Demand Estimation Technical Work Group

EUC Modelling 2019/20
Single Year Modelling Results – **Small NDM**

13th May 2019

Section 3

Small NDM Sector Modelling Results

Small NDM Sector: (<2,196 MWh pa)

- Small NDM for Demand Estimation purposes <2,196 MWh
- EUC consumption ranges are not prescribed in Uniform Network Code. There are no proposed changes to the AQ ranges used in EUC definitions for Gas Year 2019/20.
- There is a requirement to create four independent models for Bands 1 and 2 (Domestic Non-PPM, Domestic PPM, I&C Non-PPM & I&C PPM) however due to sample data limitations it was only possible to develop 5 of the 8 models.
- Current EUC Bands / Consumption Ranges for Small NDM:
  - Consumption Band 1: 0 – 73.2 MWh pa
  - Consumption Band 2: 73.2 – 293 MWh pa
  - Consumption Band 3: 293 – 732 MWh pa *
  - Consumption Band 4: 732 – 2,196 MWh pa *
  - Note: Bands 3 and 4 also include 4 x Winter Annual Ratio (WAR) Bands alongside the Consumption Band EUC
- Small NDM is the main component of the overall NDM (c88% of total AQ)

Section 3 – Part 1

Small NDM Consumption Bands: 1 to 4
AQ Range: <2,196 MWh pa

Single Year Results for 2018/19 sample data

Small NDM Consumption Bands: Agreed Modelling Runs

EUC Bands: Range	Comments on 2018/19 data TWG Agreed Modelling Runs
Band 1 PPM Domestic: **0 to 73.2 MWh pa**	Individual LDZ analysis (including WN on its own)
Band 1 Non PPM Domestic: **0 to 73.2 MWh pa**	Individual LDZ analysis (including WN on its own)
Band 1 PPM I&C: **0 to 73.2 MWh pa**	Sample size issues - No model viable
Band 1 Non PPM I&C: **0 to 73.2 MWh pa**	Individual LDZ analysis (including WN on its own)

