Imperial College London

The Energy White Paper: An Academic Critique

Distributed Energy

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- Drivers for change
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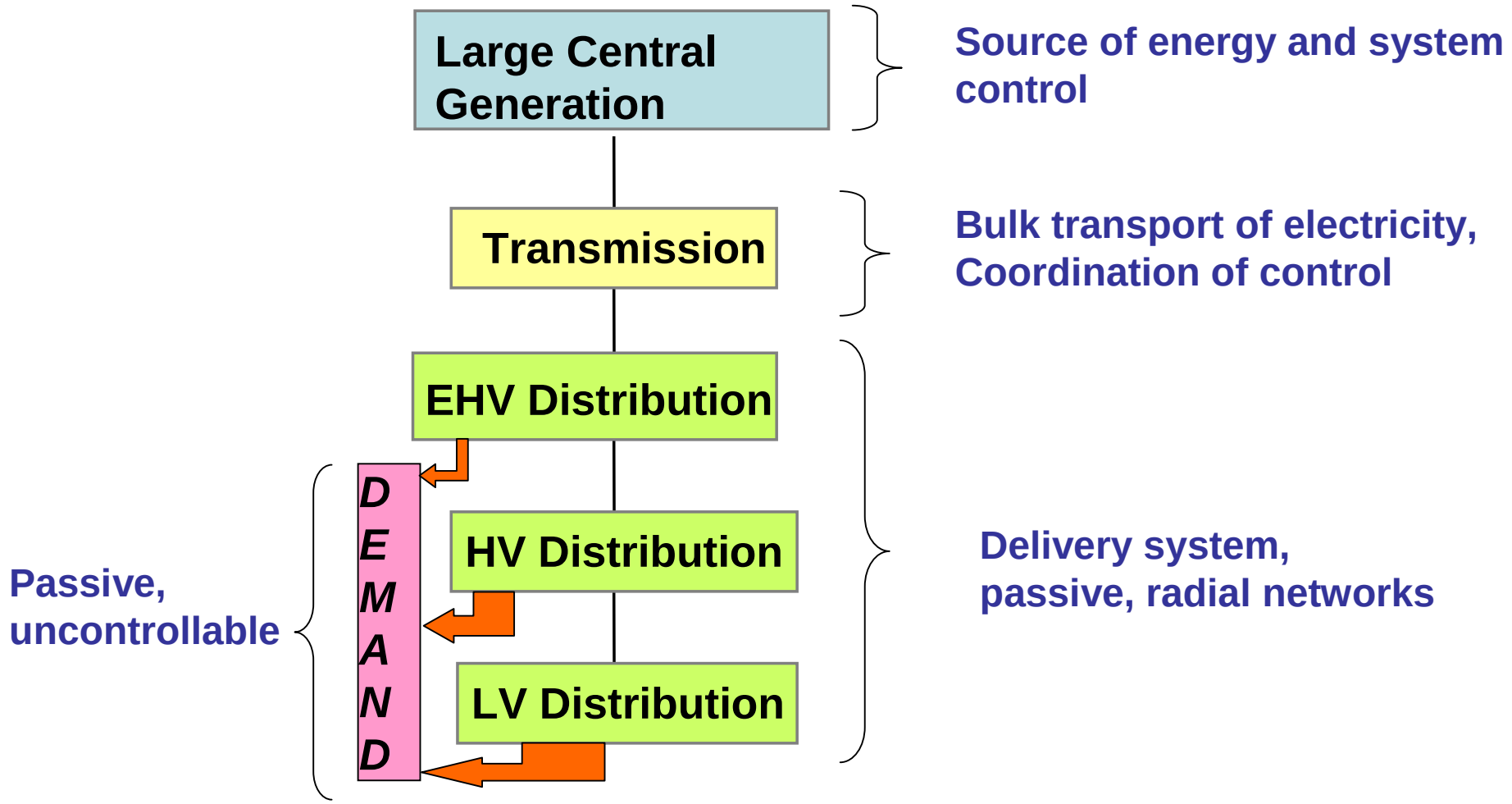
Today's centralised electricity system



