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# DESC Technical Workgroup

## CWV Optimisation Trial Phase Update

**22<sup>nd</sup> September 2014**

- Trial Phase Update
- Explanation of results provided
- Preliminary Results for SW
- Pseudo SNET
- Next Steps

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# CWV Optimisation

## Trial Phase Update

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# Trial Phase Update - Background

- As per the approved Approach document: *“The objective of the Trial phase is to establish key principles and approaches for how the main CWV optimisation analysis will be carried out during the Production phase”*
- TWG agreed to reviewing the results of 4 LDZs (SC,NE,WM and SW)
- The Trial phase has analysed results for an 17 year period and 12 year period, namely:
  - 17 years – 1996/97 to 2012/13
  - 12 years – 2001/02 to 2012/13
- The values of the CWV parameters are chosen to give the best fit to demand on average across a number of years

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## Trial Phase Update - Infilling

- One of the major inputs to this process is the weather data series which this time will be based on the Weather Station Substitution Methodology (WSSM) dataset
- For the majority of weather stations there are records where either an observation or estimate does not exist. Xoserve has been working on applying the methodology proposed by E.On in order to create a complete data series which is necessary for optimisation
- This in-filling has been completed for all current gas industry stations for both temperature and wind speed. The data will be made available soon to industry parties on the secure area of the Xoserve website

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# Trial Phase Update - Results

- Due to the additional workload relating to in-filling we are only able to share the full results for SW LDZ today. The results for the remaining 3 Trial LDZs will be shared shortly via correspondence
- At the end of the Trial phase TWG are required to have selected a number of years to be used for deriving the CWV parameters.
- It is also important that Xoserve are clear on analysis / charts required for presenting the final results in the Production phase (Q4)
- Feedback on the results for SW is therefore welcome

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## Trial Phase – Assessment of alternative periods

- Derive alternative CWVs for 4 LDZs (SC, NE, WM and SW) based on 17 and 12 gas years' data and derive aggregate NDM demand models for 4 LDZs for alternative CWVs (plus current CWV)
- Calculate revised SNET values for alternative periods
- Assess average fit of CWVs to aggregate NDM demand and Assess change to 1 in 20 peak aggregate NDM demand estimates from current CWV (using demand models and 1 in 20 peak CWVs)
- Where results have been benchmarked to the current CWV, it should be appreciated that 'current' is based on EXISTING parameters but with the NEW weather data series.

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## Trial Phase – Explanation of results provided

### Results 1 – Example Format

- Objective: To provide a summary of all the iterations attempted with best option highlighted. This will be provided for each 'run' – i.e. 12yrs, 17yrs etc

|            |                |
|------------|----------------|
| <b>LDZ</b> | <b>Station</b> |
| NE         | WAT            |

| Run Description       | MIN_ET | MAX_ET | L1    | L2     | L3   | V0 | V1   | V2   | Q    | Increase in R-sq | % decrease in RMSE |
|-----------------------|--------|--------|-------|--------|------|----|------|------|------|------------------|--------------------|
| Previous Optimisation | 3      | 15     | 0.692 | 0.0150 | 0    | 0  | 14.8 | 17.9 | 0.43 | 0.00%            | 0.00%              |
| Old Param - New SNET  | 3      | 15     | 0.692 | 0.0150 | 0    | 0  | 14.8 | 17.9 | 0.43 | 0.02%            | 0.43%              |
| New alternative       | 3      | 15     | 0.623 | 0.0150 | 0.11 | 0  | 15   | 18.1 | 0.39 | -0.05%           | -1.58%             |
| New alternative       | 2      | 15     | 0.626 | 0.0148 | 0.09 | 1  | 15   | 18.1 | 0.40 | -0.04%           | -1.33%             |
| New alternative       | 2      | 16     | 0.621 | 0.0155 | 0.07 | 2  | 15.3 | 18.5 | 0.32 | -0.07%           | -2.03%             |
| New alternative       | 3      | 16     | 0.618 | 0.0158 | 0.07 | 2  | 15.3 | 18.5 | 0.33 | -0.07%           | -2.17%             |
| New alternative       | 4      | 16     | 0.606 | 0.0179 | 0.04 | 3  | 15.4 | 18.6 | 0.30 | -0.09%           | -2.81%             |
| New alternative       | 3      | 20     | 0.562 | 0.0199 | 0.08 | 3  | 15.8 | 19   | 0.25 | -0.28%           | -8.73%             |
| New alternative       | 3      | 25     | 0.541 | 0.0211 | 0.16 | 3  | 16   | 19.7 | 0.20 | -0.38%           | -11.91%            |

