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Summer Review & Demand Forecasting Update

Jeremy Caplin – Energy Forecasting Manager

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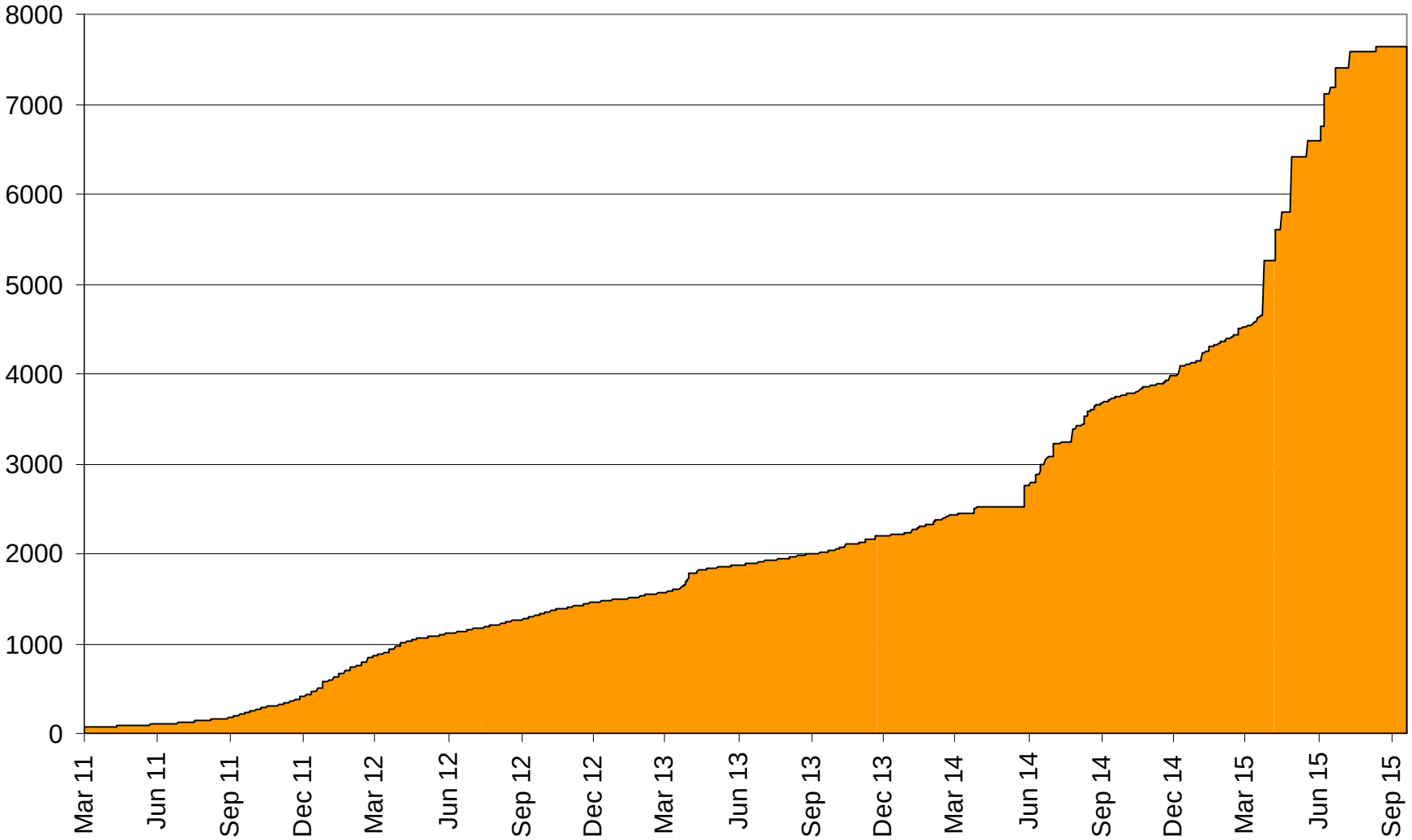
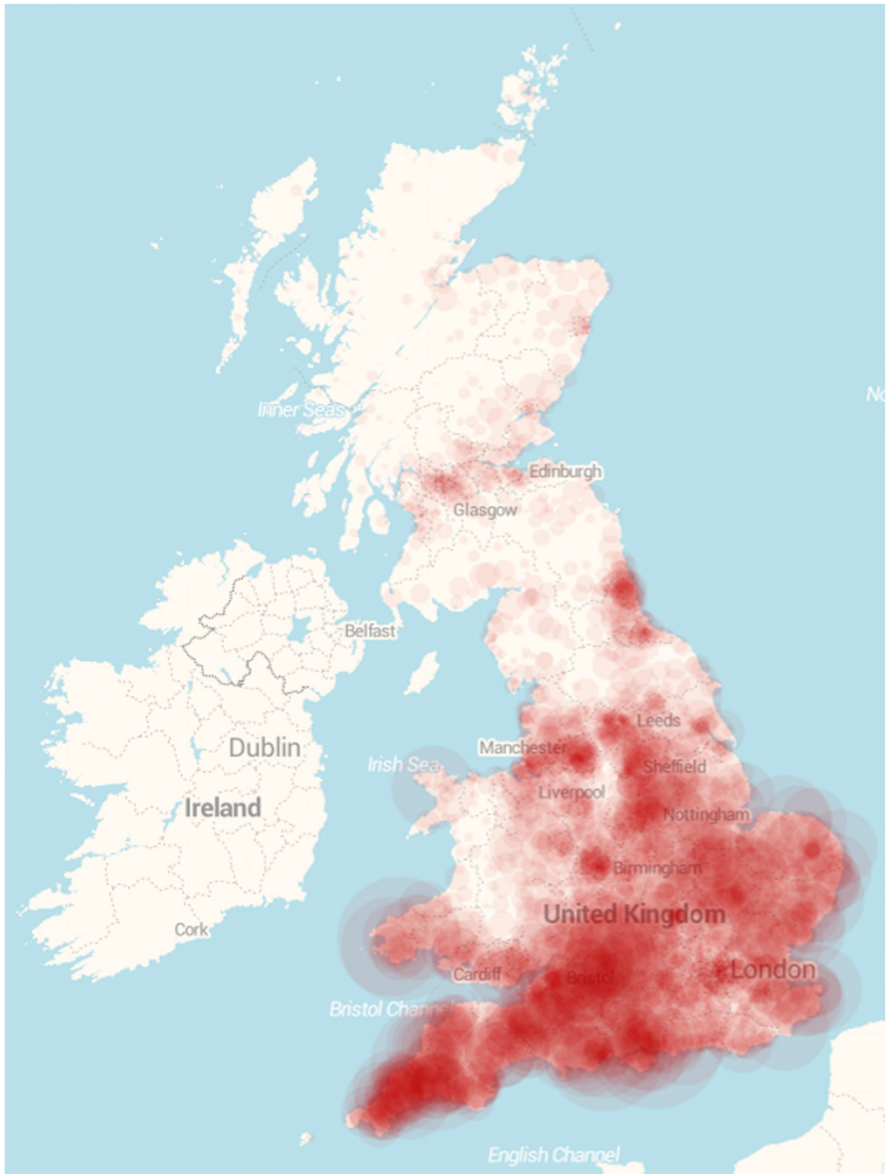
Summer Review

- Growth in Solar Capacity and Generation
- Effect of PV on Transmission System
- PV Forecasting
  - Current methodology
  - Developments

