

# The Future of Electricity Network With Disruptive Technologies

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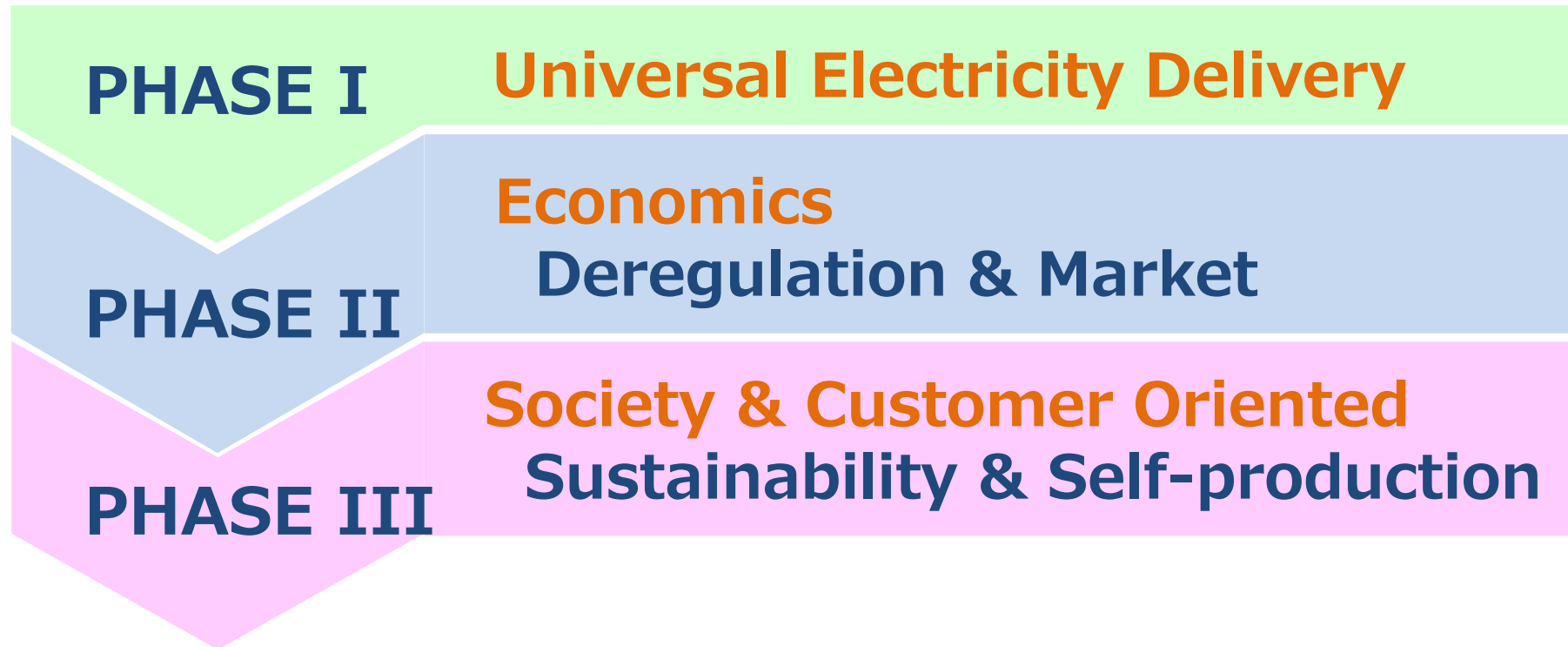


