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Rolle der intelligenten Netze für PV und Solarthermie

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Ralf Christian
CEO Power Distribution Division,
Siemens AG, Energy Sector

Energy challenges – urge for more electricity and increasing grid loading from renewables

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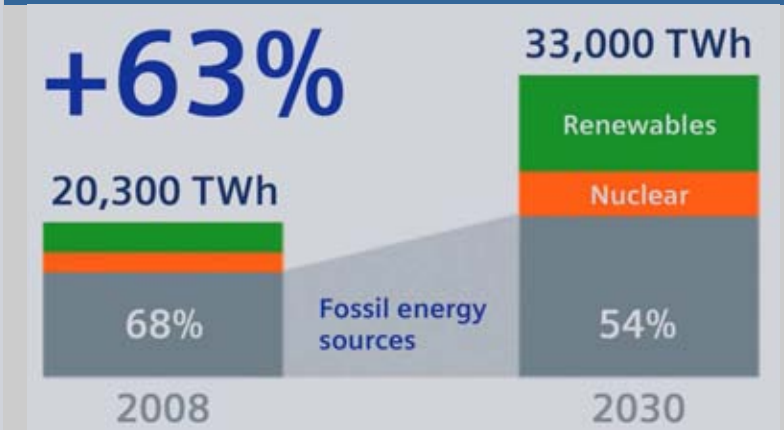
Growing demand



High share of renewables

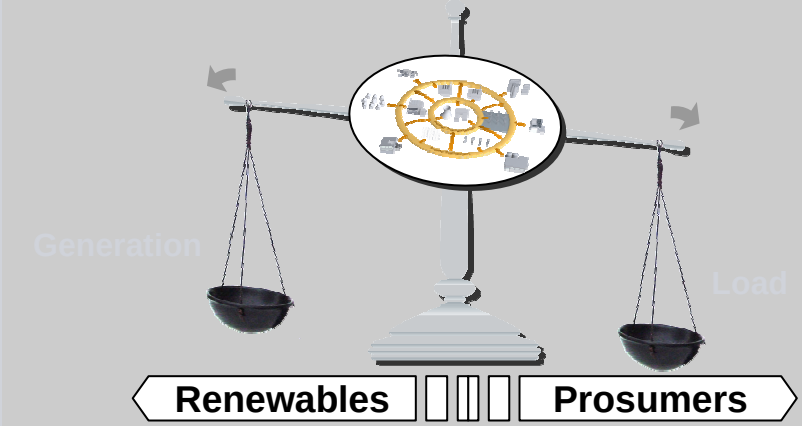
EU Agenda:

18% electricity from renewables

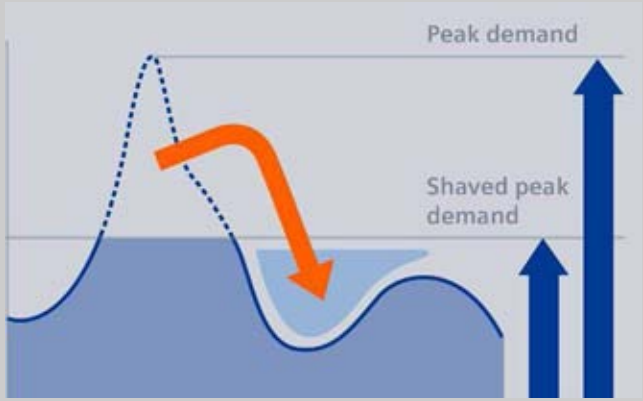
38% installed capacity of renewables

2020

Balancing



Peak load shifting



Germany: Growing share of renewable energies
Increasing problems to keep grid stability and power quality

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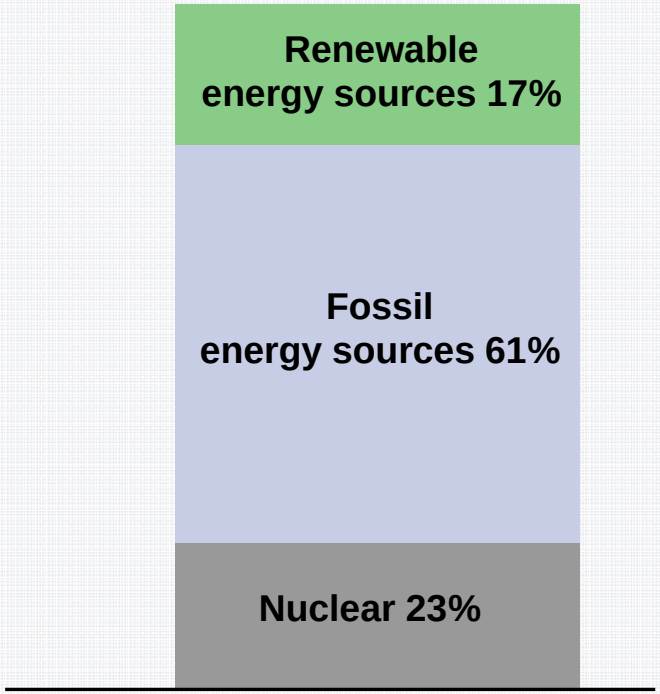
Power Generation in Germany
Energy mix in 2010 (621 TWh)



source: AG Energiebilanzen e.V.

Can we shut down all conventional power plants?

