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DESC Technical Workgroup

CWV Optimisation Update

18th August 2014

Contents

CWV Optimisation

Background

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Background

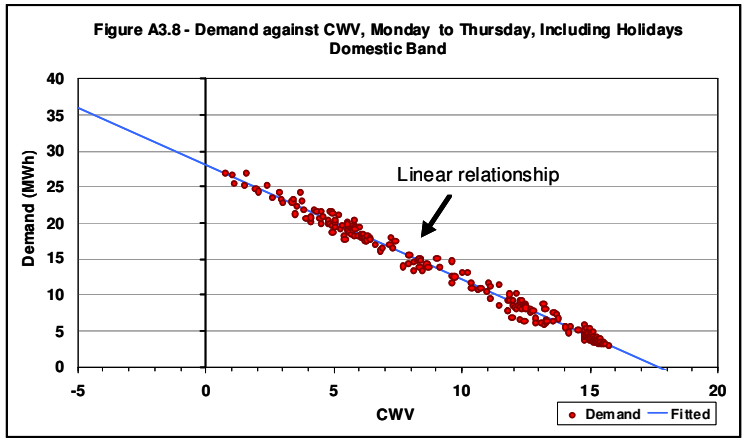
- UNC Section H 1.4.2 requires DESC to review and where appropriate revise the Composite Weather Variable (CWV) formula. This review is usually done in conjunction with an update of the Seasonal Normal basis

- With plans in place for a new SN basis for GY 2015/16 it's also time to consider the CWV formula definitions

- Last review carried out in autumn 2009 with revisions effective from 1st October 2010. The next comprehensive review will be performed in autumn 2014 in order to support a 2015/16 implementation

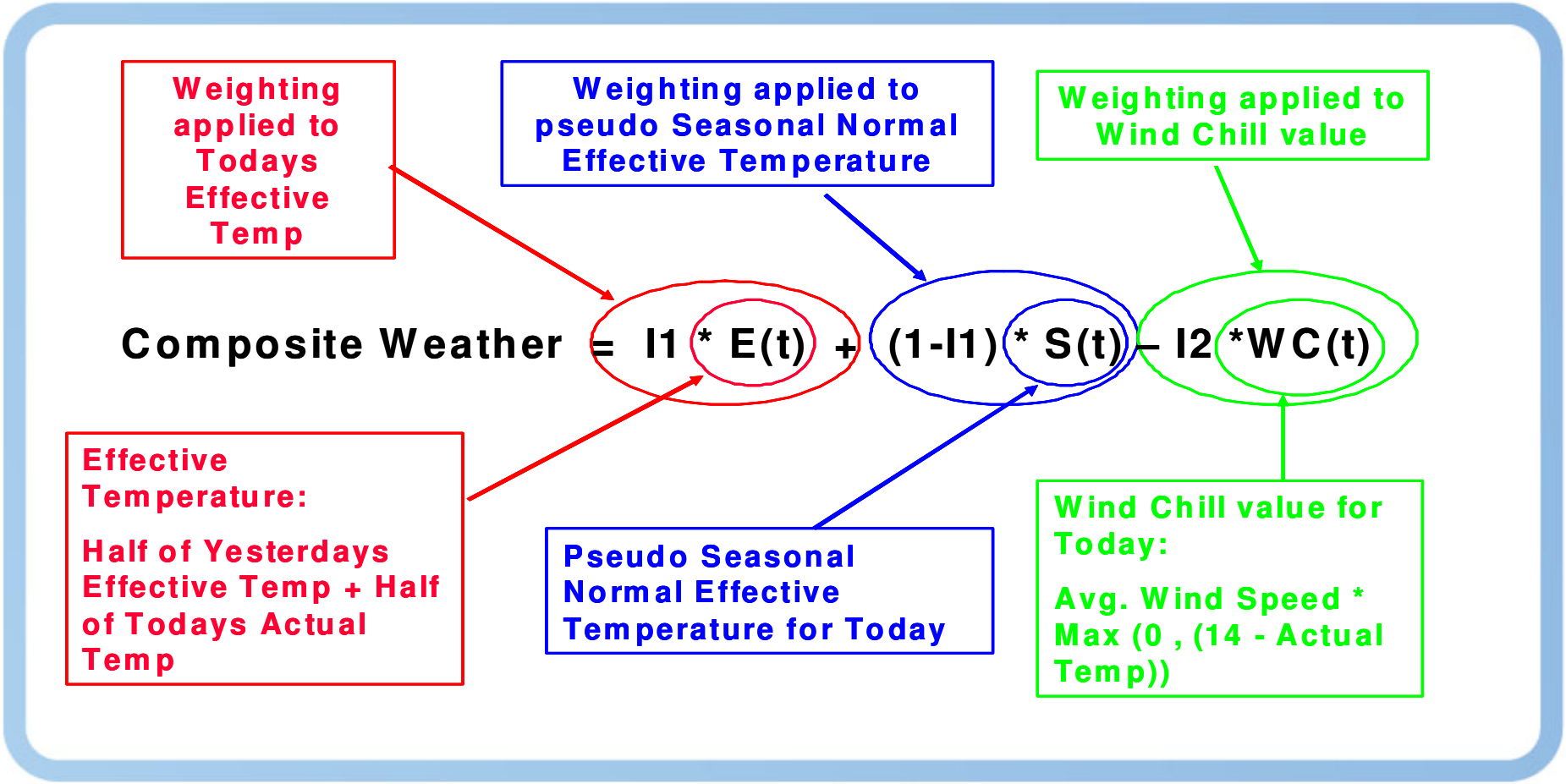
Composite Weather Variable (CWV)

