# Demand Estimation Sub Committee

## Seasonal Normal Review 2020:

## Review of CWV Optimisation

## 7th October 2019

# Meeting Objectives

At today's DESC meeting, members to consider recommendations for revised CWV parameters and provide approval for their use from 1st October 2020. This slide pack contains:

- Recap on modified CWV formula
- CWV Optimisation
  - Background
  - Methodology
  - Data
  - Results
- Conclusions and Next Steps

# Overview - Milestones

At the 10th December 2018 meeting DESC approved the following high level approach and work plan for performing this analysis - major milestones below:

- **MILESTONE**: DESC to decide whether to consider a revision to the existing **CWV** formula and confirm the template for its 'benchmark' results (1st April 2019)

- **MILESTONE**: DESC define proposed **CWV** formula for next period i.e. GY 2020/21 onwards (8th July 2019)

- **MILESTONE**: DESC confirm parameters for use in proposed **CWV** formula for Gas Year 2020/21 (7th October 2019)

- **MILESTONE**: DESC decide whether to revise existing **SNCWV** (1st April 2019)

- **MILESTONE**: DESC confirm revised **SNCWV** values (9th December 2019)

# Recap on DESC Decision - CWV Formula

DESC voted on 22nd July to approve the following CWV formula definition for Gas Year 2020/21 onwards:

$$\mathbf{CW_t = I_1 * E_t + (1.0 - I_1) * S_t - I_2 * Max(0, W_t - W_0) * Max(0, T_0 - AT_t) + S_0 * SR_t + P_0 * P_t}$$

| | | |
|---|---|---|
| $\mathbf{CWV_t = V1 + q * (V2 - V1)}$ | if $\mathbf{V_2 \leq CW_t}$ | (summer cut-off) |
| $\mathbf{CWV_t = V1 + q * (CW_t - V1)}$ | if $\mathbf{V_1 < CW_t < V2}$ | (transition) |
| $\mathbf{CWV_t = CW_t}$ | if $\mathbf{V_0 \leq CW_t \leq V1}$ | (normal) |
| $\mathbf{CWV_t = CW_t + l3 * (CW_t - V0)}$ | if $\mathbf{V_0 > CW_t}$ | (cold weather upturn) |

Where $\mathbf{E_t = } \boldsymbol{ETW} \mathbf{* E_{t-1} + (1 - } \boldsymbol{ETW}\mathbf{) * AT_t}$

And $\boldsymbol{ETW}$ is an optimised parameter which determines the weight applied to the previous Gas Days Effective Temperature vs the current days Actual Temperature

The CWV formula has been updated to included a term for Solar radiation $\mathbf{S_0 * SR_t}$ and Precipitation $\mathbf{P_0 * P_t}$, with the aim to improve accuracy of the formula for predicting demand.

# CWV Formula – Solar Term

The Solar Radiation term of the CWV formula is calculated as follows

$$\mathbf{S_0} * \mathbf{SR_t}$$

Where $\mathbf{S_0}$ is an optimised parameter which determines the magnitude of the Solar effect to be applied.

$\mathbf{SR_t}$ is measured as the log difference between actual Solar radiation observations and a Pseudo Seasonal Normal Effective Solar (SNES). The calculation for the SNES term is similar to the pseudo-SNET, with an additional term for Solar radiation, as per DESC meeting on 28th June:

$$SNES = \alpha - \sum_{i=1}^{3} \beta i \sin\left(\frac{2id\pi}{365}\right) - ci \cos\left(\frac{2id\pi}{365}\right) + \mathrm{dET} + \mathrm{eWC} + \mathrm{fSolar} + \mathrm{gFRI} + \mathrm{hSAT} + \mathrm{iSUN} + \mu$$

# CWV Formula – Precipitation Term

The Precipitation term of the CWV formula is calculated as follows

$$P_0 * P_t$$

Where $P_0$ is an optimised parameter determining how much of a precipitation effect is applied
And $P_t$ is a measure of precipitation readings for a specific gas day t.

