

# **Summary of Seasonal Normal Review Investigations**

## **CWV Review**

DESC 31<sup>st</sup> March 2009

# Contents

---

- Stage 1: The Composite Weather Variable (CWV)
  - An Introduction / background
  - Understanding of calculation
- Stage 2: Review of CWV methodology
  - Review of results for 4 LDZs
- Stage 3: Determining period to be used for defining parameters in CWV formula
  - Review of results for 4 LDZs

# The Composite Weather Variable

---

## Stage 1: Introduction to the Composite Weather Variable

# The Composite Weather Variable (CWV)

---

- Background
  - 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.
- What is the 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)
- What is its purpose ?
  - 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 definition of the CWV includes provision for summer cut-offs and cold weather upturn during low temperature periods

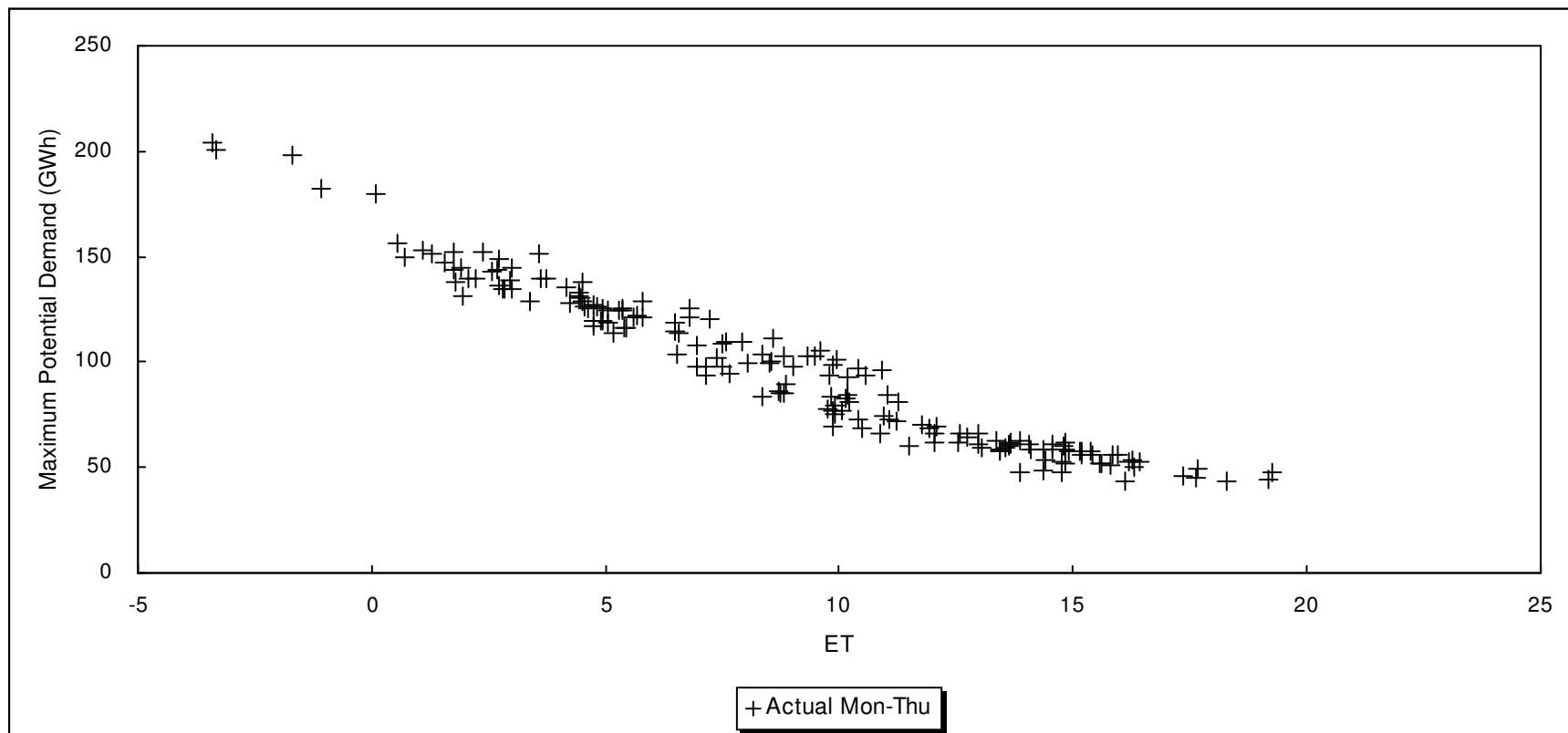
# Calculating the CWV

---

- To calculate the daily CWV values a combination of actual weather data and a set of parameters (defined at the start of a new weather station or during the seasonal normal review) are required.
- Part I – The first part of the formula includes the raw weather data to which various weightings are applied. In effect the CW is an intermediate term in the definition of the CWV
  - CW is made up of an effective temperature, a pseudo seasonal normal effective temperature and a windchill term
  - In effect it is the CWV without summer cut-offs and cold weather upturn
- Part II – The second part of the formula will incorporate parameters relating to cold or warm days depending on the outcome of the CW calculation.
  - Summer cut-offs
  - Cold weather upturn
- So why are parameters required ?.....

# Monday to Thursday non-holiday Demand against Effective Temperature

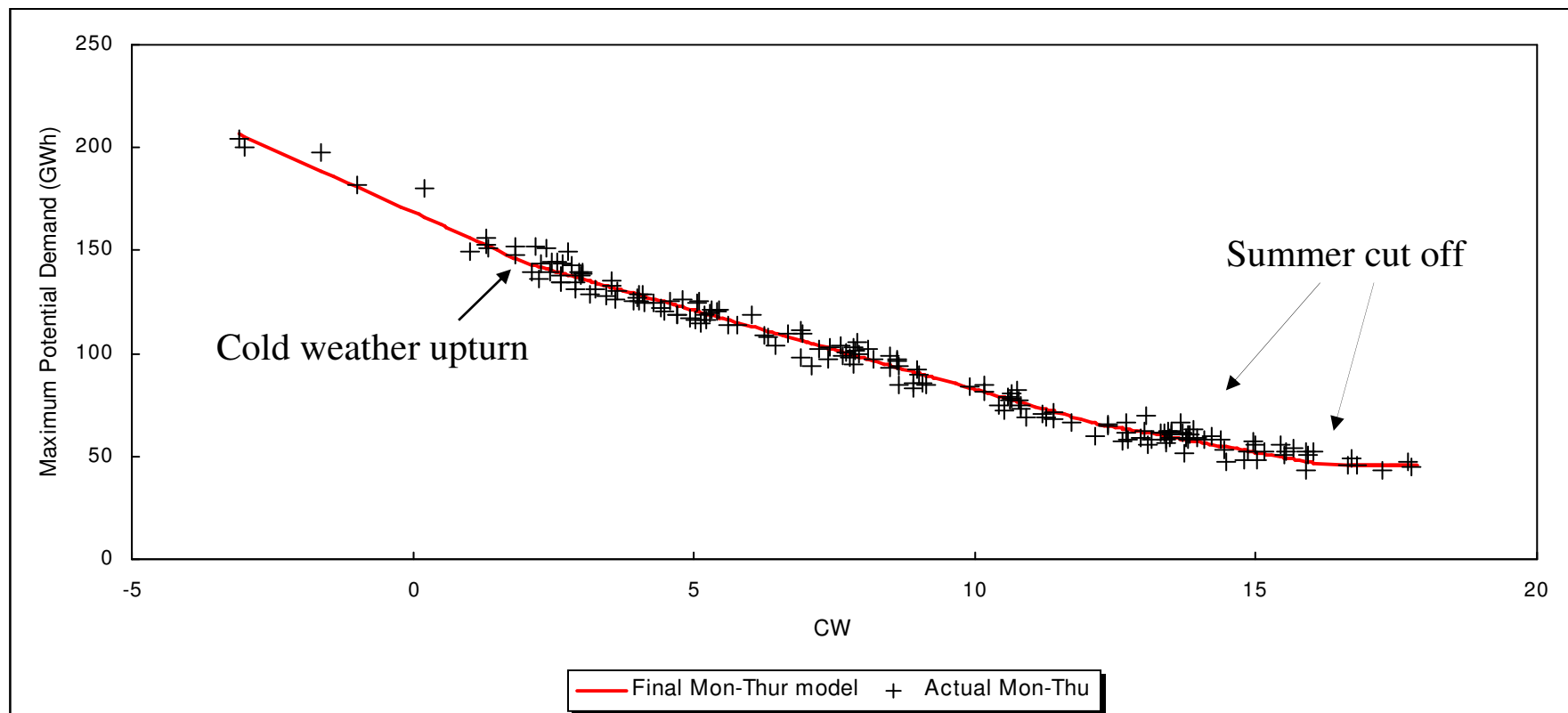
- The weather, based on Effective Temperature alone and demand relationship is not a straight line, for example:



# Monday to Thursday Non-Holiday Demand against CW

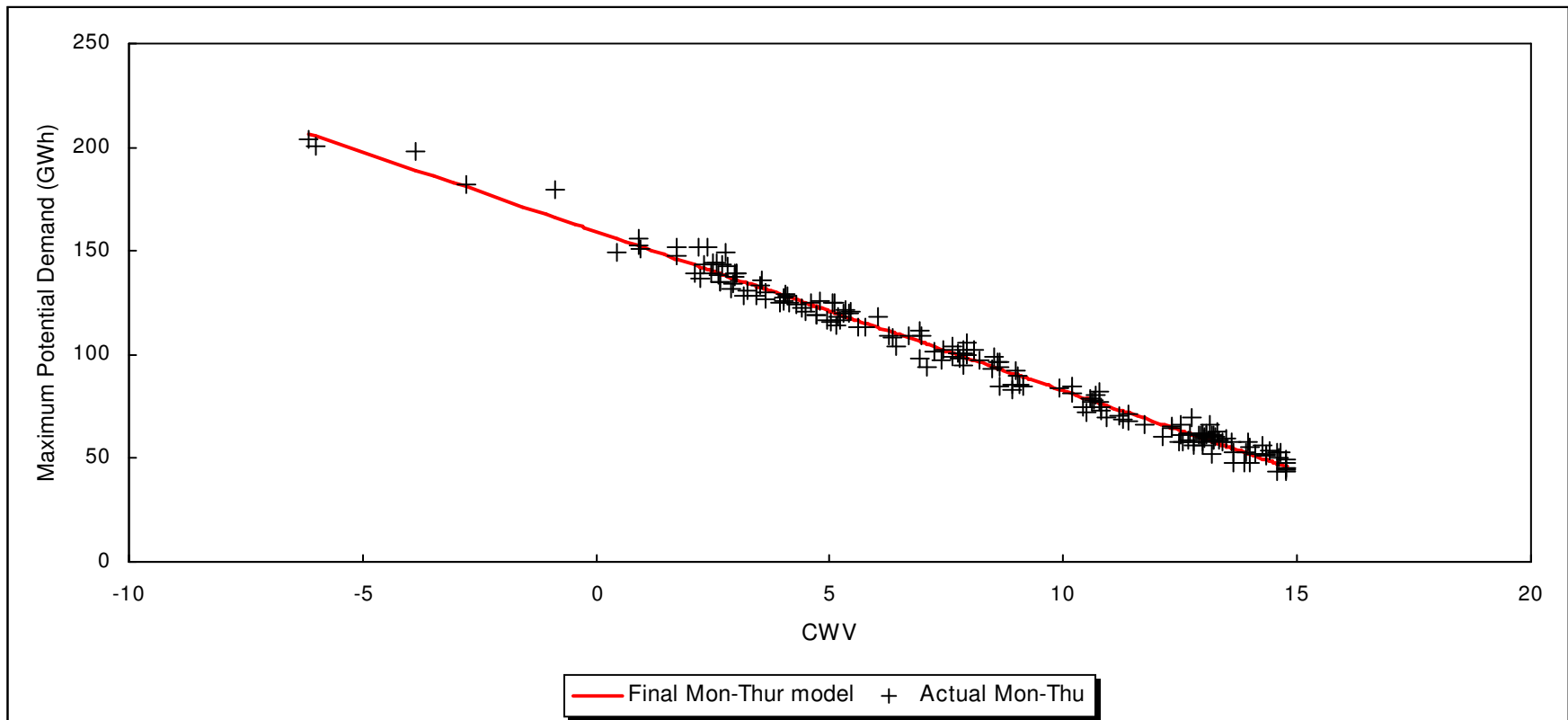
(CWV before cold and warm weather adjustments)

- CW combines effective temperatures, pseudo seasonal normal effective temperatures and wind chill into a single weather variable – better fit than previous graph but can do better.....



