

CWV Review

London Weather Station Move

6th November 2006

Demand Estimation Sub-Committee

Background

- The current composite weather variables (CWVs) for North Thames (NT), Eastern (EA) and South Eastern (SE) LDZs are based on temperatures and wind speeds from London Weather Centre (LWC).
- LWC is due to cease operation (probably in the current gas year).
- Heathrow is the recommended replacement weather station
 - Stable site and has had a weather station for many years.
 - Located on the outskirts of London, reasonably close to the centres of gas demand in the 3 LDZs.
- The revised CWVs will need to be used in the spring 2007 NDM analysis and implemented on 1st October 2007.

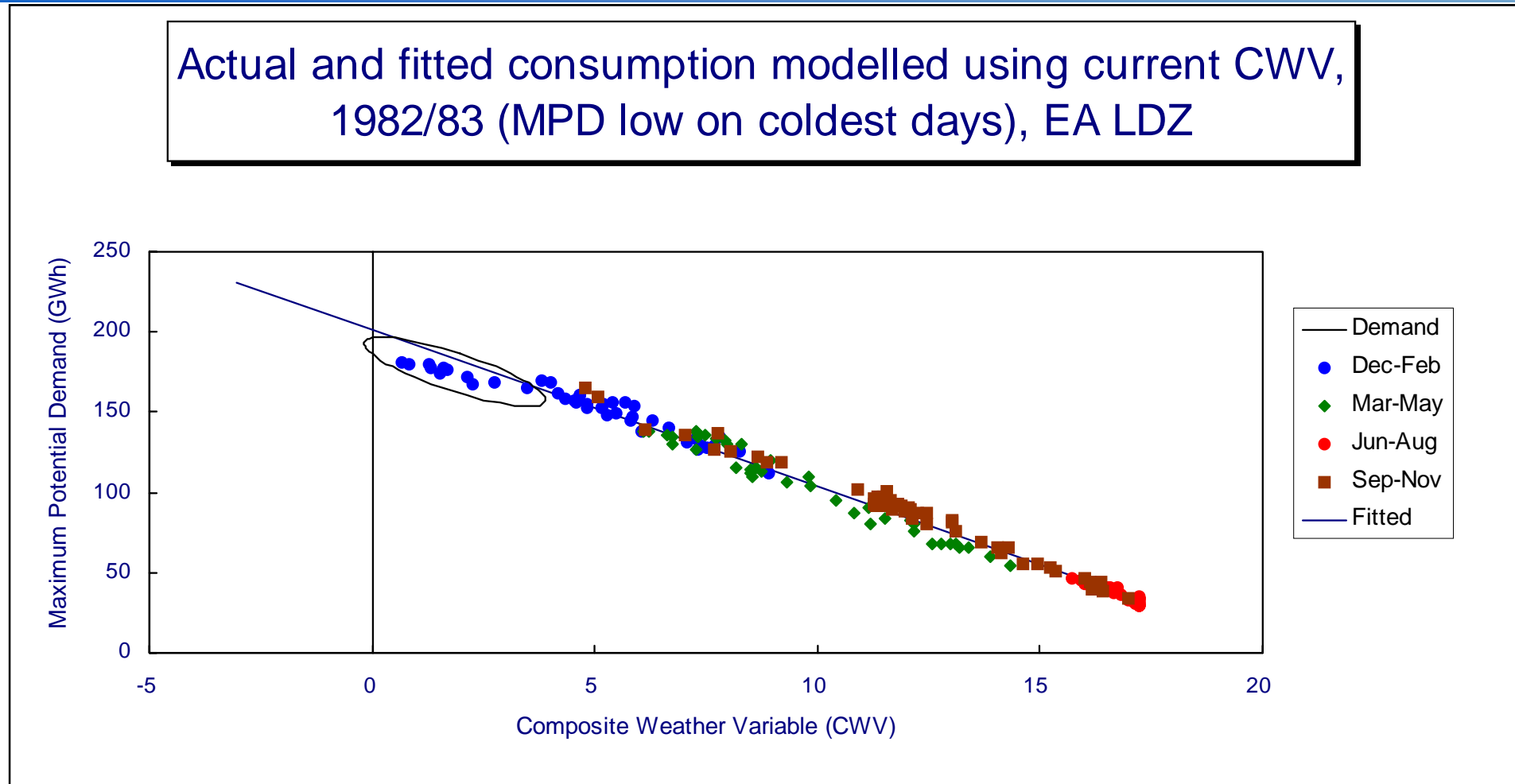
Backfilling Equations (from July DESC)

- Used to create Heathrow weather history back to 1928.
- Daily Temperatures:
Heathrow = $0.1892 + 0.9720 * LWC$
- $0.0642 * \max(0, 17.5 - LWC)$
- Daily Wind Speeds:
Heathrow = $- 1.1265 + 1.1700 * LWC$
+ $0.8076 * \max(0, 4.1 - LWC)$
- At Heathrow, daily temperatures are a lower on average than LWC, especially on cool days and very hot days.
- At Heathrow, daily wind speeds are slightly higher on average than LWC.

Approach used to derive revised CWVs

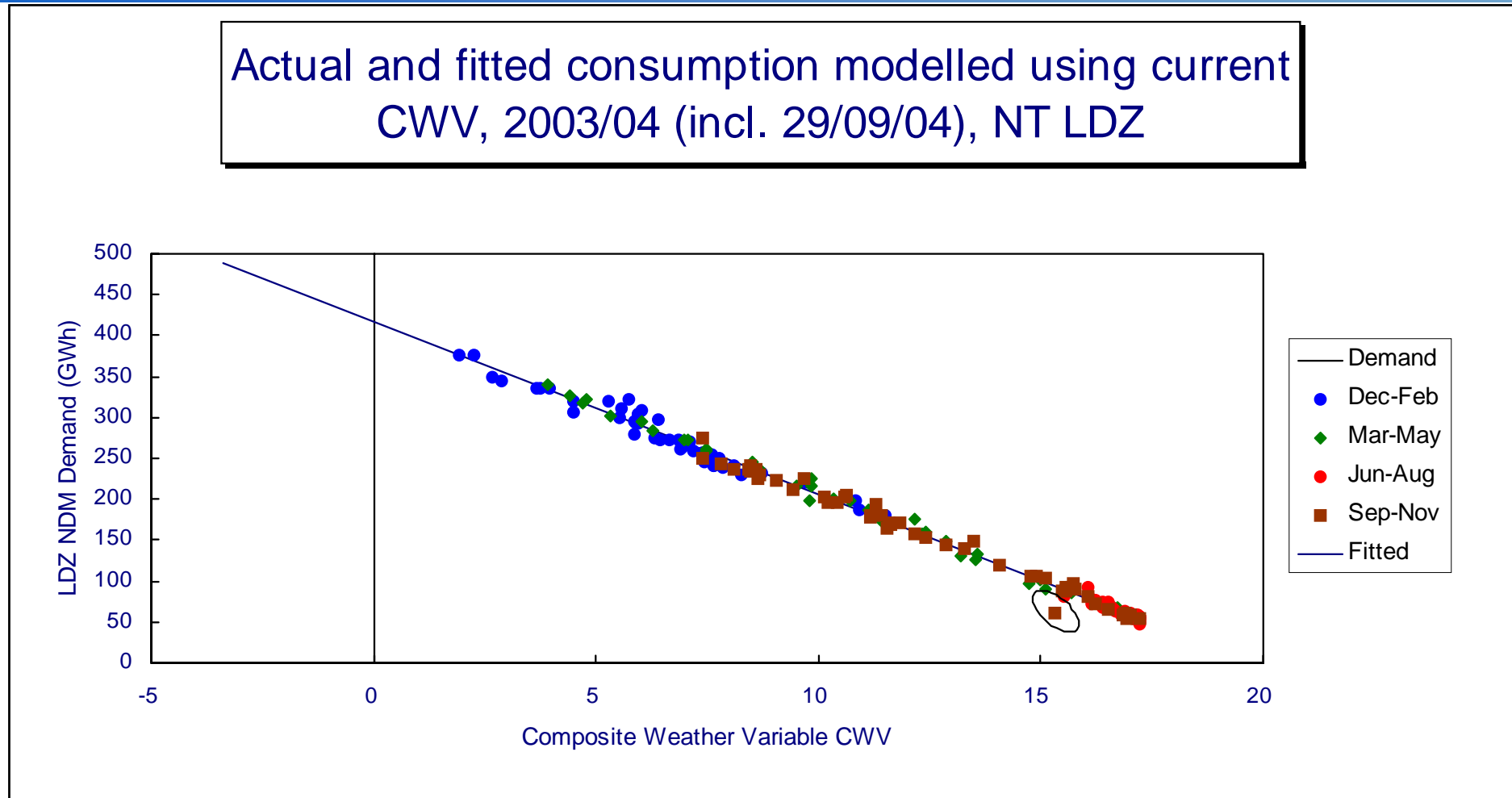
- Consistent methodology as for the comprehensive CWV review carried out in 2004.
- Most CWV parameters were derived using aggregate NDM demand data (10 gas years 1996/97 to 2005/06).
- Maximum potential demand (MPD) data prior to 1996/97 was included in the derivation of cold weather parameters.
- Some suspect / unusual data for particular days or years was excluded from the analysis or corrected.
- A pseudo seasonal normal effective temperature (SNET) profile was used – i.e. a demand adjusted profile with improved shape.