A decision was made by DESC on 22nd July 2019 that the precipitation term was to be added to future proof the CWV formula, however the values of $P_0$ will be set to a default value of zero until such time that analysis can be conducted to understand how the precipitation term will effect the CWV. Precipitation will therefore have no influence on the value of the CWV under current parameters.

# CWV Formula Recap – 2015 Parameters

| LDZ | Weather Station | $I_1$ | $I_2$ | $I_3$ | $V_0$ | $V_1$ | $V_2$ | q | $W_0$ | $T_0$ |
|---|---|---|---|---|---|---|---|---|---|---|
| EA | London Heathrow | 0.719 | 0.0144 | 0.09 | 3 | 15.3 | 19.2 | 0.34 | 0 | 14 |
| EM | Nottingham Watnall | 0.691 | 0.0144 | 0.05 | 3 | 13.5 | 16.8 | 0.49 | 0 | 14 |
| NE | Nottingham Watnall | 0.676 | 0.0159 | 0 | 0 | 14.7 | 17.9 | 0.38 | 0 | 14 |
| NO | Albermarle Barracks | 0.663 | 0.0086 | 0.15 | 3 | 13 | 16 | 0.46 | 0 | 14 |
| NT | London Heathrow | 0.727 | 0.0151 | 0.22 | 3 | 15.2 | 19.2 | 0.38 | 0 | 14 |
| NW | Rostherne No 2 | 0.697 | 0.0149 | 0.3 | 3 | 14.9 | 18 | 0.38 | 0 | 14 |
| SC | Glasgow Bishopton | 0.635 | 0.0119 | 0.15 | 3 | 12.2 | 16 | 0.64 | 0 | 14 |
| SE | London Heathrow | 0.712 | 0.014 | 0.33 | 3 | 15.1 | 18.7 | 0.38 | 0 | 14 |
| SO | Southampton Oceanographic Institute | 0.72 | 0.0134 | 0.24 | 3 | 14.8 | 18.2 | 0.37 | 0 | 14 |
| SW | Yeovilton Weather Station * | 0.682 | 0.01 | 0.22 | 3 | 14.2 | 17.3 | 0.42 | 0 | 14 |
| WM | Birmingham Winterbourne 2 (Wind speeds Coleshill) | 0.72 | 0.0111 | 0.14 | 3 | 13.7 | 17.2 | 0.43 | 0 | 14 |
| WN | Rostherne No 2 | 0.697 | 0.0149 | 0.3 | 3 | 14.9 | 18 | 0.38 | 0 | 14 |
| WS | St. Athan | 0.669 | 0.0101 | 0.11 | 3 | 14.8 | 17.9 | 0.46 | 0 | 14 |

* Filton Weather station up to and including Gas Day 30th September 2018, Yeovilton with temperature bias adjustment to mimic Filton Weather Station from Gas Day 1st October 2018 onwards