Growth in Solar Generation



Location of individual PV sites



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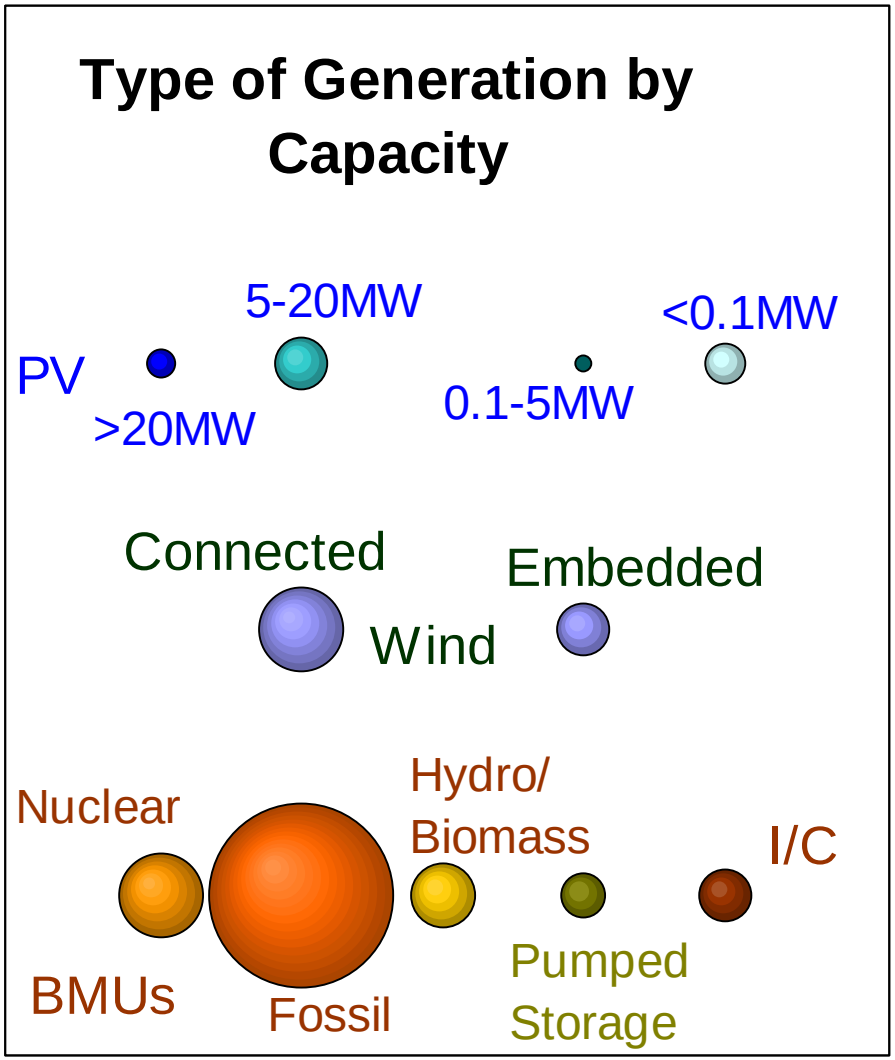
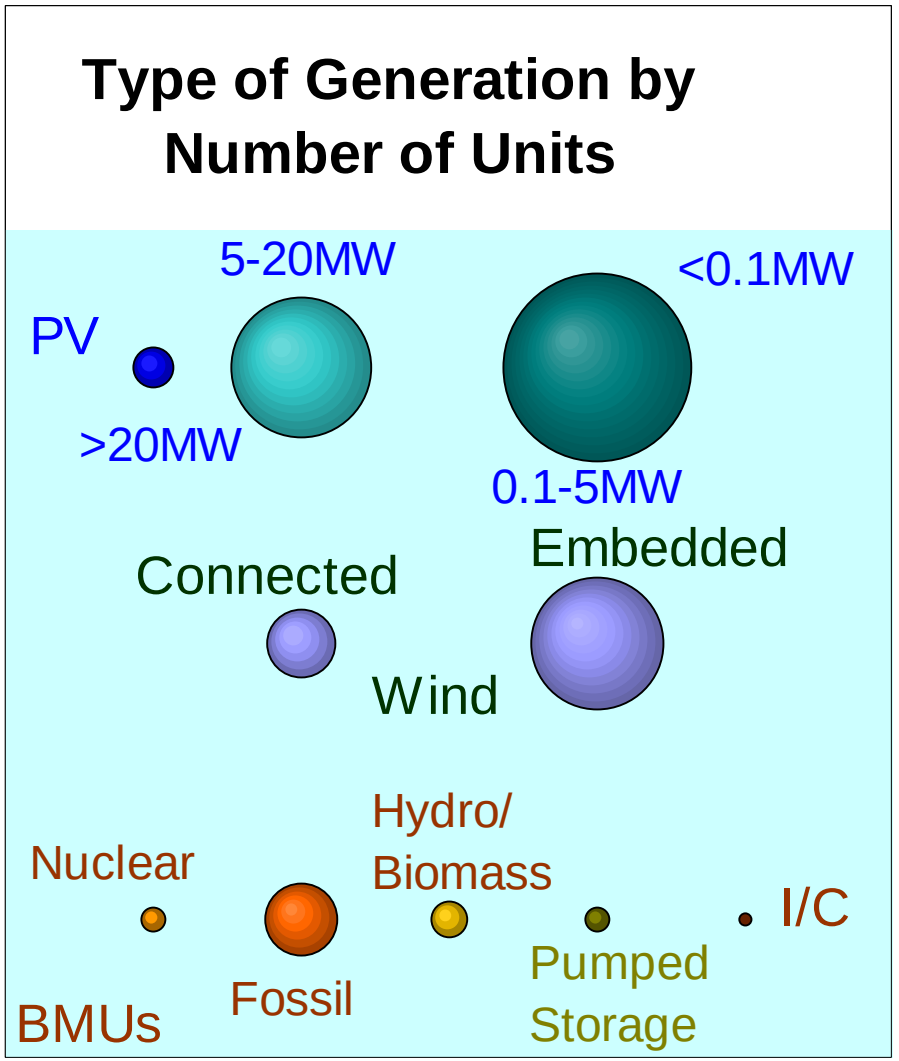
Current Generation Capacity





PV This Summer

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- **All values are estimates based on observed solar radiation data**
  - Maximum Daily Energy **64,900** MWh
- Peak Generation **6,960** MW
  - Maximum percentage of total daily national energy demand met by PV **8.6** %
- Maximum percentage of half hourly generation met by PV **19**%

Effect of PV on Transmission System

- PV generation connected to DNO networks suppresses demand on Transmission System
- Increasing Volatility of Transmission System Demand
  - Up to 3860 MW difference in peak PV on consecutive days
  - Up to 1320 MW increase in 30 minutes
- Increasing reliance of weather forecasts
- Greater uncertainty in some weather conditions
- Increasing uncertainty of Transmission System Demand

Increasing Volatility

Two consecutive Saturdays in June

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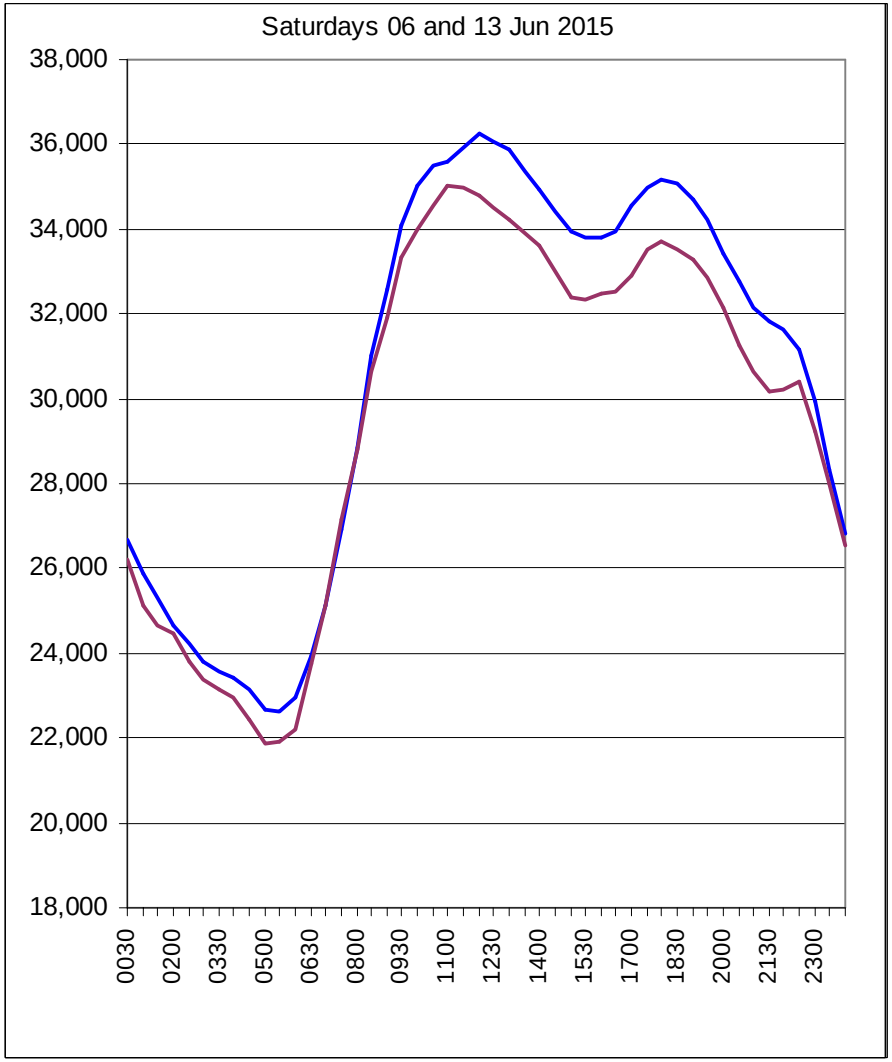
Difference between sunny and cloudy Saturdays