- The CWV is a single measure of daily weather in each LDZ and is a function of effective temperature, wind speed and pseudo Seasonal Normal Effective Temperature (SNET)
- The CWV is defined to give a linear relationship between Monday to Thursday non holiday daily aggregate NDM demand in the LDZ and the CWV
- The relationship between weather and demand is fundamental to demand estimation and forecasting processes. It is important to produce a weather variable that provides the strongest possible 'fit' for the weather and demand models.



- This relationship is key to providing the Demand Estimation parameters:
  - Annual Load Profile (ALP)
  - Daily Adjustment Factor (DAF)
  - Load Factors
- The parameters are required for:
  - Allocation process
  - AQ calculation
  - Derivation of SOQ

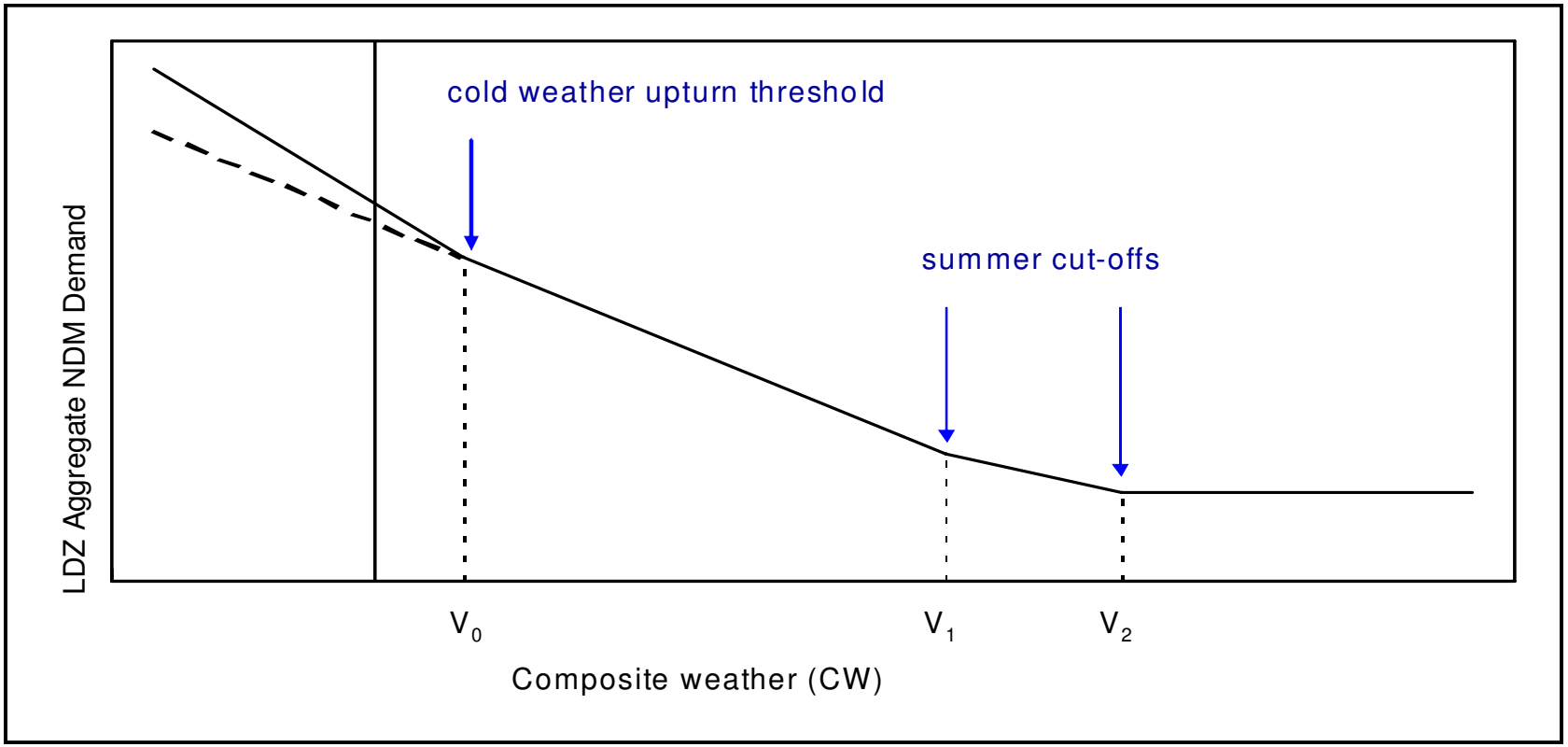
Composite Weather Variable Formula
Part 1 - CWV



