Energy storage: a solution in network operation?

Anthony Price, Innogy plc UK

Gerard Thijssen, KEMA NL

Members of the Energy Storage Association

Electricity Storage: a solution in network operation

- Overview of storage technologies
- Overview of storage applications
- Storage as a network solution
- The Energy Storage Association

Storage devices can be classified by:

- Technology type
  - Mechanical, electrical, electrochemical
- Power and energy rating
  - Large scale, small scale
- Application
  - Power quality and reliability
  - Power network applications

The Energy Storage Scene is changing...

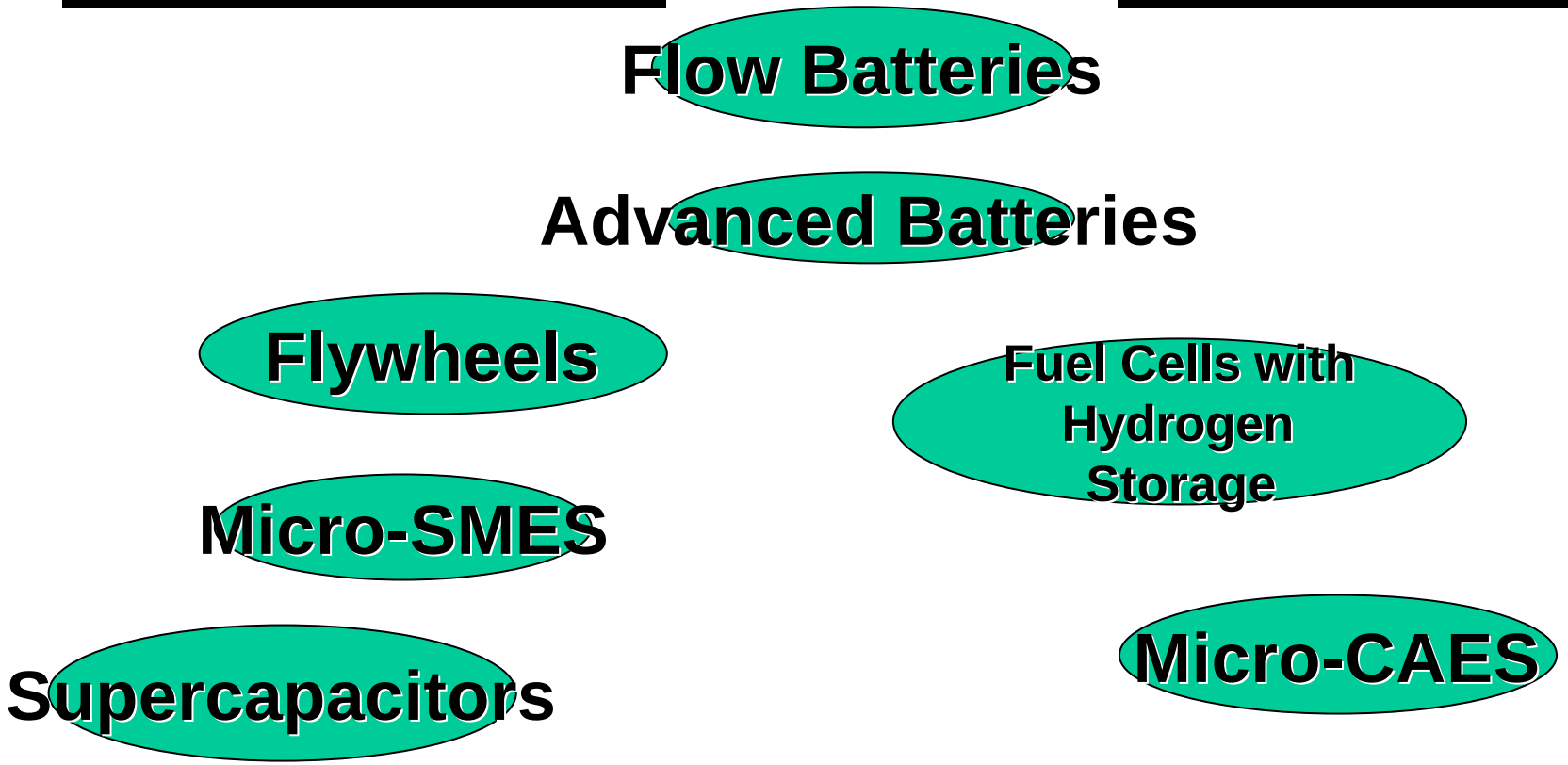
- **From: Large pumped hydro (or CAES) and small customer-side battery powered systems....**
  - **To: New technologies for specific services sized for their applications**