Saturday
6th June

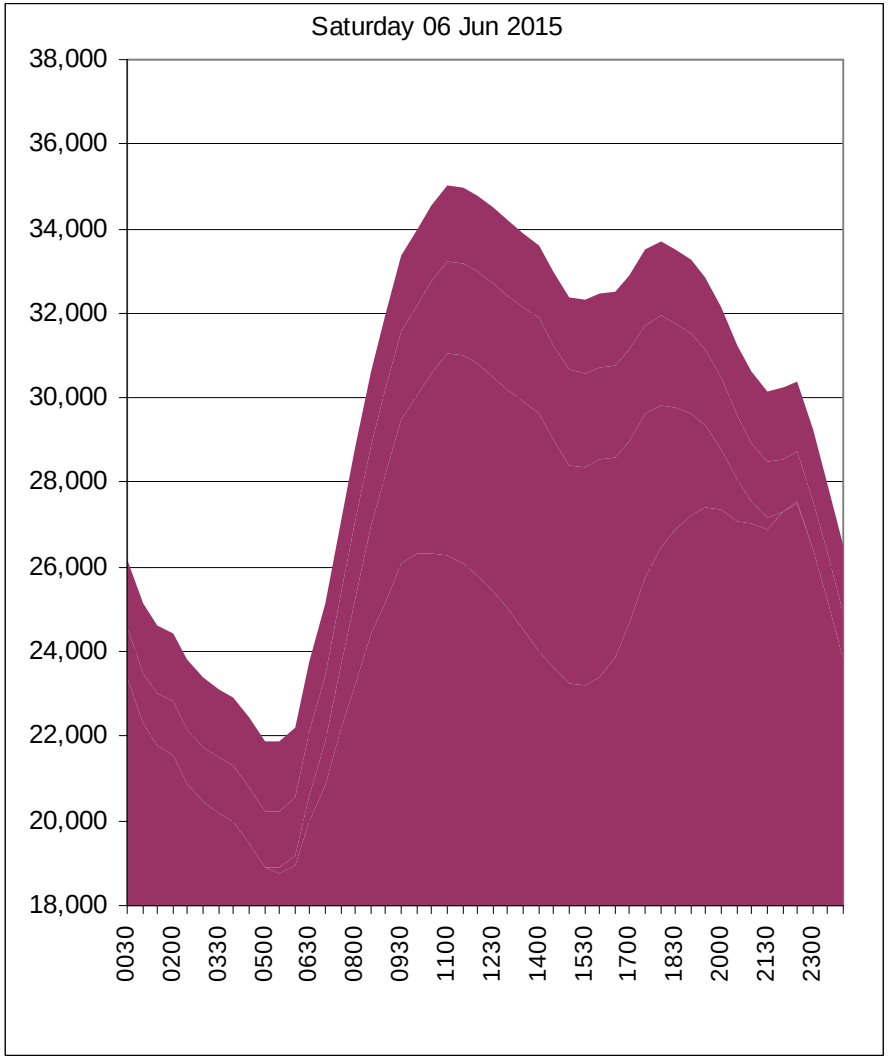
- Sunny
- Windy

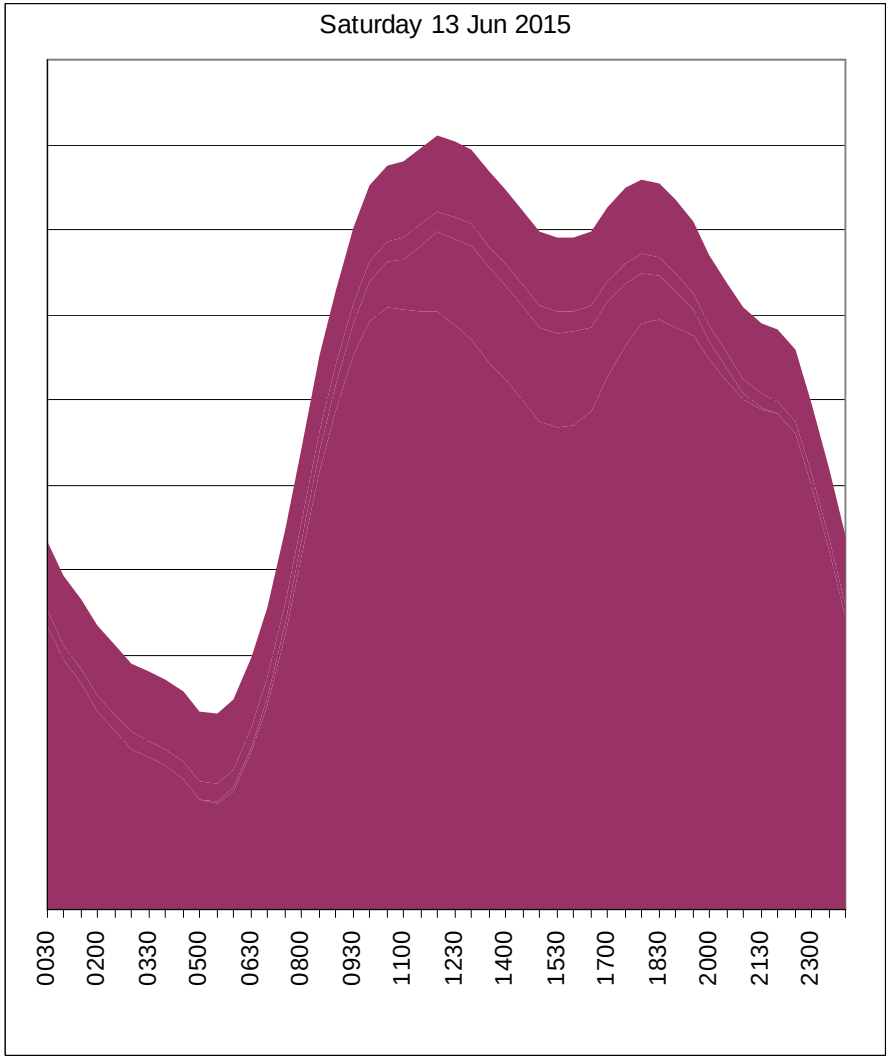


Saturday
13th June

- Overcast
- Still

Difference between sunny and cloudy Saturdays





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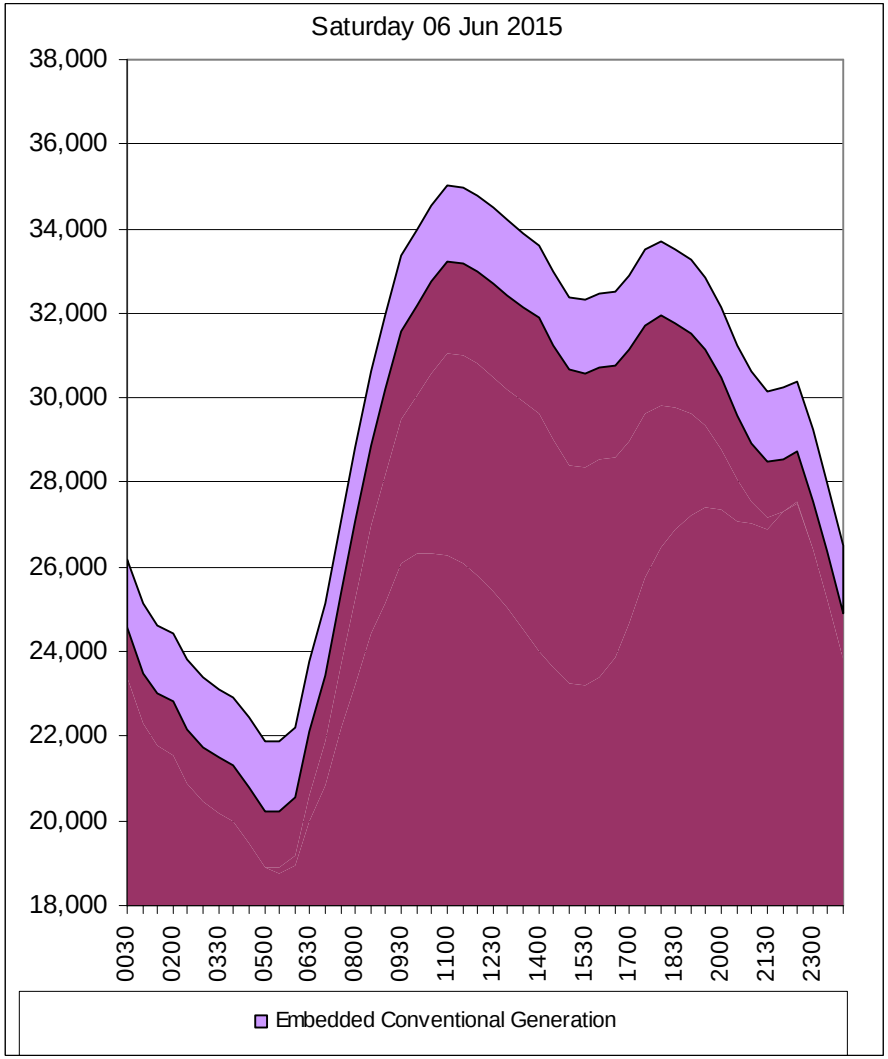