Small NDM Consumption Bands: Agreed Modelling Runs

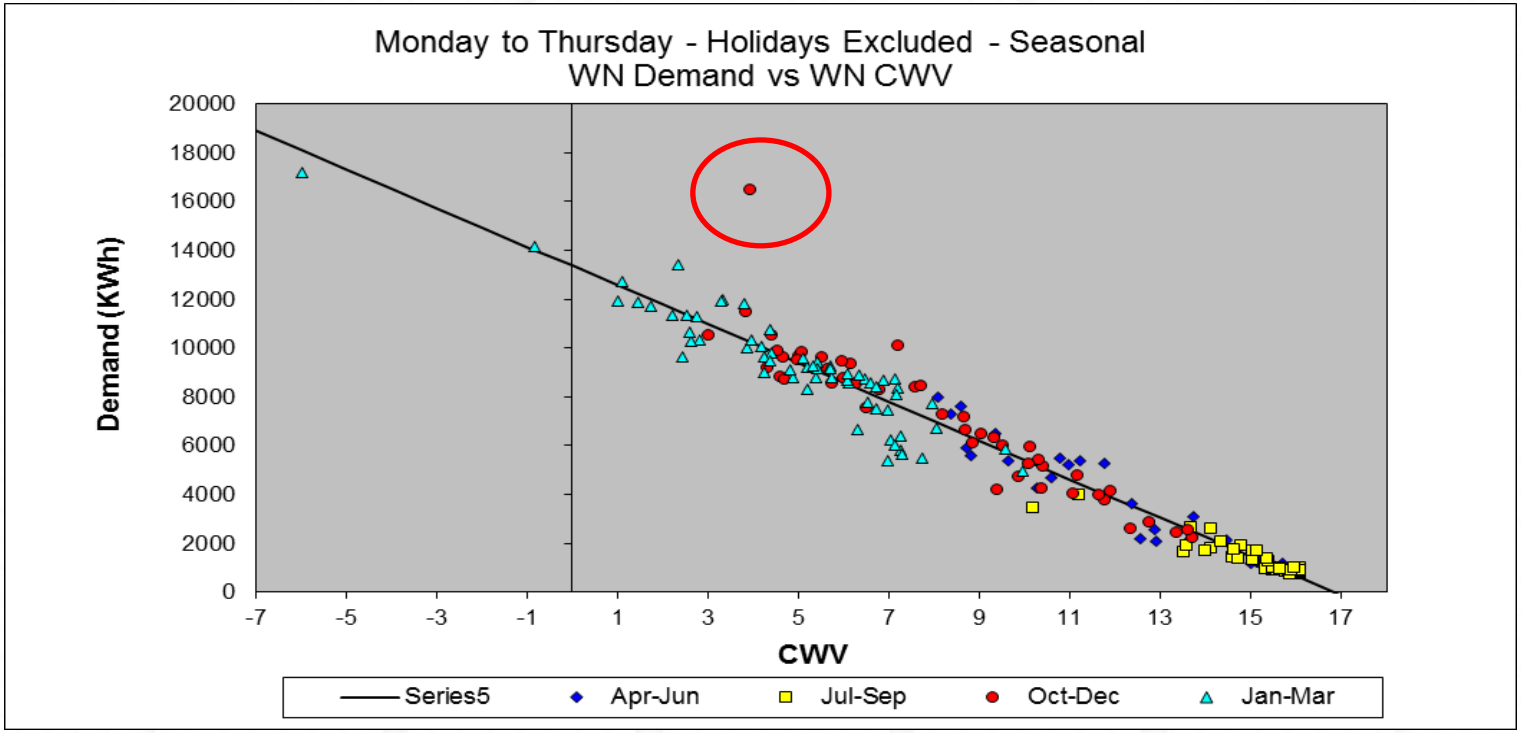
EUC Bands: Range	Comments on 2018/19 data TWG Agreed Modelling Runs
Band 2 PPM Domestic: **73.2 to 293 MWh pa**	Sample size issues - No model viable
Band 2 Non PPM Domestic: **73.2 to 293 MWh pa**	**National model or** **2 LDZ Groups (SC/NO/NW/WN/NE/EM/WM and EA/NT/SE/WS/SO/SW)**
Band 2 PPM I&C: **73.2 to 293 MWh pa**	Sample size issues - No model viable
Band 2 Non PPM I&C: **73.2 to 293 MWh pa**	Individual LDZ analysis (including WN on its own)
Band 3 : **293 to 732 MWh pa**	Individual LDZ analysis (including WN on its own)
Band 4 : **732 to 2,196 MWh pa**	Individual LDZ analysis (including WN on its own)

Small NDM Modelling Results: EUC Band 1 – Domestic Non-PPM

0 to 73.2 MWh pa Domestic Non-PrePayment	Indicative Load Factor (ILF)	R^2 Multiple Correlation Coefficient (All days)	Sample Size (Supply Points)
SC	33%	98%	272
NO	34%	96%	384
NW	31%	97%	297
NE	33%	97%	384
EM	31%	97%	366
WM	30%	98%	384
WN	30%	95%	159
WS	30%	97%	371
EA	32%	98%	309
NT	30%	99%	283
SE	29%	98%	335
SO	28%	98%	330
SW	30%	96%	384

