Long-term Issues

This presentation assumes the use of best available wind turbine technology

Hugh Outhred

School of Electrical Engineering and Telecommunications

The University of New South Wales

Sydney, Australia

Tel: +61 2 9385 4035; Fax: +61 2 9385 5993;

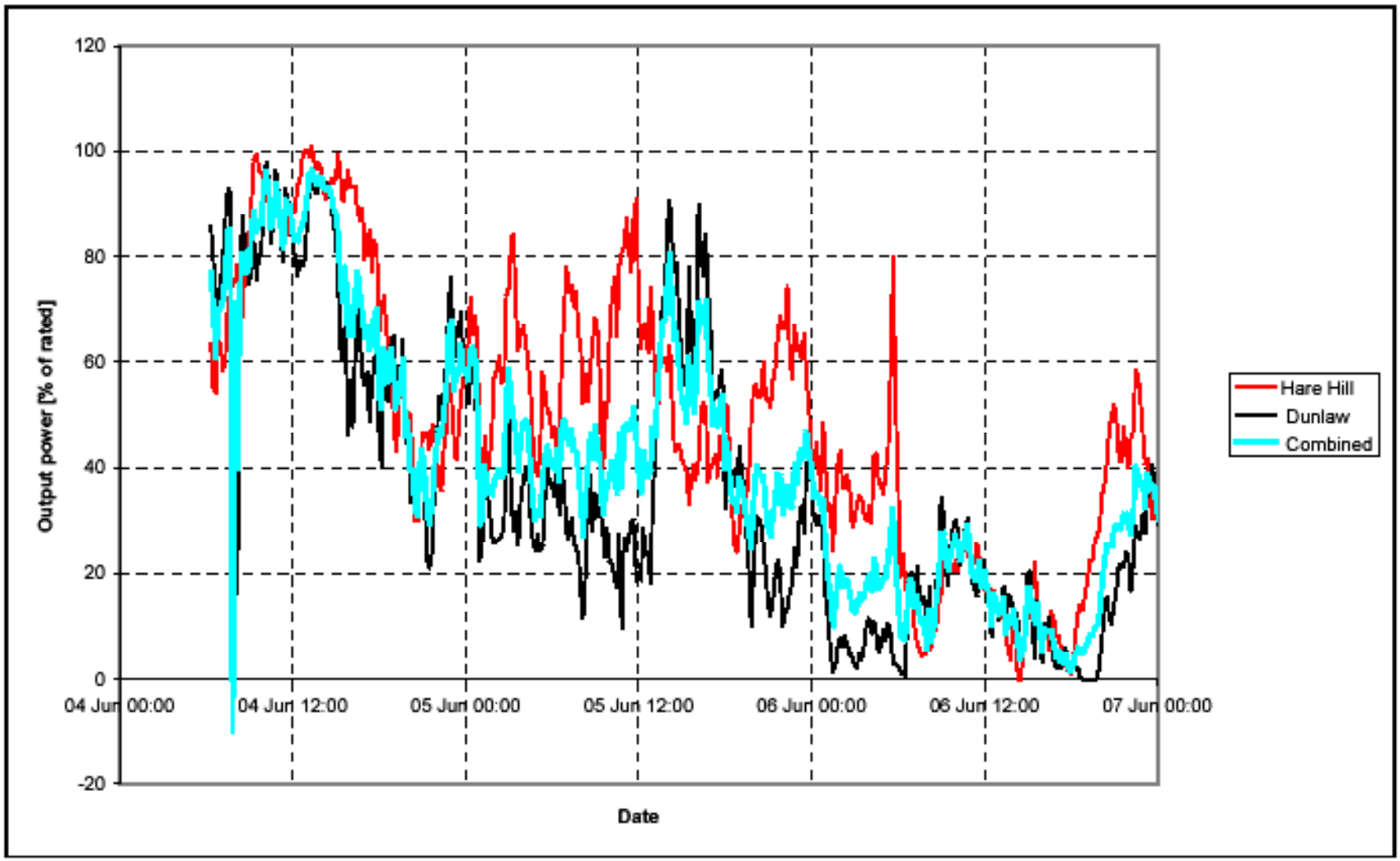
Email: h.outhred@unsw.edu.au

www.ergo.ee.unsw.edu.au

What are the key long term issues for the National Electricity Market?