- **Number of photovoltaic systems in Germany (2010): ca. 860,000 (increase of 249,000)**
- **Installed PV capacity in Germany (end of 2009): 9.8 GW**
- **Installed PV capacity in Germany (end of 2010): 17.3 GW (increase of 7.5 GW)**
- **Installed Capacity (2009) ~ 96 GW: Typical in-feed from traditional power plants ~61 GW + renewable capacity > 46 GW**

Peak load: ~80 GW **Minimum load: ~32 GW**

source: Siemens AG

We will need conventional back-up power, and the power grid infrastructure must be improved and extended to handle the increasing in-feed of electricity from renewable sources.

To ensure a balanced, sustainable Energy System, we have to put more intelligence to "dumb" power grids

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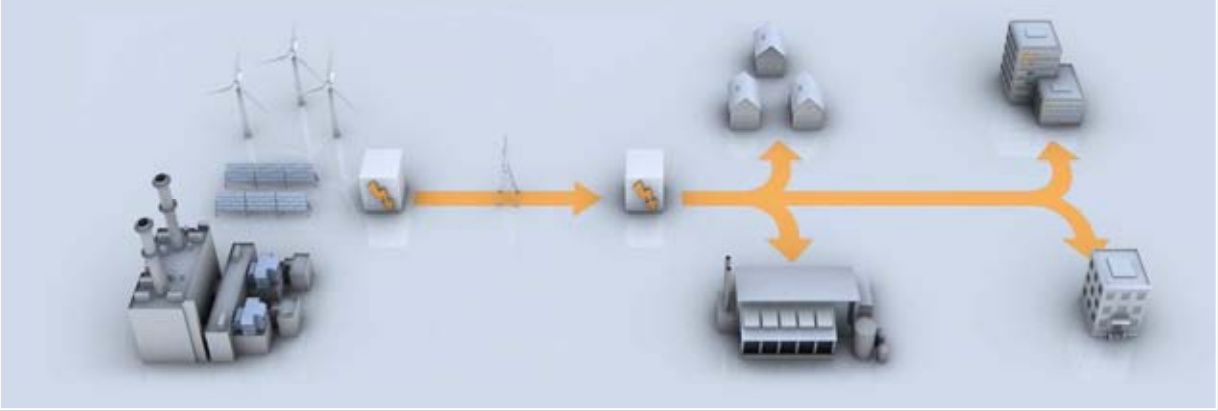
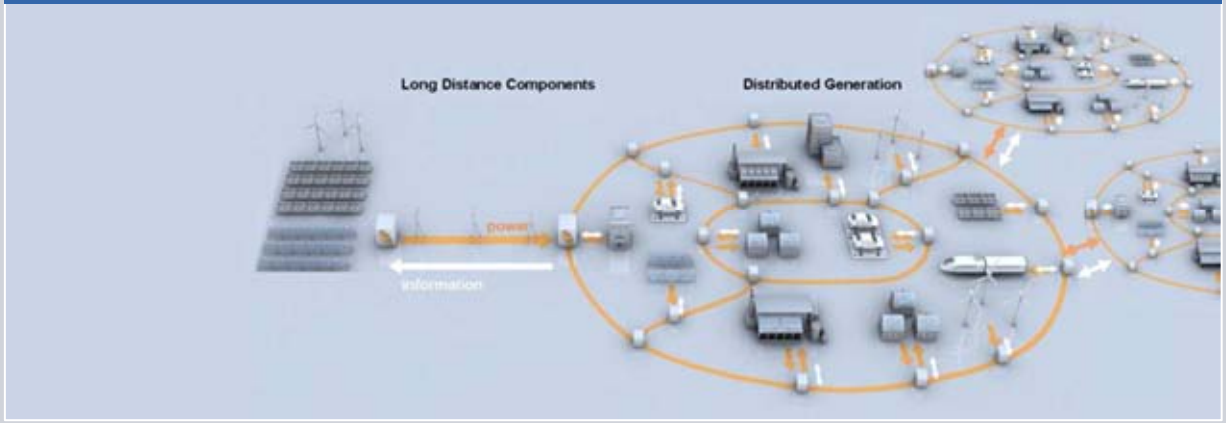
Today



- Centralized and large scale bulk power generation
- Generation follows load
- Unidirectional power flow
- Decades-old networking technology

Tomorrow



- Consumption follows generation (without loss of service quality)
- High transparency through smart sensors
- “Smart Grid” technology to control and balance distributed generation

New technologies enabling different Smart Grid approaches for transmission and distribution