Pos - improvement against benchmark  
Neg - worse than benchmark

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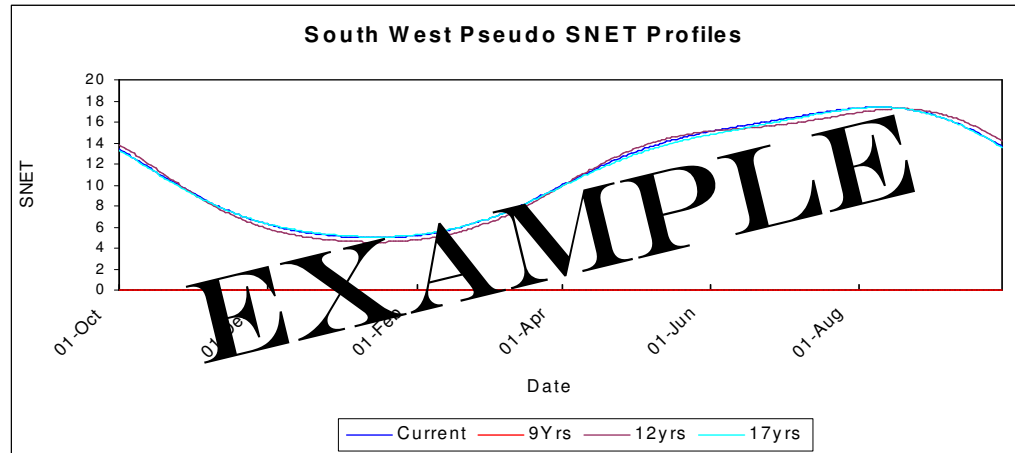
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## Trial Phase – Explanation of results provided

### Results 2 – Example Format

- Objective: For selected run compare all pseudo SNET profiles – 17yr, 12yr and Current
- Analysis: Calculate revised pseudo Seasonal Normal Effective Temperature (SNET) and visually compare profiles. High level observations on results provided



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## Trial Phase – Explanation of results provided

### Results 3 – Example Format

- Objective: To confirm which period provides the best fit between CWV and demand over a range of gas years
- Analysis: Derive aggregate NDM demand models for all alternative periods. Assess average 'fit' of CWVs to aggregate NDM demand. Results of current vs revised are represented as Green: better fit; Red: worse fit.

| Gas Year<br>Period<br>TESTED<br>against | Fit Statistic | Current CWV | 9 year CWV | 12 year CWV | 17 year CWV |
|-----------------------------------------|---------------|-------------|------------|-------------|-------------|
| 1996/97 -<br>2012/13                    | Adj. R-sq.    | 99.12%      |            | 99.12%      | 99.13%      |
|                                         | RMSE (MWh)    | 4,817       |            | 4,552       | 4,521       |
| 2001/02 -<br>2012/13                    | Adj. R-sq.    | 99.05%      |            | 99.11%      | 99.10%      |
|                                         | RMSE (MWh)    | 4,788       |            | 4,652       | 4,670       |

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## Trial Phase – Explanation of results provided

### Results 4 – Example Format

- Objective: Assess change to estimated 1 in 20 peak aggregate NDM demand estimates for alternative periods from current CWV
- Analysis: Use demand models and 1 in 20 peak CWVs to assess estimated 1 in 20 peak demand and compare with levels from current CWV

| Gas Year Period   | 9 year CWV | 12 year CWV | 17 year CWV |
|-------------------|------------|-------------|-------------|
| 1996/97 – 2012/13 |            | 6.26%       | 7.34%       |
| 2001/02 – 2012/13 |            | 6.16%       | 7.24%       |
| 2004/05 – 2012/13 |            | 6.12%       | 7.19%       |
| 2009/10 – 2012/13 |            | 5.85%       | 6.86%       |

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# CWV Optimisation

## Trial Phase

## Pseudo SNET

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## Pseudo SNET – use of Min and Max ET range

- TWG wishes to explore Pseudo SNET Max ET ranges

- Pseudo SNET calculated by the formula:

$$D = a - \sum_{i=1}^3 b \sin\left(\frac{2id\pi}{365}\right) - \sum_{i=1}^3 c \cos\left(\frac{2id\pi}{365}\right) + dET + eWC + fFRI + gSAT + hSUN + \mu$$

- This formula derives a pseudo SNET from Aggregate NDM Demand using a 3-frequency Fourier series
  - Key factor other than demand is the Effective Temperature (ET) which is given by
    - $ET_d = ET_{d-1} + 0.5 * AT_d$  (AT = Actual temperature)
  - The following slides describe the SNET calculation and impacts on it by testing different values of ET Max

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# ET Min and Max Ranges

- $ET_{\min}$  and  $ET_{\max}$  ranges:
  - $ET_{\min}$  and  $ET_{\max}$  are integers that vary by LDZ and are chosen to select most of the non-holiday days that do not fall within the cold weather upturn or warm weather flattening off periods.
  - ET values that fall outside the cold weather upturn or warm weather flattening distort the pseudo snet values when the regression models assess the demand against the ET values
  - Note in the derivation of the cold weather and warm weather flattening all data points are used including those outside this range

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# ET Influence on Pseudo SNET