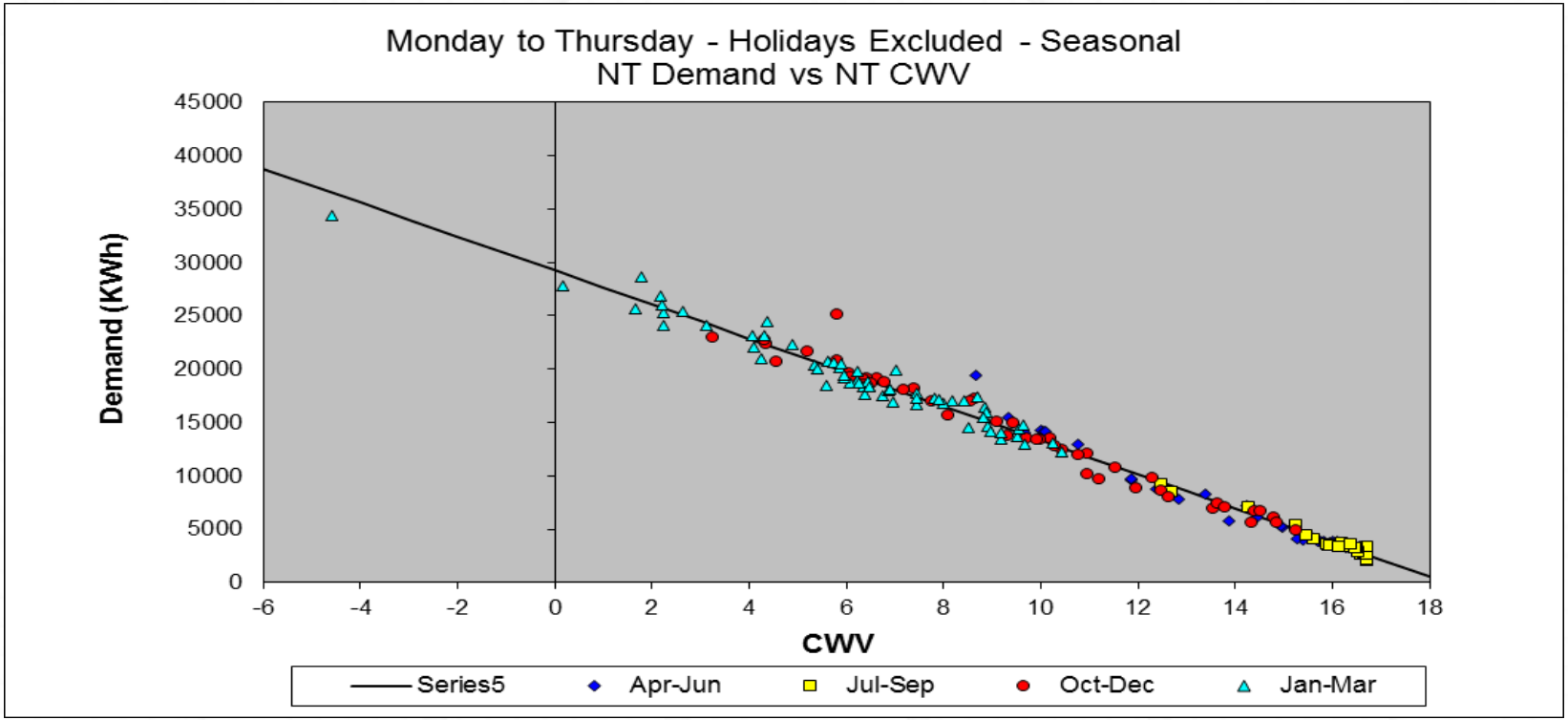
- ILFs generally in line with last year.
- R^2 values across all LDZs are in the range 95%-99%.
- Highlighted rows indicate the best and worst R^2 values.
- Sample sizes have significantly increased for all LDZs in comparison to 17/18.

Small NDM Modelling Results: WN LDZ, Band 1 Domestic Non-PPM



- WN has the lowest R^2 value of the models in this band – 95.3% (all days).
- Potential data errors within Band 1 Dom – these are currently under investigation and results will be updated for Monday's meeting