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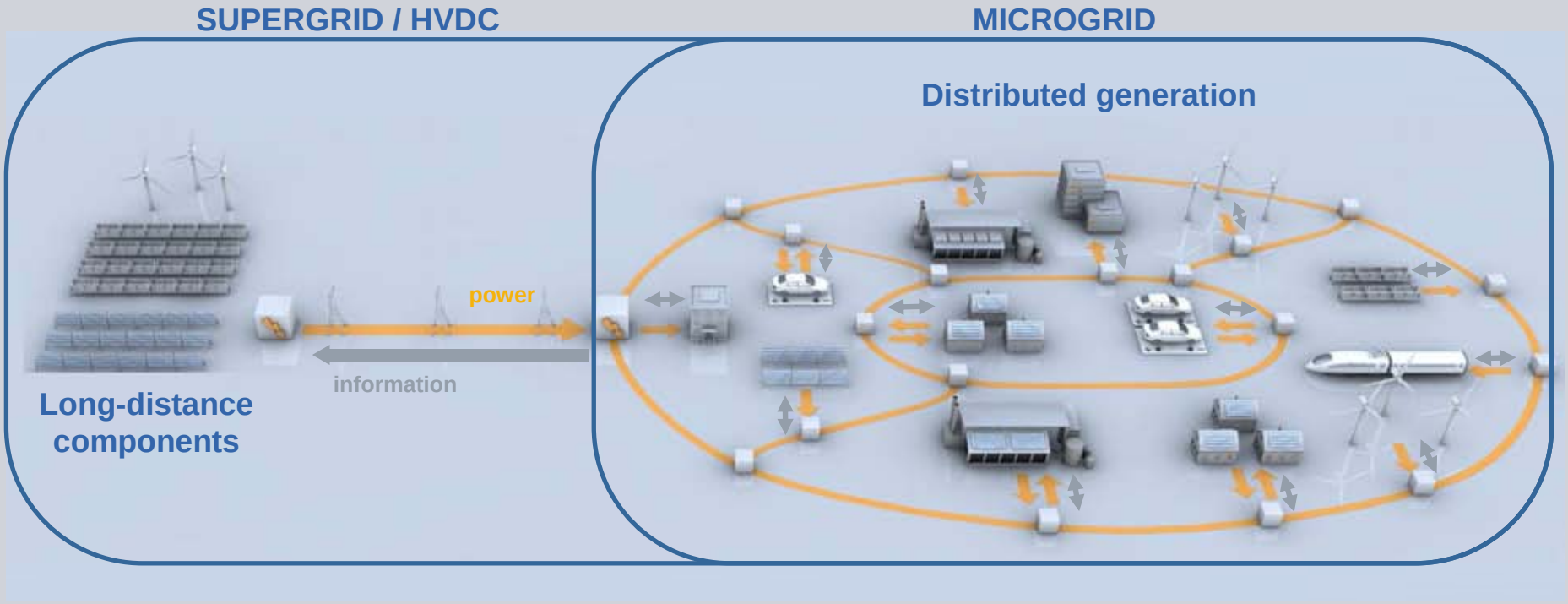

Smart Grid is an intelligent management of loads and generation through IT supported bi-directional communication and control

Need for building a new EU overlay grid regardless of future regional generation allocation & grid topology

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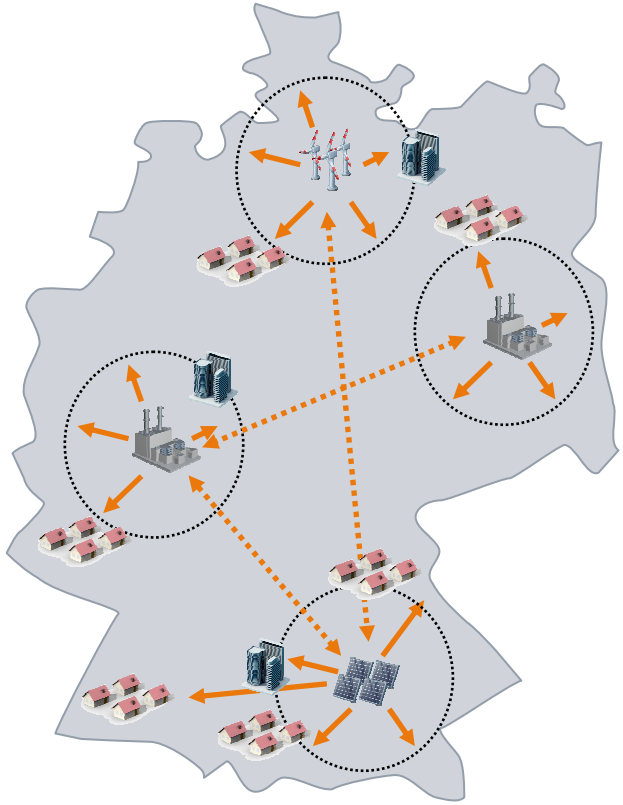
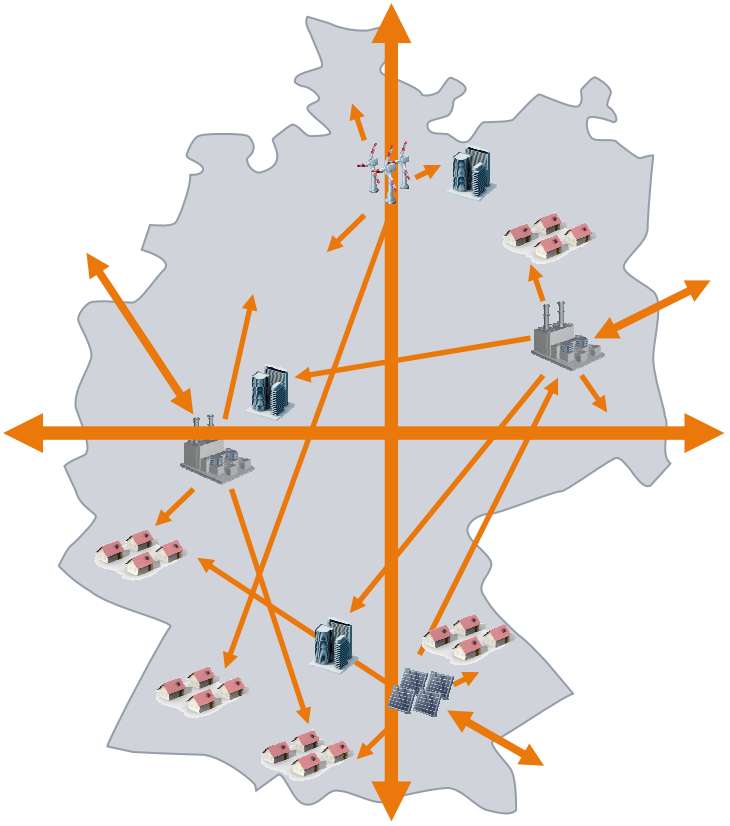
Today



