

# ***Microgrid Research at Mitsubishi***

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2005-6-17

**MITSUBISHI ELECTRIC CORPORATION**

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## (1) Necessity or purpose

Necessity or Purpose	America	EU	Japan
Reliability of power Supply	○		
Reduction of investment in plant and equipment Reduction of erection period	○		
Reduction of energy cost	○	○	
To keep environmental condition (ex. Reduction of CO <sub>2</sub> )		○	○
To ensure diversity of energy supply			○
Power supply to island and/or remote place		○	△

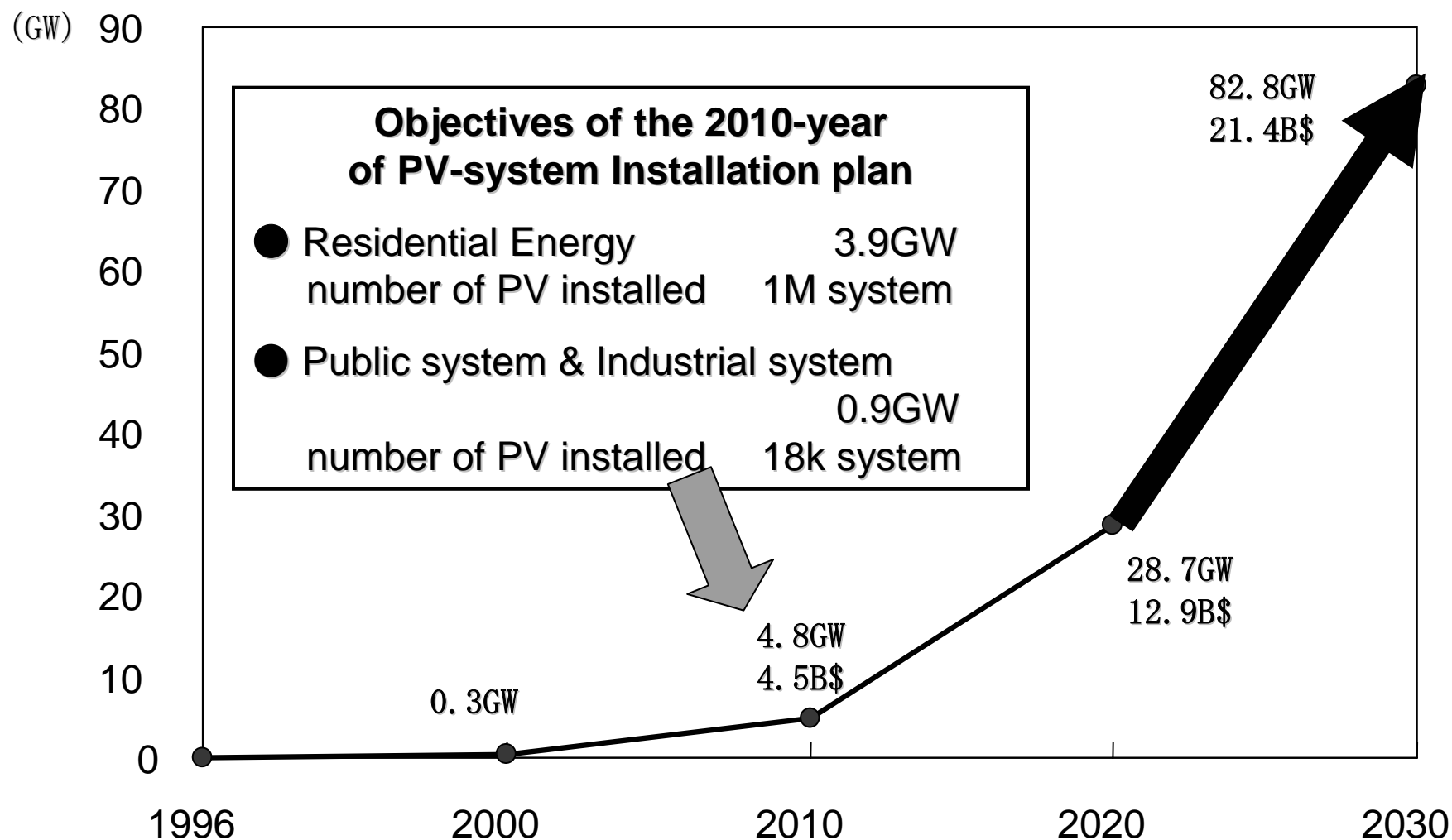
## (2) Future plan of Japanese government for spread of renewable energy resource

Generator	Year	2000	2010
PV		330MW	4.8GW
WT		144MW	3.0GW
Generation by biomass waste		70MW	330MW
Generation by combustible waste		1.0GW	4.2GW

## (3) Support Program

- METI(Ministry of Economy, Trade and Industry) and Ministry of Environment support to develop micro grid
  - Budget of METI 120M\$ / this year
  - Budget of Ministry of Environment 15M\$ / this year