Data exclusions example – EA graph for 1982/83 (excluded from cold weather parameter analysis)



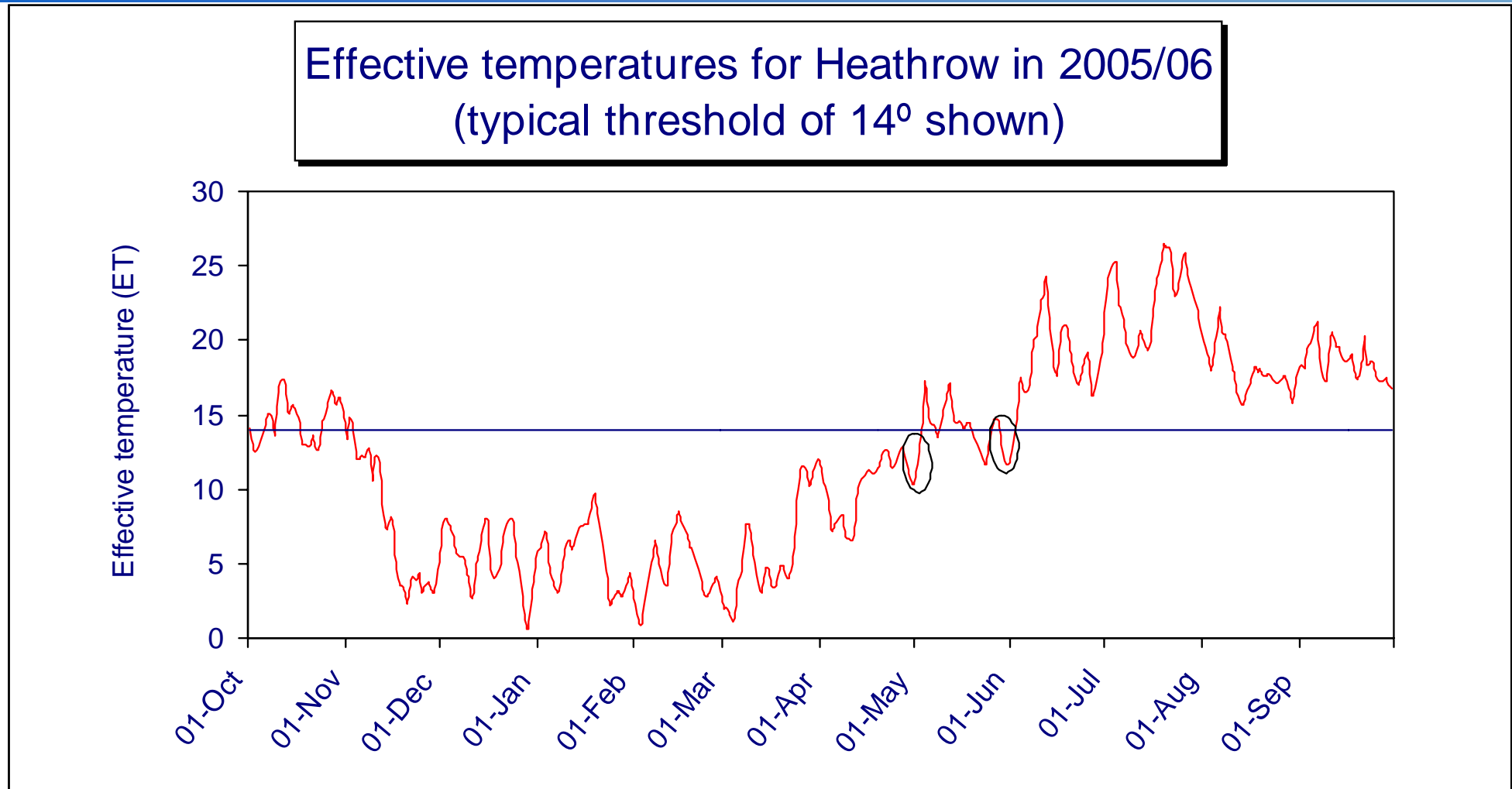
- MPD appeared to be too low on coldest days possibly due to interruption estimates not being included.

Data exclusions example – NT graph for 2003/04 (showing 1 day excluded from analysis)



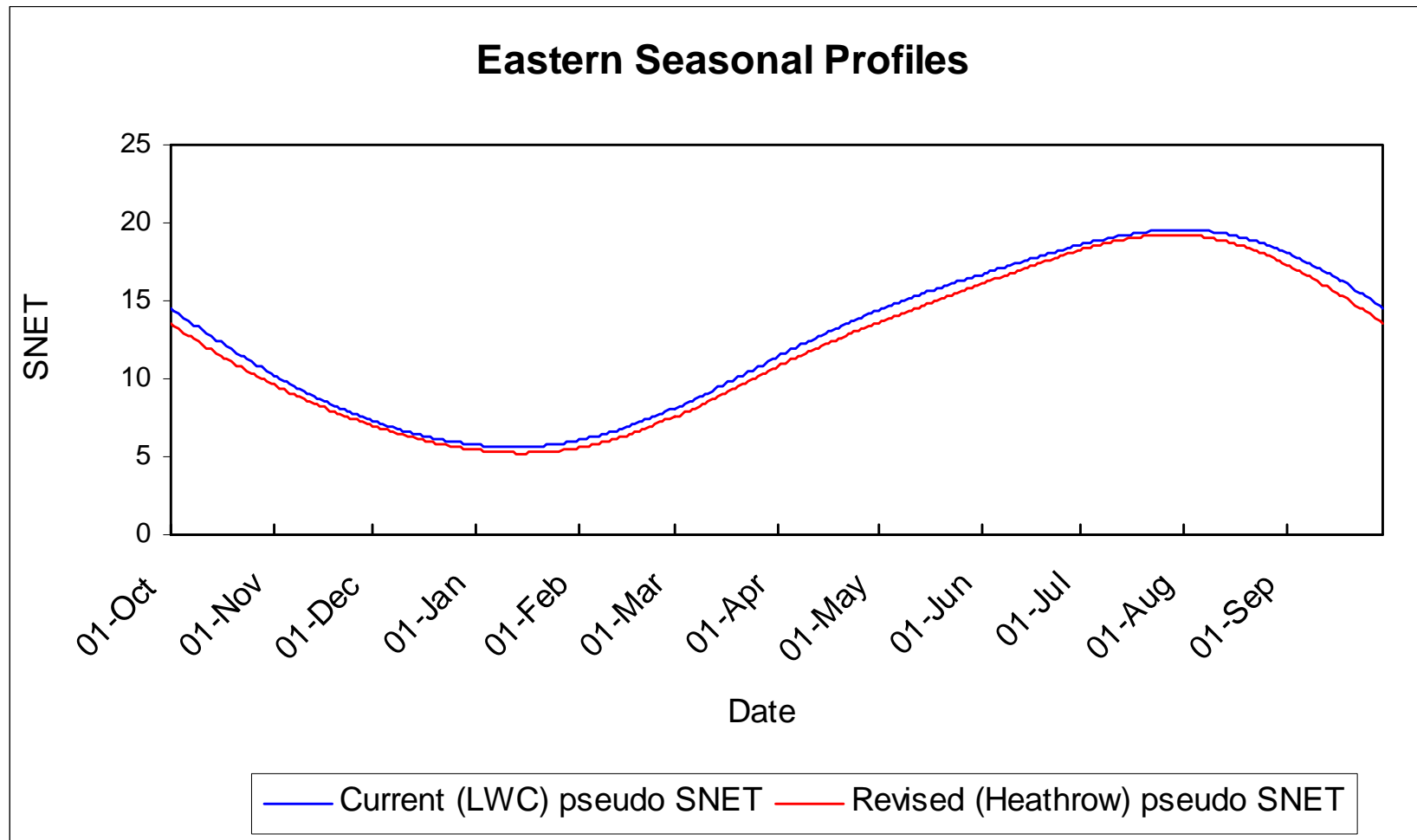
- Aggregate NDM appeared to be too low on 29/09/04, possibly due to an error in DM demand on that day.

Data exclusions example – Heathrow data for 2005/06 (excluded from pseudo SNET analysis)



- Effective temperature was consistently high from May to September (need some cooler non-holiday days in this period to derive a profile).

EA LDZ - Comparison of pseudo SNET profiles



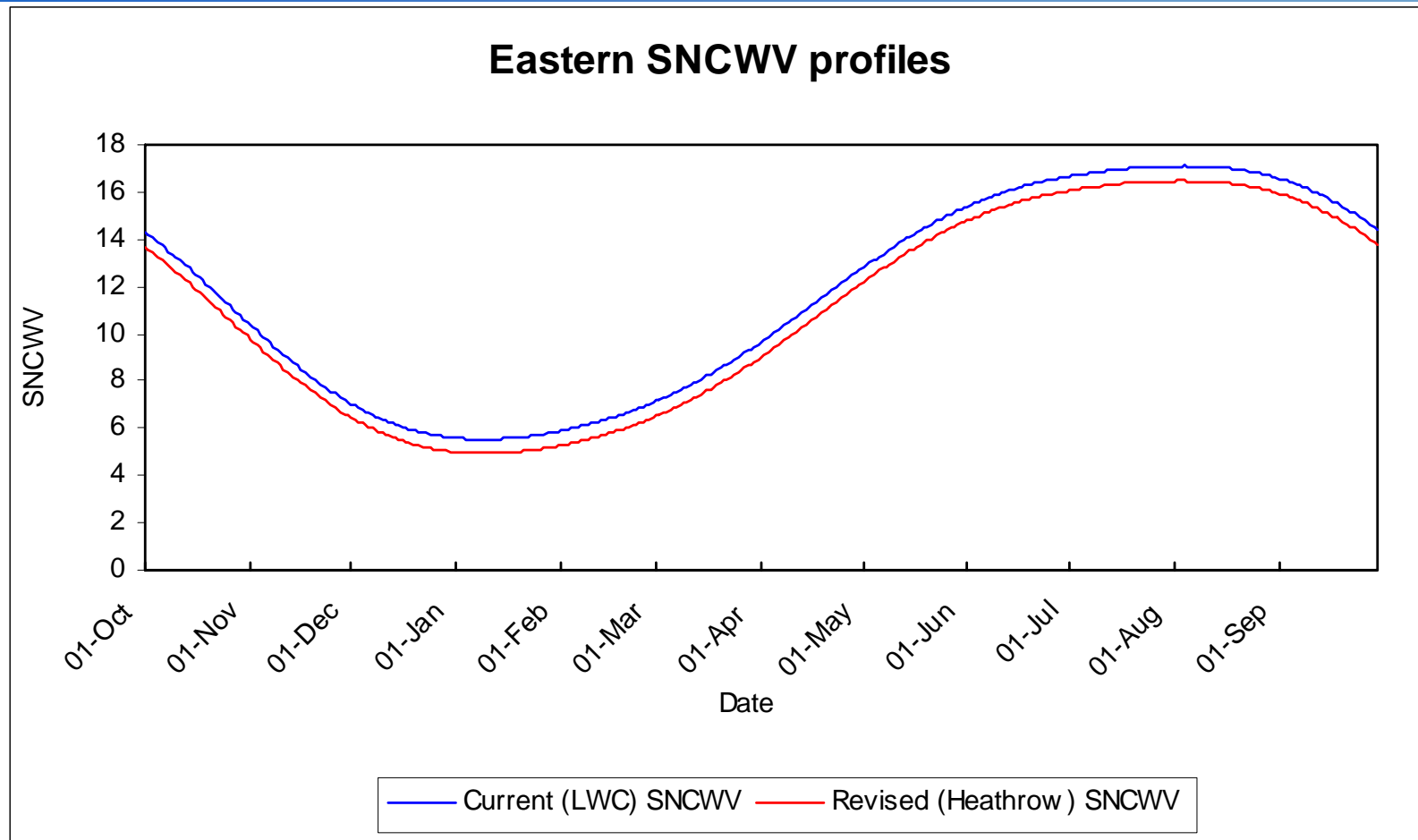
- Values for the revised (Heathrow based) pseudo SNET are lower than the current (LWC based) pseudo SNET.

EA LDZ - Comparison of CWV parameters

CWV	Weather Station	I_1	I_2	I_3	V_0	V_1	V_2	Q
Current	LWC	0.681	0.0125	0.00	0	15.9	19.5	0.37
Revised	Heathrow	0.680	0.0111	0.00	0	15.2	19.2	0.35

- The warm weather cut-offs (V_1 and V_2) are lower for the revised CWV than the current CWV because of the lower summer temperatures and pseudo SNET values at Heathrow.
- The cold weather parameters (V_0 and I_3) for the revised CWV are the same as for the current CWV.
- The differences in the other parameters are the result of differences in temperatures, wind speeds and pseudo SNET profiles.
- CWV values are generally lower for the revised CWV than the current CWV.

