

# Smart Energy Networks

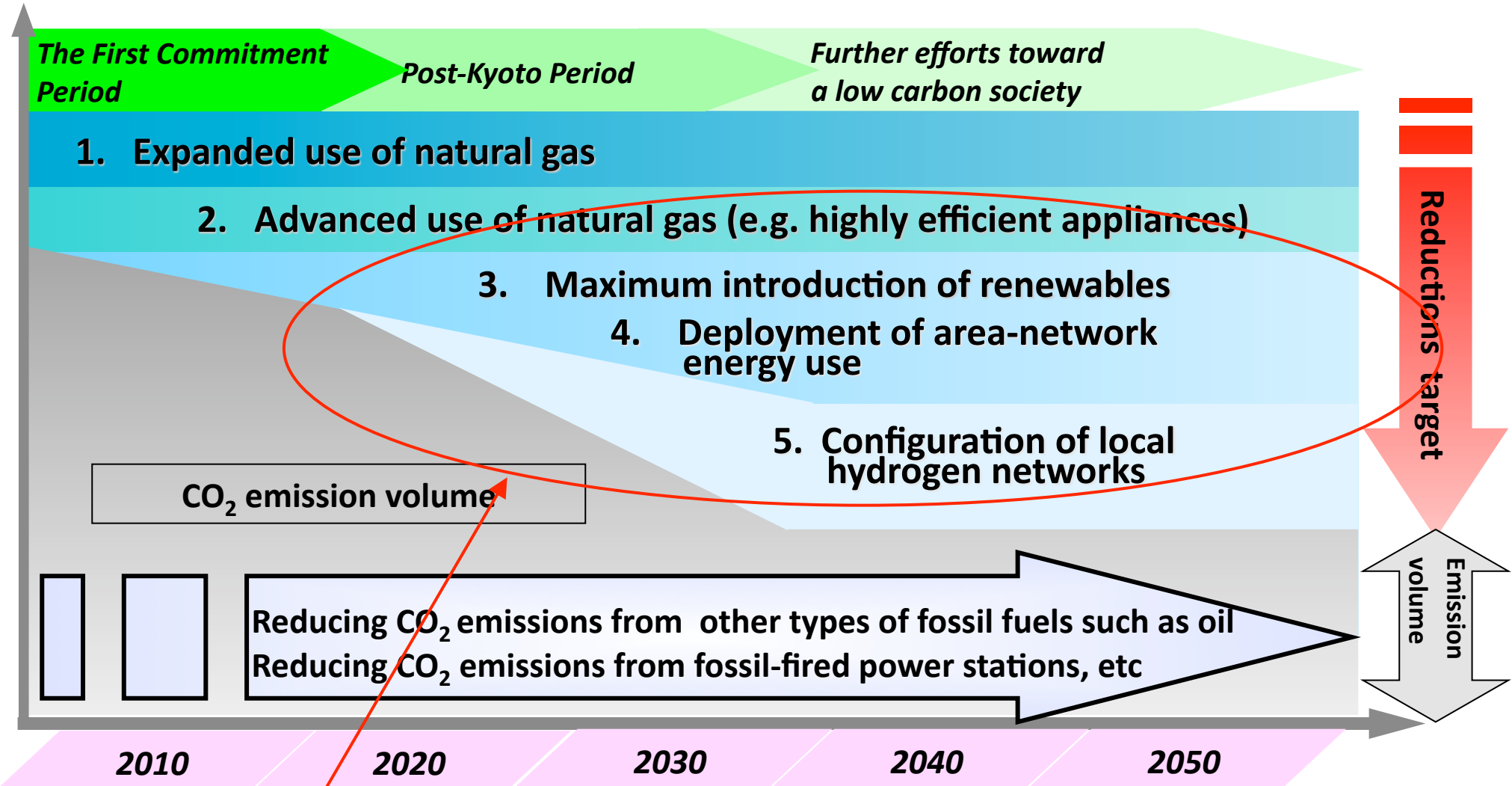
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**May 27, 2011**

