

Managing Intermittency

Wednesday 25th May 2005
All Energy - Aberdeen

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Integrating Renewables

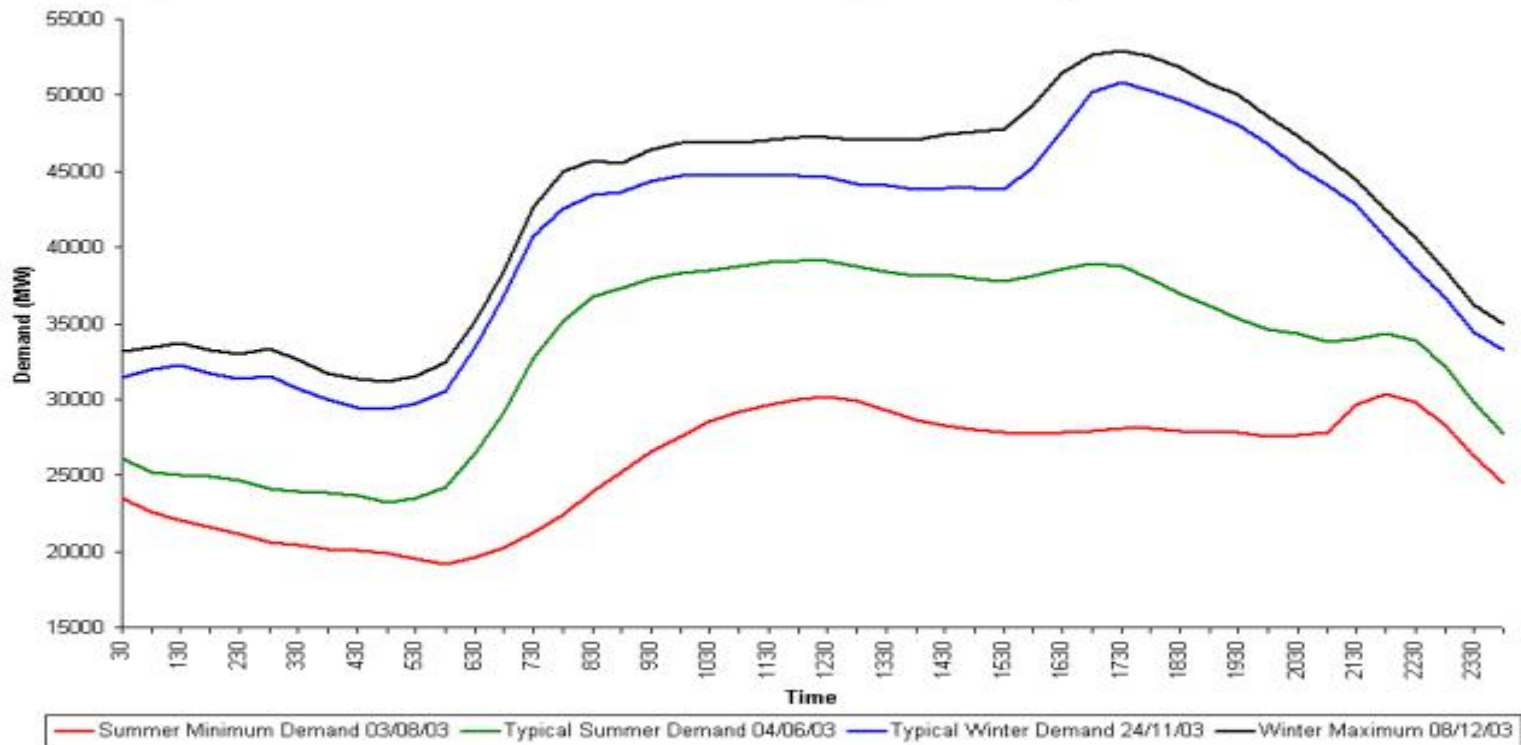
- Renewable Generation
- Characteristics of Electricity System
- Characteristics of Wind
- Integrating wind
- Costs
- Capacity Credit

Renewable Generation



Electricity Demand

Fig 2.3 - Actual National Grid Summer and Winter Demands for 2003/2004 (not weather-corrected)



