XOSERVE

Peak Load Factor

Demand Estimation – October 2024

Peak Load Factor – What is it?

- A Peak Load Factor (PLF) is one of the key outputs from the Demand Estimation process, as described in Section H of UNC:

  The "EUC Peak Load Factor" for an End User Category is a load factor reflecting the average daily load (on a seasonal normal basis) of any Supply Meter Point in that End User Category ***as a proportion*** *of the 1-in-20 peak day demand of such Supply Meter Point.*

- So, the Peak Load Factor represents an EUC's weather sensitivity in the event of extreme cold weather scenarios
- Each End User Category (EUC) will have its own Peak Load Factor
- The value is a percentage (%) and will therefore range from 0 to 100
  - the closer the value is to 100 the **less weather sensitive** the EUC

Peak Load Factor Examples

A Small Domestic consumer in West Midlands,
EUC: WM:E2401BND,
reacts strongly to cold weather conditions,
current PLF 29.1% (or 0.291)

A Large Industrial consumer in West Midlands,
EUC: WM:E2407W01,
is more process driven and less weather sensitive,
current PLF 72.2% (or 0.722)

Peak Load Factor – Why is it needed?

- The Peak Load Factor is used to determine the 'Supply Offtake Quantity' for Class 3 and 4 Supply Points, referred to as the 'SOQ'
- When aggregated at LDZ level, the SOQ provides Distribution Networks with an estimated view of the maximum transportation capacity physically needed to support peak demand in the event of an extreme cold weather event
- The SOQ is a key parameter in the calculation of LDZ Capacity Invoicing for Class 3 and 4 Supply Points
- The SOQ for each Supply Point is calculated using its Annual Quantity (AQ) and relevant EUC Peak Load Factor:

$$SOQ = AQ / (\mathbf{PLF} \times 365)$$

Timetable

Each August a set of industry approved Peak Load Factors are required for each End User Category for the new Gas Year

UK Link is updated in readiness for calculating the Rolling SOQ each month for the new Gas Year and the Formula Year SOQ which is effective from the following 1st April (based on a snapshot taken in December)

Peak Load Factor– How is it calculated?

- The Peak Load Factor for each EUC is calculated as:

$$PLF = \frac{\text{Average Demand}}{\text{1-in-20 Peak Day Demand}}$$

where:

- Average Demand is an estimate of the Seasonal Normal demand for an End User Category
- Peak Day Demand is an estimate of the 95% confidence level of highest demand that might be expected to be experienced for an End User Category (see later slides)

- Estimates of both sets of Demand (i.e. Average and Peak Day) are derived from EUC Demand Models, another key output from the annual Demand Estimation process

Responsibility

The Demand Estimation Sub Committee (DESC) is responsible for the production of the Peak Load Factors each year, including any changes to the formula which is set out in the UNC document: "NDM Demand Estimation Methodology" – see final slide for link

EUC Demand Model – Background

- The derivation of the EUC Demand Model is the responsibility of DESC
- Each year DESC sets out the principles to be followed in its 'Modelling Approach' document
- Typically, EUC Demand Models are based on 3 individual years of analysis of daily demand data collected from a sample of consumers within the relevant EUC
- The behaviours learned from the 3 years are then averaged or 'smoothed' in order to produce an EUC Demand Model which provides year on year stability, by minimising impacts of single warmer or colder years
- Seasonal Normal Demand (SNDt) from the EUC Demand Model is calculated as follows:

$$SND_t = P_t * (C_1 + C_2 * SNCWV_t)$$

- where:

C_1 is the constant derived from the smoothed EUC Demand Model
C_2 is the weather sensitivity from the smoothed EUC Demand Model
$SNCWV_t$ is the seasonal normal value of the CWV on day_t
P_t is a factor which represents weekend and holiday effects

More Information

For more information on the Demand Models see the Demand Estimation home page here

Average Demand – Numerator in PLF calculation

- The Peak Load Factor for each EUC is calculated as:

$$PLF = \frac{\textbf{Average Demand}}{\text{1-in-20 Peak Day Demand}}$$

- The numerator in the Peak Load Factor is the ‘Average Demand’ and is calculated by summing the Seasonal Normal Demand (SNDt) for each day from the smoothed EUC Demand Model
- This totalled demand effectively represents the AQ for the EUC Demand Model
- The AQ value is then divided by 365 to produce the daily Average Demand value for the EUC Demand Model i.e. the numerator in the Peak Load Factor calculation

Average Demand – Denominator in PLF calculation

- The Peak Load Factor for each EUC is calculated as:

$$PLF = \frac{\text{Average Demand}}{\textbf{1-in-20 Peak Day Demand}}$$

- The denominator in the Peak Load Factor is the '1-in-20 Peak Day Demand'
- Peak Day Demand is an estimate of the 95% confidence level (i.e. 1/20) of highest demand that might be expected to be experienced for an End User Category
- Peak Day Demand will be determined by simulation using a long period of actual historic weather (CWV) data for the relevant LDZ
- DESC will determine (and from time to time may review) the number of years of historic data used in the simulation of Peak Day Demand and the method of simulation

Weather History

The gas industry weather history used by the Demand Estimation process begins in 1960.

