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# Demand Estimation Technical Forum

10<sup>th</sup> June 2011



# Agenda

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- Overview of Demand Estimation & Timetable
- Presentation of Current Completed Analysis
  - Modelling Basis
  - Small NDM – sample details, aggregations, initial models
  - Large NDM – sample details, aggregations, initial models
- Recommendations

# Scope of NDM Demand Estimation

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- Provides a method to differentiate NDM loads and provide profiles of usage  
i.e. End User Category (EUC) Definitions
- Provide a reasonable equitable means of apportioning aggregate NDM demand (by EUC / shipper / LDZ) to allow daily balancing regime to work  
i.e. NDM profiles (ALPs & DAFs)
- Provide a means of determining NDM Supply Point capacity  
i.e. NDM EUC Load Factors
- The underlying NDM EUC and aggregate NDM demand models derived each year are intended to deliver these obligations only

# Scope of NDM Demand Estimation

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- NDM EUC profiles are used to apportion aggregate NDM demand
- The profiles do not independently forecast NDM EUC demand
- Any forecasting that happens is only of aggregate NDM demand (Forecast LDZ Demand – Sum of DM Nominations)
- LDZ Demand Forecast comes from the short term demand forecasting processes
- Demand models of aggregate NDM and of EUCs, derived for NDM demand estimation, are not suitable for short term demand forecasting - this is not their intended purpose
- The models are fit for their intended purpose of deriving profiles to make the apportionment process work and deriving load factors

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## Consultation Process : NDM Demand Models & EUCs

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- 10 June      Technical Forum / DESC meeting      (H 1.8.1)  
(To guide analysis)
  - 30 June      NDM draft proposals published by now      (H 1.8.1)
  - 15 July      Users make representation by now      (H 1.8.3)  
Consultation (DESC meeting 29 July)      (H 1.8.4/5/6)
  - 15 Aug      Final proposals published by now      (H 1.9.1)
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- Transporters' Final proposals published (*date X*)  
- No later than 15 August
- Transporter or User application for disapproval to Ofgem (*date Y*)  
- by 5 business days of *date X*
- Ofgem determination (if required)  
- by 5 business days of *date Y*

## Spring 2011 – Ongoing analysis

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- UNC obligation to consult and seek agreement with DESC in June on ongoing analysis of latest available data sets
- Key objective of Technical Forum:
  - Inform DESC of numbers of validated data sets collected
  - Consider the most appropriate data sets and aggregations to apply to the most recently available sample data - i.e. 2010/11
- Validation and analysis for **Small NDM** (up to 2196 MWh pa) and **Large NDM** (> 2196 MWh pa) are considered separately

# Modelling Basis 1

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- Key aspects of EUC demand modelling basis for Spring 2011 analysis:
  - Model smoothing (over 3 years) retained
    - More robust: minimises year on year volatility (Load Factors, profiles shapes)
  - Variable weekend weather sensitivity model
  - Warm-weather cut-offs not applied to EUC models < 293 MWh pa
    - To help mitigate the identified impact of summer Scaling Factor volatility
  - 12 month analysis for datalogger data sets (2010/11)
    - Data sets cover April to March (as in 2009/10)
  - 12 month analysis for datarecorder data sets (2010/11)
    - Data sets always cover mid-March to mid March
  - Holiday codes applicable to Christmas / New Year period revised since Spring 2010 (changes agreed at the November 2010 DESC meeting)
  - CWV definitions and SN basis same as Spring 2010

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## Modelling Basis 2

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- Aggregate NDM demand models:
  - Historical aggregate NDM demand models based on data from 3 previous gas years will be used to compute DAFs
  - Previous practice has used results from a forecast model for the target gas year
  - UNC does not explicitly state the aggregate NDM demand value should be based on a forecast or historical model
  - Accordingly, for NDM proposals 2011/12 the aggregate NDM models used are models obtained from the average of 3 previous gas years aggregate NDM data modelled against weather (2007/08, 2008/09, 2009/10)
  - The historical model has been applied to the appropriate day of the week and holiday pattern of the target gas year 2011/12 - no forecast element added to the model



# Modelling Basis 3

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- All demand modelling is data driven – intention to model based on the sampled data
- If the modelling results indicate then:
  - Holiday & Weekend Factors, Summer Reductions & CWV Cut-Offs will be applied
  - As defined in the methodology presented to DESC in February
- 3 year Model smoothing removes the impact of any extreme instances during a single year
- DESC confirmed in November 2009 to continue to apply model smoothing
  - Next assessment of model smoothing due in Autumn 2011

# Modelling Basis 4

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- Summer reductions can apply to EUC models over the period 3<sup>rd</sup> June to 30<sup>th</sup> September 2012 (Spring Bank Holiday Monday to last Sunday in September)
  - Applied by modelling results over 3 years
- Applies along with the more general summer holiday period in July and August
- Warm Weather Cut-offs are not applied to EUCs <293 MWh pa.
  - Cut-offs increase summer Scaling Factor volatility
  - Therefore no cut-off is placed on warm weather demand reduction in EUC models representing 80% of NDM load
  - Any cut-offs are based on modelling results from 3 years
- Modelling methodology described in NDM Report (Appendices 3 & 4)

# Comparing Data and Model Accuracy / Appropriateness

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- The Technical Forum offers a comparison of data and profiles for analysis
- Analysis:
  - Create profiles of the relationship of demand to weather
  - Identify the best fit profile based on available data samples
  - Identifies and addresses any significant instances of change year-on-year
- Tools used to identify best model ('goodness of fit' of profile):
  - Root Mean Squared Error and  $R^2$  – statistical tool for identifying 'goodness of fit' (100% perfect fit / direct relationship)
  - Variations in Indicative Load Factors.....

# Indicative Load Factors (ILF) & Load Factors (LF)

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- ILF used to compare variations in models
  - $LF = \text{average daily demand (i.e AQ/365)} / 1 \text{ in } 20 \text{ peak demand}$
  - $ILF = (AQ/365) / \text{model demand corresponding to } 1 \text{ in } 20 \text{ CWV}$
- ILF based on available 1 in 20 CWV against demand to create replicated LF
- ILFs are only used to compare prospective demand models as an aid to making decisions on model choice
- ILFs are not the same as proper LFs and their values are not an indicator of the values of proper LFs (ILFs not used for determining NDM capacities).
- There should be distinguishable ILF values between consumption and WAR bandings

## Winter to Annual Ratio (WAR) Band EUCs

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- The WAR value of a supply point is defined as the actual consumption in the months December to March divided by the supply point AQ.
- Since the numerator is an actual demand and the denominator a weather corrected annual consumption, WAR values change from year to year.
- For consumption ranges over which meter points are monthly read, EUCs may be defined on the basis of WAR values as well as consumption band and LDZ.
- The limits defining WAR band EUCs are those applicable to the most recent winter (in this case winter 2010/11).
- This is essential because supply points will be assigned to these newly defined WAR band EUCs (for 2011/12) based on their (Dec-Mar) consumption behaviour over winter 2010/11.

## WAR Band Basics

- In each consumption range, WAR band EUCs sub-divide the range in to subsets of different weather sensitivity
  - WAR band 1 is the least weather sensitive and WAR band 4 is the most weather sensitive.
- WAR values are affected by December to March weather experience:
  - 2010/11 and 2009/10 were cold, however Winter 2010/11 was slightly less cold than Winter 2009/10 overall.
- When setting WAR band limits, the approach adopted is to aim for a 20%:30%:30%:20% split of sample numbers on a national basis.
- There are practical limitations due to the actual distribution of WAR values of individual sample supply points in the consumption band.
- Must also have reasonably robust sample sizes in the ensuing data sets.
- Post-modelling sense check of clear spread in WAR band EUC load factors helps confirm appropriateness of limits.

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# Small NDM Analysis <2,196 MWh

# Small NDM

- Small NDM for Demand Estimation purposes <2,196,000 kWh
- Represents 90% of total NDM load (74% <73,200) and 99.97% of all supply points
- EUC consumption ranges not prescribed in Uniform Network Code
  - Process to analyse most appropriate small NDM EUC bands
  - Split consumption range – test profiles (regression analysis, ‘goodness of fit’)
- Purpose of analysis:
  - Present validated sample data available and proposed data sets
  - View of results so far, proposed EUCs and proposed aggregations
  - Highlight any issues raised



## Data Available: Small NDM Data Recorders / AMR devices

Active Data Recorders at 17/03/10	4,143
Previous 12 Months:	
• Net change in sample (commissions / closures)	+83
Active AMR equipment at 16/03/11	4,226
Data Recorders / AMRs with data successfully gathered	3,604
Total No. of Validated Data Recorders / AMRs	<u>3,484</u>
Total No. of Validated Supply Points (3,612 Spring 2010)	<u>3,484</u>
<i>(2,809 classified Domestic &amp; in 0-73.2 MWh pa range. 544 in the 73.2-293 MWh pa range)</i>	

- 120 data recorders / AMRs failed validation - missing days / consecutive zeros / spikes
- 3484 data recorders / AMRs available for analysis – net decrease of 128 compared to 2010

## Data Available: Small NDM Dataloggers

- Data Recorders / AMRs & Dataloggers used in Small NDM Analysis (<2,196 MWh pa)
- Small NDM Datalogger Counts:

Total Number of Small NDM Validated Dataloggers	6,261
Total Number of Validated Supply Points:	5,334 (5,482)
73.2 to 293 MWh pa Range (Combined with Datarecorders: 1,150)	606 (660)
293 to 2,196 MWh pa Range	4,728 (4,822)

- 2010 highlighted in (x)

## Small NDM: Proposed Data Sets For Analysis

Consumption Range	Sample Data Used	Supply Point Count
0 to 73.2 MWh pa (EUC Band 1)	12 Months Data Recorder / AMR Data	2,809 Supply Points <i>(Domestic sub-set)</i>
73.2 to 293 MWh pa (EUC Band 2)	12 Months Combined Data Recorder & Datalogger Data	1,150 Supply Points
293 to 2,196 MWh pa (EUC Band 3 & 4)	12 Months Datalogger Data	4,728 Supply Points

- Small NDM Analysis undertaken at individual LDZ level
- Band 1 decreased (100) Bands 2 to 4 decreased (152)
- However still sufficient sample data to allow analysis

## Small NDM Investigations

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- Current EUC Bands Small NDM (not defined in UNC):
  - 0 – 73.2 MWh pa
  - 73.2 – 293 MWh pa
  - 293 – 732 MWh pa
  - 732 – 2,196 MWh pa
- Appropriateness of Small NDM EUC bandings investigated
  - Analysis in 2010 - no significant reason for changing the EUC bandings from 'current'
  - 2011 Investigates:
    - Split Band 2 at 145 MWh pa
    - Split Band 4 at 1,465 MWh pa
- Spring approach document confirmed Band 01B would be modelled as one band using 'domestic' only data to current band definitions – informed by previous analysis (Autumn 2007 and 2008)

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# Representing 0 - 73.2 MWh pa Previous Analysis