EA LDZ - Comparison of Seasonal Normal CWV profiles



- SNCWV values based on 17 gas years (1987/88 to 2003/04).
- Values for the revised (Heathrow based) SNCWV are lower than for the current (LWC based) SNCWV.

EA LDZ - Comparison of average fit and peaks

CWV	Weather Station	1 in 20 peak CWV	Avg. Mean Abs. % Error	Avg. Adj. R-sq.	Avg. RMSE (MWh)	Avg. % diff. in est. 1 in 20 peak demand
Current	LWC	-3.03	3.67%	99.15%	6,200	-
Revised	Heathrow	-4.01	3.78%	99.12%	6,315	1.79%

- The average statistics were calculated from Mon-Thu models for 1996/97 to 2005/06.
- The 1 in 20 peak CWV values calculated using 1928/29 to 2005/06.
- Estimated 1 in 20 peak aggregate NDM demands were calculated from the demand models and the 1 in 20 peak CWV values.
- Revised CWV produced a very good fit to aggregate NDM demand.
- For the revised CWV, the estimated 1 in 20 peak demand was slightly higher than for the current CWV. However, this increase is smaller than the recent drop in annual aggregate NDM demand AQ observed for this LDZ (3.2%).

EA LDZ - Comparison of seasonal fit

CWV	Weather Station	Dec. to Feb.		Mar. to May		Jun. To Aug.		Sep. to Oct.	
		MPRE	MAPE	MPRE	MAPE	MPRE	MAPE	MPRE	MAPE
Current	LWC	-0.08%	2.90%	0.30%	4.36%	-0.22%	4.90%	-0.12%	3.89%
Revised	Heathrow	-0.02%	2.93%	0.28%	4.59%	0.59%	4.98%	-0.39%	4.02%

- The average statistics by seasonal quarter were calculated from Monday to Thursday models of aggregate NDM demand (excluding holidays) for 1996/97 to 2005/06.
- Like the current CWV, the revised CWV displayed little seasonal bias (average MPRE close to 0 for all seasonal quarters).
- The seasonal fit for the revised CWV was very good, almost as good as the current CWV.

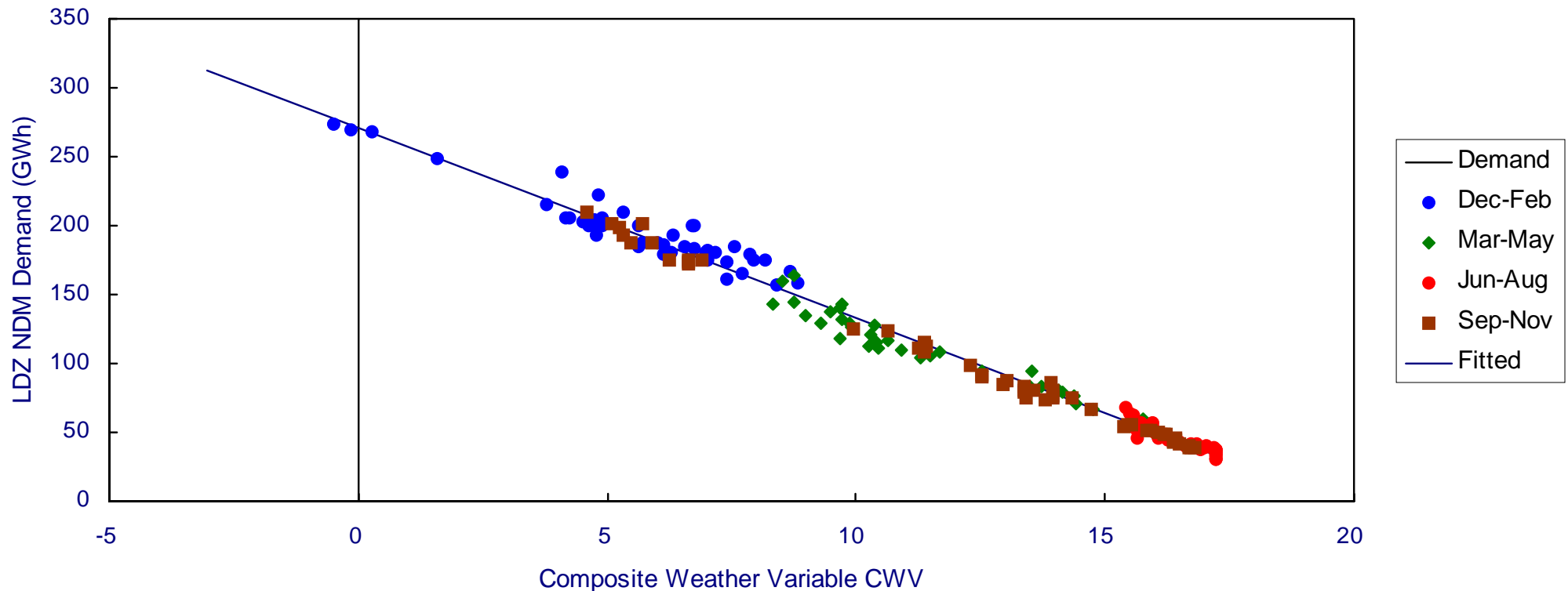
EA LDZ - Example graphs – parameters & statistics

Gas Year	CWV	Weather Station	Demand Intercept (GWh)	CWV Param. (GWh/°)	Mean Abs.% Error	Avg. Adj. R-sq.	Avg. RMSE (MWh)
1996/97	Current	LWC	270.74	-13.81	4.57%	98.80%	7,152
1996/97	Revised	Heathrow	262.07	-13.78	4.60%	98.78%	7,209
2005/06	Current	LWC	303.93	-15.69	3.33%	99.44%	6,054
2005/06	Revised	Heathrow	295.83	-15.84	3.47%	99.44%	6,034

- Two gas years were chosen as examples (both had winters slightly warmer than the 78 year average):
- 1996/97 (contained some cold days outside a holiday period)
- 2005/06, the most recent gas year (the coldest days occurred in a holiday period).

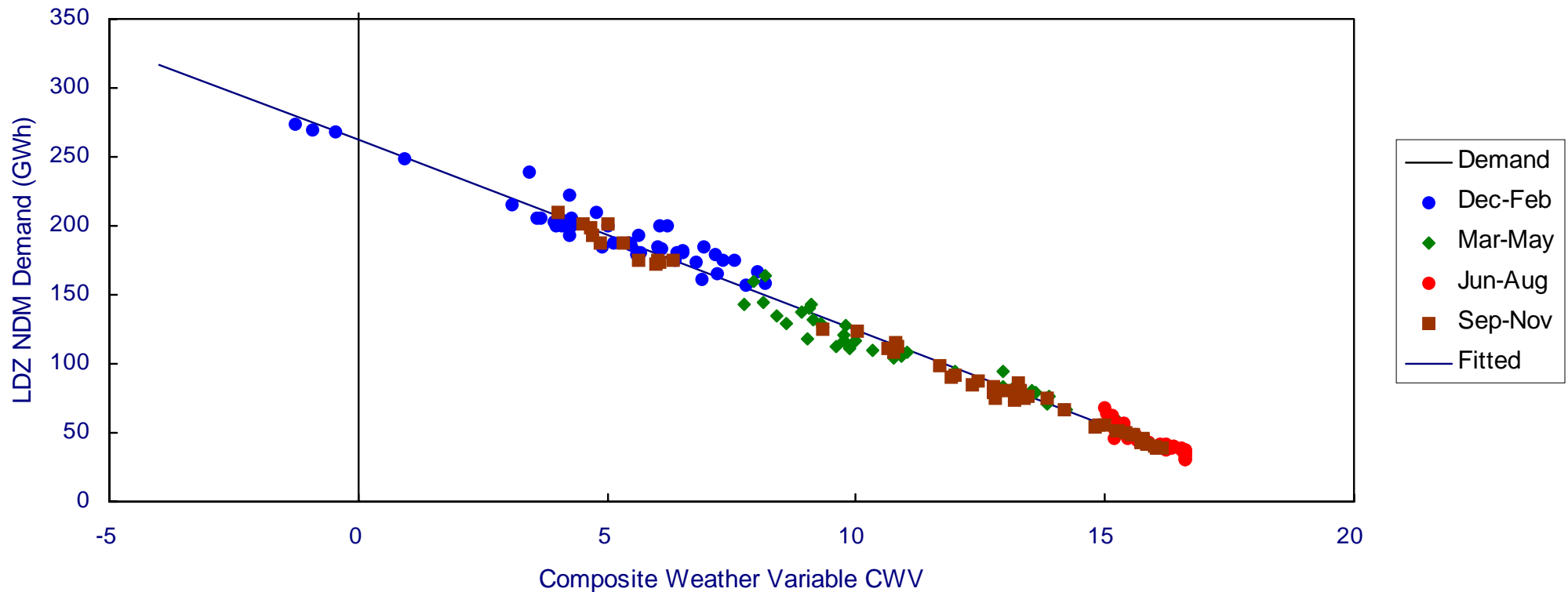
EA LDZ - Example graph for current CWV (1996/97)

Actual and fitted consumption, Monday to Thursday (excl. holidays), modelled using current CWV, 1996/97, EA LDZ