Composite Weather Variable Formula Part 2 - CWV

- Series of tests applied to the CW value (using parameters below) to determine if changes need to be made. Parameters to consider:
  - V0 – Cold Weather Upturn Threshold
  - V1 – Lower Warm Weather Cut-Off
  - V2 – Upper Warm Weather Cut-Off
  - Q – Slope relating to Warm Weather Cut-off
- **'Normal'**: If CW is > cold weather threshold and < lower warm weather cut off: **CWV = CW.**
- '**Summer Transition**': If CW is > lower warm weather cut-off but < upper warm weather cut-off:
  CWV = Lower Cut-Off + Slope * (CW – Lower Cut-Off)
- '**Summer Cut-Off**': If CW is > upper warm weather cut off:
  CWV = Lower Cut-Off + Slope * (Upper Cut-Off – Lower Cut-Off)
- '**Cold Weather Upturn**': If CW is < cold weather upturn threshold:
  CWV = CW + Cold Weather sensitivity * (CW – Cold Weather Upturn Threshold)

Composite Weather Variable: Schematic



Composite Weather Variable: Existing Parameters

LDZ	Weather Station	I_1	I_2	I_3	V_0	V_1	V_2	q	W_0	T_0
SC	Glasgow Bishopton	0.653	0.0118	0.19	3	13.2	16.0	0.64	0.0	14.0
NO	Albermarle Barracks	0.636	0.0102	0.50	0	12.5	15.7	0.56	0.0	14.0
NW	Hulme Library	0.661	0.0149	0.26	3	15.5	18.5	0.41	0.0	14.0
NE	Nottingham Watnall	0.692	0.0150	0.00	0	14.8	17.9	0.43	0.0	14.0
EM	Nottingham Watnall	0.687	0.0131	0.00	0	13.8	16.9	0.52	0.0	14.0
WM	Birmingham Winterbourne 2* (wind speeds Coleshill)	0.698	0.0104	0.23	1	14.0	17.9	0.39	0.0	14.0
WN	Hulme Library	0.661	0.0149	0.26	3	15.5	18.5	0.41	0.0	14.0
WS	St. Athan	0.634	0.0111	0.15	2	14.9	17.9	0.47	0.0	14.0
EA	London Heathrow	0.690	0.0118	0.00	0	15.1	19.1	0.37	0.0	14.0
NT	London Heathrow	0.703	0.0129	0.00	0	15.2	19.2	0.35	0.0	14.0
SE	London Heathrow	0.704	0.0125	0.05	3	15.1	19.0	0.37	0.0	14.0
SO	Southampton Oceanographic Institute	0.677	0.0127	0.39	2	14.8	18.1	0.38	0.0	14.0
SW	Filton Weather Station	0.637	0.0088	0.09	3	14.3	17.6	0.38	0.0	14.0

CWV Optimisation

Approach Summary

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Approach to CWV Optimisation Summary

- TWG agreed the Approach to CWV Optimisation document in April 2014
- The following summaries the main points from this agreement:
- A Trial calculation phase would take place in order to agree all of the key dates and principles for use in the main calculation phase in Q4
- 4 LDZs were selected for the Trial phase, these were NE, SC, SW and WM.
  - The weather stations associated with these LDZs had minimal requirements for data infilling
  - Covered a wide geographical area
- Optimisation to be performed over two different date ranges
  - Range 1: Extend existing years to include 2012/13 (additional 4 years) so 1996/97 to 2012/13
  - Range 2: Add additional 4 years and remove 4 years so 2000/01 to 2012/13.

