System-level benefits of using DER in operating future power systems

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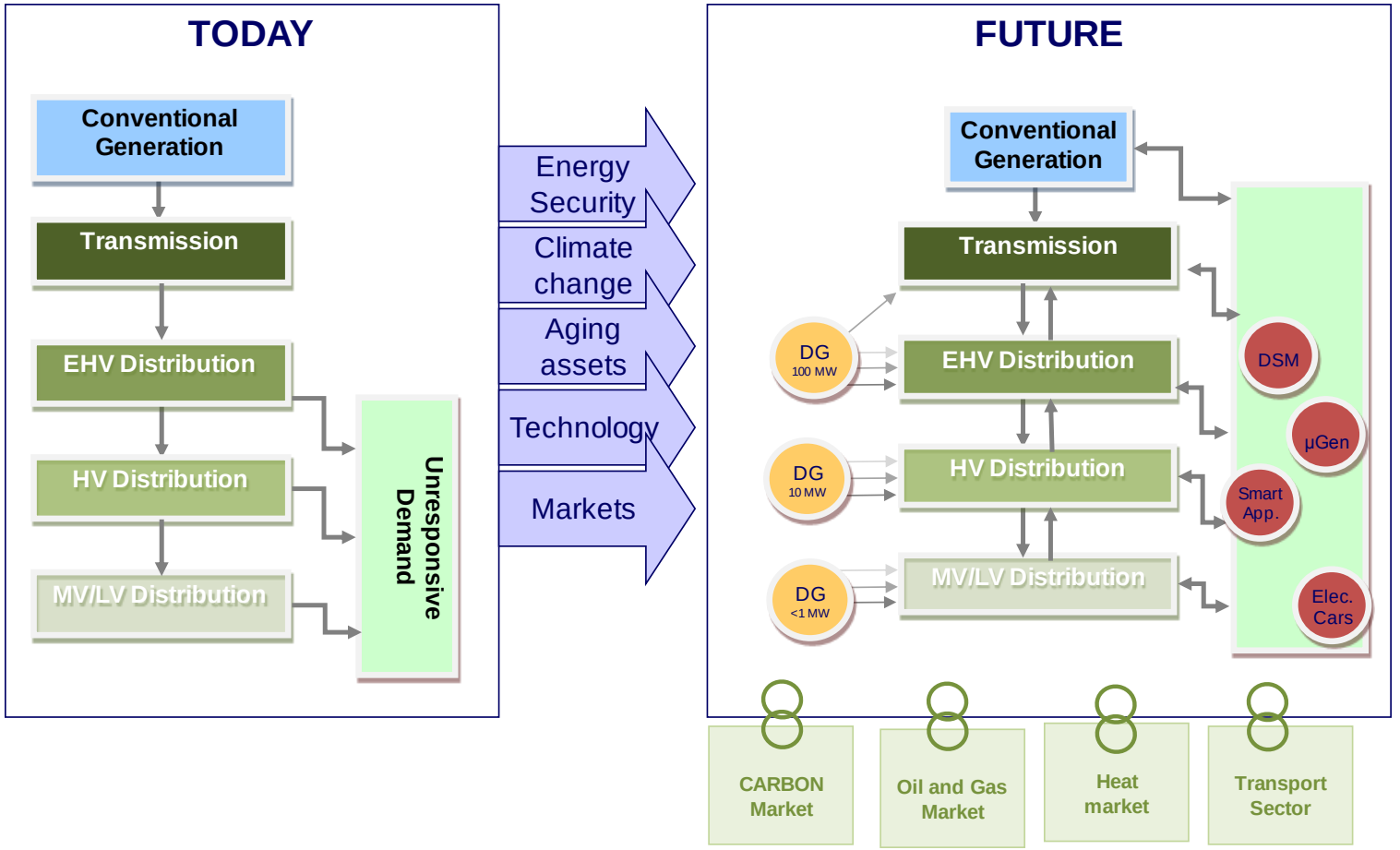
Electricity system in transition