# Monday to Thursday Demand against CWV

- CWV adjusts CW for cold weather upturn and summer cut off providing an even better fit between weather and demand

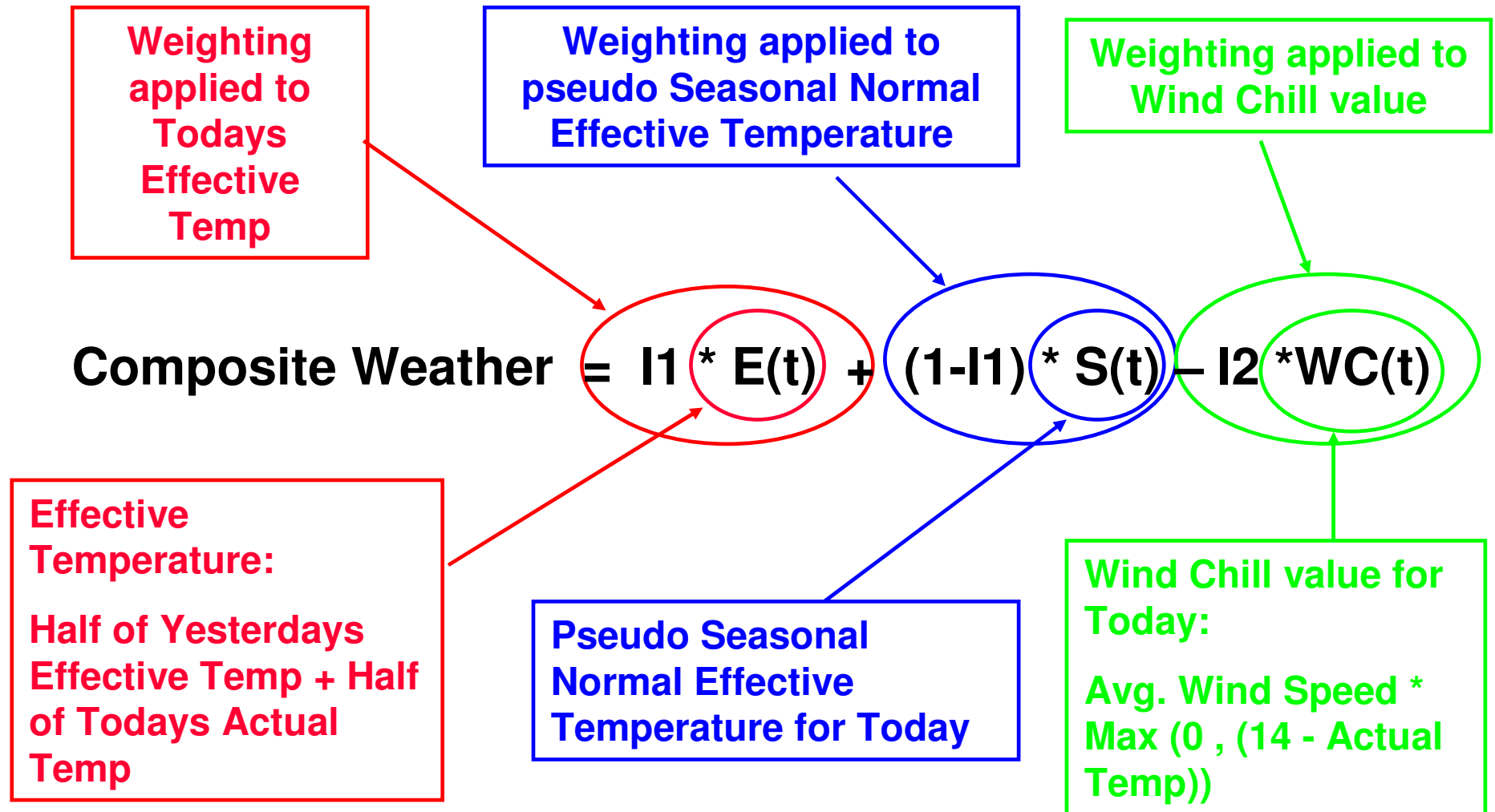


- Following slides attempt to 'step through' the CWV calculation



# Composite Weather Variable Formula

## Part 1 - CWV

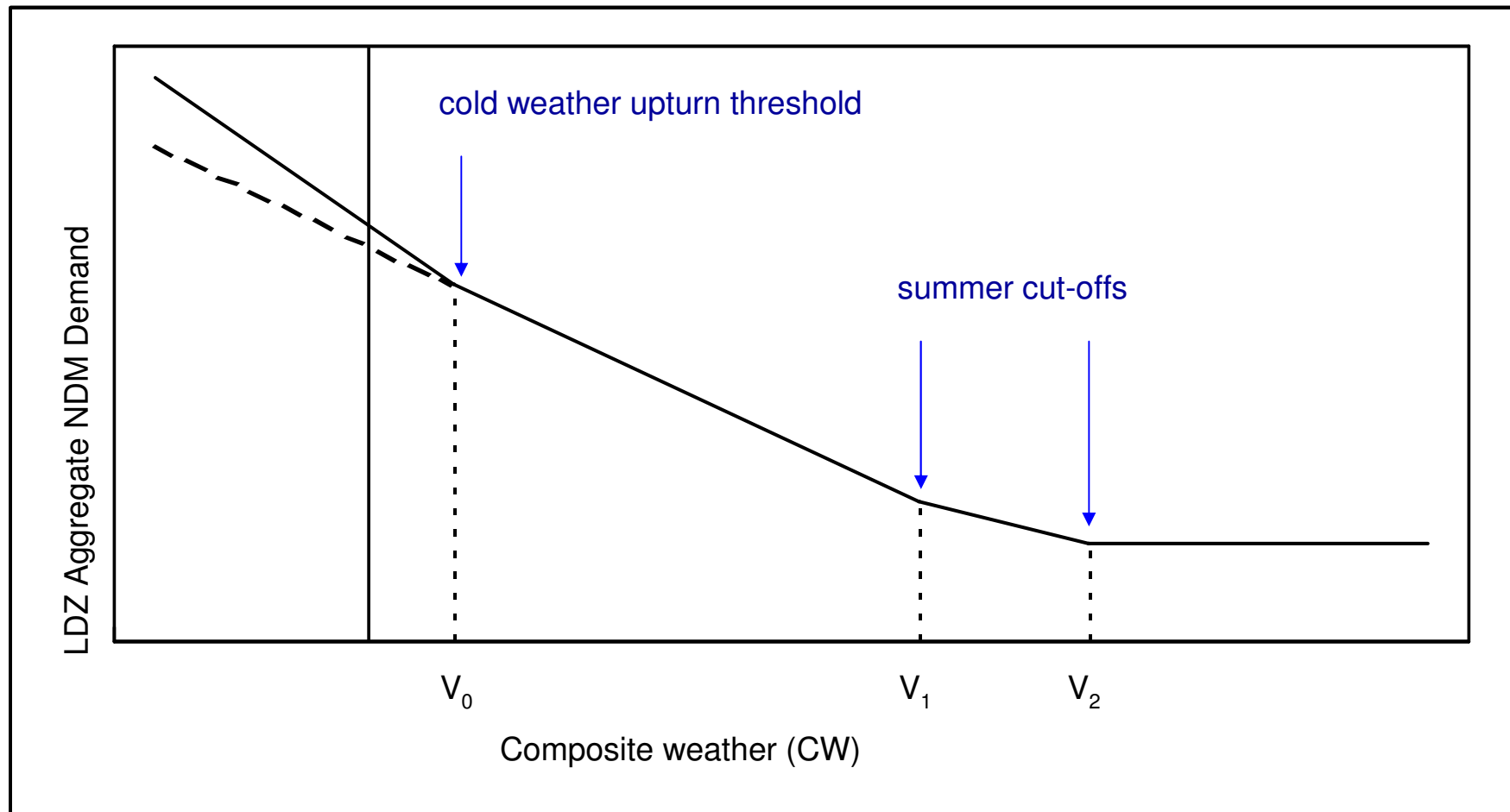


# Composite Weather Variable Formula

## 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’ weather:** If CW is greater than cold weather threshold and less than lower warm weather cut off then:
  - $CWV = CW$ .
- ‘Summer Transition’:** If CW is greater than lower warm weather cut-off but lower than upper warm weather cut-off then:
  - $CWV = \text{Lower Cut-Off} + \text{Slope} * (CW - \text{Lower Cut-Off})$
- ‘Summer Cut-Off’:** If CW is greater than upper warm weather cut off then
  - $CWV = \text{Lower Cut-Off} + \text{Slope} * (\text{Upper Cut-Off} - \text{Lower Cut-Off})$
- ‘Cold Weather Upturn’:** If CW is less than cold weather upturn threshold then:
  - $CWV = CW + \text{Cold Weather sensitivity} * (CW - \text{Cold Weather Upturn Threshold})$

# Definition of Composite Weather Variable (CWV)



# Why does the CWV need to be reviewed

---

- UNC (H1.4.2) requires xoserve every 5 years after consultation with DESC "to review and where appropriate revise with effect from the start of a gas year" composite weather variable (CWV) definitions for each LDZ.
- Last such review carried out in autumn 2004 and implemented on 1st October 2005. (Some CWVs revised since then because of weather station changes).
- Therefore comprehensive review of all LDZ CWVs will be carried out in autumn 2009 for implementation on 1st October 2010.
- This analysis was carried out to assess whether the current methodology is fit for purpose and if so, to explore the appropriate period of years to use in CWV derivation.

# Key points of current CWV methodology

---

- Uses aggregate NDM demand (outside holiday periods)
  - 12 gas years currently available, 1996/97 to 2007/08.
- The pseudo SNET profile (introduced during last review in 2004) is derived from models of aggregate NDM demand and weather. Its shape is designed to minimise seasonal bias on average for years modelled.
- CWV parameters (except for cold weather upturn) are derived from models of aggregate NDM demand and weather.
- Maximum potential demand (MPD) data prior to 1996/97 is included in the derivation of cold weather upturn parameters (insufficient cold weather in recent years to derive these).
- The values of the CWV parameters are chosen to give the best fit to demand on average.
- Suspect / unusual data for particular days or years may be excluded from the analysis or corrected.

# The Composite Weather Variable

---

## Stage 2: Results of review of the effectiveness of CWV methodology

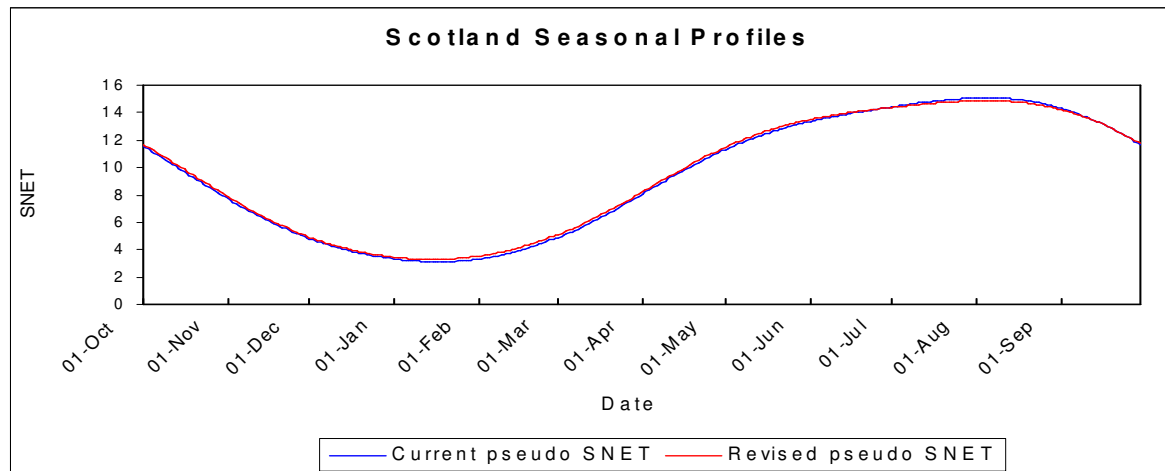
# Explanation of CWV review results

- 4 LDZ's subject to analysis, namely SC,NO,WM and SW – one selected per Network
- Results presented per LDZ over 7 slides
- **Slide 1:**
  - **Objective:** Compare revised CWV parameters with current CWV parameters including 1 in 20 peak CWV
  - **Analysis:** Use current methodology to derive revised CWVs for each LDZ including the additional 4 years of weather/demand history. High level observations on results provided

CWV	1 in 20 Peak CWV	$I_1$	$I_2$	$I_3$	$V_0$	$V_1$	$V_2$	Q
Current	-4.65	0.656	0.0125	0.22	3	13.3	16.0	0.64
Revised	-4.25	0.652	0.0119	0.19	3	13.4	16.2	0.62

# Explanation of CWV review results

- **Slide 2:**
  - **Objective:** Compare revised pseudo SNET profile with current pseudo SNET profile
  - **Analysis:** Calculate revised pseudo Seasonal Normal Effective Temperature (SNET) and visually compare profile with current pseudo SNET. High level observations on results provided





# Explanation of CWV review results

## ■ Slide 3:

- **Objective:** To confirm the current CWV methodology provides a strong fit between weather and demand and to assess change in estimated 1 in 20 peak aggregate NDM demand estimates
- **Analysis:** Derive aggregate NDM demand models for 4 LDZs for revised and current CWVs. Assess average 'fit' of CWVs to aggregate NDM demand. Results of current vs revised are represented as Green: better fit; Red: worse fit.  
Use demand models and 1 in 20 peak CWVs to assess estimated 1 in 20 peak demand.

CW V	Gas Year(s)	Avg. Mean Abs. % Error	Avg. Adj. R-sq.	Avg. RMSE (MWh)	Avg. % diff. in est. 1 in 20 peak demand
Current	2004/05	3.33%	99.16%	5,801	-0.87%
Revised		3.36%	99.15%	5,819	
Current	2005/06	3.95%	99.15%	6,604	-0.94%
Revised		3.92%	99.17%	6,554	
Current	2006/07	4.22%	98.59%	6,885	-0.89%
Revised		4.15%	98.63%	6,787	
Current	2007/08	3.43%	99.21%	5,600	-0.92%
Revised		3.41%	99.21%	5,576	
Current	1996/97 - 2007/08	3.64%	98.97%	6,169	-0.90%
Revised		3.63%	98.97%	6,167	

# Explanation of CWV review results

## ■ Slide 4:

- **Objective:** To ensure strong relationship is maintained throughout the seasons ('seasonal fit')
- **Analysis:** Assess average seasonal bias ((for quarters Mar-May, Jun-Aug, Sep-Nov and Dec-Feb) of aggregate NDM demand models using the mean percentage residual error (MPRE):

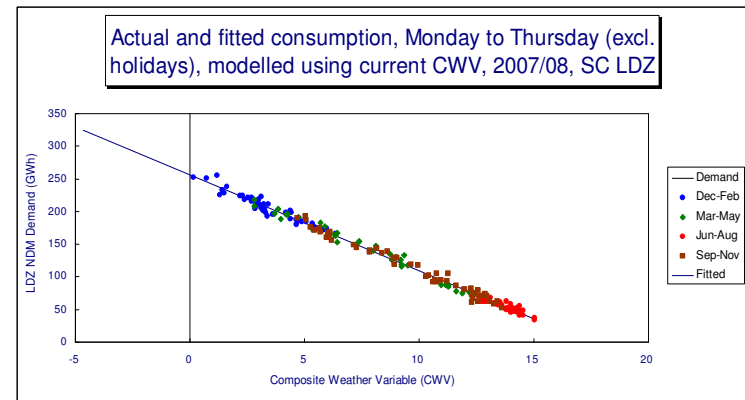
$$\text{MPRE} = 100 * \frac{(\text{avg. actual demand} - \text{avg. fitted demand})}{\text{avg. actual demand}}$$

CWV	Gas Year(s)	Dec. to Feb.		Mar. to May		Jun. To Aug.		Sep. to Oct.	
		MAPE	MPRE	MAPE	MPRE	MAPE	MPRE	MAPE	MPRE
Current	2004/05	2.31%	-0.03%	3.53%	0.12%	6.32%	-2.11%	3.66%	0.56%
Revised		2.39%	-0.07%	3.51%	0.30%	6.19%	-2.12%	3.69%	0.46%
Current	2005/06	3.05%	-0.98%	3.75%	0.45%	7.75%	-3.90%	4.35%	2.12%
Revised		3.05%	-1.04%	3.73%	0.65%	7.71%	-3.88%	4.26%	2.00%
Current	2006/07	2.95%	0.54%	4.58%	-2.82%	7.74%	4.42%	4.39%	-0.06%
Revised		2.84%	0.49%	4.49%	-2.64%	7.98%	4.34%	4.30%	0.11%
Current	2007/08	2.30%	-0.12%	3.43%	0.52%	6.52%	-0.12%	4.10%	-0.25%
Revised		2.28%	-0.13%	3.39%	0.69%	6.50%	-0.14%	4.12%	-0.38%
Current	1996/97-	2.51%	-0.13%	3.93%	-0.12%	6.18%	-0.38%	4.09%	0.42%
Revised	2007/08	2.51%	-0.16%	3.93%	0.03%	6.19%	-0.40%	4.08%	0.34%