## (4) Objectives of the 2030-year of PV-system Installation plan



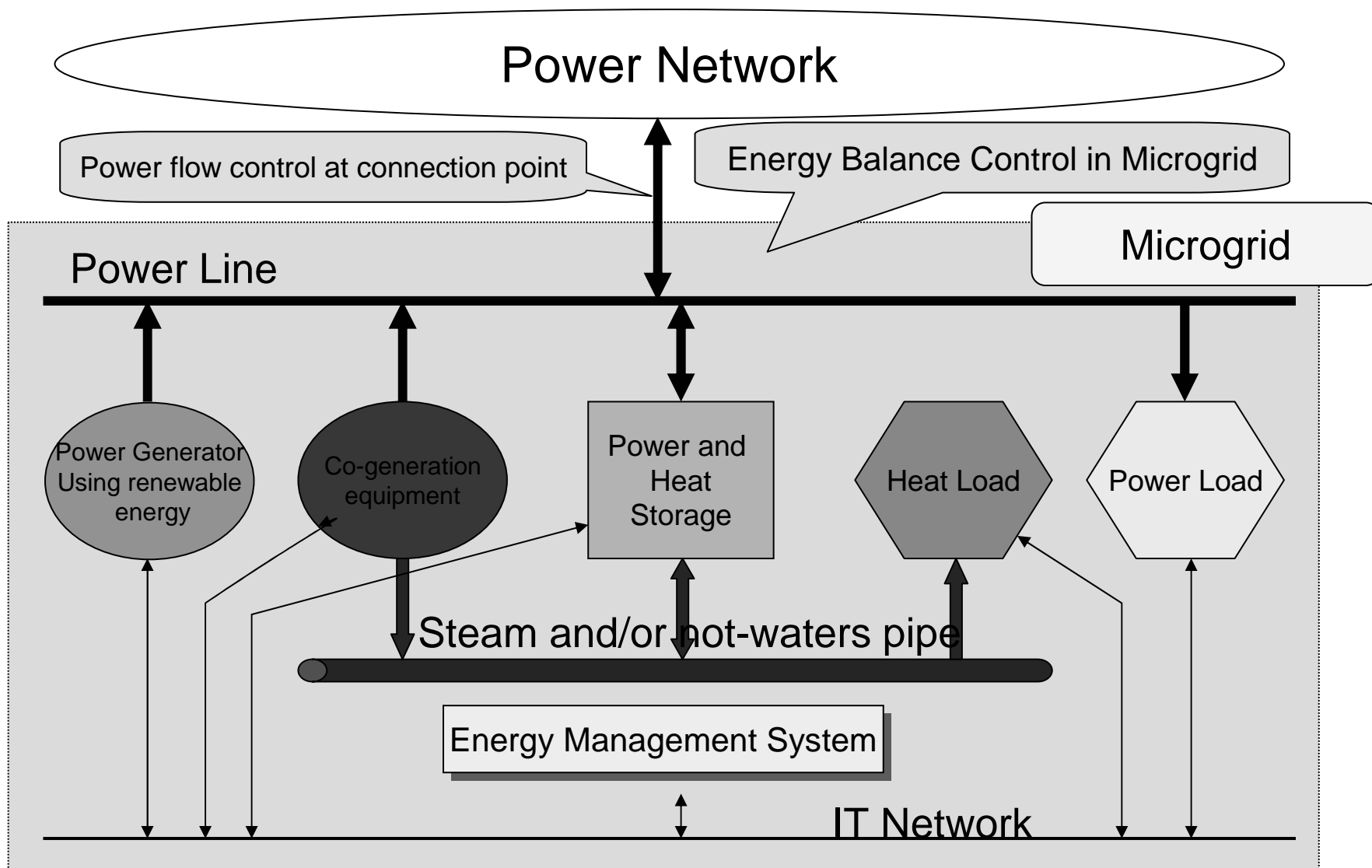
## (1) Melco classifies micro grid into 3 groups

	Generation capacity	Fuel	Application	Market size
Large Scale	1000MW	heavy oil and/or coal	Industrial complex	10-20
Middle Scale	100MW	heavy oil and/or coal renewable energy	Industrial park	100
Small Scale	10MW	renewable energy	-small area network -condominium -island and remote area	3000

## (2) Four jobs are in progress

	Sponsor	Existing state
Microgrid project in Hsinchiang Uighur Autonomous Region, China	METI	Under operation
Microgrid project for Aichi EXPO	METI	Under operation
Microgrid project in Hachinohe-city	METI	Under production in Melco's works
Microgrid project for condominium	Ministry of Environment	This program starts at this April
Microgrid project in Oki-island	METI	Feasible study starts at this April

## (3) Basic system configuration of Microgrid



## (4) Operation Mode of Microgrid

	Feature	Note
Connection Mode	1. Main purposes are - reduction of energy cost - reduction of environmental burdens 2. Generator operation :P- $\theta$ (or P-Q) control	When blackout occurs in power network, Operation mode of microgrid changes from connection mode to island mode.
Island Mode	1. Main purposes is to keep -reliability of power supply -power quality 2. Generator operation :F-V (or P-V) control	_____