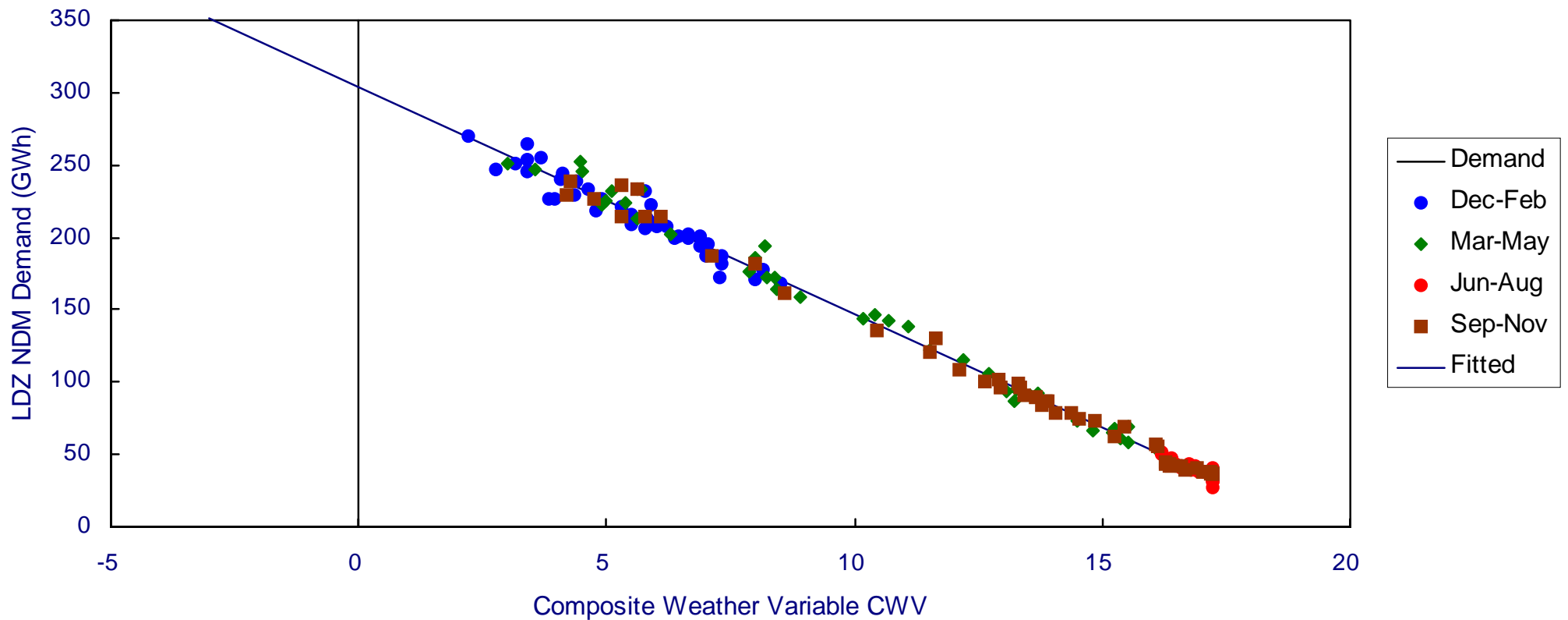
EA LDZ - Example graph for revised CWV (1996/97)

Actual and fitted consumption, Monday to Thursday (excl. holidays), modelled using revised CWV, 1996/97, EA LDZ



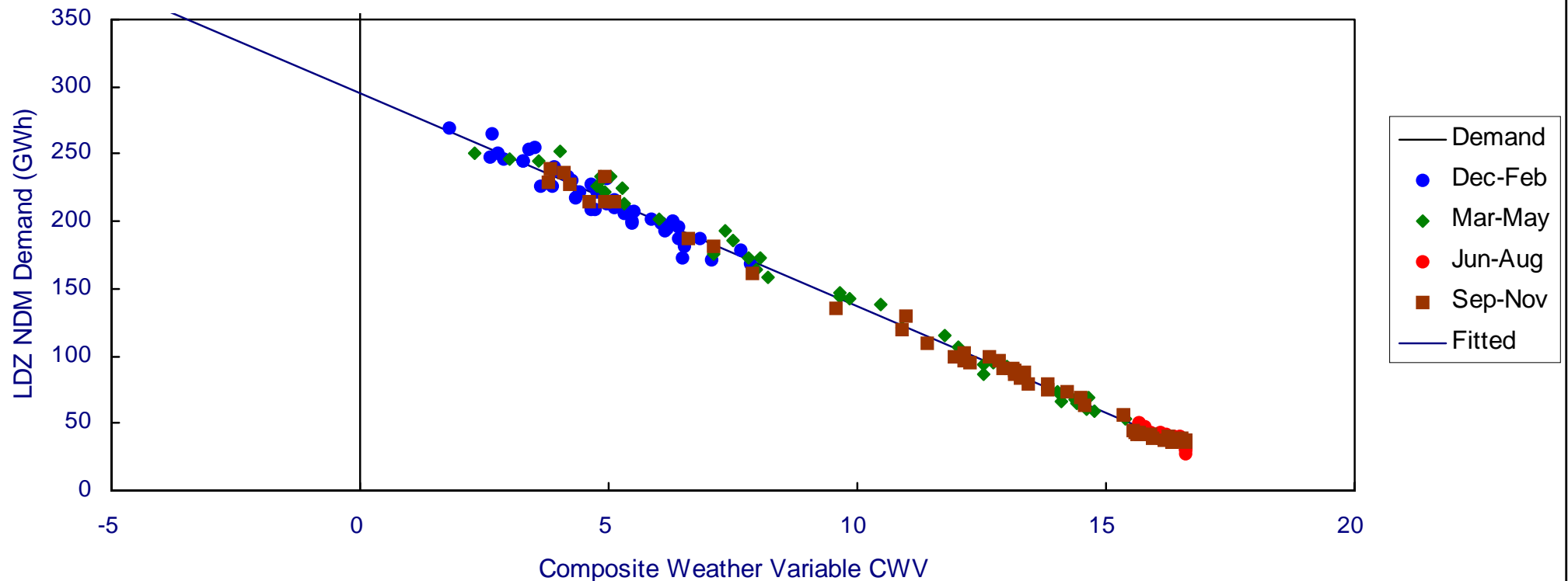
EA LDZ - Example graph for current CWV (2005/06)

Actual and fitted consumption, Monday to Thursday (excl. holidays), modelled using current CWV, 2005/06, EA LDZ

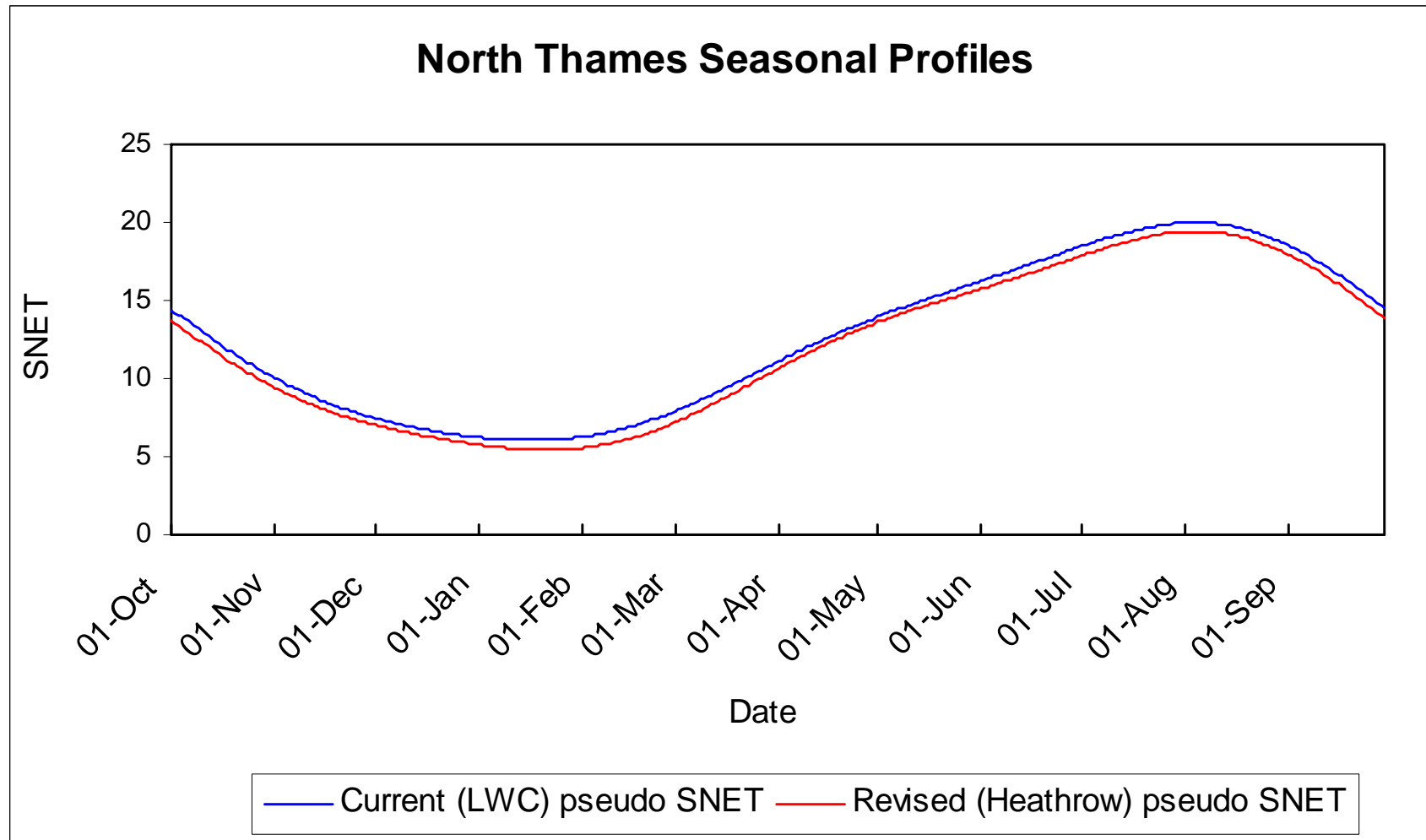


EA LDZ - Example graph for revised CWV (2005/06)

Actual and fitted consumption, Monday to Thursday (excl. holidays), modelled using revised CWV, 2005/06, EA LDZ



NT LDZ - Comparison of pseudo SNET profiles



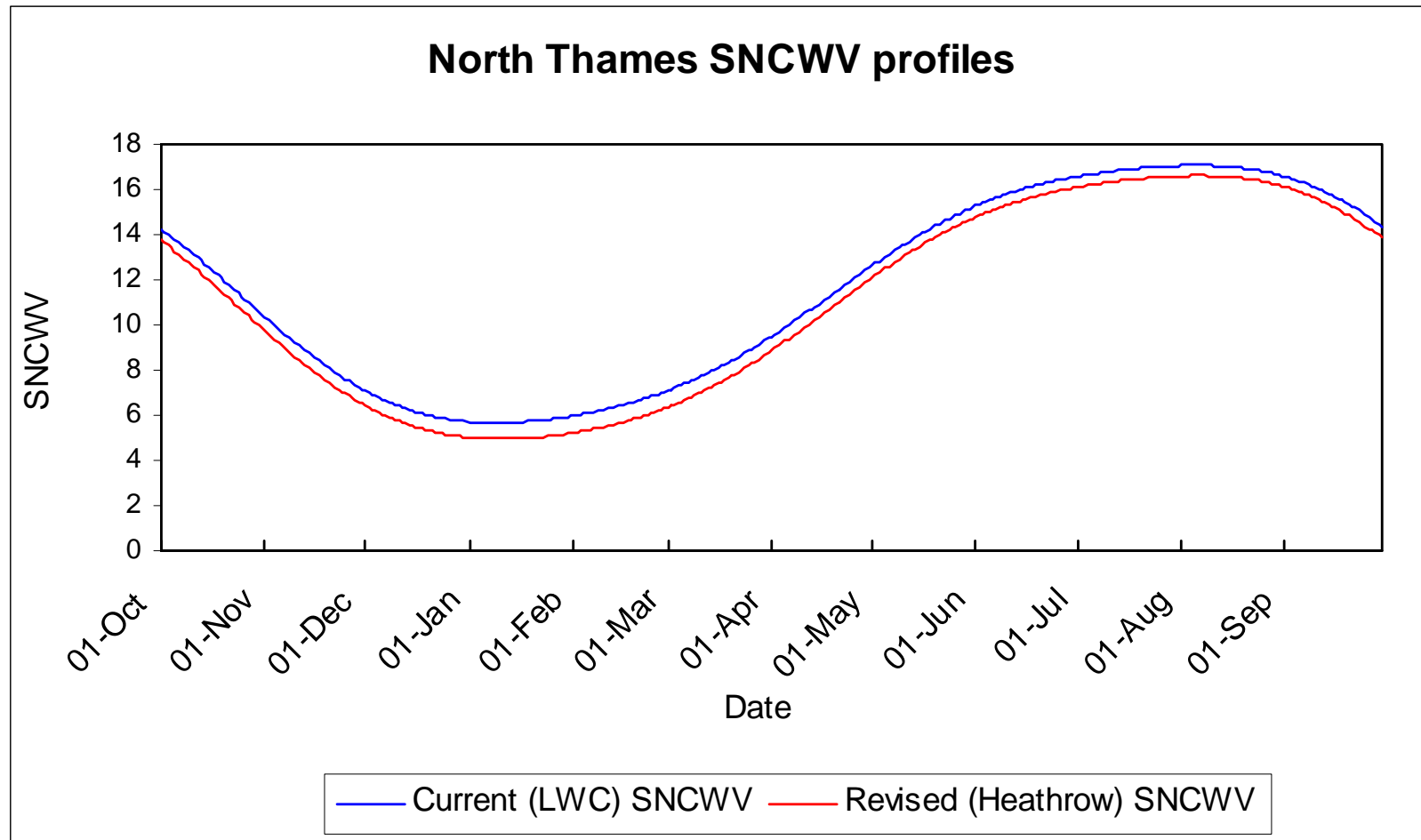
- Values for the revised (Heathrow based) pseudo SNET are lower than the current (LWC based) pseudo SNET.