Approach to CWV Optimisation Summary

- Weather data series:
  - Use the WSSM datasets from 01/10/1960 to 30/09/2012
  - Fill in any gaps using the Infill Methodology proposed by E.On
  - From 30/09/2012 to 30/09/2013 use data in S&M (used to calculate CWVs)

- Demand data series
  - Suspect / unusual data for particular days or years may be excluded from the analysis or corrected
  - From Gas Year 2006/07 Xoserve shall use the Aggregate NDM demand adjusted to reflect known significant measurement errors
  - Cold weather upturn analysis to continue to use Maximum Potential Demand (MPD) data back to 1981/82 – *but see Slide 16*

- Stages involved in deriving individual parameters agreed along with a requirement on Xoserve to share results of all of the various trials

CWV Optimisation

Trial Phase Update

Proposed amendments to approach

- Gas day Change
  - Following TWG on 30th July Xoserve were asked to consider undertaking the trial assessment based on gas day running from 5am to 3am
    - Xoserve have updated system to allow this for the Trial and Production phases
- Use of non-holiday Monday to Thursday
  - Initial investigations used the current EUC modelling holiday code rules to determine those days to exclude from Optimisation (16 holiday codes in total)
  - Xoserve wanted to ensure days were not removed from the analysis unnecessarily (particularly in the Summer) and so have reviewed the results of the recent run of the aggregate NDM demand model used in this years NDM proposals

Proposed amendments to approach

- Holiday Codes 13 – 16 and their factors

LDZCODE	13	14	15	16
SC	0.896	0.966	0.953	0.987
NO	0.844	0.982	0.900	0.963
NW	0.918	1.000	0.946	1.000
NE	0.889	0.991	0.896	0.996
EM	0.886	0.994	0.895	1.000
WM	0.904	0.992	0.907	1.000
WN	0.933	1.000	0.960	1.000
WS	0.958	1.000	0.922	0.985
EA	0.982	1.000	0.936	1.000
NT	0.979	0.991	0.930	0.984
SE	1.000	1.000	0.973	0.996
SO	0.990	1.000	0.997	1.000
SW	0.987	1.000	1.000	1.000
Overall	0.936	0.994	0.940	0.993