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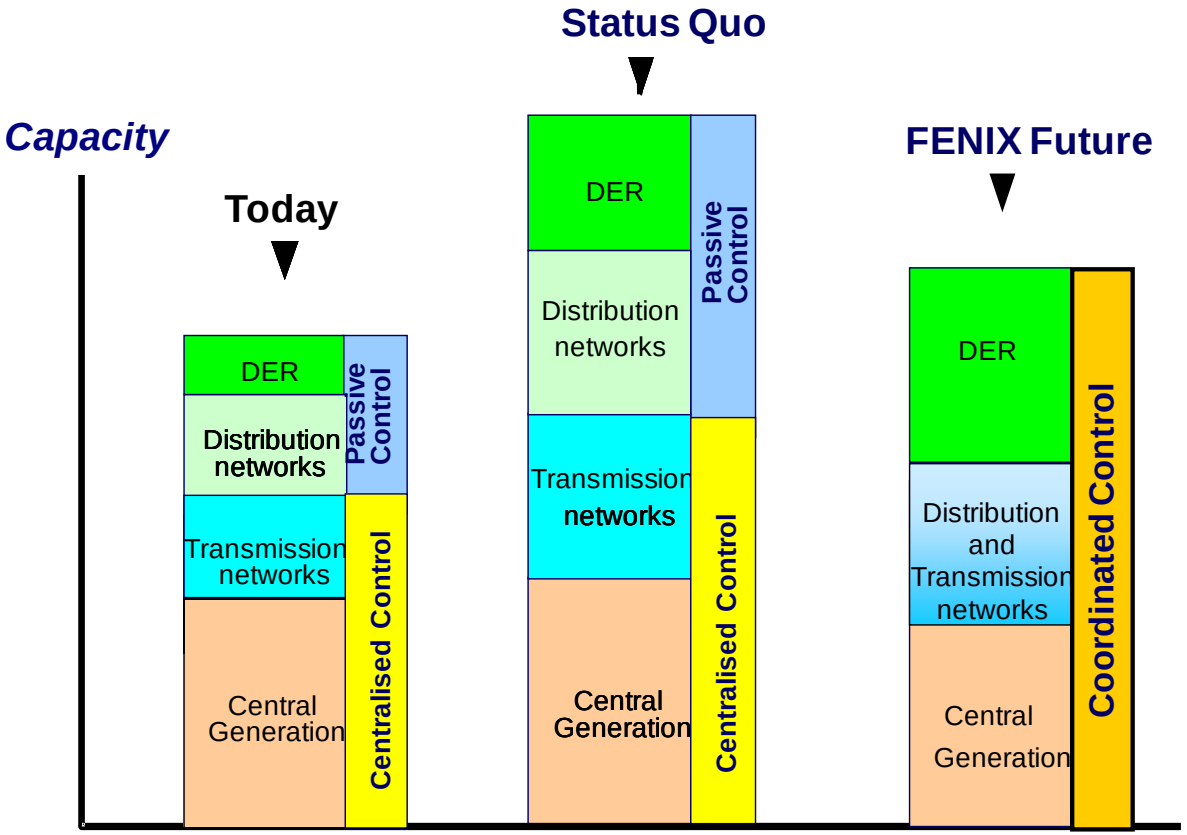
Can we afford BaU approach to network operation and development?

- Business as Usual
  - Flexibility achieved through investment in primary infrastructure
- “FENIX Future”
  - Flexibility achieved through more sophisticated operation and control (making the infrastructure intelligent)

What are the benefits of DER?

Cost effectiveness of high DER penetrations

- What are the barriers?
- Are there technical limits?
- Key challenge is cost effectiveness:
  - Potentially very low utilisation of generating plant and networks in BaU scenario



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Key statistics of a typical EU electricity system

- Generation capacity utilisation: 55% (capacity margin 20%)
- Efficiency: CCGT ~60%, coal 35% (CHP 80%)
- Network peak capacity utilisation 20-50%
- Distribution networks contribute more than 90% of interruptions;
- Losses in transmission ~2%, distribution ~5-8%

Challenges of integrating renewable generation and DER (1)

- Generation capacity adequacy
  - How “reliable” are renewable and DER as a source?
  - How much conventional plant can be displaced by renewables and DER?