**EGC**

Electricity and Gas Market  
Surveillance Commission

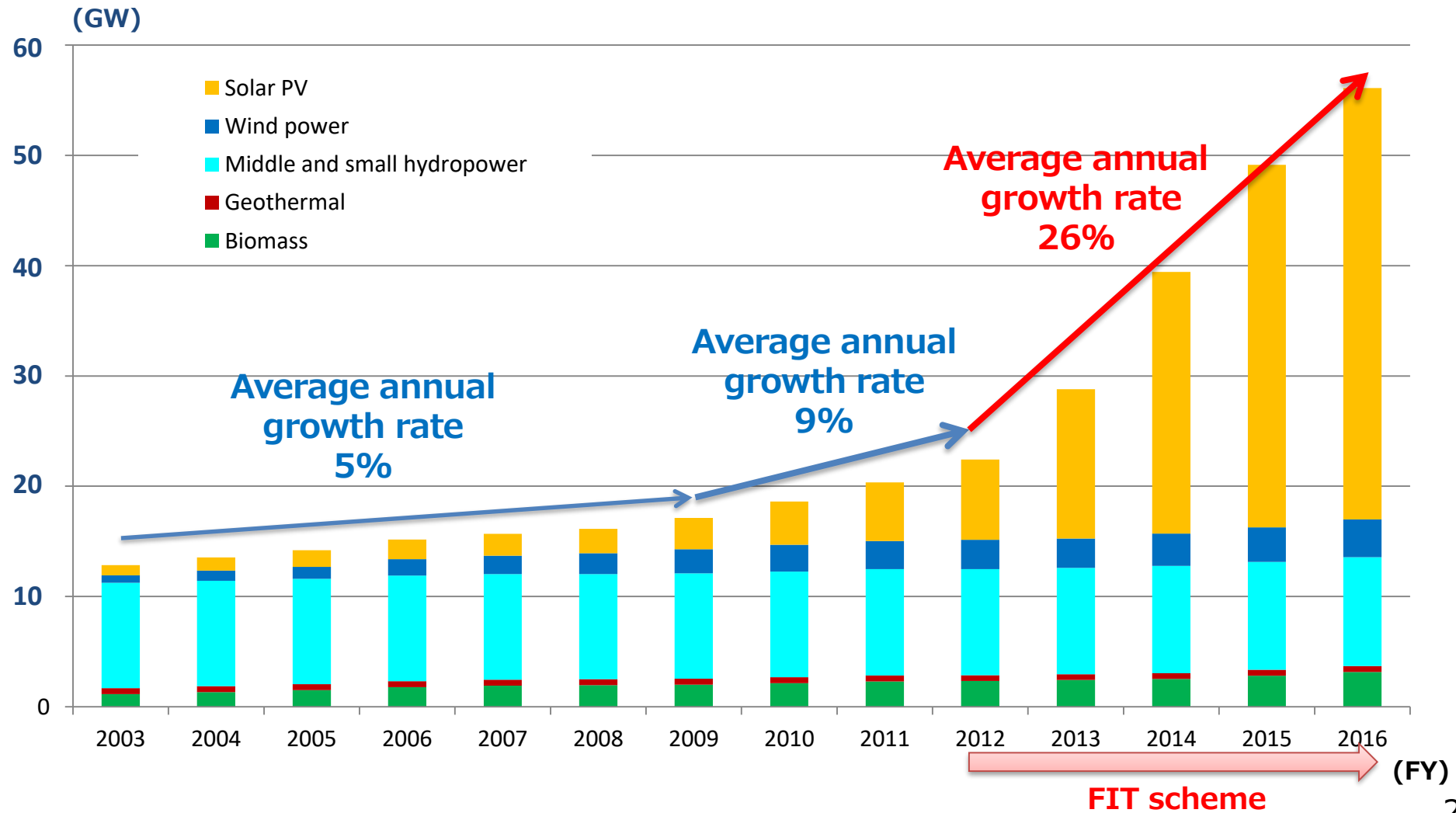
# Trends in Electric Energy Systems

- In Japan, Phase II & III are taking place simultaneously.
  - Power System Reform
  - Acceleration of Renewables: Feed-in-Tariff



# Acceleration of Renewables : Feed-in-Tariff

- After introduction of FIT in 2012, 26% annual increase in RES introduction.
- Deployment of solar PV increased dramatically: 170% increase since 2012.



# Characteristics and Challenges in Emerging Power System

□ IEC / MSB (Market Strategy Board) White Paper



## “Advanced Electric Grid Operations with Demand-Side Resources”

### Change Drivers = 5 **Ds**

- **D**ecarbonization
- **D**ecentralization
- **D**eregulation
- **D**emocratization
- **D**igitalization

+

### Challenges = 4 **Ls**

- **L**imited Visibility
- **L**imited Control
- **L**imited Predictability
- **L**imited Regulation  
(Coordination)