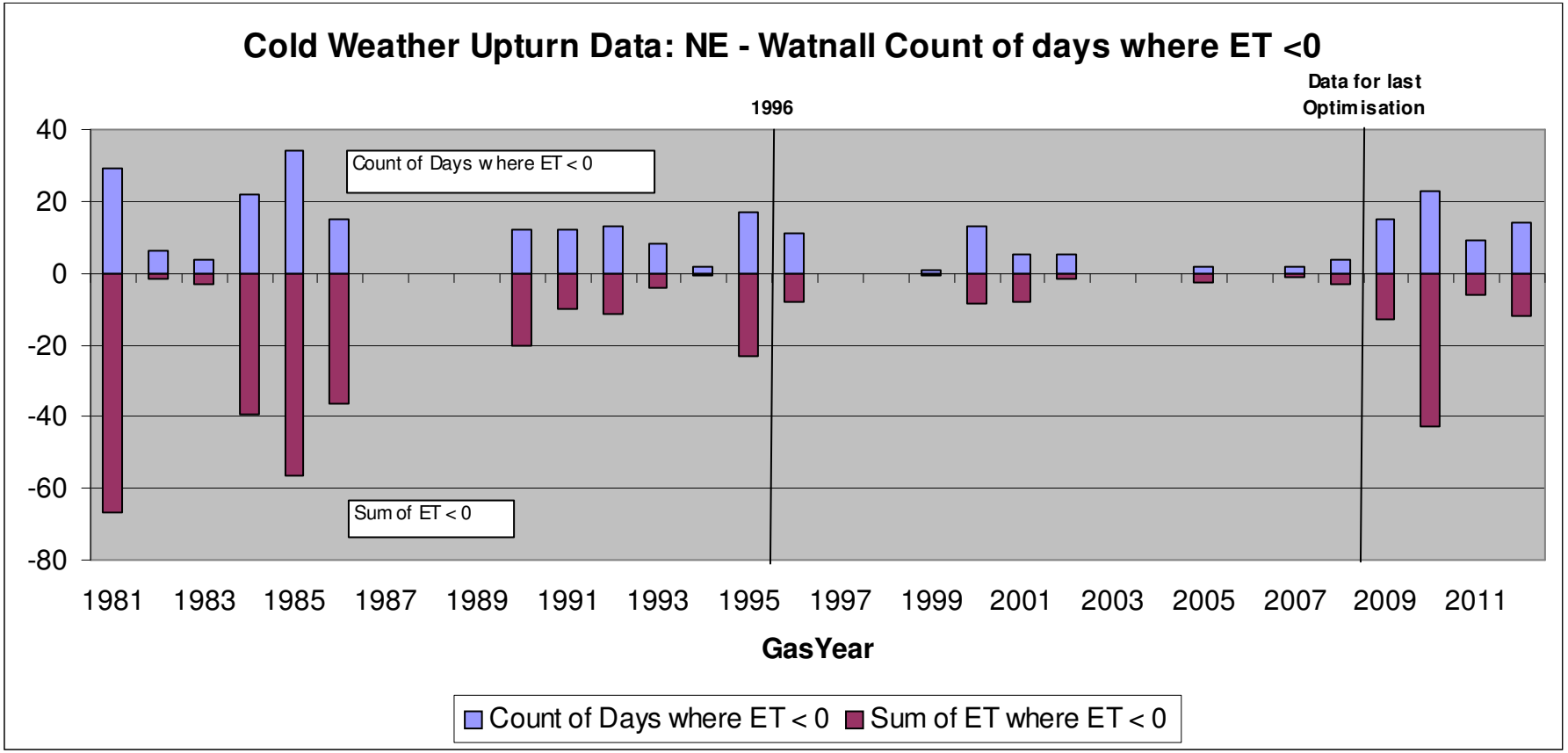
Shaded values indicates factor > 0.98

- These codes and in particular 14 and 16 representing Mon – Fridays are close to 1 meaning the fitted to actual was quite close.
- These could be left in to give more Monday – Thursday data points in the analysis of summer cut-offs – what are the group's views?

Proposed amendments to approach

- Demand data series
  - As CWV is optimised against Aggregate NDM demand data ideally all parameter would use this level of demand
  - At the last CWV review there was insufficient cold weather days available in the aggregate NDM demand 'era' (1996 onwards) and so MPD data was used in derivation of cold weather parameters
  - Audit trail of MPD data is not as strong as Aggregate NDM Demand
  - There have been a number of colder years since the last optimisation and TWG may consider the years to be included in cold weather upturn no longer requires use of the MPD data ?
  - Following slides show the historic cold weather for the 4 Trial LDZs
    - Figures quoted are based on Effective Temperature (ET)
      - $ET_D = 0.5 * ET_{D-1} + 0.5 * \text{Actual Temperature}$

NE – Days where ET < 0



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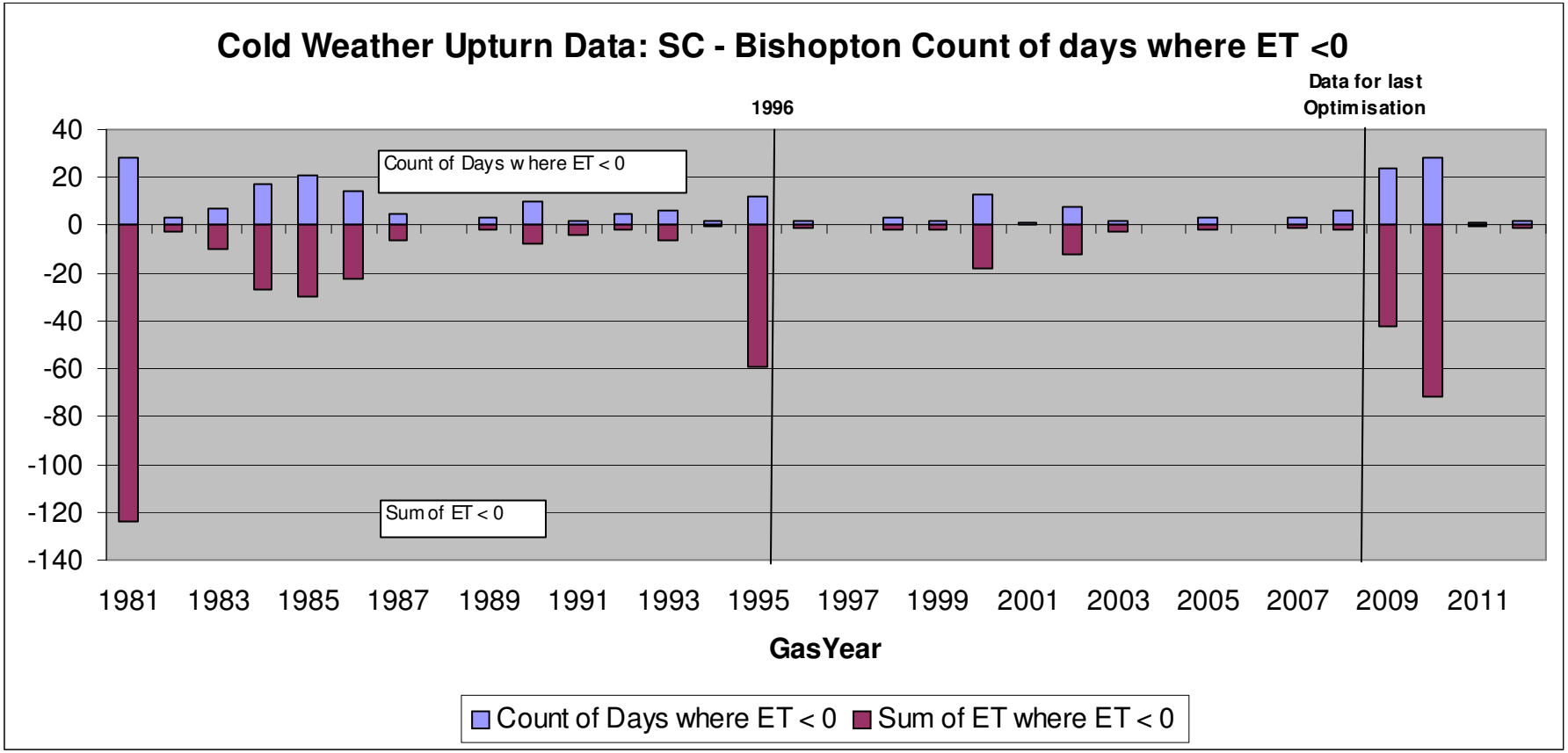
SC – Days where ET < 0