Small NDM Modelling Results: NT LDZ, Band 1 Domestic Non-PPM



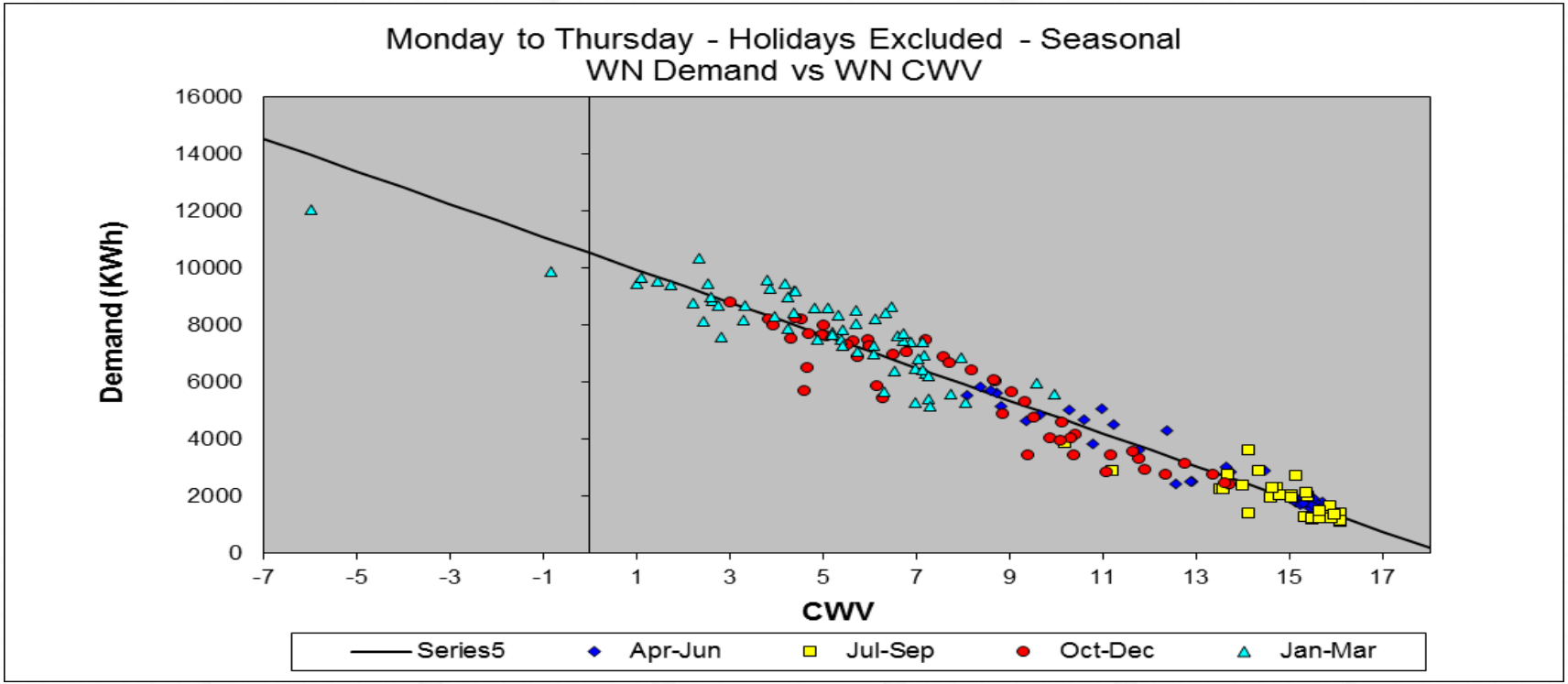
- NT has the highest R^2 value of the models in this band – 98.7% (all days).

Small NDM Modelling Results: EUC Band 1 – I&C Non-PPM

0 to 73.2 MWh pa I&C Non-PrePayment	Indicative Load Factor (ILF)	R^2 Multiple Correlation Coefficient (All days)	Sample Size (Supply Points)
SC	32%	95%	379
NO	34%	95%	118
NW	33%	96%	197
NE	31%	96%	112
EM	29%	96%	206
WM	30%	96%	231
WN	30%	93%	39
WS	32%	95%	93
EA	30%	94%	303
NT	34%	97%	235
SE	29%	98%	246
SO	28%	96%	185
SW	32%	95%	166