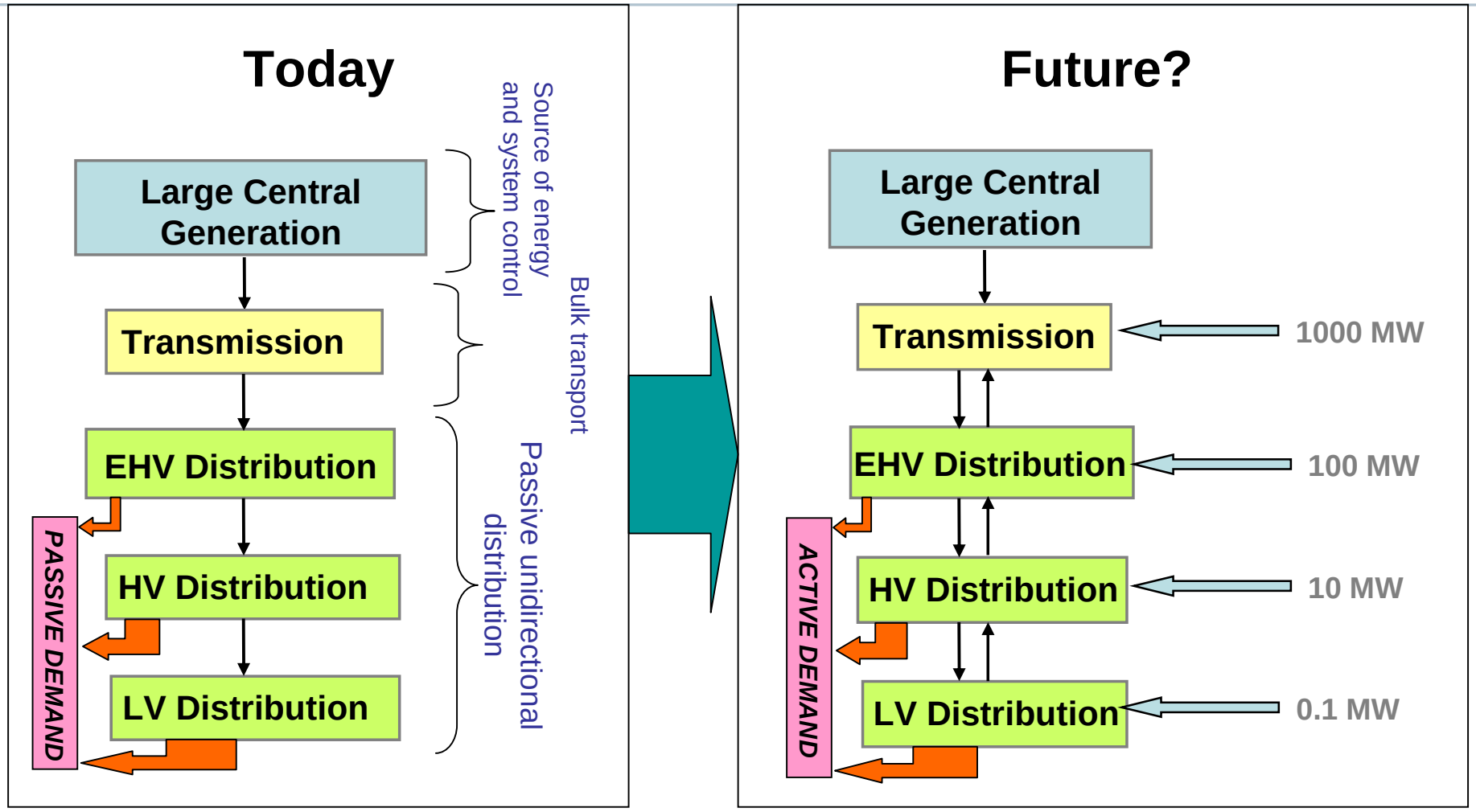
Key statistics of the UK electricity system