- Spring 2007 NDM analysis, 0-73.2 MWh pa consumption range:
  - Sample sub-divided by LDZ rather than by consumption sub-band (4 bands: 0-10,10-20,20-30,30-73.2 MWh pa)
- Autumn 2007 analysis
  - Investigated splitting 0-73.2 consumption band at 20 MWh pa and 30 MWh pa
    - i.e. 0-20 and 20-73.2 and 0-30 and 30-73.2
- Autumn 2008 analysis
  - Investigated splits of the 0-293 MWh pa range at 30 and 60 MWh pa
    - i.e 0-30 and 30-293 and 0-60 and 60-293
- January 2009 analysis
  - Applying band 01 profiles to domestics in band 02 and applying band 02 profiles to non domestics in band 01
- In all cases there were no compelling statistical grounds to change current arrangements for 0-73.2 band - All results available on Joint Office website

# Representing 0 - 73.2 MWh pa Additional Analysis

- Although Spring Approach confirmed methodology for how 0-73.2 would be modelled additional analysis has been carried out.
- Analysis performed in Spring 2007 has been redone using the 2010/11 data i.e:
  - Sample sub-divided by consumption sub-band (4 bands: 0-10,10-20,20-30,30-73.2 MWh pa)
  - Analysis performed at National level to ensure sufficient sample sizes
  - Results showed ILF differences more significant across individual LDZs (i.e. current method) than sub-bands (Slide 26)
- Analysis also performed using 4 additional non-domestic supply points in each individual LDZ
  - This equates to similar make-up of 0-73.2 population based on Market Sector Flag (MSF)
  - Of sites where MSF populated - 1.84% were non domestic (March 2011)  
6 million MSF remain unpopulated.
  - Results showed little difference in ILFs (Slide 27)
  - Potential effects on weekend Scaling Factors would need to be considered (Slide 28)

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## Representing 0 - 73.2 MWh pa – SF effects

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- Post Mod 204, daily SF values (weekday and weekend) are closer to one.
- Gas year 2009/10 WCF/ SF analysis (presented at the November 2010 DESC meeting) indicates weekend (Fri / Sat / Sun) SF offsets from one have moved in line with weekday (Mon to Thu) offsets from one.
- Similar SF patterns for gas year 2010/11 (to date).
- “01B” profiles for gas years 2009/10 and 2010/11 (and previous years) were based on domestic supply points only.
- Inclusion of a proportion of non-domestic sample points would lead to lower positive or even negative weekend factors in the resulting “01B” models.
- This would lead to weekend SF offsets from one diverging away from weekday values.

# Small NDM Indicative Load Factors

(0 – 73.2 MWh pa Sample Sets: Domestic Sites Only)

	PROPOSED - Dataset: Domestic Sites Only		
SC	37%	99%	204
NO	33%	98%	223
NW / WN	34%	99%	226
NE	35%	98%	248
EM	34%	99%	244
WM	31%	99%	227
WS	32%	98%	246
EA	32%	99%	252
NT	32%	99%	213
SE	31%	99%	213
SO	29%	99%	259
SW	30%	99%	254

- Indicative Load Factor :  $R^2$  Multiple Correlation Coefficient : Sample Size

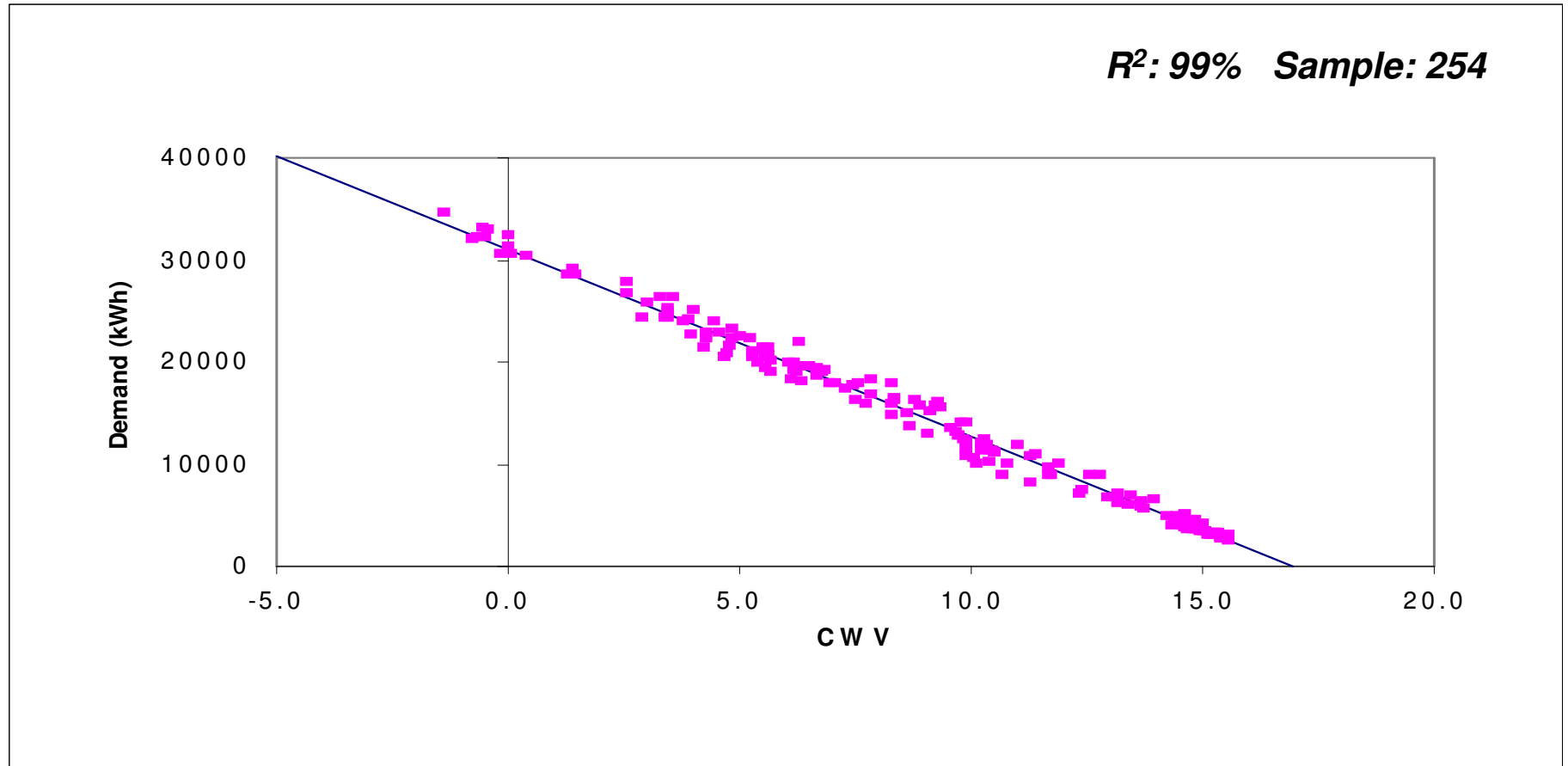
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# Demand against CWV, Monday to Thursday, holidays included, SW LDZ, 0 - 73.2 MWh pa



- Example of 'well behaved' data & excellent fit for Band 1



# Small NDM Indicative Load Factors

## 0 – 73.2 MWh pa Sub Band Analysis at National Level

	Results from Consumption Sub Band models with 2010/11 data Domestic Only datasets			
0-73.2 MWh pa	33%	99%	2809	100%
0-10 MWh pa	31%	97%	634	10.9%
10-20 MWh pa	32%	98%	1378	44.8%
20-30 MWh pa	33%	98%	494	26.4%
30-73.2 MWh pa	35%	98%	303	17.9%

• *Indicative Load Factor* : *R<sup>2</sup> Multiple Correlation Coefficient* : *Sample Size* : *Population AQ %*

▪ ILF spread across sub-bands 31-35% vs spread of 29-37% across individual LDZs. Sample better deployed for modelling as individual LDZs.

▪ Modelling at sub-band level would also require LDZs to be grouped to ensure sufficient sample numbers were available.



# Small NDM Indicative Load Factors

(0 – 73.2 MWh pa Sample Sets: Domestic Sites Only & Incl. Some Non-Domestic Sites)

	PROPOSED - Dataset: Domestic Sites Only			Dataset: Including Some Non-Domestic Sites		
SC	37%	99%	204	37%	99%	208
NO	33%	98%	223	33%	99%	227
NW / WN	34%	99%	226	35%	99%	230
NE	35%	98%	248	35%	98%	252
EM	34%	99%	244	33%	99%	248
WM	31%	99%	227	31%	99%	231
WS	32%	98%	246	33%	98%	250
EA	32%	99%	252	32%	99%	256
NT	32%	99%	213	32%	99%	217
SE	31%	99%	213	30%	99%	217
SO	29%	99%	259	29%	99%	263
SW	30%	99%	254	30%	99%	258

- *Indicative Load Factor* :  $R^2$  *Multiple Correlation Coefficient* : *Sample Size*

# EUC Band 01B – Smoothed Model Results

	Smoothed Model based on Domestic Only data sets				Smoothed Model based on Domestic Only data sets including some non domestic			
	(Const.)	(Fri)	(Sat)	(Sun)	(Const.)	(Fri)	(Sat)	(Sun)
SC	24822	144	221	247	26502	125	54	54
NO	23604	240	331	371	25039	338	99	22
NW / WN	27015	116	334	254	28523	69	22	-118
NE	27104	180	255	416	28180	469	212	182
EM	26141	123	256	324	27479	78	14	68
WM	26203	200	367	377	27601	178	337	312
WS	30814	147	161	176	31779	241	283	272
EA	32025	75	299	317	33320	70	179	179
NT	29543	0	177	255	30723	77	212	43
SE	24544	36	287	378	26080	11	281	379
SO	33905	17	223	344	35691	-67	-52	8
SW	31081	133	203	250	32725	140	198	219

- With some non-domestic in the samples:  
 Weekend factors are generally less positive and four negative  
 Will adversely impact weekend Scaling Factor offsets

# Representing 0 - 73.2 MWh pa – Proposed Approach

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- Consequences of using smoothed models derived for EUC Band 01B with data sets containing non-domestic data will have adverse impact on weekend SF offsets from one.
- Proposed approach is:
  - Domestic supply point only smoothed model for 0 – 73.2 MWh band:
    - Consistently positive Fri/Sat/Sun weekend factors in smoothed model
    - Consistent with previous years analysis and approach

# Small NDM Indicative Load Factors:

73.2 to 293 MWh pa (Band 2) Split At 145 MWh pa

		Consumption Band								
		73.2 TO 293 MWh pa (NO SPLIT)			73.2 TO 145 MWh pa (SPLIT at 145)			145 TO 293 MWh pa (SPLIT at 145)		
Data Aggregation	SC	36%	98%	86	38%	98%	42	35%	96%	44
	NO / NW / WN	30%	96%	218	33%	96%	99	29%	95%	119
	NE / EM / WM	30%	97%	281	31%	97%	152	29%	96%	129
	EA / NT / SE	32%	97%	355	32%	98%	163	31%	97%	192
	WS / SO / SW	29%	98%	210	30%	98%	124	28%	97%	86

• Indicative Load Factor :  $R^2$  Multiple Correlation Coefficient : Sample Size

- Analysis undertaken on Band 2 split at 145 MWh pa
- Impact - Aggregated LDZs required to allow sufficient sample analysis

# Small NDM Historical Indicative Load Factors:

73.2 to 293 MWh pa (Band 2) Split At 145 MWh pa

	2010/11		2009/10		2008/09	
	73.2 to 145 MWh pa	145 to 293 MWh pa	73.2 to 145 MWh pa	145 to 293 MWh pa	73.2 to 145 MWh pa	145 to 293 MWh pa
SC	38%	35%	41%	39%	43%	37%
NO / NW / WN	33%	29%	32%	31%	32%	30%
NE / EM / WM	31%	29%	31%	29%	30%	29%
EA / NT / SE	32%	31%	33%	30%	32%	33%
WS / SO / SW	30%	28%	30%	29%	30%	29%

- Differences ( $\geq 2\%$  in ILF values) across the sub-bands are inconsistent for the LDZ groups both within and between years.
- Individual LDZ analysis is not possible with split at 145 MWh pa.
- Therefore, an EUC split at 145 MWh pa is NOT proposed.