New energy storage techniques

The Energy Storage Scene is changing…….

New Technologies with potential for “seconds” duration storage

New Technologies with potential for “hours” duration storage

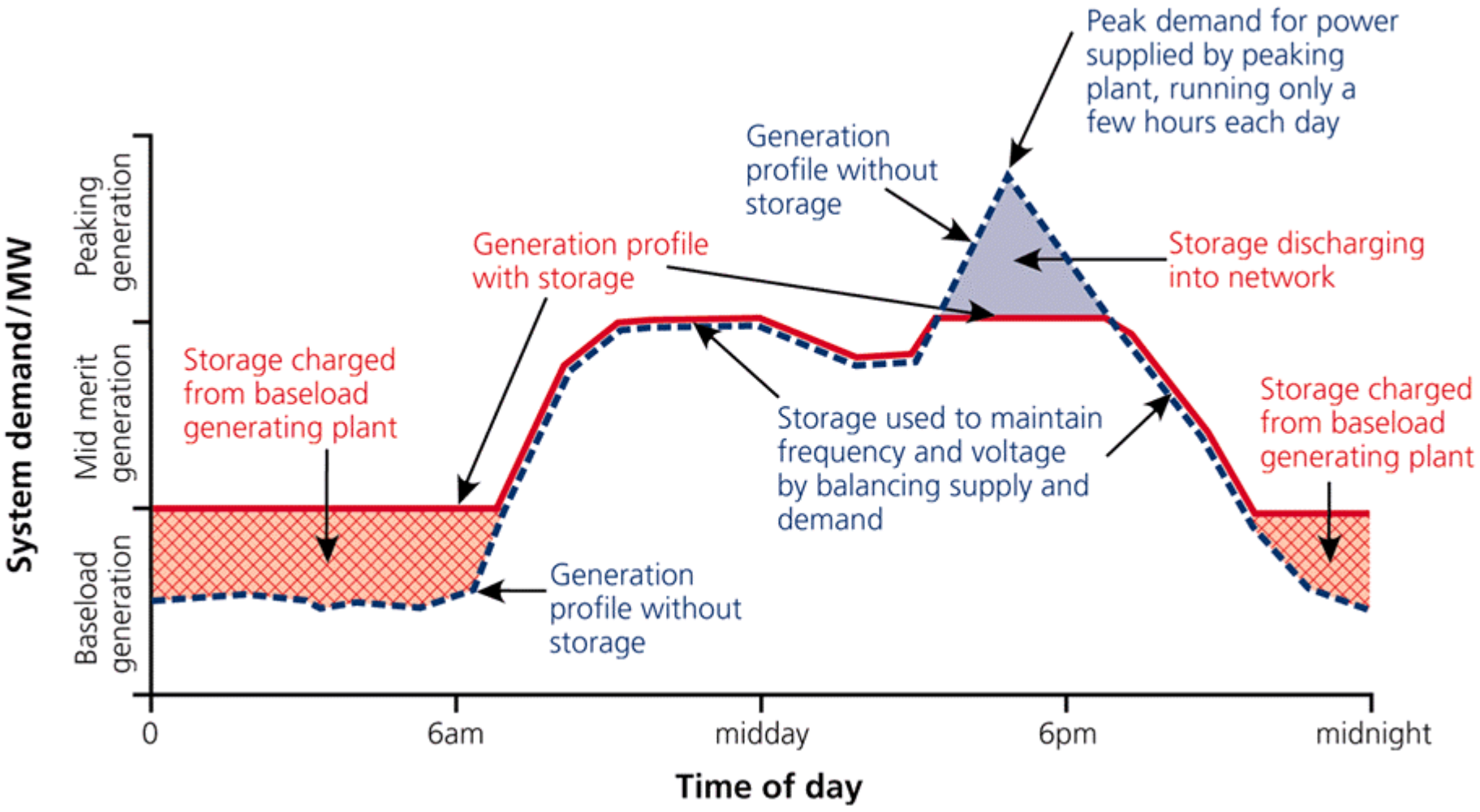


Use of energy storage

- **Balance fluctuations in supply and demand of electricity**
  - short duration ~ frequency control / stability
  - longer durations ~ energy management or reserves
- **Storage complements primary generation**
- **Storage improves network utilisation**