- The following section of the formula shows the demand, Pseudo SNET and ET elements in the regression

$$D = a - \sum_{i=1}^3 b_i \sin\left(\frac{2id\pi}{365}\right) - \sum_{i=1}^3 c_i \cos\left(\frac{2id\pi}{365}\right) - dET +$$

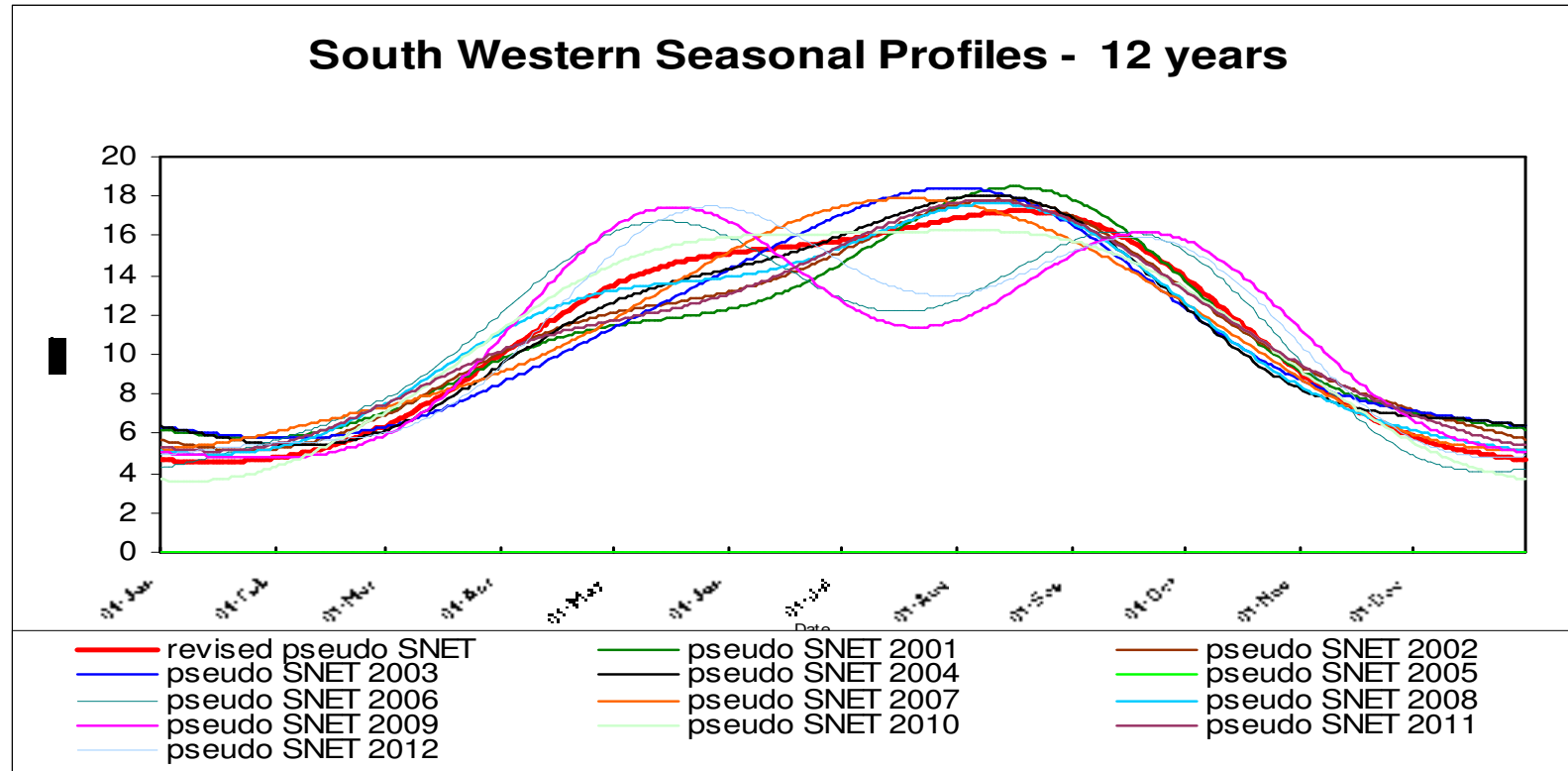
- In warmer periods as demand flattens off (red) and ET (blue) keeps rising the SNET tries to compensate which introduces some strange patterns

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# SW – Pseudo SNET for ET 3 to 13 against individual years



- The Red line is the average Pseudo SNET which would be used in the optimisation.
- The other lines are the Pseudo SNET's for the individual years