# Explanation of CWV review results

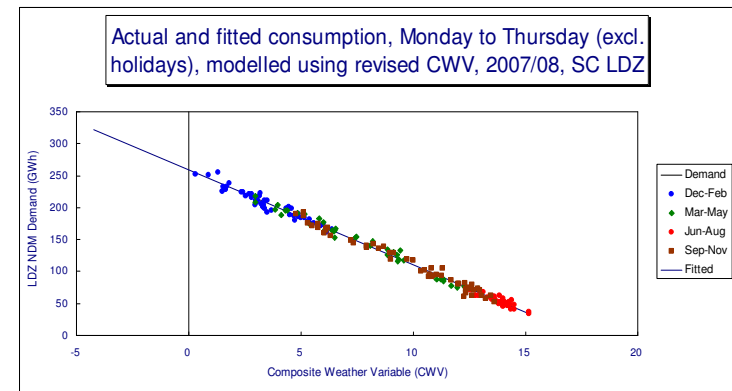
## ■ Slide 5:

- **Objective:** To view actual and fitted demand for Monday to Thursday (non-holidays) for most recent gas year (2007/08) using **current** CWV
- **Analysis:** Graph of actual demand by season vs fitted demand line



## ■ Slide 6:

- **Objective:** To view actual and fitted demand for Monday to Thursday (non-holidays) for most recent gas year (2007/08) using **revised** CWV
- **Analysis:** Graph of actual demand by season vs fitted demand line



# Explanation of CWV review results

- **Slide 7:**

- **Objective:** To compare model parameters and statistical results from current and revised CWVs for Gas Year 2007/08, i.e the numbers behind the graphs in slide 5 and 6
- **Analysis:** Table of results summarising model outputs and statistical fits with high level observations of results

Gas Year	CWV	Demand Intercept (GWh)	CWV Param. (GWh/°)	Mean Abs.% Error	Avg. Adj. R-sq.	Avg. RMSE (MWh)
2007/08	Current	255.91	-14.65	3.43%	99.21%	5,600
2007/08	Revised	258.18	-14.79	3.41%	99.21%	5,576

# **The Composite Weather Variable**

---

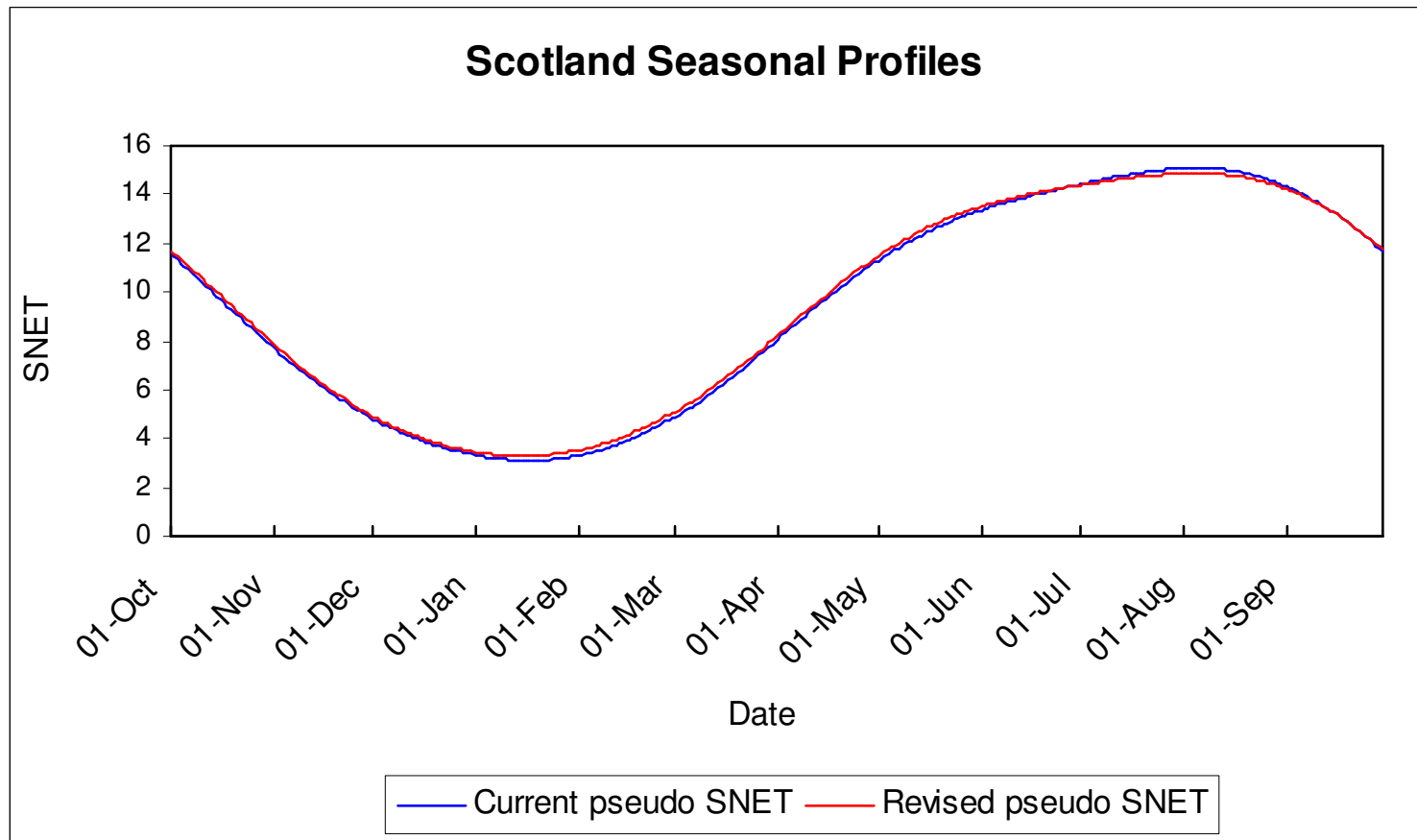
## **Review of Composite Weather Variable results for SC**

# Slide 1: SC LDZ - Comparison of CWV parameters

CWV	1 in 20 Peak CWV	$I_1$	$I_2$	$I_3$	$V_0$	$V_1$	$V_2$	Q
Current	-4.65	0.656	0.0125	0.22	3	13.3	16.0	0.64
Revised	-4.25	0.652	0.0119	0.19	3	13.4	16.2	0.62

- Similar CWV parameter values for current and revised CWV.
- Differences in 1 in 20 peak CWV due to slightly different pseudo SNET profile and other parameter values.

## Slide 2: SC LDZ - comparison of pseudo SNET profiles



- Revised pseudo SNET profile is similar to current profile, but slightly flatter (higher in winter and lower in summer).

# Slide 3: SC LDZ - comparison of average fit to demand

CWV	Gas Year(s)	Avg. Mean Abs. % Error	Avg. Adj. R-sq.	Avg. RMSE (MWh)	Avg. % diff. in est. 1 in 20 peak demand
Current	2004/05	3.33%	99.16%	5,801	-0.87%
Revised		3.36%	99.15%	5,819	
Current	2005/06	3.95%	99.15%	6,604	-0.94%
Revised		3.92%	99.17%	6,554	
Current	2006/07	4.22%	98.59%	6,885	-0.89%
Revised		4.15%	98.63%	6,787	
Current	2007/08	3.43%	99.21%	5,600	-0.92%
Revised		3.41%	99.21%	5,576	
Current	1996/97 - 2007/08	3.64%	98.97%	6,169	-0.90%
Revised		3.63%	98.97%	6,167	

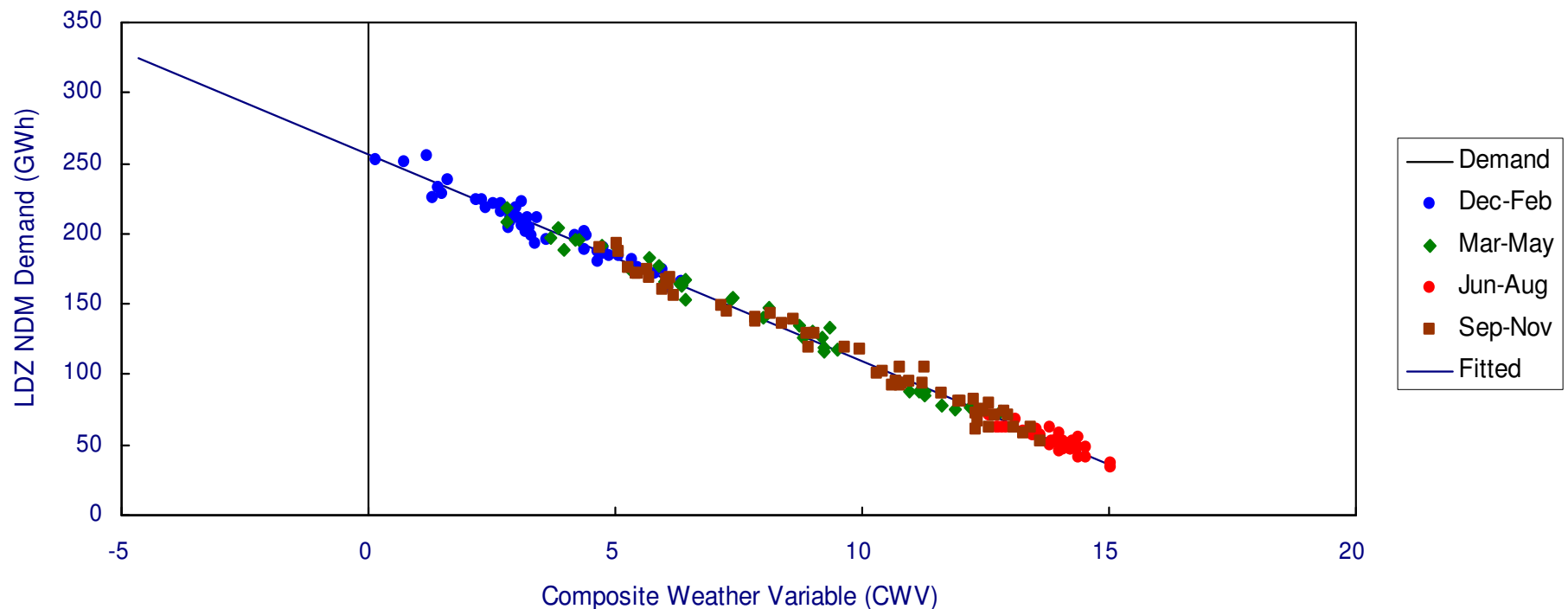


## Slide 4: SC LDZ - comparison of seasonal fit and bias

CWV	Gas Year(s)	Dec. to Feb.		Mar. to May		Jun. To Aug.		Sep. to Oct.	
		MAPE	MPRE	MAPE	MPRE	MAPE	MPRE	MAPE	MPRE
Current	2004/05	2.31%	-0.03%	3.53%	0.12%	6.32%	-2.11%	3.66%	0.56%
Revised		2.39%	-0.07%	3.51%	0.30%	6.19%	-2.12%	3.69%	0.46%
Current	2005/06	3.05%	-0.98%	3.75%	0.45%	7.75%	-3.90%	4.35%	2.12%
Revised		3.05%	-1.04%	3.73%	0.65%	7.71%	-3.88%	4.26%	2.00%
Current	2006/07	2.95%	0.54%	4.58%	-2.82%	7.74%	4.42%	4.39%	-0.06%
Revised		2.84%	0.49%	4.49%	-2.64%	7.98%	4.34%	4.30%	0.11%
Current	2007/08	2.30%	-0.12%	3.43%	0.52%	6.52%	-0.12%	4.10%	-0.25%
Revised		2.28%	-0.13%	3.39%	0.69%	6.50%	-0.14%	4.12%	-0.38%
Current	1996/97-	2.51%	-0.13%	3.93%	-0.12%	6.18%	-0.38%	4.09%	0.42%
Revised	2007/08	2.51%	-0.16%	3.93%	0.03%	6.19%	-0.40%	4.08%	0.34%

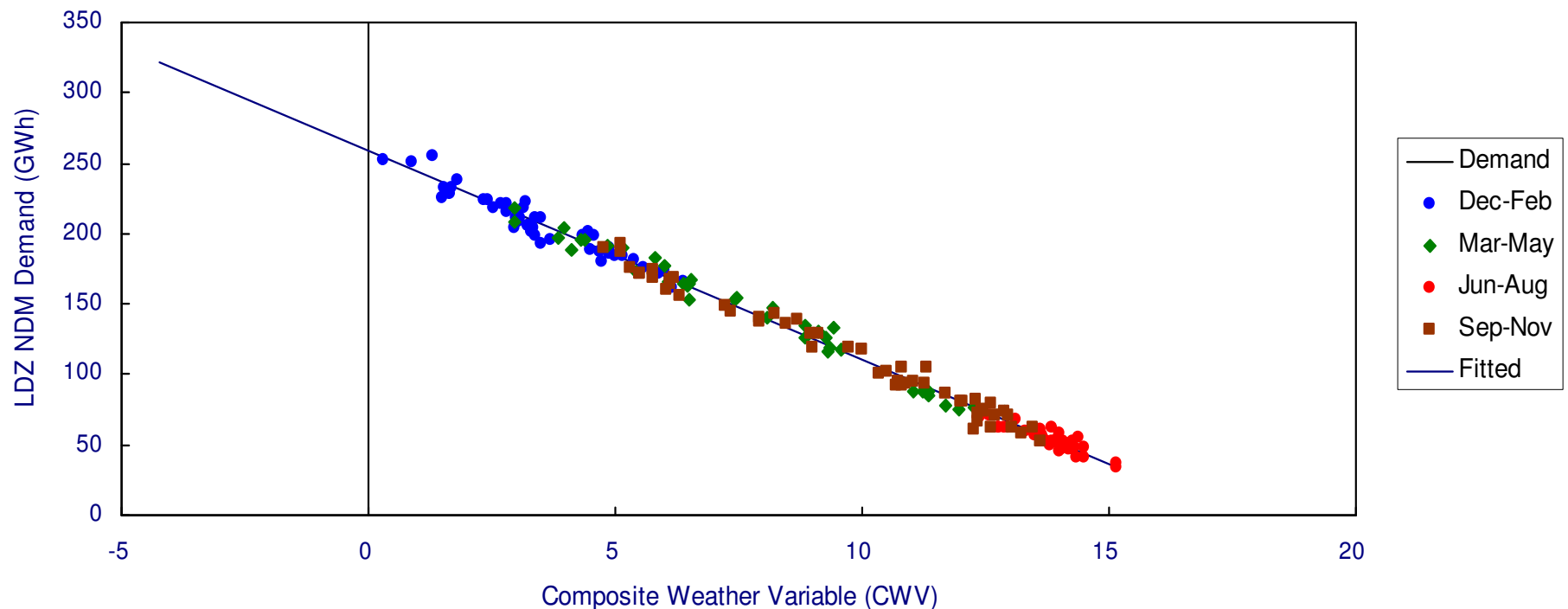
## Slide 5: SC LDZ - example graph for current CWV (2007/08)