NT LDZ - Comparison of CWV parameters

CWV	Weather Station	I_1	I_2	I_3	V_0	V_1	V_2	Q
Current	LWC	0.697	0.0125	0.05	3	16.0	20.1	0.30
Revised	Heathrow	0.708	0.0119	0.00	0	15.5	19.6	0.31

- The warm weather cut-offs (V_1 and V_2) are lower for the revised CWV than the current CWV because of the lower summer temperatures and pseudo SNET values at Heathrow.
- Zero cold weather parameters (V_0 and I_3) for the revised CWV.
- The differences in the other parameters are the result of differences in temperatures, wind speeds and pseudo SNET profiles.
- CWV values are generally lower for the revised CWV than the current CWV.

NT LDZ - Comparison of Seasonal Normal CWV profiles



- SNCWV values based on 17 gas years (1987/88 to 2003/04).
- Values for the revised (Heathrow based) SNCWV are lower than for the current (LWC based) SNCWV.

NT LDZ - Comparison of average fit and peaks

CWV	Weather Station	1 in 20 peak CWV	Avg. Mean Abs. % Error	Avg. Adj. R-sq.	Avg. RMSE (MWh)	Avg. % diff. in est. 1 in 20 peak demand
Current	LWC	-3.40	3.30%	99.28%	7,721	-
Revised	Heathrow	-4.52	3.37%	99.26%	7,874	0.86%

- The average statistics were calculated from Monday to Thursday models of aggregate NDM demand (excluding holidays) for 1996/97 to 2005/06.
- The 1 in 20 peak CWV values were calculated from 78 gas years of weather data (1928/29 to 2005/06).
- Estimated 1 in 20 peak aggregate NDM demands were calculated from the demand models and the 1 in 20 peak CWV values.
- The revised CWV produced a very good fit to aggregate NDM demand, almost as good as the current CWV.
- The revised CWV did not significantly alter the estimated 1 in 20 peak aggregate NDM demand.

NT LDZ - Comparison of seasonal fit

CWV	Weather Station	Dec. to Feb.		Mar. to May		Jun. To Aug.		Sep. to Oct.	
		MPRE	MAPE	MPRE	MAPE	MPRE	MAPE	MPRE	MAPE
Current	LWC	0.06%	2.39%	0.08%	4.13%	-0.31%	4.62%	-0.10%	3.54%
Revised	Heathrow	0.10%	2.45%	0.16%	4.26%	0.07%	4.52%	-0.33%	3.61%

- The average statistics by seasonal quarter were calculated from Monday to Thursday models of aggregate NDM demand (excluding holidays) for 1996/97 to 2005/06.
- MPRE = Mean Percentage Residual Error for seasonal quarter

$$= 100 * \frac{\text{avg. actual demand} - \text{avg. fitted demand}}{\text{avg. actual demand}}$$
- MAPE = Mean Absolute Percentage Error for seasonal quarter.
- Like the current CWV, the revised CWV displayed very little seasonal bias (average MPRE close to 0 for all seasonal quarters).
- The seasonal fit for the revised CWV was very good, almost as good as the current CWV.

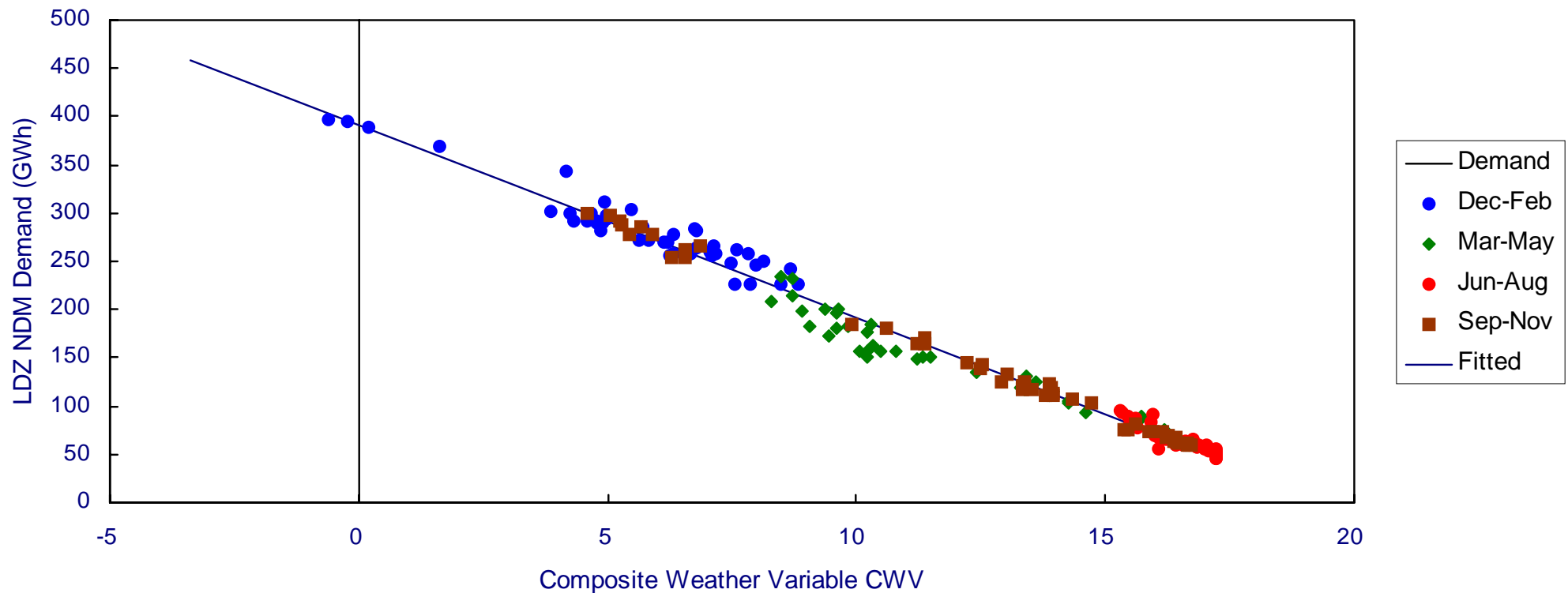
NT LDZ - Example graphs – parameters & statistics

Gas Year	CWV	Weather Station	Demand Intercept (GWh)	CWV Param. (GWh/°)	Mean Abs.% Error	Avg. Adj. R-sq.	Avg. RMSE (MWh)
1996/97	Current	LWC	391.10	-19.95	4.66%	98.66%	10,841
1996/97	Revised	Heathrow	374.08	-19.45	4.57%	98.71%	10,640
2005/06	Current	LWC	405.84	-20.83	3.03%	99.58%	6,930
2005/06	Revised	Heathrow	389.80	-20.48	3.09%	99.55%	7,176

- Two gas years were chosen as examples (both had winters slightly warmer than the 78 year average):
- 1996/97 (contained some cold days outside a holiday period)
- 2005/06, the most recent gas year (the coldest days occurred in a holiday period).

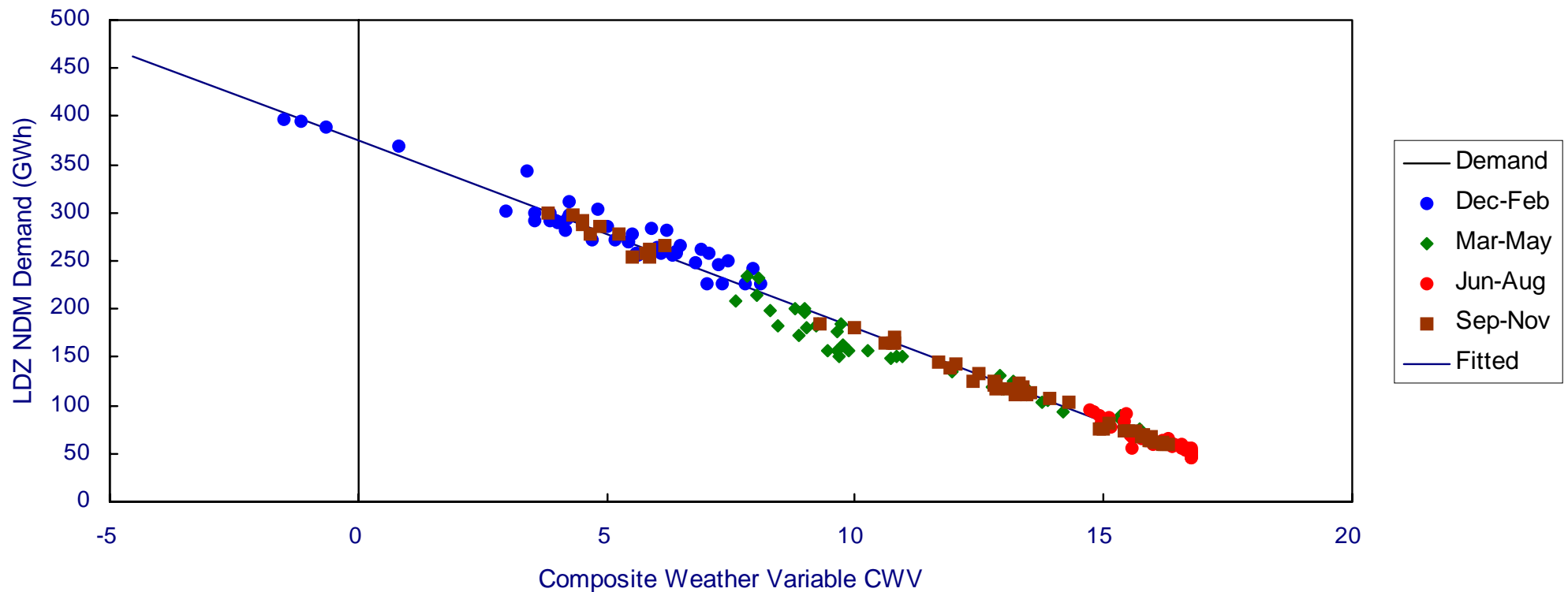
NT LDZ - Example graph for current CWV (1996/97)