Currently DESC utilize all available years in its simulation of peak day demand (i.e. over 60 years)

Peak Day Demand - Simulation (1 of 3)

- The EUC Demand Model is tested against historical weather, specifically the coldest observed day in each year in the series:
- This test is flexed to cover the 3 days before and after the gas day in question, resulting in 7 different sets of results per year
- For each of these 7 sets of results (per day), two independent random error streams are applied plus their corresponding antithetic errors, making 4 sets in total with the objective of variance reduction to minimise any chance of bias
- This results in 28 different maximum values for each year
  - 7 days of results
  - Run for 2 random number seeds
  - Run with an error and an antithetic error (i.e. error * -1)
  - Total of 28 Simulations

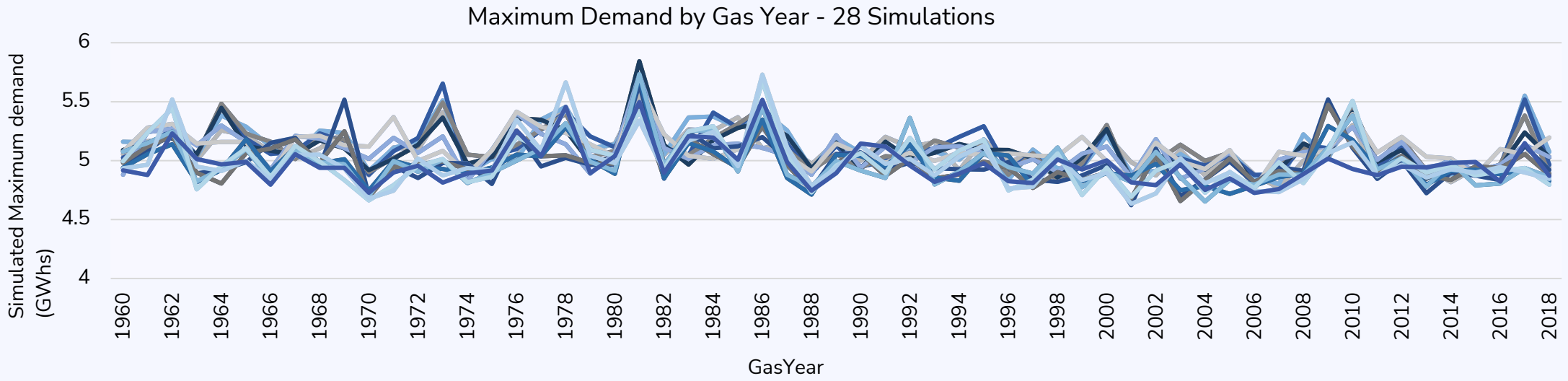
(offset x random number x error/antithetic error)

7 * 2 * 2 = 28

Peak Day Demand - Simulation (2 of 3)

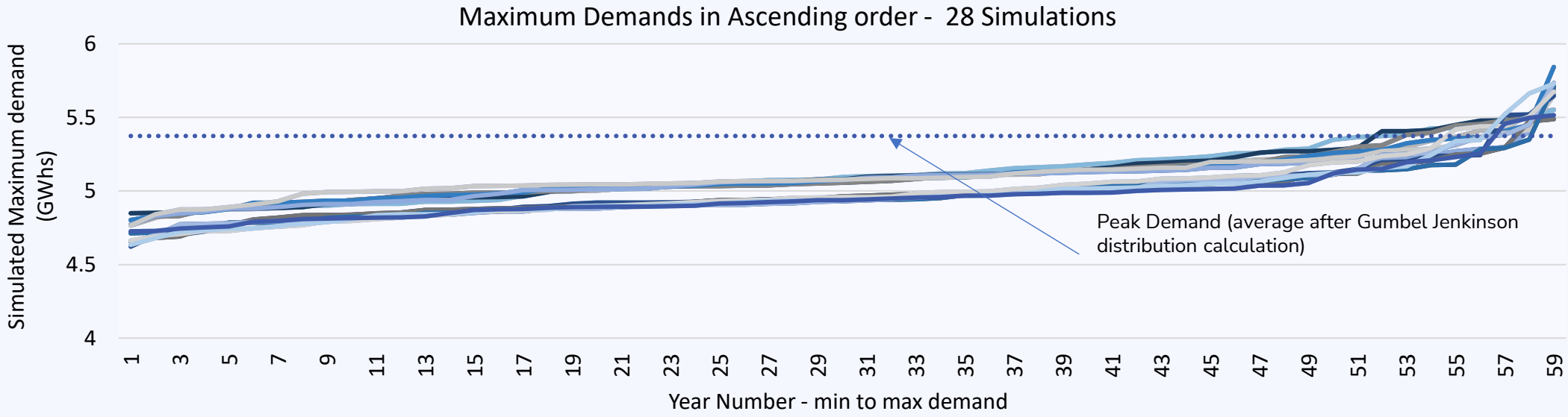
Gas Day (D)				01-Nov			
CWV Offset	D-3	D-2	D-1	D	D+1	D+2	D+3
CWV	29-Oct	30-Oct	31-Oct	01-Nov	02-Nov	03-Nov	04-Nov
SNCWV	D	D	D	D	D	D	D
ALP	D	D	D	D	D	D	D
DAF	D	D	D	D	D	D	D
Holiday Code	D	D	D	D	D	D	D
Weekend Code	D	D	D	D	D	D	D