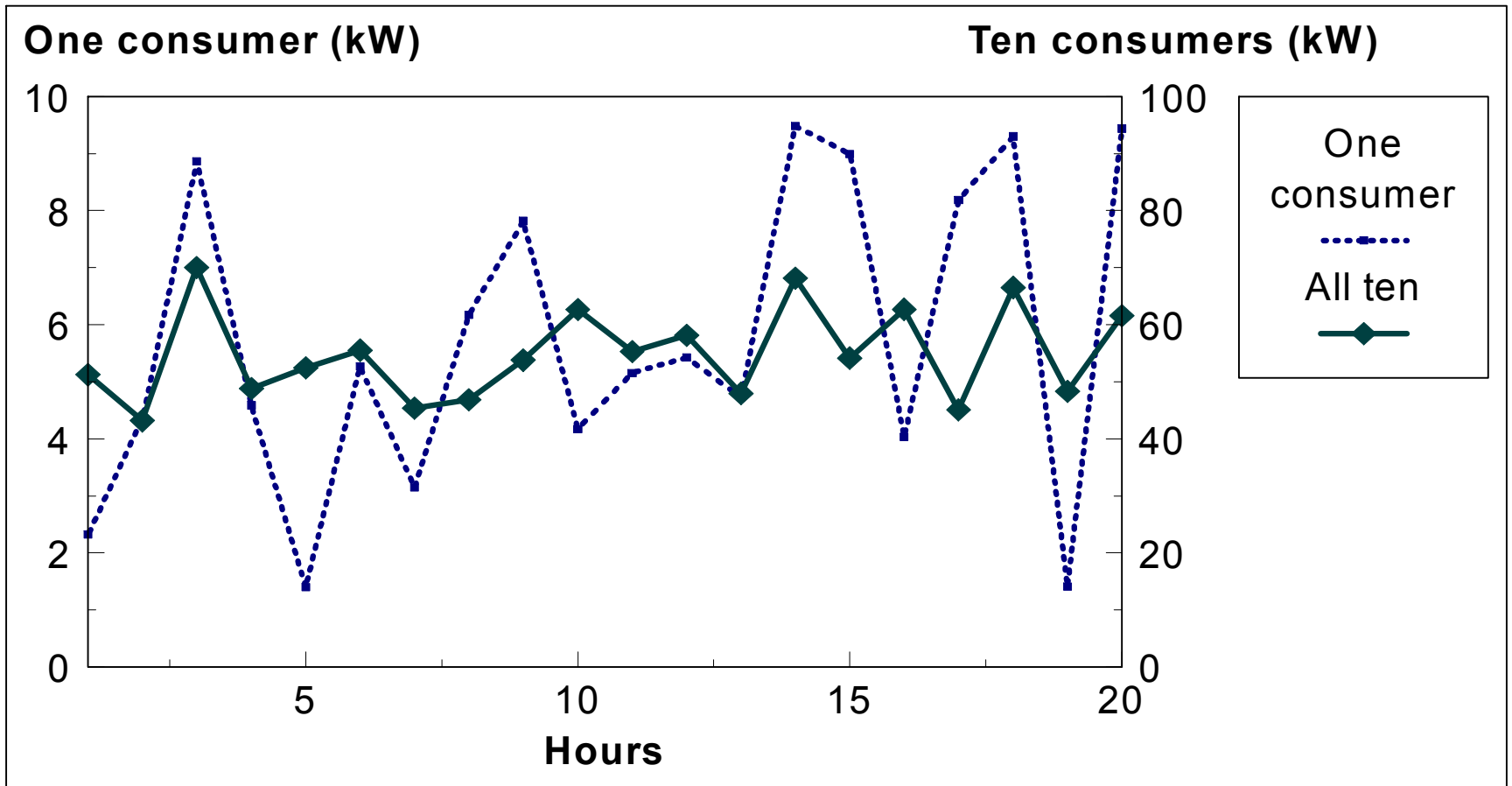
The biggest threat to the network is?

Synchronised Tea Making!