**Tokyo Gas Co., Ltd.**

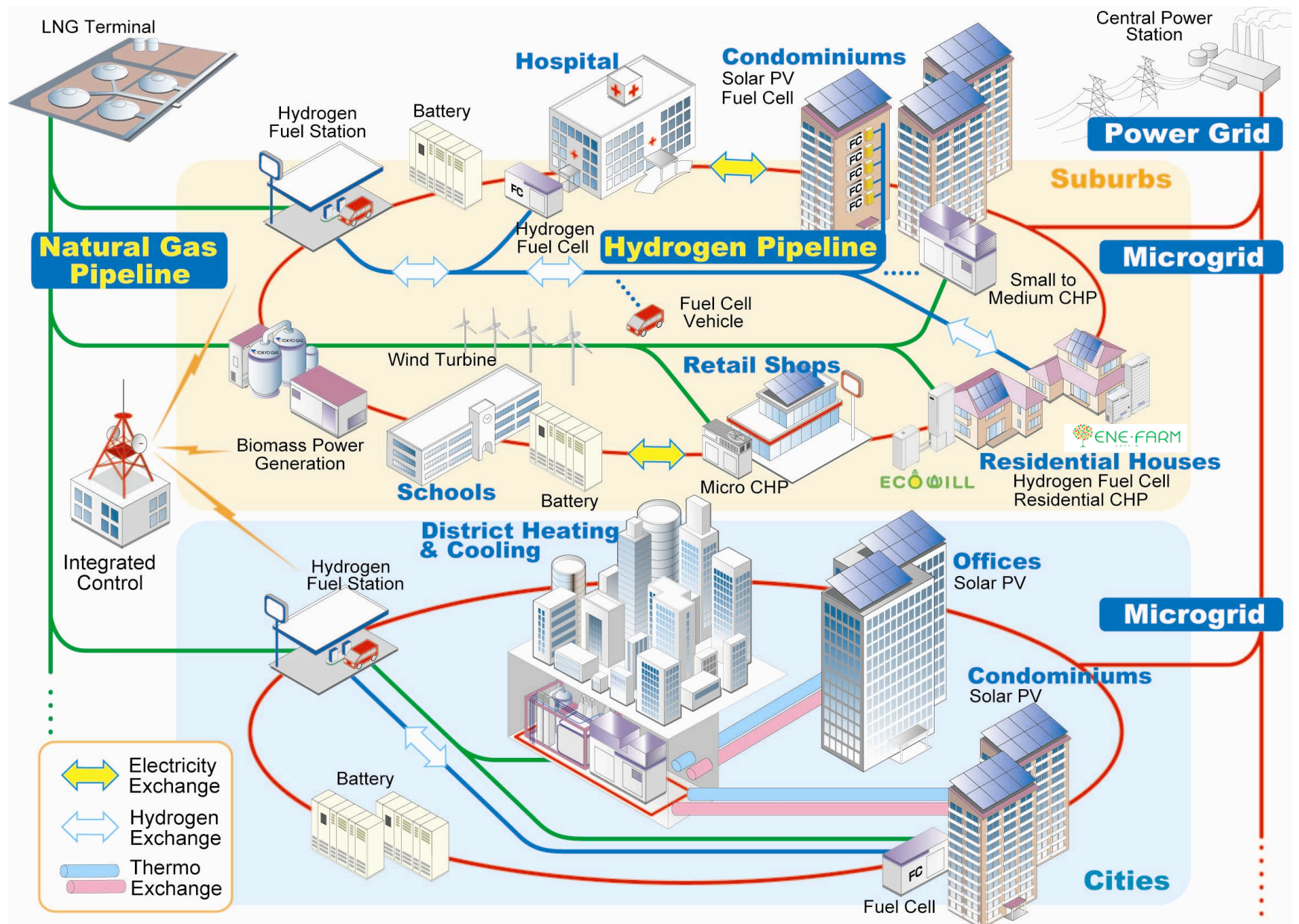
# Mid-to-long Term Scenario of Gas Industry

Supporting 60-80% CO<sub>2</sub> reduction by expanding the advanced use of natural gas