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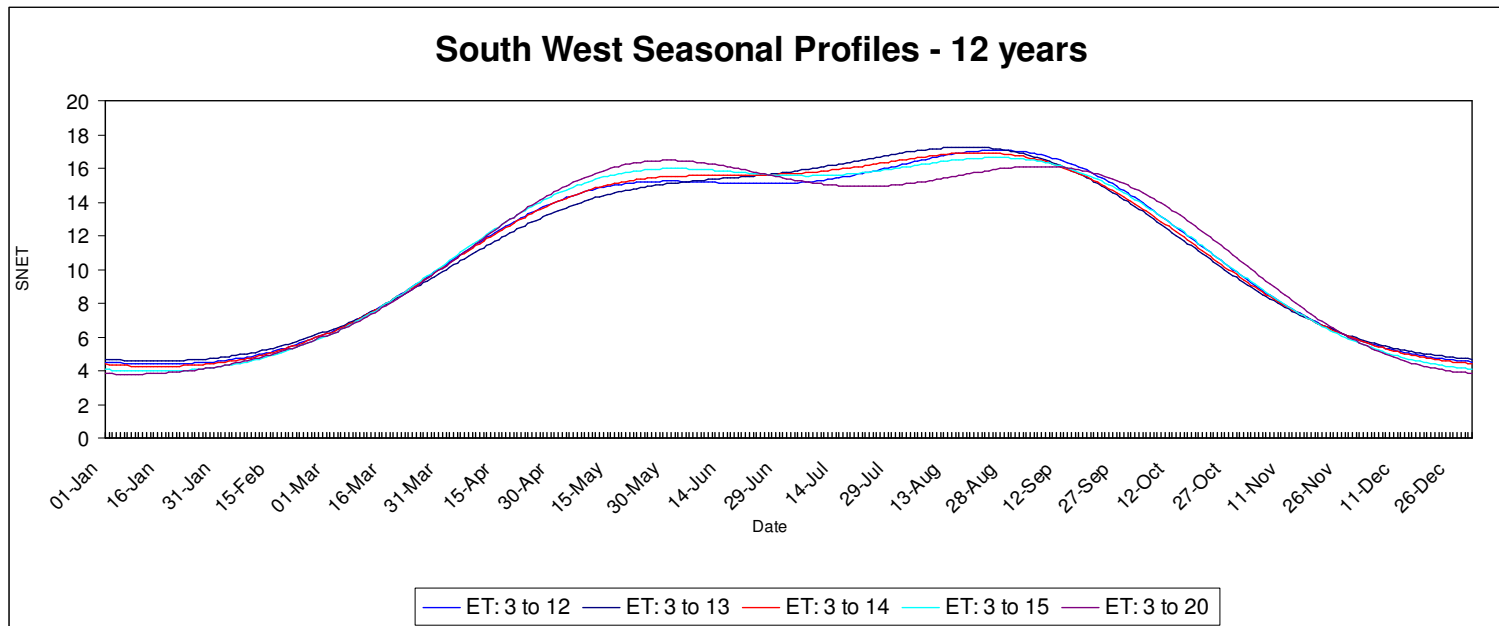


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# SW – $ET_{\text{Min}} = 3$ for variety of $ET_{\text{Max}}$ values

- Chart showing Pseudo SNET's with  $ET_{\text{min}}$  of 3 and exploring a number of  $ET_{\text{max}}$  values



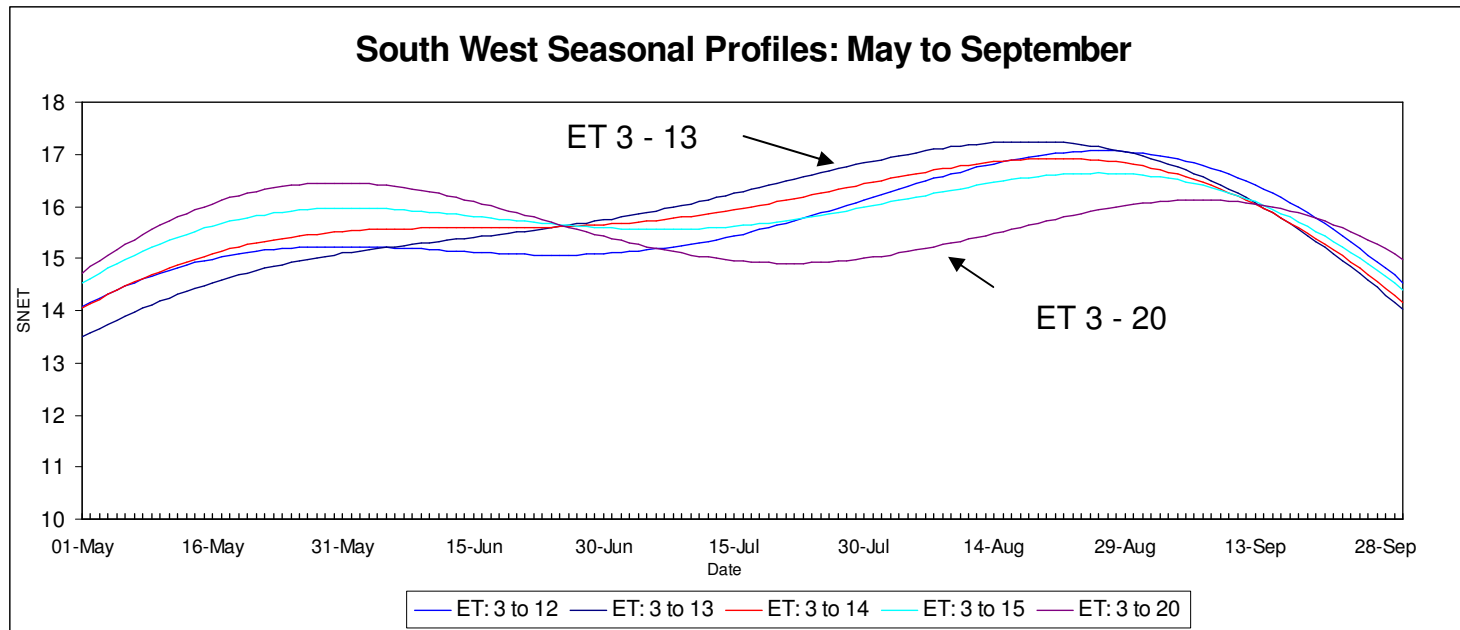
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# SW: $ET_{Min}$ of 3 for variety of $ET_{Max}$ values

