Use of data for optimal operation of energy systems

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Outline

- The future energy system – as seen by the Danish TSO (Energinet.dk)
- Quantities forecasted
- Available forecast types
- Examples
- Concluding remarks

Danish TSO – System Plan 2013

- Large amount of intermittent electricity production from wind and PV
- Significant transition of the other energy systems – heating, gas and transport
- Flexible consumption
- The intermittent resource is very large – all means must be used to buffer this

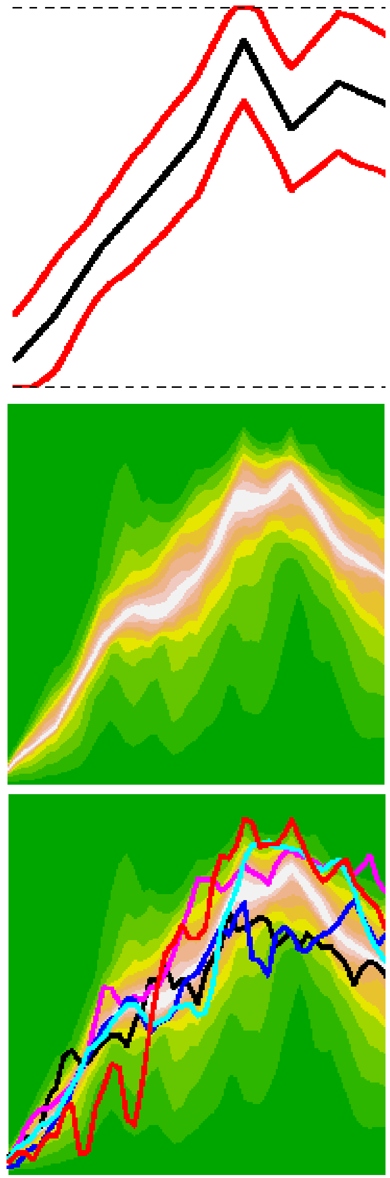
http://energinet.dk/SiteCollectionDocuments/Engelske%20dokumenter/Om%20os/System%20Plan_2013_UK_web.pdf

Quantities forecasted

- Power load
- Heat load
- Wind power production
- Solar power/thermal production
- Prices

Available forecast types

- Point forecasts (normal forecasts) – one value for each time point in the future often with simple error bands.
- Probabilistic or quantile forecasts – the full conditional distribution for each time point in the future.
- Scenarios – probabilistic correct scenarios of the future wind power production.