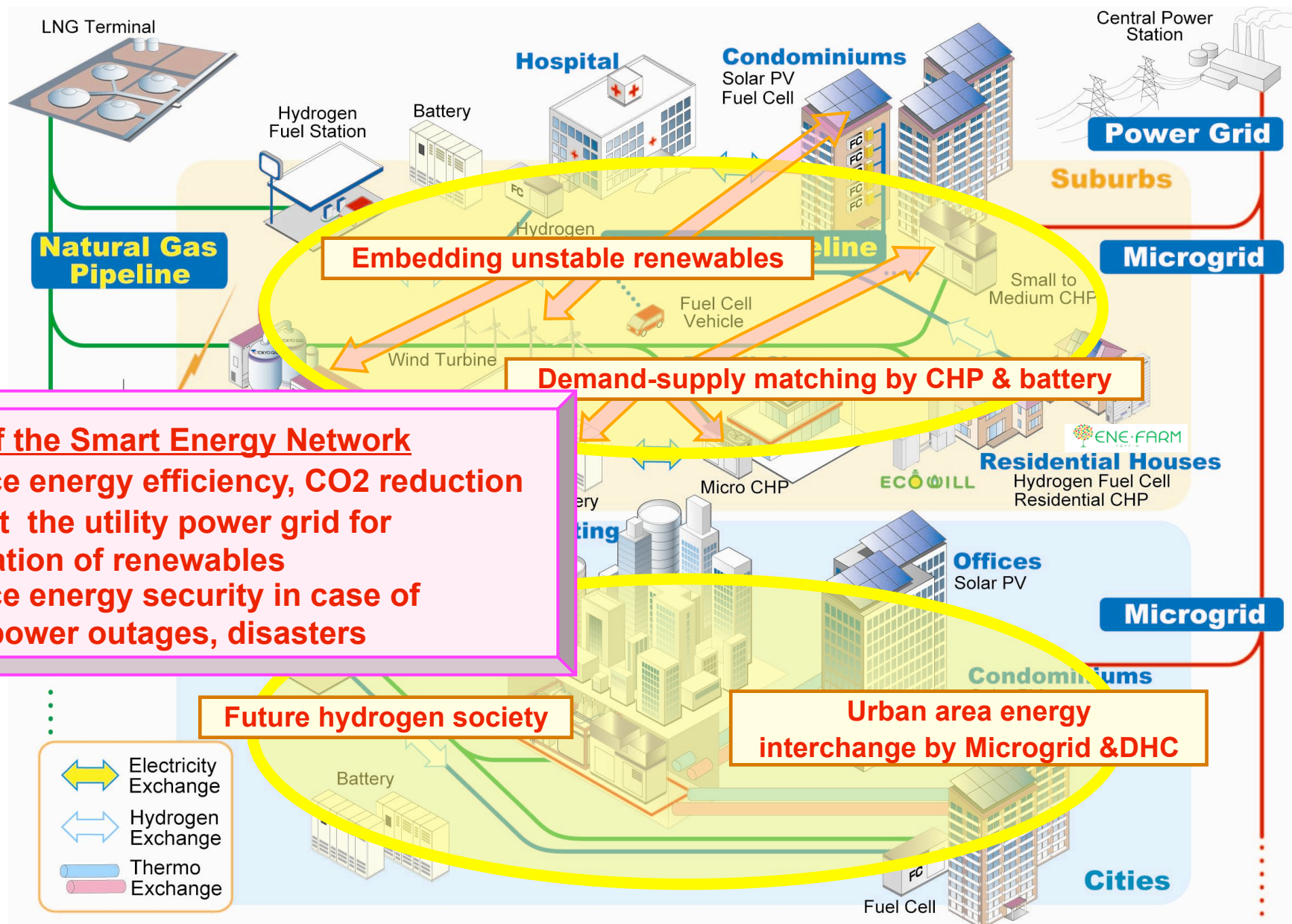


**Creation of the Smart Energy Network**

# Conceptual Scheme of the Smart Energy Network



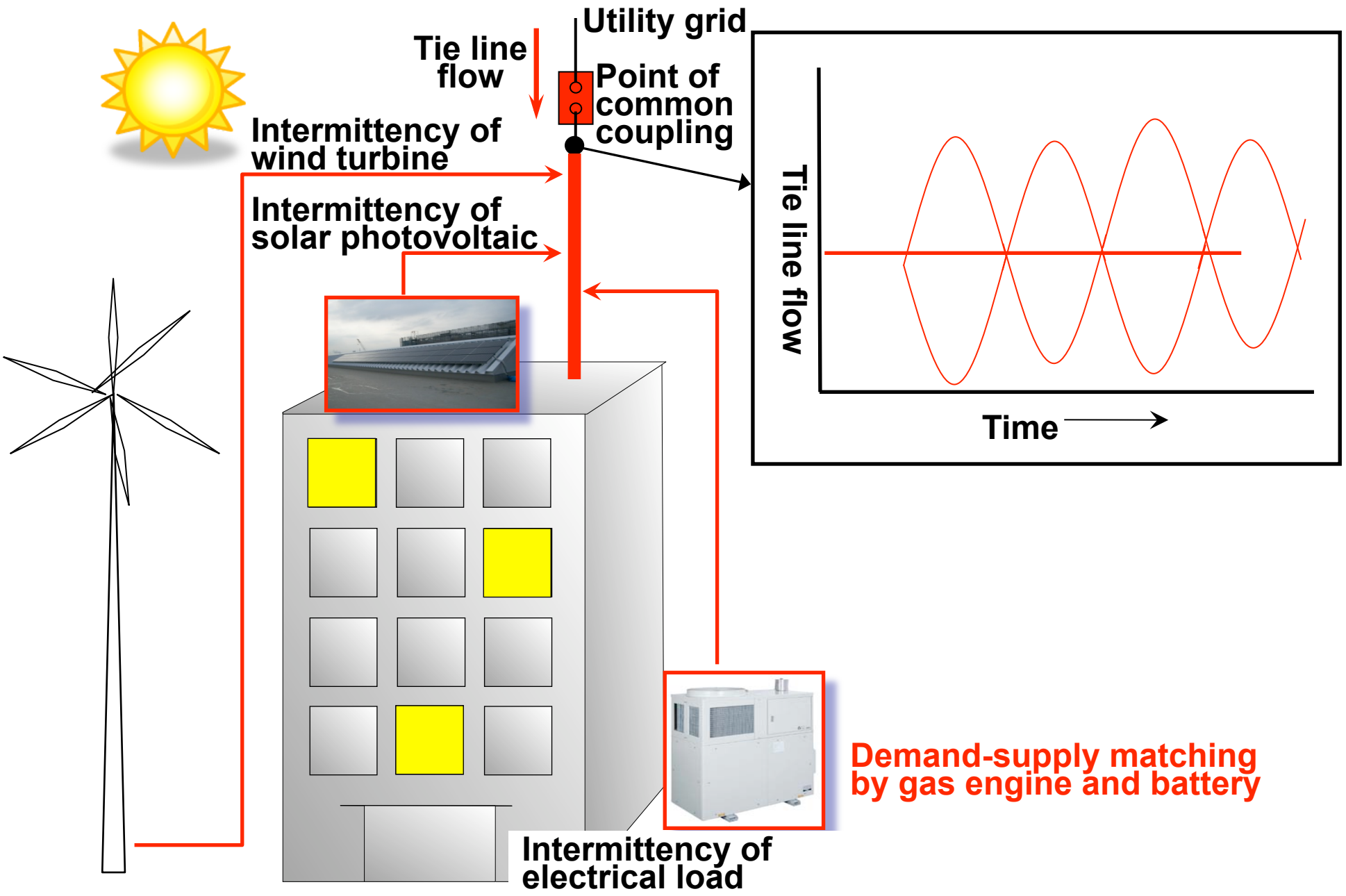
# Conceptual Scheme of the Smart Energy Network