- Generation capacity utilisation: 55%
- Efficiency: CCGT 50%-60%, Coal <35%
- Network capacity utilisation less than 50%
- Losses in transmission 2%, distribution 7%
- Distribution networks contribute more than 90% of interruptions seen by end consumers

Drivers for change

- Aging assets
  - UK infrastructure expanded in late 50s, significant replacements expected over the next decade
  - Like-with-like replacement is unlikely to be optimal (e.g. network losses, DG)
- Connection of new forms of generation
  - Response to the climate change challenge
  - Various support mechanisms for renewables and DG (ETS)
  - Security of supply concerns
- New developments in information and communication technologies
  - Change in operation philosophy
- Developments in transmission and distribution plant technologies and demand side response
  - Increase efficiency of network operation and investment

Electricity system in transition



Technical, commercial, market and regulatory framework were optimised for the centralised system. Is this a barrier for future? How big?

Centralised versus Distributed energy system

- Centralised
  - In the process of generating electricity, significant amount of heat energy is produced that is wasted.
  - Average efficiency of fossil fuel generation in the UK less than 40%
- Distributed
  - Allows greater use of the waste heat and achieves overall efficiency for the supply of heat and electricity loads together of around 80% of the fuel burnt.
    - Space heating & heat-to-cool process for air-conditioning and refrigerating

What are the costs & benefits of a Distributed System?

Identified key barriers to Distributed Generation (Ofgem/DTI review of DG)

- **Cost** – DG technologies tend to have relatively high capital costs (true cost of carbon is not yet fully reflected)
- **Electricity industry issues**: technical, commercial and regulatory framework
- **Regulatory barriers** – the difficulties of getting planning permission for DG technologies
- **Lack of reliable information** – there was a low awareness of DG options amongst potential consumers; grants and rewards such as ROCs hard to access; lack of a comprehensive accreditation scheme for suppliers

Government measures

- Zero carbon new homes programme
- Support for DG
  - Renewables (RO)
  - Microgeneration
    - Warm Front Programme
    - Low Carbon Buildings Programme
    - Enhanced Capital Allowance Scheme
  - CHP
- Renewable heat
  - Biomass strategy