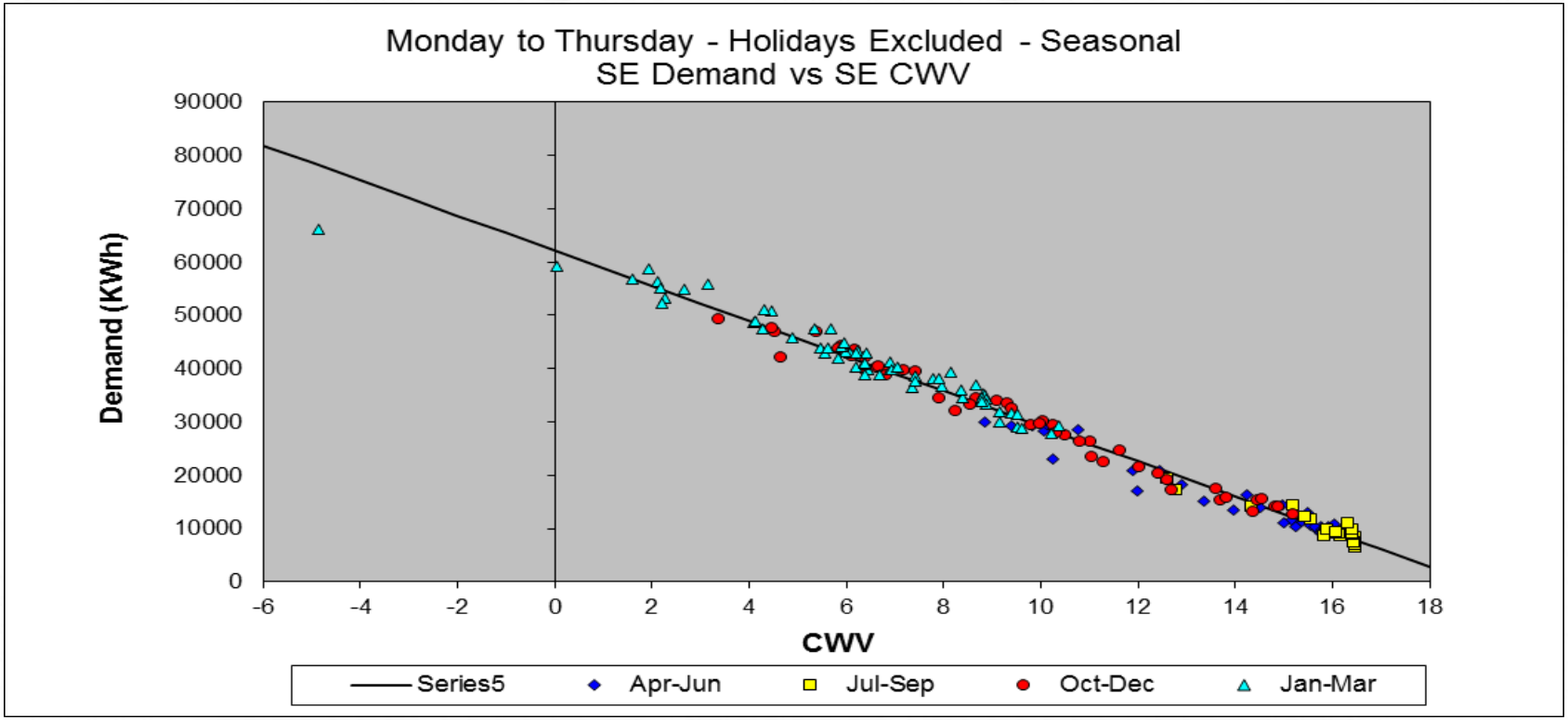
- All LDZs (except for SC) have less than the suggested sample size (targets ranges from 364 – 382).
- ILFs generally in line with last year.
- R^2 values across all LDZs are in the range 93%-98%.

Small NDM Modelling Results: WN LDZ, Band 1 I&C Non-PPM



- WN has the lowest R^2 value of the models in this band – 92.6% (all days).

Small NDM Modelling Results: SE LDZ, Band 1 I&C Non-PPM



- SE has the highest R^2 value of the models in this band – 97.7% (all days).