- Same chart as in the previous slide but focus on May to September months



- Pseudo SNET 3-20 is working over this period to as demand flattens off and effective temperature is high / rising.

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# CWV Optimisation

## Trial Phase

### Preliminary Results - SW

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# Results 1: SW LDZ – Iterations Summary – 17 years

- Preferred iteration is highlighted

| LDZ | Station |
|-----|---------|
| SW  | FIL     |

| Run Description        | MIN_ET   | MAX_ET    | L1           | L2            | L3         | V0       | V1          | V2          | Q           | Increase in R-sq | % decrease in RMSE | Average RMSE     |
|------------------------|----------|-----------|--------------|---------------|------------|----------|-------------|-------------|-------------|------------------|--------------------|------------------|
| Previous Optimisation  | 4        | 14        | 0.637        | 0.0088        | 0.09       | 3        | 14.3        | 17.6        | 0.38        | 0.00%            | 0.00%              | 4,617,173        |
| Old Param - New SNET   | 4        | 14        | 0.637        | 0.0088        | 0.09       | 3        | 14.3        | 17.6        | 0.38        | -0.02%           | -0.71%             | 4,651,983        |
| New alternative        | 4        | 14        | 0.664        | 0.0091        | 0.27       | 3        | 14.2        | 17.5        | 0.40        | 0.04%            | 1.78%              | 4,530,328        |
| New alternative        | 0        | 13        | 0.659        | 0.0090        | 0.25       | 3        | 14          | 17.6        | 0.36        | 0.04%            | 1.88%              | 4,525,100        |
| New alternative        | 0        | 13        | 0.659        | 0.0090        | 0          | 0        | 13.9        | 17.6        | 0.37        | 0.02%            | 0.92%              | 4,572,071        |
| New alternative        | 0        | 14        | 0.684        | 0.0093        | 0.22       | 3        | 14.3        | 17.6        | 0.38        | 0.03%            | 1.66%              | 4,535,818        |
| New alternative        | 1        | 13        | 0.659        | 0.0090        | 0.32       | 3        | 13.9        | 17.6        | 0.37        | 0.02%            | 1.03%              | 4,566,885        |
| New alternative        | 1        | 14        | 0.682        | 0.0092        | 0.23       | 3        | 14.3        | 17.6        | 0.38        | 0.03%            | 1.66%              | 4,536,056        |
| <b>New alternative</b> | <b>3</b> | <b>13</b> | <b>0.649</b> | <b>0.0090</b> | <b>0.3</b> | <b>3</b> | <b>13.9</b> | <b>17.6</b> | <b>0.37</b> | <b>0.04%</b>     | <b>1.97%</b>       | <b>4,520,956</b> |
| New alternative        | 3        | 15        | 0.684        | 0.0097        | 0.32       | 3        | 14.6        | 0.39        | 0.39        | 0.02%            | 1.10%              | 4,563,357        |

Pos - improvement against  
benchmark  
Neg - worse than  
benchmark

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# Results 1: SW LDZ – Iterations Summary – 12 years

