

23EE709 : Energy storage systems

Topic: diagrams and Flowchart

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Electrical Energy Storage Technologies

Roles, Applications, and Emerging Needs

Characteristics of Electricity

- ▶ Electricity is consumed at the same time it is generated.
- ▶ Generation and consumption locations are far apart.
- ▶ Power imbalance affects voltage and frequency.
- ▶ Transmission congestion may occur in power grids.

Generation

Storage / EES

Consumption

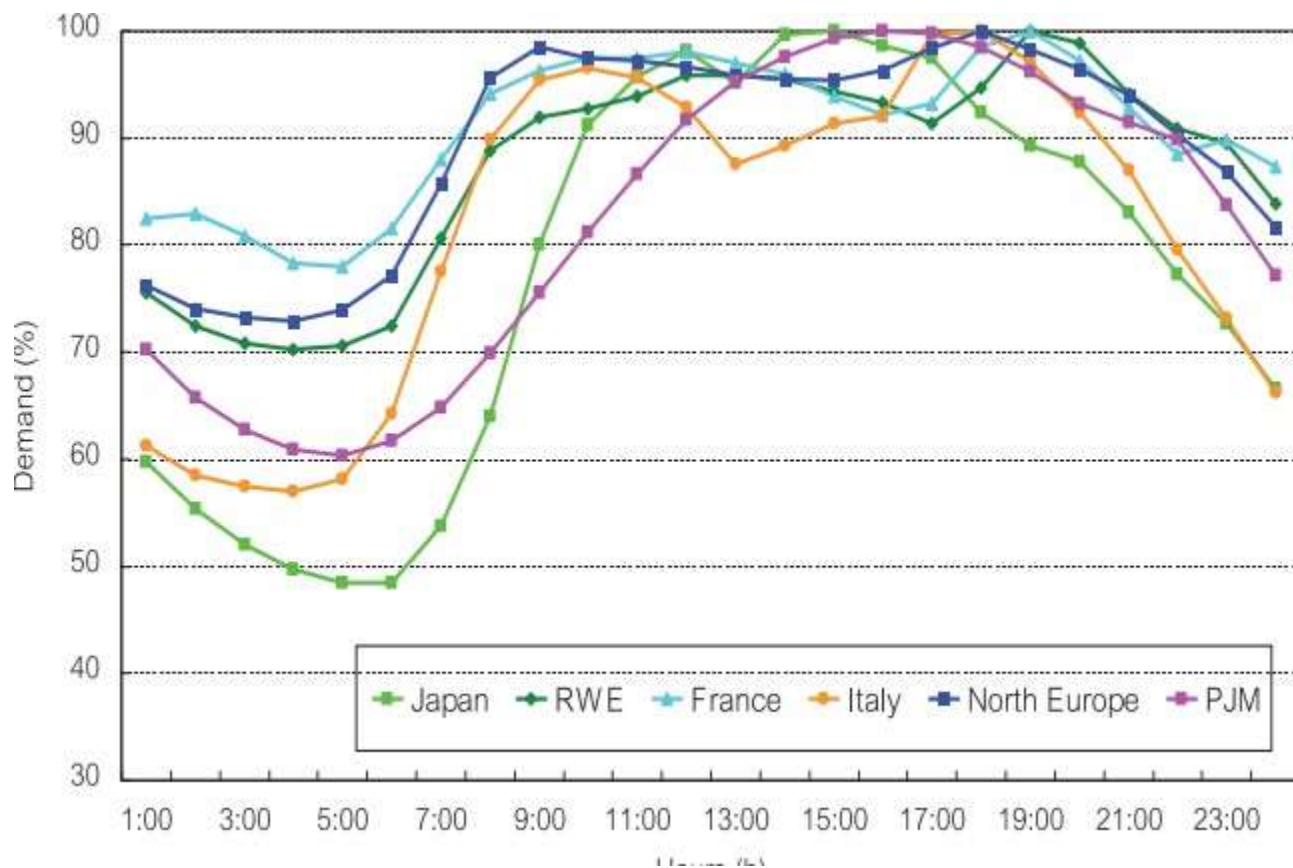
High Generation Cost During Peak Demand

- ▶ Peak demand requires expensive generators.
- ▶ Off-peak power can be stored using EES.
- ▶ Stored power is used during high-demand periods.
- ▶ Consumers can reduce electricity bills using EES.

Generation

Storage / EES

Consumption



Comparison of daily load curves

Need for Continuous and Flexible Supply

- ▶ Utilities must maintain voltage and frequency.
- ▶ Renewable energy fluctuates with weather.
- ▶ EES supports frequency control and backup power.
- ▶ Pumped hydro and batteries are common solutions.

