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PV Technology

Energy flexibility and the Smart Grid concept

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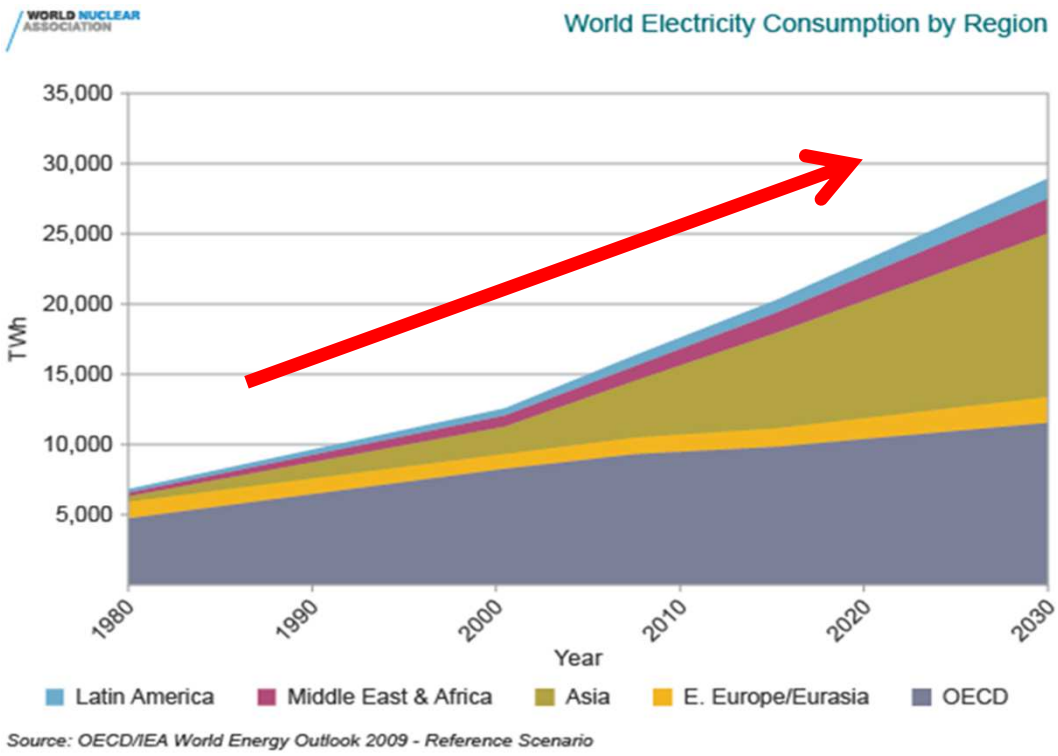
Outline

1. Introduction
2. Flexibility
3. Demand Side Management
4. The Smart Grid
5. Conclusions

Introduction

"Electricity demand almost doubled from 1990 to 2011, and is projected to grow 81% from 2011 to 2035", World Nuclear Association