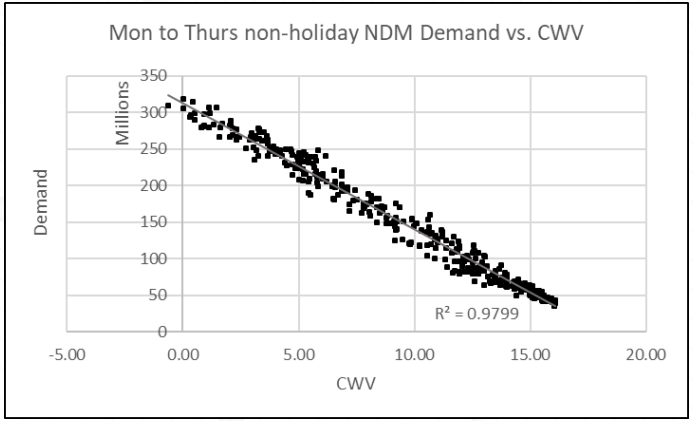
# Optimisation Overview – Methodology

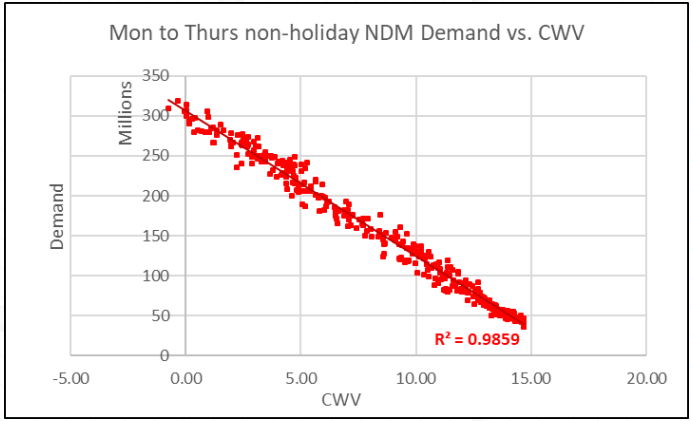
British gas DESC member Jason Blackmore has devised a tool to perform optimisation calculations and propose a set of final parameters. The broad steps followed by the tool are as follows:

- Demand and Weather data for gas years 2010/11 to 2017/18 is loaded into the tool
- SNET, SNES and the CWV formulae are broken down into their component parts and recalculated
- The optimisation tool uses Microsoft Excel add-in ‘Solver’ which utilises a goal seek methodology to run through possible combinations of inputs to these formulas with the aim of reducing the overall error sum of squares when plotted against actual demand
- In this way, the ET/AT weight, SNET and SNES are optimised to find the best fit when compared to actual observations.

# Optimisation Overview – Methodology

- Solver is utilised again to run through possible sets of CWV parameters with the target to reduce total error sum of squares across all gas years.
- As can be seen in the example, the data points become more concentrated around the regression line and the R-squared value has increased from 0.9799 to 0.9859
- Each parameter has a defined minimum and maximum range within which the optimum value can be found. No preference is given during the optimisation to lowering or raising any specific parameters, therefore the results are purely driven by which combination of parameters provides the best improvement to the overall R-squared value.



# Optimisation Overview – Weather Stations

| | Temperature | Windspeed | Solar radiation |
|---|---|---|---|
| EA | London Heathrow | London Heathrow | London Heathrow |
| EM | Nottingham Watnall | Nottingham Watnall | Nottingham Watnall |
| NE | Nottingham Watnall | Nottingham Watnall | Nottingham Watnall |
| NO | Albermarle Barracks | Albermarle Barracks | Durham Weather Station |
| NT | London Heathrow | London Heathrow | London Heathrow |
| NW | Rostherne No 2 | Rostherne No 2 | Rostherne No 2 |
| SC | Glasgow Bishopton | Glasgow Bishopton | Glasgow Bishopton |
| SE | London Heathrow | London Heathrow | London Heathrow |
| SO | Southampton Oceanographic Institute | Southampton Oceanographic Institute | Southampton Oceanographic Institute |
| SW | Yeovilton Weather Station | Yeovilton Weather Station | Yeovilton Weather Station |
| WM | Birmingham Winterbourne 2 | Coleshill | Coleshill |
| WN | Rostherne No 2 | Rostherne No 2 | Rostherne No 2 |
| WS | St. Athan | St. Athan | St. Athan |

Albemarle Barracks does not record Solar Radiation. Consultation with MeteoGroup Confirmed that Durham is the best alternative.

Coleshill was used for WM's Solar Radiation as it has fewer 'Null' readings than Winterbourne.