- Preferred iteration is highlighted

| LDZ | Station |
|-----|---------|
| SW  | FIL     |

| Run Description        | MIN_ET   | MAX_ET    | L1           | L2            | L3          | V0       | V1          | V2          | Q           | Increase in R-sq | % decrease in RMSE | Average RMSE     |
|------------------------|----------|-----------|--------------|---------------|-------------|----------|-------------|-------------|-------------|------------------|--------------------|------------------|
| Previous Optimisation  | 4        | 14        | 0.637        | 0.0088        | 0.09        | 3        | 14.3        | 17.6        | 0.38        | 0.00%            | 0.00%              | 4,787,866        |
| Old Param - New SNET   | 4        | 14        | 0.637        | 0.0088        | 0.09        | 3        | 14.3        | 17.6        | 0.38        | -0.02%           | -0.81%             | 4,830,078        |
| New alternative        | 4        | 14        | 0.672        | 0.0100        | 0.25        | 3        | 14.3        | 17.5        | 0.40        | 0.05%            | 2.57%              | 4,654,722        |
| New alternative        | 0        | 13        | 0.678        | 0.0099        | 0.21        | 3        | 14.1        | 17.5        | 0.38        | 0.05%            | 2.21%              | 4,673,194        |
| New alternative        | 0        | 13        | 0.678        | 0.0099        | 0           | 0        | 14.1        | 17.5        | 0.38        | 0.03%            | 1.18%              | 4,726,908        |
| New alternative        | 0        | 14        | 0.695        | 0.0100        | 0.19        | 3        | 14.4        | 17.5        | 0.39        | 0.05%            | 2.18%              | 4,674,823        |
| New alternative        | 1        | 13        | 0.677        | 0.0099        | 0.24        | 3        | 14.2        | 18          | 0.36        | 0.05%            | 2.39%              | 4,673,621        |
| New alternative        | 1        | 14        | 0.692        | 0.0100        | 0.21        | 3        | 14.4        | 17.6        | 0.40        | 0.05%            | 2.50%              | 4,668,396        |
| <b>New alternative</b> | <b>3</b> | <b>13</b> | <b>0.667</b> | <b>0.0101</b> | <b>0.24</b> | <b>3</b> | <b>14.1</b> | <b>17.5</b> | <b>0.39</b> | <b>0.06%</b>     | <b>2.62%</b>       | <b>4,651,779</b> |
| New alternative        | 3        | 15        | 0.688        | 0.0105        | 0.21        | 3        | 14.9        | 18.1        | 0.34        | 0.05%            | 2.49%              | 4,668,825        |

Pos - improvement against benchmark  
Neg - worse than benchmark

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# Results 1: SW LDZ – Iterations Summary – 9 years

- To be completed

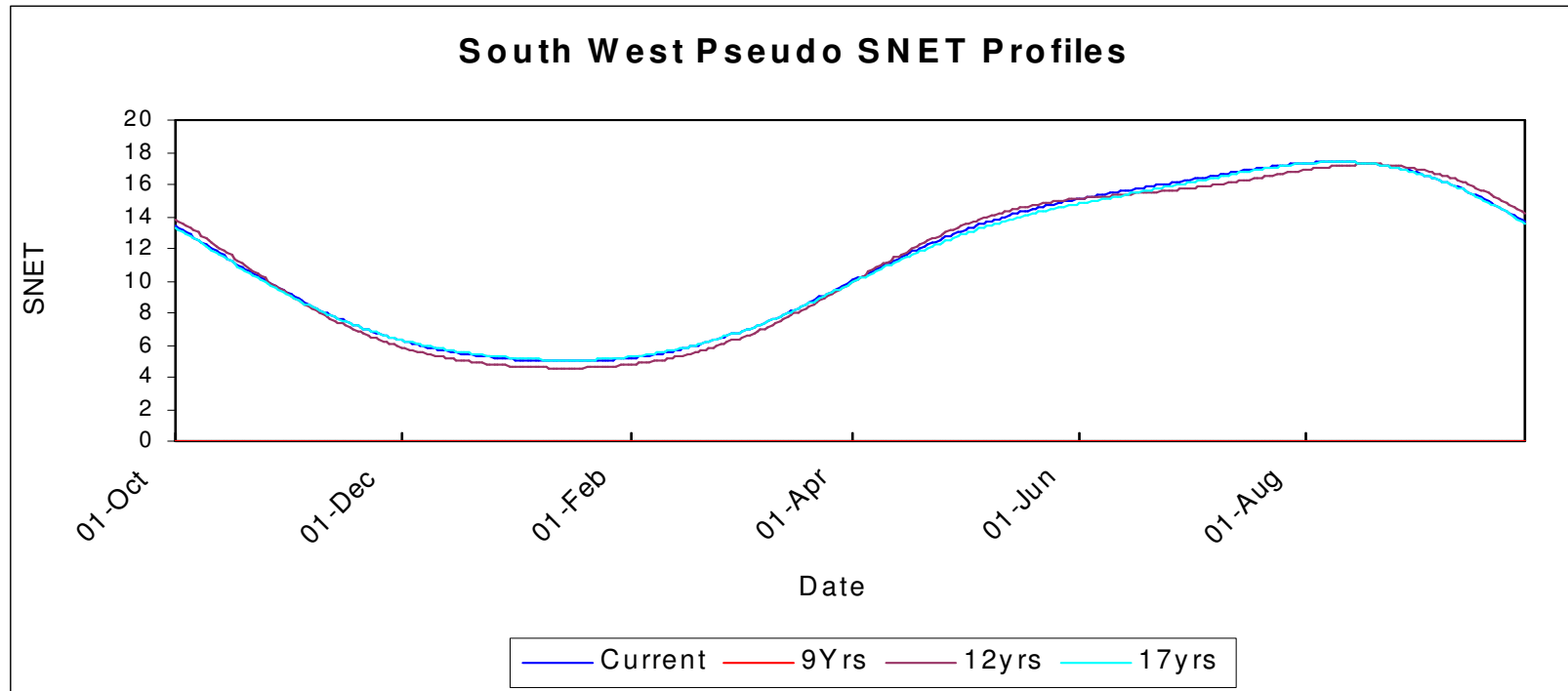
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## Results 2: SW LDZ - Pseudo SNET profiles