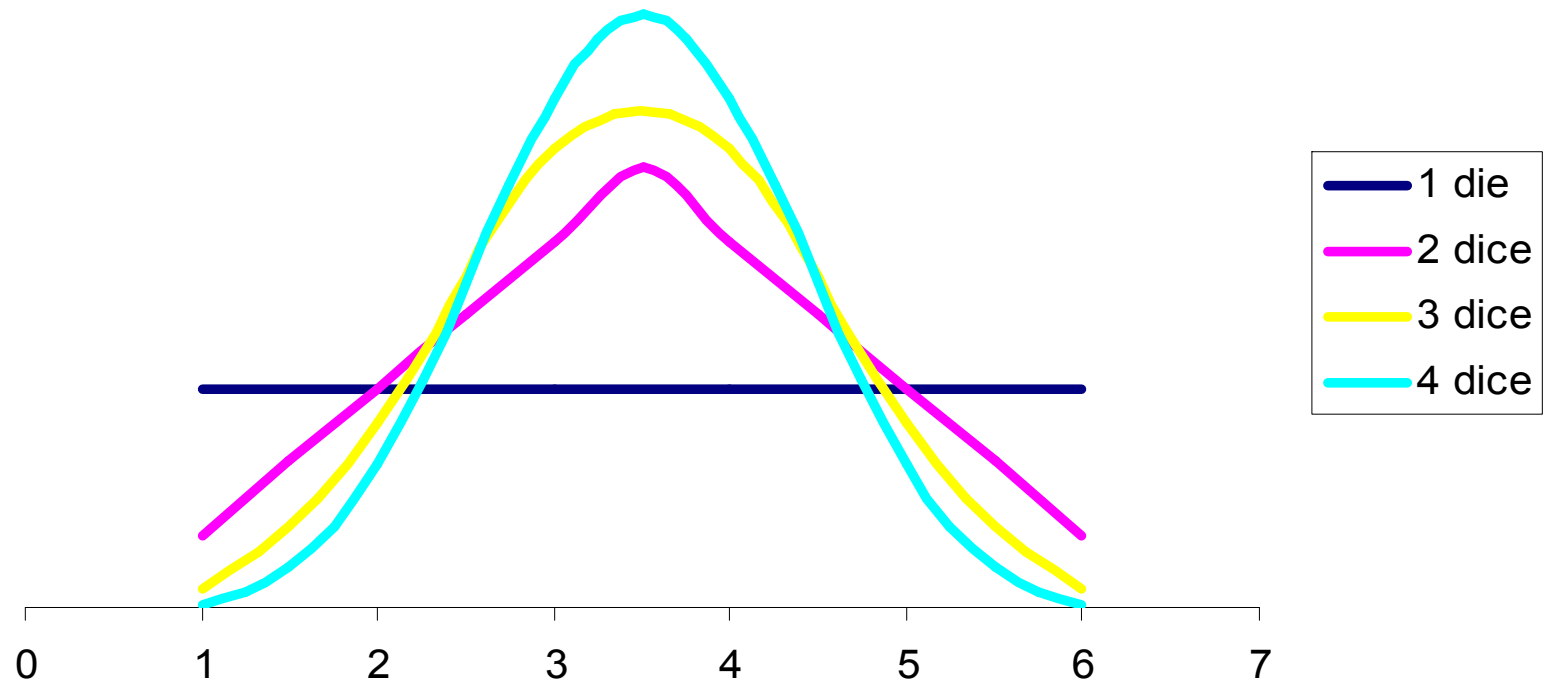
- Max demand on system 55,000 MW
- Installed Generation capacity 68,000 MW
- 25 million kettles 75,000 MW



Aggregation



Rolling Dice



Why integrated systems?