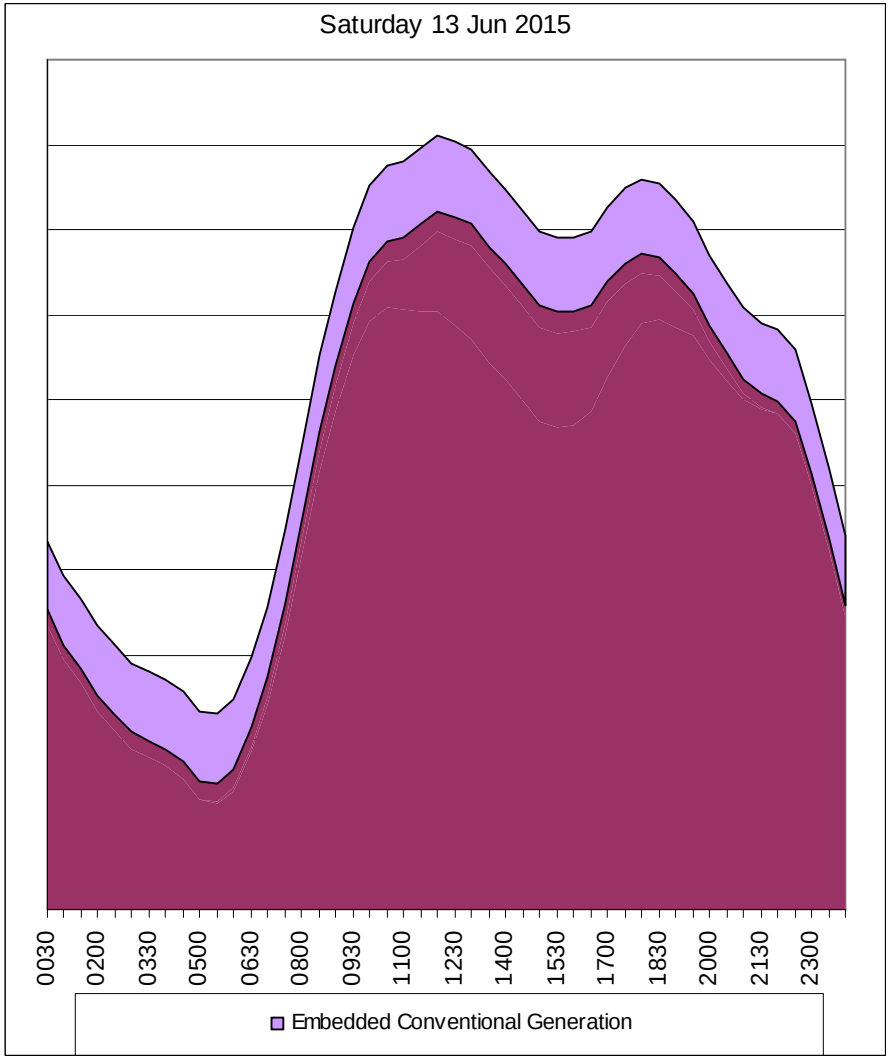

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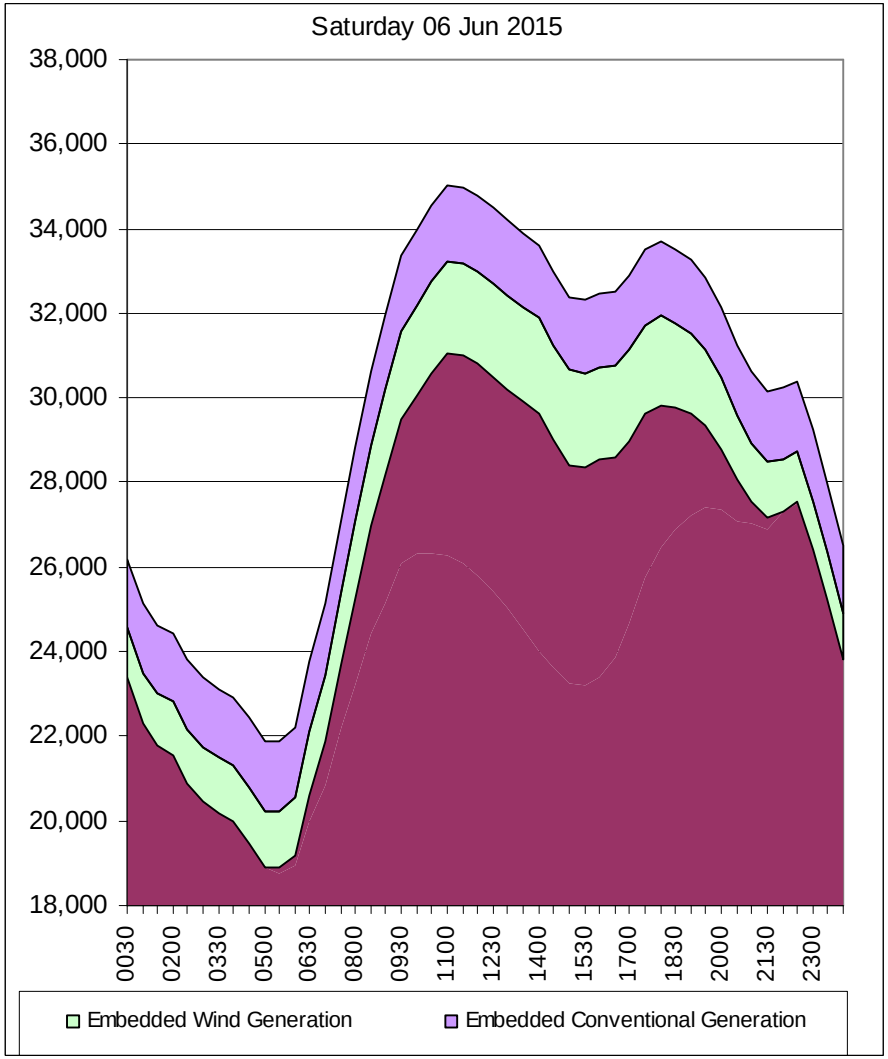