Centralized generation with only few cross-regional transmission

Tomorrow



Mix of centralized and distributed generation with broad cross-regional/cross-national transmission

New European transmission overlay grid
Balancing regional renewable generation / consumption zones

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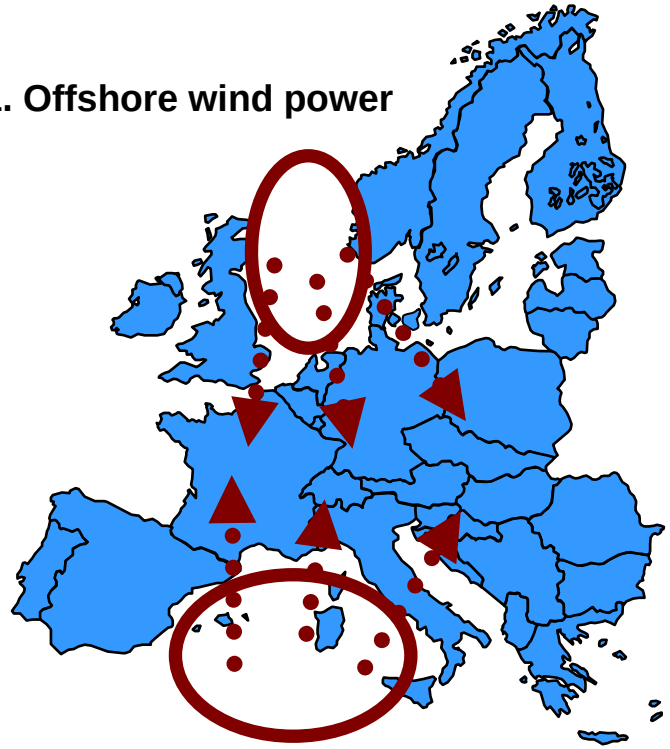
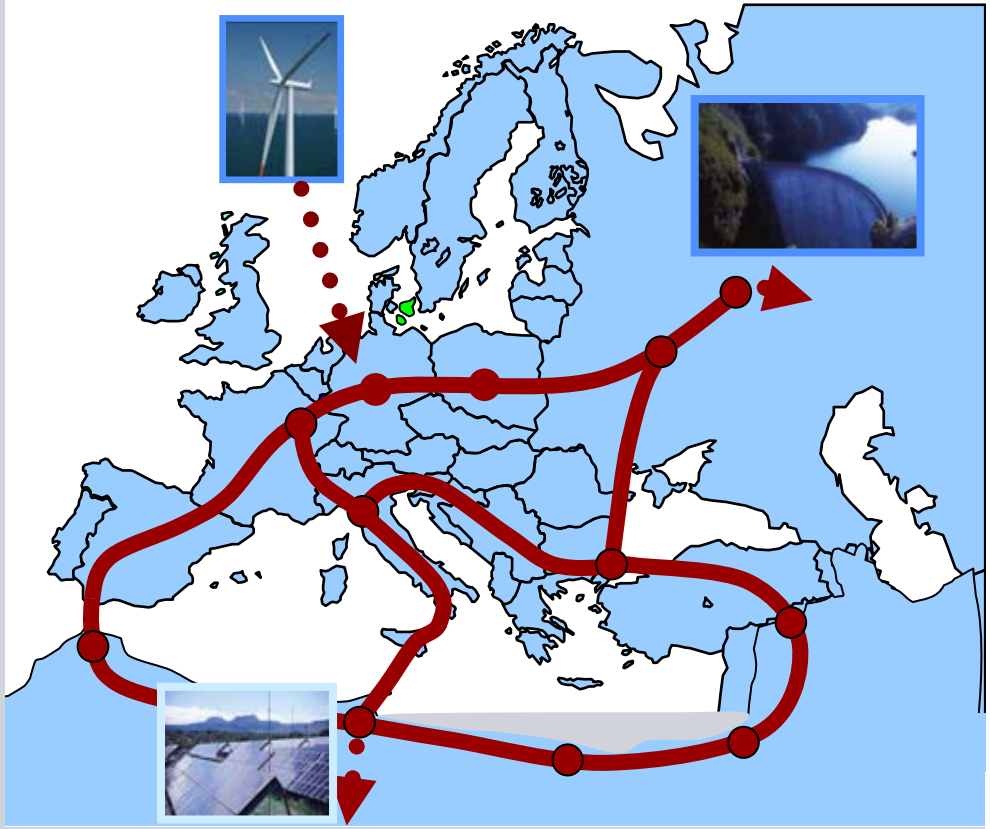
Connecting renewable & expanding to offshore grids