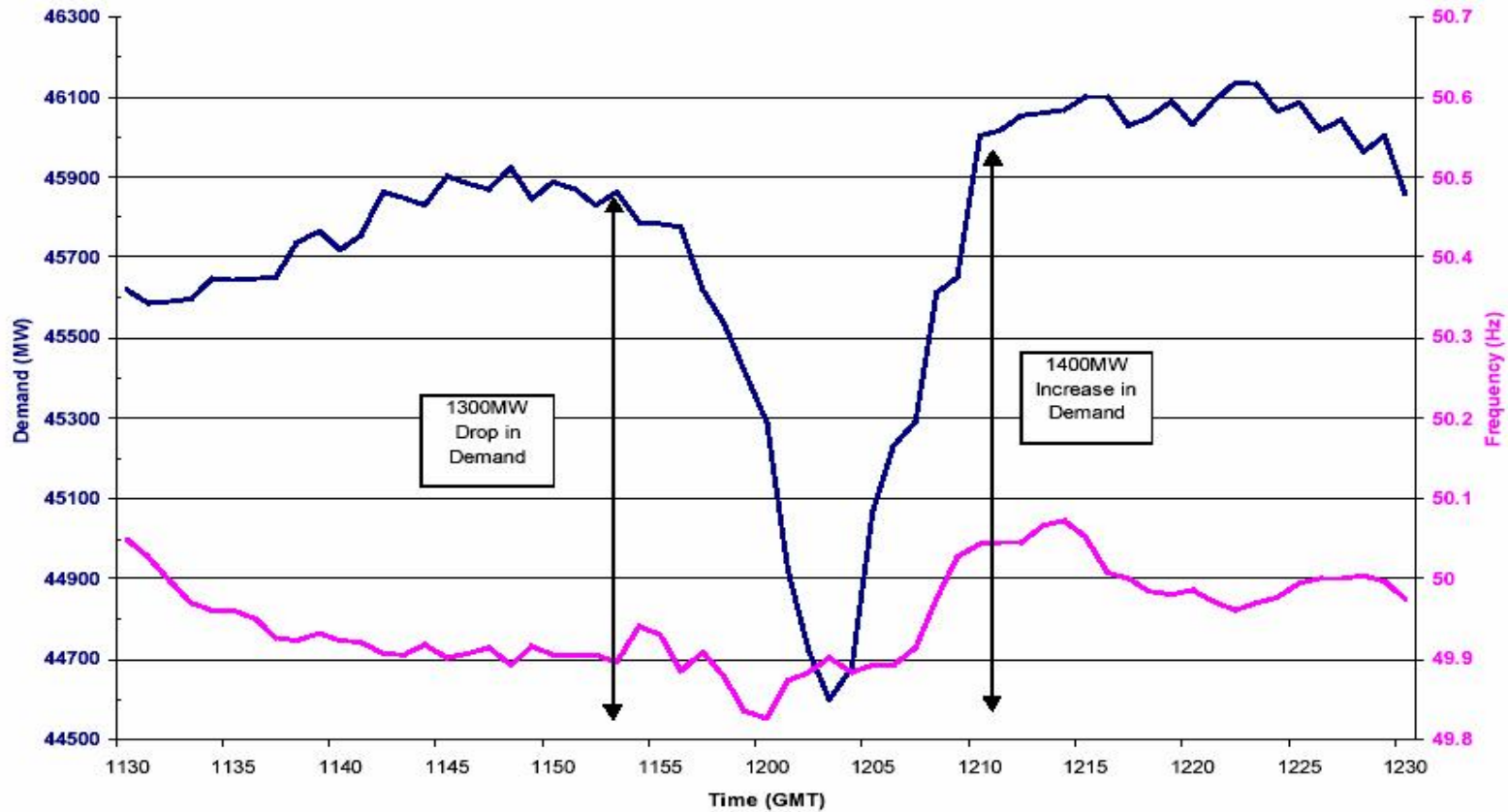
- Smoothing
 - Demands
 - Generation sources
- Peak/average
 - House: 16 (8 kW/0.5 kW)
 - UK: 1.5
- Lower plant margins needed -
 - House: at least 2*peak.....
 - Large electricity system: $\sim 1.2^*$ peak