All other LDZ's have retained their main weather station for Solar radiation

# Optimisation Overview - Data

- Gas years used for deriving parameters including pseudo-SNET and pseudo-SNES are 2010/11 to 2017/18 inclusive
- For these gas years the demand data used is Aggregate NDM demand for all available Monday to Thursday non holiday gas days
- Temperature, Wind Speed and Solar radiation data for the optimisation period has mainly been sourced from WSSM data and UKLink and validated against historic CWV calculations.
- Audits have been conducted on the data to ensure it matches data held by Xoserve which will feed into recalculating historic CWV's and Seasonal Normal calculations

# Optimisation Overview – Results

- Below is a summary of the statistics used in the main results:

- **R-Squared**

R-squared represents the proportion of the variance of a dependent variable that's explained by an independent variable or variables in a regression model. E.g. an R-squared value of 0.50 suggests that approximately half of the observed variation can be explained by the model's inputs

- **MAPE (Mean Absolute Percentage Error)**

The mean absolute percentage error (MAPE) is a statistical measure of prediction accuracy of a forecasting method. The smaller the MAPE value, the better the model is at forecasting expected results.

- **RMSE (Root Mean Squared Error)**

RMSE is defined as the standard deviation of the residuals. Residuals are a measure of how far from a regression line data points lie. RMSE is a measure of how concentrated data is around a line of best fit.

# CWV Optimisation

Detailed Results

(refer to main results in BG analysis)

# Proposed 2020 Parameters

| LDZ | Weather Station | ET/AT Weight | $I_1$ | $I_2$ | $I_3$ | $V_0$ | $V_1$ | $V_2$ | q | $W_0$ | $T_0$ | $S_0$ | $P_0$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EA | London Heathrow | 0.460 | 0.723 | 0.015 | 0.109 | -0.235 | 15.131 | 18.885 | 0.368 | -0.477 | 12.650 | 0.635 | 0.000 |
| EM | Nottingham Watnall | 0.480 | 0.689 | 0.010 | 0.138 | -1.344 | 13.008 | 16.897 | 0.424 | -2.417 | 17.377 | 0.698 | 0.000 |
| NE | Nottingham Watnall | 0.459 | 0.672 | 0.009 | 0.083 | -1.261 | 12.924 | 16.679 | 0.446 | -1.652 | 21.596 | 0.568 | 0.000 |
| NO | Albermarle Barracks (Solar Durham) | 0.492 | 0.646 | 0.008 | 0.126 | 5.000 | 12.005 | 15.779 | 0.438 | -0.894 | 16.657 | 0.950 | 0.000 |
| NT | London Heathrow | 0.473 | 0.715 | 0.015 | 0.066 | 4.898 | 15.029 | 19.184 | 0.429 | -3.811 | 12.833 | 0.695 | 0.000 |
| NW | Rostherne No 2 | 0.498 | 0.646 | 0.009 | 0.315 | 2.694 | 12.775 | 16.466 | 0.513 | -5.000 | 21.312 | 0.802 | 0.000 |
| SC | Glasgow Bishopton | 0.505 | 0.680 | 0.011 | 0.000 | 1.053 | 12.590 | 16.402 | 0.509 | -2.992 | 15.476 | 0.507 | 0.000 |
| SE | London Heathrow | 0.484 | 0.772 | 0.006 | 0.266 | 1.335 | 13.996 | 18.523 | 0.375 | -0.721 | 21.613 | 0.566 | 0.000 |
| SO | Southampton Oceanographic Institute | 0.438 | 0.692 | 0.015 | 0.405 | 0.141 | 14.745 | 18.715 | 0.345 | -2.076 | 11.978 | 0.559 | 0.000 |
| SW | Yeovilton Weather Station | 0.448 | 0.623 | 0.008 | 0.258 | 3.476 | 13.254 | 17.898 | 0.337 | 0.705 | 21.707 | 0.801 | 0.000 |
| WM | Birmingham Winterbourne 2 (Wind speeds/ Solar Coleshill) | 0.471 | 0.692 | 0.010 | 0.163 | 4.385 | 13.392 | 17.480 | 0.368 | -3.619 | 17.569 | 0.678 | 0.000 |
| WN | Rostherne No 2 | 0.482 | 0.618 | 0.009 | 0.324 | 3.773 | 13.477 | 16.987 | 0.445 | -3.926 | 18.249 | 0.679 | 0.000 |
| WS | St. Athan | 0.543 | 0.657 | 0.008 | 0.079 | 1.797 | 13.826 | 17.186 | 0.384 | -1.910 | 17.068 | 0.776 | 0.000 |