Including cross-borders power highways



Smart Overlay Grids – Integration of long-distance components through highly efficient power transmission

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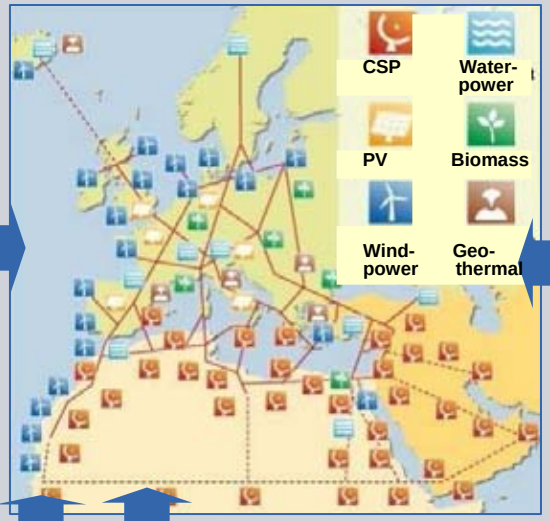
Desertec

Offshore wind farms – Photovoltaics



HVDC power transmission lines

Onshore wind power

Concentrated Solar Power plant

Solar field

Receiver

Power block

Steam turbines

Growth of bulk renewable is calling for transmission grid intelligence improvement ....

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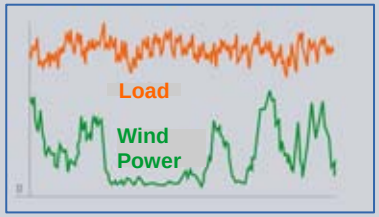
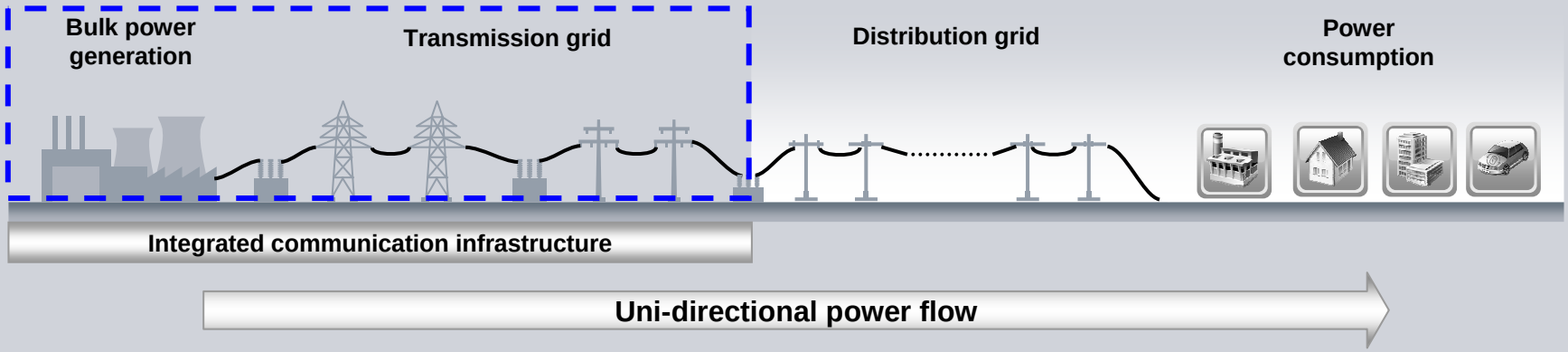
Large-scale renewables:

- Wind power plants
- Solar power plants





Enhancing Smart Transmission:

- Balancing large power in-feed
- Supporting electricity trading
- Wide area monitoring

... increasing challenges from variable loading are extending to the distribution grid ....

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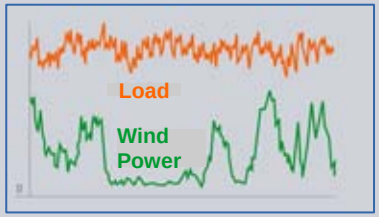
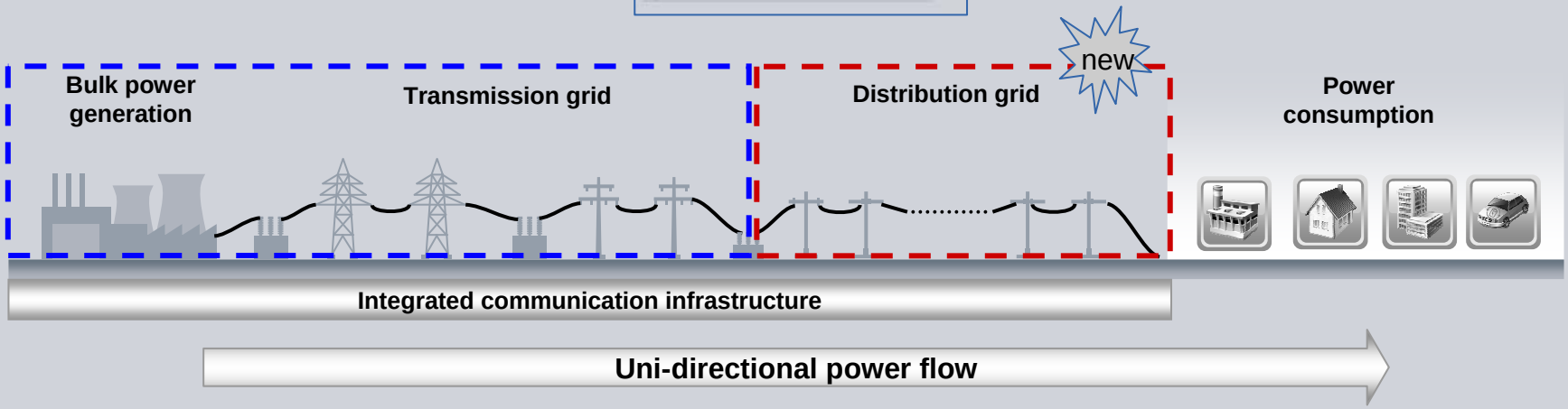
Large-scale renewables:

- Wind power plants
- Solar power plants





Enhancing Smart Transmission:

- Balancing large power in-feed
- Supporting electricity trading
- Wide area monitoring

Extending into Smart Distribution:

- Remote operation
- Intensified surveillance
- Self-healing grids

... and integration of DER becomes a further complex challenge to overall grid operation and control

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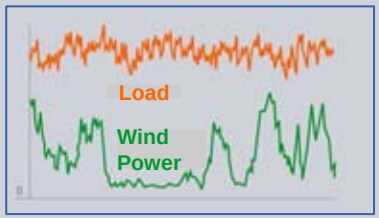
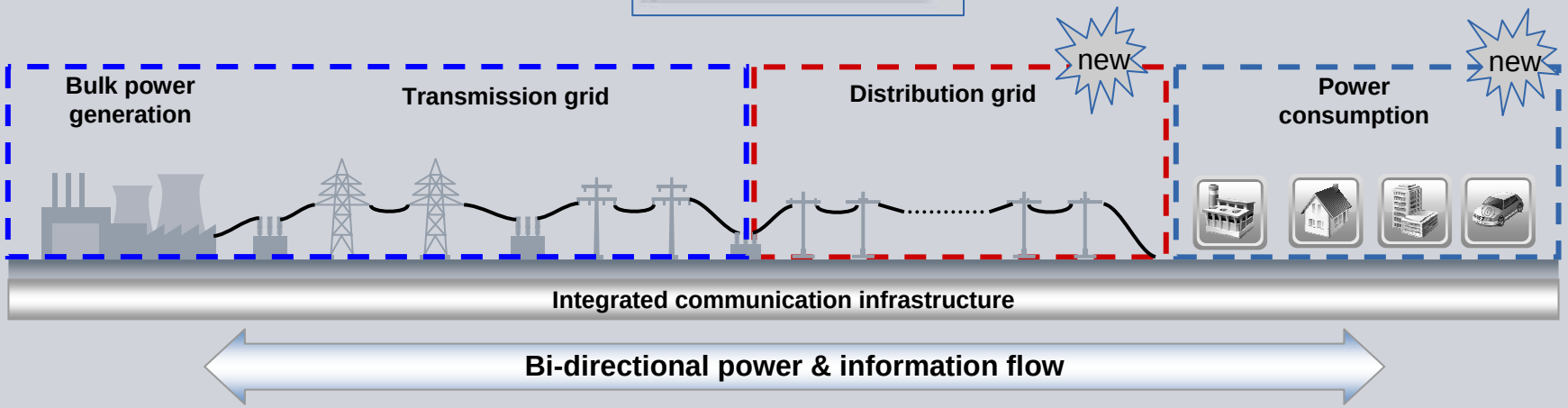
Large-scale renewables:

- Wind power plants
- Solar power plants



Decentralized generation:

- Thousands of small renewable
- E-cars and storage



Enhancing Smart Transmission:

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Extending into Smart Distribution:

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Integration of load side consumption & generation:

- Integrating active loads
- Providing new services
- Demand response

Smart Grid Applications are the enablers to meet the new requirements

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Smart Grid Applications

Smart Generation, Transmission & Distribution

Hardware & Software for intelligent automation of grids & generation

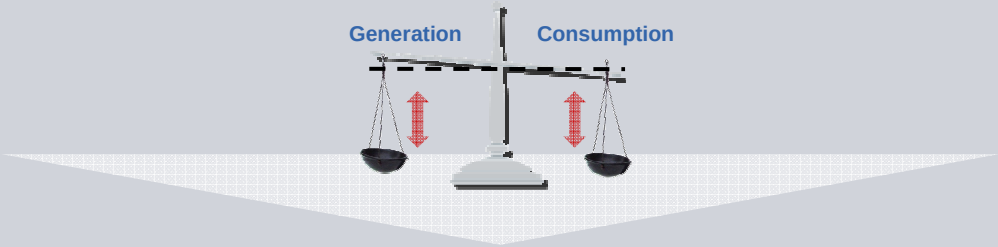
e.g.
Substation Automation

- **Demand Response**
- **Microgrids**
- **Smart Metering**
- **Smart Charging**

Smart Consumption

Hardware & Software for intelligent automation of consumption

e.g.
Building Energy Management, eCars



…to help consumers and businesses to balance intelligently between generation and consumption!