Coping with demand variations

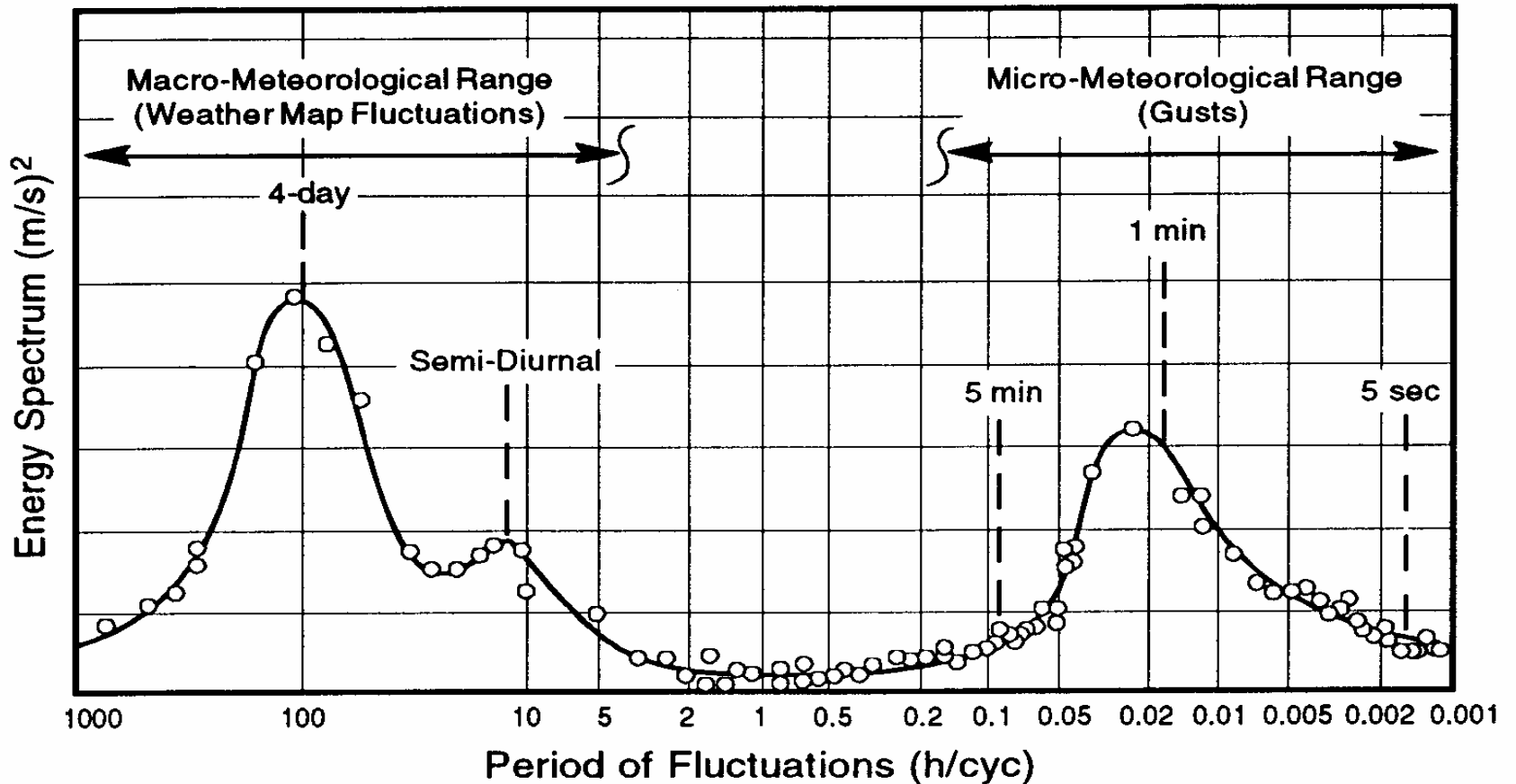
- Generator inertia
- Response
- Reserve
- Voltage changes
- Demand management

All can cope with demand increase or decrease

3 minutes silence - 5 Jan 2005



Timescales - Wind



Pre NETA

- Central Despatch of Generation
- Demand Forecast 10:00 day ahead
- Generation commitment 12:00 day ahead
- Variations from schedule incurs cost

Post NETA

- Generators/Suppliers contract bilaterally
- Outturn matches contract position
- Imbalance Penalties