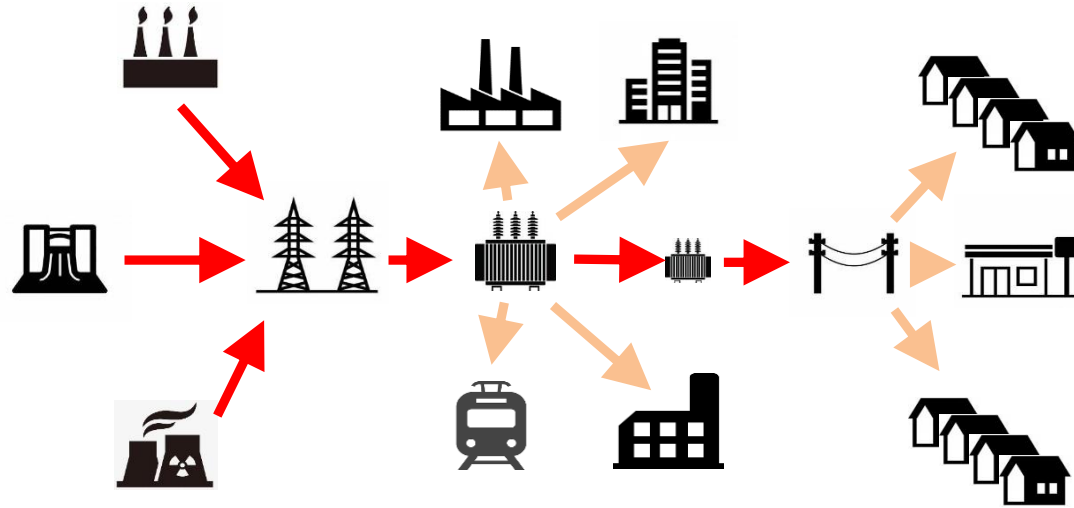
### Future Grid Operation

- ✓ Aggregation of small resources
- ✓ Communication link to ISO/TSO
- ✓ Market to accommodate aggregated resources
- ✓ PV curtailment

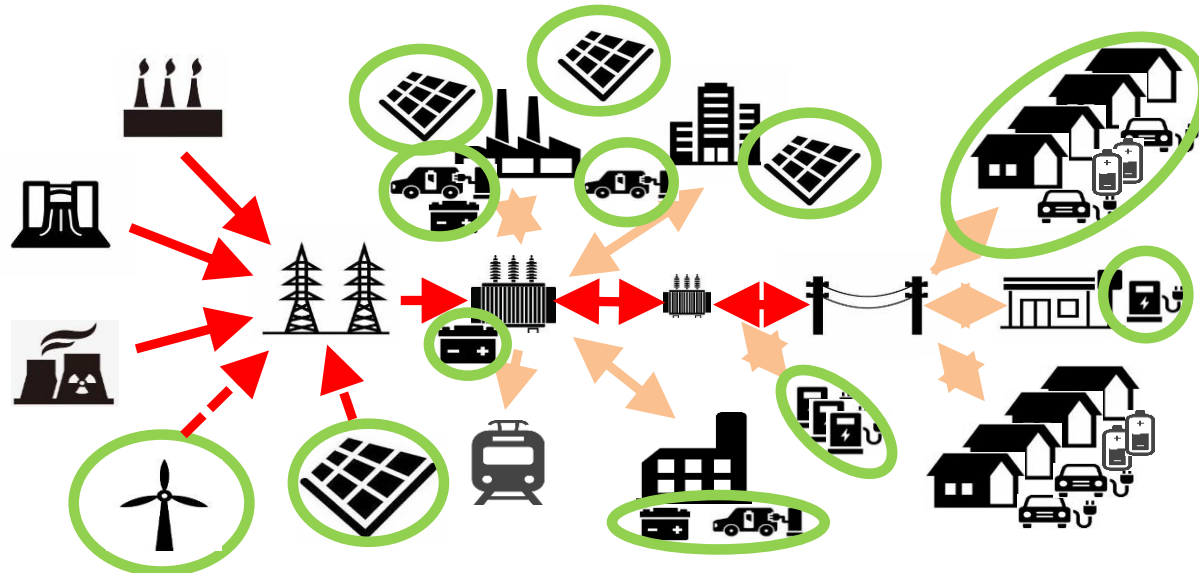
# Future of Electric Grid System

- Beyond 2030, renewables & disruptive technologies will be connected at grid edge