- **Storage can be a centralised or distributed resource**

Examples of storage / generation types

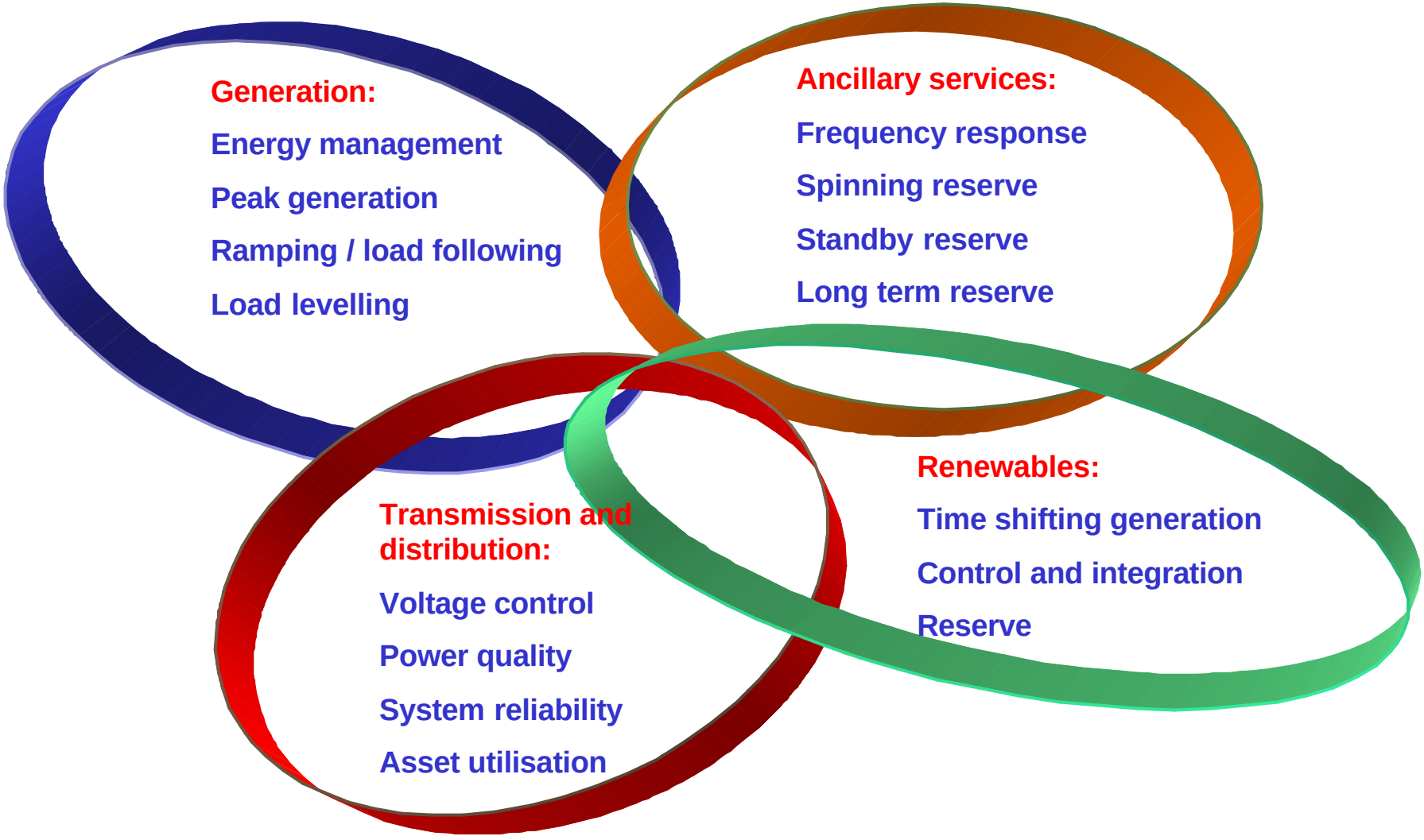
Size range	0 – 20 MW	20 – 100 MW	100 MW +
Applications	Off grid Distributed generation Power quality and reliability	Distributed generation Peaking power Network support	Grid connected Network services
Prime mover examples	Reciprocating engines Small GTs Micro hydro	Reciprocating engines GTs	GT, CCGT Conventional Plant
Storage examples	Batteries Flywheels SMES	Batteries Flow batteries Micro CAES	Pumped Hydro Flow batteries CAES


