UNIVERSITY OF Southampton
School of Engineering Sciences

Microgrids: Power Systems for the 21st Century ?

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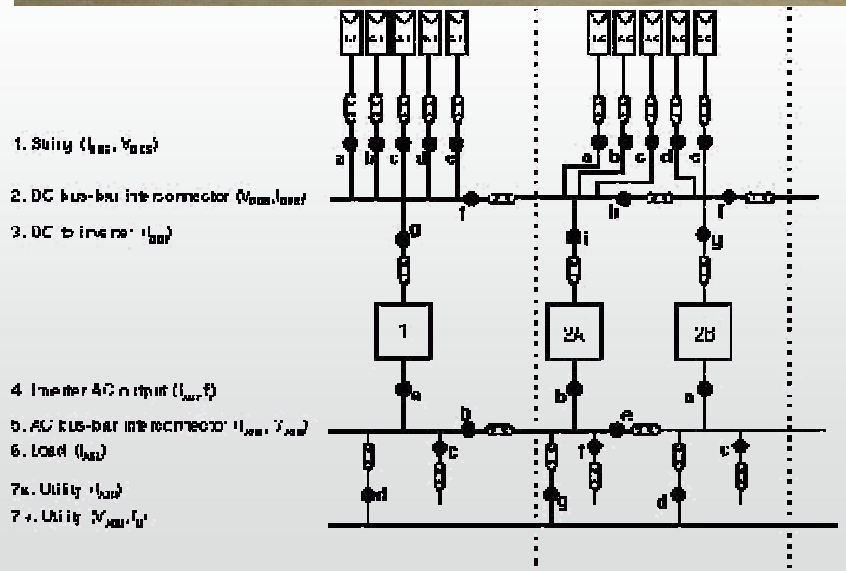
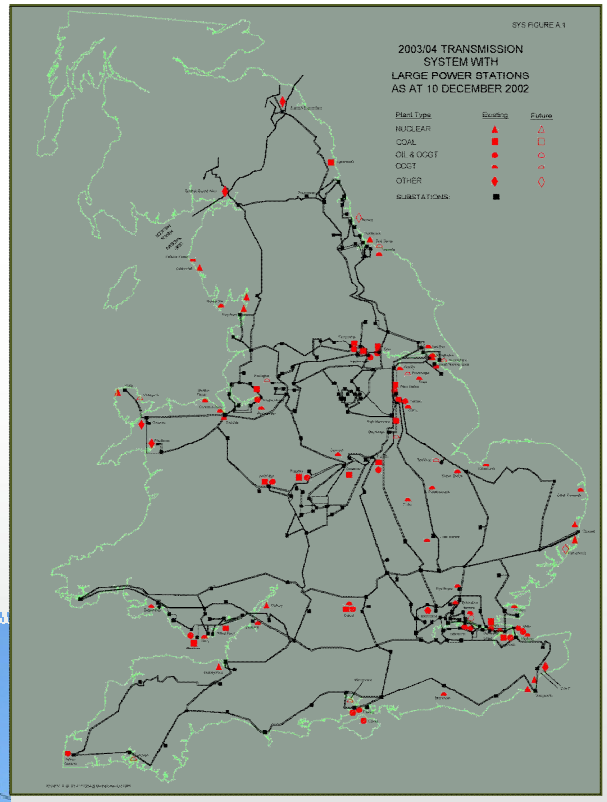


Outline

- Some history
- Future demands of the power system: efficiency & environment
- Distributed generation and microgrids
- An energy balance view
- Conclusions



Distributed generation – the pros ...

- Reducing transmission losses through close proximity to load
- Potentially high efficiency of energy usage (viz DCHP)
- Accommodates small-scale renewables (wind, solar, ...)
- Improves reliability of supply

and cons ...

- Economic viability uncertain
- Does not easily fit into the power generation hierarchy
- Intermittent generation
- Improves reliability of supply

What are microgrids ?

- Small networks of generators and load
- Generators of similar size as typical loads
- Control of energy and power balance to allow autonomous operation

Issues to consider

- Precise energy and power balance within the microgrid, on a scale ranging from milliseconds to years
- The nature of connection with the main utility (the “grid connection”):
  - Power import or export
  - Stand-alone operation

Outline of solution ...