Conventional  
NW



Beyond 2030  
NW



# Challenges toward Future Grid System

Key Challenge: **Maximization of network efficiency**

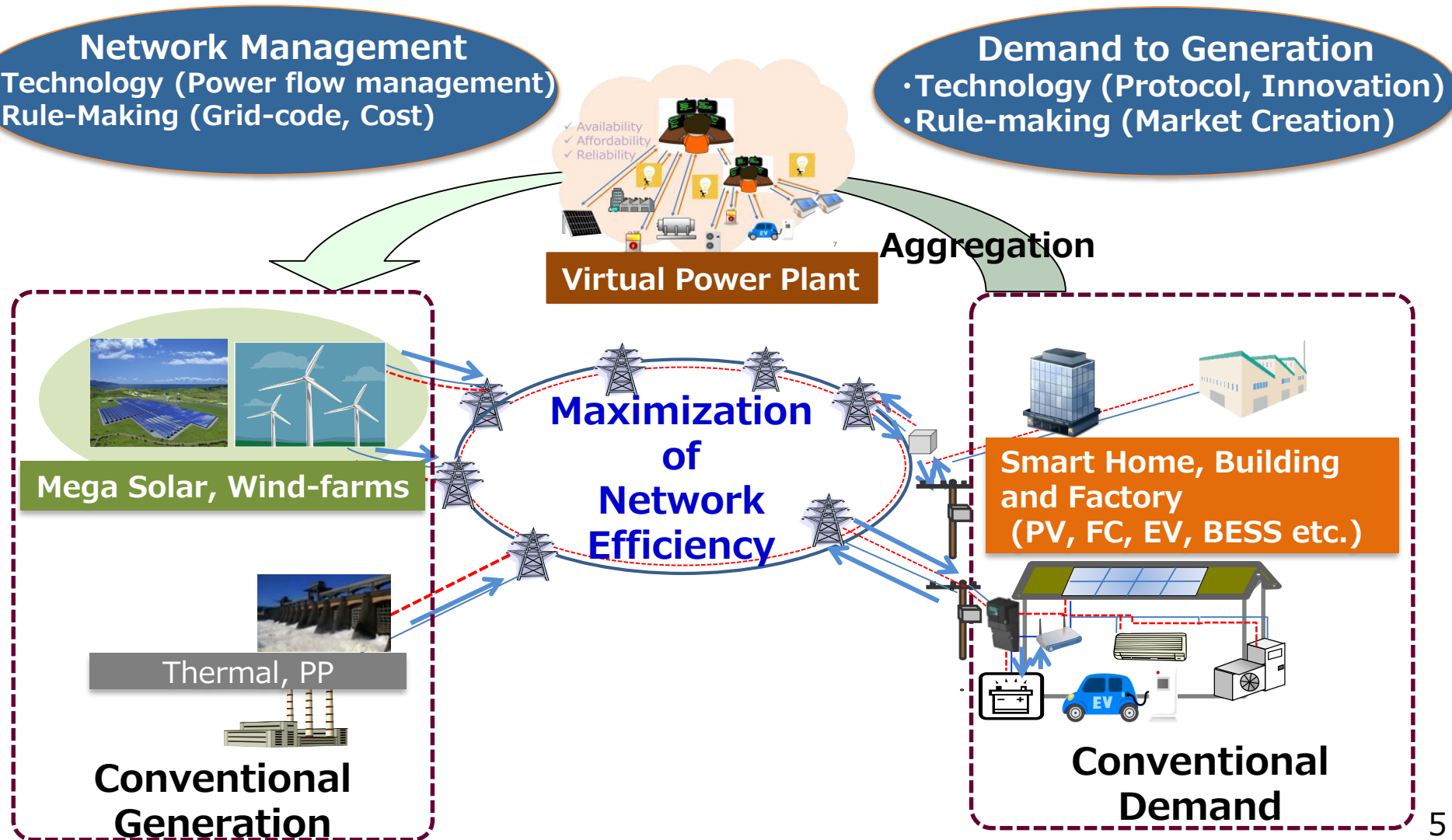
Approach: **Demand to Generation, Network Management**

## Network Management

- Technology (Power flow management)
- Rule-Making (Grid-code, Cost)

## Demand to Generation

- Technology (Protocol, Innovation)
- Rule-making (Market Creation)



# Challenges toward Future Grid System

## Network Management

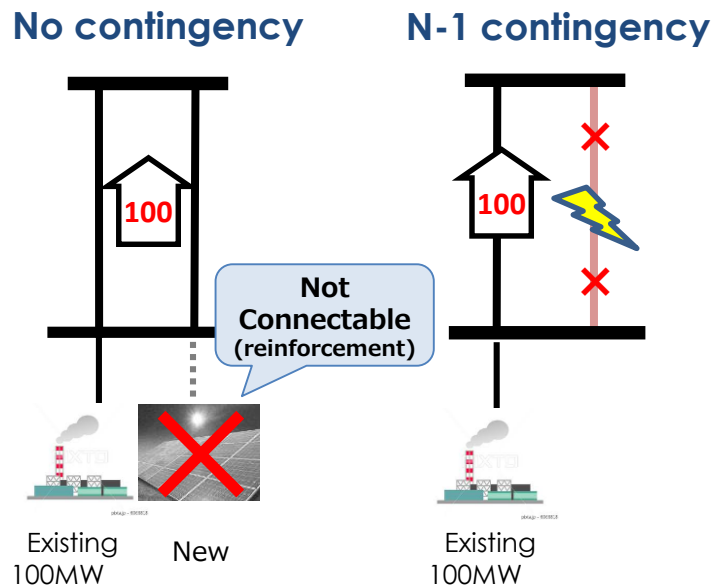
## Demand to Generation

<b>Technology &amp; Standardization Layer</b>	<b>Improving network management</b> <ul style="list-style-type: none"><li>● Connect &amp; Manage</li></ul> etc.	<b>Demand-side power/information flow</b> <ul style="list-style-type: none"><li>● VPP, DR demonstration</li><li>● Development of standard method for output control (Open ADR)</li></ul> etc.
<b>Rule-making Layer</b>	<b>Network sustainability</b> <ul style="list-style-type: none"><li>● Introduction of Generation Charge</li></ul> etc.	<b>New business scheme</b> <ul style="list-style-type: none"><li>● Negawatt Business (Guidelines for Proper Electric Power Trade)</li><li>● Product Specification in Balancing Market</li></ul> etc.