Actual and fitted consumption, Monday to Thursday (excl. holidays), modelled using current CWV, 1996/97, NT LDZ



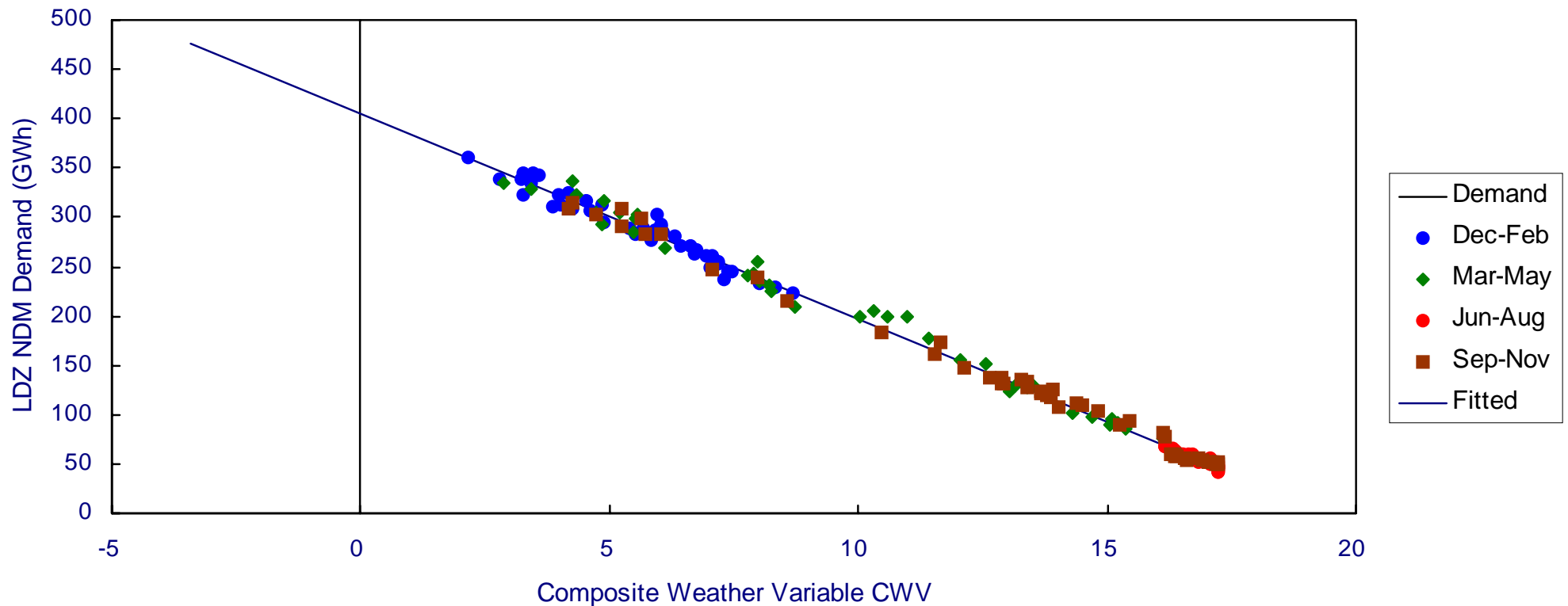
NT LDZ - Example graph for revised CWV (1996/97)

Actual and fitted consumption, Monday to Thursday (excl. holidays), modelled using revised CWV, 1996/97, NT LDZ



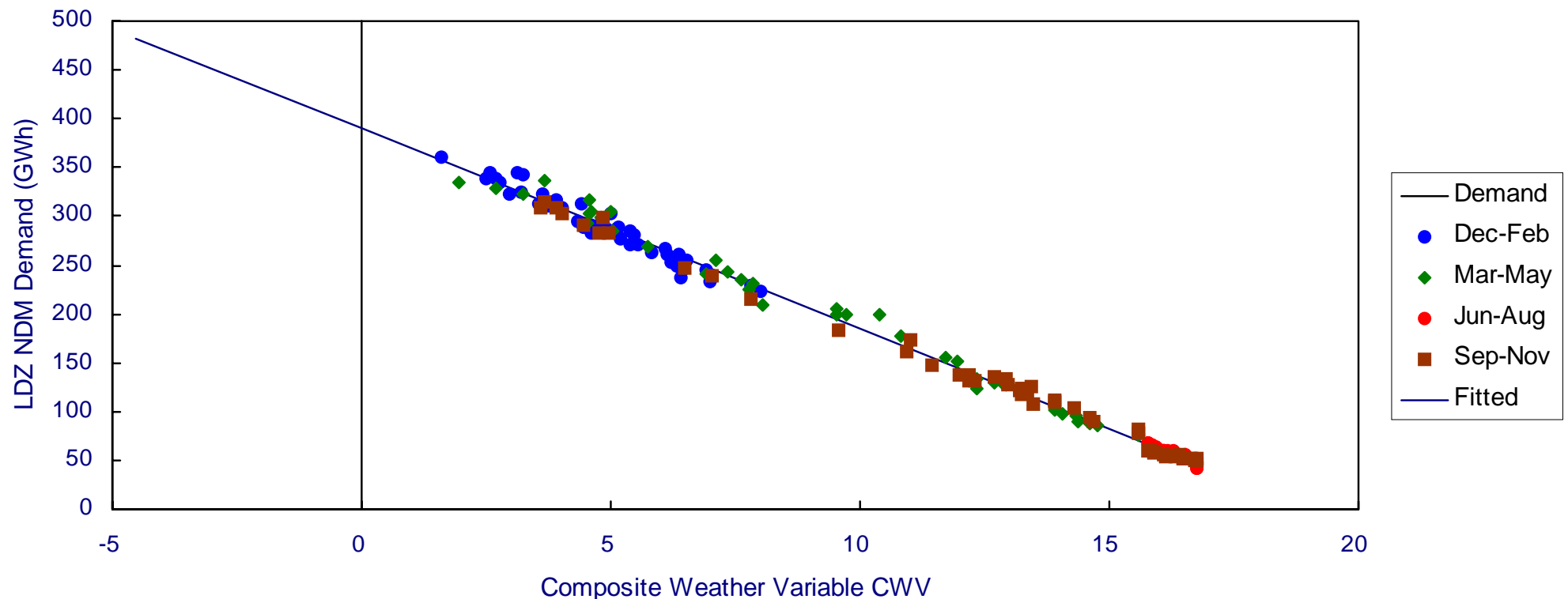
NT LDZ - Example graph for current CWV (2005/06)

Actual and fitted consumption, Monday to Thursday (excl. holidays), modelled using current CWV, 2005/06, NT LDZ

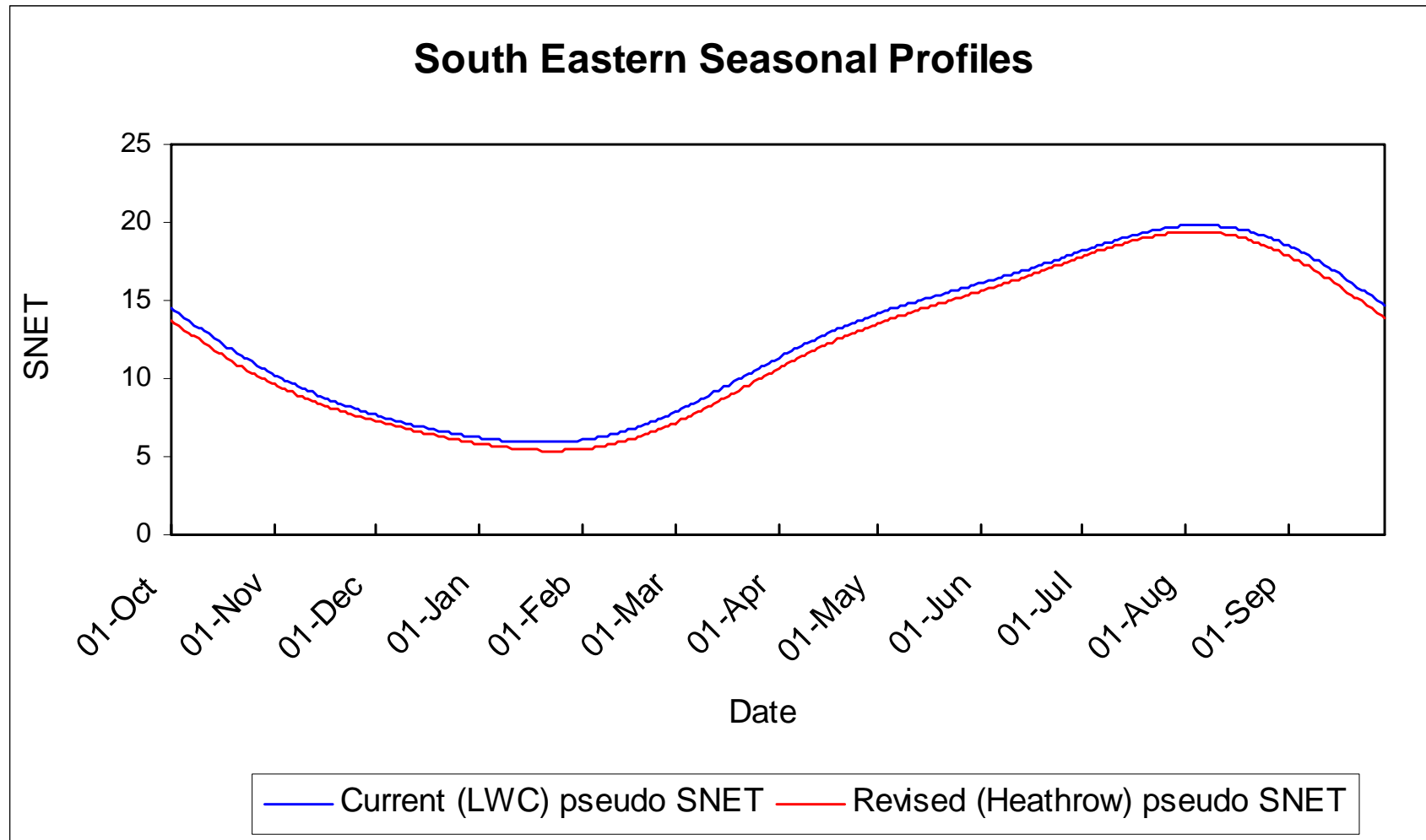


NT LDZ - Example graph for revised CWV (2005/06)