The above table represents the final set of CWV parameters which have been optimised against NDM demand and weather data for gas years 2010/11 to 2017/18.

# CWV Optimisation

## Summary Results

# Optimisation Results – Overall $R^2$

| | Average Adjusted R-Squared | |
|---|---|---|
| | 2015 | 2020 |
| EA | 0.9912 | 0.9923 |
| EM | 0.9919 | 0.9934 |
| NE | 0.9867 | 0.9883 |
| NO | 0.9859 | 0.9893 |
| NT | 0.9930 | 0.9943 |
| NW | 0.9890 | 0.9913 |
| SC | 0.9892 | 0.9903 |
| SE | 0.9915 | 0.9929 |
| SO | 0.9918 | 0.9934 |
| SW | 0.9904 | 0.9908 |
| WM | 0.9921 | 0.9940 |
| WN | 0.9840 | 0.9859 |
| WS | 0.9833 | 0.9862 |

Every LDZ has seen an improvement in its overall $R^2$ value under the new optimisation method.

# Optimisation Results – Monthly MAPE

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | All |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EA | 3.66% | 2.87% | 4.05% | 6.48% | 8.11% | 6.13% | 7.06% | 7.14% | 5.66% | 6.37% | 4.45% | 3.99% | 5.52% |
| EM | 3.70% | 3.43% | 4.38% | 6.62% | 8.19% | 8.62% | 8.93% | 9.79% | 8.22% | 5.82% | 4.42% | 4.80% | 6.43% |
| NE | 4.16% | 3.64% | 5.93% | 7.85% | 8.14% | 8.59% | 7.42% | 7.62% | 7.58% | 6.04% | 4.99% | 5.09% | 6.43% |
| NO | 3.98% | 3.62% | 5.07% | 7.82% | 8.74% | 8.98% | 7.60% | 7.26% | 8.20% | 5.74% | 4.10% | 5.03% | 6.45% |
| NT | 3.00% | 2.70% | 3.49% | 5.58% | 6.28% | 5.38% | 5.27% | 4.68% | 5.09% | 5.22% | 3.67% | 3.58% | 4.57% |
| NW | 3.36% | 3.16% | 4.47% | 7.46% | 7.53% | 8.20% | 7.14% | 7.81% | 9.05% | 6.49% | 3.83% | 4.24% | 6.07% |
| SC | 3.44% | 3.09% | 4.28% | 6.29% | 7.27% | 7.90% | 9.04% | 7.47% | 7.60% | 5.43% | 3.64% | 4.05% | 5.82% |
| SE | 3.20% | 2.78% | 3.84% | 5.99% | 7.32% | 6.91% | 6.78% | 6.86% | 5.96% | 5.77% | 3.78% | 3.84% | 5.27% |
| SO | 3.54% | 3.08% | 4.45% | 6.33% | 6.86% | 5.54% | 8.69% | 4.73% | 5.21% | 5.75% | 4.98% | 4.52% | 5.32% |
| SW | 3.69% | 3.42% | 5.18% | 8.26% | 8.16% | 6.82% | 7.21% | 7.67% | 7.17% | 7.20% | 4.55% | 5.00% | 6.21% |
| WM | 3.93% | 3.56% | 4.45% | 7.51% | 7.70% | 7.20% | 7.59% | 8.25% | 7.84% | 6.65% | 4.38% | 4.98% | 6.18% |
| WN | 4.24% | 4.50% | 5.03% | 8.21% | 9.60% | 8.84% | 7.75% | 9.37% | 8.22% | 7.40% | 4.29% | 5.34% | 6.91% |
| WS | 4.12% | 3.92% | 5.97% | 10.12% | 10.92% | 9.95% | 10.78% | 8.67% | 9.46% | 8.17% | 4.92% | 5.97% | 7.77% |