- Simulations are run for every gas day in the Simulation period - 1960 to latest complete Gas Year



Peak Day Demand - Simulation (3 of 3)

- Each set of maximum values are fitted to a statistical distribution suited for extreme value statistics (in this case Gumbel-Jenkinson, but Weibull also works)
- 95% level on cumulative distribution is 1 in 20 peak value
- 28 different simulations 1 in 20 peak values averaged to give definitive peak
- 1 in 20 value of CWV inserted in relevant demand model should give good approximation to 'real' 1 in 20 peak



Peak Load Factor – Why do the values change?

- Each Gas Year DESC will produce a revised set Peak Load Factors which have been derived from the latest set of EUC Demand Models
- As part of the annual process, the following factors can result in changes to the Peak Load Factors (when compared to the previous year):
  - DESC may change the Demand Modelling principles
  - New individual single year model will replace oldest year model which will naturally mean different sample sites (2 of the 3 years used in smoothing will remain the same)
  - Gas Industry weather history will have 'moved on' by one year
  - An update to the Seasonal Normal basis (normally every 5 years)
- The approach of applying model smoothing minimises year on year volatility

Peak Load Factor – How accurate is it?

- Due to the nature of what the Peak Load Factor represents, i.e. a view of demand reaction in the event of extremely rare cold weather events, there is not many data points available to 'prove' the accuracy of the Peak Load Factor value – this is why simulation is necessary!
- In addition to an estimate of Peak Day Demand, the Demand Estimation process also calculates an estimated view of the 1 in 20 CWV. This is done following the same simulation approach for peak demand but using the history of CWVs only

Example of Peak Day Demand conditions being met:

- In 2010, in Scotland (SC), the actual CWV towards the end of December hit the estimated 1 in 20 CWV of -4.30 (relevant at that time). These gas days were 22nd to 24th December inclusive.
- Demand was collected from around 200 sample points in the Domestic EUC for this period and a Peak Load Factor was 'back calculated' (results in table on right)
- The minor difference between the simulated Peak Load Factor (0.373) and the average estimated Peak Load Factor over the 3 days (0.371) taken from actual observations supports the methodology used for Peak Day Demand

Gas Day	Actual CWV	Actual Demand (Sample)	Total AQ (Sample)	Estimated Peak Load Factor
22/12/10	-4.48	31544	4251298	0.369243
23/12/10	-4.38	31195	4251298	0.373374
24/12/10	-4.38	31532	4251298	0.369383

- Average Estimated Peak Load Factor for 3 gas days = **0.371**
- DESC's Peak Load Factor for Gas Year 2010/11 EUC SC:E1001B was **0.373**

Peak Load Factor – Where to find more information

- Uniform Network Code (UNC): Section H (Paragraph 4: NDM Capacity)
- UNC Related Document: NDM Demand Estimation Methodology (Paragraph 3.6)
- NDM Algorithms Booklet - Section 10: UK Link Docs: Folder 18. NDM Profiling and Capacity Estimation Algorithms / Gas Year / 4 NDM Algorithms Booklet
- Demand Estimation Sub Committee (DESC): Terms of Reference
- Peak Load Factors for current Gas Year available on the Demand Estimation page of Xoserve.com. Select Download "Latest derived factors" from right hand side of page. File name: "LFyy.txt"
- Please raise any questions on Peak Load Factors via the Help Centre on Xoserve.com here by selecting "Other" and your query will be directed to the CDSP's Demand Estimation Team