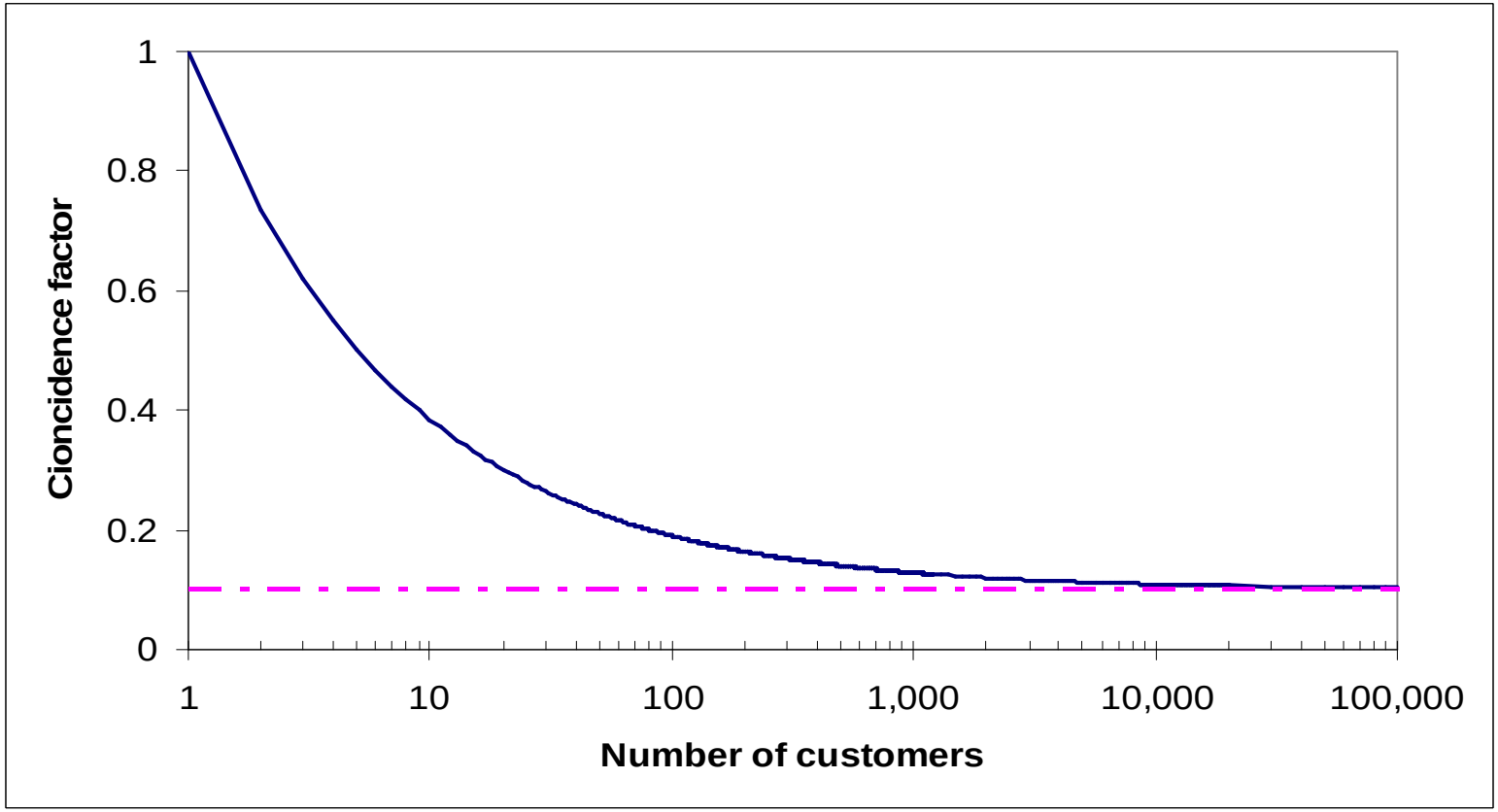
Support mechanisms for distributed generation (except RO) not likely to make a significant impact

Operation and development of an Integrated Energy System

- Will a distributed system work (balancing of electricity and heat)?
  - Future role of D & T electricity networks
    - D: high value of distribution wires - diversity
    - T: Transport of power from large renewables
  - Role of heat networks
    - Trading of heat (heat networks to be included in Ofgem remit?)
  - Role of demand response, heat and electricity storage
- Markets for distributed power to be developed