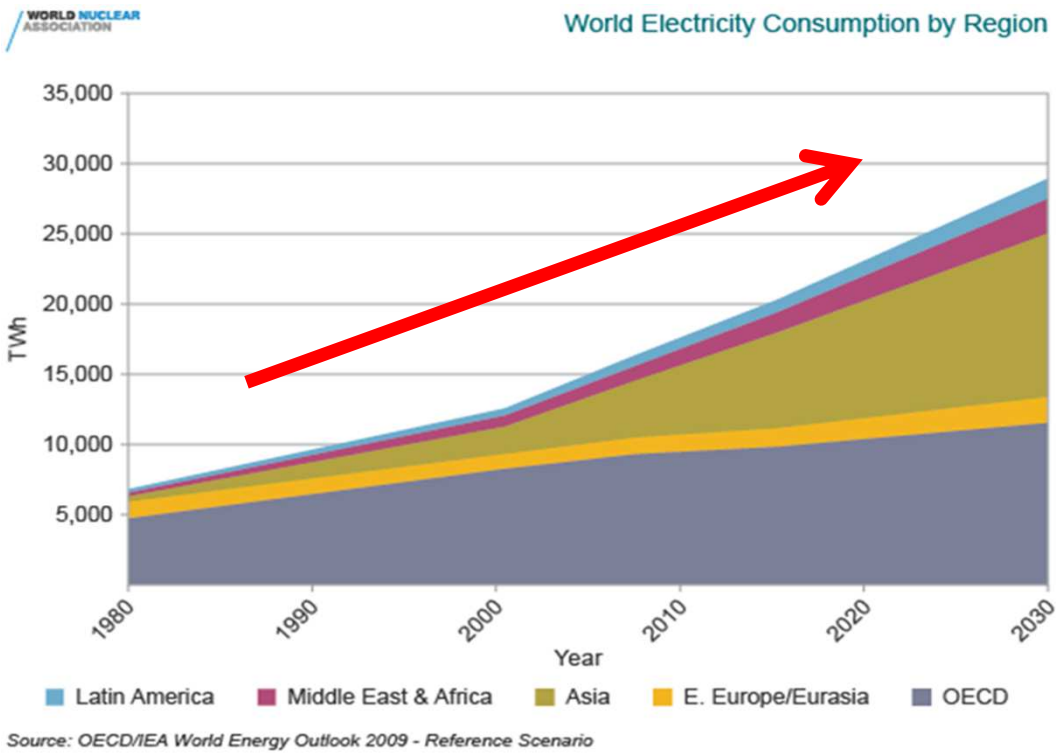


Source: OECD/IEA World Energy Outlook 2009 - Reference Scenario

Introduction

- Higher electricity capacity networks.
- Increase generation capacity.
- Increase pollutants.
- Creation of big gaps between peak and off-peak demand & RES.

→ **Stability & reliability issues**



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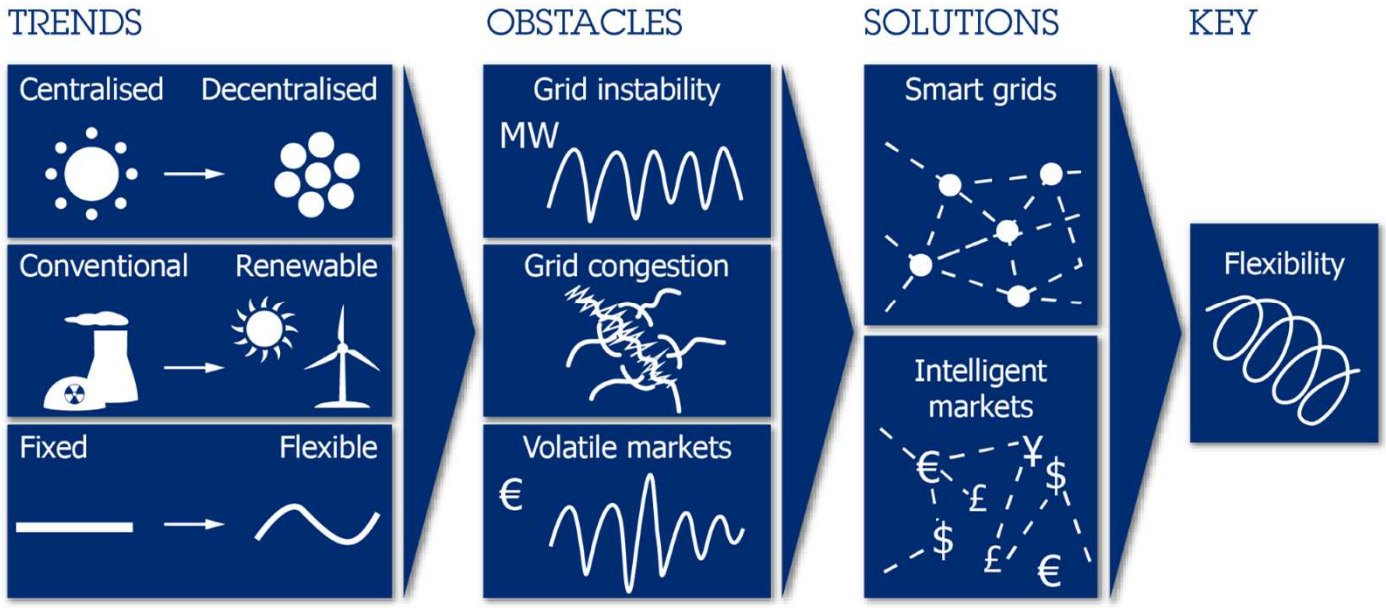
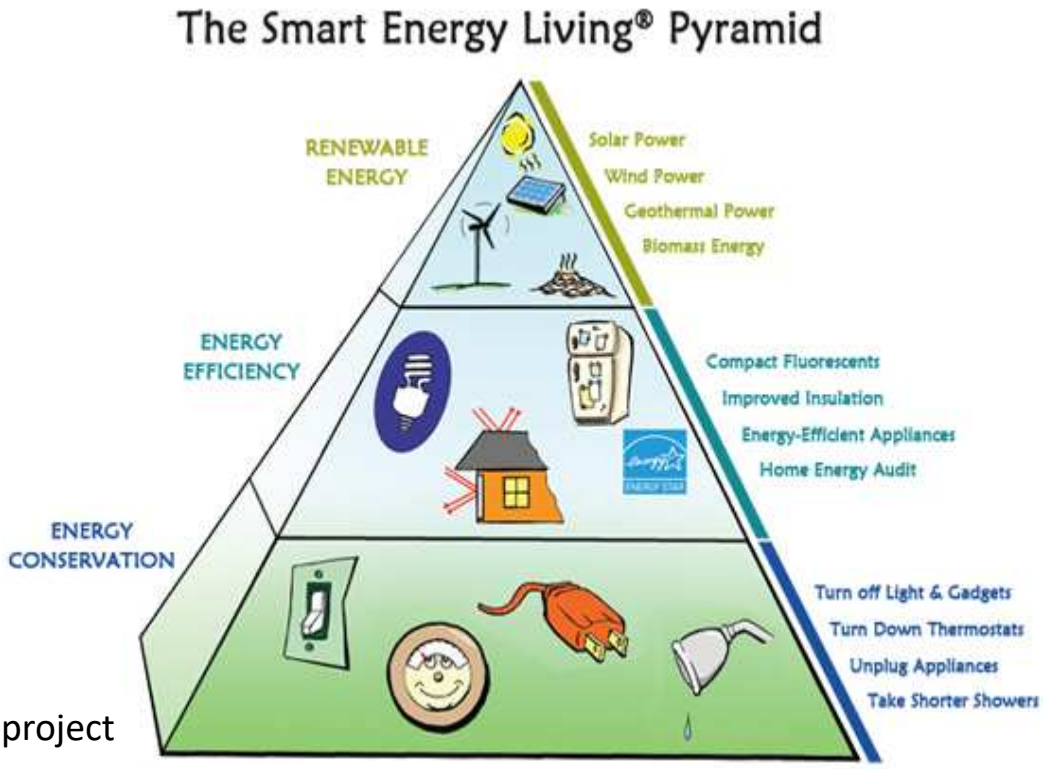
Flexibility