- Real time system balancing
  - What are the needs for flexibility and reserve?
  - Can fluctuations in generation be absorbed?
  - What are the opportunities for demand side participation and interconnections?

Challenges of integrating renewable generation and DER (2)

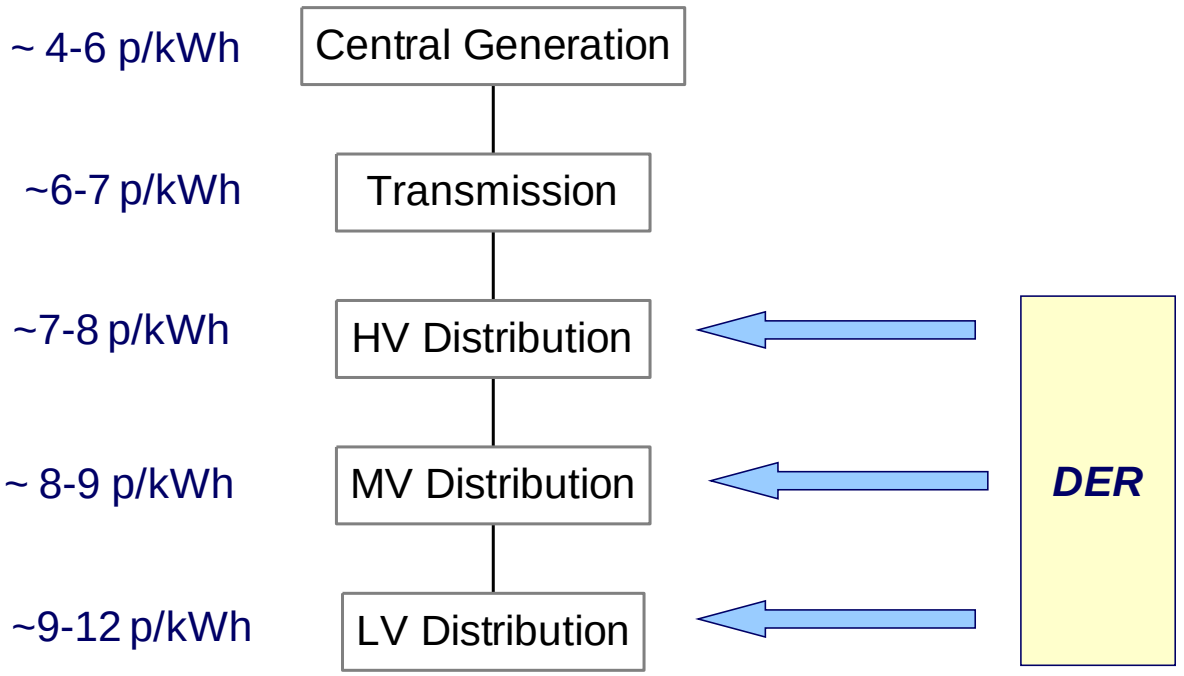
- Network requirements
  - How much network capacity is required to efficiently transport renewable power?
- System stability
  - What is the stability performance of the new system?
- Technical, commercial and regulatory framework
  - Are the technical standards and codes appropriate?
  - Does the market reward flexibility and security adequately?
  - Does the transmission access facilitate sharing of capacity?

Challenges of integrating renewable generation and DER (3)

- Demand participation
  - What is the potential of concepts such as Smart appliances, Smart homes, and Plug-in hybrids and Electric Vehicles?