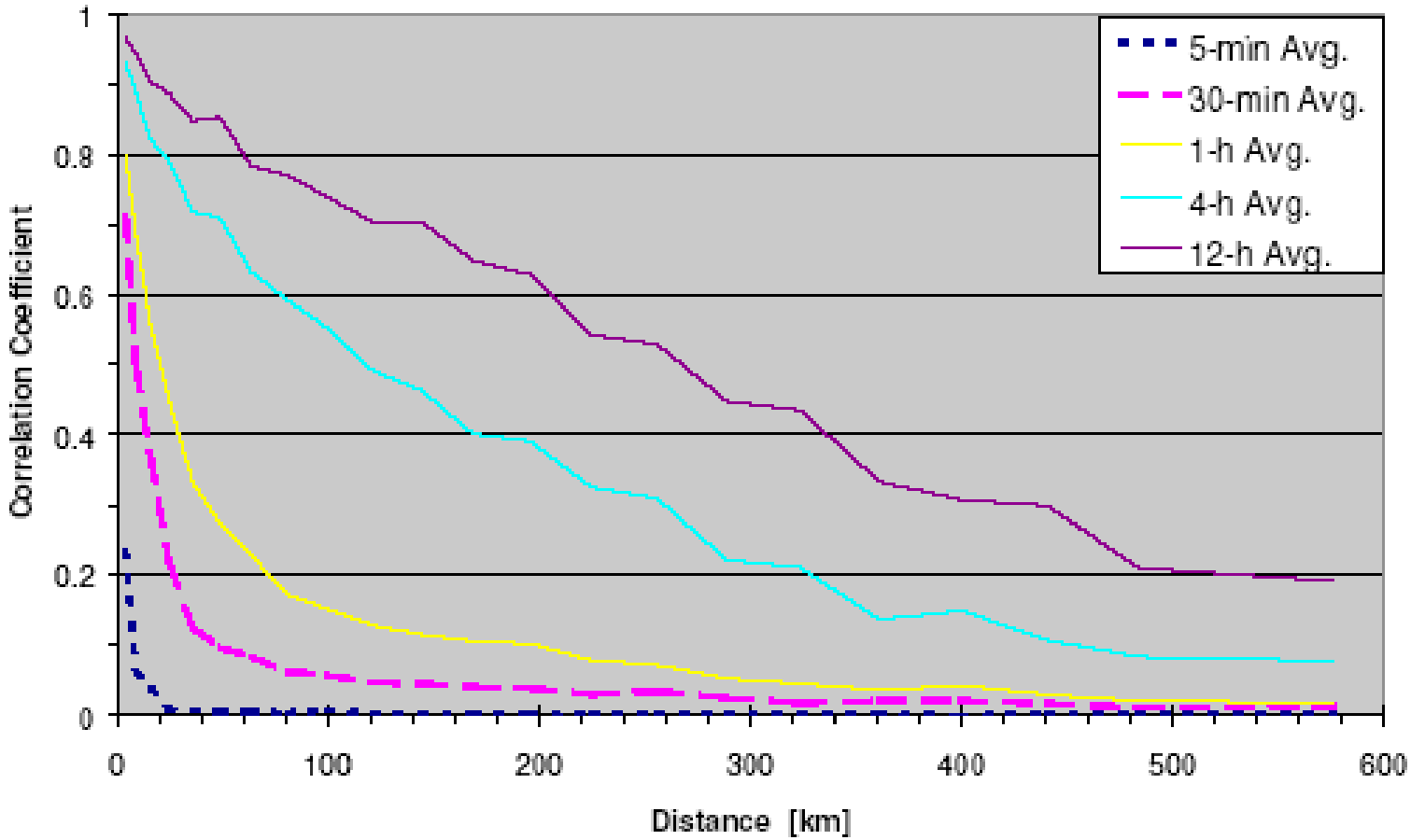
- Forecasts:
  - Medium Term Projection of System Adequacy:
    - Two year forecasts updated weekly
  - Statements of Opportunity:
    - Ten year forecasts updated annually
  - NSP annual planning statements
- Annual reliability assessments
- Derivative contracts:
  - CFDs, RECs

Combined output of 2 wind farms 80 km apart (Gardner et al, 2003)



Cross-correlations between measured power outputs of German wind farms

(Giebel (2000) Riso National Lab, Denmark)



Forecasting issues

- After diversity forecasts required
- Wind resource forecasting:
  - Regional & national rather than wind farm
    - Long=term trends, diurnal & seasonal patterns
- Wind farm installation:
  - Influenced by govt policy & developer strategy
  - Ideally, context provided by a regional plan
- *Geographical distribution of wind turbines & "back-up" required to assess network impact*