- Ability of a power system to respond **reliably**, **rapidly** and **cost-effectively** to changes in demand & supply, across all relevant timescales.



Conservation and Energy Efficiency

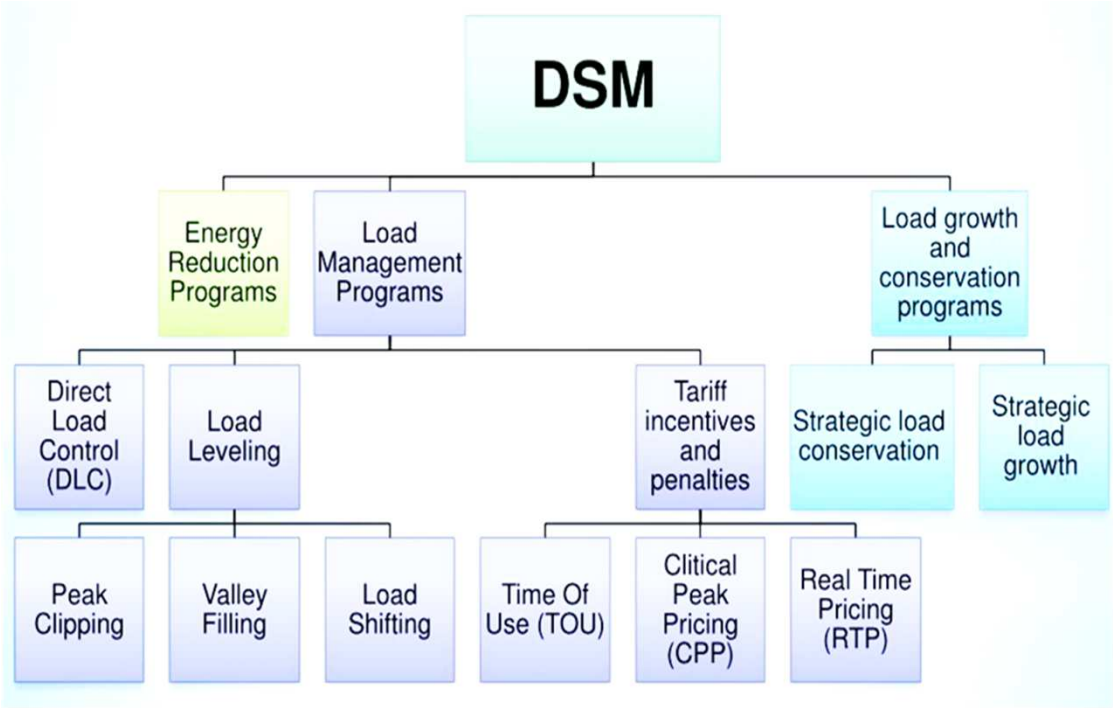


Source: Teller Energy project

Demand Side Management (DSM)

- **Matching** of supply and demand.
- **Management** of supply and demand.
- New energy philosophies, different DSM concepts.