Actual and fitted consumption, Monday to Thursday (excl. holidays), modelled using revised CWV, 2005/06, NT LDZ



SE LDZ - Comparison of pseudo SNET profiles



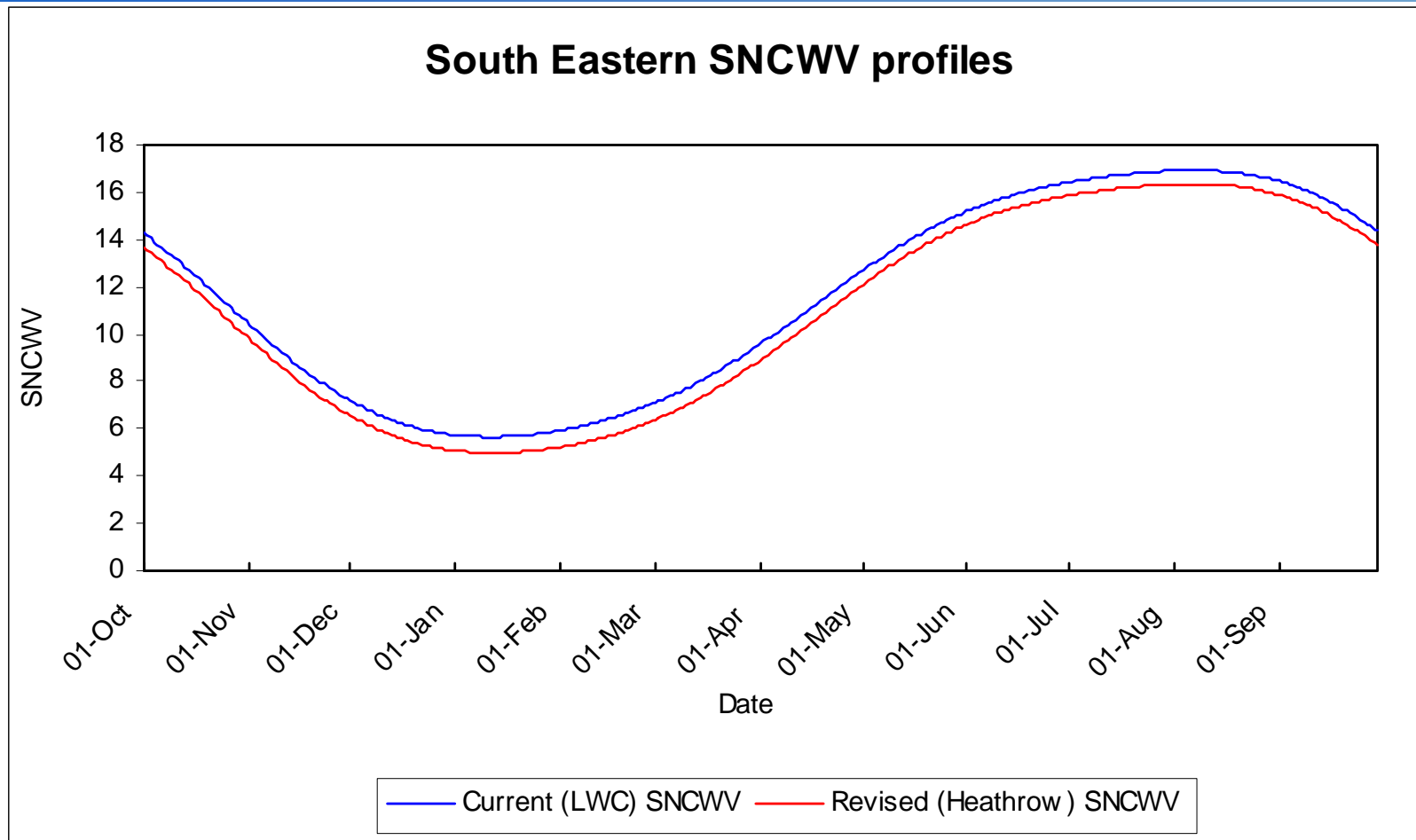
- Values for the revised (Heathrow based) pseudo SNET are lower than the current (LWC based) pseudo SNET.

SE LDZ - Comparison of CWV parameters

CWV	Weather Station	I_1	I_2	I_3	V_0	V_1	V_2	Q
Current	LWC	0.692	0.0120	0.09	3	15.6	19.3	0.38
Revised	Heathrow	0.688	0.0113	0.04	3	14.9	18.8	0.39

- The warm weather cut-offs (V_1 and V_2) are lower for the revised CWV than the current CWV because of the lower summer temperatures and pseudo SNET values at Heathrow.
- Smaller cold weather upturn parameter (I_3) for the revised CWV.
- The differences in the other parameters are the result of differences in temperatures, wind speeds and pseudo SNET profiles.
- CWV values are generally lower for the revised CWV than the current CWV.

SE LDZ - Comparison of Seasonal Normal CWV profiles



- SNCWV values based on 17 gas years (1987/88 to 2003/04).
- Values for the revised (Heathrow based) SNCWV are lower than for the current (LWC based) SNCWV.

SE LDZ - Comparison of average fit and peaks

CWV	Weather Station	1 in 20 peak CWV	Avg. Mean Abs. % Error	Avg. Adj. R-sq.	Avg. RMSE (MWh)	Avg. % diff. in est. 1 in 20 peak demand
Current	LWC	-3.49	3.74%	99.20%	8,064	-
Revised	Heathrow	-4.43	3.82%	99.17%	8,258	0.81%

- The average statistics were calculated from Monday to Thursday models of aggregate NDM demand (excluding holidays) for 1996/97 to 2005/06.
- The 1 in 20 peak CWV values were calculated from 78 gas years of weather data (1928/29 to 2005/06).
- Estimated 1 in 20 peak aggregate NDM demands were calculated from the demand models and the 1 in 20 peak CWV values.
- The revised CWV produced a very good fit to aggregate NDM demand, almost as good as the current CWV.
- The revised CWV did not significantly alter the estimated 1 in 20 peak aggregate NDM demand.

SE LDZ - Comparison of seasonal fit

CWV	Weather Station	Dec. to Feb.		Mar. to May		Jun. To Aug.		Sep. to Oct.	
		MPRE	MAPE	MPRE	MAPE	MPRE	MAPE	MPRE	MAPE
Current	LWC	-0.05%	2.71%	0.40%	4.67%	-0.32%	5.64%	-0.26%	3.97%
Revised	Heathrow	-0.02%	2.81%	0.32%	4.71%	0.55%	5.67%	-0.44%	4.07%

- The average statistics by seasonal quarter were calculated from Monday to Thursday models of aggregate NDM demand (excluding holidays) for 1996/97 to 2005/06.
- MPRE = Mean Percentage Residual Error for seasonal quarter

$$= 100 * \frac{\text{avg. actual demand} - \text{avg. fitted demand}}{\text{avg. actual demand}}$$
- MAPE = Mean Absolute Percentage Error for seasonal quarter.
- Like the current CWV, the revised CWV displayed very little seasonal bias (average MPRE close to 0 for all seasonal quarters).
- The seasonal fit for the revised CWV was very good, almost as good as the current CWV.

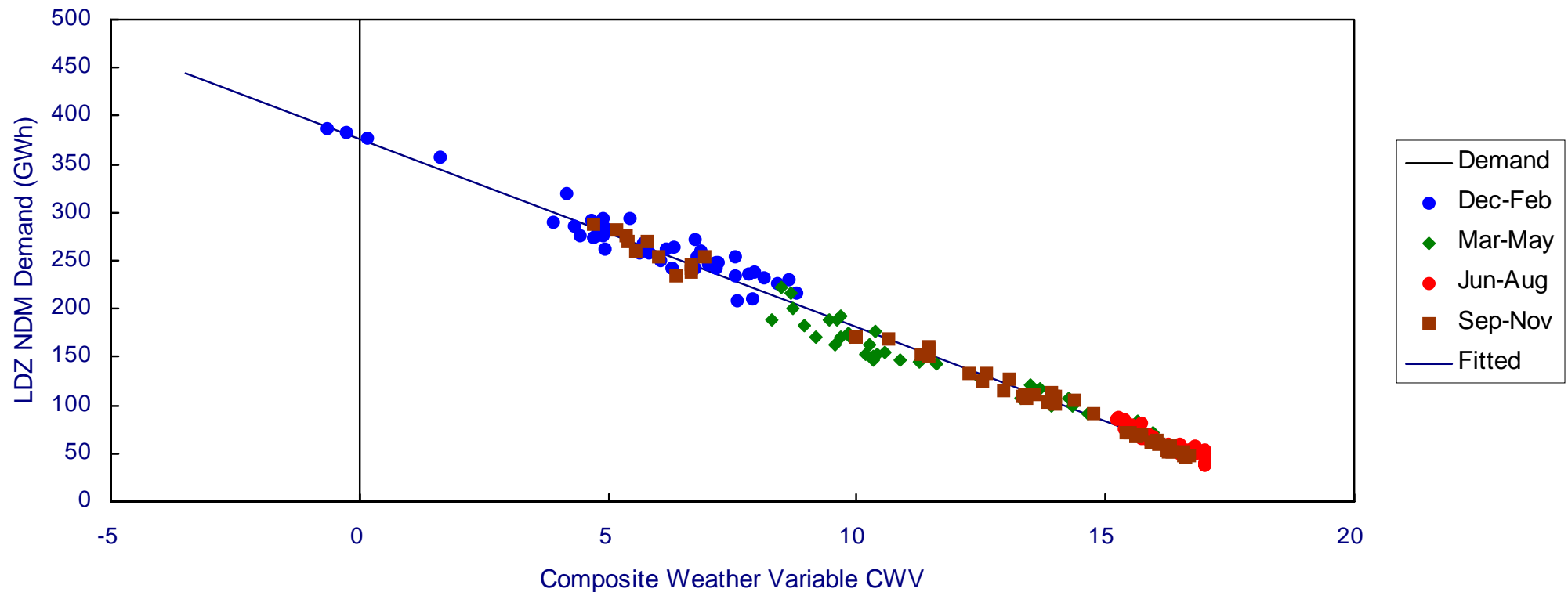
SE LDZ - Example graphs – parameters & statistics

Gas Year	CWV	Weather Station	Demand Intercept (GWh)	CWV Param. (GWh/°)	Mean Abs.% Error	Avg. Adj. R-sq.	Avg. RMSE (MWh)
1996/97	Current	LWC	375.48	-19.47	5.05%	98.74%	10,147
1996/97	Revised	Heathrow	360.98	-19.23	5.03%	98.75%	10,083
2005/06	Current	LWC	404.24	-21.30	3.67%	99.46%	7,939
2005/06	Revised	Heathrow	390.33	-21.24	3.60%	99.44%	8,068

- Two gas years were chosen as examples (both had winters slightly warmer than the 78 year average):
- 1996/97 (contained some cold days outside a holiday period)
- 2005/06, the most recent gas year (the coldest days occurred in a holiday period).