Actual and fitted consumption, Monday to Thursday (excl. holidays), modelled using current CWV, 2007/08, SC LDZ



## Slide 6: SC LDZ - example graph for revised CWV (2007/08)

Actual and fitted consumption, Monday to Thursday (excl. holidays), modelled using revised CWV, 2007/08, SC LDZ



## Slide 7: SC LDZ - example graphs - parameters & statistics

Gas Year	CWV	Demand Intercept (GWh)	CWV Param. (GWh/°)	Mean Abs.% Error	Avg. Adj. R-sq.	Avg. RMSE (MWh)
2007/08	Current	255.91	-14.65	3.43%	99.21%	5,600
2007/08	Revised	258.18	-14.79	3.41%	99.21%	5,576

- Parameters and fit statistics for most recent gas year 2007/08 - Monday to Thursday (non-holiday) models.
- Warmer year than average.
- Coldest day in Christmas holiday period

# **The Composite Weather Variable**

---

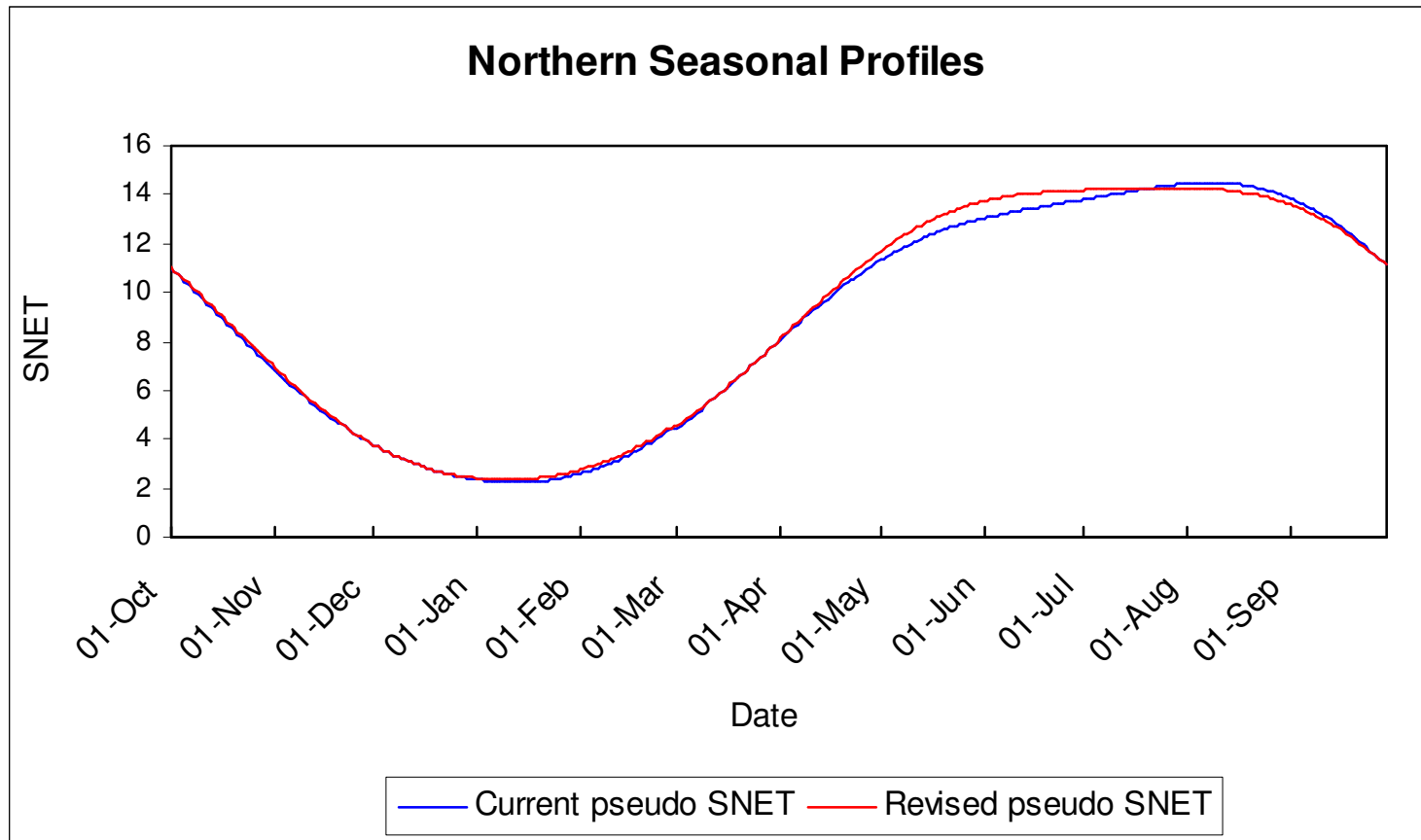
## **Review of Composite Weather Variable results for NO**

# Slide 1: NO LDZ - Comparison of CWV parameters

CWV	1 in 20 Peak CWV	$I_1$	$I_2$	$I_3$	$V_0$	$V_1$	$V_2$	Q
Current	-8.19	0.625	0.0116	0.50	0	12.6	15.7	0.55
Revised	-7.79	0.633	0.0105	0.51	0	12.8	15.8	0.53

- Some years in the 1980s had suspect MPD data and were excluded from the cold weather upturn analysis.
- Some data points (01/06/97 to 05/06/97) were excluded from the analysis to derive the other CWV parameters.
- Similar CWV parameter values for current and revised CWV.
- Differences in 1 in 20 peak CWV due to slightly different pseudo SNET profile and other parameter values.

## Slide 2: NO LDZ - comparison of pseudo SNET profiles



- Revised pseudo SNET profile is similar to current profile, but slightly flatter in summer.

# Slide 3: NO LDZ - comparison of average fit to demand

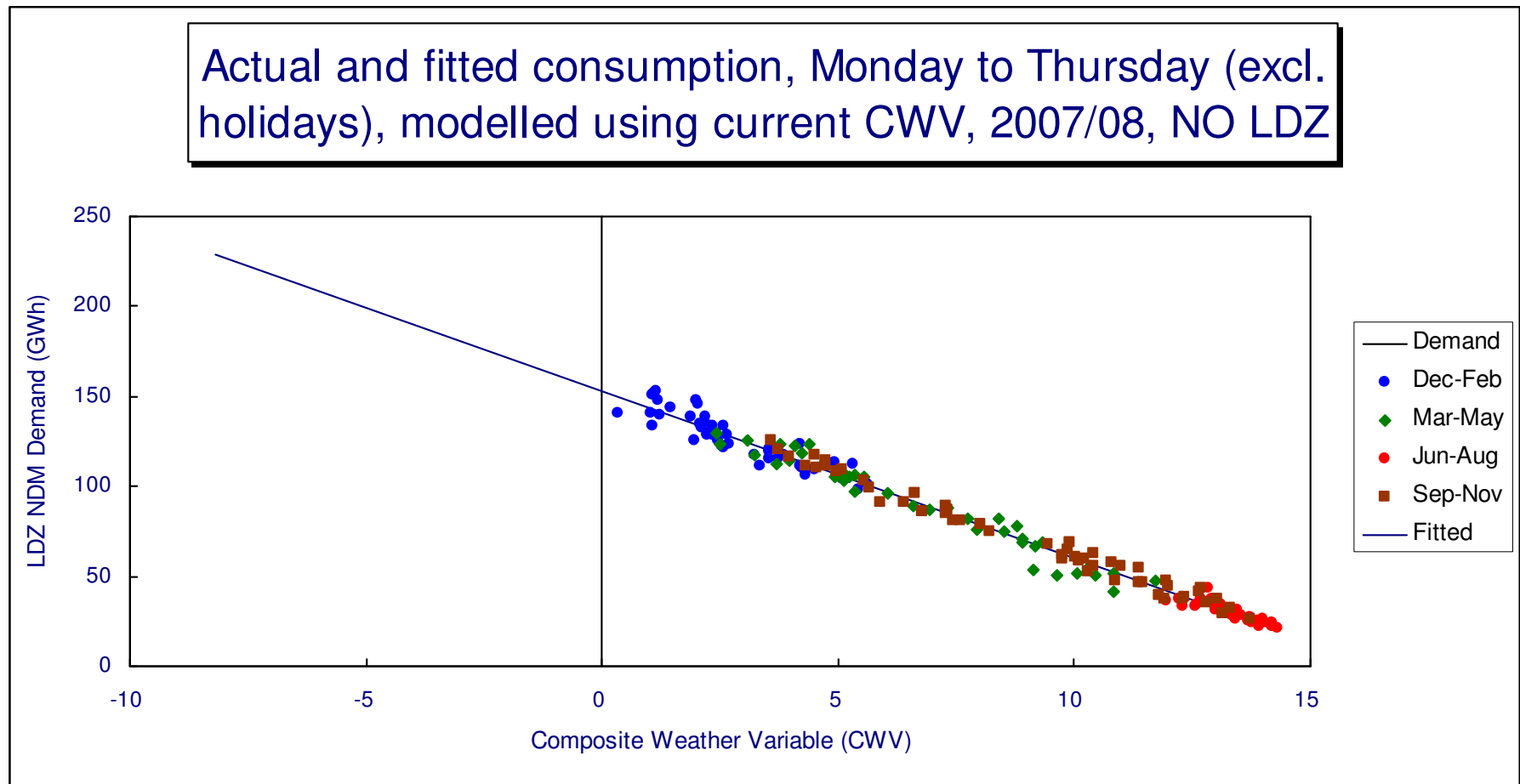
CWV	Gas Year(s)	Avg. Mean Abs. % Error	Avg. Adj. R-sq.	Avg. RMSE (MWh)	Avg. % diff. in est. 1 in 20 peak demand
Current	2004/05	4.46%	98.65%	4,978	-0.69%
Revised		4.37%	98.71%	4,875	
Current	2005/06	4.59%	98.83%	5,441	-1.01%
Revised		4.37%	98.93%	5,196	
Current	2006/07	5.57%	97.84%	5,700	-0.82%
Revised		5.68%	97.80%	5,740	
Current	2007/08	4.35%	98.65%	4,661	-0.84%
Revised		4.11%	98.80%	4,387	
Current	1996/97 - 2007/08	4.16%	98.72%	4,718	-0.85%
Revised		4.14%	98.74%	4,674	



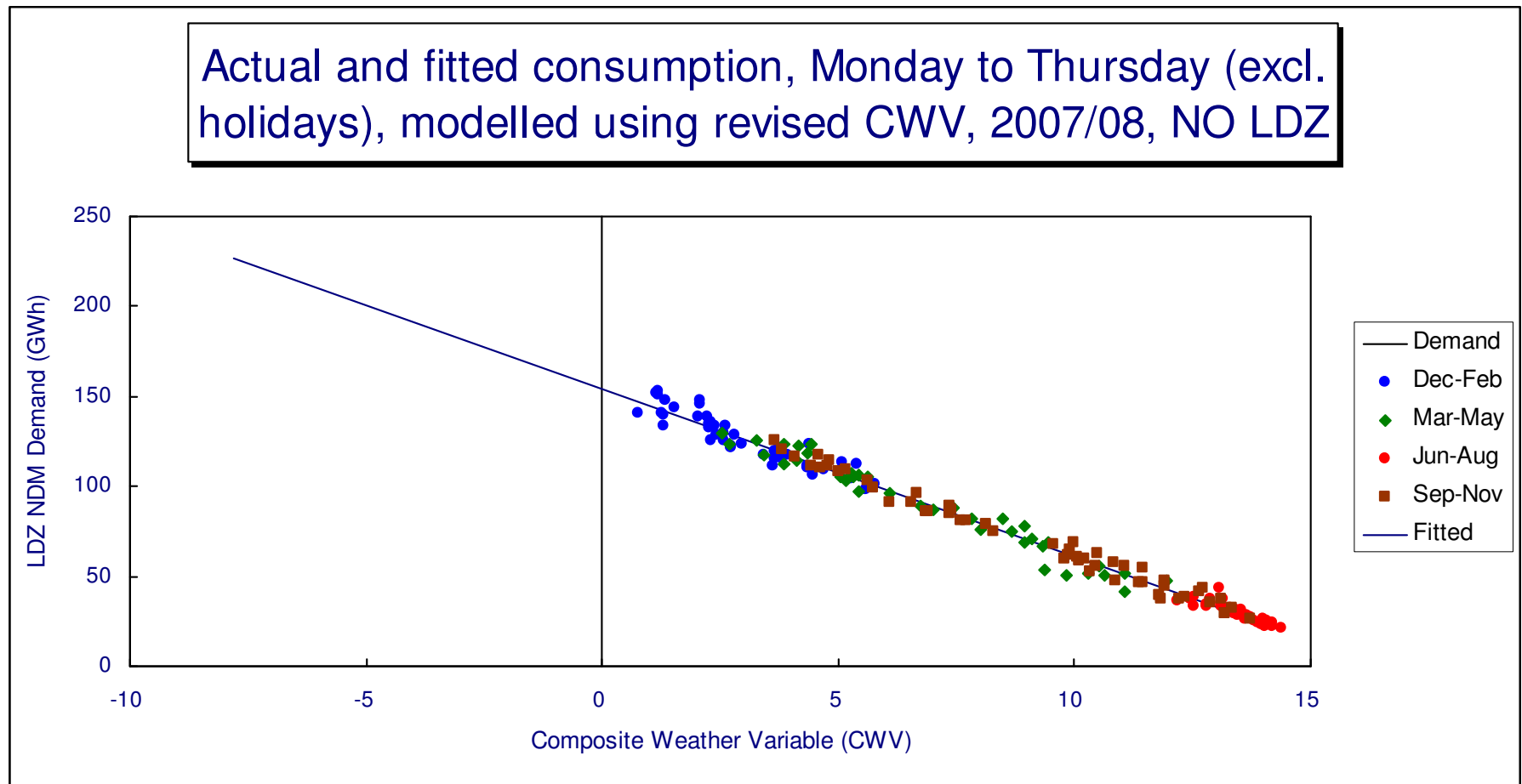
## Slide 4: NO LDZ - comparison of seasonal fit and bias