P: Active power

Q: Reactive power

$\theta$ : Power factor

F: Frequency

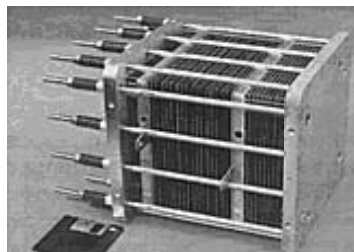
V: Voltage

## (5) Melco's products

- Renewable energy technology



*PV*



*FC*



*WT*



*Biomass*

- Power electronics



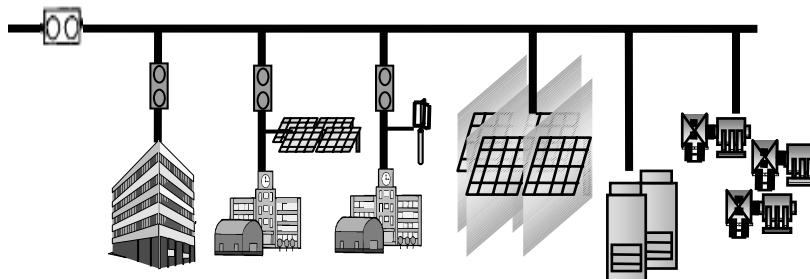
*Inverter*



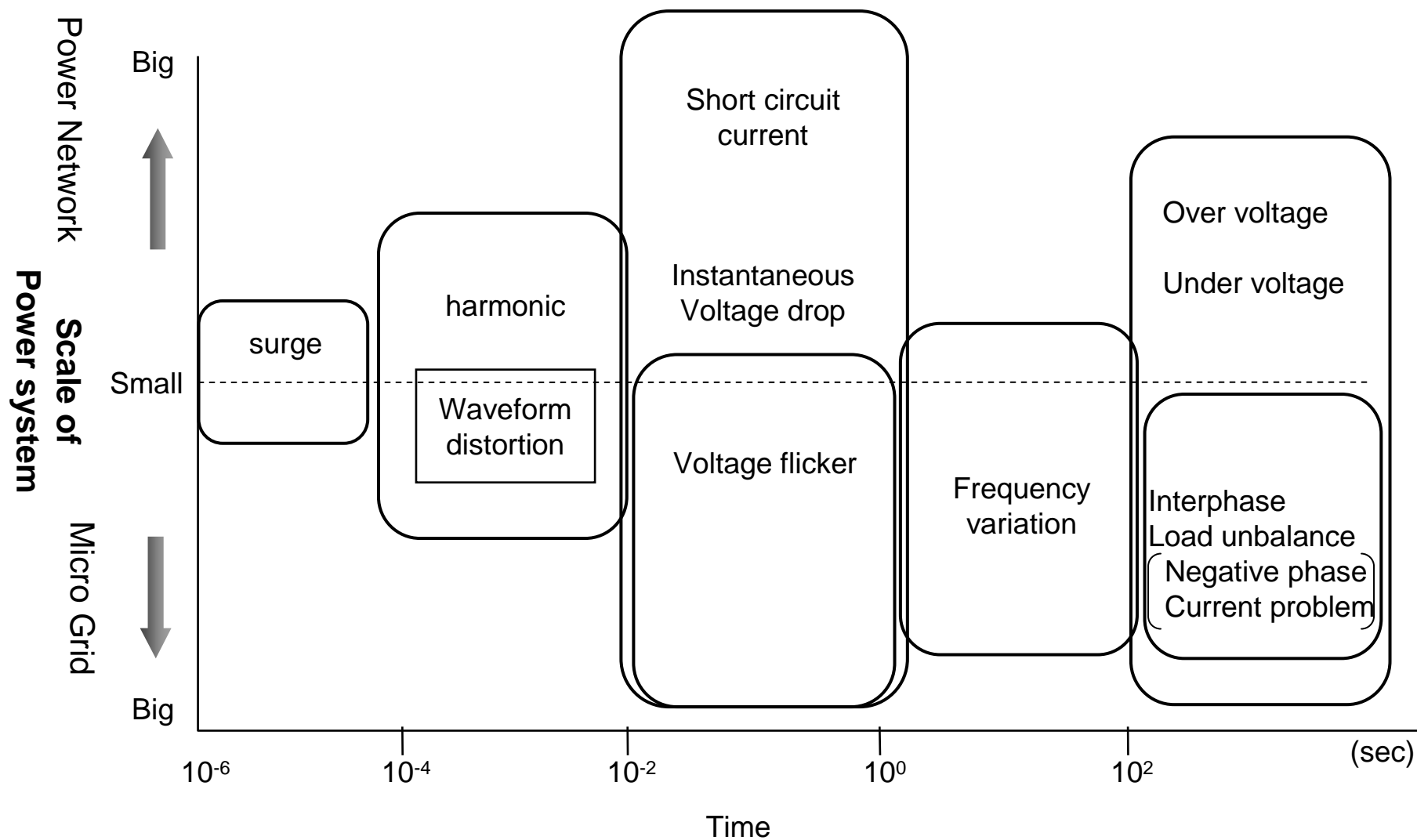