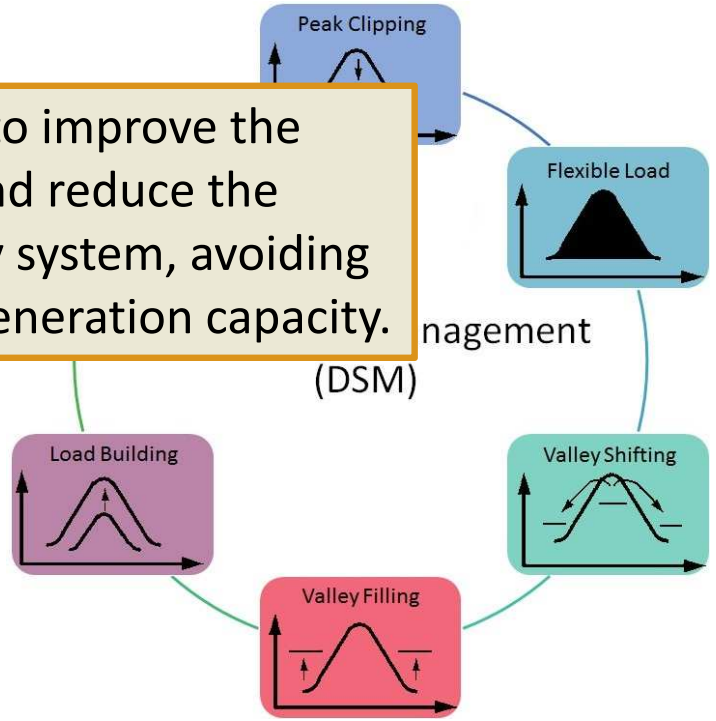
→ **Provides flexibility!**



Demand Side Management (DSM)

- Objective:
  - Influence consumers electricity use
- Two main prog
  - Load mana
  - Conservati
- Outcomes:
  - Network operator control
  - Reduction on the customers' electricity bill
  - Decrease the operation and maintenance costs (both sides, utilities & consumers)
  - Decrease carbon footprint

DSM has a high potential to improve the efficiency of operation and reduce the investments of the electricity system, avoiding capacity expansion and new generation capacity.



DSM: Benefits

Consumer Benefits	Utility Benefits	Societal Benefits
Satisfy electricity demands	Lower cost of service	Reduce environmental degradation
Reduce/stabilize costs of electricity bill	Improve operating efficiency & flexibility	Conserve resources
Maintain/improve lifestyle and productivity	Improve customer service	Protect global environment

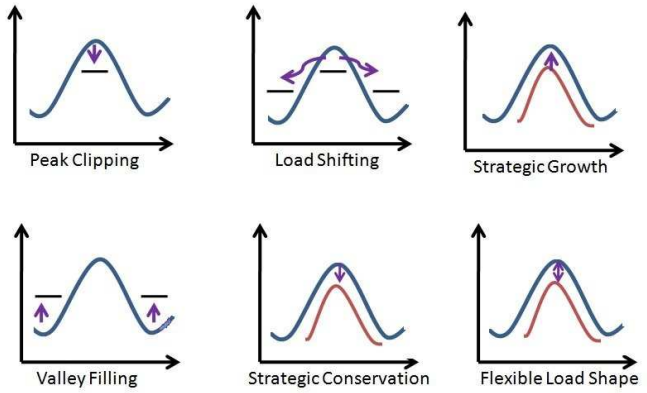
DSM: Costs and challenges

- Associated Costs:
  - Technology (initial costs)
  - Running costs
- Associated Challenges:
  - Information and communication infrastructure
  - Enabling and promoting participation

DSM: Tariff incentives and penalties

Price-based DSM

- Real-Time Pricing (RTP)
- Critical-Peak Pricing (CPP)
- Time-Of-Use (ToU) Tariffs

