electricity Saving is;

$$\begin{aligned} & 173,606.4 \text{ (kWh/year)} - 31.027.4 \text{ (kWh/year)} \\ & = 142,579 \text{ (kWh)} \\ & 119.1 \text{ (tCO}_2\text{/year)} - 21.29 \text{ (tCO}_2\text{/year)} \\ & = 97.81 \text{ (tCO}_2\text{)} \end{aligned}$$

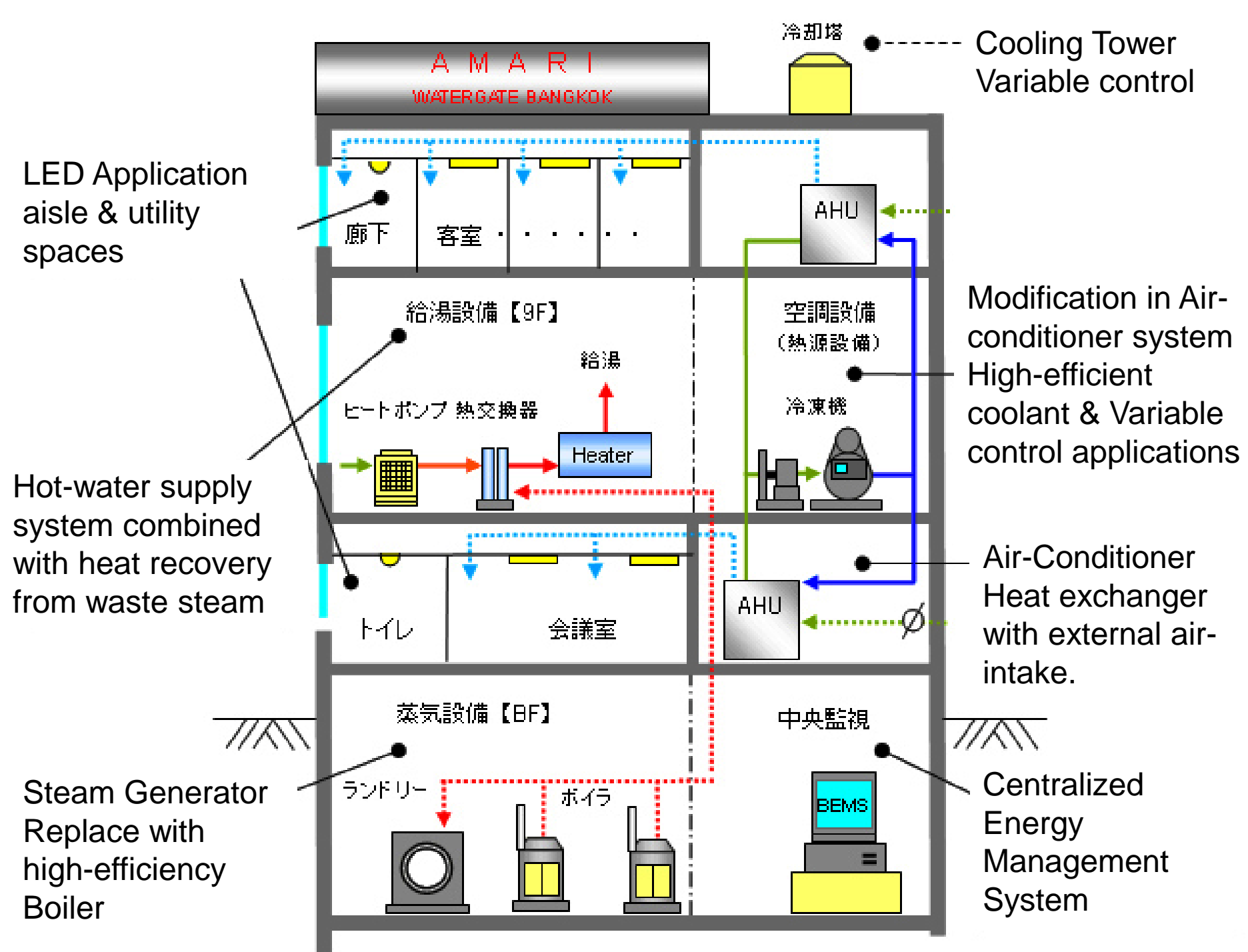


Figure 3.8- Hydro/Thermal/Non-conventional Energy Share in the National Grid

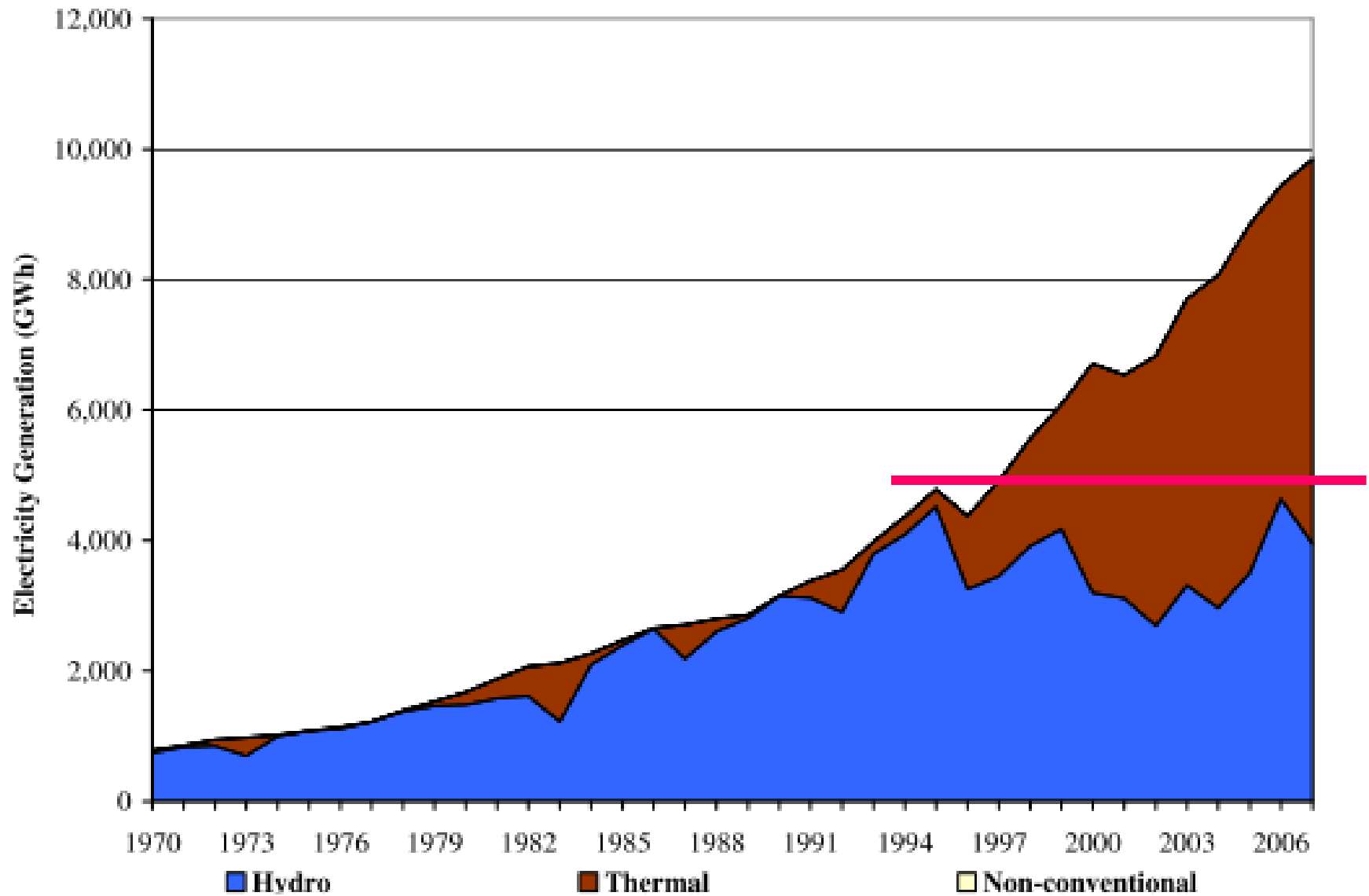


Figure 5.4 – Electricity Demand by Consumer Category