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## Small NDM

### Consumption Band Analysis 73.2 - 293 MWh pa – “RMSE” values

	Population AQ Weighted “Root Mean Squared Error” Values Models Based on 2010/11 Data Set			
	NO SPLIT 73.2 to 293	SPLIT 73.2 to 145 145 to 293	Improvement (+) or Degradation (-) Using Two Bands	
			CURRENT: 2010/11	2009/10
SC	508850.6	550232.5	-8.1%	-20.7%
NO / NW / WN	1123719.1	1131539.5	-0.7%	-6.2%
NE / EM / WM	1470540.7	1543426.8	-5.0%	-2.9%
EA / NT / SE	1584286.6	1597459.3	-0.8%	0.7%
WS / SO / SW	901326.4	945933.3	-4.9%	-4.2%
OVERALL	500001.0	520799.4	-4.2%	-2.2%

- No overall improvement in ‘goodness of fit’ by representing 73.2-293 MWh pa range using two sub-bands with breakpoint at 145 MWh pa
- RMSE analysis shows a degradation in model/profile accuracy when splitting EUC Band 2



## Proposed Approach: Small NDM Indicative Load Factors EUC Band 2: 73.2 – 293 MWh pa (No Split)

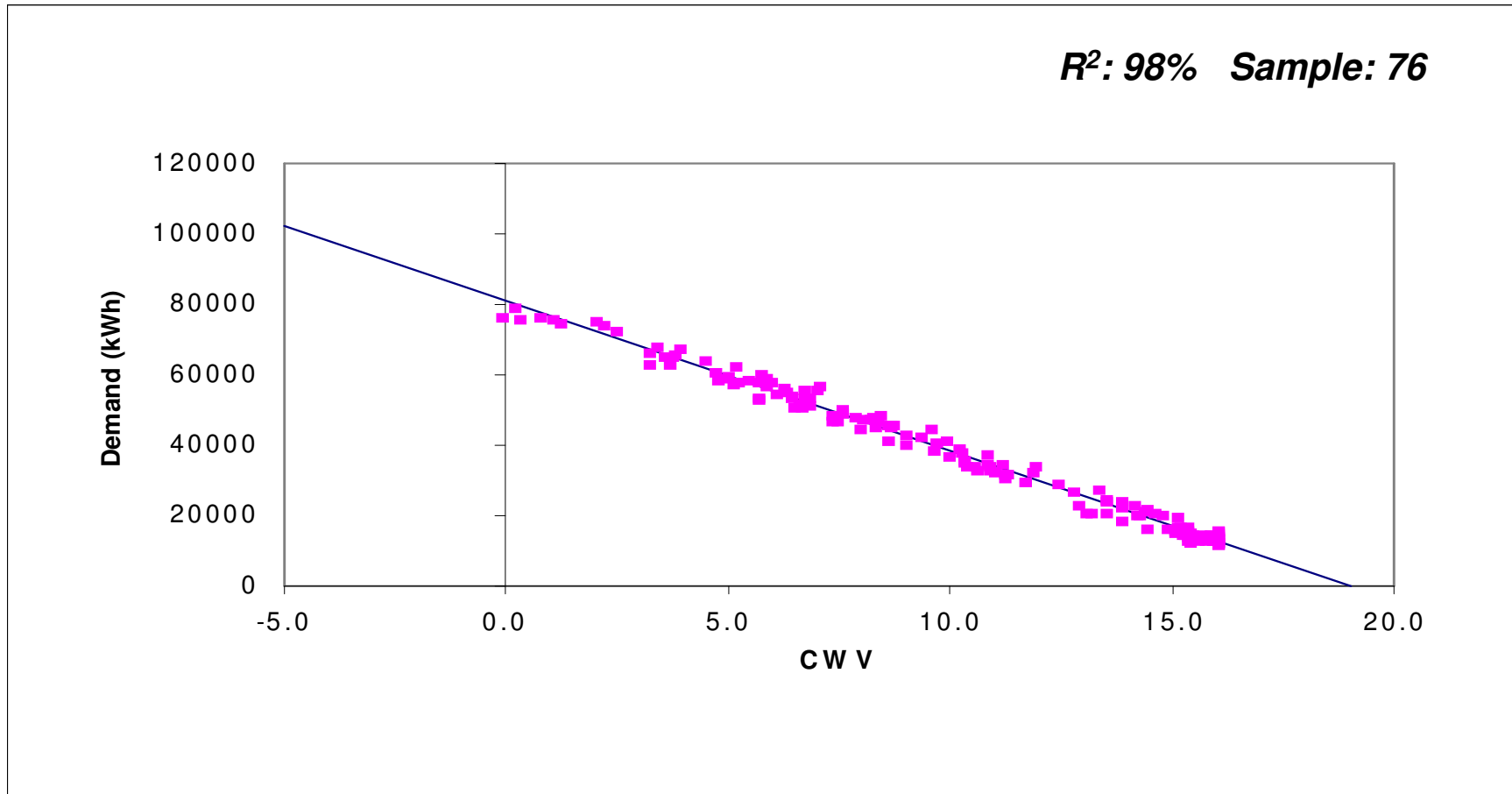
	Indicative Load Factor	R <sup>2</sup> Multiple Correlation Coefficient	Sample Size
SC	36%	98%	86
NO	30%	94%	99
NW / WN	30%	96%	119
NE	32%	96%	91
EM	31%	97%	103
WM	27%	96%	87
WS	29%	97%	56
EA	32%	96%	107
NT	33%	98%	126
SE	30%	98%	122
SO	30%	98%	76
SW	28%	96%	78

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# Demand against CWV, Monday to Thursday, holidays excluded, SO LDZ, 73.2 – 293 MWh pa



# Small NDM Indicative Load Factors:

293 to 732 MWh pa (Band 3)

732 to 2196 MWh pa (Band 4) Split At 1465 MWh pa

	293 TO 732 MWh pa			732 TO 1,465 MWh pa (SPLIT)			1,465 TO 2,196 MWh pa (SPLIT)			732 TO 2,196 MWh pa		
SC	39%	98%	132	40%	98%	193	39%	98%	156	39%	98%	349
NO	31%	97%	124	31%	97%	112	33%	97%	82	32%	97%	194
NW / WN	32%	97%	135	32%	97%	193	37%	97%	152	35%	98%	345
NE	32%	96%	105	34%	97%	161	36%	97%	103	35%	97%	264
EM	31%	97%	154	31%	97%	187	36%	98%	123	33%	98%	310
WM	27%	96%	87	28%	97%	177	32%	97%	116	30%	97%	293
EA	32%	98%	136	32%	99%	189	33%	98%	110	32%	99%	299
NT	33%	98%	143	33%	98%	202	37%	99%	167	35%	99%	369
SE	31%	98%	167	34%	98%	227	36%	98%	121	35%	98%	348
WS	27%	92%	25	27%	95%	55	36%	97%	32	31%	96%	87
SO	28%	97%	126	29%	98%	147	30%	99%	103	29%	99%	250
SW	27%	97%	100	31%	98%	122	32%	98%	64	32%	98%	186

- Indicative Load Factor :  $R^2$  Multiple Correlation Coefficient : Sample Size

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# Small NDM

## Consumption Band Analysis 732 - 2196 MWh pa – Historical ILFs

	2010/11		2009/10		2008/09	
	732-1465 MWh pa	1465-2196 MWh pa	732-1465 MWh pa	1465-2196 MWh pa	732-1465 MWh pa	1465-2196 MWh pa
SC	40%	39%	39%	39%	39%	39%
NO	31%	33%	30%	32%	30%	32%
NW / WN	32%	37%	33%	35%	33%	38%
NE	34%	36%	33%	36%	34%	36%
EM	31%	36%	31%	34%	32%	33%
WM	28%	32%	28%	31%	28%	31%
EA	32%	33%	32%	34%	32%	33%
NT	33%	37%	32%	35%	35%	36%
SE	34%	36%	33%	35%	33%	37%
WS	27%	36%	29%	31%	28%	32%
SO	29%	30%	28%	30%	29%	30%
SW	31%	32%	31%	31%	31%	33%

- 6 LDZs indicate  $\geq 2\%$  points ILF difference across all 3 years
- Consider 'goodness of fit' analysis.....

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# Small NDM

## Consumption Band Analysis 732 - 2196 MWh pa – “RMSE” values

Population AQ Weighted RMSE Values Models Based on 2010/11 Data Set				
	NO SPLIT 732 to 2196	SPLIT 732 to 1465 1465 to 2196	Improvement (+) or Degradation (-) Using Two Bands	
			CURRENT: 10/11	09/10
SC	437327.7	444900.4	-1.7%	-4.1%
NO	229119.6	238333.2	-4.0%	-5.6%
NW / WN	497342.9	540435.3	-8.7%	-8.2%
NE	294062.6	305499.1	-3.9%	-6.1%
EM	389676.2	416354.1	-6.8%	-3.7%
WM	434308.9	468078.2	-7.8%	-8.3%
EA	159765.1	183136.2	-14.6%	-5.6%
NT	282661.9	292388.4	-3.4%	-4.6%
SE	436723.4	506682.8	-16.0%	-13.5%
WS	323868.4	347947.4	-7.4%	-3.4%
SO	301148.7	324846.9	-7.9%	-4.9%
SW	216217.3	231208.9	-6.9%	-4.8%
Overall	360379.3	385900.8	-7.1%	-5.7%

- No overall improvement in RMSE (‘goodness of fit’) when splitting Band 4
- Retain current approach
- EUC split at 1,465 is not proposed

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# Small NDM <2,196 MWh WAR Band Analysis

# Winter Annual Ratio: WAR Band Analysis

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- WAR Band – Winter Annual Ratio profiles
  - Profile split by consumption in winter as a ratio of total consumption
- Applied to Supply Points where Consumption >293 MWh pa
  - Band 3 and above
  - 2 Small NDM EUC Bands have WAR Bands
    - 293 to 732 MWh pa and 732 to 2,196 MWh pa
    - BUT - Grouped to allow individual LDZ analysis
  - 4 bands defined as 20:30:30:20 percentage split of sample population
  - WAR Band definitions change by Consumption Band and by year
    - Analysis – WAR Band limits have moved slightly away from one as the winter overall in 10/11 was less cold than 09/10
- Due to low sample sizes in WS WAR Bands a further modelling run was carried out combining WS and SW

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## Small NDM Bands 3 & 4: 293 – 2196 MWH pa WAR Band Analyses – Disposition of Validated Sample