Pre Payment Data

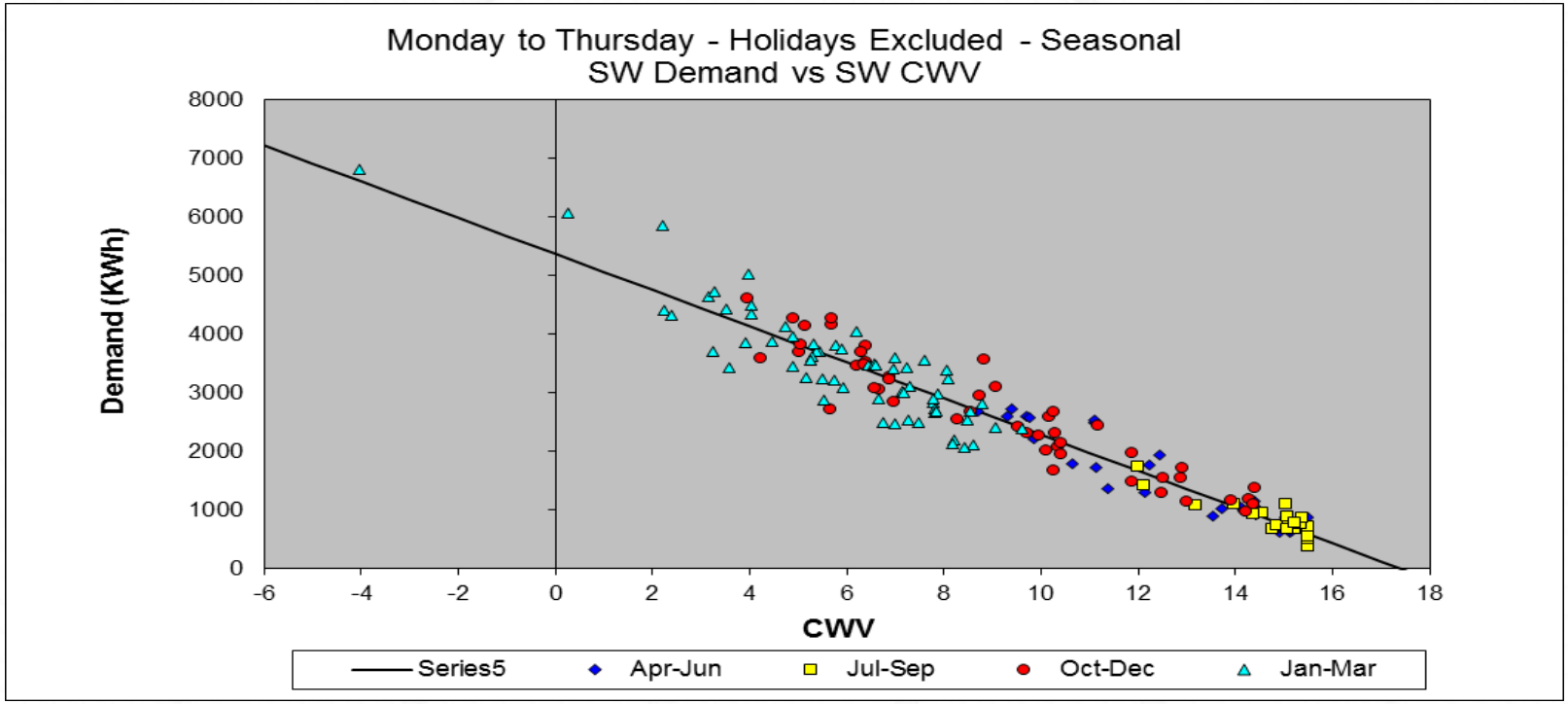
- Daily consumption data for pre-payment customers was provided by Third parties, consisting of 1,325 MPRs (SMART data)
- After applying validation this number reduced to 1,291 (1,288 Domestic; 3 I&C)
- Last year, the data used to derive the pre-payment profile for Band 1 was based on periodic reads (i.e. non-daily). Daily consumption was derived by applying the 01B WAALP and therefore did not necessarily represent actual daily behaviour.
- Analysis previously presented at DESC indicates pre-payment customers exhibit a 'flatter' less weather sensitive profile when compared to the standard 01B Domestic customer. The observed ILF results from this years analysis appear to support this (all ILFs bigger than equivalent Domestic Non-PPM model)

Small NDM Modelling Results: EUC Band 1 – Domestic PPM

0 to 73.2 MWh pa Domestic PrePayment	Indicative Load Factor (ILF)	R^2 Multiple Correlation Coefficient (All days)	Sample Size (Supply Points)
SC	36%	95%	84
NO	35%	94%	75
NW	33%	94%	87
NE	36%	93%	84
EM	32%	94%	85
WM	34%	93%	88
WN	31%	93%	87
WS	33%	94%	92
EA	36%	93%	89
NT	33%	94%	86
SE	32%	95%	90
SO	29%	94%	85
SW	32%	92%	88