*Device*

- EMS

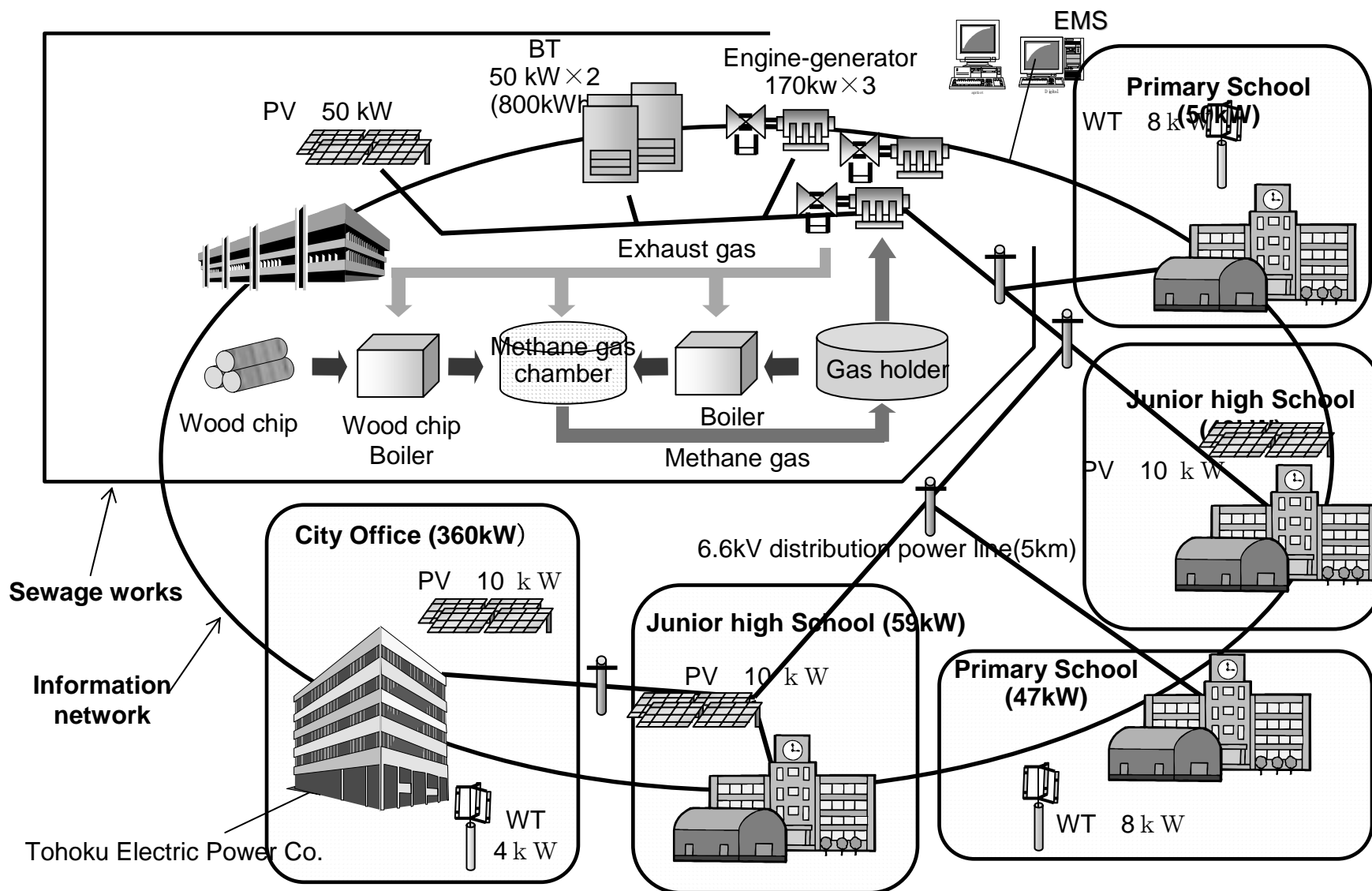
*Microgrid*



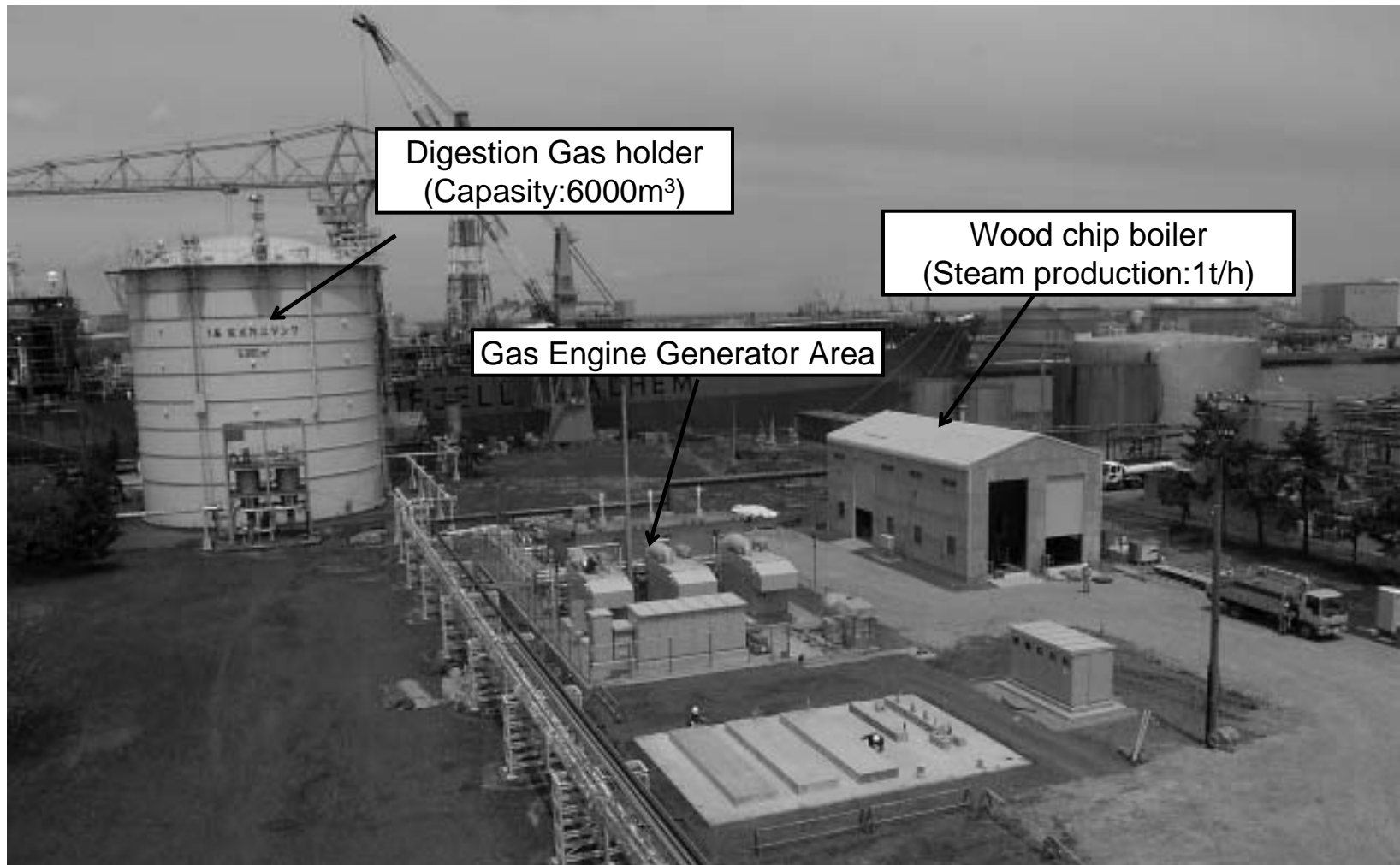




## (1) System Configuration



## (2) Overview of Generation System at Sewage works



## (3) Renewable Generators

### 10kW PV System

(installed at roof of city office and Junior high school)