# Introduction of “Connect and Manage”

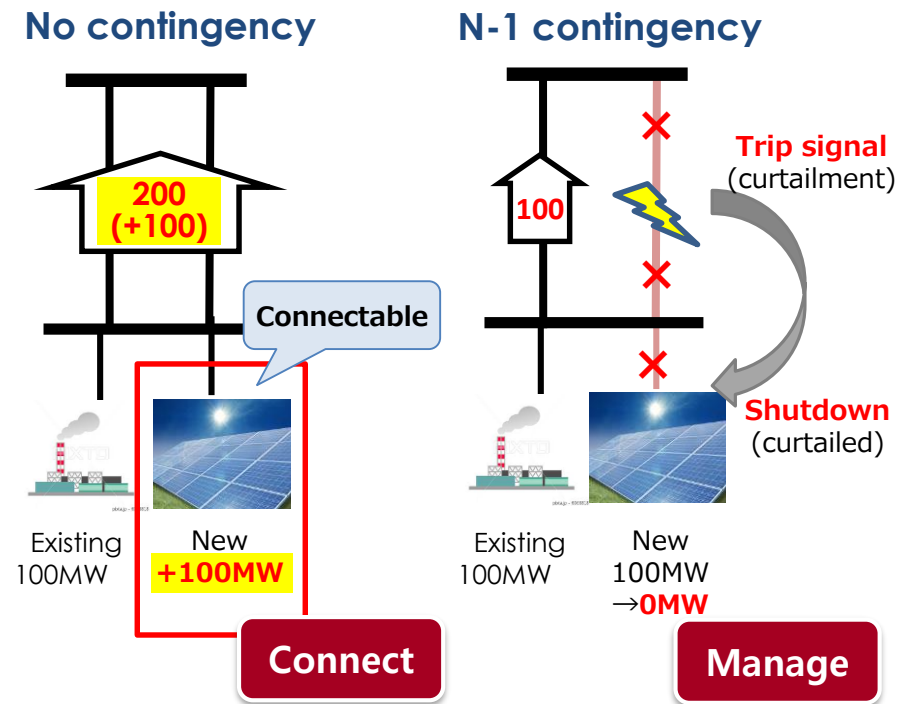
- With a view to maximizing the use of existing grids, current grid operation will be revised. EGC has now joined the detailed discussion to revise the grid operation in OCCTO.