	WAR Banding				Total
	0.00 - 0.48	0.48 - 0.57	0.57 - 0.67	0.67 - 1.00	
SC	139	149	136	57	481
NO	63	104	111	40	318
NW / WN	126	142	138	74	480
NE	93	106	102	68	369
EM	97	118	142	107	464
WM	80	87	114	99	380
EA	68	138	148	81	435
NT	114	175	144	79	512
SE	96	177	151	91	515
WS	23	24	27	38	112
SO	58	107	106	105	376
SW	44	81	72	89	286
Total	1001	1408	1391	928	4728
WS / SW	67	105	99	127	398

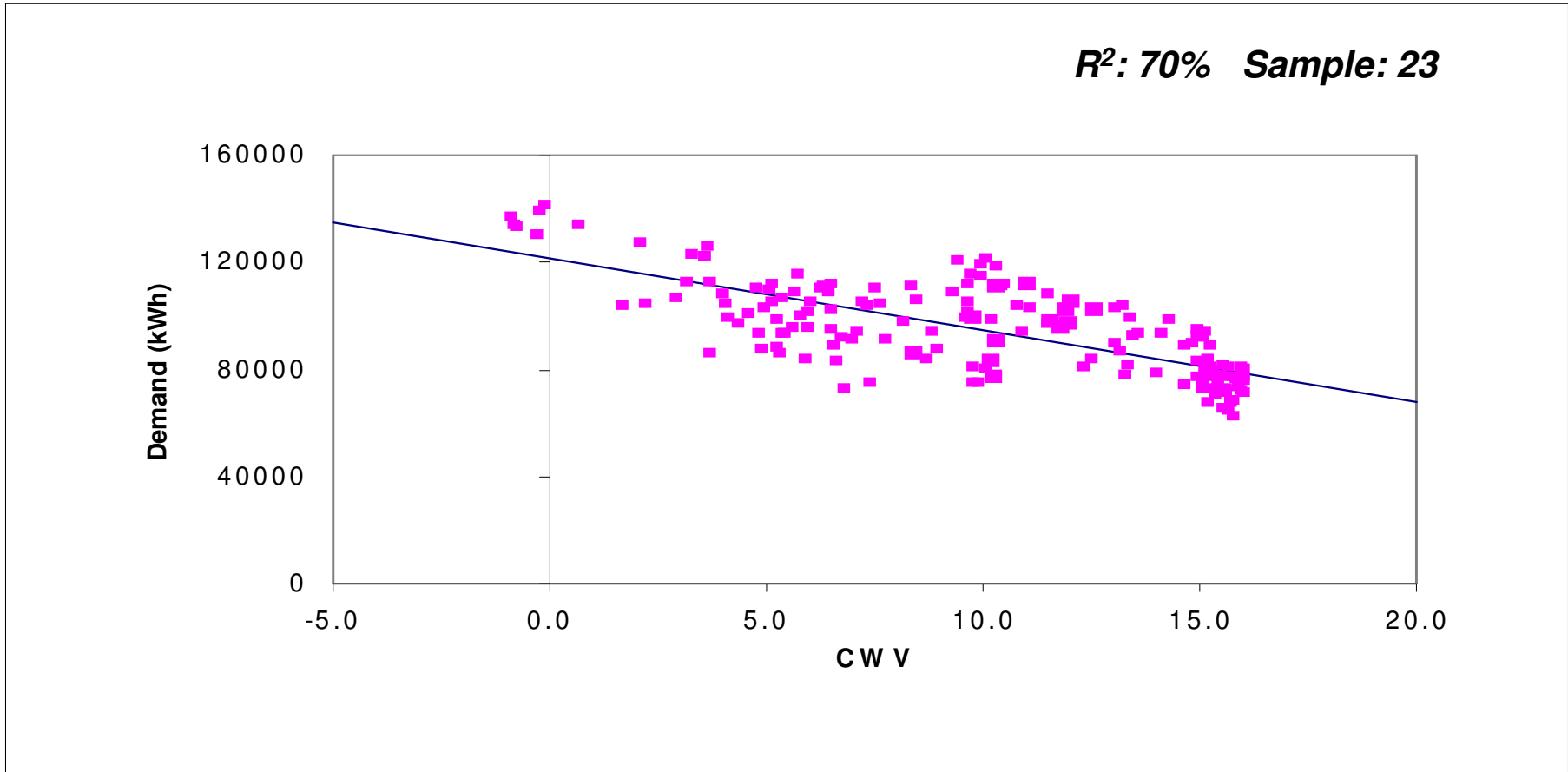


## Small NDM Indicative Load Factors: WAR Band Analysis - 293 to 2196 MWh pa

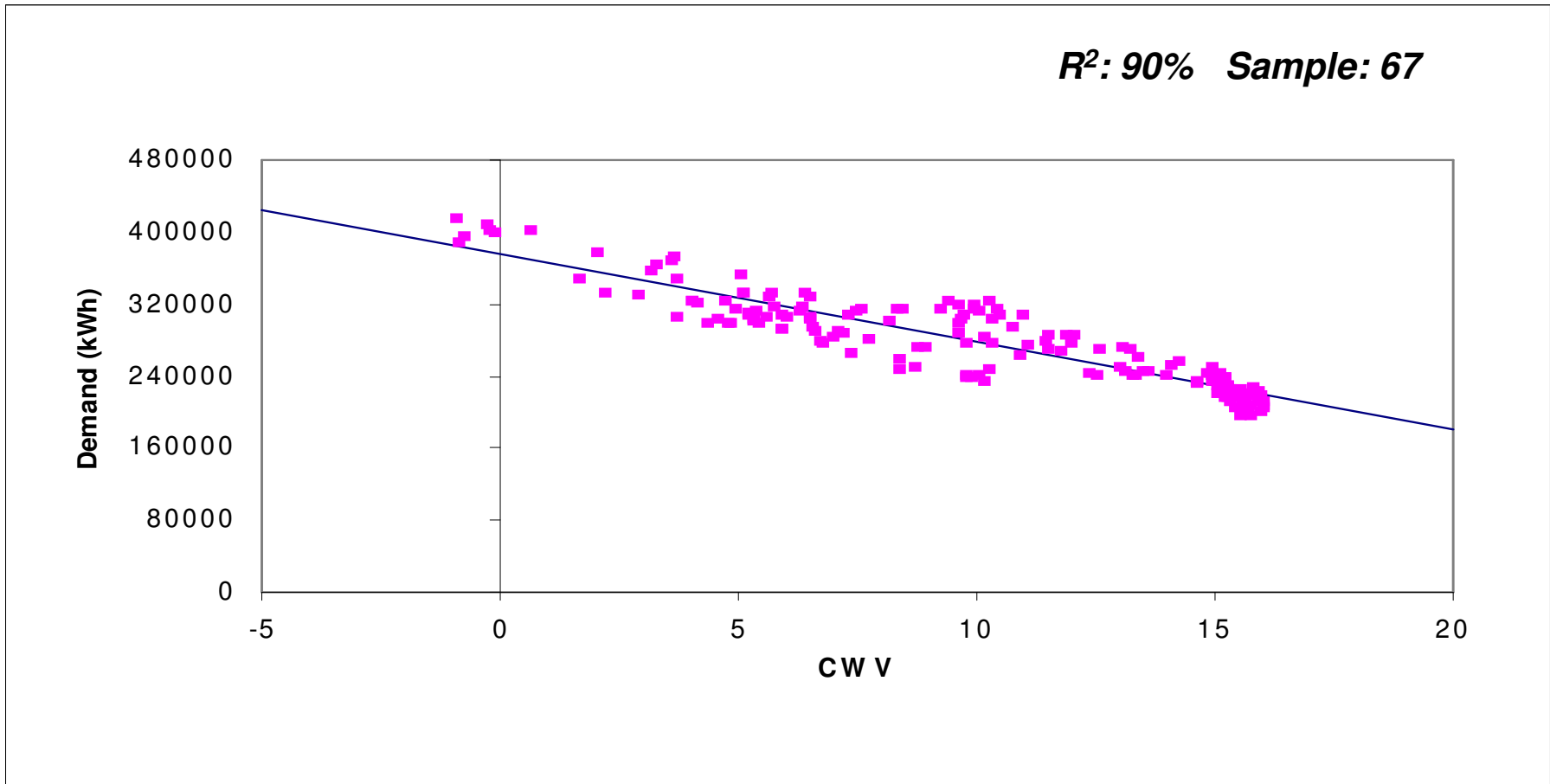
	WAR Banding											
	0.00 – 0.48			0.48 – 0.57			0.57 – 0.67			0.67 – 1.00		
SC	57%	97%	139	43%	98%	149	32%	98%	136	27%	96%	57
NO	58%	90%	63	38%	98%	104	26%	96%	111	20%	96%	40
NW / WN	55%	95%	126	38%	99%	142	27%	97%	138	22%	96%	74
NE	52%	97%	93	41%	97%	106	29%	96%	102	23%	95%	68
EM	54%	98%	97	41%	99%	118	29%	97%	142	23%	96%	107
WM	51%	98%	80	35%	98%	87	26%	96%	114	21%	96%	99
EA	56%	95%	68	39%	99%	138	28%	98%	148	22%	97%	81
NT	57%	94%	114	41%	99%	175	29%	98%	144	22%	97%	79
SE	54%	88%	96	40%	99%	177	28%	98%	151	22%	96%	91
WS	61%	70%	23	40%	98%	24	27%	96%	27	21%	94%	38
SO	57%	89%	58	37%	99%	107	28%	99%	106	20%	96%	105
SW	53%	94%	44	39%	99%	81	28%	98%	72	21%	97%	89
WS/ SW	56%	90%	67	40%	99%	105	28%	98%	99	21%	96%	127

- Indicative Load Factor :  $R^2$  Multiple Correlation Coefficient : Sample Size