Application example Microgrid Solution: Grid autonomy with integration of renewables

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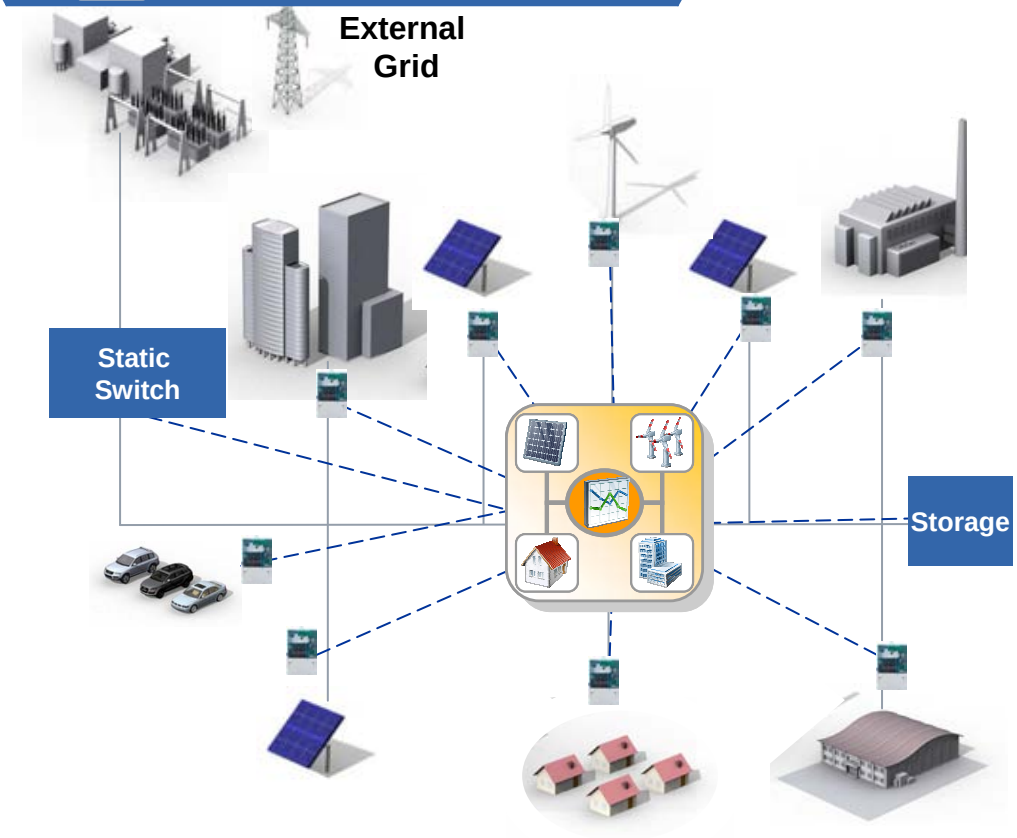
Microgrids



Microgrid monitoring & control components (e.g. Intelligent End Devices, Gateways, Inverters)

Microgrid

- **Integrated energy systems** consisting of distributed generation & multiple load resources which **operate as a single autonomous grid**
- **Siemens Solution:** **Central control systems**, intelligent end devices, communication systems and power infrastructure

Decentralized grid structures

Application example Smart Metering: Enables consumption transparency for energy suppliers

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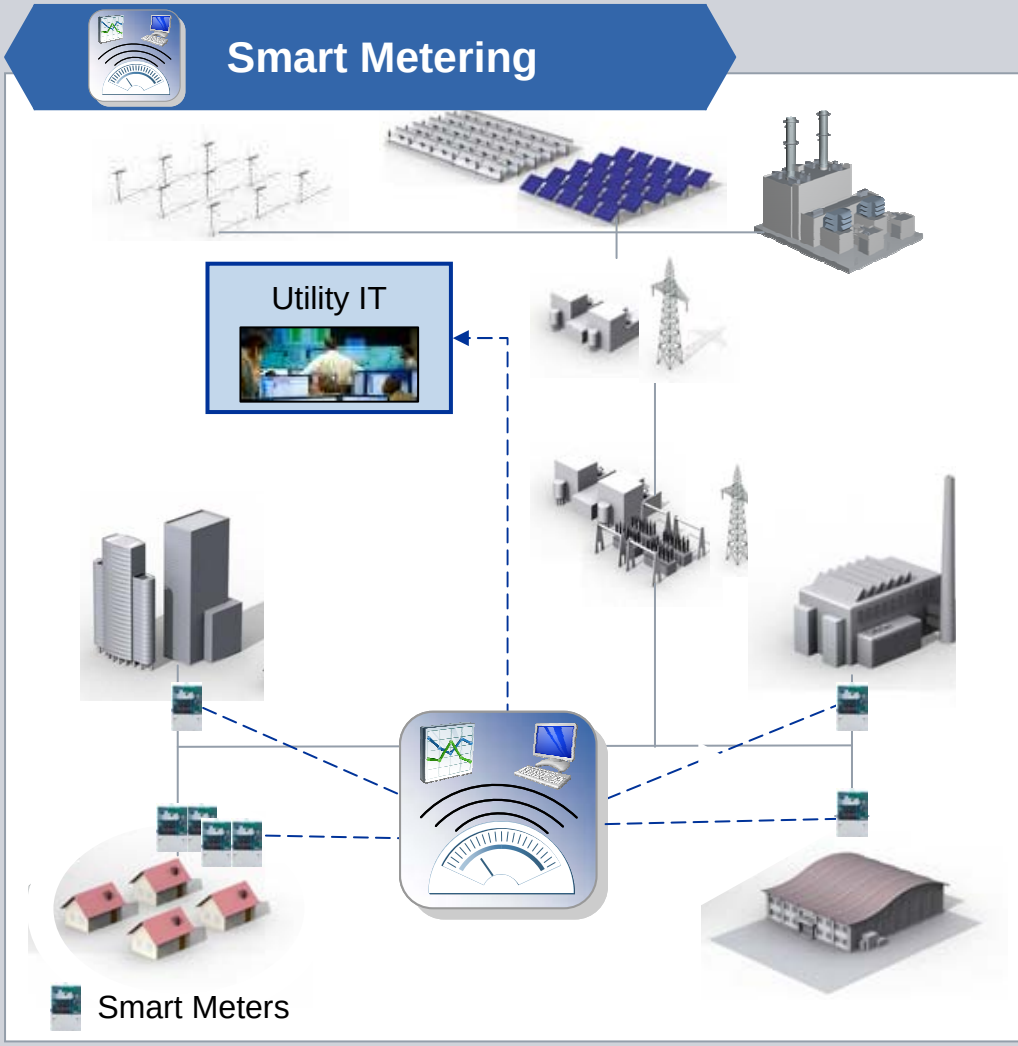