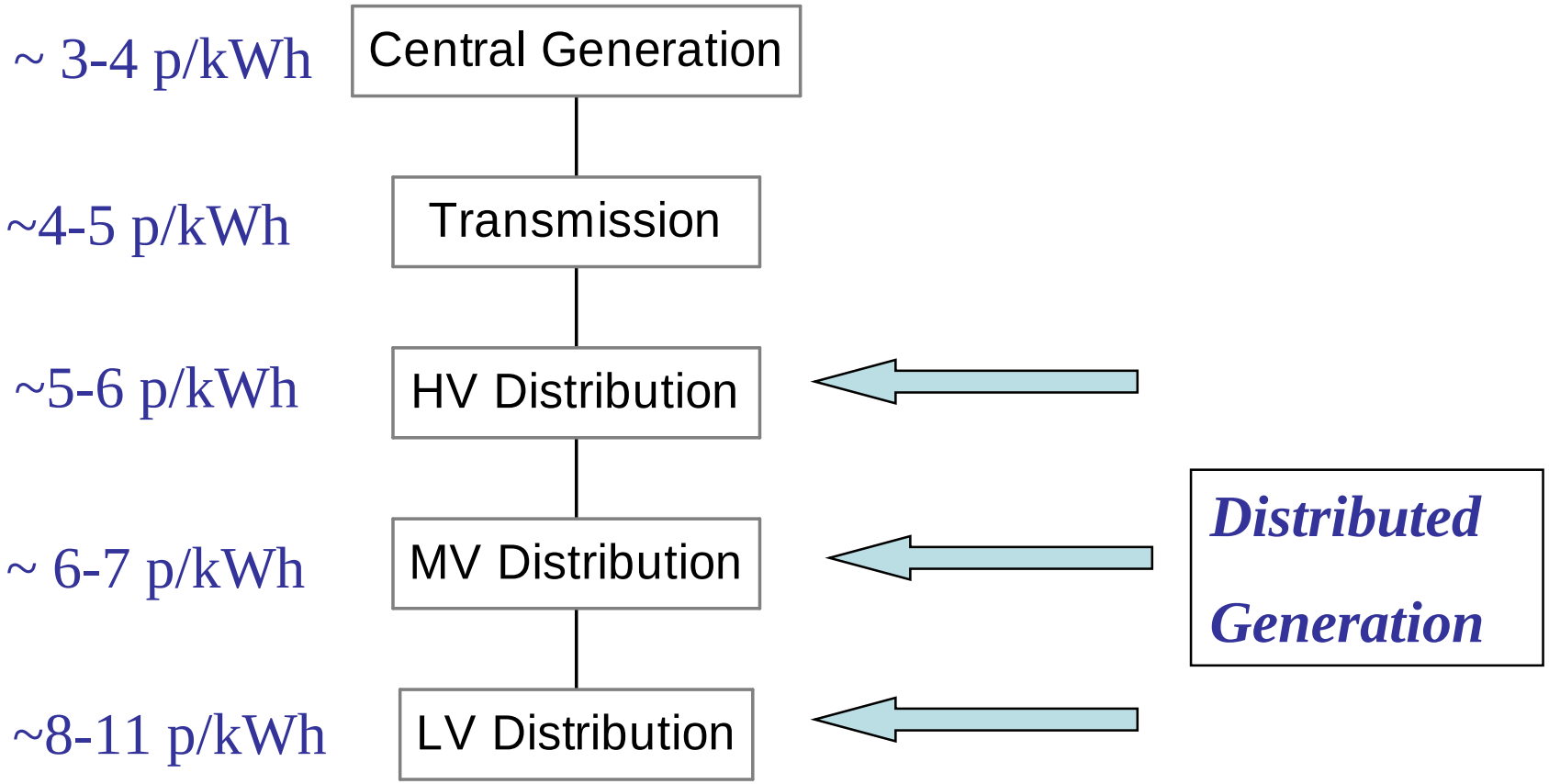
More work required to understand the full economic, environmental and security performance of distributed energy systems