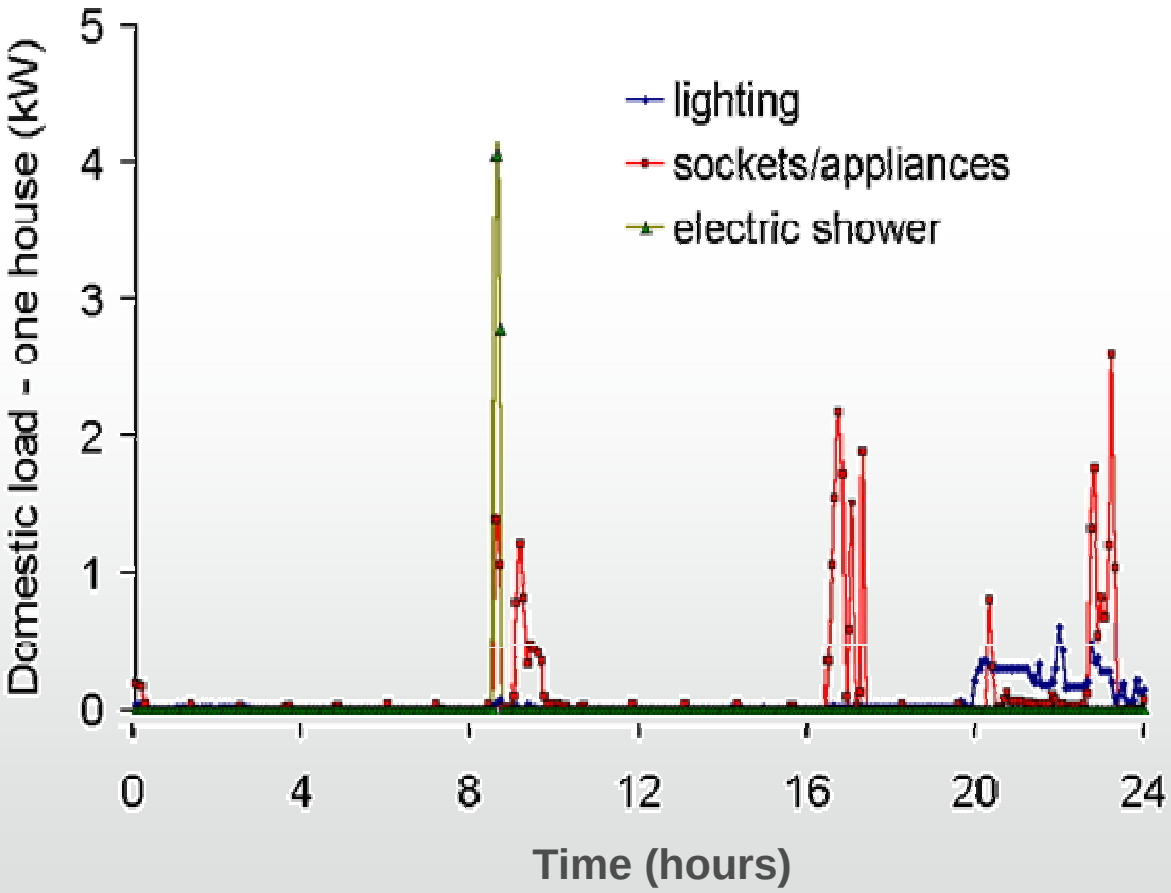
- Diversity of generation to provide seasonal match between generation and load
- Energy storage to bridge over diurnal mismatch
- Demand management !

T. Markvart & R.J. Arnold, Ingenia, Sept. 2005.

S.M. Abu Sharkh *et al,* Renewable & Sustainable Energy Reviews, Vol. 10, p. 78 (2006);