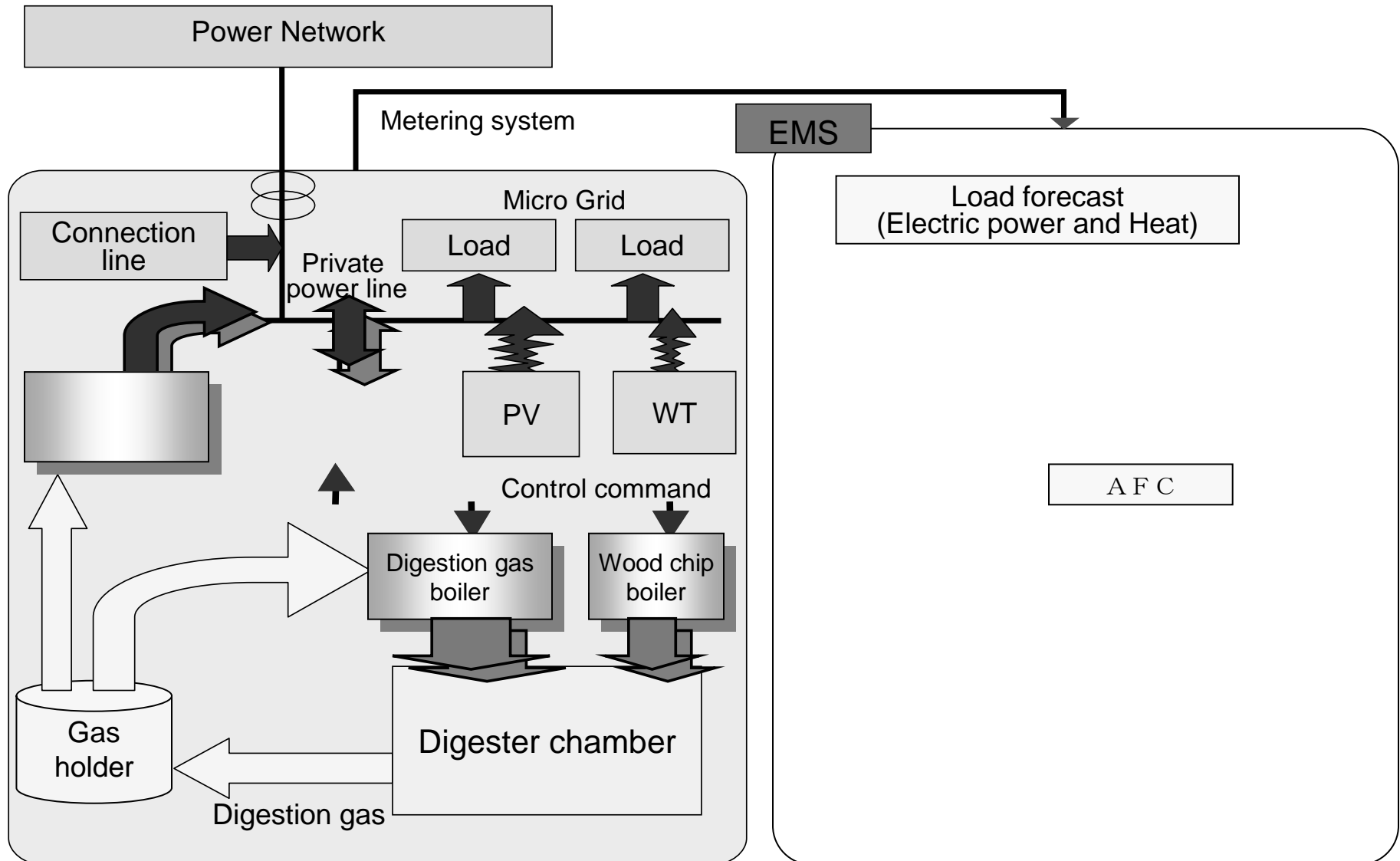


### 8kW WT Generator

(installed at primary school)

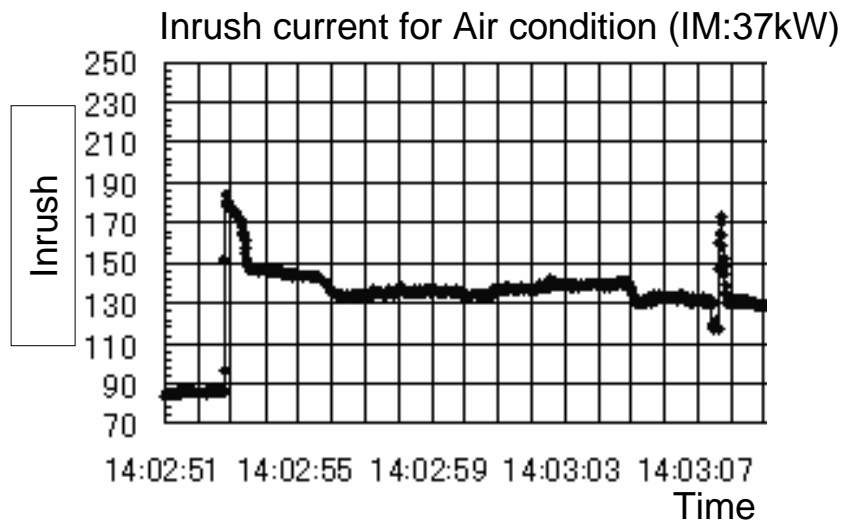
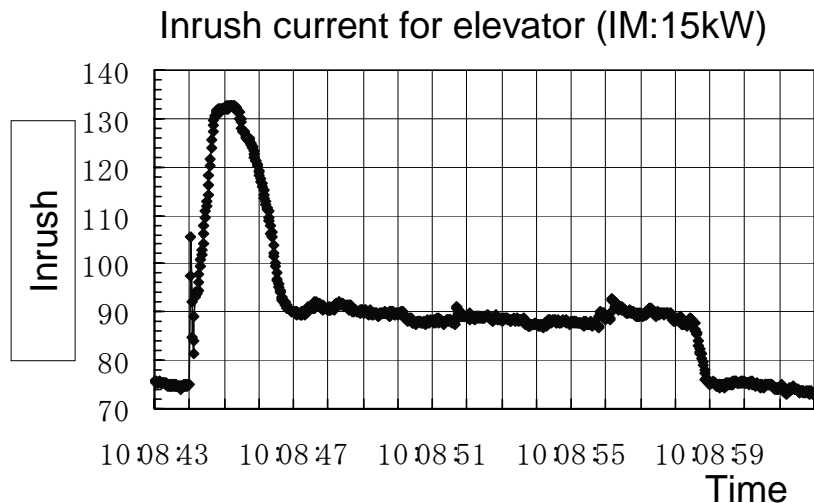