- Large Wind treated as Generation
- Embedded Wind treated as negative Demand

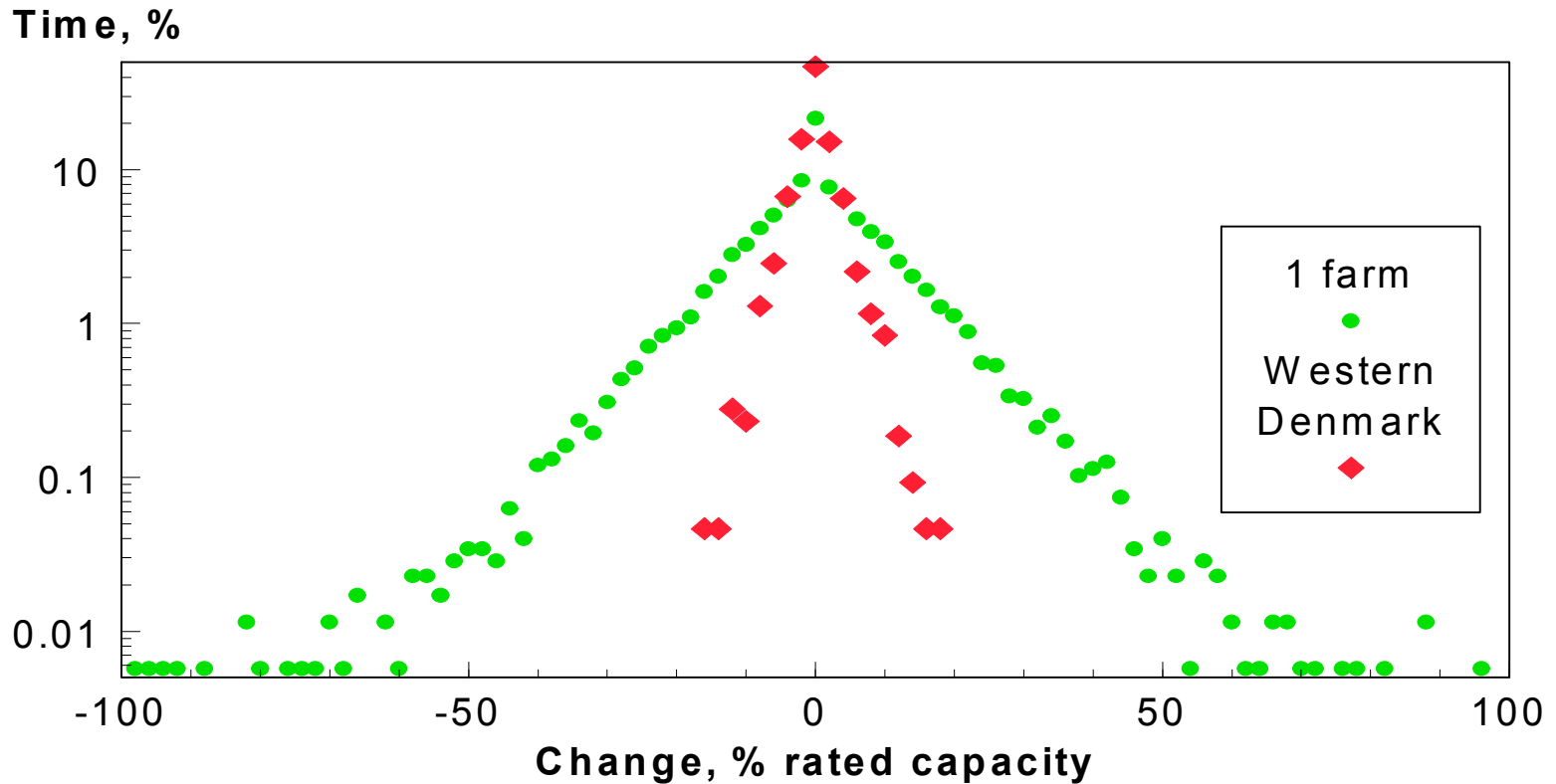
Wind and Wind Plant variability

Are not the same



windpark Holtriem 35 * E 66
output of the windpark/single unit about 10 minutes

Wind Aggregation



Who has looked at integration issues previously?

