Embedded Generation Behaviours & Customer Demand Management

Jeremy Caplin - Energy Forecasting Manager
What is Demand?

- Large Power Station
- Station Load
- Initial National Demand Outturn
- Pump Storage Demand
- Pump Storage Generation
- Embedded Generation
- HV Transmission Losses
- Electricity Transmission System Demand
- National Demand
- Micro Generation
- LV Transmission Losses
- Interconnector Exports
- Interconnector Imports
- Total Load Per Bidding Zone
### Demand Definitions

<table>
<thead>
<tr>
<th></th>
<th>Supply from GSPs</th>
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</table>
II

(Non-legislative acts)

REGULATIONS

COMMISSION REGULATION (EU) No 543/2013
of 14 June 2013


(Text with EEA relevance)

THE EUROPEAN COMMISSION,

Having regard to the Treaty on the Functioning of the European Union,

...
European Transparency Regulations

- ETR requires all EU members to publish market data, much of it close to real time

- Data includes
  - Total Load
  - Unavailability of Demand
  - Forecast Margins
  - Unavailability of transmission infrastructure
  - Cross Zonal Capacities and Use
  - Congestion Management Measures
  - Generation – Forecast, Actual and Unavailability
  - Balancing Data
European Transparency Regulations

- Information National Grid is required to publish includes:
  - Outturn total load – one hour after end of each settlement period
  - Day-ahead forecast of total load per settlement period at 1200 on D-1, updated if forecast changes by more than 10%
  - Week-ahead forecast of daily maximum and minimum total load (Monday – Sunday) by 1400 on Friday. Updated if forecast changes by more than 10%
  - Month-ahead forecast of weekly maximum and minimum total load, one week before first day of month.
  - Year-ahead forecast of weekly maximum and minimum total load, by 15th of each month for following 12 months.
European Transparency Regulations

- Total Load Per Bidding Zone is defined as “equal to the sum of power generated by plants on both TSO/DSO networks”
Demand Definitions

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| BM Reports                     |                   |                    |              |                           |                        |                     |                               |                                               |                  |                  |
| TSD - Transmission System Demand |                   |                    |              |                           |                        |                     |                               |                                               |                  |                  |
| TSDF - Transmission System Demand Forecast |                   |                    |              |                           |                        |                     |                               |                                               |                  |                  |
| ITSDO - Initial Transmission System Demand Out-Turn |                   |                    |              |                           |                        |                     |                               |                                               |                  |                  |
| National Demand Forecast       | ✓                | X                  | X            | X                         | ✓                      |                     |                               |                                               |                  |                  |
| INDO - Initial National Demand Outturn | ✓               | X                  | X            | X                         | ✓                      |                     |                               |                                               |                  |                  |

| Grid Code                      |                   |                    |              |                           |                        |                     |                               |                                               |                  |                  |
| National Demand - Grid Code    | ✓                | X                  | X            | X                         | ✓                      |                     |                               |                                               |                  |                  |
| National Electricity Transmission System Demand |                   |                    |              |                           |                        |                     |                               |                                               |                  |                  |

| European Transparency Regulations |                   |                    |              |                           |                        |                     |                               |                                               |                  |                  |
| ETR Total Load                 | ✓                | ✓                  | ✓            | ✓                         | ✓                      | ✓                   |                               |                                               |                  |                  |

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Embedded Generation Behaviours

- Until now, our models have implicitly assumed consistent behaviour of ‘conventional’ (non-weather variable) embedded generation.

- We are starting to see variations in the behaviour of this plant year on year.

- In order to comply with the European Transparency Regulations we have developed models of embedded generation.

- Non-weather variable embedded generation has increased in recent years.
Embedded Generation Behaviours

Average Winter Weekday Generation Profiles 2010/11 to 2013/14
Non Weather Variable Embedded Generation
Embedded Generation Behaviours

- Base generation has increased by 1 GW since 10/11
- Peak generation has increased by 1.2 GW since 10/11
- Ratio of Peak to Base much the same (about 1.25)
- According to Digest of UK Energy Statistics (DUKES) embedded generation capacity increase by 147 MW between 2011 and 2014
- It would appear that embedded generators are running at higher load factors
Back to Demand Definitions
Demand Definitions – Starting Point

GB Generation 11 Aug 2014

GB Other
GB Hydro
GB Oil
GB CCGT
GB Coal
GB Wind
GB Nuclear
GB Pump Storage
Total Interconnector
Demand Definitions – Modified for Illustration

GB Generation

- GB Other
- GB Hydro
- GB Oil
- GB CCGT
- GB Coal
- GB Wind
- GB Nuclear
- GB Pump Storage
- Total Interconnector

0:00 to 23:00

-5,000 to 35,000
Initial National Demand Outturn
Where Have Transmission Losses Gone?