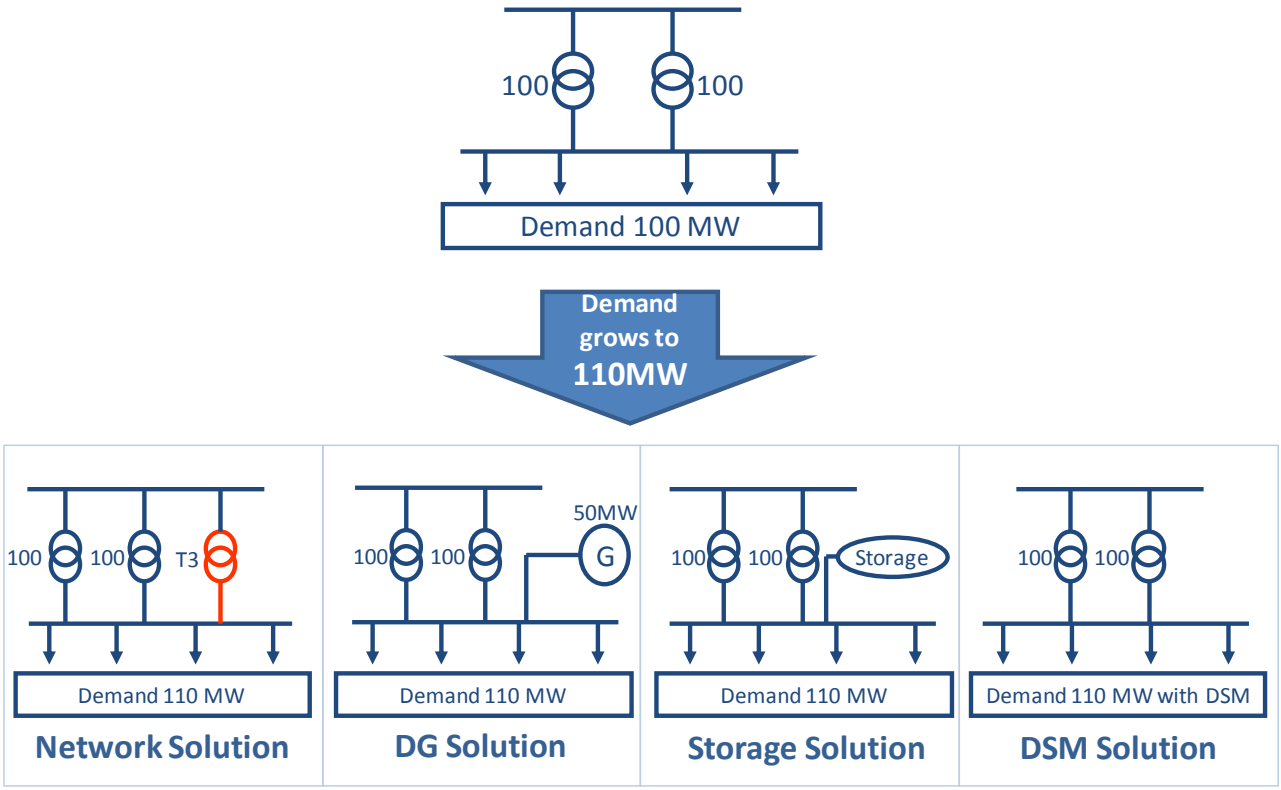
- System operation
  - Is there a need for new planning and operational practices, and decision support tools?
  - How will centralised and distributed control coexist?
  - How will the increased complexity of operation and the associated risks be handled?

Facilitating competition in generation, networks and enabling technologies



Does the commercial and regulatory framework reflect and reward location & time of use?

Network vs. non-network resolution of network security problems



Does the market allow for the most cost-effective solution to be chosen?