Peak demand for power supplied by peaking plant, running only a few hours each day
Generation profile without storage
Generation profile with storage
Storage discharging into network
Storage charged from baseload generating plant
Storage used to maintain frequency and voltage by balancing supply and demand
Storage charged from baseload generating plant
Generation profile without storage
Peaking generation
Mid merit generation
Baseload generation
System demand/MW
0
6am
midday
6pm
midnight
Time of day

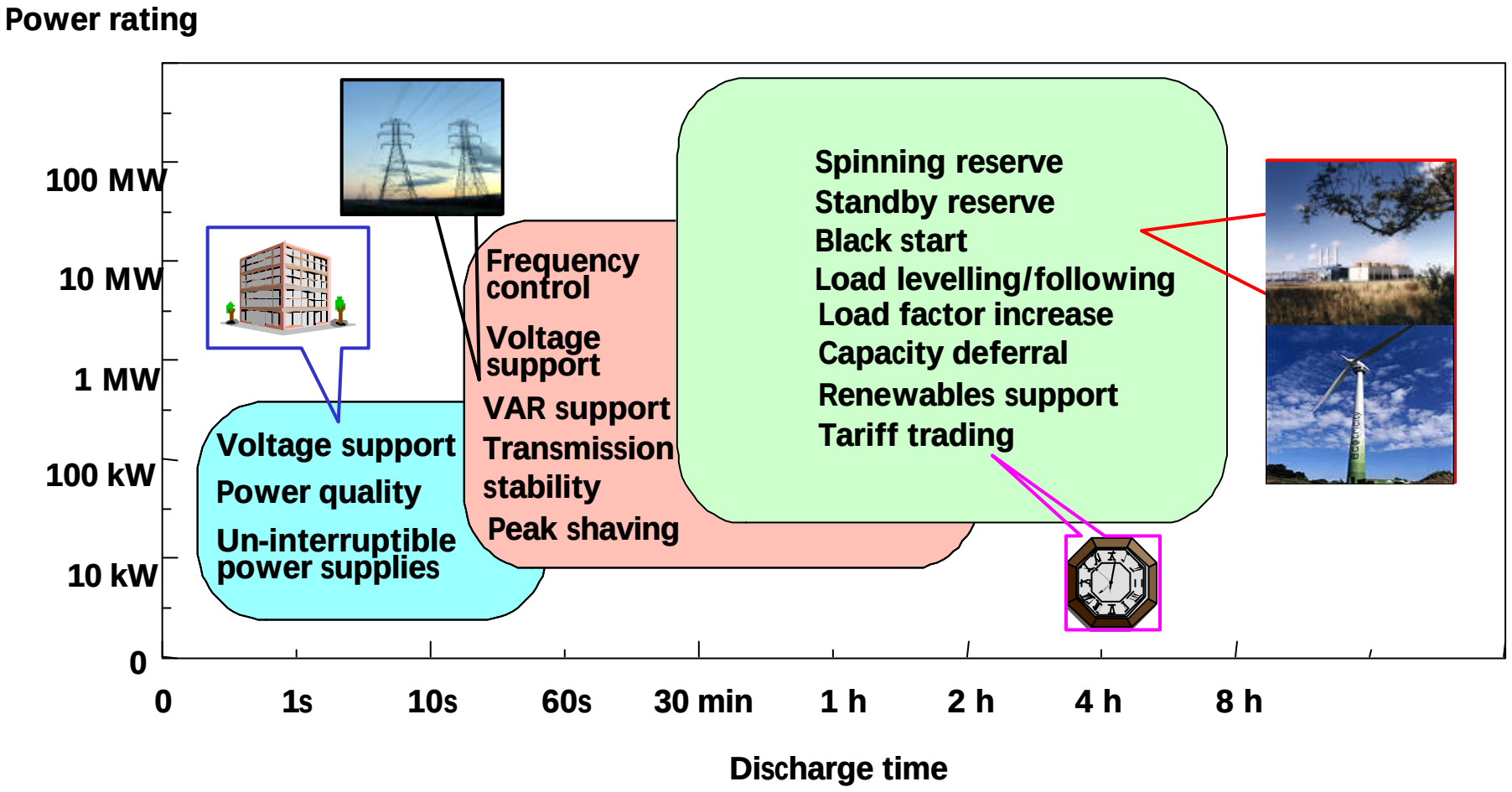
Generation and storage

- Existing and planned generating capacity used for peaking and mid merit duties
- Defer or avoid peaking plant by increasing utilisation of mid merit plant
- Use storage for transmission and distribution applications