CWV	Gas Year(s)	Dec. to Feb.		Mar. to May		Jun. To Aug.		Sep. to Oct.	
		MAPE	MPRE	MAPE	MPRE	MAPE	MPRE	MAPE	MPRE
Current	2004/05	2.89%	-0.60%	5.65%	1.22%	7.59%	-1.78%	4.57%	0.22%
Revised		2.76%	-0.51%	5.55%	1.39%	7.51%	-1.08%	4.54%	-0.30%
Current	2005/06	3.15%	-1.59%	5.73%	0.75%	7.47%	-2.18%	4.81%	2.31%
Revised		3.05%	-1.51%	5.56%	0.96%	6.45%	-1.97%	4.57%	1.89%
Current	2006/07	3.94%	-0.19%	6.98%	-1.66%	10.06%	4.55%	5.17%	0.05%
Revised		3.81%	-0.07%	6.86%	-1.50%	11.92%	5.27%	5.16%	-0.53%
Current	2007/08	3.79%	-0.11%	4.78%	-1.11%	6.28%	0.13%	4.23%	1.09%
Revised		3.50%	-0.02%	4.57%	-0.92%	5.55%	1.44%	4.17%	0.40%
Current	1996/97-	2.85%	-0.18%	5.33%	-0.09%	6.89%	-0.48%	4.11%	0.50%
Revised	2007/08	2.79%	-0.08%	5.29%	0.09%	7.01%	0.22%	4.11%	-0.04%

# Slide 5: NO LDZ - example graph for current CWV (2007/08)



## Slide 6: NO LDZ - example graph for revised CWV (2007/08)



## Slide 7: NO LDZ - example graphs - parameters & statistics

Gas Year	CWV	Demand Intercept (GWh)	CWV Param. (GWh/°)	Mean Abs.% Error	Avg. Adj. R-sq.	Avg. RMSE (MWh)
2007/08	Current	153.08	-9.26	4.35%	98.65%	4,661
2007/08	Revised	154.47	-9.30	4.11%	98.80%	4,387

- Parameters and fit statistics for most recent gas year 2007/08 - Monday to Thursday (non-holiday) models.
- Warmer year than average.
- Coldest day in Christmas holiday period

# **The Composite Weather Variable**

---

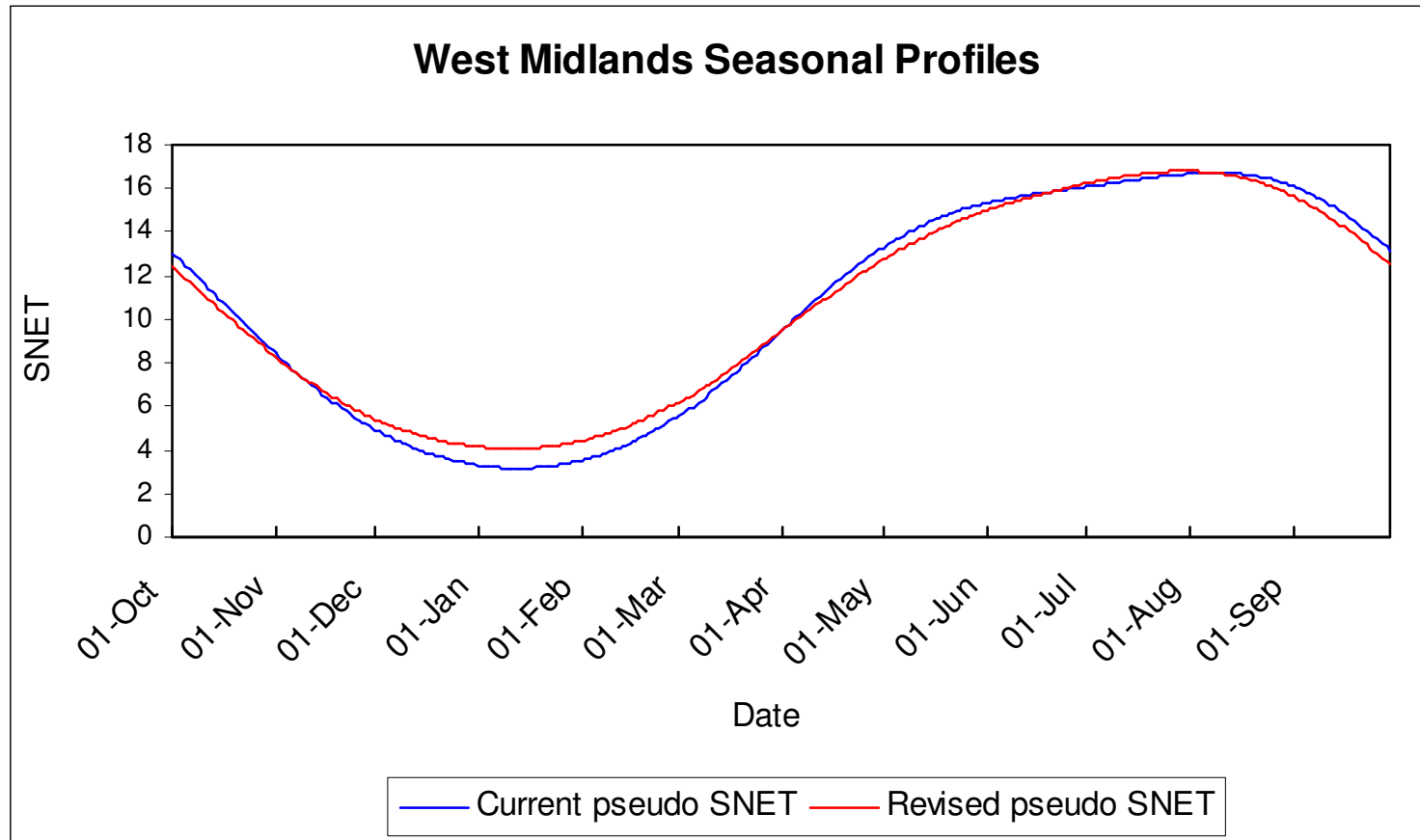
## **Review of Composite Weather Variable results for WM**

# Slide 1: WM LDZ - Comparison of CWV parameters

CWV	1 in 20 Peak CWV	$I_1$	$I_2$	$I_3$	$V_0$	$V_1$	$V_2$	Q
Current	-6.53	0.717	0.0113	0.25	1	14.7	18.2	0.34
Revised	-5.72	0.686	0.0108	0.25	1	14.0	17.8	0.40

- CWV parameter values broadly similar.
- Differences in 1 in 20 peak CWV due to slightly different pseudo SNET profile and other parameter values.

## Slide 2: WM LDZ - comparison of pseudo SNET profiles



- Revised pseudo SNET profile is slightly flatter in winter.

# Slide 3: WM LDZ - comparison of average fit to demand

CWV	Gas Year(s)	Avg. Mean Abs. % Error	Avg. Adj. R-sq.	Avg. RMSE (MWh)	Avg. % diff. in est. 1 in 20 peak demand
Current	2004/05	3.17%	99.39%	6,328	-0.16%
Revised		3.14%	99.40%	6,246	
Current	2005/06	3.43%	99.46%	6,795	-0.15%
Revised		3.43%	99.47%	6,726	
Current	2006/07	4.32%	98.97%	7,111	-0.10%
Revised		4.15%	99.02%	6,960	
Current	2007/08	3.61%	99.17%	6,753	-0.20%
Revised		3.50%	99.22%	6,522	
Current	1996/97 - 2007/08	3.45%	99.21%	6,884	-0.21%
Revised		3.45%	99.22%	6,848	

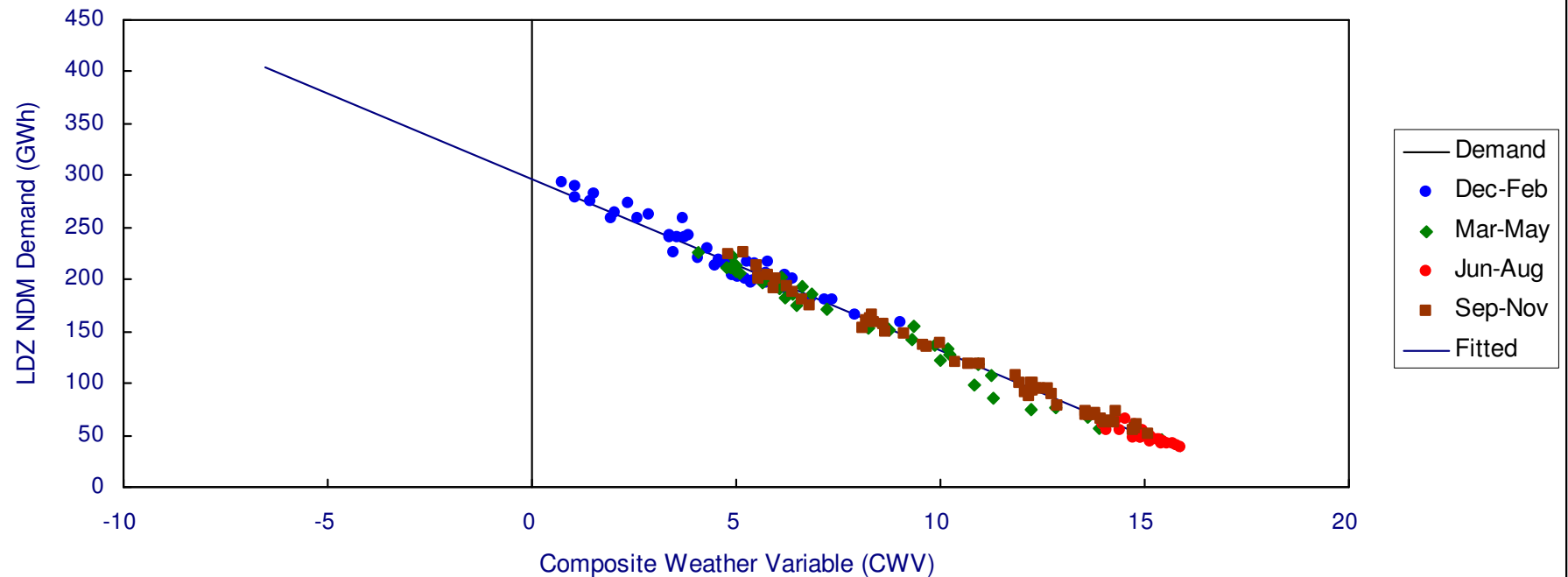


# Slide 4 : WM LDZ - comparison of seasonal fit and bias

CWV	Gas Year(s)	Dec. to Feb.		Mar. to May		Jun. To Aug.		Sep. to Oct.	
		MAPE	MPRE	MAPE	MPRE	MAPE	MPRE	MAPE	MPRE
Current	2004/05	2.36%	-0.63%	3.87%	0.24%	5.07%	-1.82%	3.14%	1.22%
Revised		2.34%	-0.57%	3.83%	0.55%	4.83%	-0.67%	3.16%	0.50%
Current	2005/06	2.37%	-0.83%	4.09%	-0.12%	4.51%	-2.32%	4.20%	2.18%
Revised		2.25%	-0.77%	4.00%	0.29%	4.81%	-1.90%	4.43%	1.51%
Current	2006/07	2.85%	0.56%	6.20%	-2.74%	6.13%	3.88%	4.42%	0.17%
Revised		2.81%	0.61%	6.05%	-2.37%	5.31%	4.54%	4.23%	-0.45%
Current	2007/08	3.04%	0.64%	4.25%	-2.32%	5.67%	1.84%	3.32%	0.52%
Revised		2.98%	0.73%	4.06%	-2.06%	5.48%	1.54%	3.23%	0.25%
Current	1996/97-	2.45%	-0.02%	4.30%	-0.13%	5.03%	-0.84%	3.69%	0.41%
Revised	2007/08	2.42%	0.06%	4.28%	0.15%	5.13%	-0.08%	3.74%	-0.20%

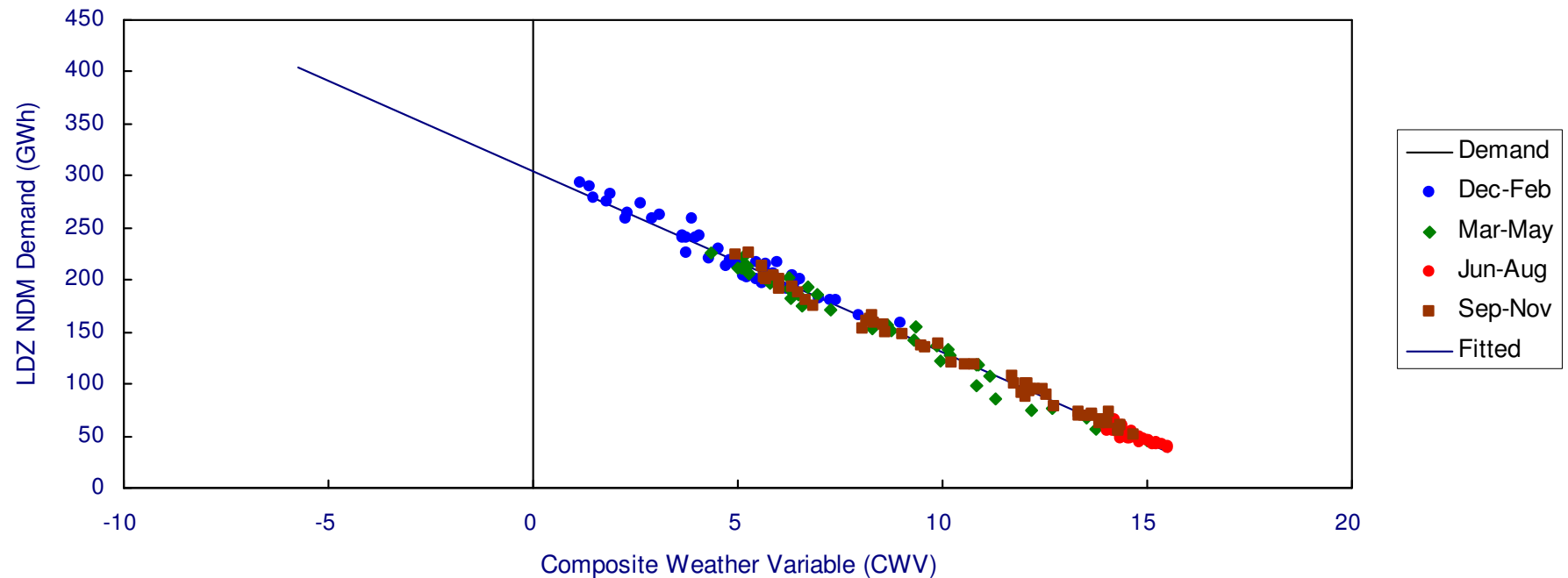
# Slide 5: WM LDZ - example graph for current CWV (2007/08)