Present market design barriers for stronger DER participation (“fit and forget”)

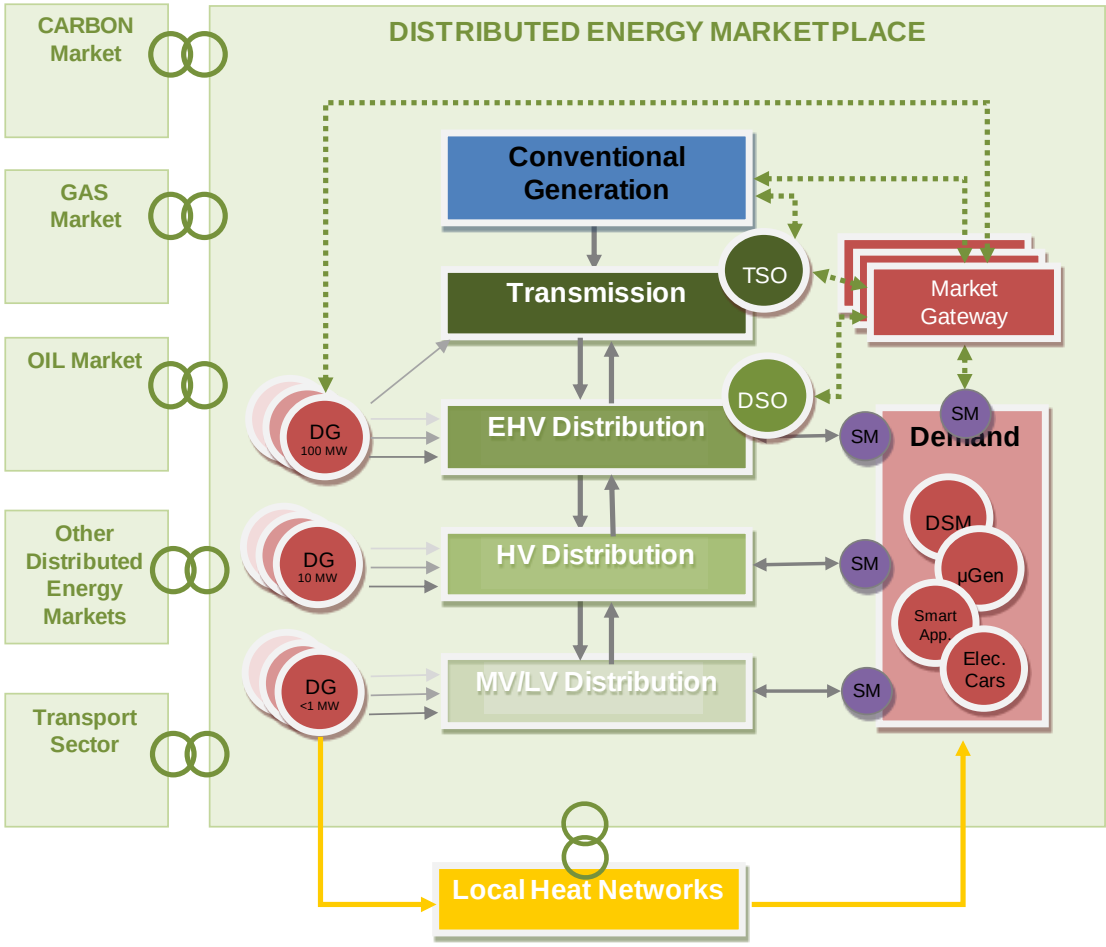
- DER unable to provide system support, no control or access to DER flexibility
- As DER connections grow, security of the system is compromised & operating costs increase
- Inefficiencies in infrastructure investments, DER displacing energy not capacity
- Disconnection between wholesale market (real time) and retail market (tariff based)
- Value of energy < Value of flexibility
- Lack of clear market signals to end-users – possibly resulting in suboptimal solutions

Future Electricity System

- Fundamental change in system operation philosophy
- Flexibility: reallocate control functions from generation to other sectors, demand and networks
- Enhance system control capability to release latent generation and network capacity
  - More sophisticated control and decision-making using advances in metering, communication, information and infrastructure
  - Enabling technologies: demand side, storage, FACTS
  - Competition between investing in infrastructure and investing in advanced control schemes

A Distributed Energy Marketplace

- Puts users at the centre of the development / evolution of the power system
- Identifies the value of end user response according to time and location (unlock demand)
- Provides System Operators with access to the most cost effective solutions for system management



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