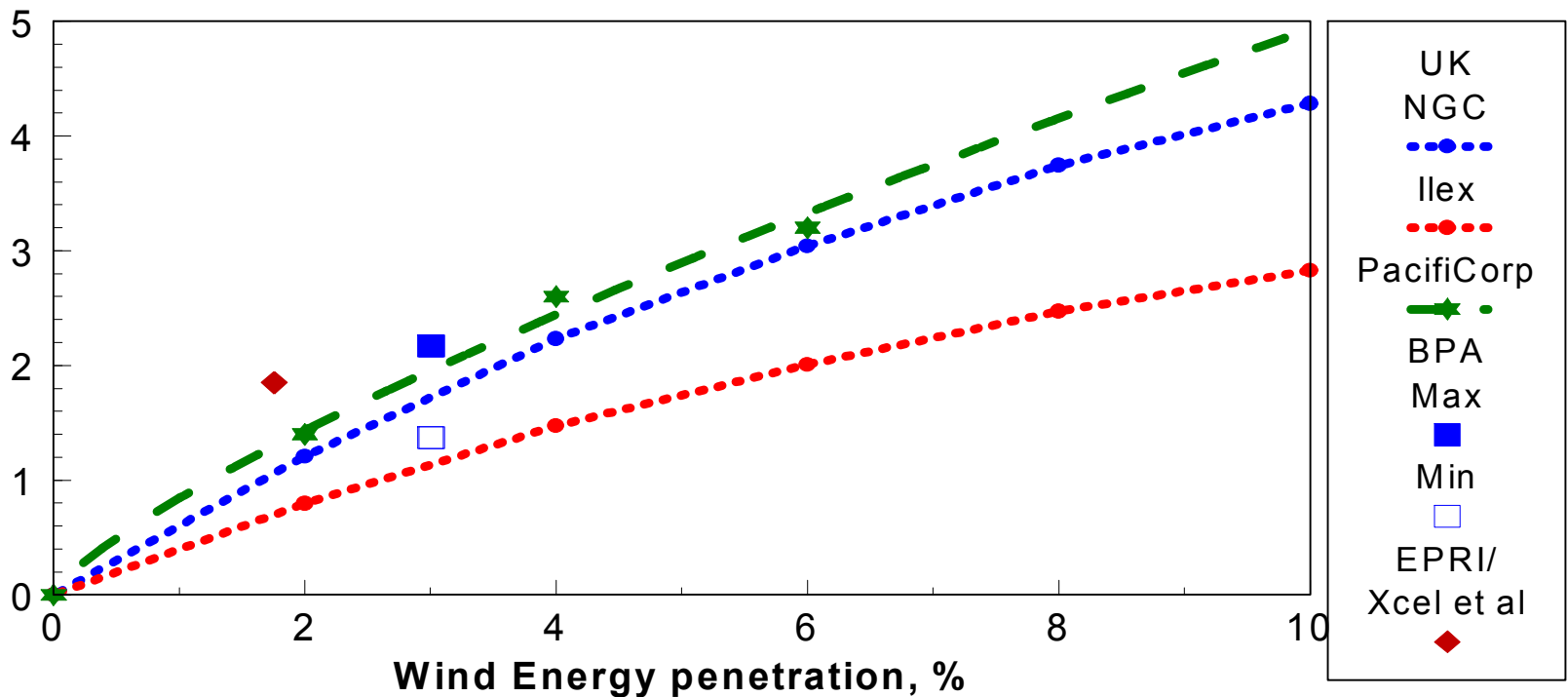
- General
 - CEGB+EU utilities, as part of co-ordinated study
 - Universities: Imperial, East Anglia, Oxford
- Grid operators: Eltra, NGT, Nordel, and US utilities
- PV studies, especially in California

Who has looked at integration issues more recently?

- Grid Operators
- UK DTI/Carbon Trust *Network Study*
 - Intermittency Module, has c.40 worldwide refs back to 1980
- DENA (Germany)
- Ministry of Economic Development (NZ)
- Sustainable Development Commission (UK)