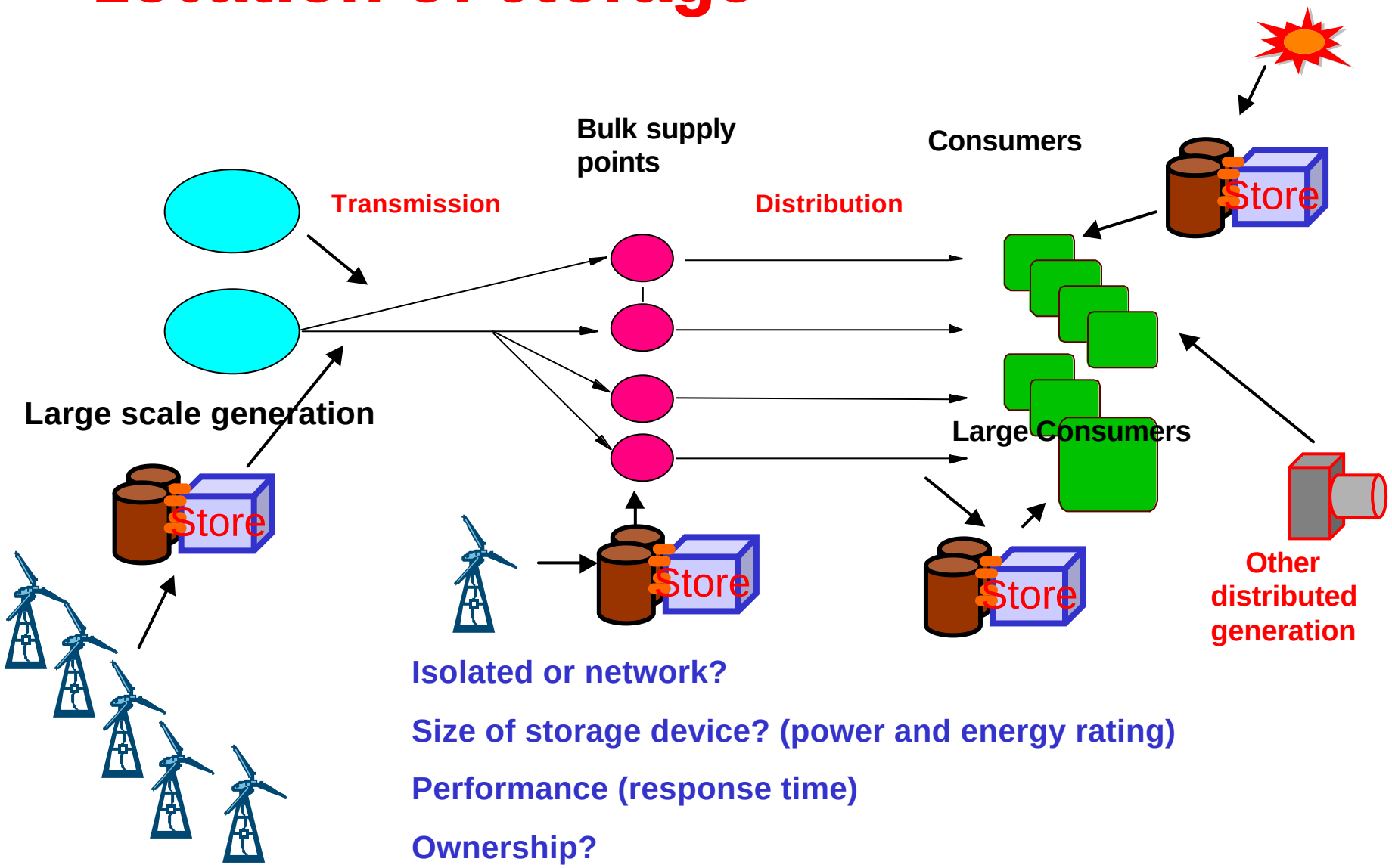
Utility energy storage applications



Storage applications



Location of storage



Isolated or network?

Size of storage device? (power and energy rating)

Performance (response time)

Ownership?

Size and utilisation of T & D?

Storage as a network solution (1)

- Charge storage plant off peak - run as an embedded generator during peak periods. Avoids transmission costs. Compare with small recip or GT.
- Fuel is electricity at marginal cost. Avoids use of fossil fuel
- Fuel flexibility and emissions benefit

Storage as a network solution (2)

- Ancillary services - frequency response, rapid response, black start
- Contract with network operator

Storage as a network solution (3)

- Defer or avoid investment in new distribution plant such as wires and transformers
- Increase utilisation of wires and transformers

Storage as a network solution (4)

- Enhance customer services
- Improve power quality
- Avoid service interruptions
- Peak shaving / load levelling / tariff trading

Storage as a network solution (5)

- Environmental benefits
- Storage balances supply and demand, integrate intermittent renewable generators such as wind and solar
- Network support during periods of islanding

The Energy Storage Association

- To maximise the profitability of energy storage services
  - reduce costs
  - increase reliability, efficiency and environmental acceptability of electricity supply
- Provides communication between suppliers, customers and stakeholders in the power industry

www.energystorage.org

Conclusions

- Energy storage is a disruptive technology - altering network planning and operation
- T & D networks can use energy storage
  - to make best use of assets:
  - reduce standby equipment or redundant circuits
  - Reduce system operating costs
  - Reduce the environmental impact of the power network
- The Energy storage association is the leading international group for promotion of energy storage