## (4) Energy Management System

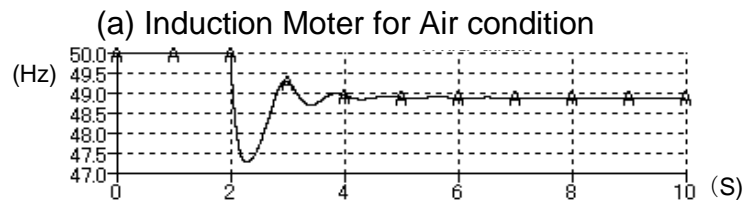
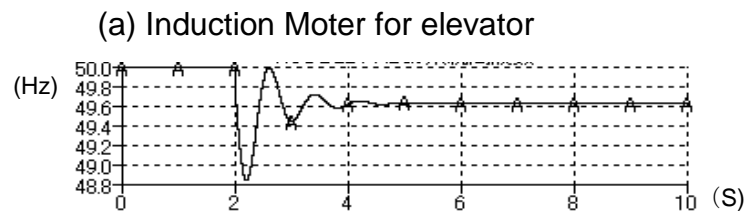


## (5) Power System Analysis

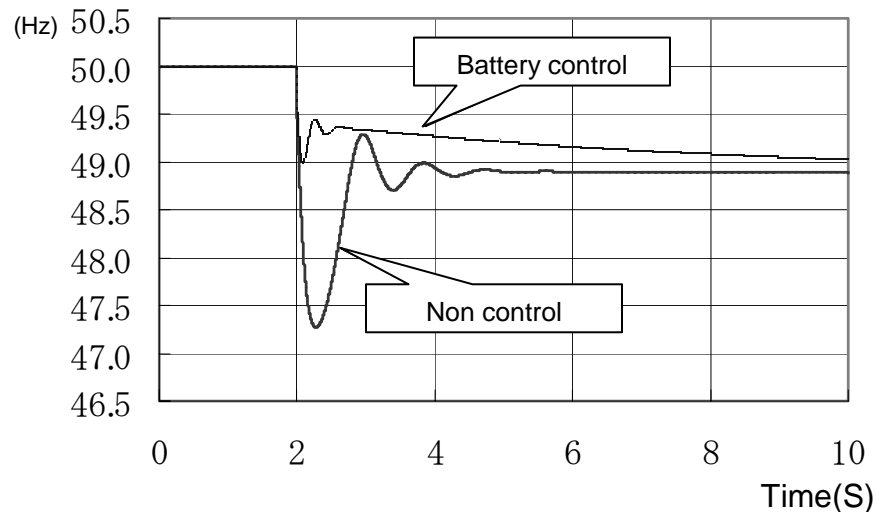
(A) Inrush current of Induction Moter

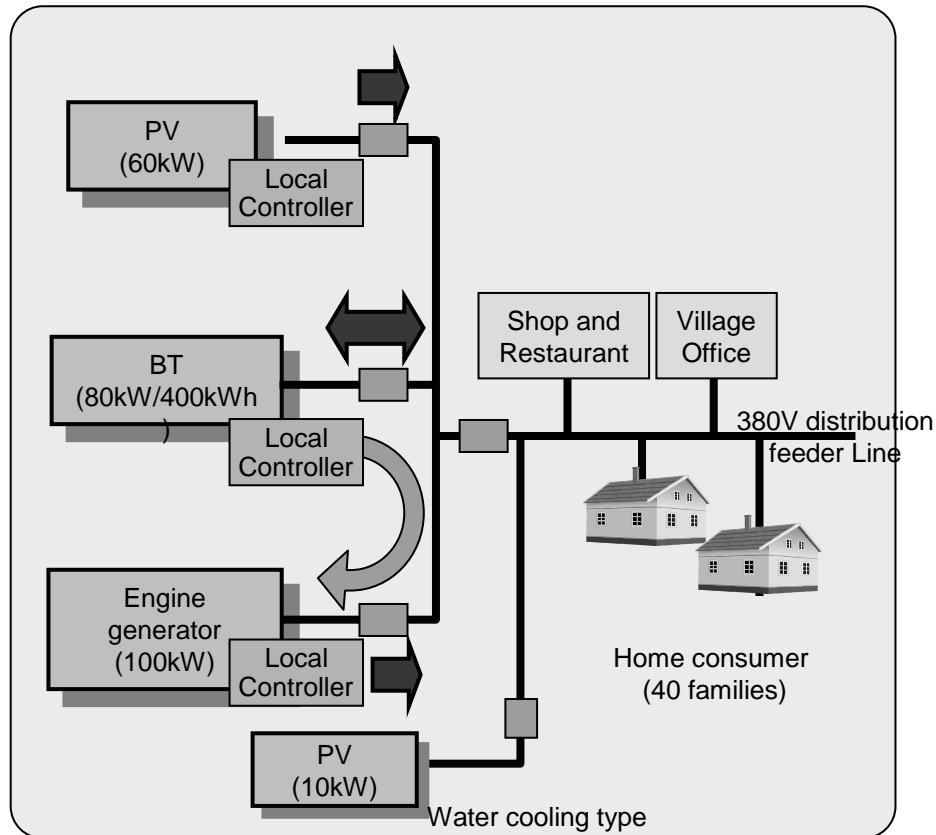