Smart Metering

- **Integrated and automated monitoring systems** for real-time consumption transparency
- **Siemens Offering:** **meter data management (Energy IP)**, communication networks, smart meters & utility IT system integration

Real-time data transparency

Application example Smart Charging: Central application to enable holistic solutions

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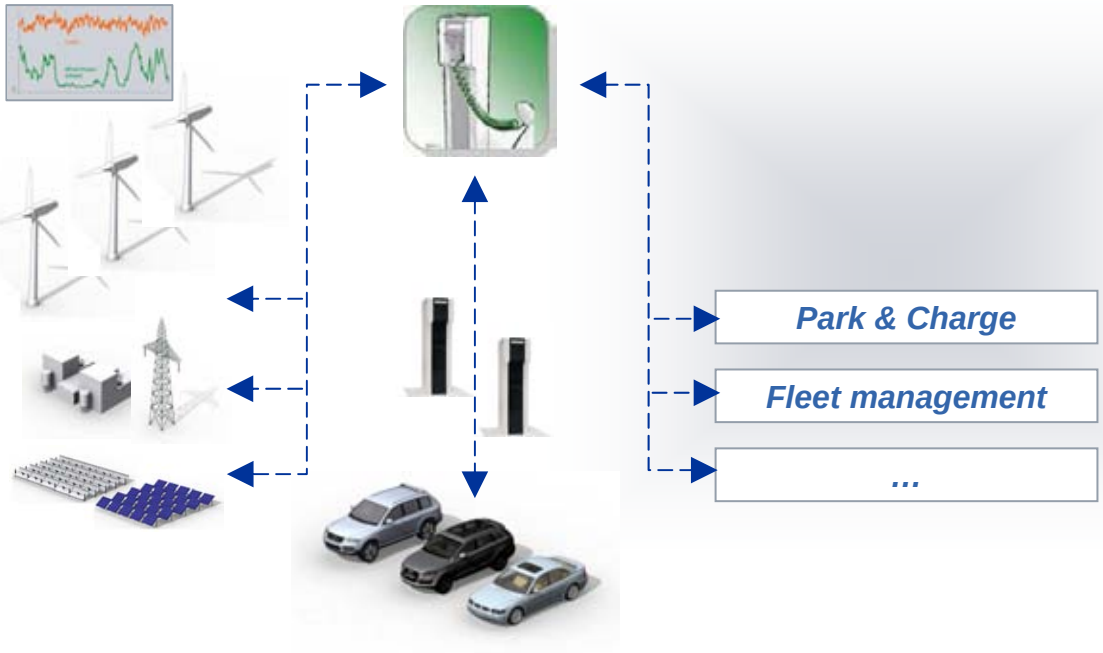
Smart Charging



Integration into Smart Grid

eCar Infrastructure & Components

Integration into Mobility Infrastructure

Charging infrastructure and **Smart Charging application** allow **bi-directional power flow** and the **intelligent integration** of eCars…

… into the **smart grid**

… into **mobility infrastructure** and **mobility concepts**

Developing the power grid for Solar Generation

1	**Challenges**	In-feed from renewable bulk power and decentralized generation ▪ Variable generation: forecast & dispatch optimization needs ▪ Bi-directional power flow through load side in-feed ▪ Economic optimization of generation & grid (studies to be developed)
2	**Overlay Grid**	▪ Need for an additional transmission overlay grid for long distance power exchange ▪ Urgent request: intensifying investments for grid expansion
3	**Smart Grid**	Very complex requests to maintain security of supply & power quality ▪ Need for more intelligence enhancing grid operation and grid observability ▪ Integration of independent small grid segments into the overall network
4	**Outlook**	Innovative grid technologies to be applied and further developed ▪ HVDC technologies for long distance transmission ▪ Virtual power plants, Microgrids, Smart Metering ▪ Storage technologies including electromobility

To optimize the energy system in all, grid development as well as the choice of future power generation sites have to be taken into account within a holistic approach.

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Thank you for your attention!