- Comparison of current to proposed Pseudo SNET



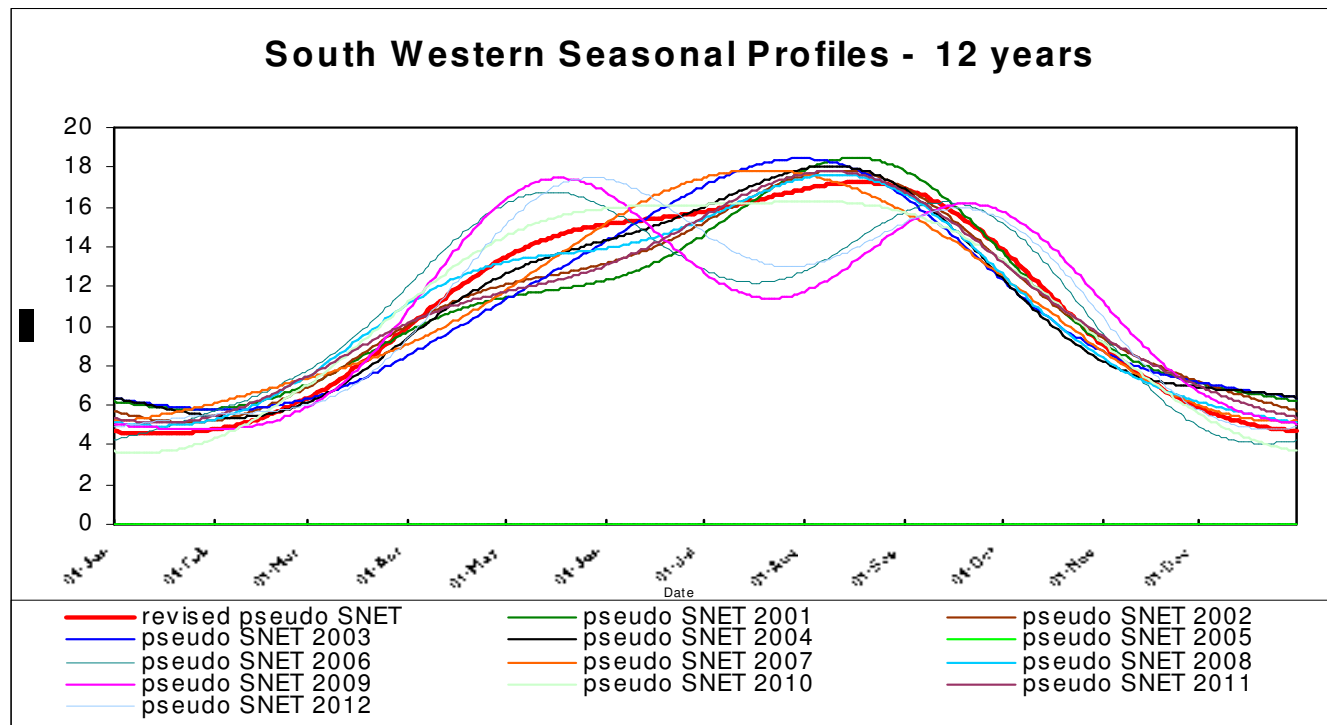
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## Results 2b: SW LDZ - Pseudo SNET 12 year