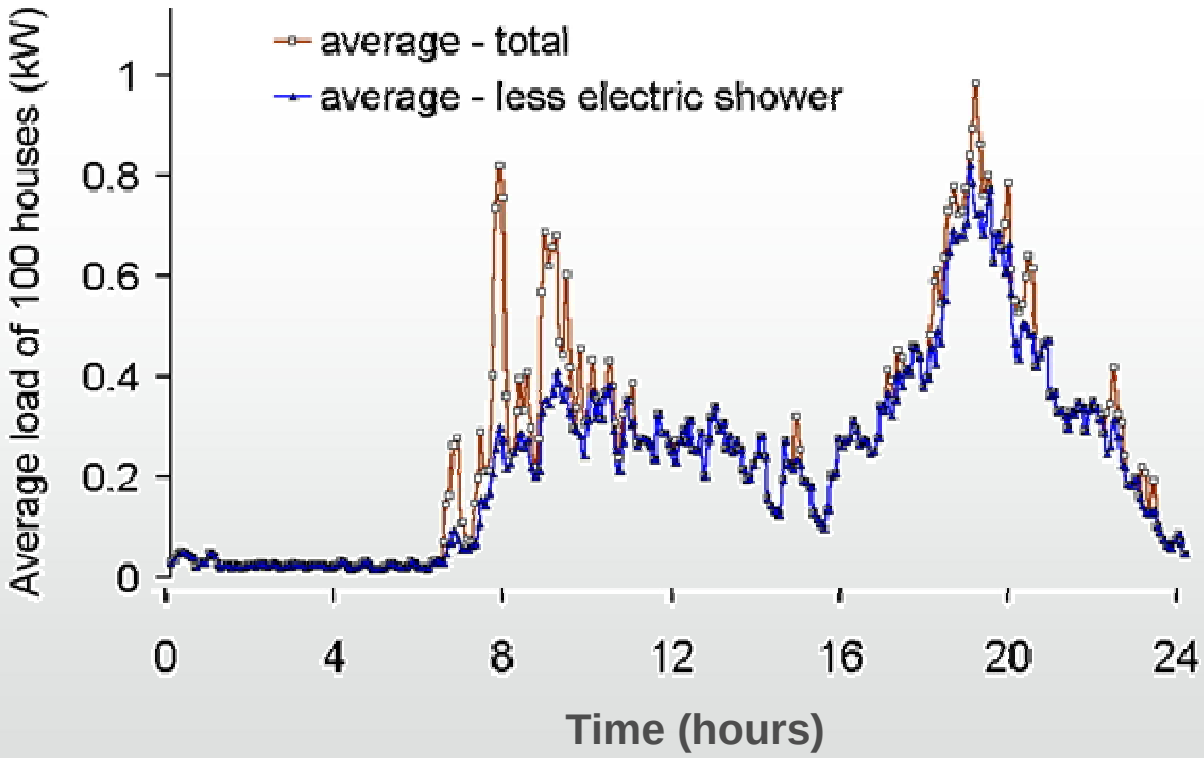
An illustration:
A residential area powered by PV and μCHP

The demand – a single house



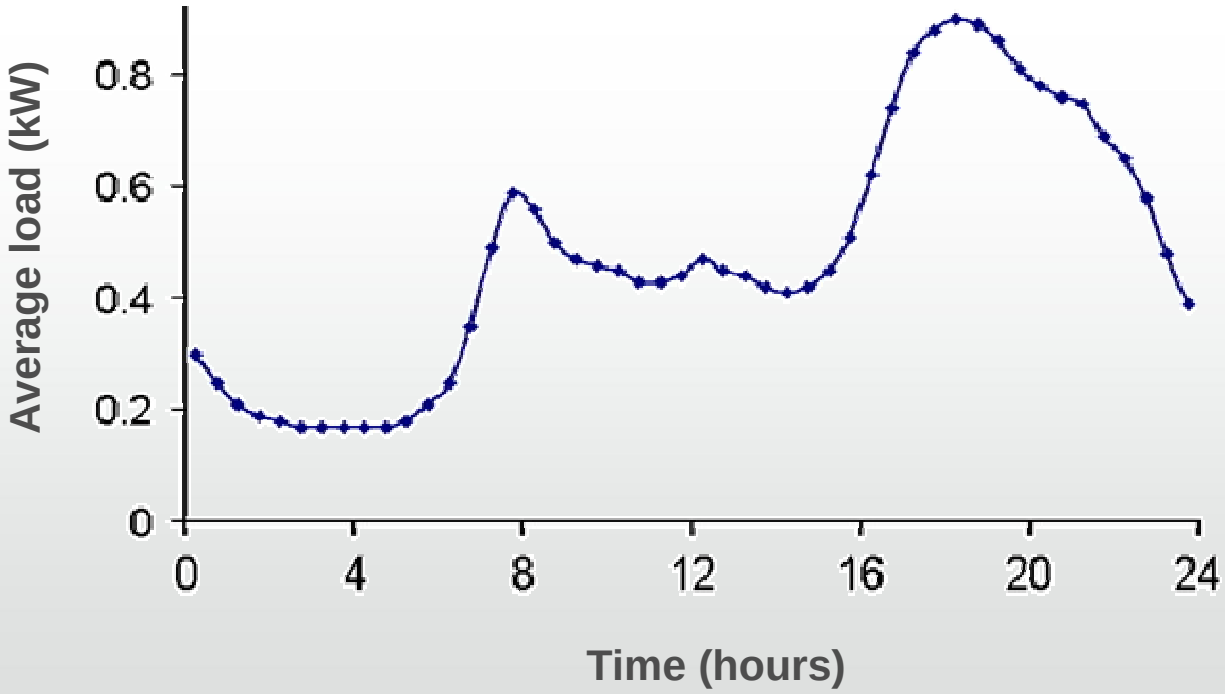
An illustration:
A residential area powered by PV and μCHP