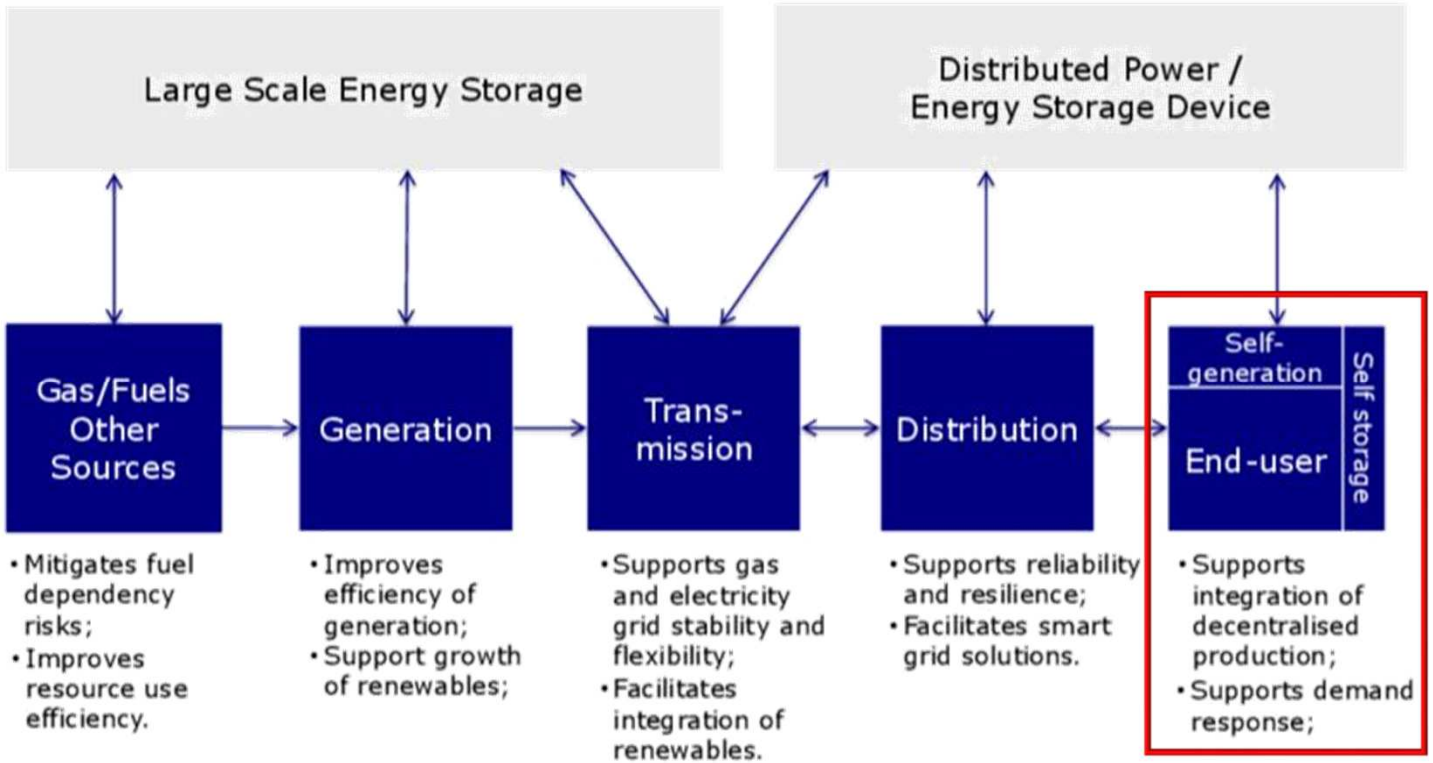


→ Ideal for Energy Storage and mostly BESS!

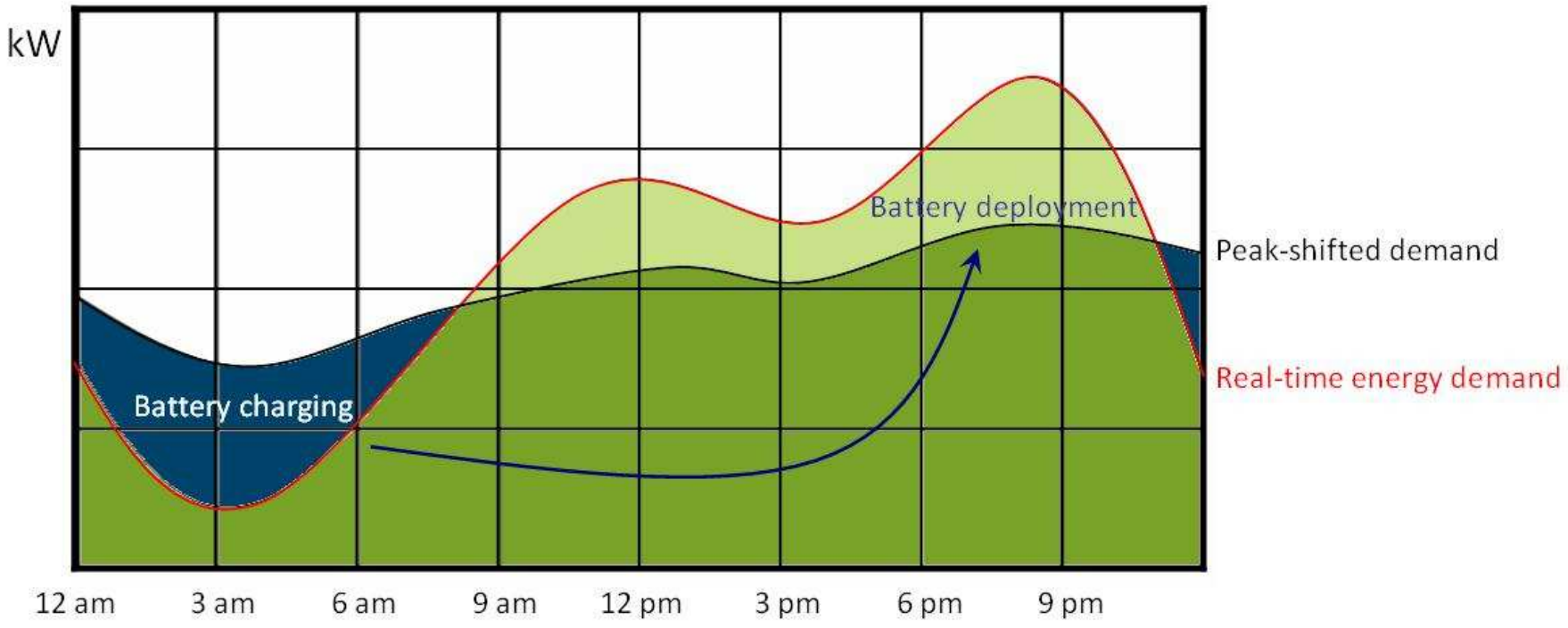
- The network operator will be able to control the demand.