## Before



## After

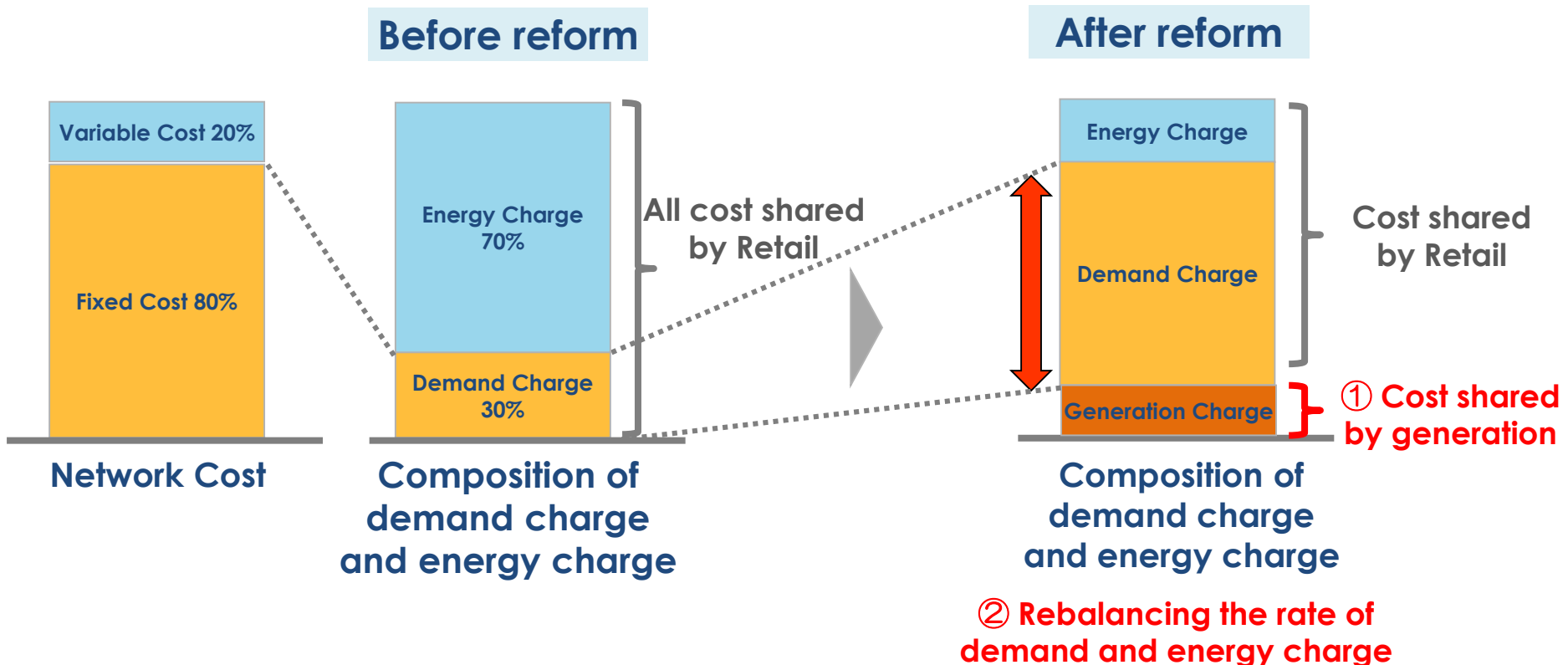
### N-1 Inter-trip scheme





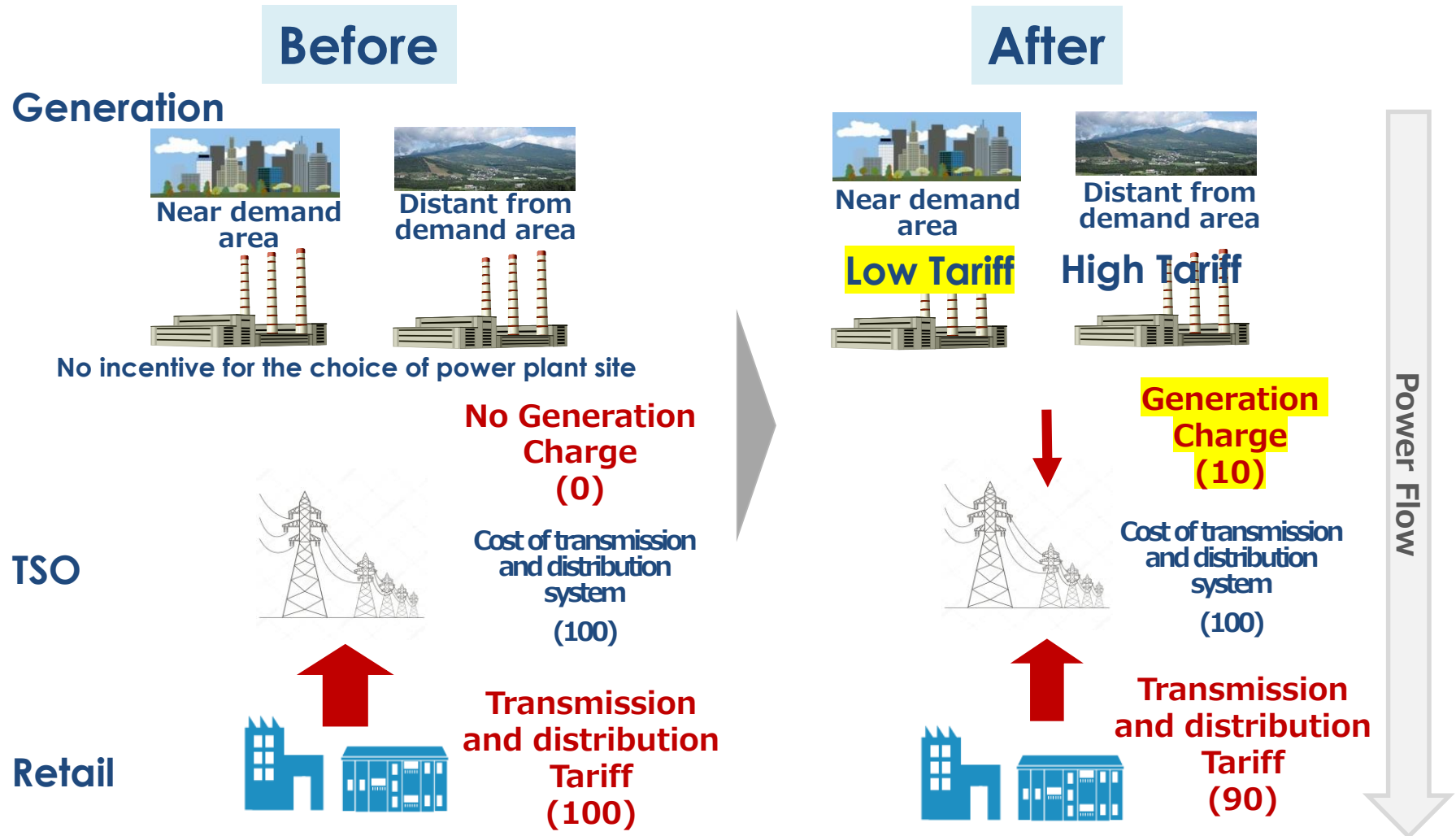
# Rebalance of Network Cost for Network Sustainability

- Through the mass connection of renewables, network costs are no longer sustainable when supported only by tariffs (demand-side).
- Based on the beneficiary-pays principle, rebalancing of the burdens (between demand-side and generation-side) is critical for the future network system.