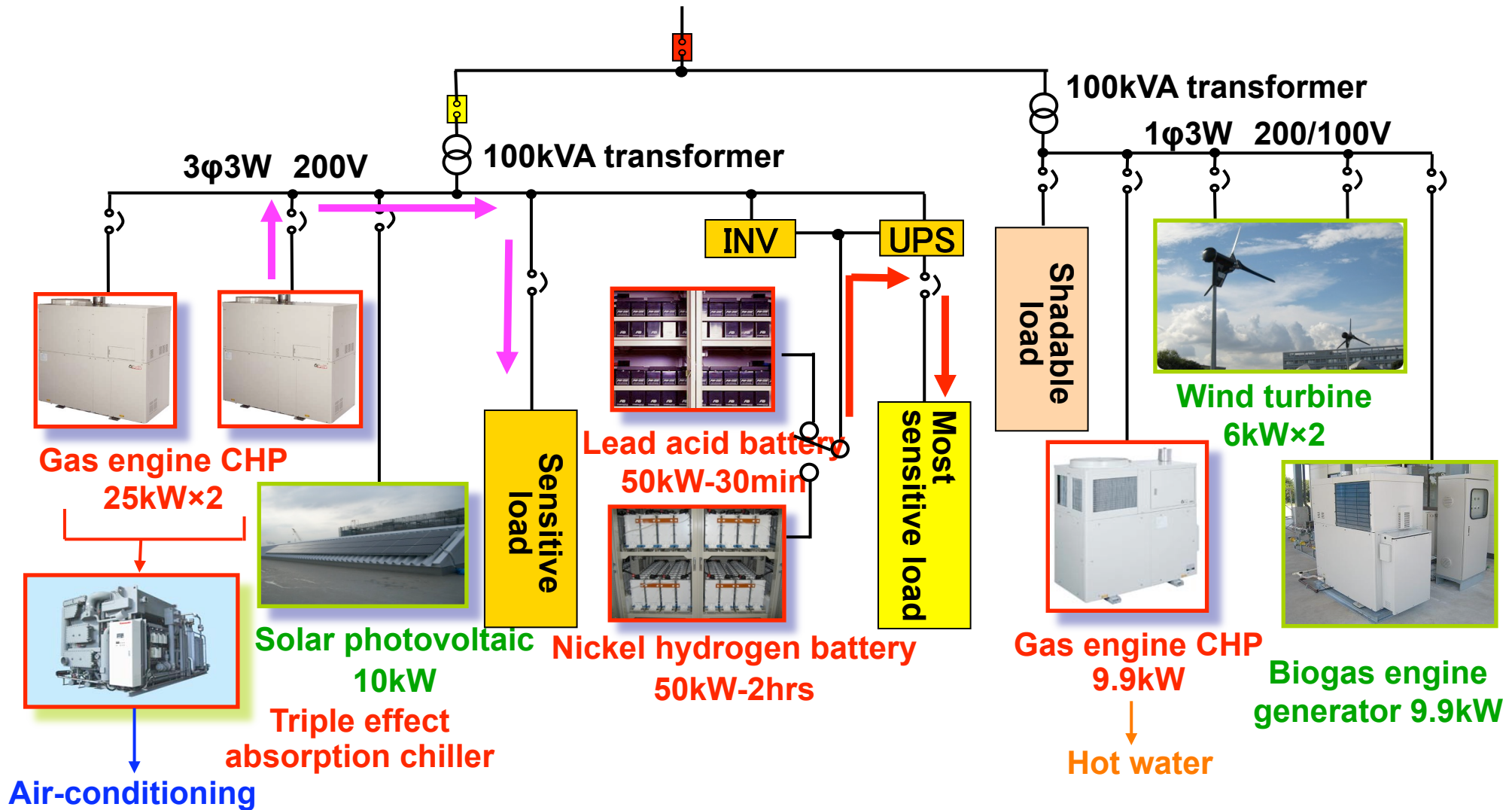
## Values of the Smart Energy Network

- ① Enhance energy efficiency, CO2 reduction
- ② Support the utility power grid for penetration of renewables
- ③ Enhance energy security in case of utility power outages, disasters