(B) Frequency drop caused by inrush current



(C) Effect of BT control



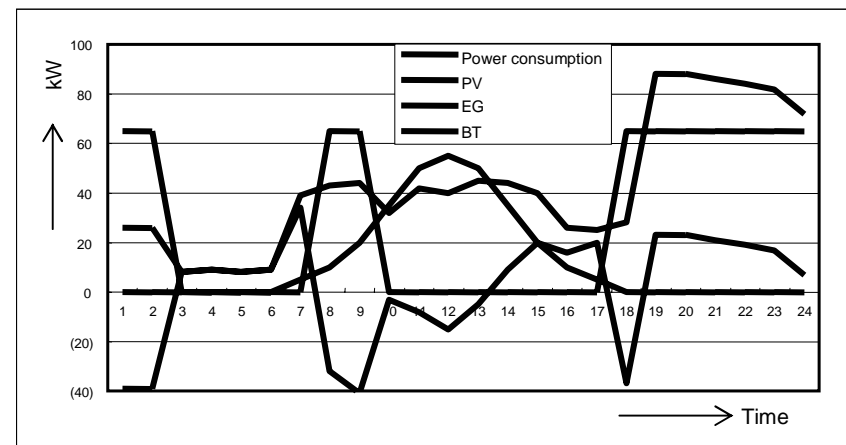
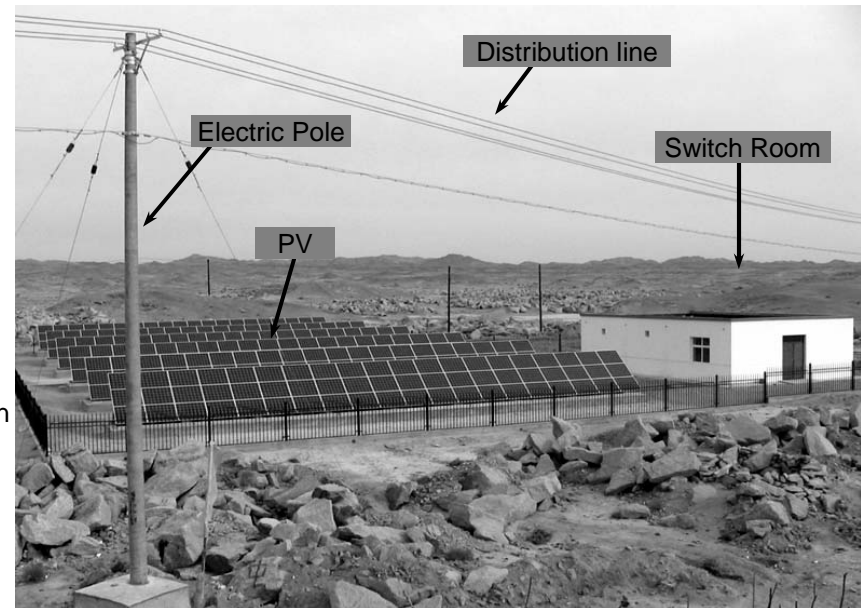


### 1. Electric Power Generation

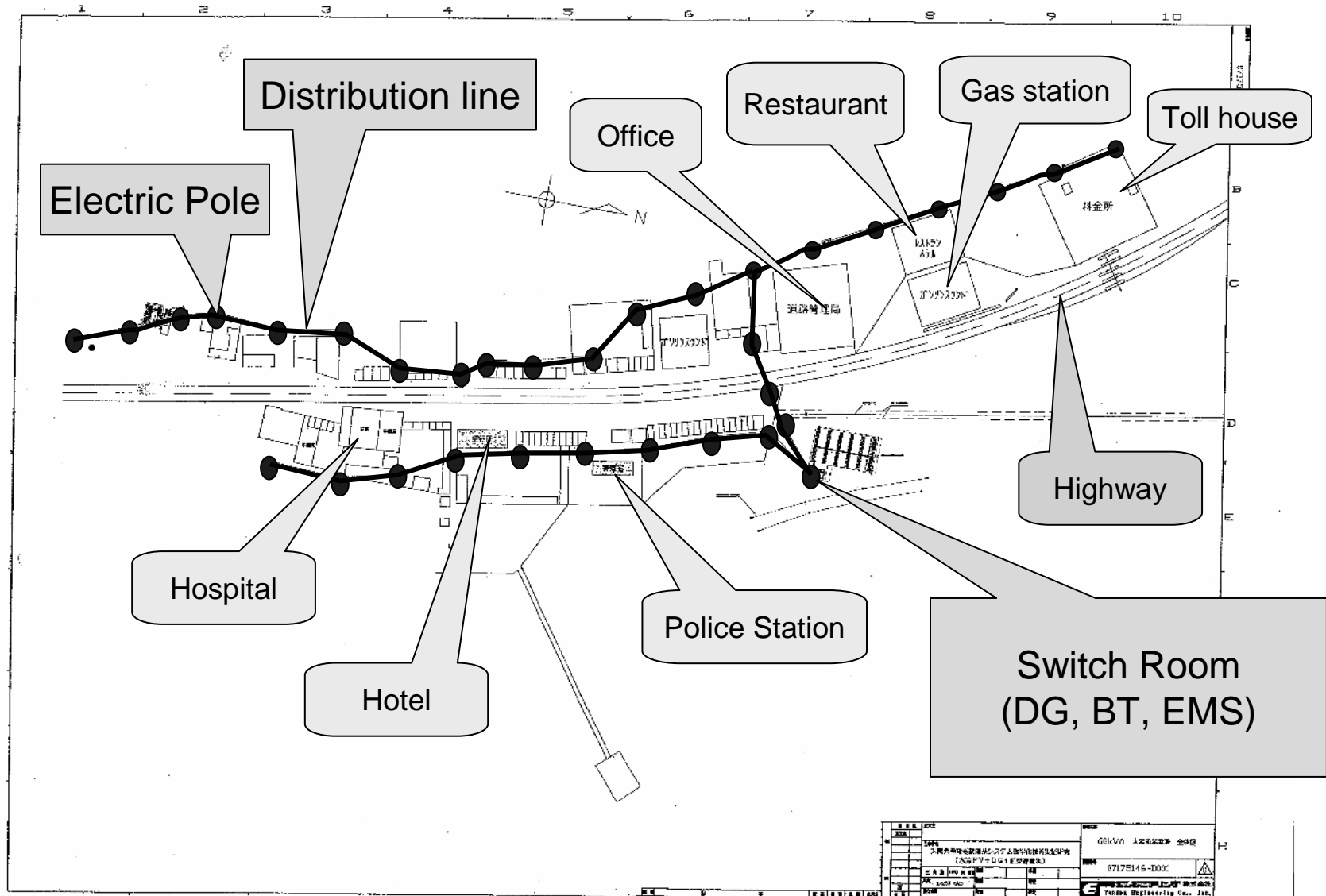
Engine Generator	100kW
PV	70kW
BT	80kW (400kWh)
<b>Total</b>	<b>250kW</b>