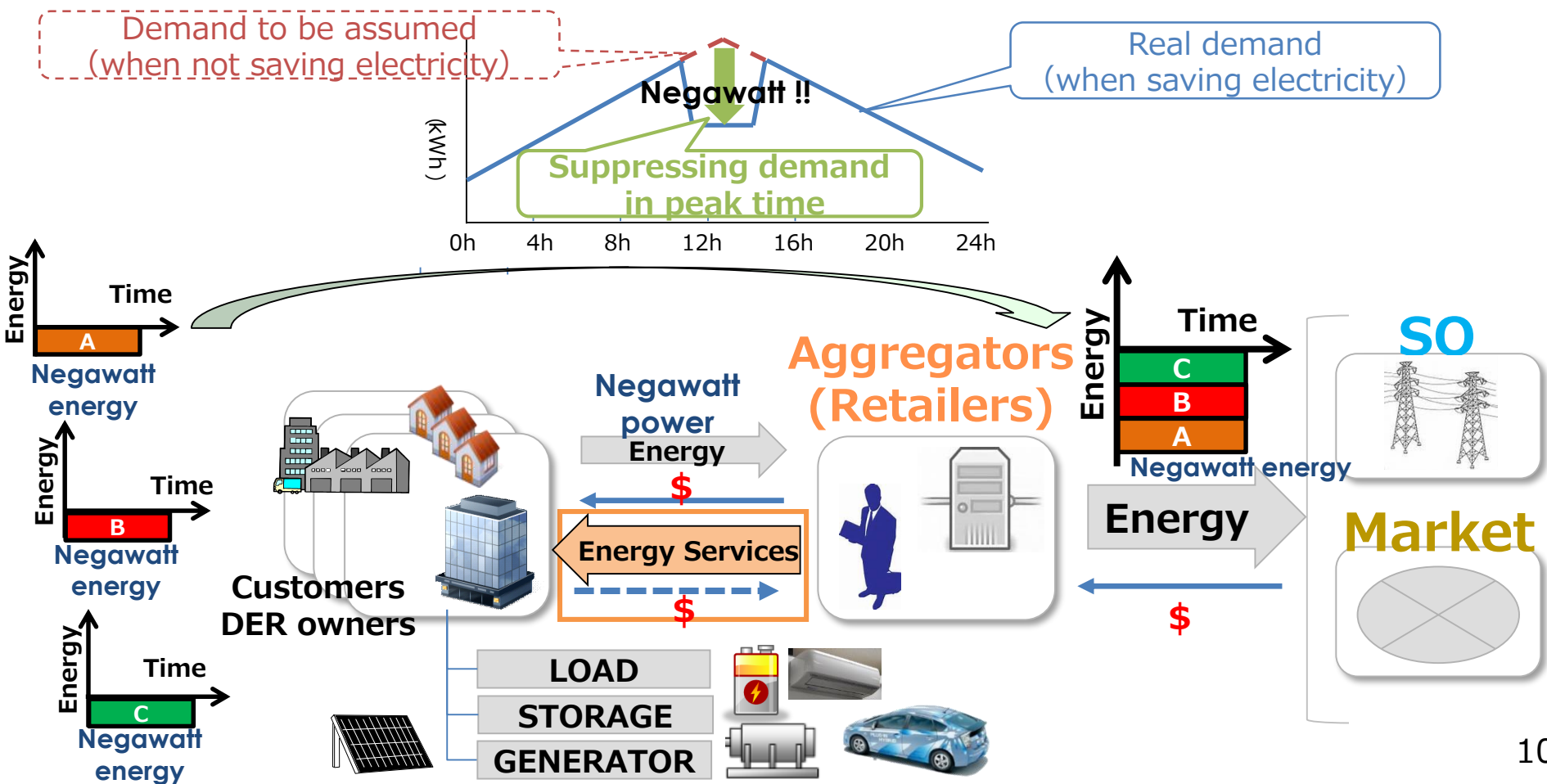
# Introduction of Generation Charges and Discount System

- To appropriately share costs between generation and demand, and to recover fixed costs properly, EGC proposed the introduction of generation charges and a discount system to incentivize better choice of generation site (June 2018).



# Aggregation Business (Demand Response, Virtual Power Plants)

- Aggregators reshape negawatts (energy savings) into products (electricity-bid), utilizing information communication technology (ICT).
- EGC jointly created guidelines with METI to promote a new business scheme, called "negawatt business" (in Proper Electric Power Trade Guideline).