# Demand against CWV, Monday to Thursday, holidays excluded, WS LDZ, 293 - 2196 MWh pa, WAR band 1

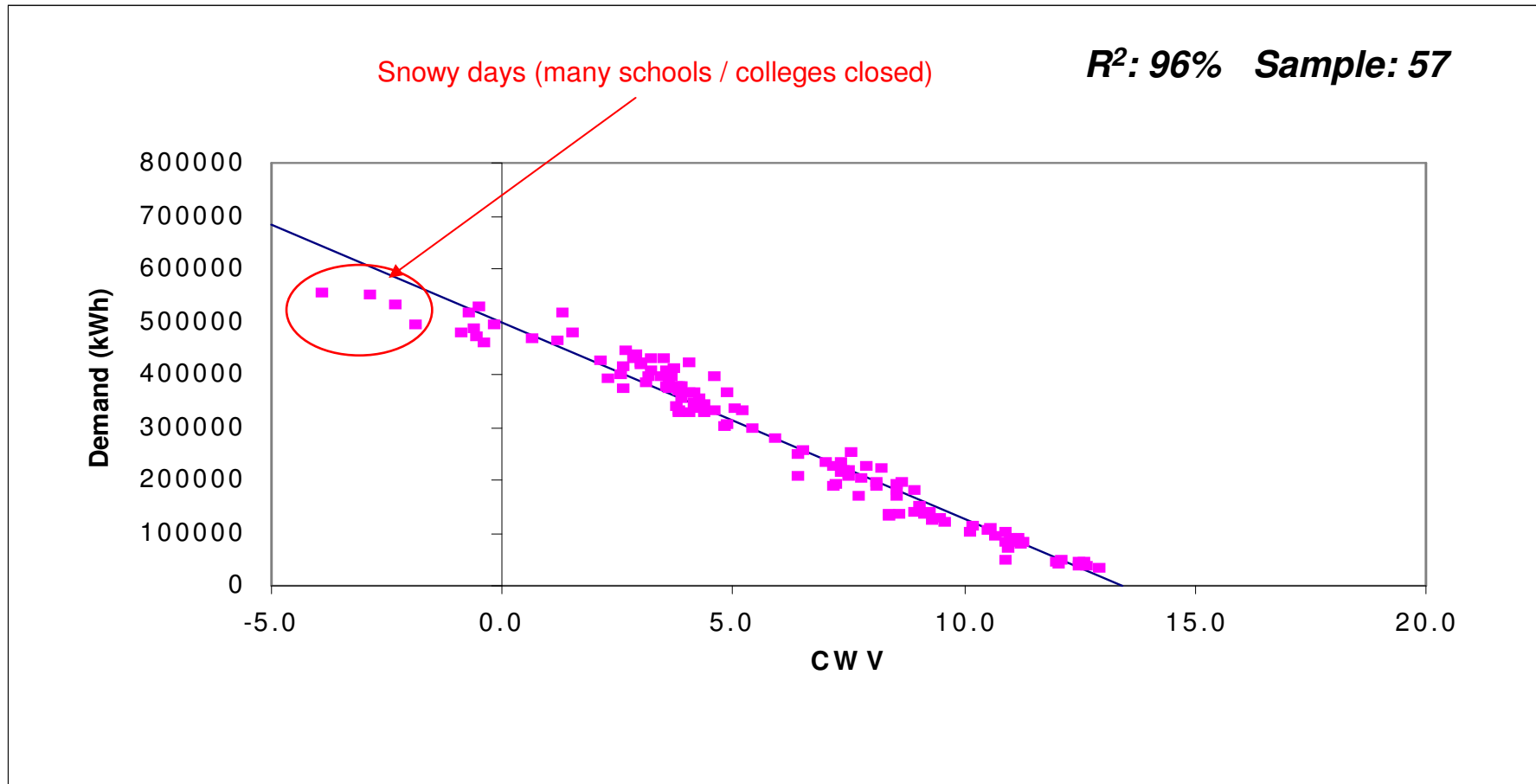


# Demand against CWV, Monday to Thursday, holidays excluded, WS/SW Combined, 293 - 2196 MWh pa, WAR band 1



- Combined model shows much less scatter. ILF comparable with previous years for both LDZs

# Demand against CWV, Monday to Thursday, holidays excluded, SC LDZ, 293 - 2196 MWh pa, WAR band 4



- Reduced demand on cold days in December. Snow on these days resulted in widespread travel disruption with many schools and colleges being closed. Gas days circled 1<sup>st</sup>, 2<sup>nd</sup>, 7<sup>th</sup> and 8<sup>th</sup> December

## Small NDM - WAR Band Analysis 293 - 2196 MWh pa

- Recommend combining WS and SW LDZs due to low sample sizes for WS LDZ in 3 WAR bands, low  $R^2$  value for WS WAR Band 1 model and ILF for WAR band 1 model out of line with WS/SW combined ILF.
- Modelling whole 293 - 2196 MWh pa consumption range for WAR band analysis allows individual LDZ analyses (with NW/WN and WS/SW combined).
- Sample sizes are reasonable for all 44 data sets.
- Model fits ( $R^2$  values) for all WAR band 2,3 and 4 data sets are 95% or better
- In WAR band 1 there are single instances of 88%,89%,90% and 94%. All other models have values of 95% or greater
- Proposal is to use this approach:  
WAR band models derived for 293 - 2196 MWh pa range on an individual LDZ basis (with NW/WN and WS/SW combined)

---

# Small NDM <2,196 MWh Analysis Summary

## Small NDM EUC Smoothed Models Provisional Results

- Review of provisional model results

Number 'Straight' (no cut-offs, no summer reductions)	54	(51)
Number with Warm Weather Cut-Off	47	(43)
Number with Summer Reduction	51	(54)
Number with no Slope (weather insensitive)	0	(0)
Number with Cut-Offs and Reductions	4	(8)
Last years figures in (x)		

- No cut-offs are applied to EUCs in consumption bands 0-73.2 and 73.2 to 293 MWh pa (which represents 80% of the overall NDM load)
- Cut-offs have been primarily applied for the peakier WAR bands (3 & 4) across consumption range 293 to 2,196 MWh pa (74%)

# Small NDM - Proposed Data Aggregations for Analysis

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- Therefore:
  - 0 to 73.2 MWh pa
    - Consumption Band Analysis by LDZ
    - Domestic sites only
  - 73.2 to 293 MWh pa
    - Consumption Band Analysis by LDZ
    - No additional split at 145 MWh pa
  - 293 to 732 and 732 to 2,196 MWh pa
    - Consumption Band analysis by LDZ for 293 – 732 and 732 – 2,196
    - WAR Band analysis across whole band 293 – 2,196 by LDZ (with WS/SW combined)
    - No additional split at 1,465 MWh pa
- Overall minimal change from previous year analysis (WS/SW aggregation for WAR Band 1)



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# Large NDM Analysis >2196 MWh p.a.

# Large NDM Analysis (>2,196 MWh pa)

- Defined Demand Estimation purposes > 2,196,000 kWh
  - Prescribed EUCs for Large NDM (in respect of consumption range) defined (UNC) as:
    - 2,196 to 5,860 MWh
    - 5,860 to 14,650 MWh
    - 14,650 to 29,300 MWh
    - 29,300 to 58,600 MWh
    - >58,600 MWh
- 1 Consumption Band  
x4 Winter Annual Ratio (WAR)  
Bands
- However, underlying demand modelling can be done on basis of more broadly aggregated bands
    - For example - DESC already agreed 14,650 to 29,300 and 29,300 to 58,600 could be done as a combined range, if necessary
  - Identify sample data available post validation and propose aggregations

# Available Sample Data: Large NDM Dataloggers

	TOTAL		
Number of Active Dataloggers As At 01/04/2010	14,885		
Number of Validated Dataloggers	10,984	6,261	4,723
Number of Supply Points After Validation	2011 Analysis	2010 Analysis	
Large NDM	3,481	3,621	
Small NDM	5,334	5,482	
Total	8,815	9,103	

- Both Large & Small validated sample have decreased since 2010
- Overall decrease of 288 validated supply points
- Remains a good representation of the population (population numbers also decreased)
- Following slides highlight proposed aggregations

## Large NDM Supply Points (>2,196 MWh pa) Sample Data Aggregations

	Consumption Band Analysis	WAR Band Analysis
Band 05 2,196 to 5,860 MWh pa	Individual LDZ ( <i>Individual LDZ</i> )	By 5 LDZ Groups ( <i>By 5 LDZ Groups</i> )
Band 06 5,860 to 14,650 MWh pa	Individual LDZ ( <i>Individual LDZ</i> )	By 3 LDZ Groups ( <i>By 3 LDZ Groups</i> )
Band 07 14,650 to 29,300 MWh pa	By 4 LDZ Groups ( <i>By 4 LDZ Groups</i> )	National ( <i>National</i> )
Band 08 29,300 to 58,600 MWh pa	By 3 LDZ Groups ( <i>By 3 LDZ Groups</i> )	National ( <i>National</i> )
Band 09 >58,600 MWh pa	National ( <i>National</i> )	N/A - No WAR Bands

- Aggregation of sample data to allow sufficient sample analysis
- Overall comparable with 2010 - values shown (x)

# Large NDM Supply Points (>2196 MWh pa)

## Count Per Consumption Band (+ Aggregations)

	2,196 - 5,860	5,860 – 14,650	14,650 – 29,300	29,300 – 58,600	>58,600
SC	247	79	16	6	3
NO	131	55	9	9	12
NW & WN	272	91	33	23	14
NE	145	60	29	13	5
EM	194	95	38	26	13
WM	245	97	35	29	13
EA	158	61	20	5	6
NT	262	79	18	12	4
SE	204	62	14	6	4
WS	47	32	11	6	5
SO	153	61	16	4	0
SW	107	60	16	5	6
TOTAL	2165	832	255	144	85

- Aggregations of validated sample for 2011 highlighted

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## Large NDM: Count of Sample Supply Points to Total Market Supply Points Comparison

Consumption Range	Validated Sample	Firm Supply Point Population (1)
2,196 to 5,860 MWh pa	2, 165 (40%)	5,350
5,860 to 14,650 MWh pa	832 (52%)	1,610
14,650 to 29,300 MWh pa	255 (55%)	460
29,300 to 58,600 MWh pa	144 (63%)	230
>58,600 MWh pa	85 <sup>(2)</sup> (61%)	140 <sup>(3)</sup>

(Brackets) as % of population

### Notes:

1. Approx. for all Firm supply points at April 2011: >2,196 MWh represents 10% of NDM load (0.03% of Supply Points)
2. Sample data includes all firm supply points passing data validation because there are too few NDM supply points with AQ>58,600 MWh pa. Supply points >58,600 MWh pa should be DM.
3. Number of NDM supply points with AQ>58,600 MWh pa as at April 2011 was 6 (~0.13% of aggregate NDM AQ).

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## Total NDM Population Counts: Supply Point & AQ

Consumption Range	% of Total NDM	
	Total AQ	Total Count
0 – 73.2 MWh pa	73.8%	98.71%
0 – 293 MWh pa	79.8%	99.66%
0 – 2,196 MWh pa	90.0%	99.97%
>2,196 MWh pa	10.0%	0.03%

- On an AQ basis:
  - Small NDM is by far the main component of the overall NDM sector
  - The range 0-73.2 MWh pa constitutes nearly 3/4 of overall NDM
  - The range 0-293 MWh pa constitutes 4/5 of overall NDM
  - The range 0-2196 MWh pa constitutes 9/10 of overall NDM
  - Large NDM is very much a minority component of overall NDM

## Large NDM Supply Points (>2196 MWh pa) Consumption Band Analyses – Indicative Load Factors

	Large NDM Consumption Band (MWh pa)														
	2,196 TO 5,860			5,860 TO 14,650			14,650 TO 29,300			29,300 TO 58,600			>58,600		
SC	42%	99%	247	48%	98%	79	53%	96%	58	61%	92%	38	60%	93%	85
NO	36%	98%	131	43%	98%	55									
NW / WN	37%	98%	272	47%	98%	91									
NE	39%	98%	145	45%	97%	60	52%	98%	102	60%	95%	68			
EM	40%	98%	194	45%	98%	95									
WM	35%	98%	245	43%	98%	97									
EA	37%	99%	158	41%	98%	61	49%	96%	52	47%	96%	38			
NT	39%	99%	262	43%	98%	79									
SE	39%	99%	204	43%	98%	62									
WS	39%	97%	47	43%	97%	32	44%	96%	43						
SO	32%	98%	153	35%	98%	61									
SW	36%	98%	107	43%	98%	60									