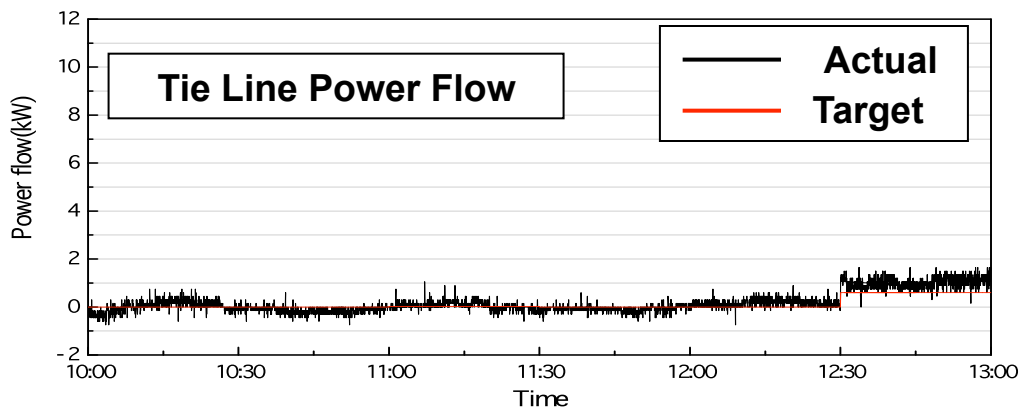
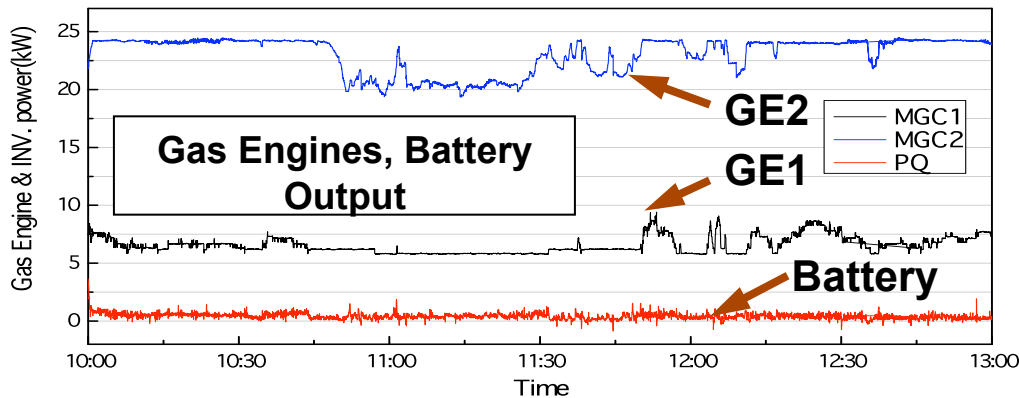
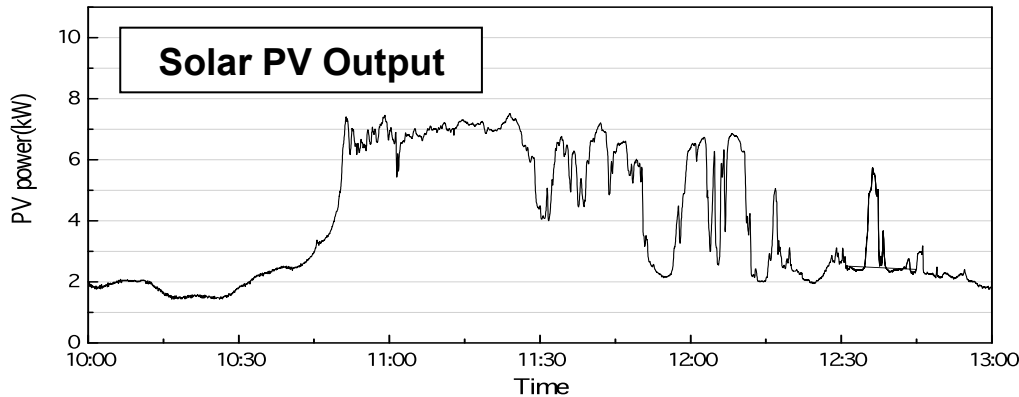
# Support the Utility Power Grid for Renewables Penetration