# Design of balancing market

- EGC has joined the detailed discussion to start new energy balancing market.
- Through product specification (requirements), generators and demand response (DR) may compete equally within balancing market.

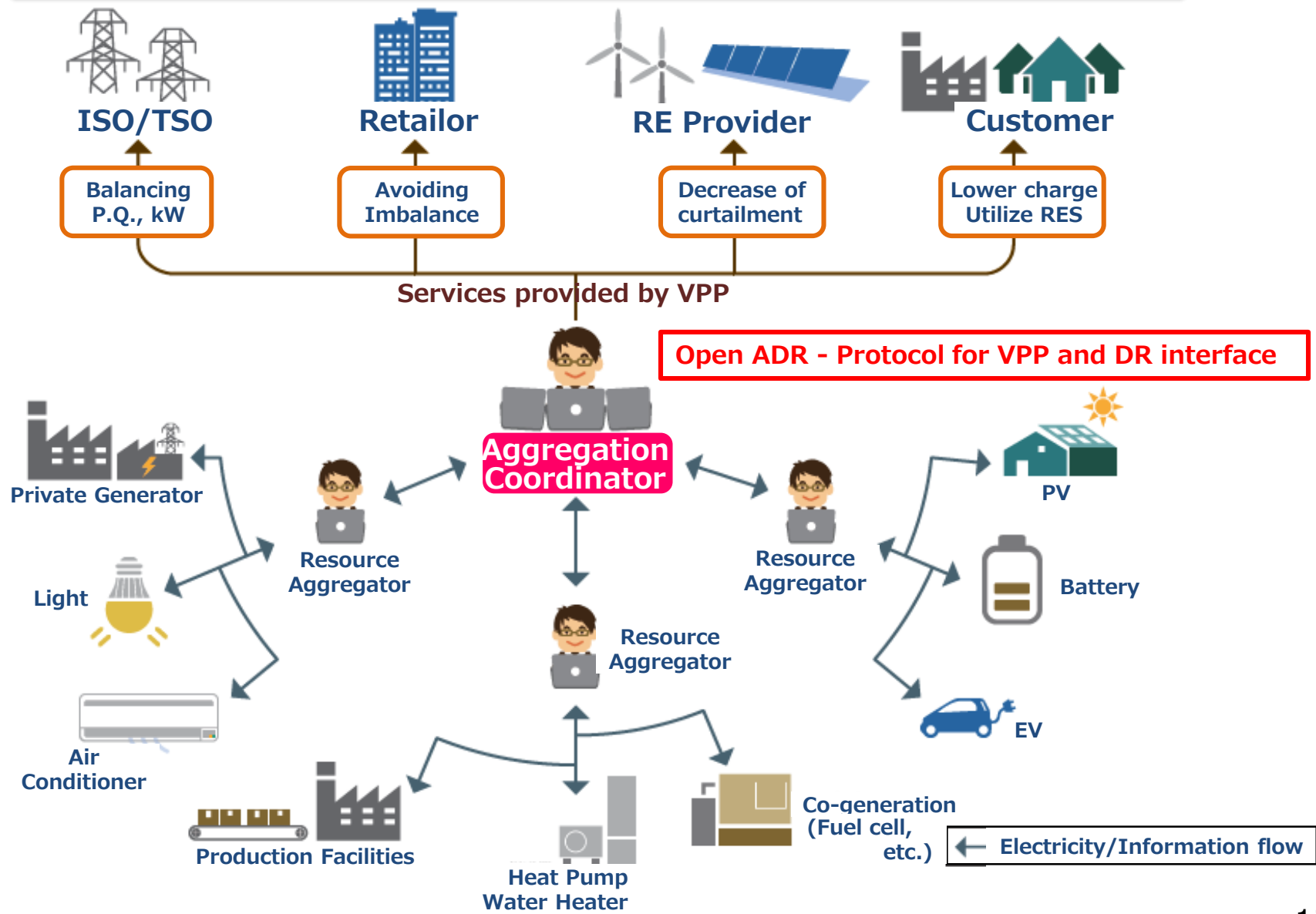
## Draft requirements in balancing market, as of September 2018

	Frequency Containment Reserve (FCR)	Synchronized Frequency Restoration Reserve (S-FRR)	Frequency Restoration Reserve (FRR)	Replacement Reserve (RR)	Replacement Reserve-for FIT (RR-FIT)
Opening of Markets	After 2021	After 2024	By 2024	By 2024	2021
Response time	Within 10 Sec.	Within 5 Min.	Within 5 Min.	15 Min.	45 Min.
Duration time	5 Min. or more	30 Min. or more	30 Min. or more	4 hours	4 hours
Minimum Capacity	5MW	5MW	5MW	5MW	1MW



# Demand-side Power/Information Flow by VPP

## VPP Scheme in business demonstration, FY 2017



# EGC's Future Challenges