Predicted annual wind energy for Northern Europe for 34 years

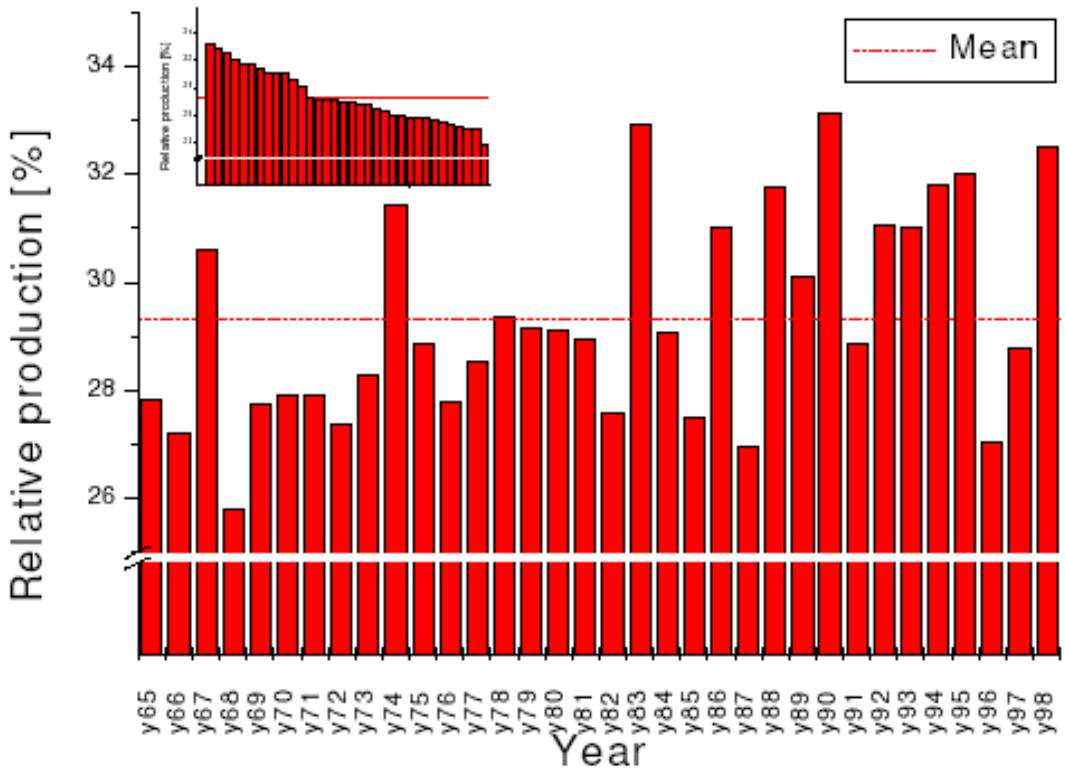


Figure 2: Mean wind power production in Northern Europe for 34 years as a percentage of installed capacity. In the inset: the same graph, ordered by size.

(Giebel (2000) - Riso National Lab, Denmark)

Forecasting challenges

- Wind resource forecasts based on either:
  - Extrapolation of historical data; or
  - Simulation using Numerical Weather Program
- Extrapolation of historical data:
  - Adequate data may not be available
  - May be unreliable due to long term trends
- Simulation using NWP:
  - Prediction ability may be uncertain
- *Will either approach accurately predict the output of one or many wind farms?*

Challenges for NSP Annual Planning Statements & Reliability Assessments

- Need for network services depends on spatial patterns of generation & demand:
  - Distribution of & production from wind farms
  - Location of "back-up" generation
  - *Uncertainties in wind farm output translate into uncertainties in network flows*
- Reliability assessment:
  - Depends on extreme events in wind behaviour:
    - Frequency & duration of occurrence & geographical pattern of wind speeds that are less than cut-in or greater than cut-out

Issues for NEM spot market

- Wind farms operate as “price takers”:
  - Generate whenever wind is blowing
- NEM spot market prices are volatile with a “rectangular” price distribution:
  - Prices are usually low, sometimes high
  - Timing of high prices irregular & hard to predict
- Value of wind energy in the spot market:
  - *Will depend on how regularly wind farms are producing when spot prices are high*

Derivative pricing for wind energy

- Wind farms may have to accept a lower CFD price than “flat contract” due to uncertainty in production:
  - Daily, Seasonal, Annual
- Wind farms may similarly have to accept a lower REC price than if dispatchable
- Pricing outcomes would be improved by liquid secondary markets in CFDs & RECs

Conclusions

- Issues for MTPASA & SOO:
  - Resource behaviour at regional & national levels
  - Trends in wind farm installation
- Issues for NSP annual planning statements:
  - Geographical patterns of power flow matter
- Issues for reliability assessment:
  - Extreme events (<cut-in; >cut-out)
    - Frequency & duration; geographical distribution
- Issues for spot & derivative markets
  - Uncertainty in price & volume

The three most important issues to allow 5000 MW wind in Australia

- Regional planning procedures that address network issues & stakeholder concerns
- A national strategy to achieve:
  - Adequate diversity in wind farm siting
  - Use of best available technology
- Forecasting techniques to predict diversified behaviour of wind farms:
  - Likely future production (days, months, years)
  - Characterisation of extreme events
  - Timing of significant changes in next few days