The demand – one hundred houses



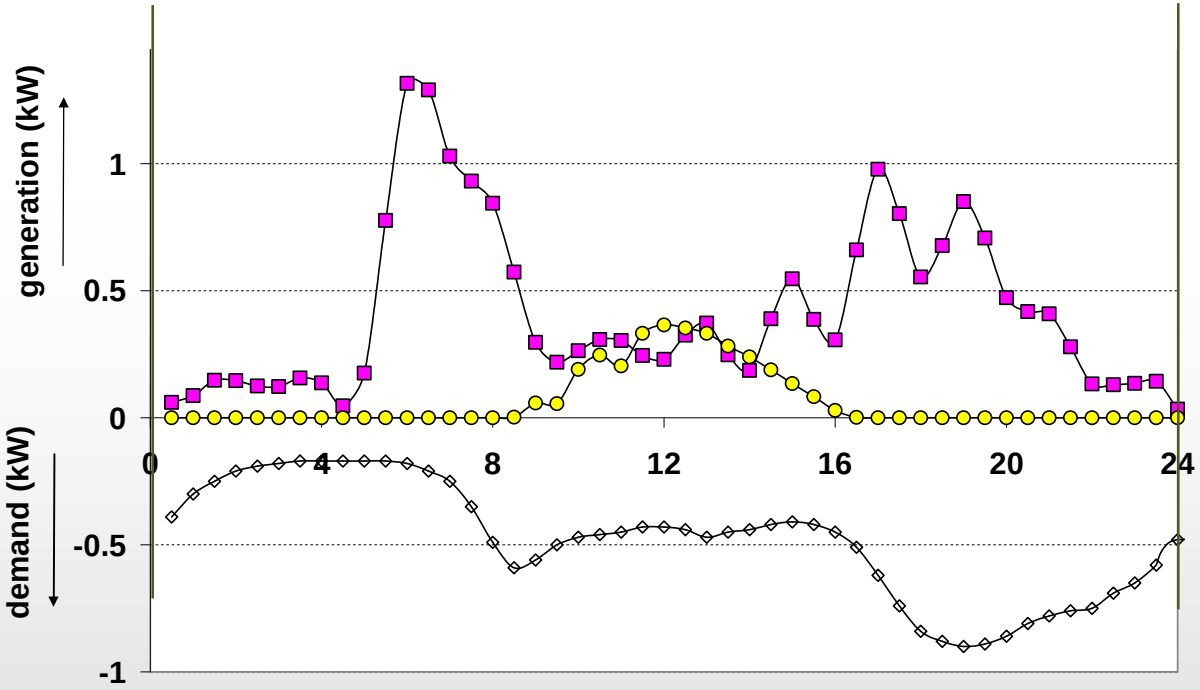
An illustration:
A residential area powered by PV and μCHP

The demand – National Grid



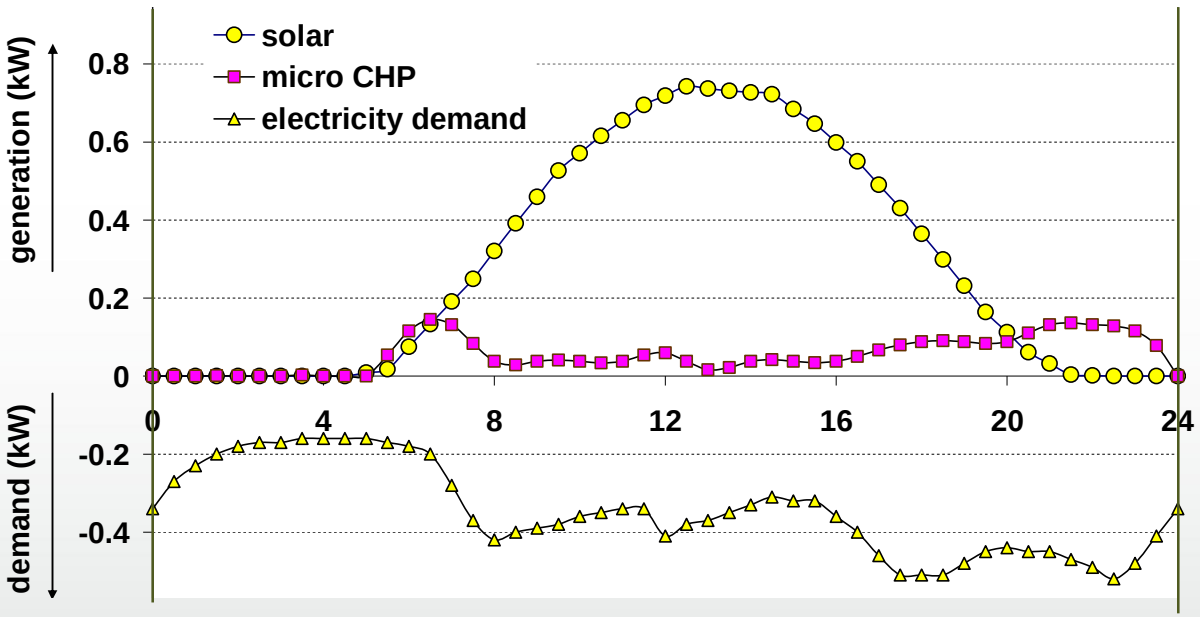
An illustration:
A residential area powered by PV and μCHP