→ End-users (prosumers) gain benefits for their participation and the BESS operation!

DSM application of Energy Storage



DSM application of Energy Storage



The Smart Grid

- Who is “smart”?
- One who knows something.
- Need for information.
- Smart Grid: Need for continuous information.

→ Need for data (operation of assets, etc.)

→ Need for (advanced) metering and communication devices!

The Smart Grid: Theoretical frame

- Concurring targets of energy economy are shown as a triangle of:
  - Energy Efficiency
  - Supply Security
  - Environmental Compatibility
- Smart Grid: potential for bringing amount of innovation to consumption/production:
  - Increase flexibility and intelligence
  - Achieve optimization of energy use and management
  - Integrate distributed energy resources

The Smart Grid

- Intelligent power system supporting state-of-the-art telecommunication and electronics technologies to meet future energy requirements.
- Ensures stability and security of supply through communication with other parts of the network such as conventional power plants and distributed RES.

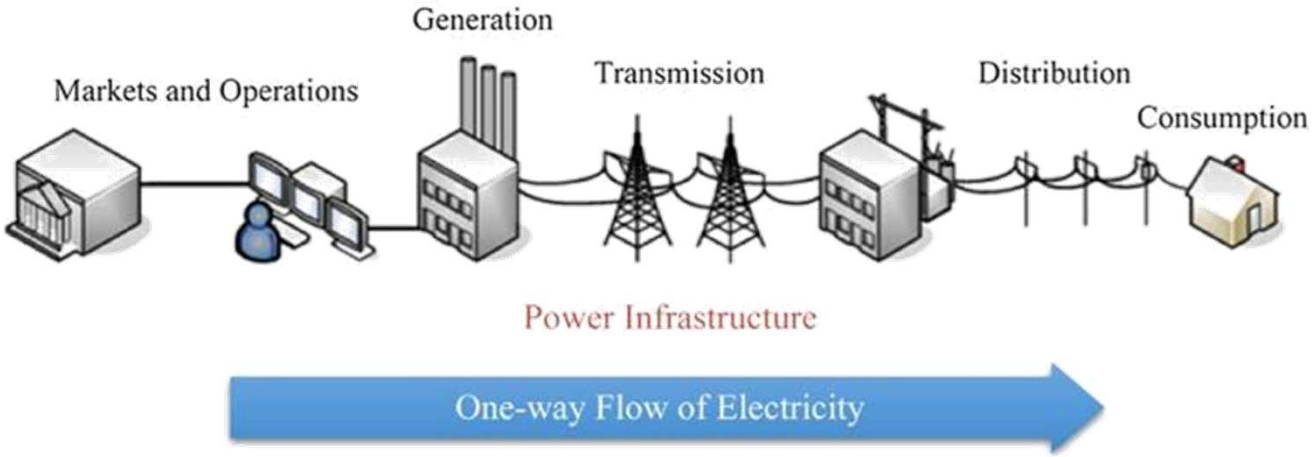
The Smart Grid

Main advantages:

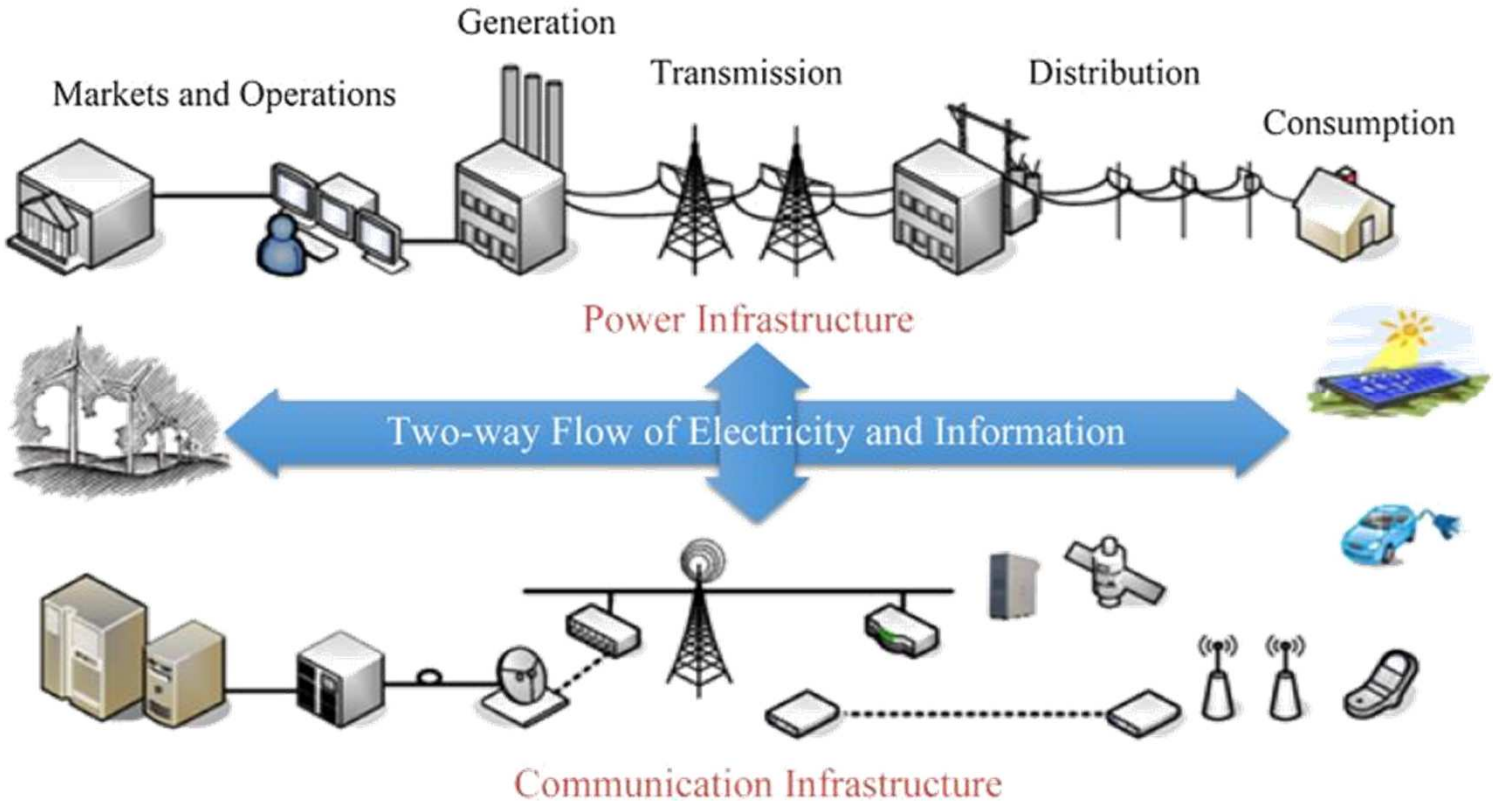
- Greater reliability and better service quality.
- Better use of existing infrastructure and alternative forms of energy to minimize the use of conventional generating units in order to meet demand.
- Reducing carbon dioxide (CO2) emissions.
- Active participation of consumers in the effort to save energy (Demand Response, Dynamic Pricing, Time-of-Use Tariffs).

The Smart Grid

Traditionally the development of electricity markets has centered on the role of the supply side in meeting consumers' needs.



