Role of ICT for future power grids

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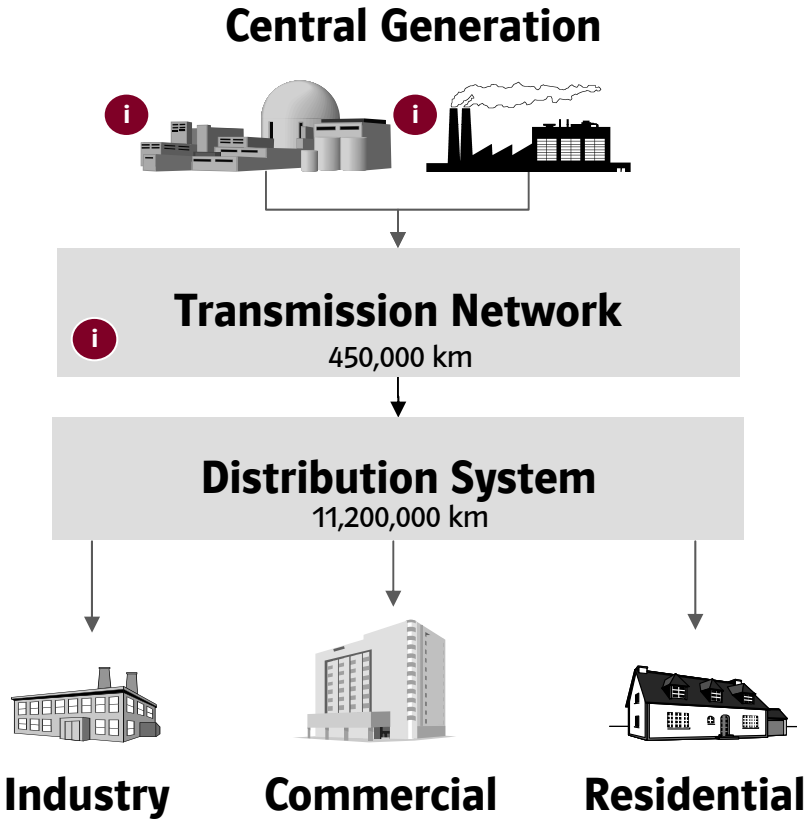
The current energy system is characterized by centralized supply meeting fluctuating demand



Supply and demand balancing takes place between central generation and transport grid

Generation output following demand

Unidirectional flows of energy, system stability managed by transmission system operator

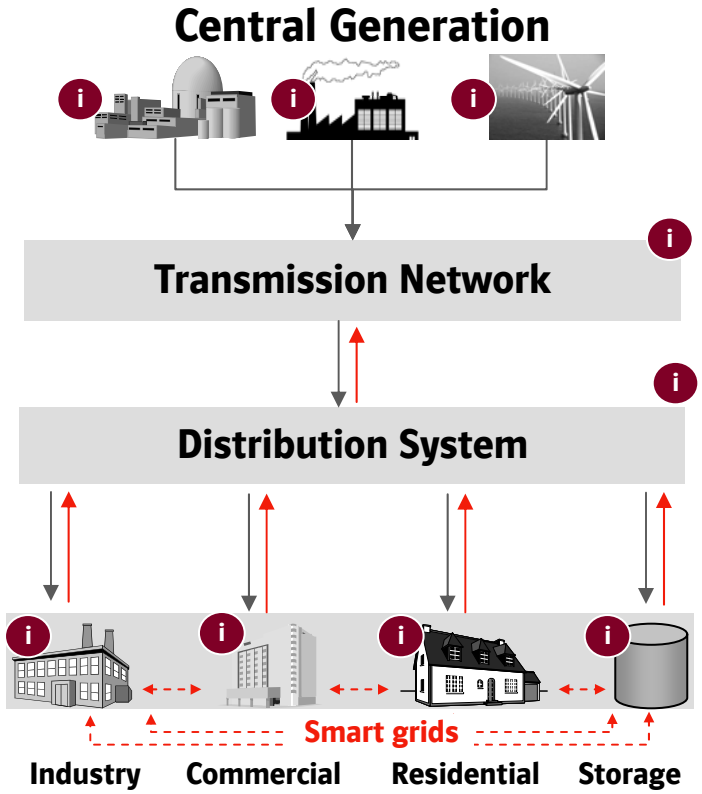
Consumers buy products in bulk tariffs

Information technology at the level of central generation and transport network

A number of societal, political and technical trends supported new technologies which imply change for the system

Drivers	Result	System Impact
Renewables policy • Energy independence • CO_2 reduction	Large loads of PV and wind connected to distribution grids	1 Smaller and more volatile residual demand or Smaller and flat residual demand
Information technology • Affordable systems • Internet as a large scale decentralized system	OEM's / IT companies market smart grids DSM easy to implement	2 Increasing complexity in distribution grids including 2-way flow
Society • Self sufficient life styles • Distrust of large organizations • Rising fuel prices	Development of decentralized generation technology, supported by subsidies Rollout of smart meters	3 Possibility for end users to directly interact in power markets

The future system could be characterized by centralized & decentralized supply meeting more stable demand



Information technology at all levels is the central link of the energy system forming the smart grid