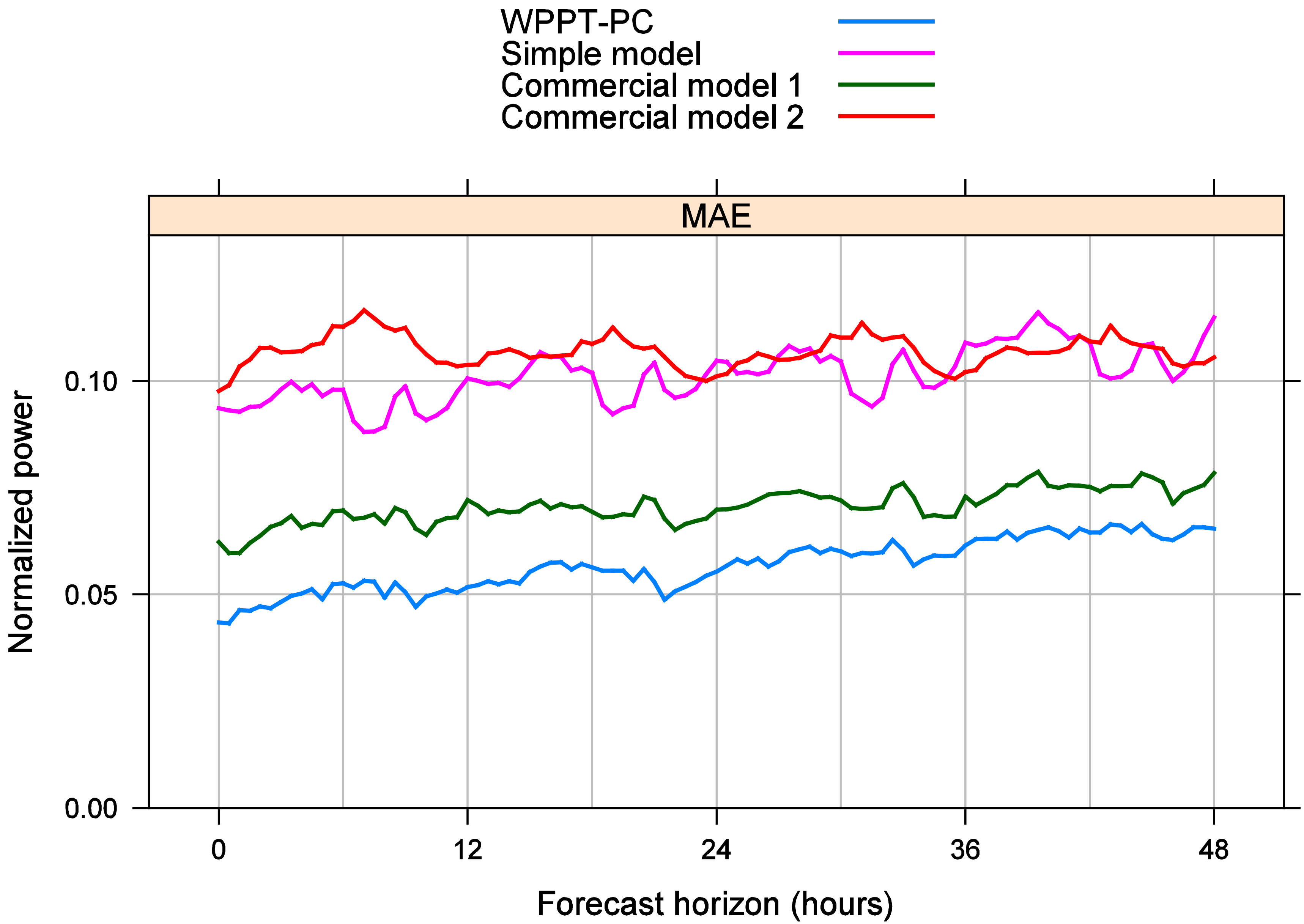


Why use advanced forecast types?

Point forecasts are simple to understand and use because they can be used in standard (deterministic) calculations.

However, still point forecasts of wind power production are uncertain and this uncertainty should be handled systematically.

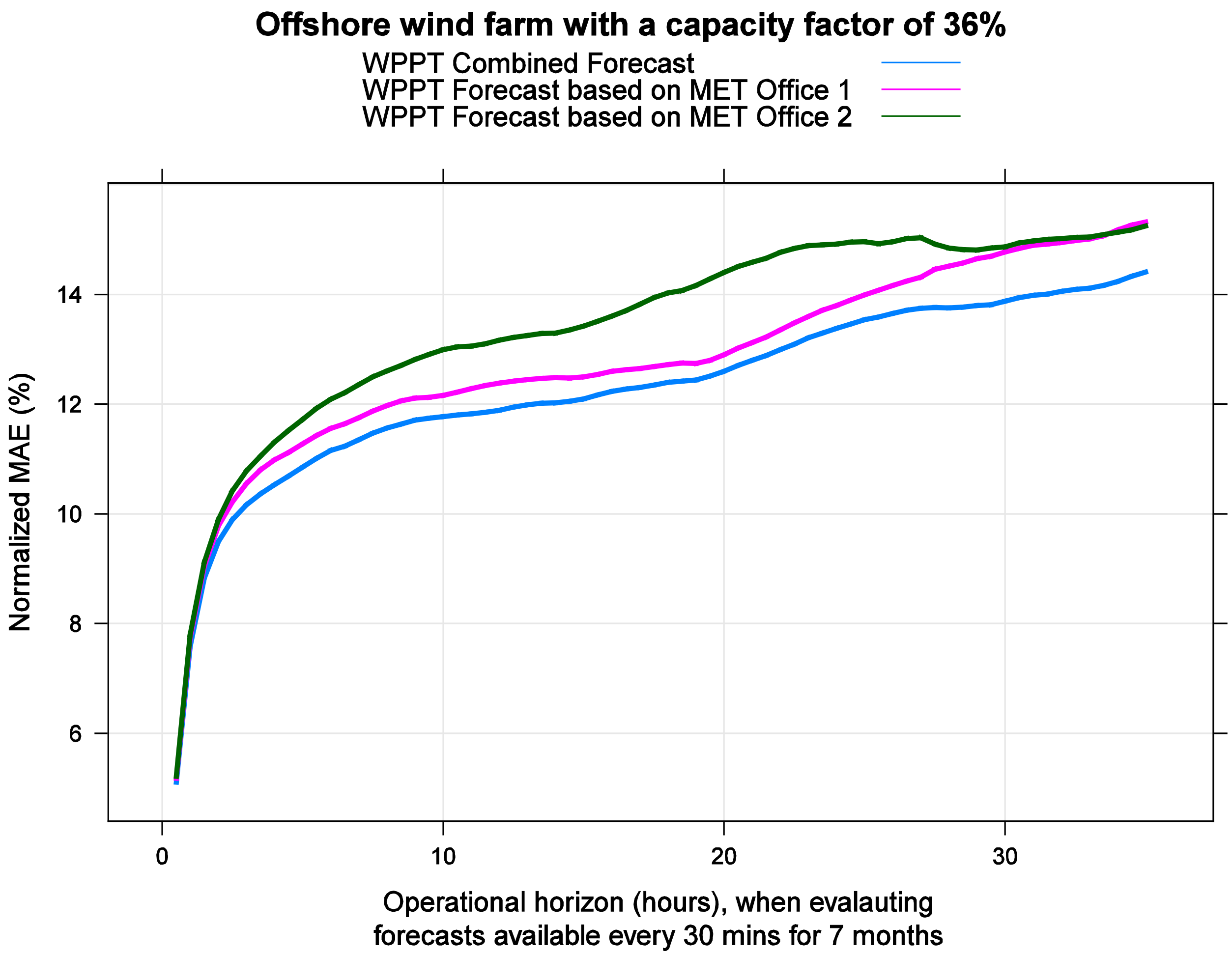
Focus should always be on providing the best possible point forecast and adding probalistic / scenario information on top of this.