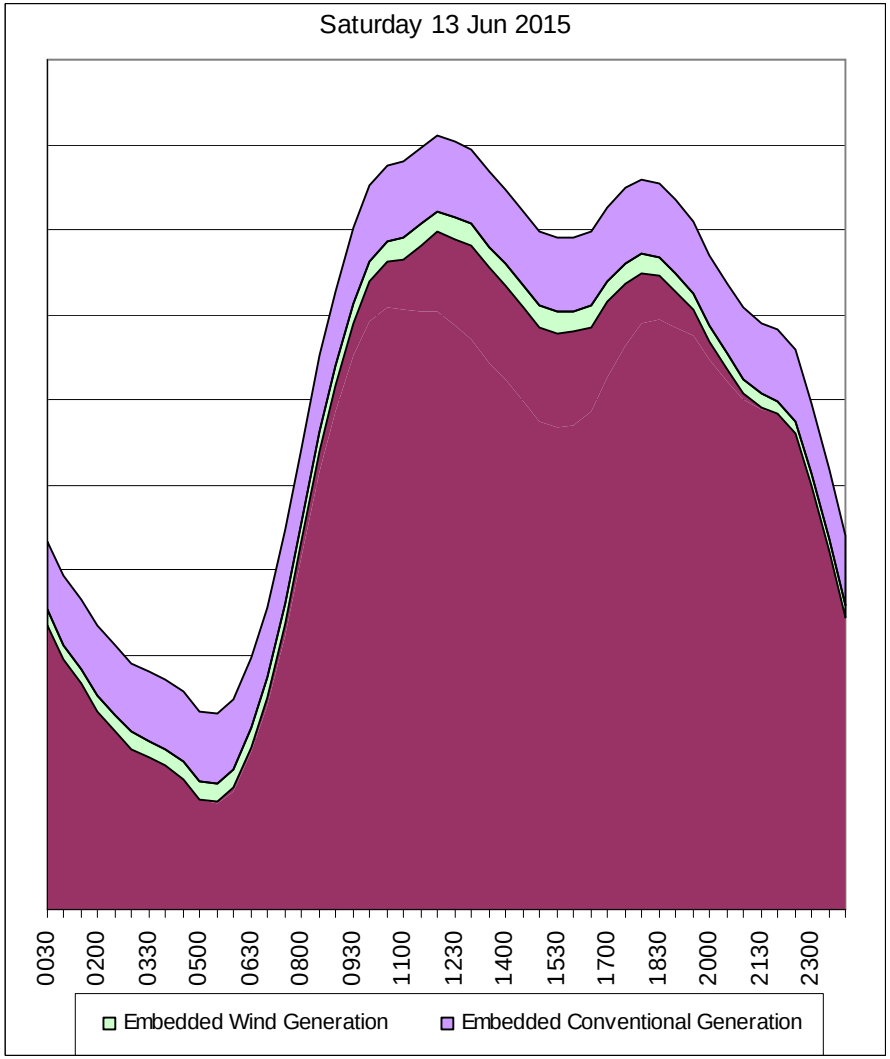

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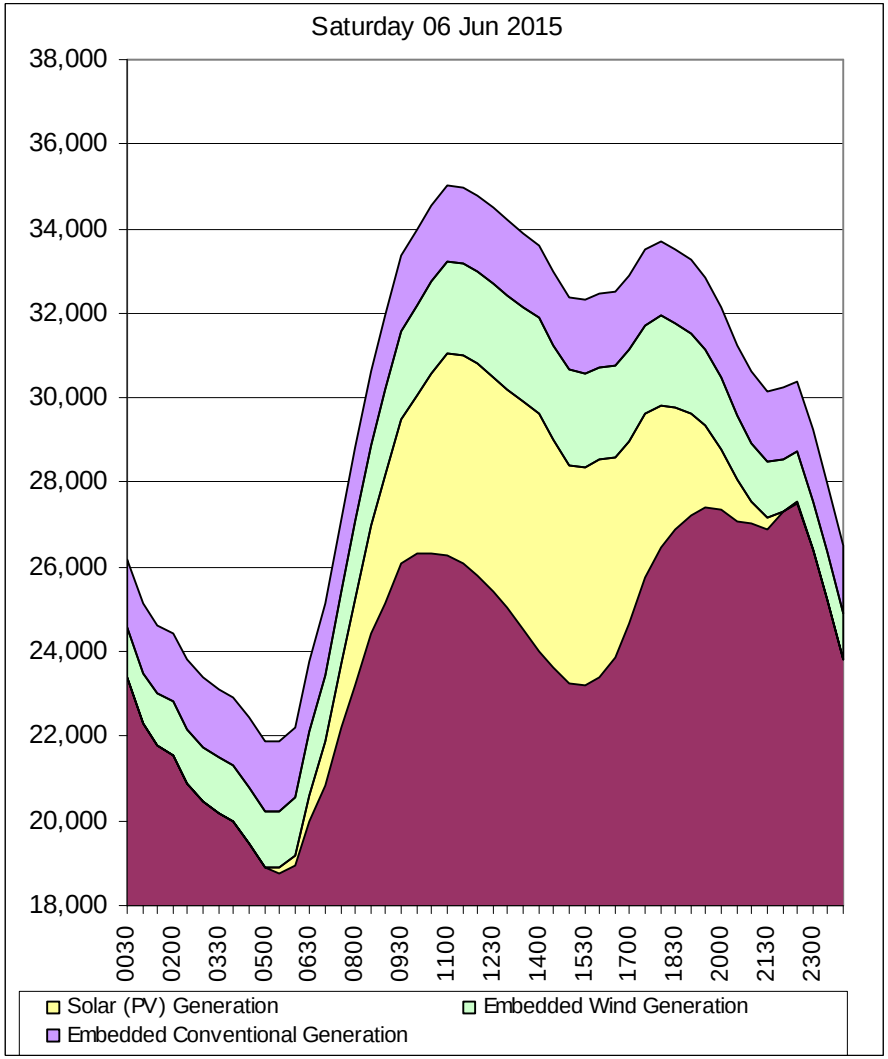