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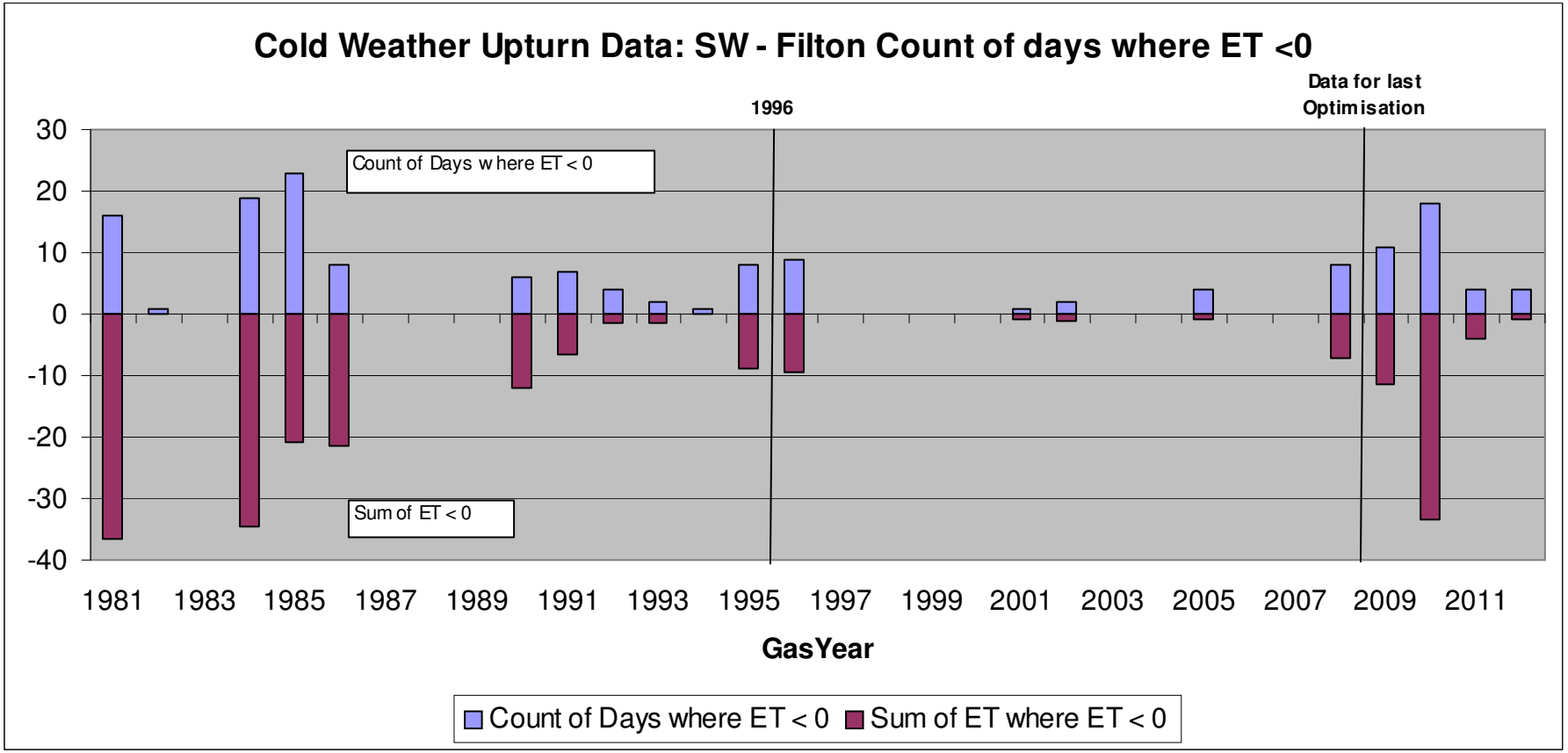
SW – Days where ET < 0