WPPT-PC
Simple model
Commercial model 1
Commercial model 2
MAE
Normalized power
0.00
0.05
0.10
0
12
24
36
48
Forecast horizon (hours)

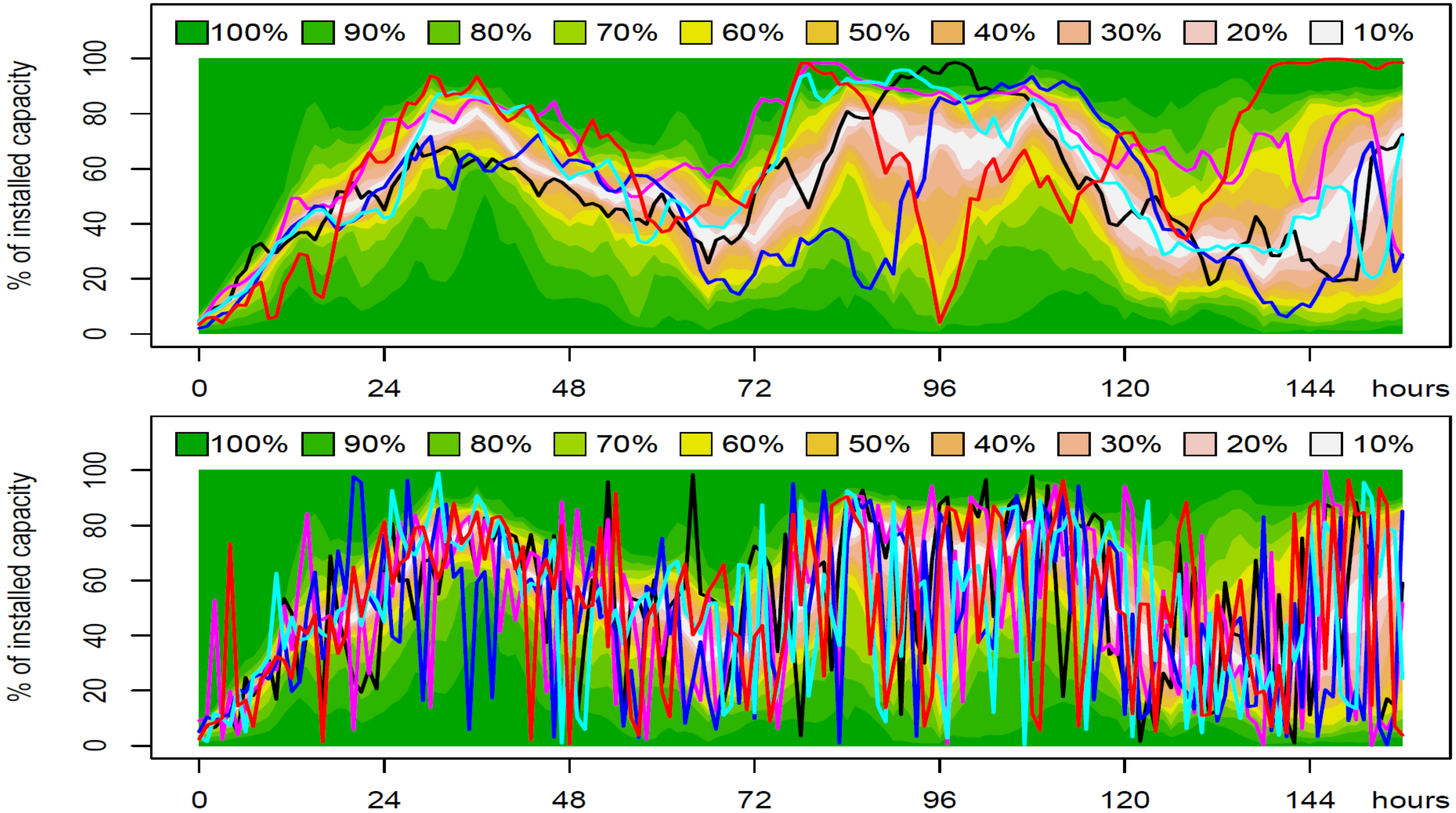
Optimally combined forecasting

- Difficult offshore site
- WPPT setups for two NWP providers
- WPPT optimally combine the forecast
- The resulting forecast performs better than the best individual forecast
- Increased operational robustness