- Individual years influence on proposed 12 year Pseudo SNET



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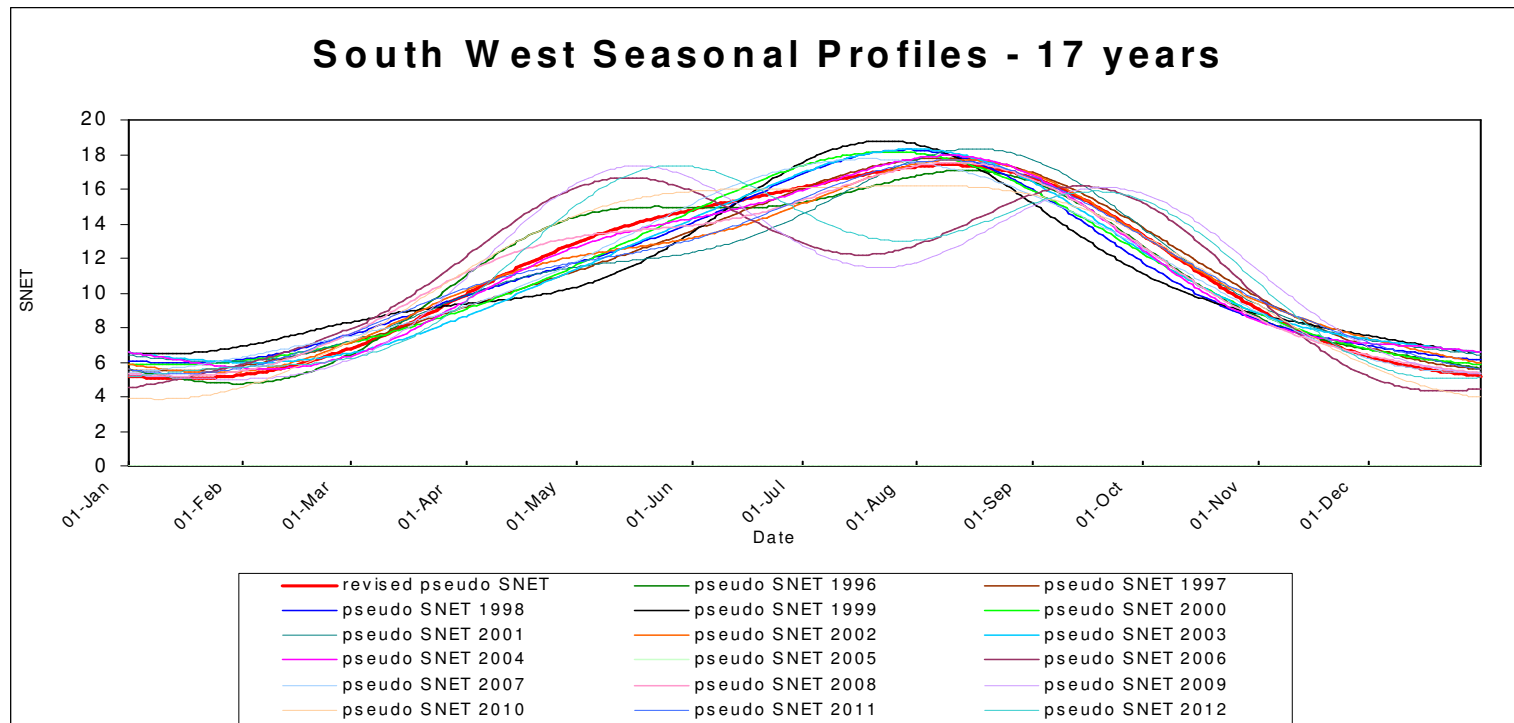


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# Results 2c: SW LDZ - Pseudo SNET 17 year

- Individual years influence on proposed 17 year Pseudo SNET



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## Results 3: SW LDZ – Fit between CWV and Demand

| Gas Year<br>Period TESTED<br>against | Fit Statistic | Current CWV | 9 year CWV | 12 year CWV | 17 year CWV |
|--------------------------------------|---------------|-------------|------------|-------------|-------------|
| 1996/97 -<br>2012/13                 | Adj. R-sq.    | 99.12%      |            | 99.12%      | 99.13%      |
|                                      | RMSE (MWh)    | 4,617       |            | 4,552       | 4,521       |
| 2001/02 -<br>2012/13                 | Adj. R-sq.    | 99.05%      |            | 99.11%      | 99.10%      |
|                                      | RMSE (MWh)    | 4,788       |            | 4,652       | 4,670       |
| 2004/05 -<br>2012/13                 | Adj. R-sq.    | 99.03%      |            | 99.12%      | 99.11%      |
|                                      | RMSE (MWh)    | 4,823       |            | 4,603       | 4,636       |
| 2009/10 –<br>2012/13                 | Adj. R-sq.    | 98.86%      |            | 99.08%      | 99.05%      |
|                                      | RMSE (MWh)    | 5,173       |            | 4,659       | 4,742       |

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## Results 4: SW LDZ – change in estimated peak demand (compared to current CWV)

| Gas Year Period   | 9 year CWV | 12 year CWV | 17 year CWV |
|-------------------|------------|-------------|-------------|
| 1996/97 – 2012/13 |            | 6.26%       | 7.34%       |
| 2001/02 – 2012/13 |            | 6.16%       | 7.24%       |
| 2004/05 – 2012/13 |            | 6.12%       | 7.19%       |
| 2009/10 – 2012/13 |            | 5.85%       | 6.86%       |

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## Next steps

- Results for the remaining 3 Trial LDZs (SC,NE and WM) will be shared over the next few weeks
- TWG will be asked to review these results and provide their view on how many years should be selected for optimising parameters over, in the Production phase
- Any questions on the process so far and/or additional information the TWG may need to make this decision

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