2. Peak Load            90kW (at night time)

3. Distribution feeder    380V /500m

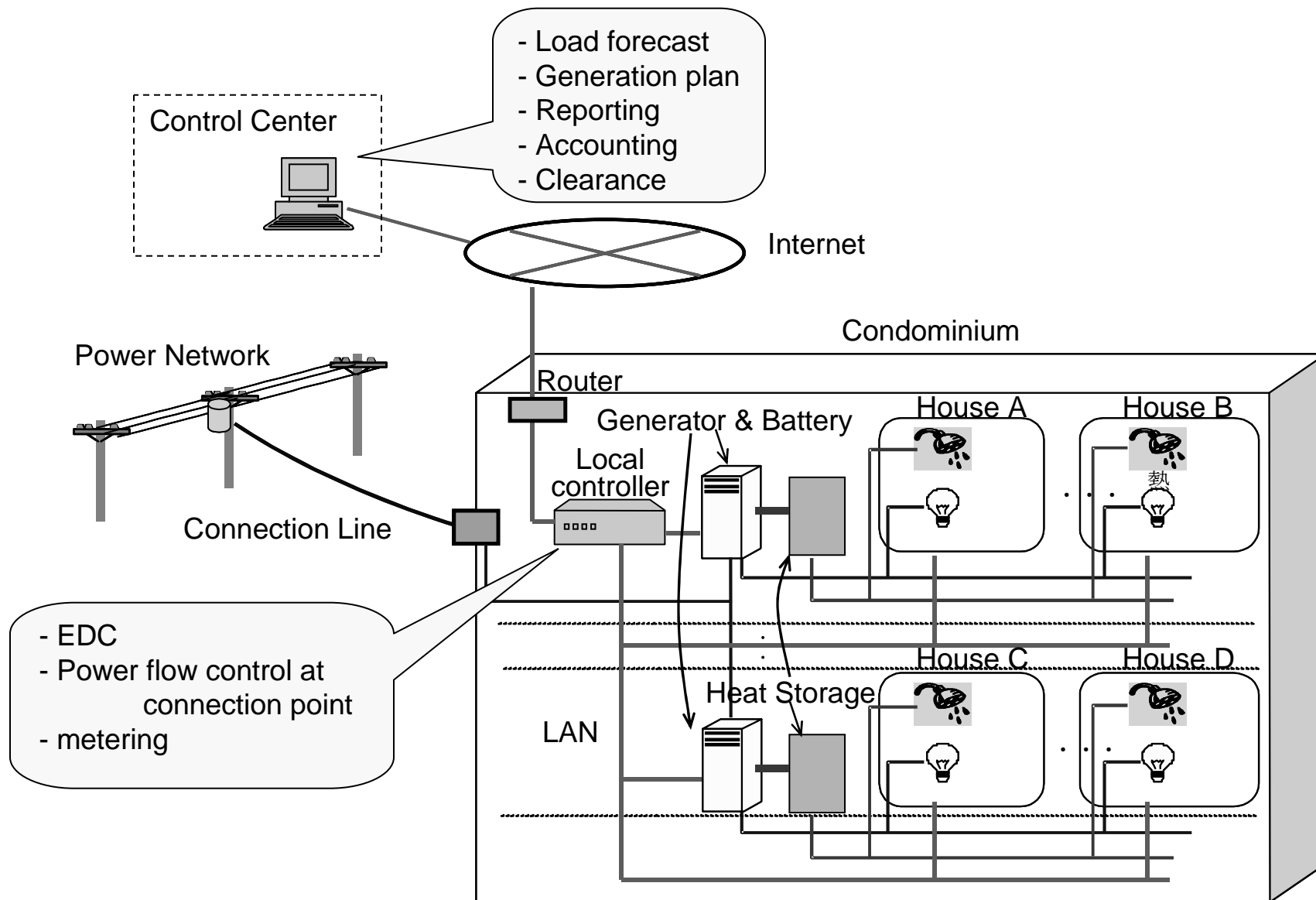


Load and Generation curve

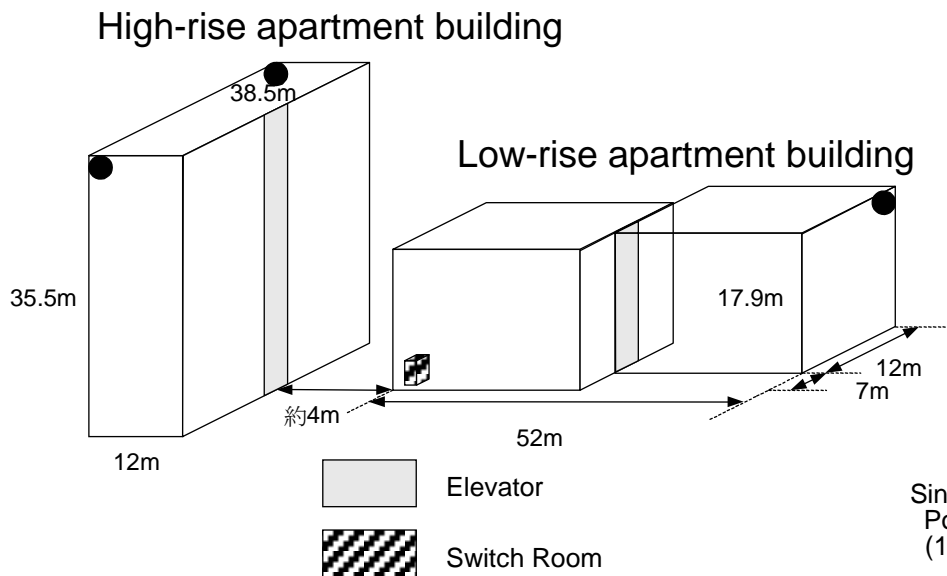




## (1) System Configuration



## (2) Model condominium



### Power network in condominium