- Indicative Load Factor : R2 Multiple Correlation Coefficient : Sample Size

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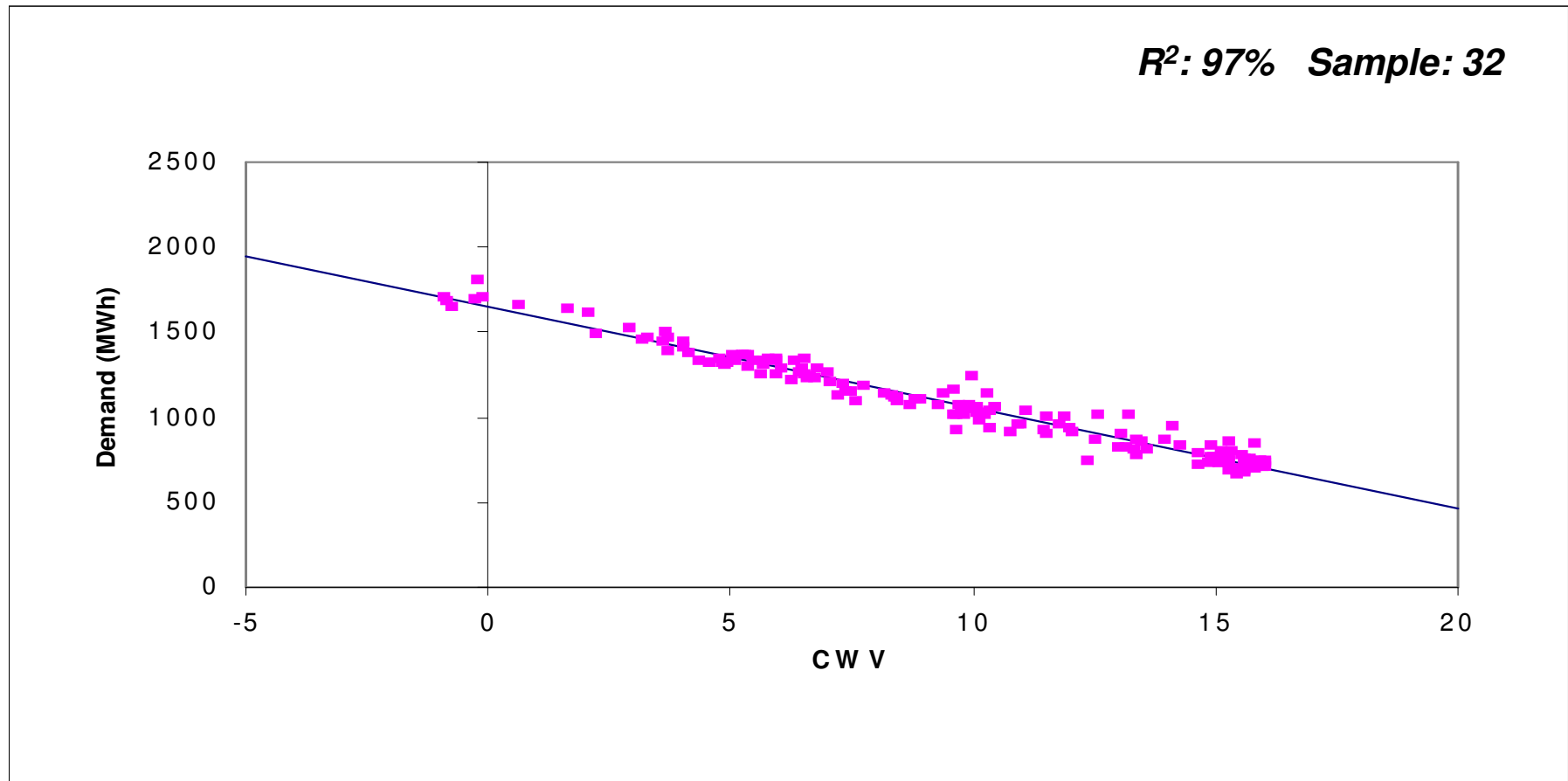


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# Demand Against CWV, Monday to Thursday, Non-Holiday

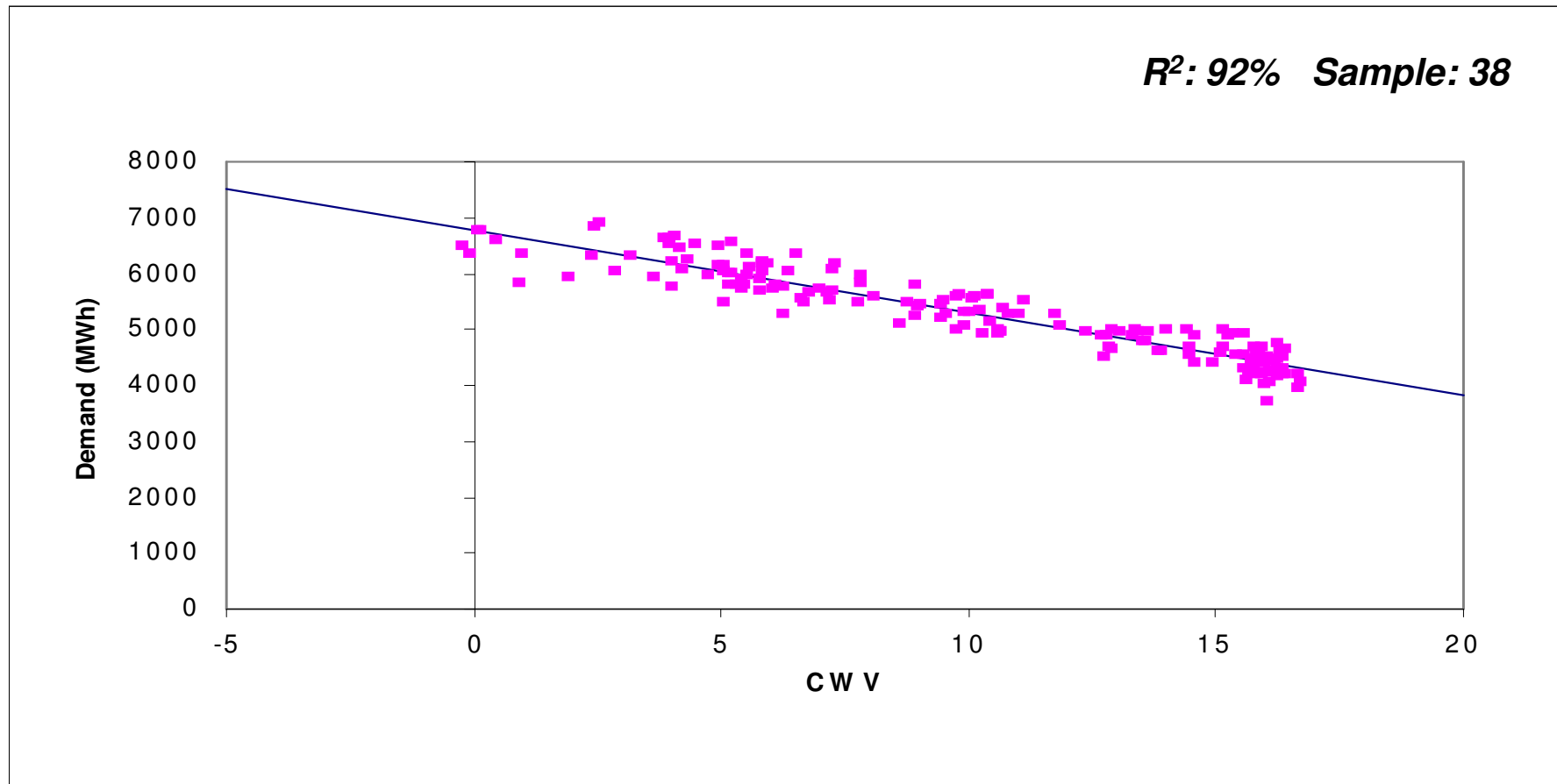
WS LDZ, 5860-14650 MWh pa, Consumption Band



- Small sample size BUT population is only 62 FIRM supply points
- Model is also well behaved with good  $R^2$  value

# Demand Against CWV, Monday to Thursday, Non-Holiday

SC/NO/NW/WN LDZ Group, 29300-58600 MWh pa, Consumption Band, NW CWV



- Small sample size BUT population is only 62 FIRM supply points
- Model is also well behaved with quite good  $R^2$  value

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# Large NDM >2,196 MWh WAR Band Analysis

# Winter Annual Ratio: WAR Band Analysis

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- WAR Band – Winter Annual Ratio profiles
  - Profile split by consumption in winter (December to March) as a ratio of total consumption
- Applied to all Large supply point bands
  - Bands 5 and above
  - 4 bands defined as 20:30:30:20 percentage split of sample population
  - WAR Band definitions change by Consumption Band and by year
    - Analysis – WAR Band limits have moved slightly away from one as the winter overall in 10/11 was less cold than 09/10
  - WAR Band 1 is the least weather sensitive and WAR Band 4 is the most weather sensitive

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## Large NDM Supply Points (>2196 MWh pa) WAR Band Analysis Aggregations

	2,196 - 5,860	5,860 – 14,650	14,650 – 29,300	29,300 – 58,600	>58,600
SC	247	79	16	6	3
NO	131	55	9	9	12
NW & WN	272	91	33	23	14
NE	145	60	29	13	5
EM	194	95	38	26	13
WM	245	97	35	29	13
EA	158	61	20	5	6
NT	262	79	18	12	4
SE	204	62	14	6	4
WS	47	32	11	6	5
SO	153	61	16	4	0
SW	107	60	16	5	6
TOTAL	2165	832	255	144	85

- Aggregations of WAR Band analysis for 2011 highlighted

## Large NDM Supply Points (>2196 MWh pa) 5 LDZ Group WAR Band Analyses – Disposition of Validated Sample

- Consumption Band 5: 2,196 to 5,860 MWh pa : 5 LDZ Aggregations Applied

	WAR Banding			
	0.00 – 0.44	0.44 – 0.52	0.52 – 0.61	0.61 – 1.00
SC	45	79	84	39
NO / NW / WN	104	127	83	89
NE / EM / WM	151	161	145	127
EA / NT / SE	113	190	198	123
WS / SO / SW	68	69	84	86
TOTAL	481	626	594	464

- Numbers in each WAR Band aggregation
- Numbers are healthy for all data sets – no issues with sample sizes