'Must-run' renewables creates load fluctuation which need to be balanced

"Active distribution grids" with two-way flows of energy and information

Larger share of distributed generation connected to the distribution grid

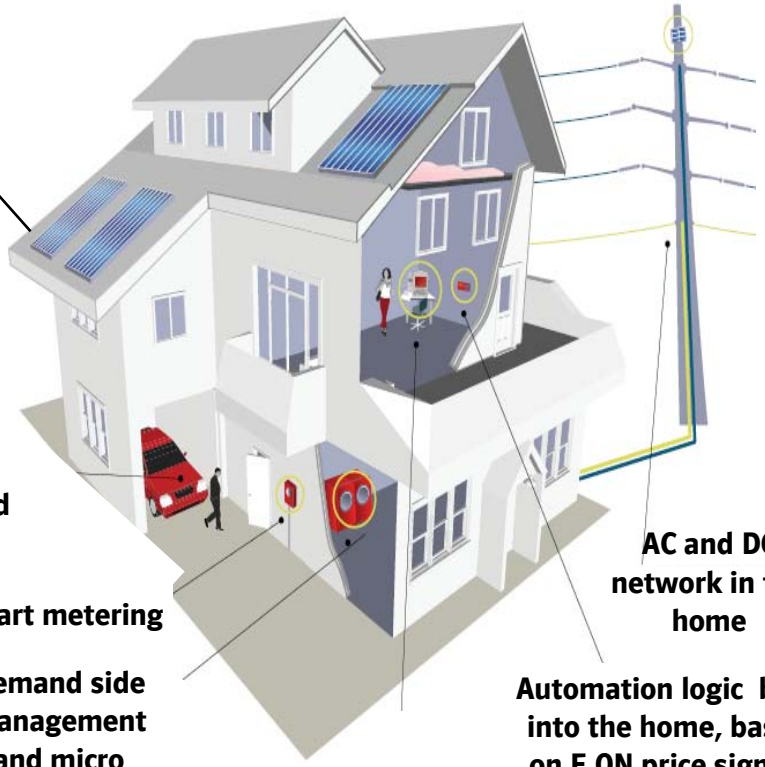
Decentralized 'must-run' generation creates load fluctuation which need to be balanced

Supply and demand balancing takes place between customers and DSO

Microgrids, Electricity storage, Demand-Side-Management & "Prosumers"[1]

1. Prosumers: Hybrid of producers & consumers

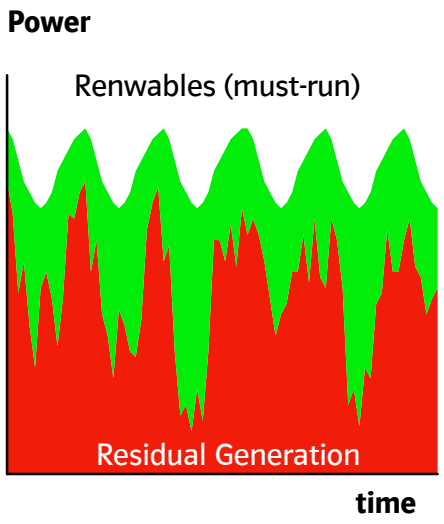
Localized technologies could change the role of customers and also open the way for distributed generation



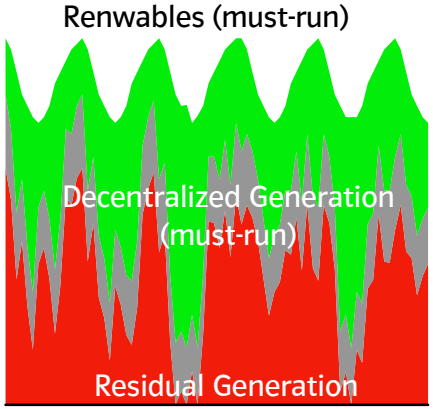
Distribution company	Control of the local grid and home for balancing purposes
Retail company	Smart products and services for the consumer
Pricing / EEX	Price signals to the home for automation and cost saving
New entrance	IT company providing hardware and data services / new energy interface to the customer?

Deployment of DSM[1] & storage would reduce peak running hours, and decentralized generation reduces residual share

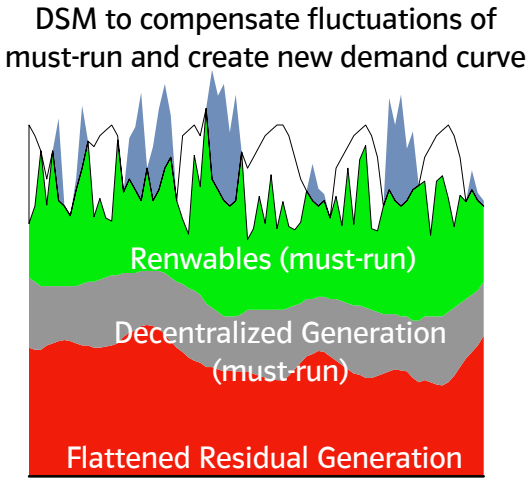
No significant DSM and decentralized generation



Significant decentralized generation



Significant decentralized generation and DSM



1. DSM Demand side management

There are a number of potential barriers preventing this future system from being realized

Technical Restraints

- Smart meters must be rolled out across all of Europe by 2030. Circa 345 m meters are required
- Decentralized technologies like mCHP with fuel cells need to be commercially rolled out. Most viable in regions with high emissions from the power sector and high heating demand (UK, D, Blx, ...)
- "Smart" processes, systems and interfaces need to be created in line with IP protocols
- E-heating, freezer, mCHP need standard interfaces to Smart Meters. Changing the entire portfolio of appliances needs years

Economics

- Significant cost reductions of technologies need to be achieved by mass production e.g.:
  - mCHP needs to reduce purchase costs to be competitive
  - PV, … need to reduce purchase costs to be competitive
- Funding for smart grids needs to be accepted by the regulator

Thank you for your attention