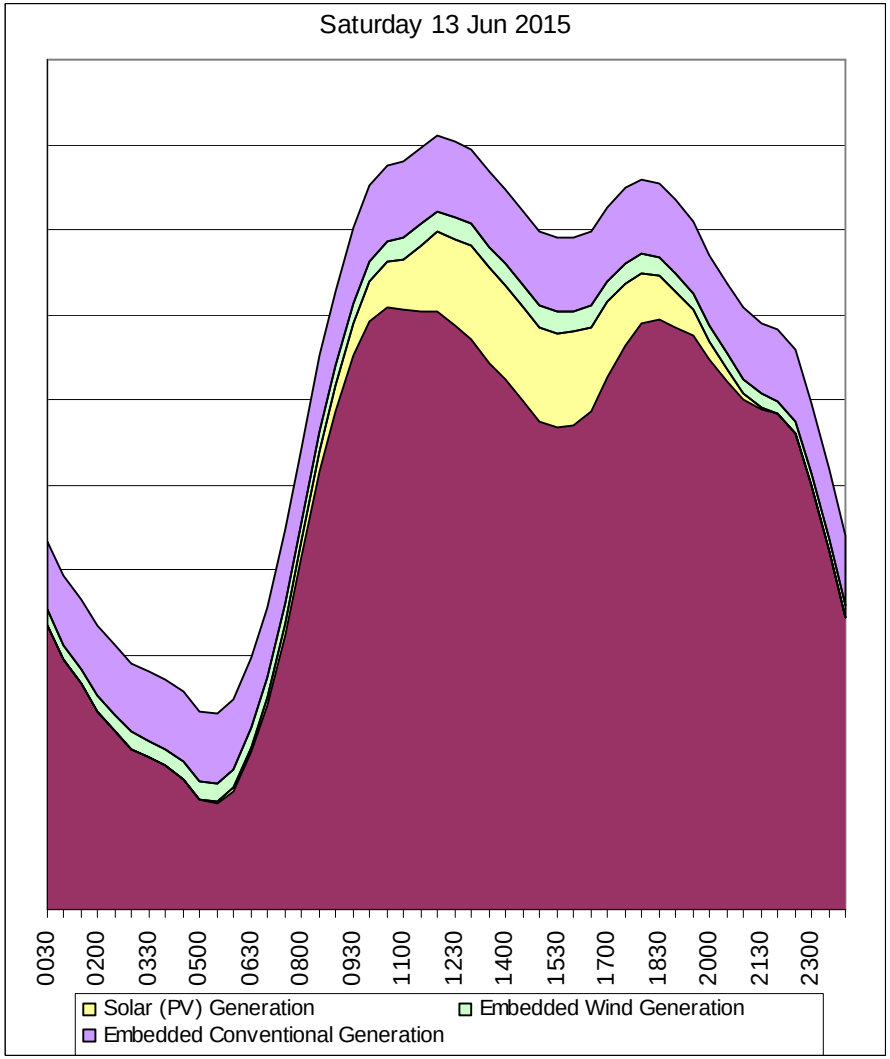

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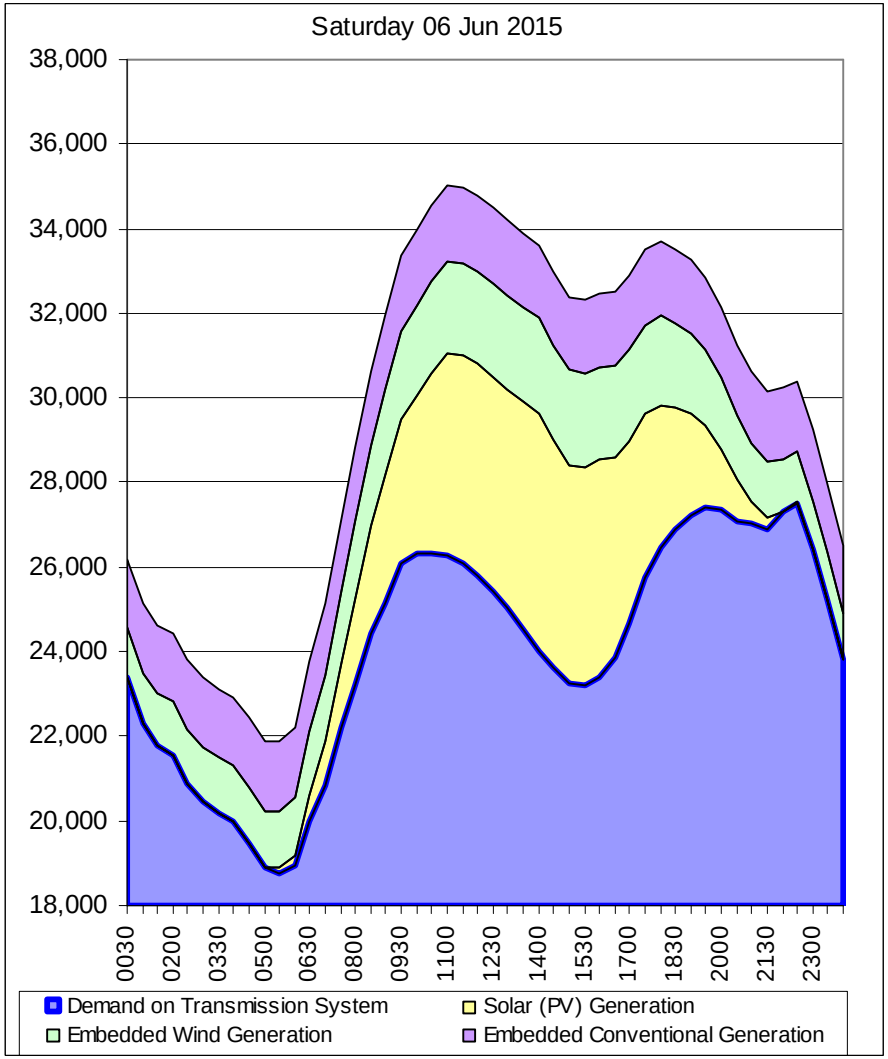