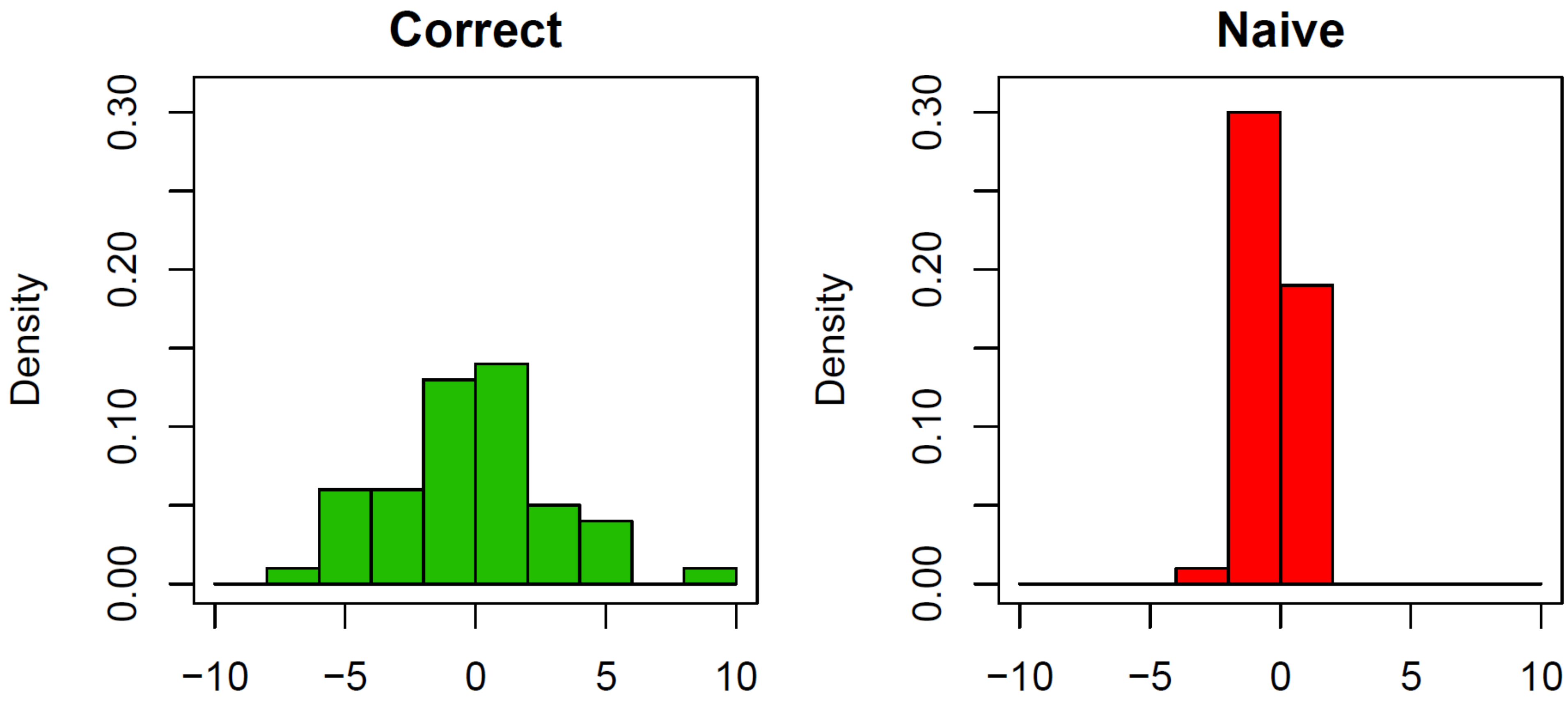
- Similar results in other areas of application, e.g. solar power.



Correct (top) and naïve (bottom) scenarios



Example: Balancing wind power



Based on 50 day ahead scenarios for the specific forecast on the previous slide

Concluding remarks

- Future energy systems must be able to handle large amounts of intermittent electricity production
- Forecasts required for decision support on a large range of time scales
- Forecast systems benefit from combining multiple NWP data with measurements of the quantity forecasted