## Large NDM Supply Points (>2196 MWh pa) 5 LDZ Group WAR Band Analysis – Indicative Load Factors

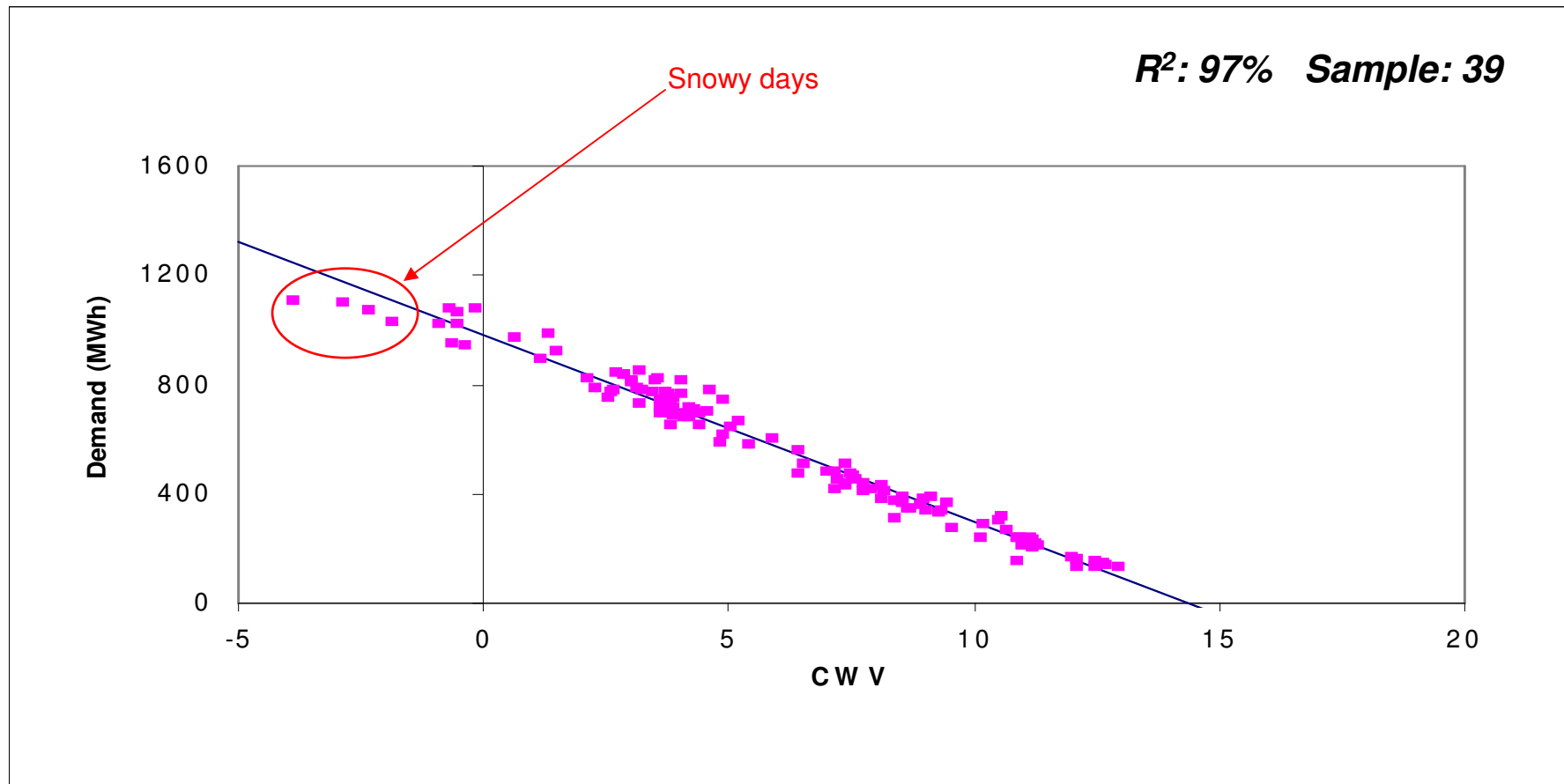
- Consumption Band 5: 2,196 to 5,860 MWh pa : 5 LDZ Aggregations Applied

	WAR Banding											
	0.00 – 0.44			0.44 – 0.52			0.52 – 0.61			0.61 – 1.00		
SC	65%	95%	45	50%	99%	79	38%	98%	84	29%	97%	39
NO / NW / WN	58%	98%	104	44%	99%	127	33%	98%	83	23%	96%	89
NE / EM / WM	60%	99%	151	44%	99%	161	34%	98%	145	24%	97%	127
EA / NT / SE	61%	92%	113	46%	98%	189	35%	99%	199	25%	98%	123
WS / SO / SW	63%	95%	68	43%	98%	69	33%	99%	84	23%	97%	86

- Indicative Load Factor : R2 Multiple Correlation Coefficient : Sample Size

# Demand Against CWV, Monday to Thursday, Non-Holiday

SC LDZ (5 LDZ Group Analysis), 2196-5860 MWh pa, WAR Band 4



- Smallest sample set of data aggregations for WAR Band 5 analysis
- Snow effect likely to explain slightly lower than expected demand



## Large NDM Supply Points (>2196 MWh pa)

### WAR Band Analyses – Disposition of Validated Sample (Bands 06, 07, 08)

- Consumption Band 6: 5,860 to 14,650 MWh pa : 3 LDZ Aggregations Applied

	WAR Banding			
	0.00 – 0.38	0.38 – 0.47	0.47 – 0.57	0.57 – 1.00
SC/NO/NW/WN	51	65	68	41
NE/EM/WM	62	84	61	45
EA/NT/SE/WS/SO/SW	51	99	113	92
TOTAL	164	248	242	178

- Consumption Band 7: 14,650 to 29,300 MWh pa : National Aggregations Applied

	0.00 – 0.36	0.36 – 0.40	0.40 – 0.53	0.53 – 1.00
ALL LDZs	45	79	78	53

- Consumption Band 8: 29,300 to 58,600 MWh pa : National Aggregations Applied

	0.00 – 0.36	0.36 – 0.39	0.39 – 0.48	0.48 – 1.00
ALL LDZs	32	44	40	28

# Large NDM Supply Points (>2196 MWh pa)

## WAR Band Analysis – Indicative Load Factors

- Consumption Band 6: 5,860 to 14,650 MWh pa : 3 LDZ Aggregations Applied

	WAR Banding											
	0.00 – 0.38			0.38 – 0.47			0.47 – 0.57			0.57 – 1.00		
SC/NO/NW/WN	69%	94%	51	55%	97%	65	42%	98%	68	30%	97%	41
NE/EM/WM	70%	94%	62	53%	98%	84	38%	99%	61	26%	97%	45
EA/NT/SE/WS/SO/SW	70%	86%	51	52%	98%	99	40%	99%	113	28%	98%	92

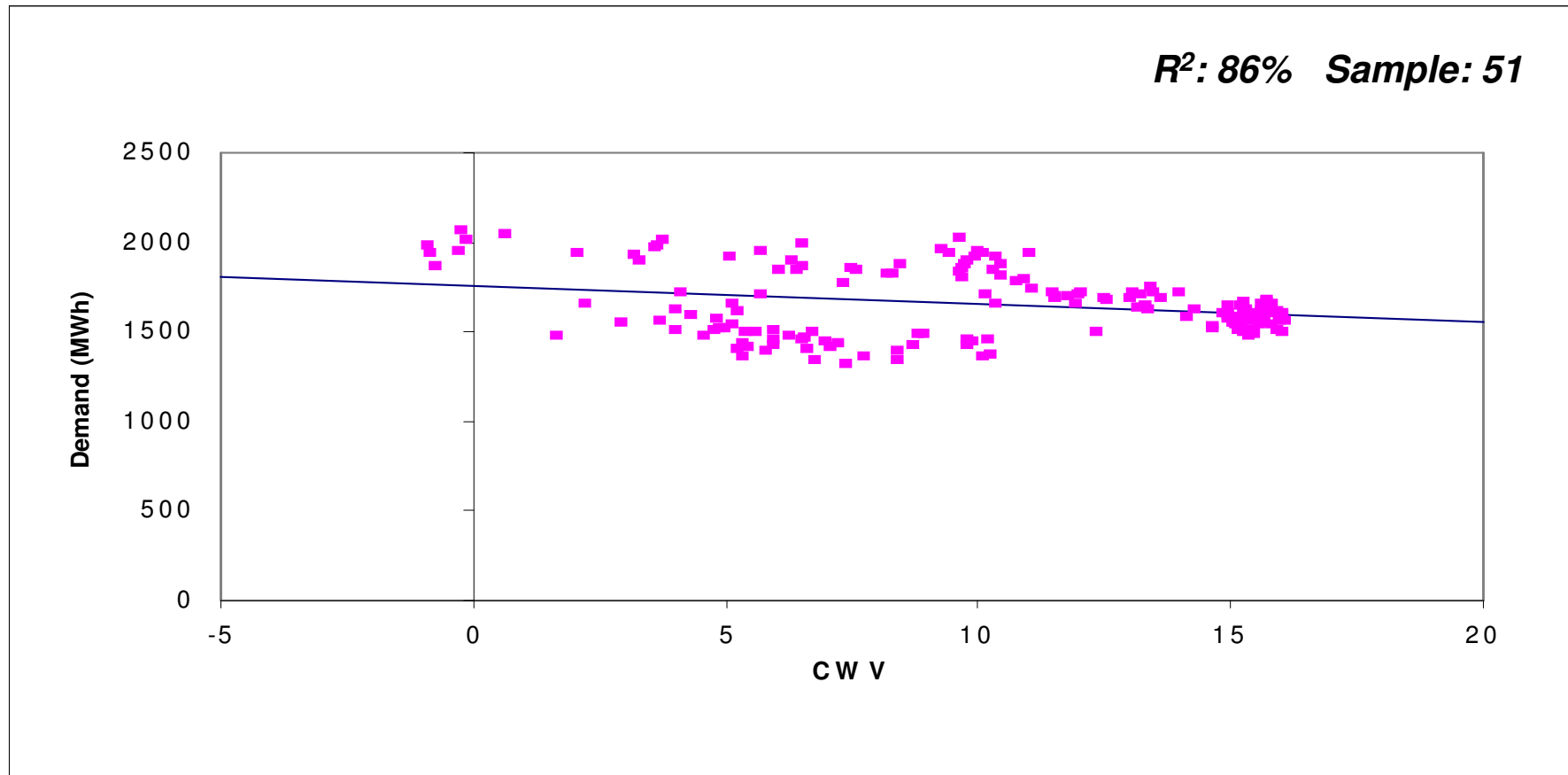
- Consumption Band 7: 14,650 to 29,300 MWh pa : National Aggregations Applied

	0.00 – 0.36			0.36 – 0.40			0.40 – 0.53			0.53 – 1.00		
	ALL LDZs	84%	75%	45	66%	98%	79	47%	97%	78	31%	97%

- Consumption Band 8: 29,300 to 58,600 MWh pa : National Aggregations Applied

	0.00 – 0.36			0.36 – 0.39			0.39 – 0.48			0.48 – 1.00		
	ALL LDZs	82%	46%	32	69%	92%	44	55%	91%	40	34%	97%

Demand Against CWV, Monday to Thursday, Non-Holiday,  
EA/NT/SE/WS/SO/SW LDZ Group, 5860-14650 MWh pa, WAR Band 1, WS CWV



- Dataset has quite a lot of scatter resulting in lower  $R^2$  values compared with other Consumption Band 06 WAR Band 1 models