# Test Facility at Tokyo Gas Yokohama Techno Station



# Test Results of Renewable Intermittency Compensation



**Test on Solar PV Intermittency Compensation at the Yokohama Techno Station**

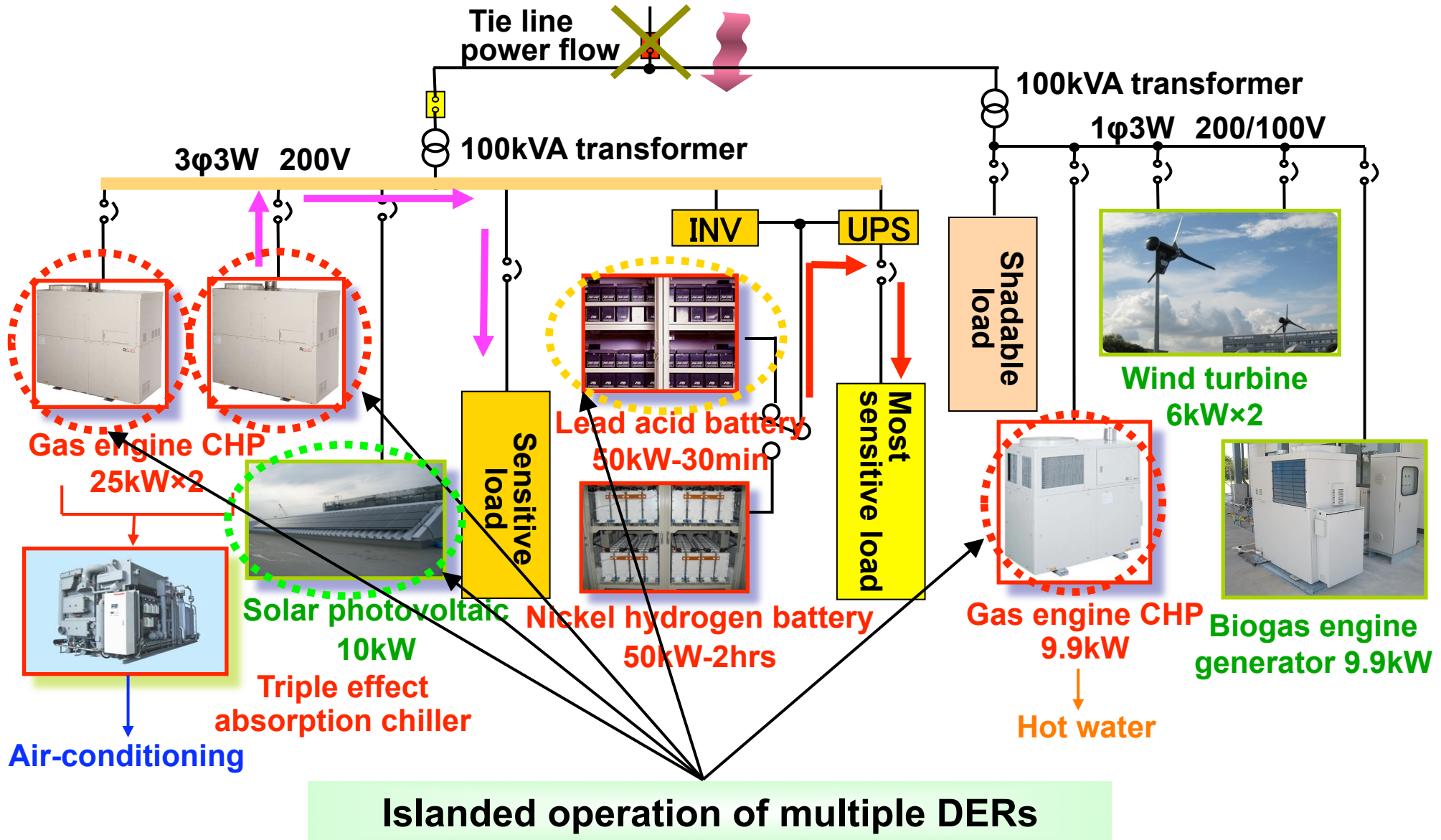
**Integrated Control of Gas Engines and a Battery**

- ✓ Low frequency intermittency compensated by Gas Engines
- ✓ High frequency intermittency compensated by a Battery