Generation (Winter)



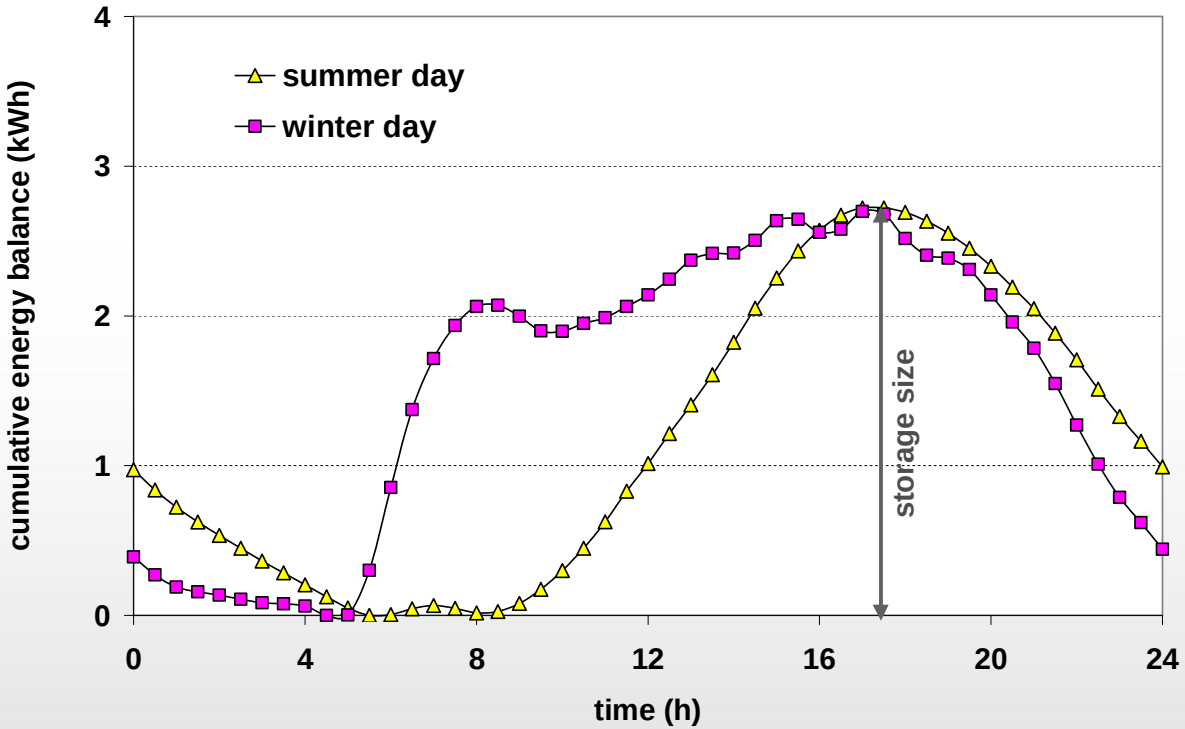
An illustration:
A residential area powered by PV and μCHP

Generation (Summer)



An illustration:
A residential area powered by PV and μCHP

... and the storage.



Example of a similar concept

Conclusions

- No fundamental technical reasons why microgrids cannot supply a large part of energy consumption
- Energy cost roughly comparable with the current price if photovoltaics subject to current support mechanisms
- Regulatory framework to be established; support required from network operators

Acknowledgements

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