Transmission Loss Effect

- GSP Demand
- Transmission Losses
- INDO
ETR Total Load

European Transparency Regulation Total Load

- Emb Non-Weather Var
- Photo-Voltaic
- Embedded Wind
- Interconnector Exports
- Pump Storage Load
- Pump Storage Gen
- Interconnector Import
- GB Other
- GB Hydro
- GB Oil
- GB CCGT
- GB Coal
- GB Wind
- GB Nuclear
- Station Load
- ETR Total Load
- GB Pump Storage
- Total Interconnector
Effect of Weather Variable Embedded Generation

Effect of Embedded Wind and PV

- Emb Non-Weather Var
- Photo-Voltaic
- Embedded Wind
- Interconnector Exports
- Pump Storage Load
- Pump Storage Gen
- Interconnector Import
- GB Other
- GB Hydro
- GB Oil
- GB CCGT
- GB Coal
- GB Wind
- GB Nuclear
- Station Load
- TGSD
- ETR Total Load
Effect of Weather Variable Embedded Generation

Effect of Embedded Wind and PV

- Emb Non-Weather Var
- Photo-Voltaic
- Embedded Wind
- Interconnector Exports
- Pump Storage Load
- Pump Storage Gen
- Interconnector Import
- GB Other
- GB Hydro
- GB Oil
- GB CCGT
- GB Coal
- GB Wind
- GB Nuclear
- Station Load
- TGSD No Wind or PV
- TGSD
- ETR Total Load
Customer Demand Management
Customer Demand Management

- Grid Code Defines Customer Demand Management as:

Reducing the supply of electricity to a **Customer** or disconnecting a **Customer** in a manner agreed for commercial purposes between a **Supplier** and its **Customer**.
Customer Demand Management

- National Grid can not measure CDM
- CDM can be estimated by looking at shape of demand curve at darkness peak – CDM gives flatter profile over peak
Customer Demand Management

Comparison of Low and High CDM Days

- Thurs 23 Jan 14 - No CDM
- Wed 29 Jan 14 - High CDM
Customer Demand Management

CDM significantly increased last year

![Number of Days With CDM](chart.png)

- Number of days with CDM >= 1000 MW
- Total number of days with CDM
Customer Demand Management

- CDM significantly increased last year

![Number of Days With CDM](chart.png)

- Number of days with CDM >= 1000 MW
- Total number of days with CDM
Customer Demand Management

- CDM significantly increased last year
  - 27 days with CDM estimated to be 1000 MW or more compared with 10 such days in previous three years combined.
- Partially driven by Triad Avoidance
  - Last year was very hard to forecast Triads
- Partially driven by changes in customer behaviour
- We anticipate high levels of CDM this year
Customer Demand Management

- We have developed new model of CDM
- This will NOT feed into our day ahead forecasts
- All our forecasts at Day Ahead or longer timescales assume no CDM
  - If we include CDM in our forecasts then forecast demand is lower, and so less CDM will occur.
- Within Day forecasts INCLUDE CDM – published data comes direct from systems used by Control Room and so reflect forecast actual demand
- CDM Will be included in overnight forecasts by Control Room from 1930 on day ahead
Help Us Forecast Better

Grid Code OC1 says

OC1.5.5.2 Customer Demand Management

(a) Each Supplier will notify NGET of any Customer Demand Management proposed by itself which may result in a Demand change equal to or greater than the Customer Demand Management Notification Level averaged over any half hour on any Grid Supply Point which is planned to occur at any time in the Control Phase and of any changes to the planned Customer Demand Management already notified to NGET as soon as possible after the formulation of the new plans.

Customer Demand Management Notification Level

The level above which a Supplier has to notify NGET of its proposed or achieved use of Customer Demand Management which is 12 MW in England and Wales and 5 MW in Scotland.
Help Us Forecast Better

- Grid Code OC1 says

OC 1.5.6 (b) Customer Demand Management

Each **Supplier** will supply MW profiles of the amount and duration of **Demand** reduction achieved by itself from the use of **Customer Demand Management** equal to or greater than the **Customer Demand Management Notification Level** (averaged over any half hour on any **Grid Supply Point**) on a half hourly and **Grid Supply Point** basis during the previous calendar day.
Help Us Forecast Better

- Some Suppliers still give us data
- Some have fallen out of the habit
- We are seeking to engage with Suppliers through several different routes to improve data flows to allow us to better forecast CDM
Help Us Forecast Better

- Grid Code requirements are out of date
- We would like to know if you plan to do on-the-day discretionary despatch of demand and generation
- At present we are not asking for the post event data, just a warning of plans for the next day
- Please send CDM plans / forecasts to Demand.Forecasting@nationalgrid.com by 1600 on day ahead
Q&A

Jeremy.caplin@nationalgrid.com