Actual and fitted consumption, Monday to Thursday (excl. holidays), modelled using current CWV, 2007/08, WM LDZ



## Slide 6: WM LDZ - example graph for revised CWV (2007/08)

Actual and fitted consumption, Monday to Thursday (excl. holidays), modelled using revised CWV, 2007/08, WM LDZ



## Slide 7: WM LDZ - example graphs - parameters & statistics

Gas Year	CWV	Demand Intercept (GWh)	CWV Param. (GWh/°)	Mean Abs.% Error	Avg. Adj. R-sq.	Avg. RMSE (MWh)
2007/08	Current	297.04	-16.56	3.61%	99.17%	6,753
2007/08	Revised	304.69	-17.43	3.50%	99.22%	6,522

- Parameters and fit statistics for most recent gas year 2007/08 - Monday to Thursday (non-holiday) models.
- Warmer year than average.
- Coldest day in Christmas holiday period

# **The Composite Weather Variable**

---

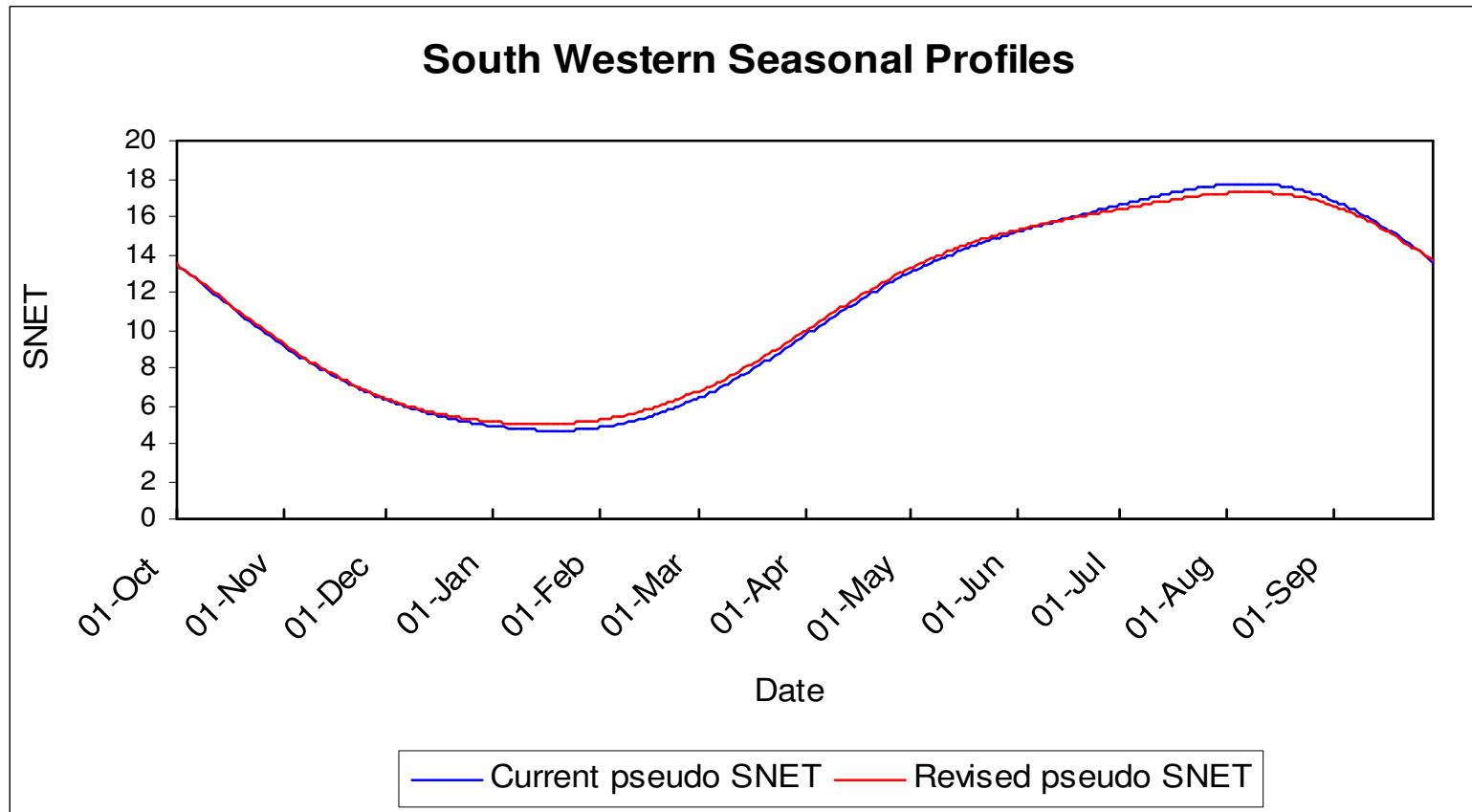
## **Review of Composite Weather Variable results for SW**

# Slide 1: SW LDZ - Comparison of CWV parameters

CWV	1 in 20 Peak CWV	$I_1$	$I_2$	$I_3$	$V_0$	$V_1$	$V_2$	Q
Current	-4.55	0.660	0.0094	0.05	3	14.5	17.8	0.36
Revised	-4.26	0.651	0.0089	0.06	3	14.4	17.7	0.38

- 2005/06 was excluded from the analysis to derive the pseudo SNET profile because effective temperature was consistently high from May to September.
- Similar CWV parameter values for current and revised CWV.
- Differences in 1 in 20 peak CWV due to slightly different pseudo SNET profile and other parameter values.

## Slide 2: SW LDZ - comparison of pseudo SNET profiles



- Revised pseudo SNET profile is similar to current profile, but slightly flatter (higher in winter and lower in summer).

## Slide 3: SW LDZ - comparison of average fit to demand

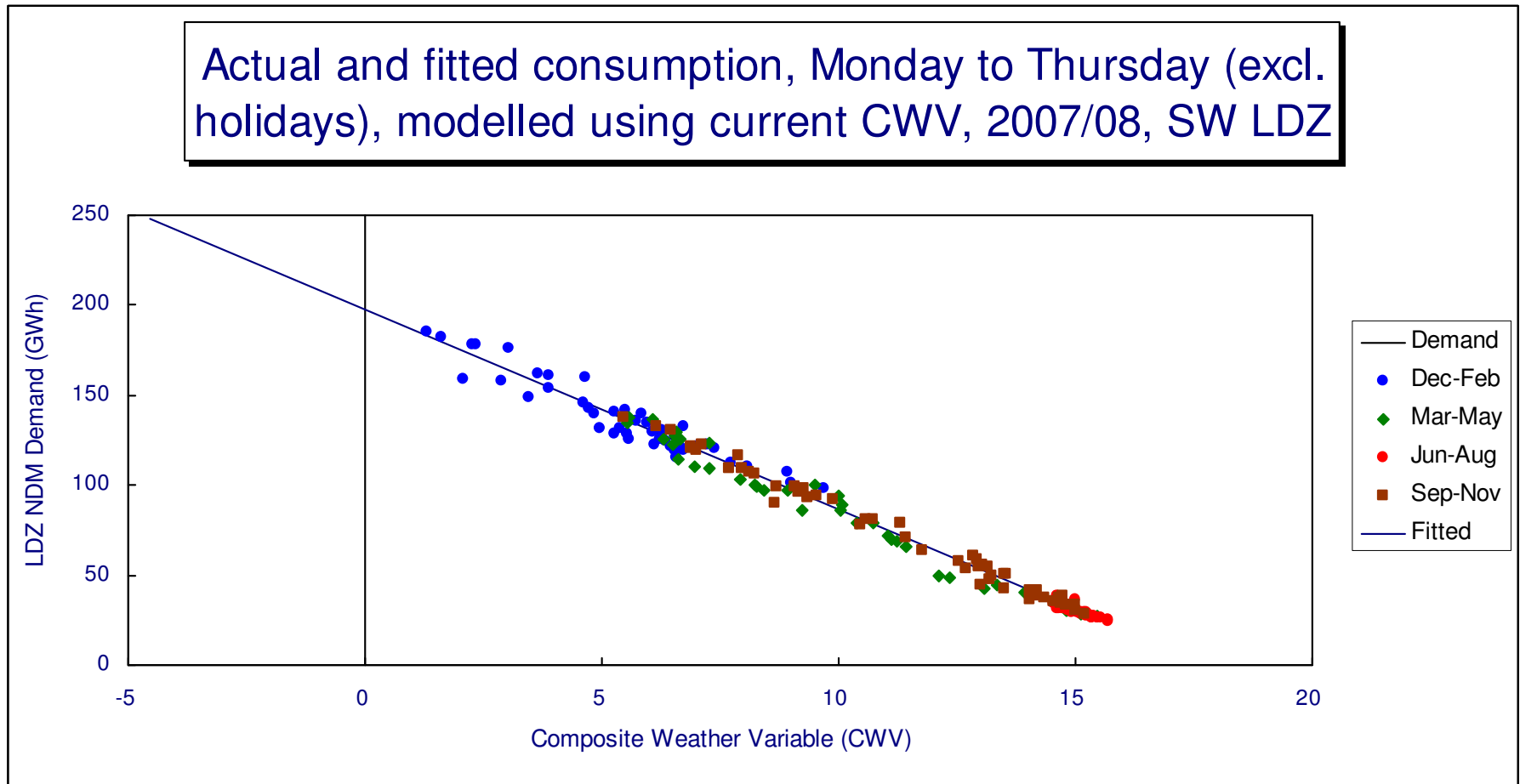
CWV	Gas Year(s)	Avg. Mean Abs. % Error	Avg. Adj. R-sq.	Avg. RMSE (MWh)	Avg. % diff. in est. 1 in 20 peak demand
Current	2004/05	3.88%	99.09%	4,762	0.07%
Revised		3.92%	99.08%	4,776	
Current	2005/06	4.01%	99.30%	4,872	0.01%
Revised		4.03%	99.29%	4,907	
Current	2006/07	4.85%	98.67%	5,118	0.12%
Revised		4.67%	98.78%	4,914	
Current	2007/08	4.19%	98.91%	4,816	0.11%
Revised		4.00%	99.00%	4,602	
Current	1996/97 - 2007/08	3.85%	99.09%	4,539	0.05%
Revised		3.85%	99.09%	4,537	



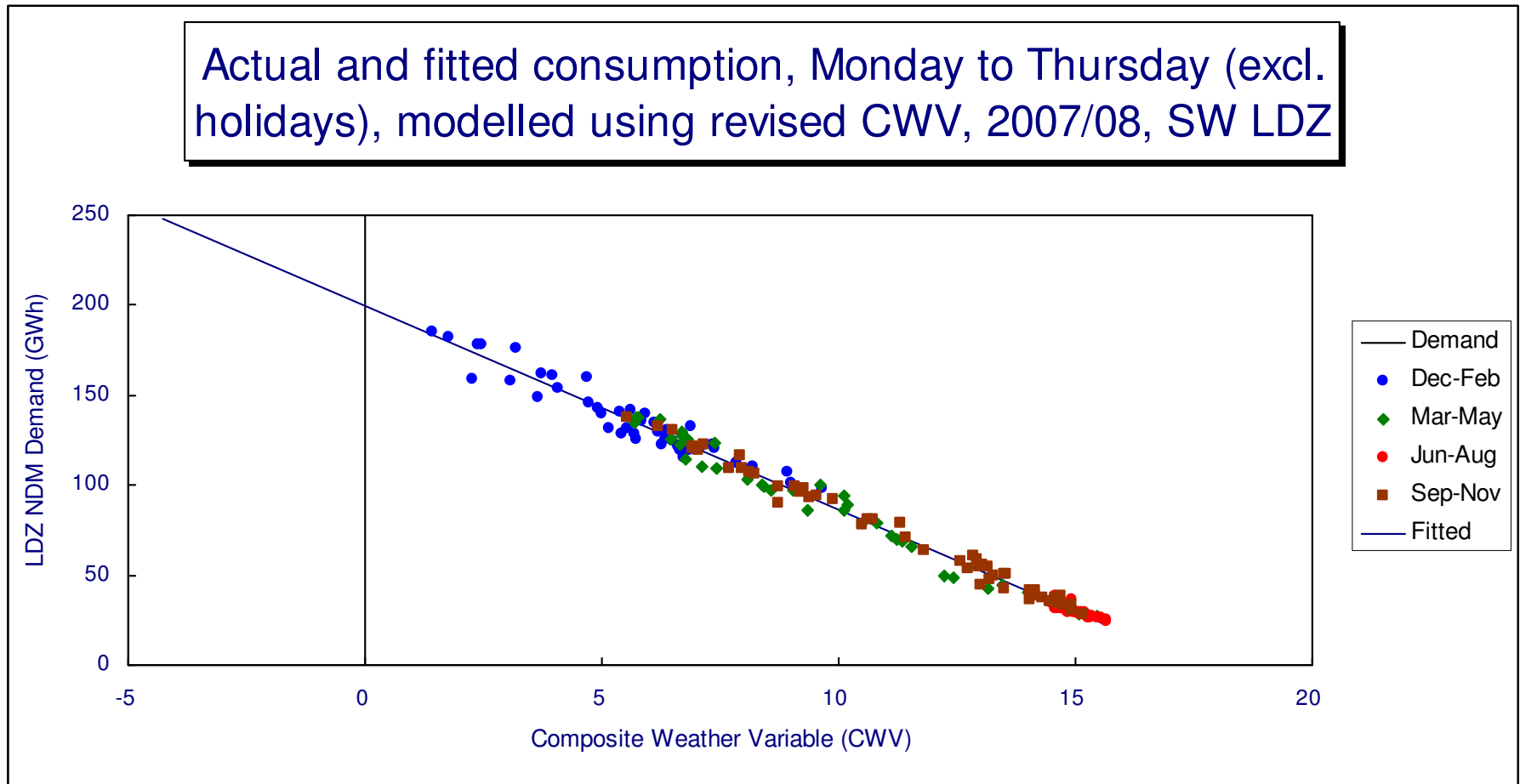
## Slide 4: SW LDZ - comparison of seasonal fit and bias

CWV	Gas Year(s)	Dec. to Feb.		Mar. to May		Jun. To Aug.		Sep. to Oct.	
		MAPE	MPRE	MAPE	MPRE	MAPE	MPRE	MAPE	MPRE
Current	2004/05	2.58%	-0.64%	6.00%	0.21%	3.84%	0.43%	3.72%	0.67%
Revised		2.68%	-0.72%	5.94%	0.79%	3.70%	0.20%	3.82%	0.25%
Current	2005/06	2.81%	-0.34%	4.86%	0.75%	5.08%	-1.91%	4.91%	0.28%
Revised		2.78%	-0.37%	4.87%	1.35%	5.34%	-2.43%	4.99%	-0.20%
Current	2006/07	3.63%	1.01%	7.19%	-4.27%	5.42%	3.02%	4.65%	0.99%
Revised		3.46%	0.96%	6.91%	-3.54%	5.44%	2.42%	4.45%	0.65%
Current	2007/08	4.07%	0.27%	5.06%	-2.06%	4.10%	0.96%	3.63%	1.14%
Revised		3.82%	0.20%	4.83%	-1.38%	4.15%	0.39%	3.50%	0.80%
Current	1996/97-	2.79%	-0.02%	5.29%	-0.11%	4.61%	-0.18%	3.95%	0.20%
Revised	2007/08	2.77%	-0.07%	5.27%	0.49%	4.67%	-0.64%	3.97%	-0.17%

## Slide 5: SW LDZ - example graph for current CWV (2007/08)



## Slide 6: SW LDZ - example graph for revised CWV (2007/08)



## Slide 7: SW LDZ - example graphs - parameters & statistics

Gas Year	CWV	Demand Intercept (GWh)	CWV Param. (GWh/°)	Mean Abs.% Error	Avg. Adj. R-sq.	Avg. RMSE (MWh)
2007/08	Current	197.10	-11.10	4.19%	98.91%	4,816
2007/08	Revised	199.71	-11.30	4.00%	99.00%	4,602

- Parameters and fit statistics for most recent gas year 2007/08 - Monday to Thursday (non-holiday) models.
- Warmer year than average.
- Coldest day just before Christmas holiday period.