The Smart Grid



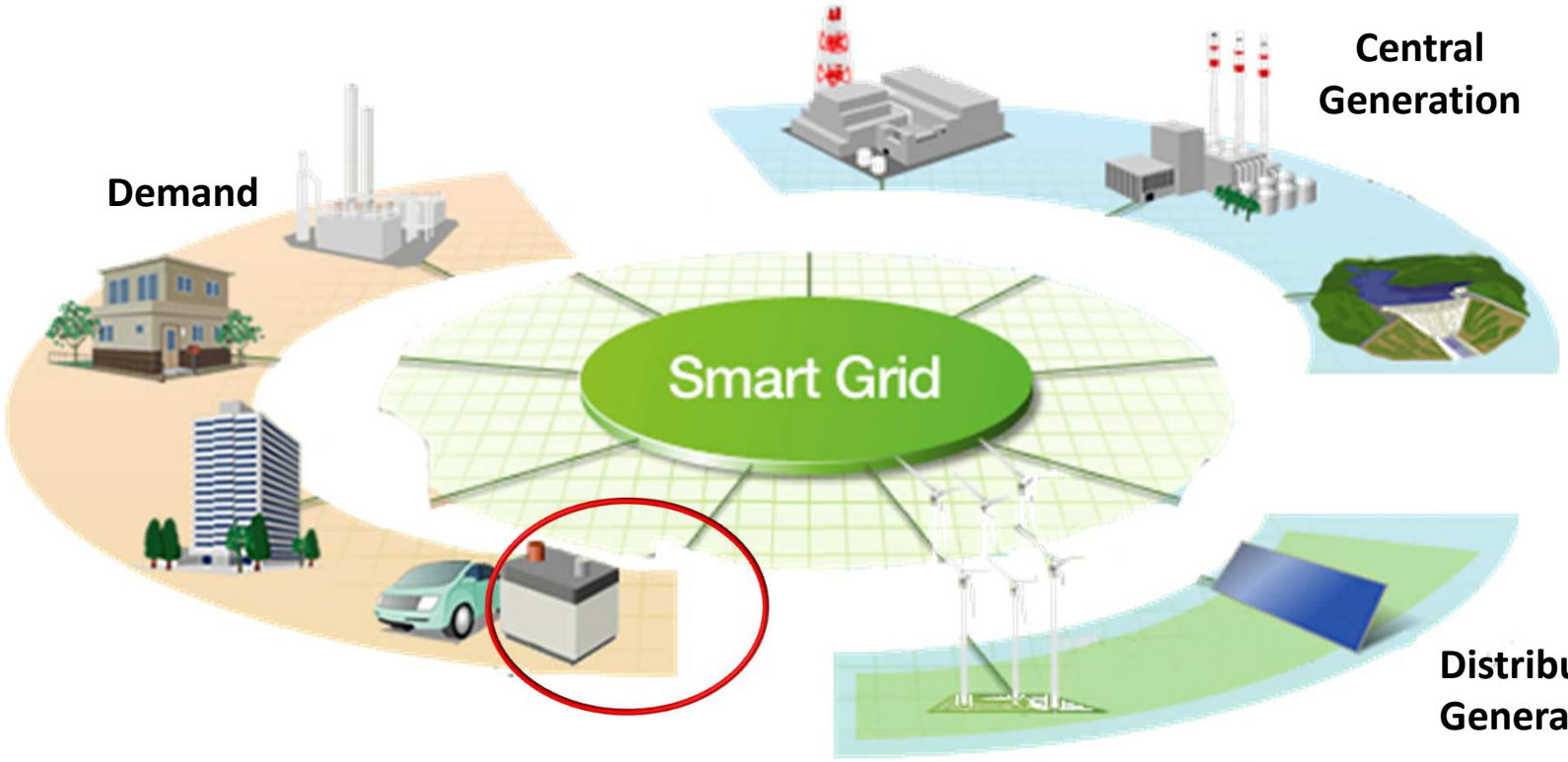
Smart Grid Technologies

- Smart Energy Efficient end-use Devices
  - Energy Efficient and economically feasible appliances
  - Intelligent devices allowing for two-way communications (e.g. controlled by external signals from the utility)
- Distributed Energy Resources
  - Energy Storage Devices
  - Dynamically controlled Renewable Energy Sources
- Advanced whole-building Control Systems
  - Energy Management Systems
  - Automated control of end-use devices and DERs in response to various signals
  - Forecasting

Existing vs Smart Grid

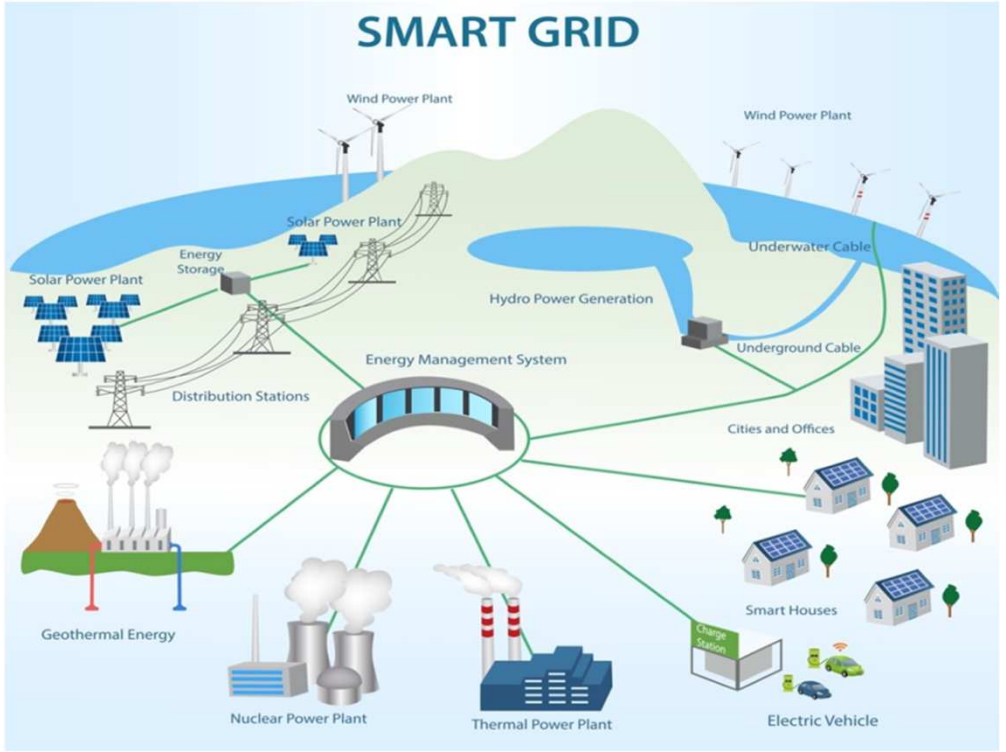
Existing Grid	Smart Grid
Electromechanical	Digital
1-way communication	2-way communication
Centralised Generation	Distributed Generation
Few sensors	Sensors throughout
Manual monitoring	Self monitoring
Manual restoration	Self healing
Failures & blackouts possible	No blackouts

The Smart Grid



Conclusions

- Increasing gap between demand and supply.
- Power network instability issues.
- Need for energy flexibility.
- DSM: various techniques providing flexibility.
- Future power system: Towards Smart Grid.



Thank you for your attention!

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Acknowledgment

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