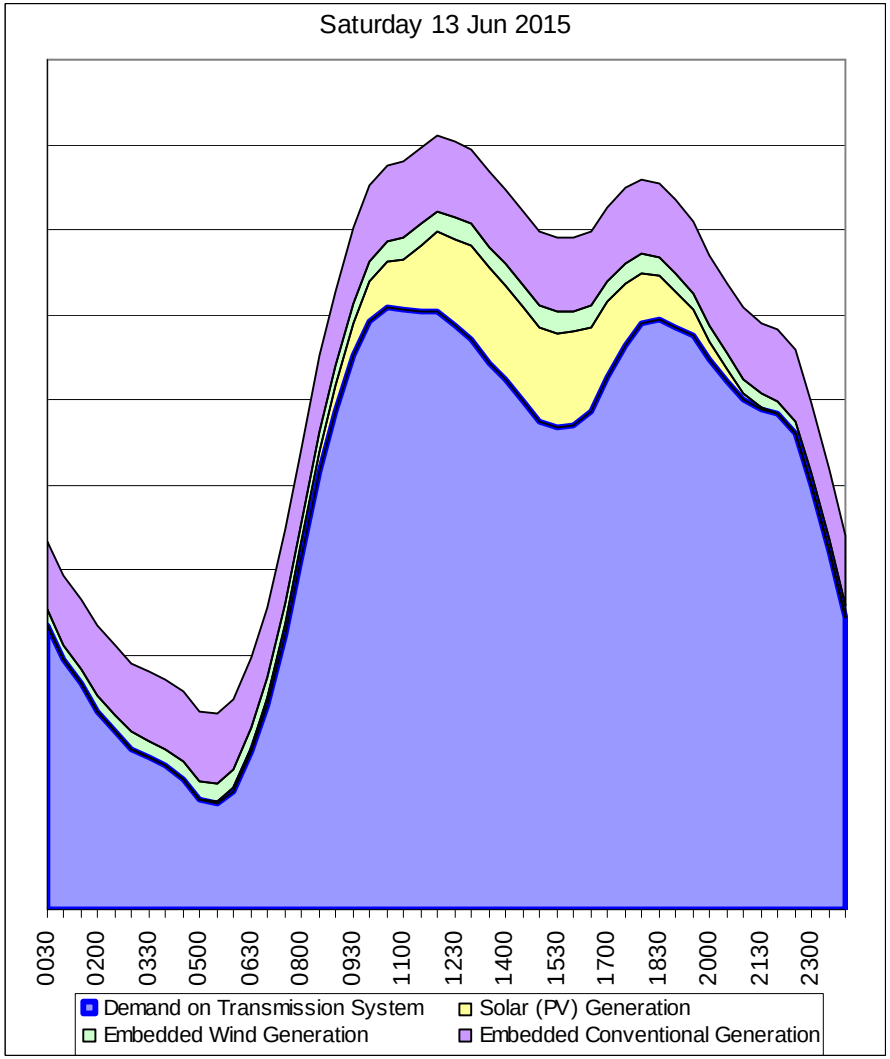

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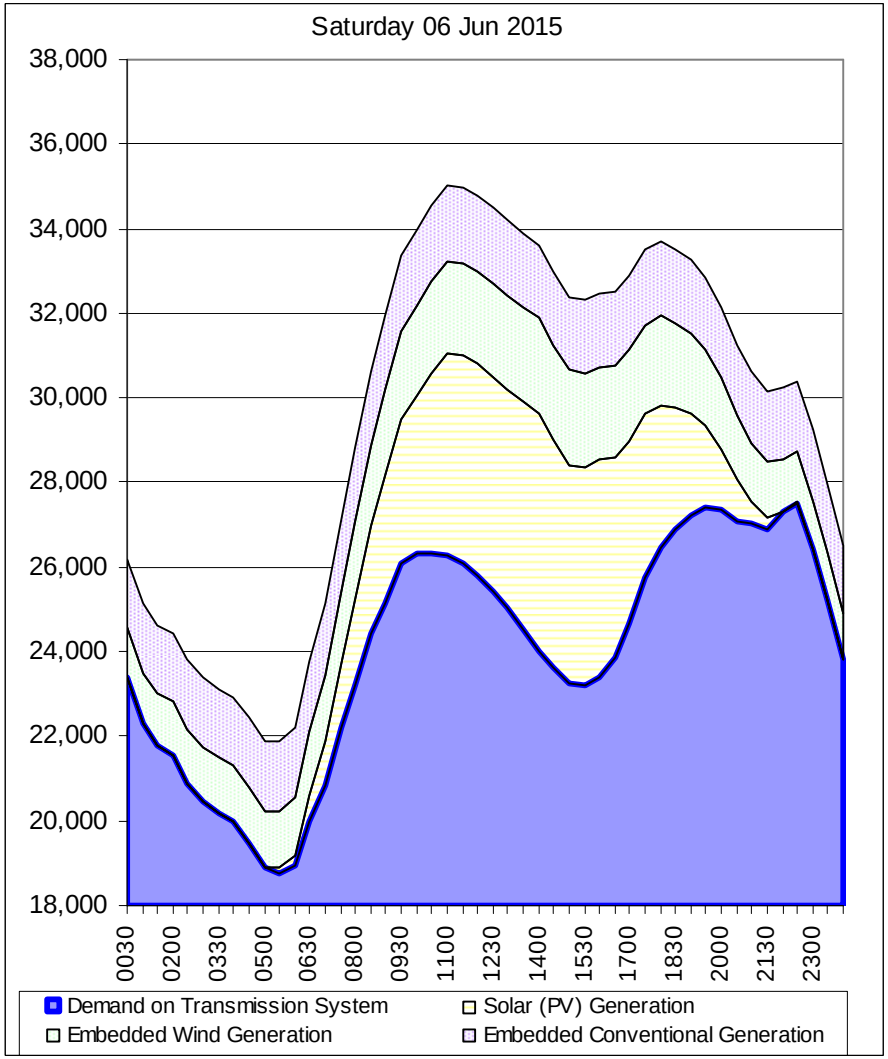
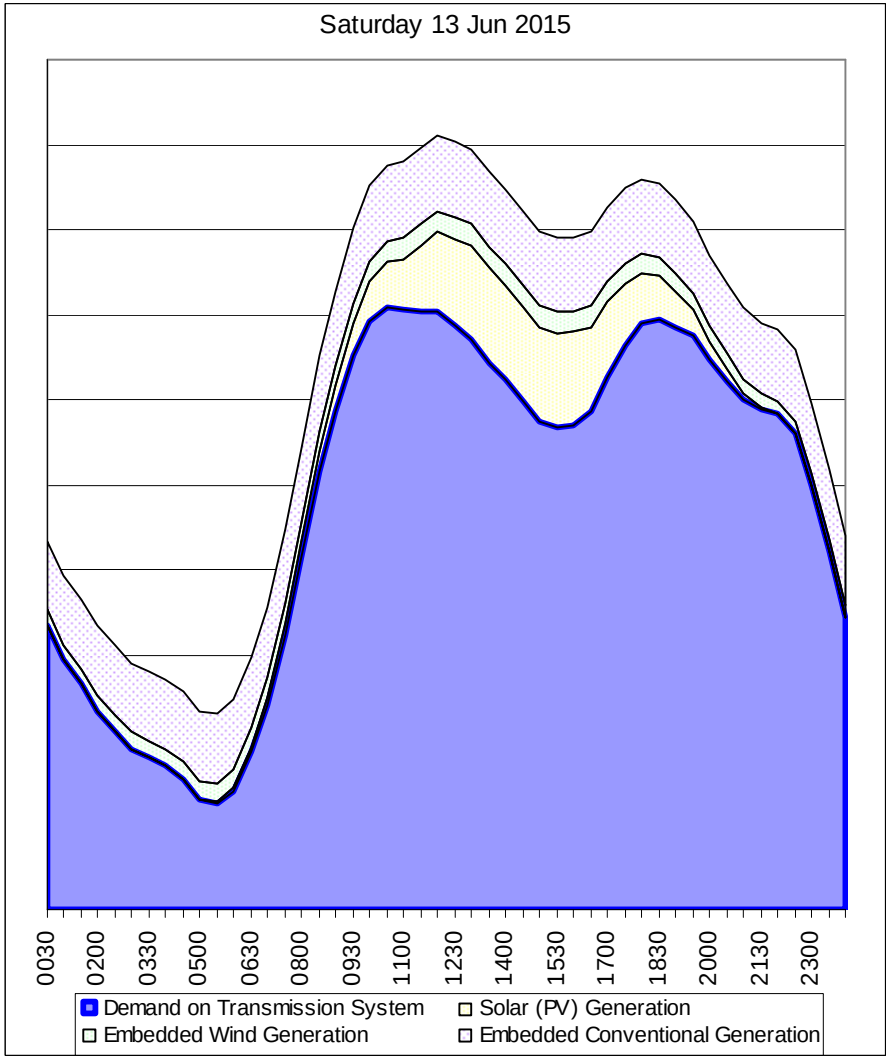
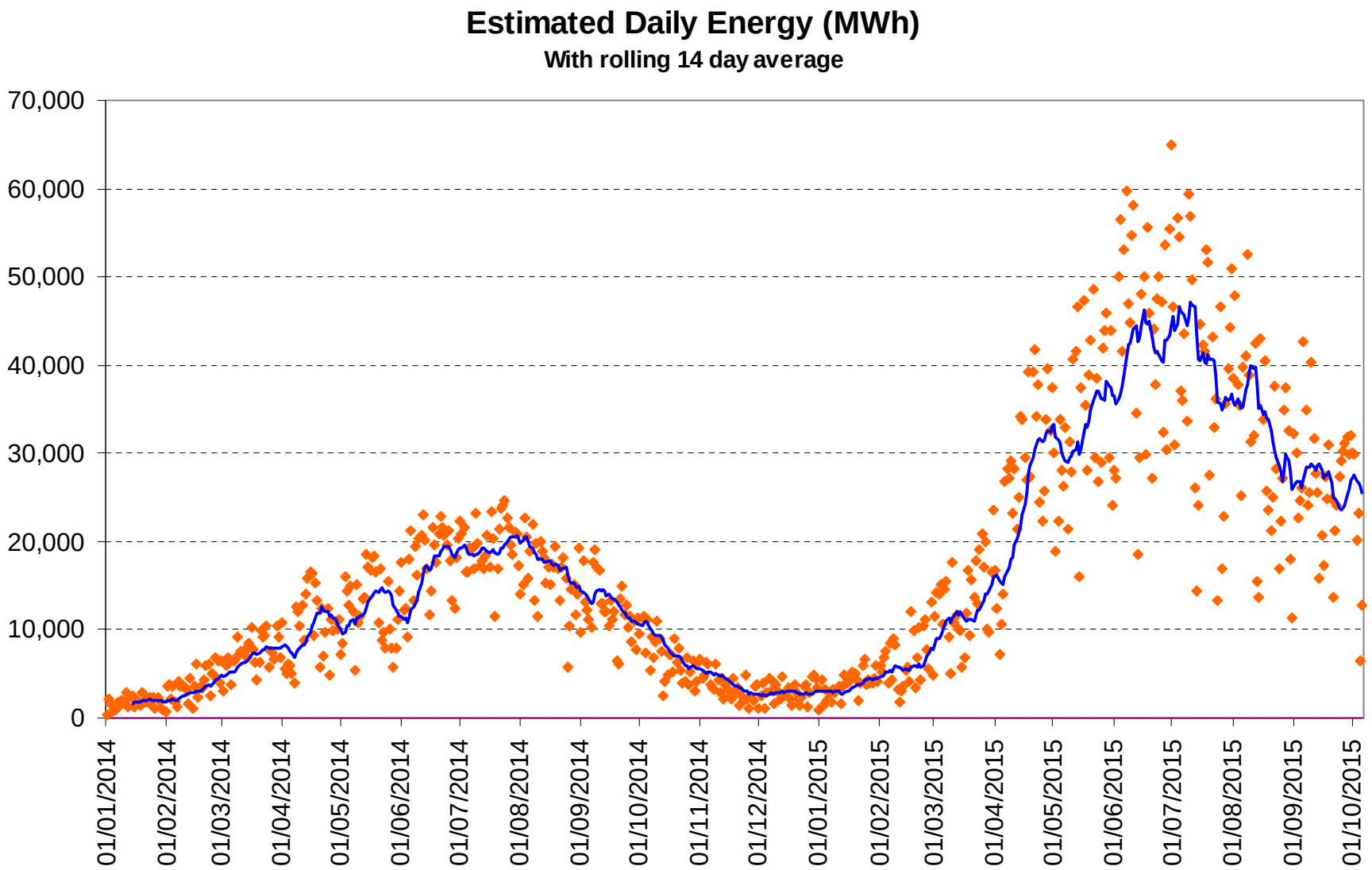




Increasing Volatility – Growth in Daily Energy



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Increasing Reliance on Weather Forecasts

- Solar Radiation is hard to forecast
- Physics of cloud formation highly complex
- Some metrological conditions particularly challenging
- Can see large errors – particularly when clouds form unexpectedly