# Summary of observations on Stage 2 analysis

---

- For each of the 4 LDZs, the revised CWVs derived using the current CWV methodology produced a slightly better fit to aggregate NDM demand *on average* than the current CWV over the 12 gas years modelled and in a majority of cases over the last 4 gas years.
- The revised CWVs did not significantly change the estimated 1 in 20 peak aggregate NDM demand.
- Models based on the revised CWVs showed little seasonal bias and a good seasonal fit to aggregate NDM demand *on average* over the 12 gas years modelled.
- As expected, the seasonal fit of the revised CWV was less good on a few days in exceptional seasons (with weather that was significantly different from seasonal normal).

# Conclusions on Stage 2 analysis

---

- Current methodology produces CWVs that create:
  - **Good fit to aggregate NDM demand**
  - **Demand models which display little seasonal bias in all but a few days in the most exceptional seasons**
- Current methodology is therefore **fit for purpose.**
- Current methodology should be retained largely unaltered for use in the next CWV review
- The only part of the methodology where a change could be considered is the period used to derive the pseudo SNET profile and most of the CWV parameters
  - **Currently this is all of the gas years containing aggregate NDM data - at this moment, 12 gas years from 1996/97 to 2007/08 – see Stage 3 analysis.....**

# The Composite Weather Variable

---

**Stage 3: Review of period to be used for determining SNET and CWV parameters**

# Assessment of alternative periods

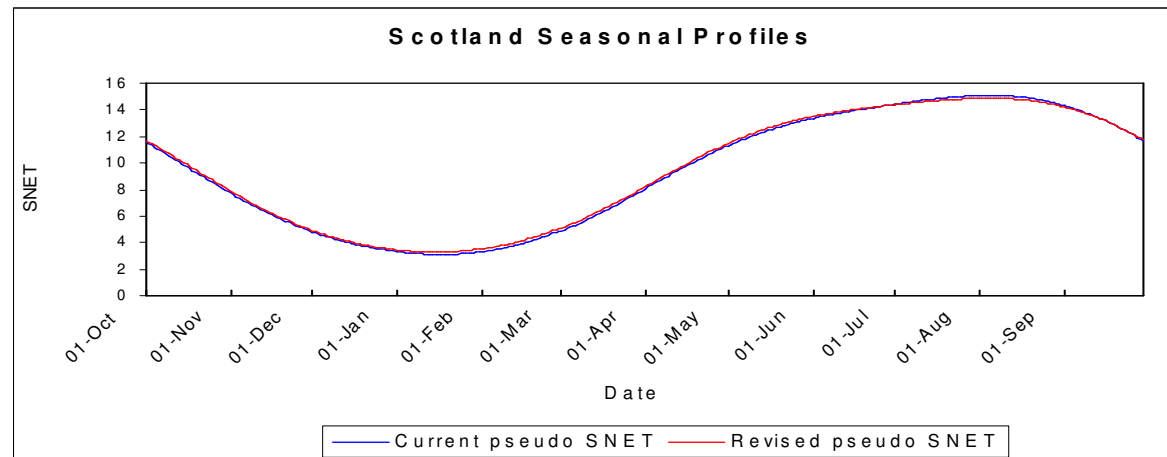
---

- Derive alternative CWVs for 4 LDZs (one from each Network - SC, NO, WM and SW) based on 11 and 7 gas years' data
- Derive aggregate NDM demand models for 4 LDZs for alternative CWVs (plus current and 12 year CWV)
- Calculate revised SNET values for alternative periods
- Assess average fit of CWVs to aggregate NDM demand
- Assess change to 1 in 20 peak aggregate NDM demand estimates from current CWV (using demand models and 1 in 20 peak CWVs)
- Analysis for WM follows, results for 3 remaining LDZs provided in Appendix 1



# Explanation of results for alternative periods

- 4 LDZ's subject to analysis, namely SC,NO,WM and SW
- Results presented per LDZ over 3 slides – more detail available if required
- **Slide 1:**
  - **Objective:** Compare all pseudo SNET profiles – 7yr, 11yr, 12yr and current
  - **Analysis:** Calculate revised Seasonal Normal Effective Temperature (SNET) and visually compare profiles. High level observations on results provided



# Explanation of results for alternative periods

- **Slide 2:**

- **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 4 LDZs 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 Period	Fit Statistic	Current CW V	7 year CW V	11 year CW V	12 year CW V
1996/97 – 2007/08	Adj. R-sq.	98.97%	98.96%	98.97%	98.97%
	RMSE (MW h)	6,169	6,184	6,159	6,167
1997/98 – 2007/08	Adj. R-sq.	98.99%	98.98%	98.99%	98.99%
	RMSE (MW h)	6,172	6,179	6,152	6,171
2001/02 – 2007/08	Adj. R-sq.	99.07%	99.08%	99.07%	99.07%
	RMSE (MW h)	6,089	6,038	6,055	6,069
2004/05 – 2007/08	Adj. R-sq.	99.03%	99.04%	99.04%	99.04%
	RMSE (MW h)	6,223	6,185	6,174	6,184

# Explanation of results for alternative periods

- **Slide 3:**
  - **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

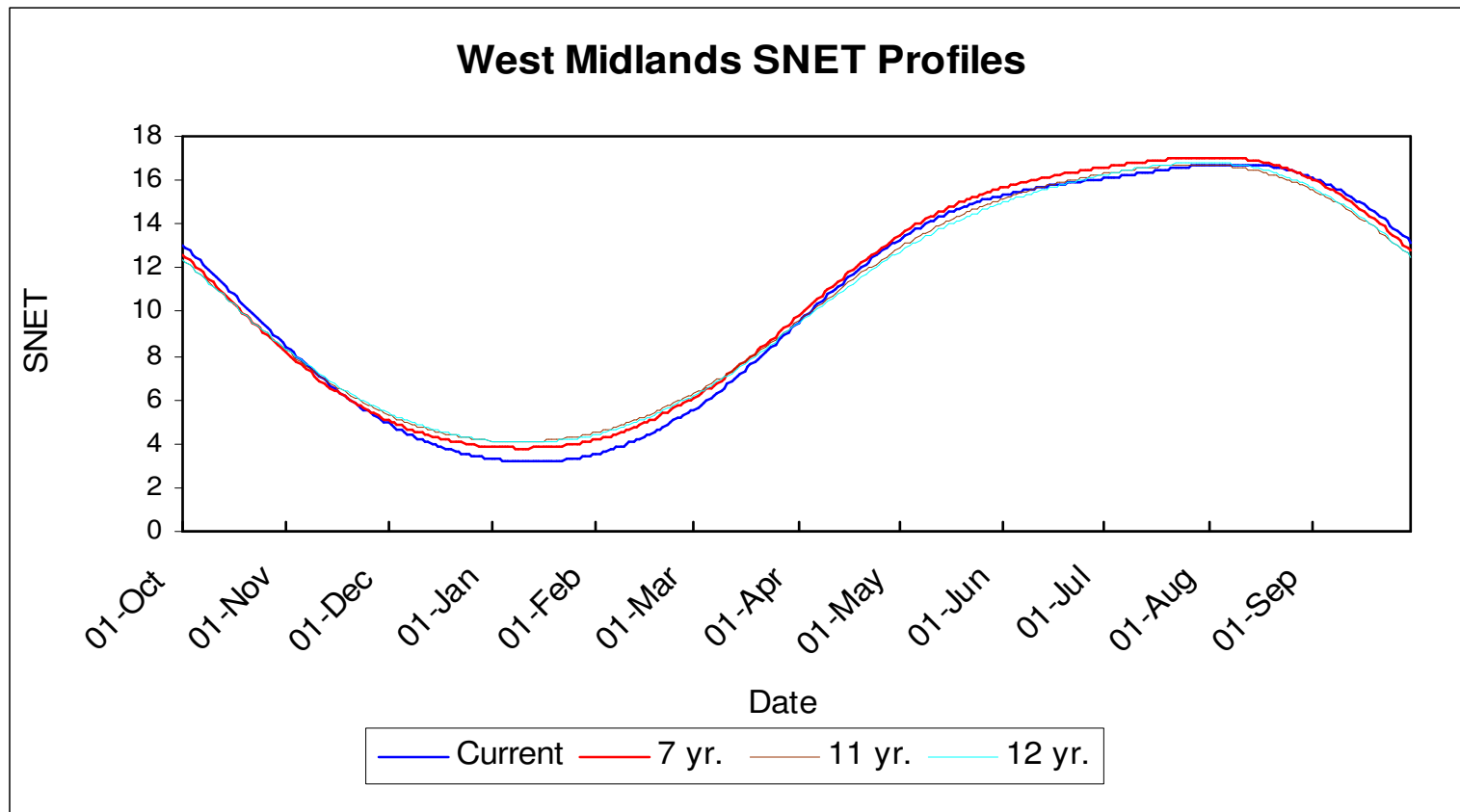
Gas Year Period	7 year CWV	11 year CWV	12 year CWV
1996/97 – 2007/08	-0.75%	-0.29%	-0.88%
1997/98 – 2007/08	-0.74%	-0.28%	-0.87%
2001/02 – 2007/08	-0.77%	-0.31%	-0.90%
2004/05 – 2007/08	-0.75%	-0.29%	-0.90%

# **The Composite Weather Variable**

---

## **Review of periods for LDZ WM**

# Slide 1: WM LDZ - pseudo SNET profiles



- Alternative pseudo SNET profiles are all similar to current profile, but slightly flatter in winter.

## Slide 2: WM LDZ - comparison of average fit to demand

Gas Year Period	Fit Statistic	Current CWV	7 year CWV	11 year CWV	12 year CWV
1996/97 – 2007/08	Adj. R-sq.	99.21%	99.21%	99.21%	99.22%
	RMSE (MWh)	6,884	6,899	6,861	6,848
1997/98 – 2007/08	Adj. R-sq.	99.19%	99.20%	99.20%	99.20%
	RMSE (MWh)	6,955	6,949	6,910	6,908
2001/02 – 2007/08	Adj. R-sq.	99.22%	99.24%	99.23%	99.23%
	RMSE (MWh)	6,939	6,860	6,878	6,877
2004/05 – 2007/08	Adj. R-sq.	99.25%	99.29%	99.28%	99.28%
	RMSE (MWh)	6,747	6,541	6,579	6,613

## Slide 3: WM LDZ – change in estimated peak demand (compared to current CWV)

---

Gas Year Period	7 year CWV	11 year CWV	12 year CWV
1996/97 – 2007/08	-0.67%	-0.36%	-0.21%
1997/98 – 2007/08	-0.66%	-0.35%	-0.21%
2001/02 – 2007/08	-0.65%	-0.33%	-0.19%
2004/05 – 2007/08	-0.60%	-0.30%	-0.15%

## Summary of Stage 3 analysis

---

- For the 4 LDZs in most cases, the alternative CWVs produced a slightly better fit to aggregate NDM demand *on average* than the current CWV over the years modelled.
- In all cases, the alternative CWVs did not significantly change the estimated 1 in 20 peak aggregate NDM demand.
- Models based on the alternative CWVs showed little seasonal bias and a good seasonal fit to aggregate NDM demand *on average* over the years modelled.
- There was little to choose between the alternative CWVs in terms of fit and seasonal bias. In general, *on average*:
  - the 7 year CWV was marginally best over the 7 yr. period
  - the 11 year CWV was marginally best over the 11 yr. period
  - the 12 year CWV was marginally best over the 12 yr. period



## Conclusions on Stage 3 analysis

---

- Since all of the alternative CWVs showed a marginal improvement on the current CWV *on average* over the years they were based on, any of the 3 alternative periods would be suitable for the CWV review (plus an extra year - 2008/09)
- Since there is not much to choose between the 3 alternative periods, **it is recommended that the choice of period should be aligned with the chosen base period for seasonal normal weather**
- The suggested period will be used to derive the pseudo SNET profile and most of the CWV parameters for each LDZ
- The cold weather parameters will continue to be derived from all available data (minus any exclusions), including MPD data prior to 1996/97