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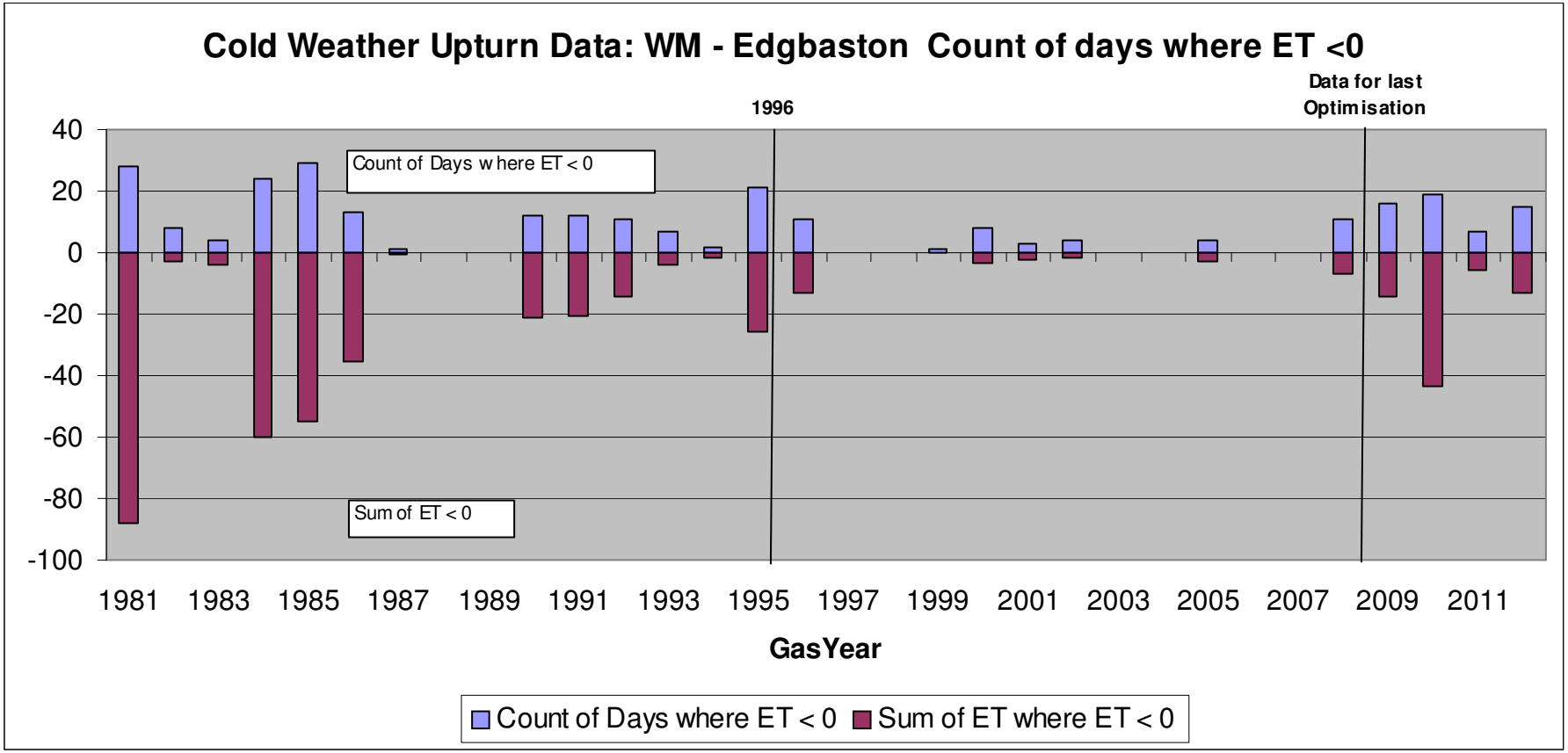
WM – Days where ET < 0



- Xoserve's view is there is now sufficient cold weather experienced in UNC data to not use MPD dataset
- What are the group's views?