Costs of backup

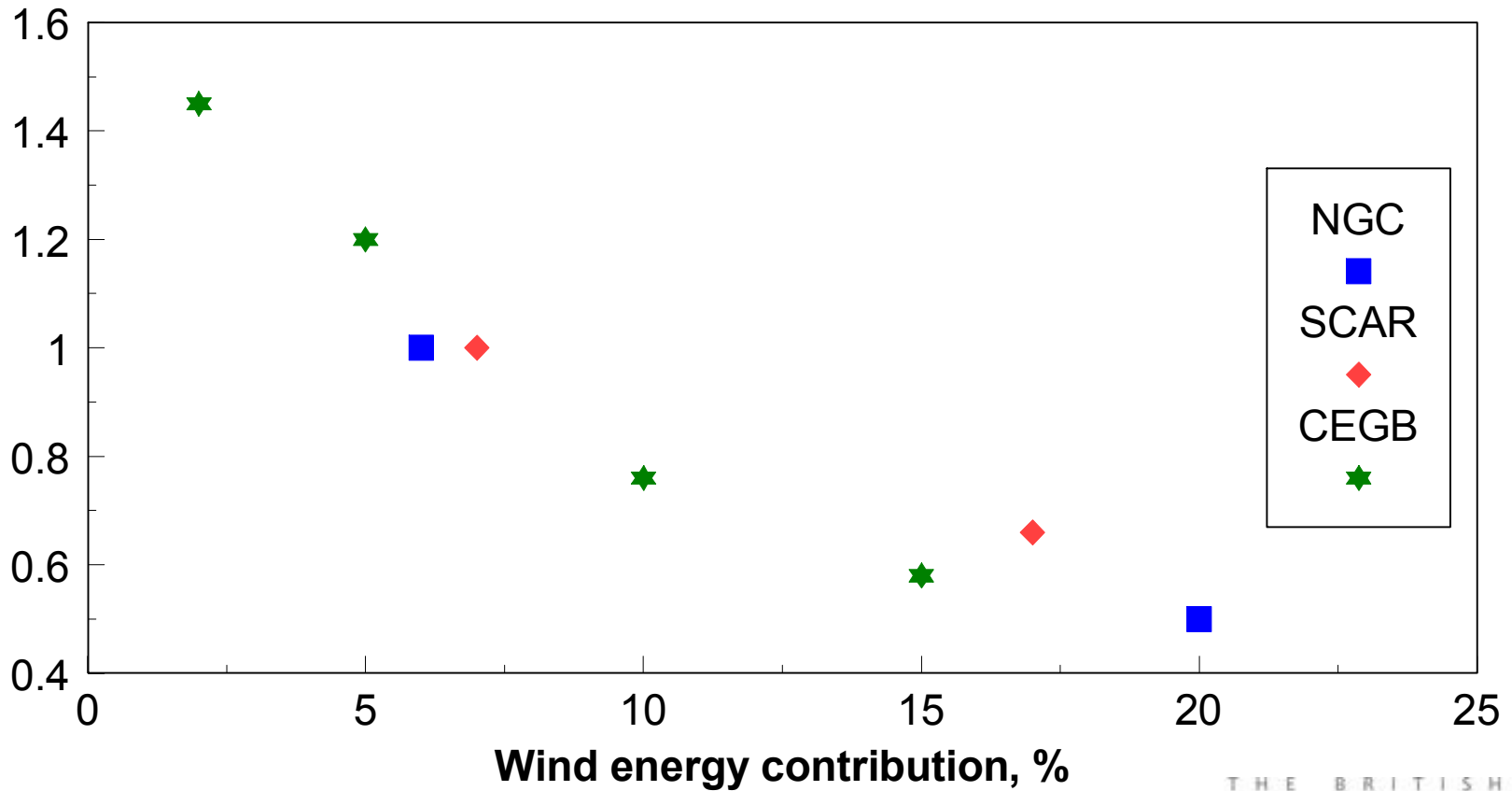
Cost of extra balancing, \$/MWh



Numerous studies, worldwide, and more in recent months

Capacity Credit

Capacity credit/annual capacity factor



Recent publications 1

- **German Energy Agency (DENA)**
- **February 2005 - Germany**

“Wind energy annual production can triple from 23.5 TWh in 2003 to 77.2 TWh in 2015, providing 14% of the German net electricity consumption in 2015”

Recent publications 2

- **Ministry of Economic Development**
- **May 2005 – New Zealand**

"wind energy could achieve levels of penetration and market share that are at least comparable with the higher levels currently achieved around the world, and which would have appeared far-fetched until only recently"

Recent publications 3

- **Sustainable Development Commission**
- **May 2005 – UK**

"It is generally considered that up to 20% wind capacity penetration is possible on a large electricity network without posing any serious technical or practical problems. Indeed, there is no absolute technical limit to UK wind capacity – instead the issue is an economic one"

And Finally...

“However, based on recent analysis of the incidence and variation of wind speed we have found that the expected intermittency of wind does not pose such a major problem for stability and we are confident that this can be adequately managed.”

“It is a property of the interconnected transmission system that individual and local independent fluctuations in output are diversified and averaged out across the system.”

“We believe that current levels of frequency response are sufficient even if the Government’s 2010 goal of 10 per cent of electricity supplies sourced from renewable fuels were all to be met by, say, wind technologies.”