# **Appendix 1**

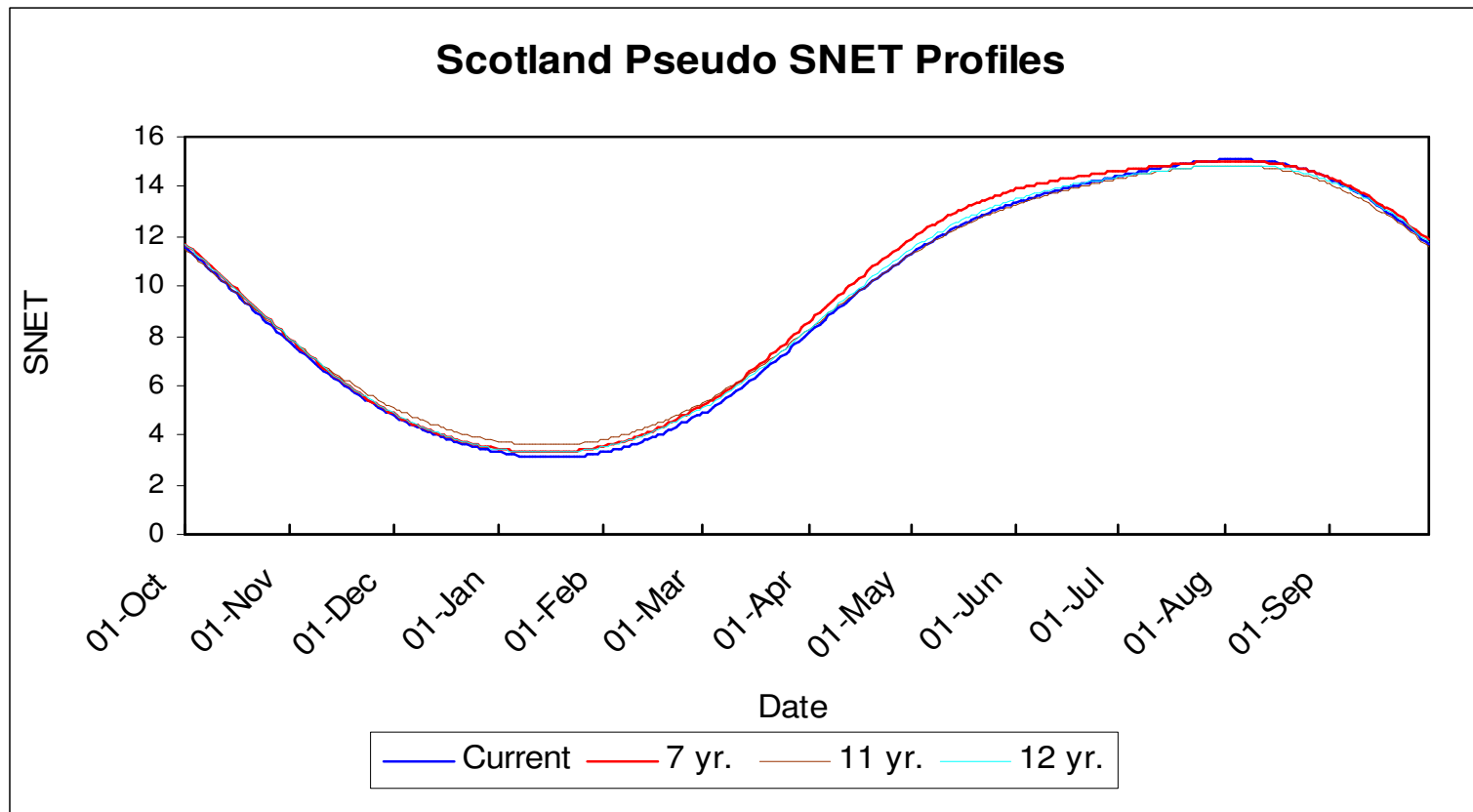
Analysis for remaining 3 LDZs

# **The Composite Weather Variable**

---

## **Review of periods for LDZ SC**

# Slide 1: SC LDZ - pseudo SNET profiles



- Alternative pseudo SNET profiles are all similar to current profile, but slightly flatter.

## Slide 2: SC LDZ - comparison of average fit to demand

Gas Year Period	Fit Statistic	Current CWV	7 year CWV	11 year CWV	12 year CWV
1996/97 – 2007/08	Adj. R-sq.	98.97%	98.96%	98.97%	98.97%
	RMSE (MWh)	6,169	6,184	6,159	6,167
1997/98 – 2007/08	Adj. R-sq.	98.99%	98.98%	98.99%	98.99%
	RMSE (MWh)	6,172	6,179	6,152	6,171
2001/02 – 2007/08	Adj. R-sq.	99.07%	99.08%	99.07%	99.07%
	RMSE (MWh)	6,089	6,038	6,055	6,069
2004/05 – 2007/08	Adj. R-sq.	99.03%	99.04%	99.04%	99.04%
	RMSE (MWh)	6,223	6,185	6,174	6,184

### Slide 3: SC LDZ – change in estimated peak demand (compared to current CWV)

---

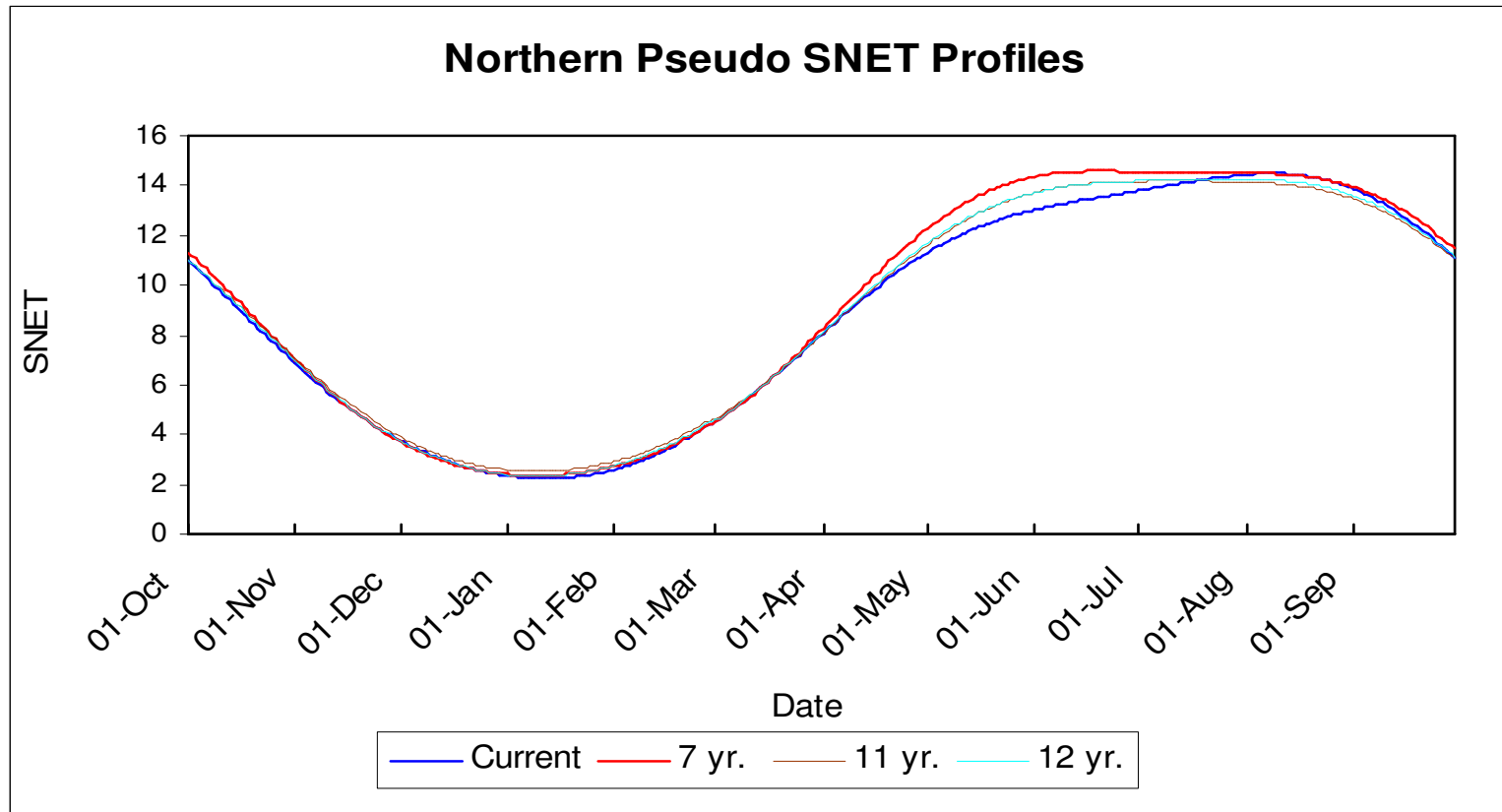
Gas Year Period	7 year CWV	11 year CWV	12 year CWV
1996/97 – 2007/08	-0.75%	-0.29%	-0.88%
1997/98 – 2007/08	-0.74%	-0.28%	-0.87%
2001/02 – 2007/08	-0.77%	-0.31%	-0.90%
2004/05 – 2007/08	-0.75%	-0.29%	-0.90%

# The Composite Weather Variable

---

## Review of periods for LDZ NO

# Slide 1: NO LDZ - pseudo SNET profiles



- Alternative pseudo SNET profiles are similar to current profile, but have different shape in April to June.



## Slide 2: NO LDZ - comparison of average fit to demand

Gas Year Period	Fit Statistic	Current CWV	7 year CWV	11 year CWV	12 year CWV
1996/97 – 2007/08	Adj. R-sq.	98.72%	98.72%	98.74%	98.74%
	RMSE (MWh)	4,718	4,706	4,677	4,674
1997/98 – 2007/08	Adj. R-sq.	98.73%	98.74%	98.76%	98.76%
	RMSE (MWh)	4,723	4,699	4,668	4,670
2001/02 – 2007/08	Adj. R-sq.	98.66%	98.71%	98.69%	98.69%
	RMSE (MWh)	4,944	4,848	4,878	4,875
2004/05 – 2007/08	Adj. R-sq.	98.49%	98.62%	98.57%	98.56%
	RMSE (MWh)	5,195	4,932	5,038	5,050

## Slide 3: NO LDZ – change in estimated peak demand (compared to current CWV)

---

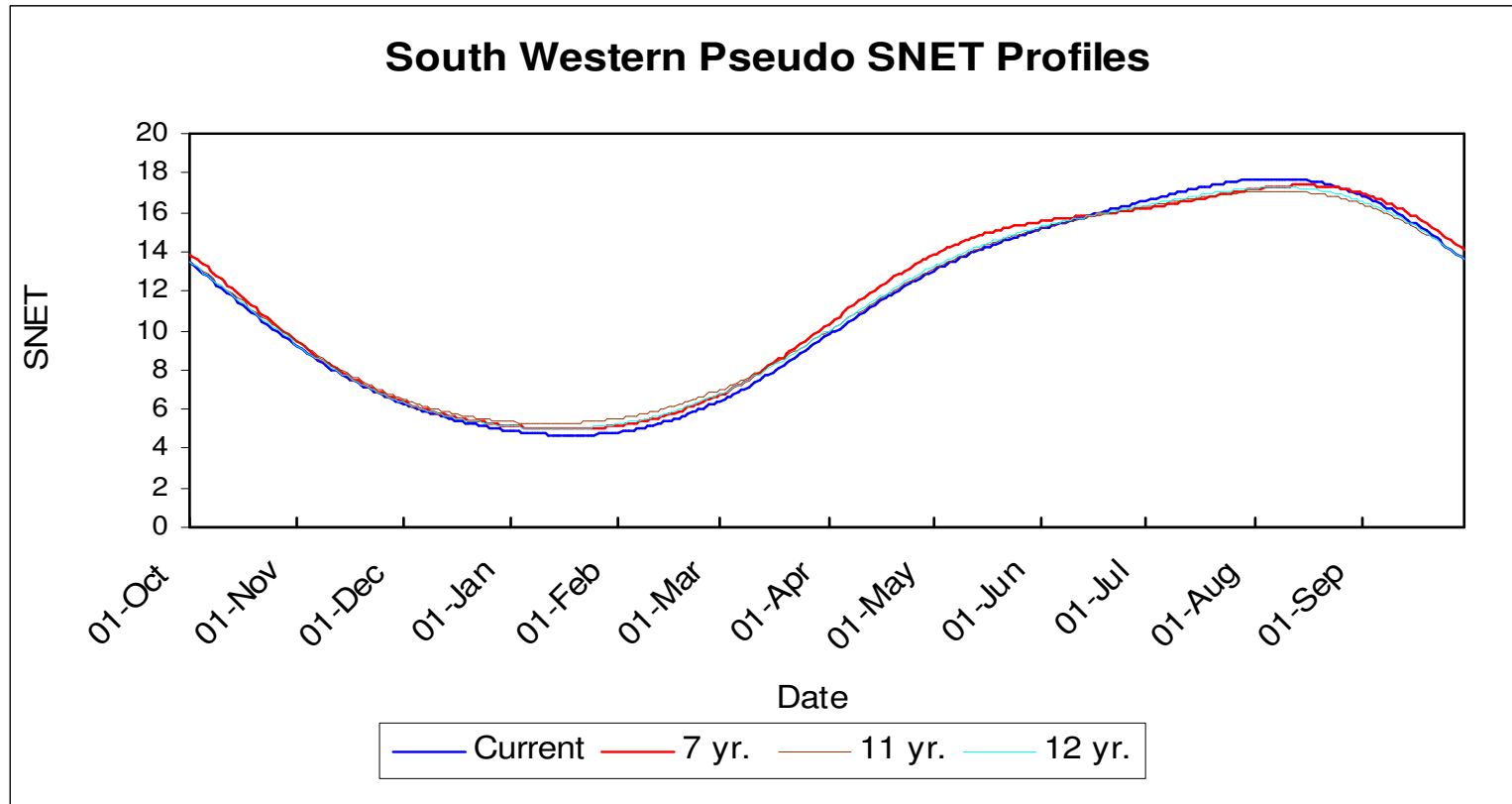
Gas Year Period	7 year CWV	11 year CWV	12 year CWV
1996/97 – 2007/08	-0.27%	-0.53%	-0.85%
1997/98 – 2007/08	-0.25%	-0.53%	-0.84%
2001/02 – 2007/08	-0.27%	-0.53%	-0.85%
2004/05 – 2007/08	-0.21%	-0.53%	-0.84%

# **The Composite Weather Variable**

---

## **Review of periods for LDZ SW**

# Slide 1: SW LDZ - pseudo SNET profiles



- Alternative pseudo SNET profiles are all similar to current profile, but slightly flatter.

## Slide 2: SW LDZ - comparison of average fit to demand

Gas Year Period	Fit Statistic	Current CWV	7 year CWV	11 year CWV	12 year CWV
1996/97 – 2007/08	Adj. R-sq.	99.09%	99.09%	99.09%	99.09%
	RMSE (MWh)	4,539	4,554	4,532	4,537
1997/98 – 2007/08	Adj. R-sq.	99.07%	99.07%	99.08%	99.08%
	RMSE (MWh)	4,588	4,610	4,575	4,587
2001/02 – 2007/08	Adj. R-sq.	99.03%	99.04%	99.03%	99.03%
	RMSE (MWh)	4,812	4,781	4,811	4,803
2004/05 – 2007/08	Adj. R-sq.	98.99%	99.04%	99.03%	99.04%
	RMSE (MWh)	4,892	4,787	4,808	4,800

## Slide 3: SW LDZ – change in estimated peak demand (compared to current CWV)

---

Gas Year Period	7 year CWV	11 year CWV	12 year CWV
1996/97 – 2007/08	-0.08%	0.07%	0.05%
1997/98 – 2007/08	-0.07%	0.08%	0.05%
2001/02 – 2007/08	-0.08%	0.07%	0.05%
2004/05 – 2007/08	-0.07%	0.11%	0.08%