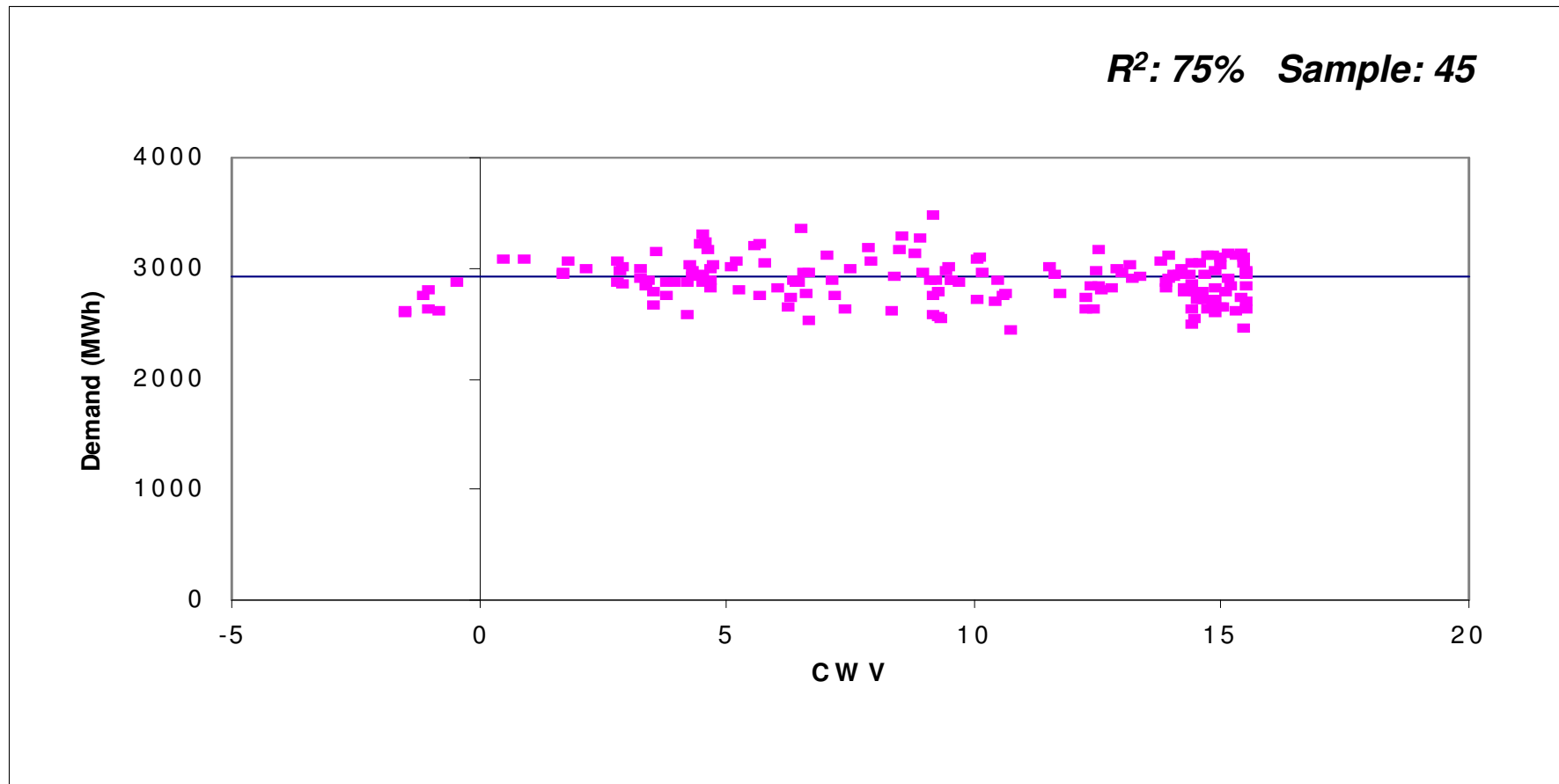
# Large NDM Supply Points (>2196 MWh pa)

## WAR Band Analysis 5860 – 14650 MWh pa

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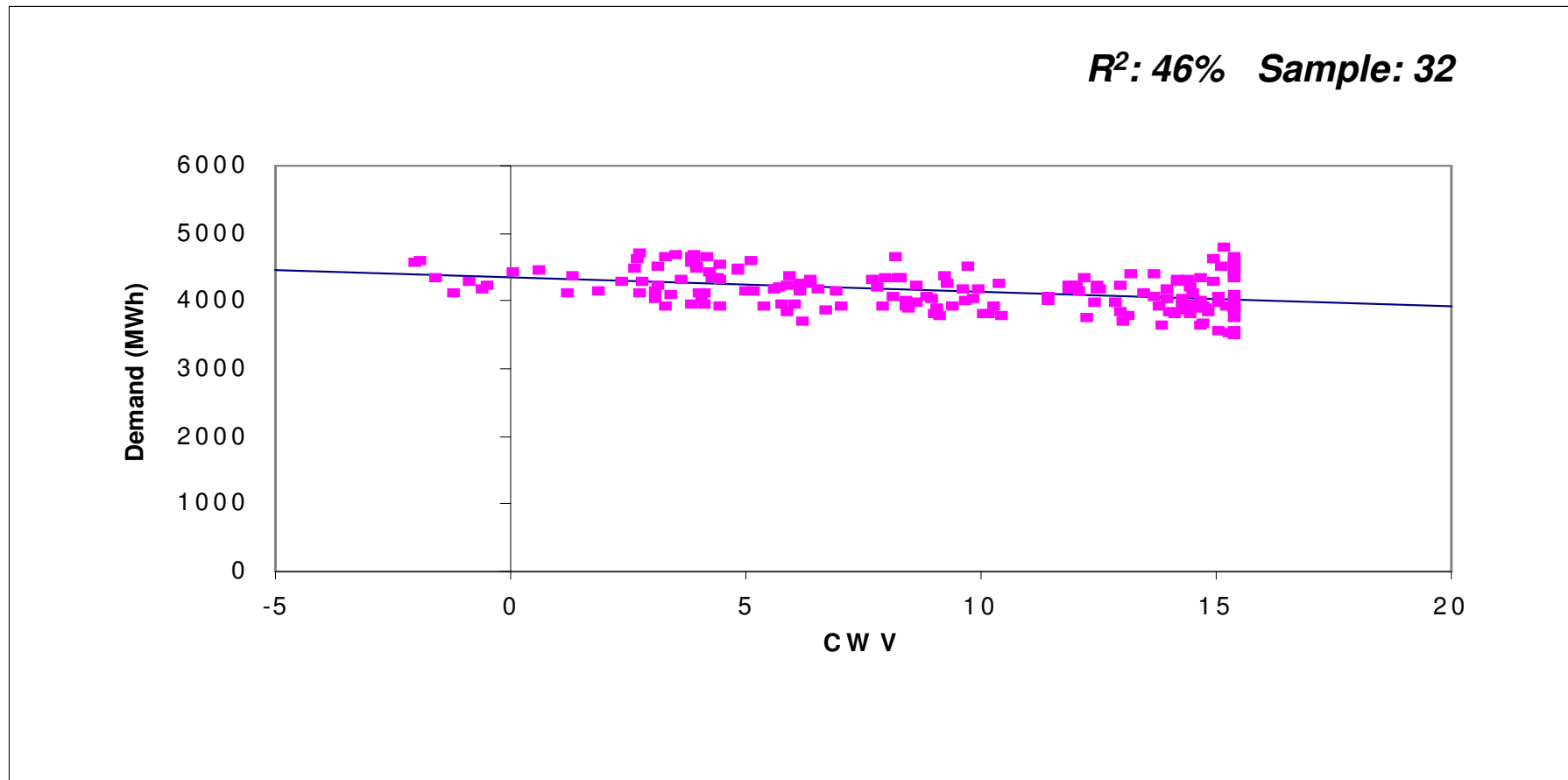
- 3 LDZ group basis gives adequate sample sizes (41 or greater) for all data sets.
- Not feasible to break southern LDZ group into two (NE/EM/WM & WS/SO/SW) – This will give sample sizes as low as 29 and 22 in WAR band 1.
- All model fits ( $R^2$  values) are good with 3 groups: all 94% or greater (except EA/NT/SE/WS/SO/SW LDZ group model in WAR band 1 (86%)).
- Same level of aggregation as applied in 2010, 2009, 2008, 2007 and 2006.

## Demand Against CWV, Monday to Thursday, Non-Holiday National Aggregation, 14650-29300 MWh pa, WAR Band 1, WM CWV



- WAR Band 1 models usually weather insensitive which explains the lower  $R^2$  value. Model has shown a zero or near zero slope for a number of years

## Demand Against CWV, Monday to Thursday, Non-Holiday National Aggregation, 29300-58600 MWh pa, WAR Band 1, EM CWV



- WAR Band 1 models usually weather insensitive which explains the lower  $R^2$  value. Model also shows very little day of the week pattern to demand either which explains the even lower  $R^2$  value compared with previous chart

# Large NDM Supply Points (NOT Combining Bands 07 & 08)

## WAR Band Analysis 14650-29300 & 29300-58600 MWh pa

- Decision is to not combine bands 07 and 08 for WAR band analysis.
- Sample sizes sufficient to model WAR bands separately.
- Indicative load factors for corresponding WAR band models are distinctly different in each band.

Band	Indicative Load Factors			
	WAR 1	WAR 2	WAR 3	WAR 4
07	84%	66%	47%	31%
08	82%	69%	55%	34%

- Combining bands would give a common model for each WAR band – but one that will not be appropriate for either.
- Sample size of 28 in WAR band 4 in consumption band 08 is lowest in the WAR band data sets over both bands ( $R^2$  value for this model is very good: 97%).

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# Large NDM >2,196 MWh Summary



## Large NDM EUC Provisional Smoothed Models for 2011/12

- Review of provisional model results

Number 'Straight' (no cut-offs, no summer reductions)	156	(157)
Number with Warm Weather Cut-Off	71	(54)
Number with Summer Reduction	31	(33)
Number with no Slope (weather insensitive)	13	(26)
Number with Cut-Offs and Reductions	2	(3)
		Last years figures in (x)

- No change from last year in terms of proposed data aggregations
- Cut-offs have been primarily applied for the peakier WAR bands (3 & 4) across consumption bands

# Large NDM – Aggregation Proposals for Analysis

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- Therefore:
  - 2,196 to 5,860 MWh pa
    - Consumption Band Analysis by LDZ
    - WAR Band Analysis by 5 LDZ groups
  - 5,860 to 14,650 MWh pa
    - Consumption Band Analysis by LDZ
    - WAR Band Analysis by 3 LDZ groups
  - 14,650 to 29,300 MWh pa
    - Consumption Band Analysis by 4 LDZ groups
    - WAR Band Analysis by National Aggregation
  - 29,300 to 58,600 MWh pa
    - Consumption Band Analysis by 3 LDZ groups
    - WAR Band Analysis by National Aggregation
  - >58,600 MWh pa
    - Consumption Band Analysis by National Aggregation

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# Recommendations

# Summary

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- Analysis presented is an overview of the ongoing analysis
- Small and Large NDM Analysis
- Consumption and WAR Bandings
  - Derive EUCs
  - Model consumption profiles
- Draft proposals due to be published by June 30<sup>th</sup> will include:
  - In depth analysis of what has been presented here
  - Calculated profiling and capacity estimation parameters to be applied in new Gas Year
  - Available on the xoserve UK Link Docs Extranet, access via:
  - (<https://www.xoserveextranet.com/uklinkdocs/default.asp>)
- Recommendations at this stage.....

# Recommendations

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- Retain Small NDM EUC Breakpoints at same values as previous years
- Same aggregations for Small NDM EUCs as last year except for combining WS and SW in the WAR band models for bands 03 & 04
- Model Large NDM EUC bands using same level of aggregation as last year
- Publication of initial proposals: by 30<sup>th</sup> June
  - Note: Subject to DESC acceptance of data aggregations and resultant EUC demand models then it will be possible to publish an early preview of ALPs, DAFs, Load Factors, agg. NDM SND and WSENS and model parameter files immediately following this meeting
  - Remaining Documentation/Files will be published to UNC deadline
- Consultation: Representations invited by 15<sup>th</sup> July
- Publication of final proposals: by 15<sup>th</sup> August