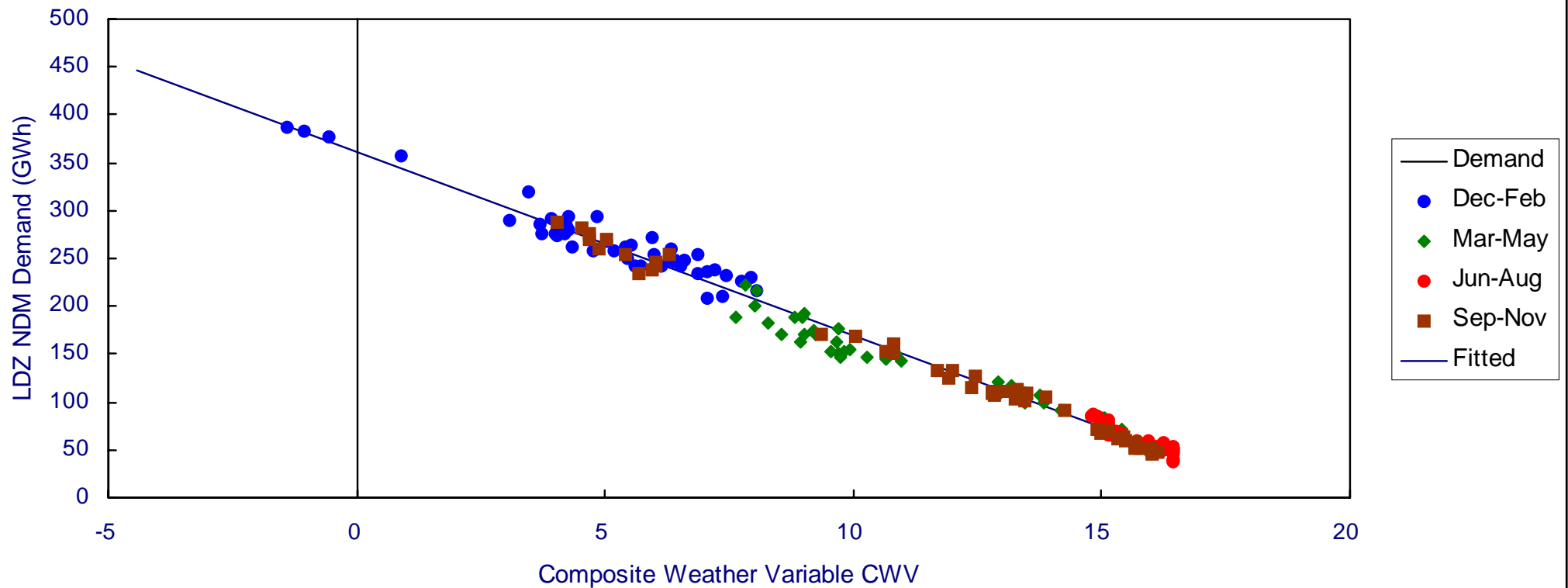
SE LDZ - Example graph for current CWV (1996/97)

Actual and fitted consumption, Monday to Thursday (excl. holidays), modelled using current CWV, 1996/97, SE LDZ



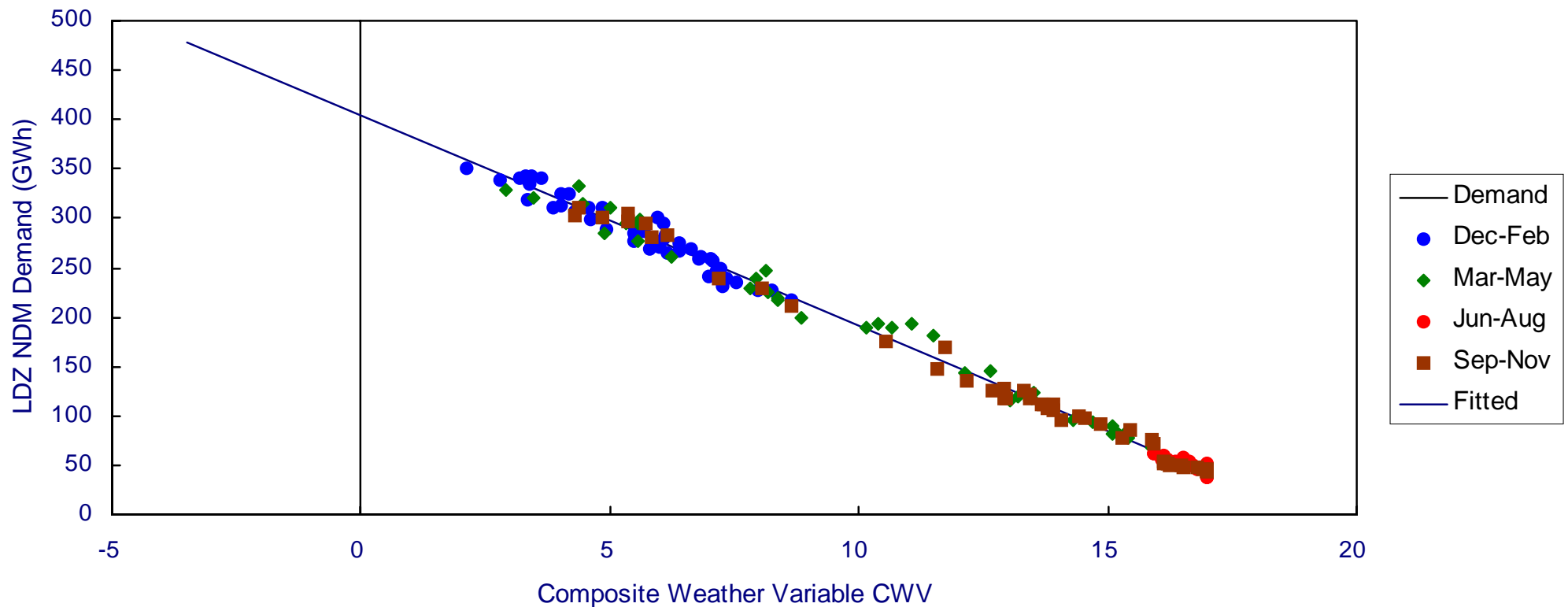
SE LDZ - Example graph for revised CWV (1996/97)

Actual and fitted consumption, Monday to Thursday (excl. holidays), modelled using revised CWV, 1996/97, SE LDZ



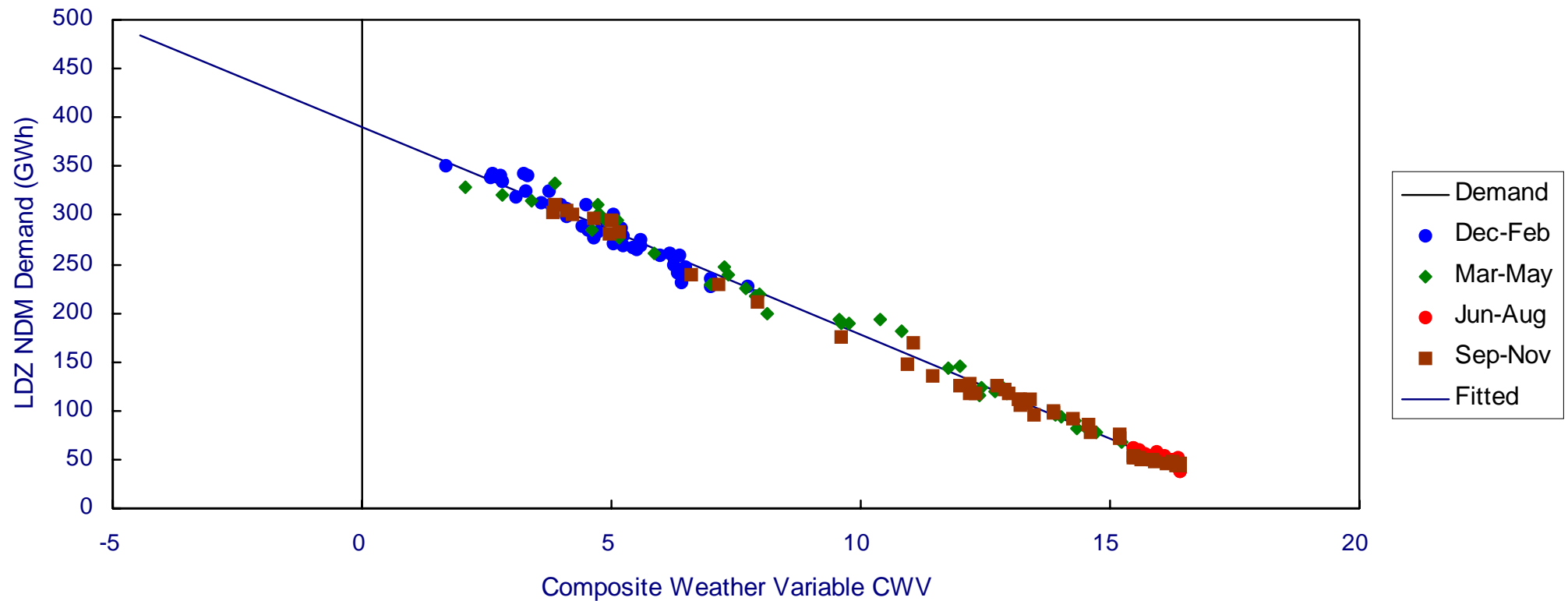
SE LDZ - Example graph for current CWV (2005/06)

Actual and fitted consumption, Monday to Thursday (excl. holidays), modelled using current CWV, 2005/06, SE LDZ



SE LDZ - Example graph for revised CWV (2005/06)

Actual and fitted consumption, Monday to Thursday (excl. holidays), modelled using revised CWV, 2005/06, SE LDZ



Summary

- Revised CWVs based on Heathrow data have been derived for 3 LDZs.
 - To be used in the spring 2007 NDM analysis and implemented on 1st October 2007.
 - Produce a very good fit to aggregate NDM demand, almost as good as the current CWVs in all 3 LDZs.
 - NT and SE LDZs did not significantly alter the estimated 1 in 20 peak aggregate NDM demand.
 - Little seasonal bias & a good seasonal fit to demand in all 3 LDZs.
- For EA LDZ, the increase (1.8%) in estimated 1 in 20 peak NDM demand for the revised CWV is smaller than the recent drop in AQ observed for this LDZ (3.2%).
- The very small reduction in fit for the revised CWVs may indicate that at Heathrow the weather is slightly less representative of the conditions experienced by the main centres of demand in the 3 LDZs.