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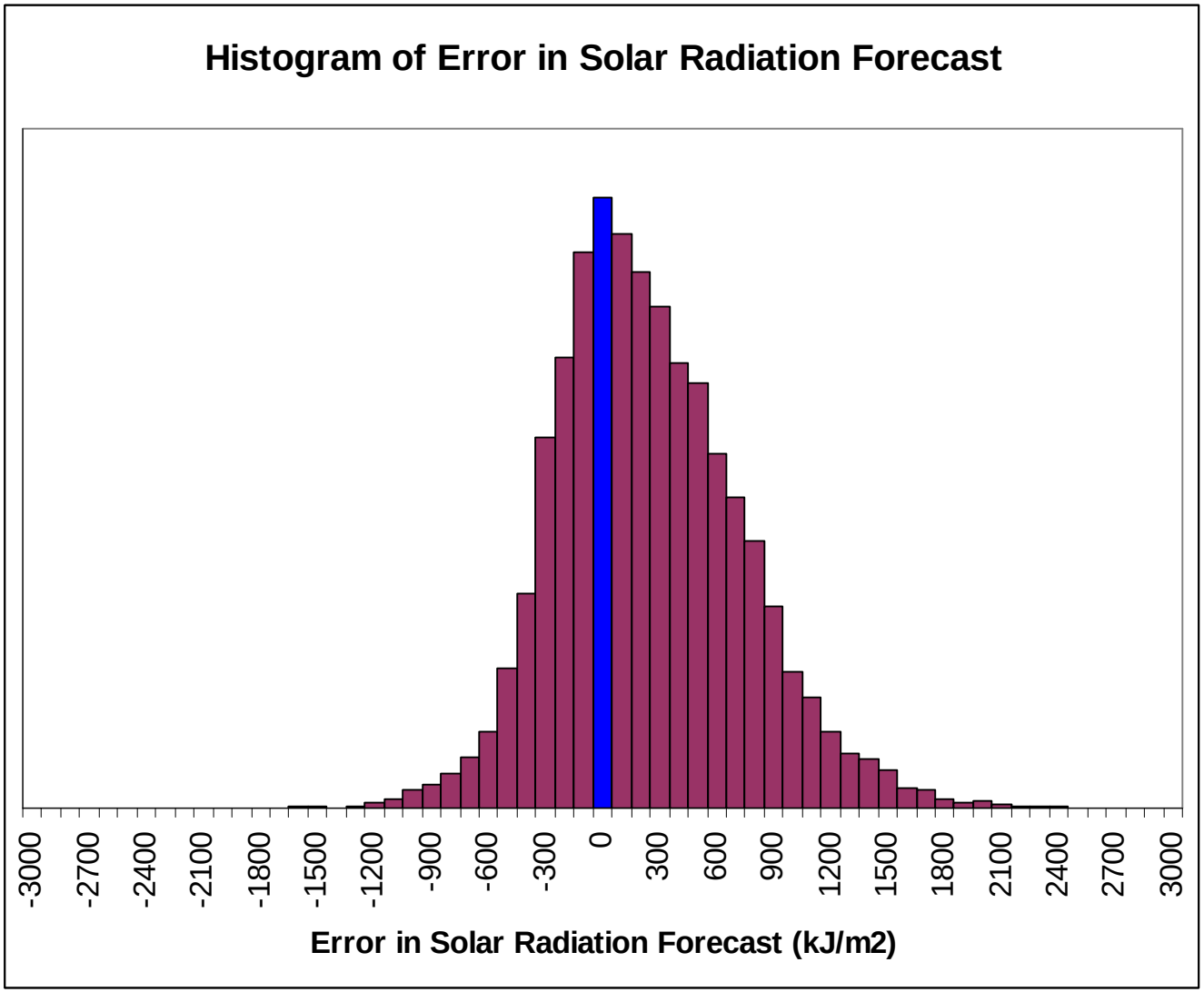
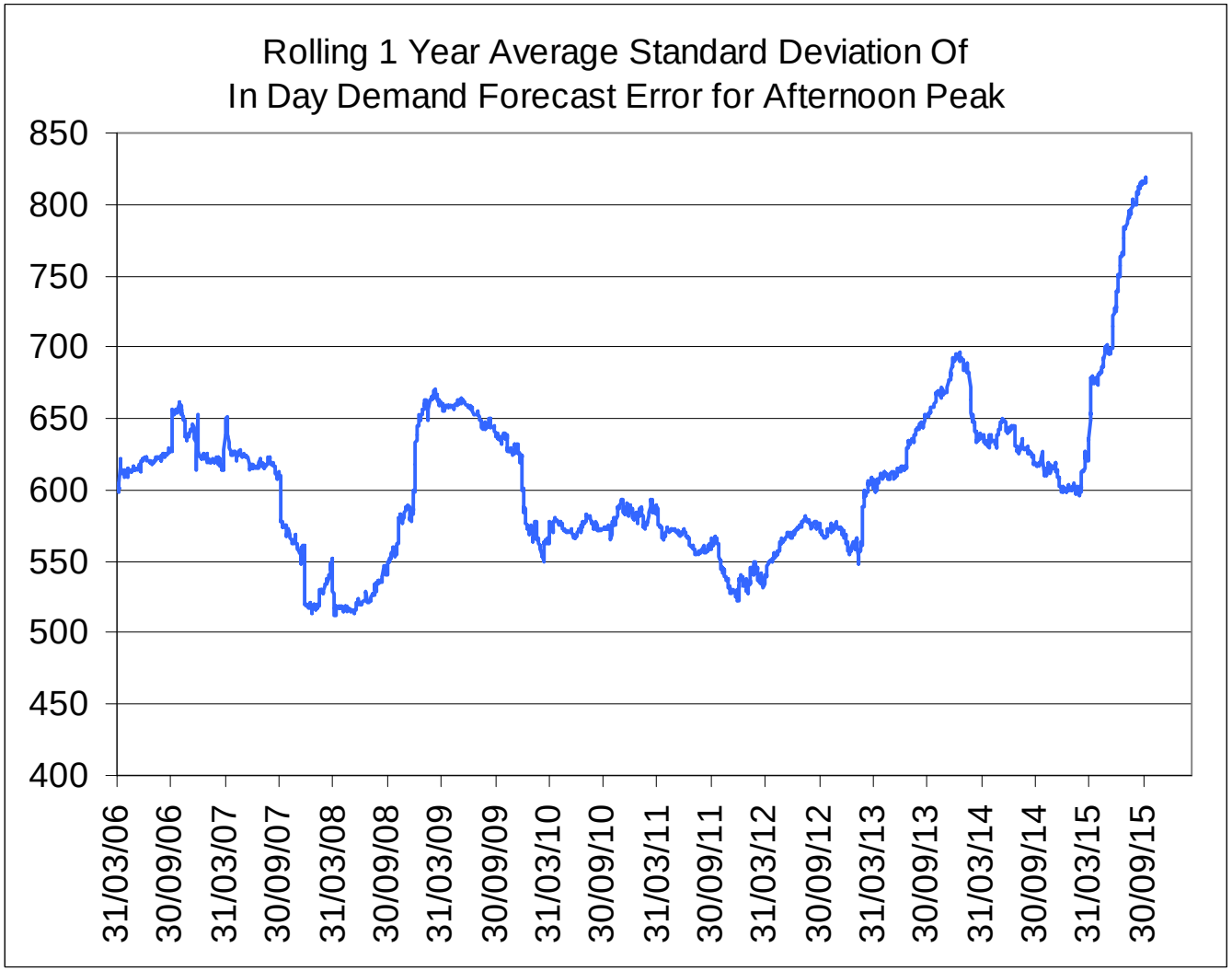
Increasing Reliance on Weather Forecasts



Mean error of 191 kJ/m2 corresponds to error in PV forecast of 435 MW at current capacity

Increasing Uncertainty



Errors in solar radiation forecasts lead to errors in demand forecasts

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PV Forecasting

Forecasting PV Generation

- Receive weather forecasts for solar radiation
- All solar generation allocated to a weather location
- Solar forecast converted to MW
- PV generation forecast subtracted from demand forecast
- Forecast also published on National Grid website

Estimating Actual PV Generation

- Observed solar radiation converted into estimated PV generation
- Same methodology as used to produce forecasts
- Estimated outturns published daily on National Grid website

PV Forecasting

- Requirements for PV Forecasting:
  - Best possible Solar Forecasts
  - Metered Data to refine models
- Currently solar forecasts are being improved
- We do not yet have any metered PV output data

Developments in PV Forecasting

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- Solar Radiation Forecasts
  - Working closely with weather forecast providers
  - More forecast locations
  - Forecasts for region not point
  - Improving understanding of uncertainty
- Data
  - Seeking data from individual solar farms
  - Seeking data from energy management companies
  - Exploring relationships with domestic solar community

Developments in PV Forecasting

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- Models
  - Individual models for larger solar farms
  - Develop multiple variable models
  - Forecast by Grid Supply Point
- Network Innovation Allowance Projects:
  - PV Monitoring Phase 1:
    - PV in substations
  - PV Monitoring Phase 2:
    - Simulation of historic GB output
    - Daily estimate of GB solar at half hour resolution
    - Models and data at substation level

Demand Forecasting Update

- When Triad Avoidance is included in Demand Forecasts
- Additional Data about to be published on National Grid Website

Triad Avoidance In Demand Forecasts

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1200 Day - 1

Initial forecast for tomorrow's Triad Avoidance volume

All forecasts up to day ahead **EXCLUDE** Triad Avoidance

Only exception is ACS Peak forecast

1700 Day - 1

Volume of Triad Avoidance estimated

Forecast for tomorrow's Triad Avoidance volume modified in the light of observed effect

Published Forecast **EXCLUDES** Triad Avoidance

~ 2100 Day - 1

Demand Forecast updated with latest weather

Forecast Triad Avoidance subtracted from Demand Forecast

Published Forecast **INCLUDES** Triad Avoidance

Publication time dependent on Operational constraints

Triad Avoidance In Demand Forecasts

0900 On Day	During Day
Triad Forecasts received from Suppliers	Forecast for Triad Avoidance volume updated as necessary
Forecast for Triad Avoidance volume updated	
Forecast **INCLUDES** latest Triad Avoidance forecast	Forecast **INCLUDES** latest Triad Avoidance forecast

Coming Soon…

- Demand Data published on National Grid Website will be refreshed
- Historic half hourly demand data since 2005 re-validated
- Will publish half hourly resolution National demand forecasts daily
- Will publish current and historic estimated capacities for PV and embedded wind
- Note: PV estimated outturns will be revised again next year as we further refine our PV models based on metered data

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Q&A

jeremy.caplin@nationalgrid.com