Importance of demand diversity and size of the electricity system



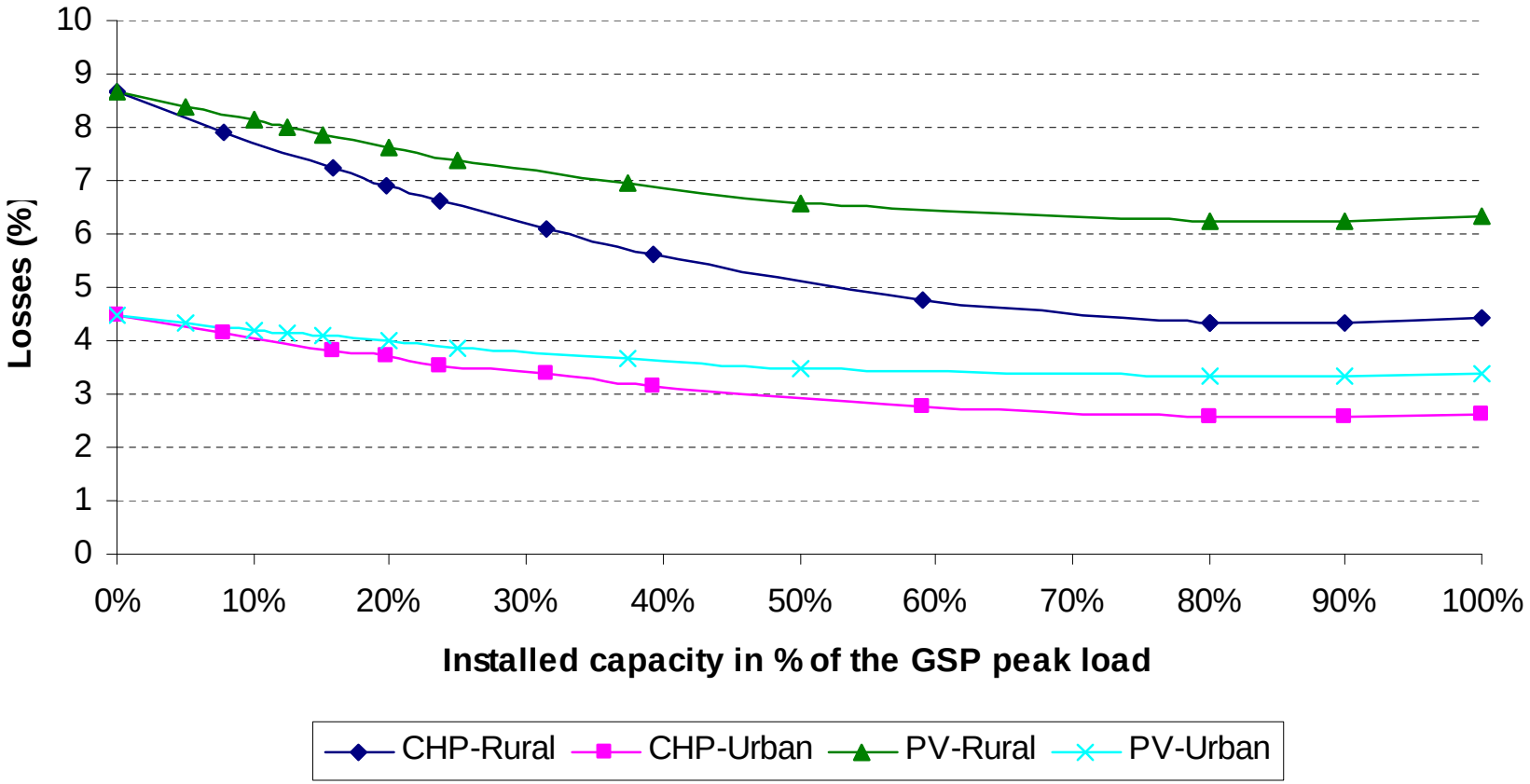
Peak demand of a typical house is about 10kW: to supply 10,000 houses we do NOT need 100,000kW of supply capacity but ONLY about 10,000kW due to load diversity

Integration of DG and its competitiveness



Is the market and regulatory framework cost reflective?