- Monthly MAPE value for all LDZ's
- Improvements have been made by the majority of LDZ's across the shoulder months
- 10 of 13 LDZ's have shown an overall improvement in total MAPE values

# Optimisation Results – Overall RMSE

| | Average RMSE (MWhs) | |
|---|---|---|
| | 2015 | 2020 |
| EA | 6636 | 6253 |
| EM | 9060 | 8528 |
| NE | 6301 | 5989 |
| NO | 5257 | 4760 |
| NT | 7748 | 7259 |
| NW | 10536 | 9647 |
| SC | 7330 | 7023 |
| SE | 8184 | 7584 |
| SO | 5956 | 5508 |
| SW | 5125 | 5101 |
| WM | 8155 | 7626 |
| WN | 1104 | 1059 |
| WS | 4097 | 3759 |

Every LDZ has seen an improvement in its overall average RMSE value under the new optimisation method.

# Optimisation Results – Monthly RMSE

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | All |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EA | 8,117 | 6,375 | 7,654 | 7,739 | 6,608 | 3,919 | 2,877 | 2,878 | 3,411 | 6,057 | 7,248 | 8,207 | 6,253 |
| EM | 10,877 | 9,612 | 9,541 | 9,945 | 8,481 | 5,632 | 4,438 | 4,943 | 6,096 | 7,120 | 9,290 | 12,281 | 8,528 |
| NE | 7,393 | 6,405 | 8,150 | 7,788 | 5,434 | 4,127 | 2,461 | 2,574 | 3,891 | 5,063 | 6,506 | 8,100 | 5,989 |
| NO | 5,598 | 5,095 | 5,796 | 6,132 | 4,848 | 3,604 | 2,183 | 2,392 | 3,646 | 4,027 | 4,502 | 6,652 | 4,760 |
| NT | 8,777 | 7,852 | 8,606 | 9,512 | 7,095 | 4,665 | 3,218 | 3,272 | 4,538 | 6,876 | 7,899 | 9,972 | 7,259 |
| NW | 10,866 | 10,343 | 11,484 | 13,236 | 9,111 | 6,509 | 4,389 | 4,843 | 7,905 | 9,919 | 9,334 | 13,031 | 9,647 |
| SC | 8,060 | 7,235 | 8,081 | 8,888 | 6,970 | 5,414 | 4,478 | 4,190 | 6,392 | 6,741 | 6,778 | 9,050 | 7,023 |
| SE | 9,245 | 8,198 | 9,683 | 9,497 | 7,092 | 4,594 | 4,468 | 3,794 | 4,384 | 6,939 | 8,438 | 10,454 | 7,584 |
| SO | 6,893 | 6,043 | 7,006 | 6,944 | 4,755 | 2,760 | 2,406 | 1,689 | 2,878 | 4,801 | 6,971 | 8,014 | 5,508 |
| SW | 5,880 | 5,496 | 6,460 | 6,998 | 4,973 | 2,603 | 2,071 | 2,251 | 2,893 | 4,679 | 5,470 | 7,472 | 5,101 |
| WM | 9,791 | 8,746 | 8,636 | 9,778 | 6,638 | 4,308 | 3,301 | 3,698 | 5,224 | 7,086 | 8,155 | 11,181 | 7,626 |
| WN | 1,268 | 1,320 | 1,181 | 1,401 | 1,074 | 661 | 461 | 562 | 720 | 989 | 1,033 | 1,453 | 1,059 |
| WS | 4,360 | 3,724 | 4,546 | 5,118 | 3,953 | 2,416 | 1,898 | 1,689 | 2,799 | 3,347 | 3,957 | 5,213 | 3,759 |

