Regulation and Distributed Generation

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Outline

- Definition
- History and models
- Costs and benefits of distributed generation
- Regulation and distributed generation

What is distributed generation?

- Definitions vary from country to country but can be based on:
  - Size – e.g. UK under 50 MW
  - Type of connection – i.e. all generation connected to a distribution network
  - Type of generation – e.g. only renewables, even on a transmission network
  - Proximity to the point of use
- For this presentation, DG is defined as renewables connected to distribution networks, often close to the point of use

From centralisation…

- Most established systems rely on centralised generation from large scale, remote plant
- Drive towards centralisation from:
  - Technical developments (transformers, boilers)
  - Economies of scale, scope and system
- Centralisation became the norm:
  - Active transmission, passive distribution
- Degree of centralisation versus distributed generation varies from country to country
  - E.g. Denmark versus the UK or Italy

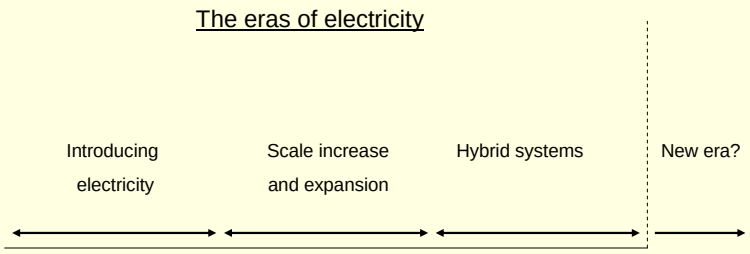
…to decentralised systems?

- Centralised systems a product of history and economics
- But the conditions which created them no longer hold true:
  - Environmental concerns and drive for efficiency
  - Liberalisation – investment risks of large projects
  - Technical development allow greater control of networks
- Question is how to shift from centralised to decentralised systems?

How can distributed generation help networks?

- Environmental:
  - Lower emissions
  - Increased efficiency through reduced grid losses
  - Provision of heat (cogeneration)
- System:
  - Quality/reliability issues through raising voltage in networks
  - Avoided transmission and distribution costs
  - Possible ancillary services/reactive power
  - Security: can reduce risks of large failures
- Financial:
  - Flexibility can provide a hedge against price fluctuations
  - Efficient use of cheap fuel sources (e.g. landfill sites)

The four eras of electricity?



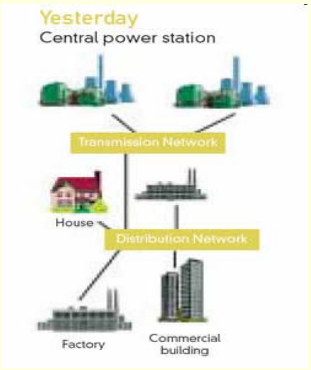
Source: SUSTELNET, 2002

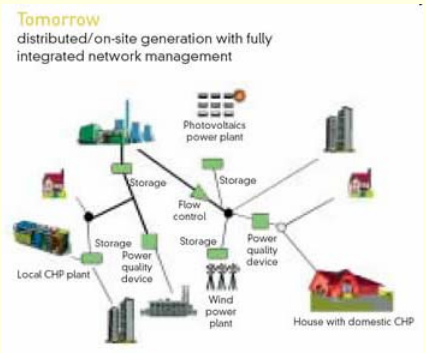
Networks with distributed generation

- **Active network:**
  - **Bi-directional power flow on distribution lines**
  - **Management using ICT**
  - **Own generation/individual connections – network interacts with consumers**
- **Micro grid:**
  - **Small network systems (a few hundred households) connected to their own network**
  - **Remote communities**
- **Stand alone systems**

→ **New roles for system actors –**
  - → **Transmission System Operators,**
  - → **Distributed Network Systems,**
  - → **consumers**

Centralised and decentralised systems





Mix of solutions

Issues	Grid-connection	Stand-alone	Mini-grid
Power availability	May be power outages	Usually readily available	Readily available
Transmission and distribution costs	High	Nil	Low
Infrastructure	Significant for fuel supplies & electricity distribution	None	Small and more straight forward
Site selection/ new plant development	Large plant – selection & procurement challenging although well understood	Usually based on location of need but may also be site specific	Based on location of need but may also be site specific, less complicated than plant for grid-connection
Environmental impact	High although newer generation systems offer improvements	Low	Usually low depending on the power source

Source: Unido/REEEP, 2007

Why is DG an issue for electricity networks?

- Performance – widespread introduction can:
  - Cause instability in network voltages and frequency
  - Complicate reactive power flows
  - Raise fault levels
- Economics:
  - Changes in network configuration
  - Increased management costs for DNOs

➔ These are technical and design problems

➔ solutions exist

How can regulation discourage distributed generation?

Regulatory issues vary – the more common are:

- Charging structures
  - e.g. shallow connection charges on transmission networks, deeper on reinforcing the distribution networks
- Price controls: reward distributor's asset base not performance
  - Shifting kWh/lines rather than supplying services
  - DNO get revenue from load customers
- Market design:
  - Transaction costs, inequality of penalties for intermittency versus ancillary services
- Vertical integration:
  - Disincentive to allow equal access for all
- Technical standards designed for centralised generation

➔ DG not treated on an equal basis with generation on the transmission network

Regulating for DG (principles)

To create a level playing field

- Removal of subsidies for centralised generation?
- Equal access to the grid
- Use of transmission & distribution should be priced according to the services, rather than the kWh delivered
- Requirement to compare costs of distributed generation and costs of network upgrade
- Benefits of DG should be reflected in system pricing
- Back up provision should be fairly priced

➔ Need to complement support measures for sustainable energy

Regulating for DG (in practice)

- Connection rules for the use of the network – shallow charge rather than deep charge for DG
- Link between revenues and performance –
  - i.e. not just the size of a DNO's asset base
  - encourage alliances with other players including DG operators
- Requirement to compare costs of DG and costs of network upgrade
- Market - reward reactive power and ancillary services on an equal basis with penalties for intermittency
- Technical standards:
  - Update to account for technical advances
  - Address DG contribution to security of supply
- Information provision - connection sites

In conclusion

- Centralised generation is just one model and the product of political, economic and technical forces in place during the decades when the systems were being established
- with the evolution of technology, developing systems do not need to grow along the same lines as those established in the early years of the last century.
- However, distributed generation with small sources of generation disseminated over a country raises specific issues. The challenge for the future is to find for each country an appropriate mix of centralised and decentralised generation.