**<Results>**

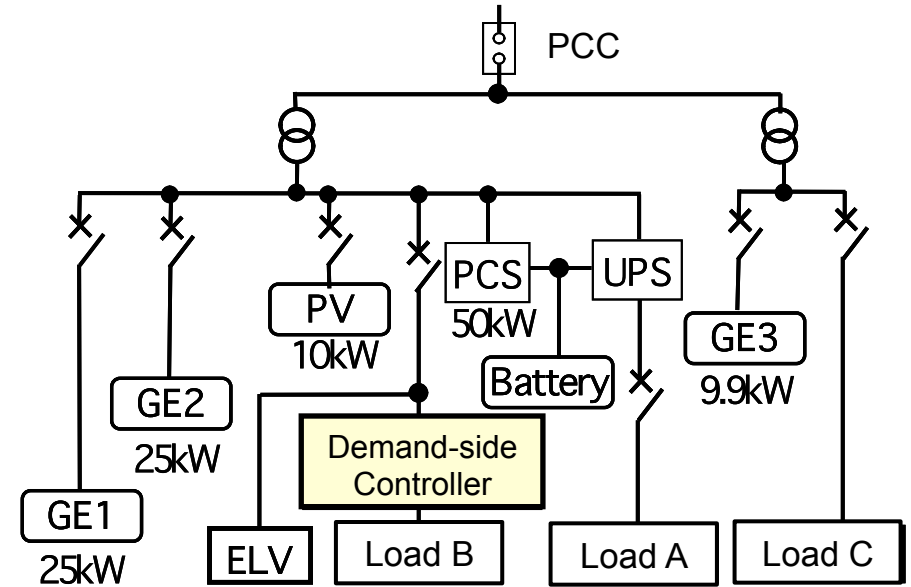
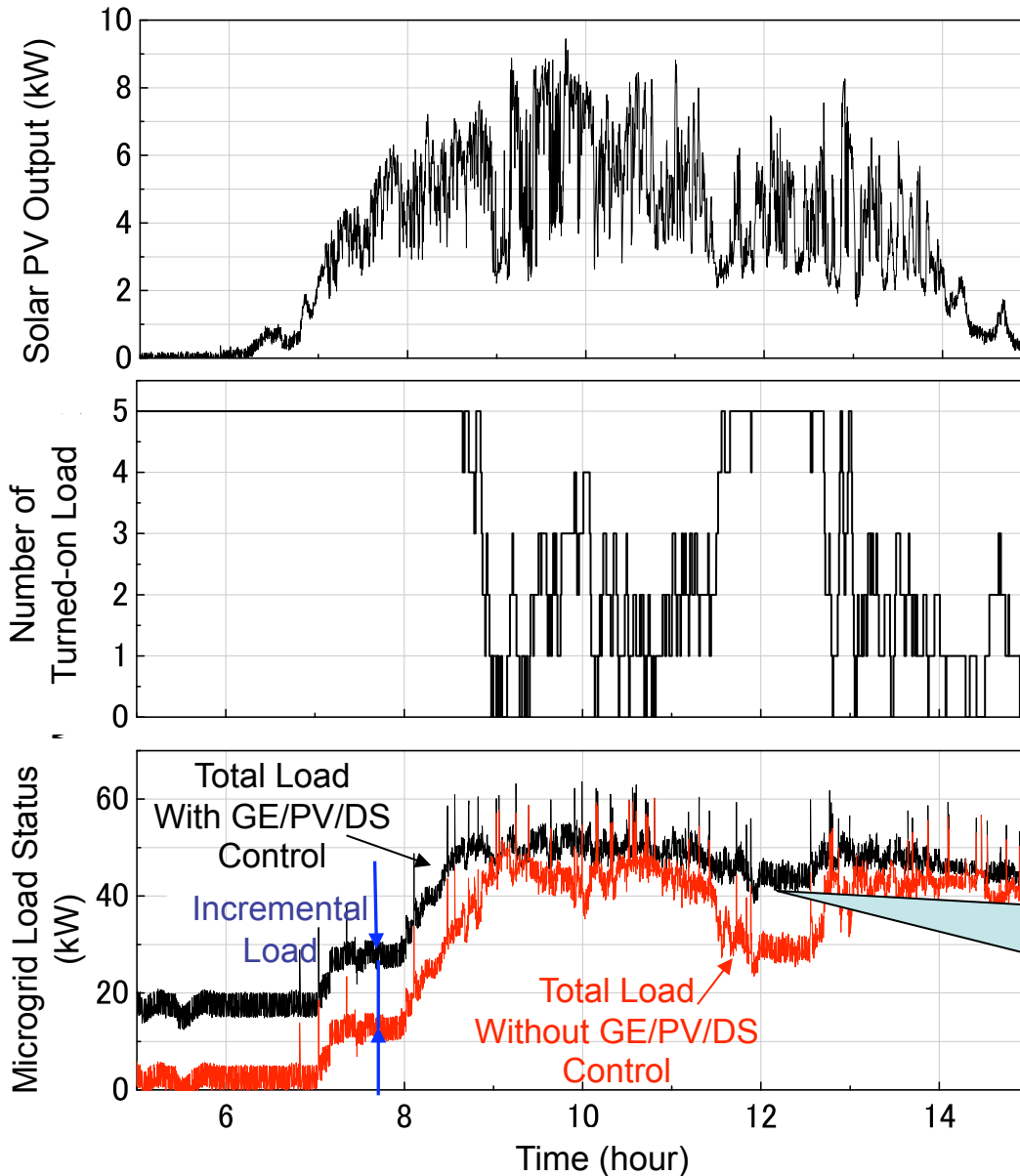
- ✓ Superior Tie Line Flow Control within  $\pm 3\%$  Matching Error in Every 5 Minutes
- ✓ 2kW Battery Power for Compensating 6kW Solar PV Volatility