Impact of micro generation on losses

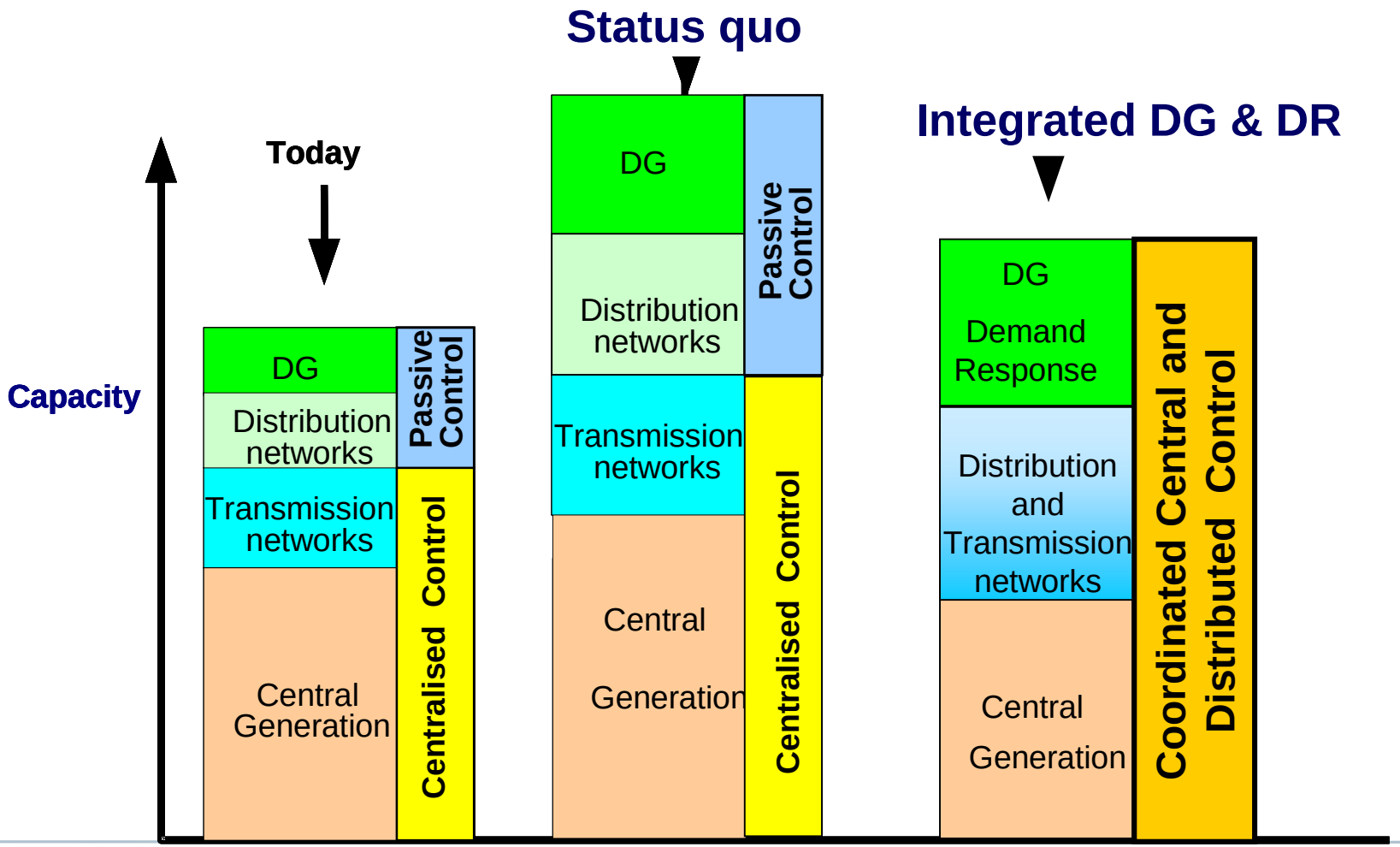


Potential value (£M) of small scale DG in replacing network assets in the UK

Density → / Penetration level ↓	Low density	High density
2.5GW	232	236
5GW	473	483
7.5GW	729	624
10GW	970	382

Additional benefits: from 30£/kW to 100£/kW

Importance of cost effective integration of DG



Framework for cost effective integration of DG in the UK electricity system /1

- Significant progress made in the UK to achieve cost effective integration of DG (UK has a leading position)
  - Distribution network security standards updated to include the contribution that DG can provide to network security (DG to provide solutions to network problems)
  - Incentives for the introduction of active management of distribution networks developed and innovation incentives set up to minimise cost of DG integration

Framework for cost effective integration of DG in the UK electricity system /2

- Significant modifications of the present commercial and regulatory framework required
  - System benefits and cost associated with DG are not fully recognised
  - Cost reflective distribution network charging mechanism for DG yet to be develop
  - Contribution of DG to reducing network investment costs and losses not rewarded
  - Access arrangements for transmission network are a barrier for integration of DG
    - Transmission Access Review

Summary

- Key issues associated with Distributed Power identified in the EWP
- Case for distributed power yet to be made (urgently)
  - Slow growth in DG
  - Key barrier to DG: Cost of technologies relatively high (is true cost of carbon is fully reflected)
  - Support mechanisms for distributed generation not likely to make a significant impact
- Integration
  - UK is a leader in cost effective integration of DG in the system operation and development
  - Considerable further work required in technical, commercial and regulatory arrangements to facilitate cost effective integration of DG and Demand Response
    - Access to T & D networks are barrier for integration

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