- Monthly RMSE value for all LDZ's
- Improvements have been made by the majority of LDZ's across the shoulder months
- All LDZ's have improved RMSE values across the entire optimisation period

# Changes to Cold weather cut-off's

| | Cold Weather Sensitivity (I3) | | |
|---|---|---|---|
| | 2015 | 2020 | Change in value |
| EA | 0.09 | 0.109 | + 0.019 |
| EM | 0.05 | 0.138 | + 0.088 |
| NE | 0.00 | 0.083 | + 0.083 |
| NO | 0.15 | 0.126 | -0.024 |
| NT | 0.22 | 0.066 | -0.154 |
| NW | 0.30 | 0.315 | + 0.015 |
| SC | 0.15 | 0.000 | -0.150 |
| SE | 0.33 | 0.266 | -0.064 |
| SO | 0.24 | 0.405 | + 0.165 |
| SW | 0.22 | 0.258 | + 0.038 |
| WM | 0.14 | 0.163 | + 0.023 |
| WN | 0.30 | 0.324 | + 0.024 |
| WS | 0.11 | 0.079 | -0.031 |

| | Cold Weather Upturn Threshold (V0) | | |
|---|---|---|---|
| | 2015 | 2020 | Change in value |
| EA | 3 | -0.235 | -3.235 |
| EM | 3 | -1.344 | -4.344 |
| NE | 0 | -1.261 | -1.261 |
| NO | 3 | 5.000 | + 2.000 |
| NT | 3 | 4.898 | + 1.898 |
| NW | 3 | 2.694 | -0.306 |
| SC | 3 | 1.053 | -1.947 |
| SE | 3 | 1.335 | -1.665 |
| SO | 3 | 0.141 | -2.859 |
| SW | 3 | 3.476 | + 0.476 |
| WM | 3 | 4.385 | + 1.385 |
| WN | 3 | 3.773 | + 0.773 |
| WS | 3 | 1.797 | -1.203 |

There has been a noticeable increase in the range of Cold weather upturn thresholds across all LDZ's. As mentioned this value is driven by the optimisation methodology which finds the best overall fit when compared to observed Demand

# Changes to Warm weather cut-off's

| | Lower Warm Weather Cut-Off **(V1)** | | | Upper Warm Weather Cut-Off **(V2)** | | | Slope Relating to Warm Weather Cut-Off **(q)** | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2015 Parameters | 2020 Parameters | Percentage difference | 2015 Parameters | 2020 Parameters | Percentage difference | 2015 Parameters | 2020 Parameters | Percentage difference |
| EA | 15.3 | 15.131 | -1.10% | 19.2 | 18.885 | -1.64% | 0.34 | 0.368 | 8.14% |
| EM | 13.5 | 13.008 | -3.65% | 16.8 | 16.897 | 0.58% | 0.49 | 0.424 | -13.42% |
| NE | 14.7 | 12.924 | -12.08% | 17.9 | 16.679 | -6.82% | 0.38 | 0.446 | 17.34% |
| NO | 13 | 12.005 | -7.65% | 16 | 15.779 | -1.38% | 0.46 | 0.438 | -4.83% |
| NT | 15.2 | 15.029 | -1.13% | 19.2 | 19.184 | -0.08% | 0.38 | 0.429 | 12.91% |
| NW | 14.9 | 12.775 | -14.26% | 18 | 16.466 | -8.52% | 0.38 | 0.513 | 34.88% |
| SC | 12.2 | 12.590 | 3.19% | 16 | 16.402 | 2.51% | 0.64 | 0.509 | -20.50% |
| SE | 15.1 | 13.996 | -7.31% | 18.7 | 18.523 | -0.94% | 0.38 | 0.375 | -1.37% |
| SO | 14.8 | 14.745 | -0.37% | 18.2 | 18.715 | 2.83% | 0.37 | 0.345 | -6.85% |
| SW | 14.2 | 13.254 | -6.66% | 17.3 | 17.898 | 3.46% | 0.42 | 0.337 | -19.74% |
| WM | 13.7 | 13.392 | -2.25% | 17.2 | 17.480 | 1.63% | 0.43 | 0.368 | -14.32% |
| WN | 14.9 | 13.477 | -9.55% | 18 | 16.987 | -5.63% | 0.38 | 0.445 | 17.11% |
| WS | 14.8 | 13.826 | -6.58% | 17.9 | 17.186 | -3.99% | 0.46 | 0.384 | -16.42% |