CWV Optimisation

Trial Phase

Preliminary Results Example

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Trial Analysis – Clarification of the format of results

- As a reminder there is a requirement on Xoserve to share results of all of the various trials
- Need to agree what this looks like as it is potentially very substantial.
- The following slides show possible format but also the type of information that was provided during last review, namely:
  - Assess average fit of CWVs to aggregate NDM demand
  - Assess average seasonal bias of aggregate NDM demand models using the mean percentage residual error (MPRE):
    $$MPRE = 100*\left(\frac{\text{avg. actual demand} - \text{avg. fitted demand}}{\text{avg. actual demand}}\right)$$
    (for quarters Mar-May, Jun-Aug, Sep-Nov and Dec-Feb)
  - Assess change to 1 in 20 peak aggregate NDM demand estimates (using demand models and 1 in 20 peak CWVs)

Trial – Multiple Iterations

LDZ	Station
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		
Old Param - New SNET	3	15	0.692	0.0150	0	0	14.8	17.9	0.43		
New alternative	3	15	0.623	0.0150	0.11	0	15	18.1	0.39		
New alternative	2	15	0.626	0.0148	0.09	1	15	18.1	0.40		
New alternative	2	16	0.621	0.0155	0.07	2	15.3	18.5	0.32		
New alternative	3	16	0.618	0.0158	0.07	2	15.3	18.5	0.33		

Pos - improvement against benchmark
Neg - worse than benchmark

- The table reflects the request to include runs for a wider range of Min and Max ETs

Trial – Preliminary Results NE

LDZ	Station
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

- **Worked example of layout – not final results**
- **Shaded line indicates preferred optimised parameters**
- **Runs performed :**
  - Average of 13 years
  - Includes MPD back to 1981
  - All holidays excluded

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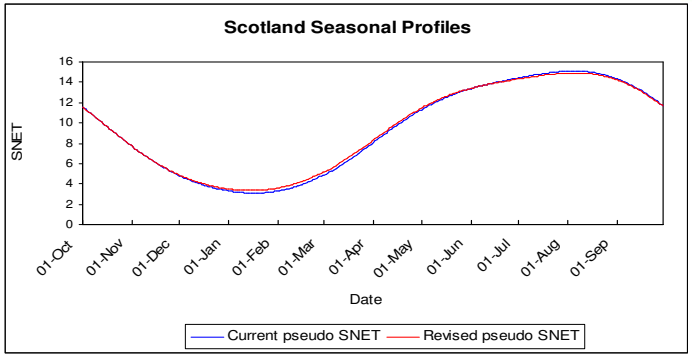
Example Results Slide

CWV	1 in 20 Peak CWV	I_1	I_2	I_3	V_0	V_1	V_2	Q
Current	-4.63	0.656	0.0125	0.22	3	13.3	16.0	0.64
Revised	-4.19	0.653	0.0118	0.19	3	13.2	16.0	0.64



CWV	Gas Years	Avg. Mean Abs. % Error	Avg. Adj. R-sq.	Avg. RMSE (MWh)	Avg. % diff. in est. 1 in 20 peak demand
Current	1996/97 - 2008/09	3.69%	98.97%	6,218	-0.66%
Revised		3.68%	98.98%	6,196	
Current	2004/05 - 2008/09	3.84%	99.02%	6,338	-0.67%
Revised		3.80%	99.05%	6,258	

CWV	Gas Years	Dec. to Feb.		Mar. to May		Jun. To Aug.		Sep. to Nov.	
		MAPE	MPRE	MAPE	MPRE	MAPE	MPRE	MAPE	MPRE
Current	1996/97-2008/09	2.50%	-0.11%	4.03%	-0.41%	6.46%	-0.41%	4.13%	0.67%
Revised		2.48%	-0.10%	4.02%	-0.05%	6.53%	-0.52%	4.11%	0.35%
Current	2004/05-2008/09	2.58%	-0.10%	4.10%	-1.06%	7.74%	-0.30%	4.21%	1.21%
Revised		2.55%	-0.10%	4.01%	-0.68%	7.84%	-0.39%	4.14%	0.89%

Note: In the last optimisation in 2009 these were provided for the proposed optimised parameters.

Next steps

- These slides have been trying to give you an idea of the information you need to decide on the outcome of the trials for discussion at the 22nd September meeting
- Do these give you the information you need?
- For Infilled data – what sign off does the group require?
  - This could necessitate infilling the dataset, publishing data for review, review period, comments and any futher iterations.
  - Xoserve could infill the data and contact the group where there are queries / problems