Generation

Storage / EES

Consumption

Long Distance Between Generation and Consumption

- ▶ Failures in transmission interrupt power supply.
- ▶ UPS systems protect sensitive industries.
- ▶ Portable batteries provide emergency support.

Generation

Storage / EES

Consumption

Congestion in Power Grids

- ▶ Heavy power flow causes congestion.
- ▶ EES stores energy during low load periods.
- ▶ Stored power is supplied during congestion.

Generation

Storage / EES

Consumption

Emerging Needs for EES

- ▶ Supports renewable energy integration.
- ▶ Reduces fossil fuel dependency.
- ▶ Essential for Smart Grid applications.
- ▶ Helps electric vehicles and EMS systems.

Generation

Storage / EES

Consumption

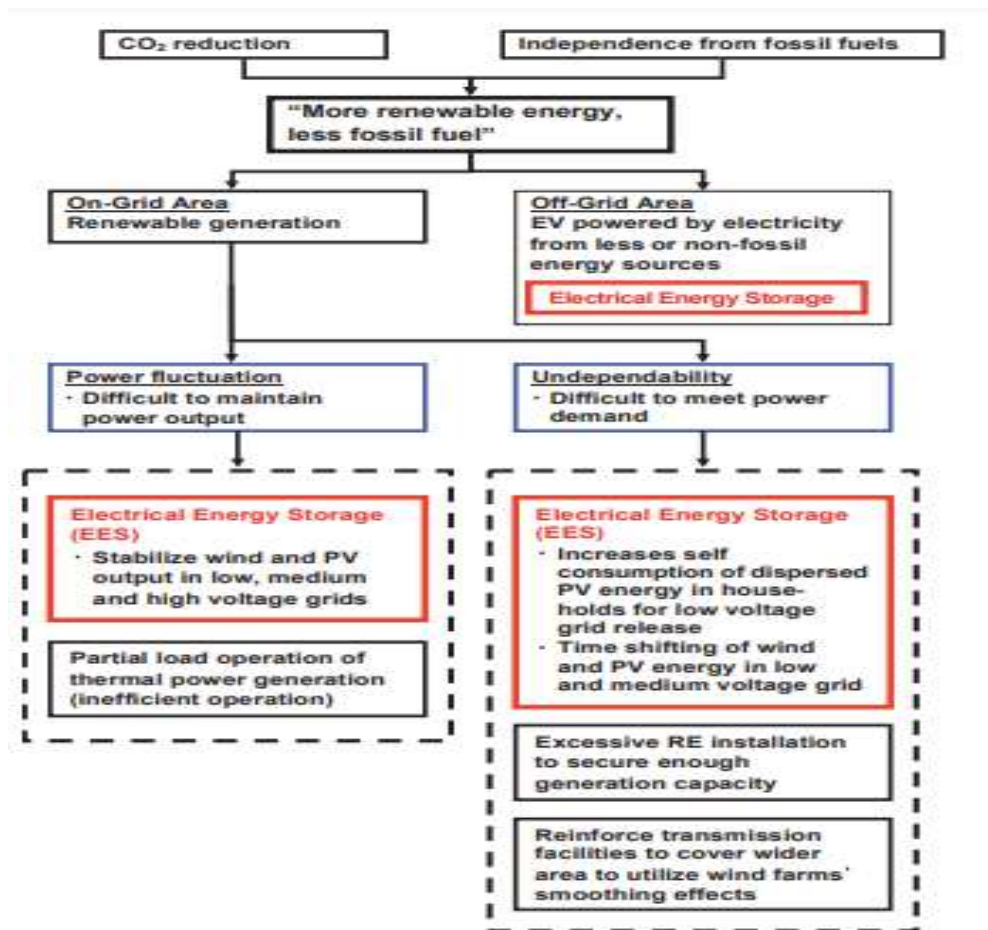
Renewable Energy and Smart Grid

- ▶ EES smooths renewable power fluctuations.
- ▶ Improves thermal plant efficiency.
- ▶ Electric vehicles can act as energy storage.
- ▶ Smart Grids use distributed battery systems.

Generation

Storage / EES

Consumption



Problems in renewable energy installation and possible solutions

Roles of EES Technologies

- ▶ Time shifting of energy.
- ▶ Power quality improvement.
- ▶ Emergency backup supply.
- ▶ Support for EVs and renewable energy.

Generation

Storage / EES

Consumption

Summary

- ▶ EES demand is increasing worldwide.
- ▶ Supports renewable integration and Smart Grids.
- ▶ Electrochemical storage technologies are expanding.
- ▶ Long-term storage solutions like Hydrogen are important.

Generation

Storage / EES

Consumption

The background features abstract, overlapping geometric shapes in various shades of green, ranging from light lime to dark forest green. These shapes are primarily located on the left and right sides of the frame, creating a modern, layered effect. The central area is a clean white space.

Thank You