# Changes to maximum CWV values

| LDZ | Current max CWV | Proposed max CWV | Change in max value | Percentage change |
|---|---|---|---|---|
| EA | 16.63 | 16.51 | -0.12 | -0.72% |
| EM | 15.12 | 14.66 | -0.46 | -3.04% |
| NE | 15.92 | 14.60 | -1.32 | -8.29% |
| NO | 14.38 | 13.66 | -0.72 | -5.01% |
| NT | 16.72 | 16.81 | 0.09 | 0.54% |
| NW | 16.08 | 14.67 | -1.41 | -8.77% |
| SC | 14.63 | 14.53 | -0.10 | -0.68% |
| SE | 16.47 | 15.69 | -0.78 | -4.74% |
| SO | 16.06 | 16.11 | 0.05 | 0.31% |
| SW | 15.50 | 14.82 | -0.68 | -4.39% |
| WM | 15.21 | 14.90 | -0.31 | -2.04% |
| WN | 16.08 | 15.04 | -1.04 | -6.47% |
| WS | 16.23 | 15.12 | -1.11 | -6.84% |

The Max CWV value has been reduced in 11 of 13 LDZ's, only NT and SO have been increased.

# Count of Maximum CWV values

| LDZ | 2015 Parameters | 2020 Parameters |
|---|---|---|
| EA | 203 | 267 |
| EM | 282 | 228 |
| NE | 114 | 234 |
| NO | 92 | 108 |
| NT | 211 | 227 |
| NW | 111 | 198 |
| SC | 96 | 54 |
| SE | 291 | 309 |
| SO | 285 | 192 |
| SW | 253 | 113 |
| WM | 178 | 160 |
| WN | 111 | 163 |
| WS | 68 | 91 |
| Total | 2295 | 2344 |

The number of days the maximum value of CWV has been reached during the optimisation period (Gas Years 2010/11 up to and incl. 2017/18)

- The reduction in NE's max CWV of 8.29% has lead to a 105.3% increase in the number of days at max CWV
- Overall the number of Gas Days at maximum CWV value has increased by a total of 49 across all LDZ's

# Conclusions

- When compared to the previous CWV formula, the newly proposed parameters have lowered the value of the majority of LDZ's maximum CWV. This has lead to a slight increase in the number of gas days which have reached the newly optimised maximum CWV across all LDZ's
- The associated R-squared value has increased for each LDZ, meaning each set of optimised parameters results in a model with data closer to the fitted regression line.
- Improvements have been made in the MAPE and RMSE values across the majority of LDZ's during shoulder months
- DESC are now asked to provide approval for the use of the revised parameters detailed in this meeting for use from 1st October 2020

# Next Steps

- The CWV optimisation process is complete
- The final set of optimum parameters and the revised formula will be used to derive a new CWV weather history (back to 1960)
- In addition the revised 1 in 20 peak CWVs can be calculated, although these will not be directly comparable with the existing values due to the formula change
- This CWV history will be used for demand modelling in 2020 and form the basis of the SNCWV calculations (see next agenda item)
- The daily values of SNET and SNES for each LDZ will be made available