# Enhance Energy Security in Case of Utility Power Outages





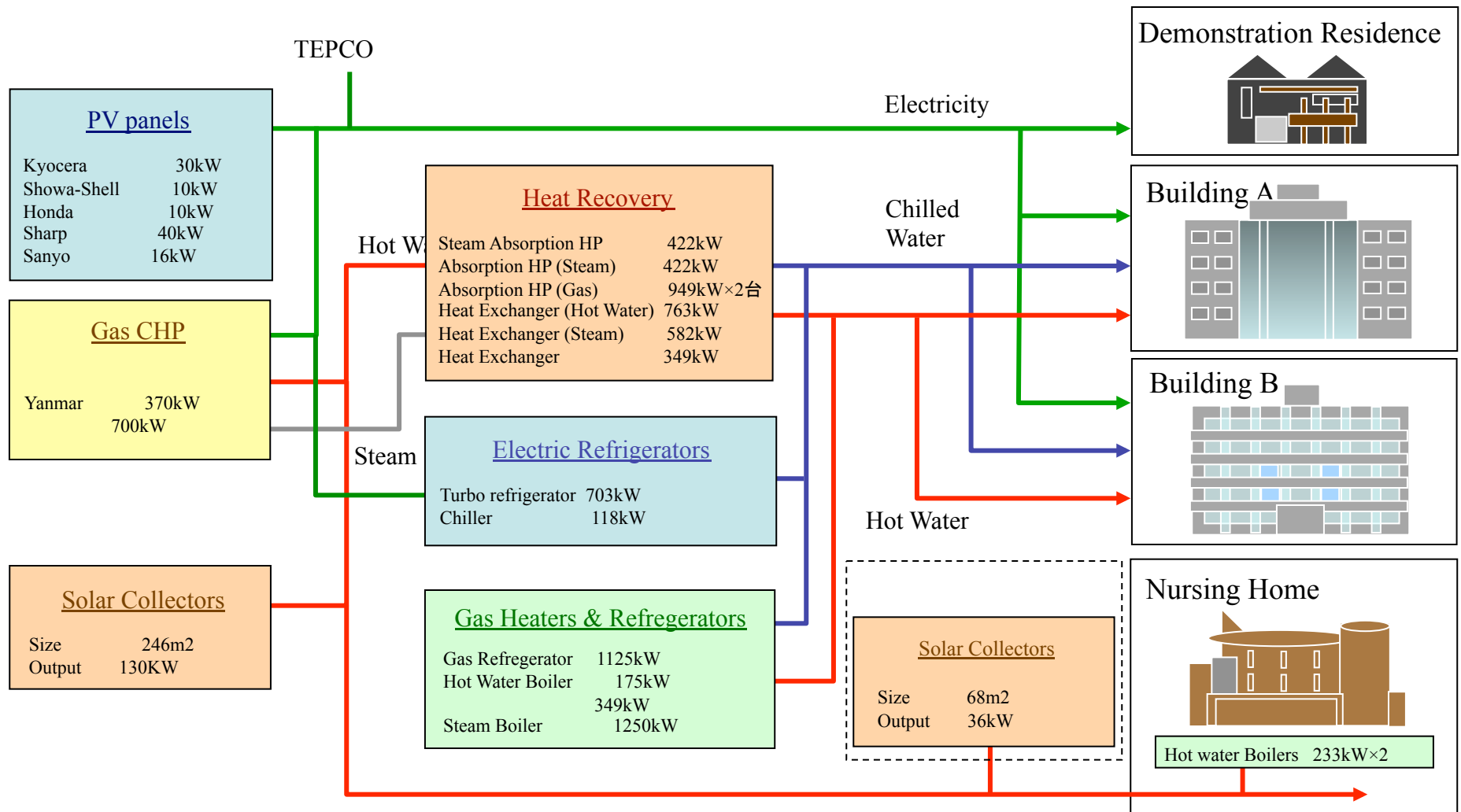
# Islanded Operation of Multiple DERs & Demand-side Control



Total Available Load Improved by 40% with Control Integration of Islanded Gas Engines, Solar PV and Demand-side Controllers

# Test Facility at Tokyo Gas Senju Techno Station

## ◇ Flow Chart



# Conclusions

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- **Natural gas must play a significant role in a low carbon society through advanced utilization technologies.**
- **Need to expand the scope of our R&D activities not only single device but also integrated energy systems to create smart energy network.**
- **Appropriate combination and harmonization with renewables and centralized power sources required.**
- **Strong need of a single voice (lobbying) toward each country's policy makers.**