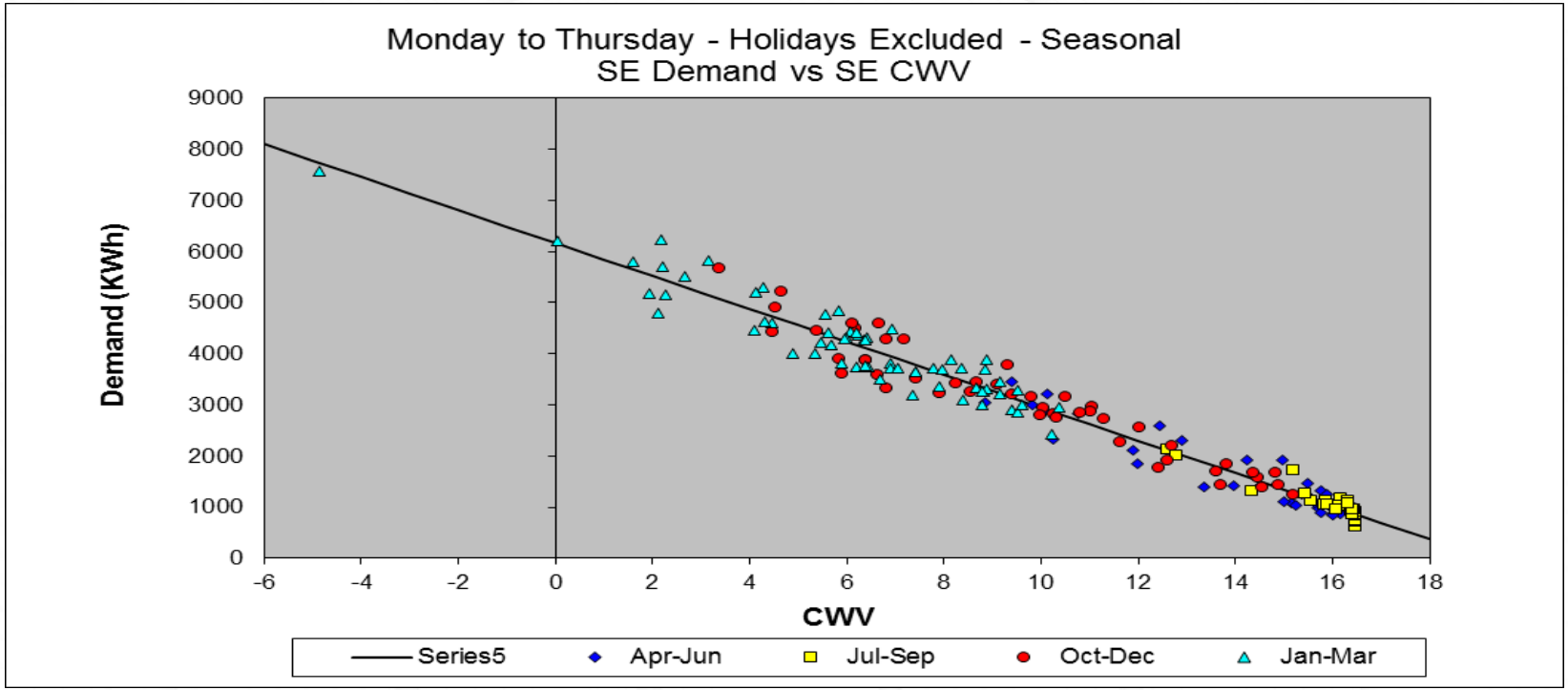
- ILFs are lower than those derived last year (daily volumes were not available last year).
- R^2 values across all LDZs are in the range 92%-95%
- No decision on this year results, however for smoothing do TWG wish to include last years model ?.

Small NDM Modelling Results: SW LDZ, Band 1 Domestic PPM



- SW has the lowest R^2 value of the models in this band – 91.6% (all days).

Small NDM Modelling Results: SE LDZ, Band 1 Domestic PPM



- SE has the highest R^2 value of the models in this band – 94.7% (all days).

Weekend Effects

- With the introduction of new EUC models, observing R^2 values and ILFs may not be enough on its own to confirm a difference in the underlying behaviour.
- Interrogating the weekend effects is a good way to examine if the new EUCs are displaying an increase or decrease in demand where expected and not just observing the strength of Demand/CWV relationship.

EUC Bands	Expected Behaviour
• Band 1 PPM Domestic • Band 1 Non-PPM Domestic • Band 2 Non-PPM Domestic	*Expected overall INCREASE in demand on the weekend days*
• Band 1 Non-PPM I&C • Band 2 Non-PPM I&C	*Expected overall DECREASE in demand on the weekend days*

- The following slides show the results from the modelling runs on the new EUCs.

Analysis of weekend effects – Band 1

	Band 1 Non-PPM Domestic			Band 1 PPM Domestic			Band 1 Non-PPM I&C		
LDZ	Fri	Sat	Sun	Fri	Sat	Sun	Fri	Sat	Sun
SC	not sig. -	not sig. +	not sig. +	not sig. -	not sig. -	0.962	0.889	0.723	0.78
NO	not sig. -	not sig. +	not sig. +	not sig. +	1.06	not sig. -	0.955	0.807	0.755
NW	not sig. +	not sig. +	not sig. +	not sig. +	1.083	not sig. -	0.956	0.858	0.836
NE	not sig. -	not sig. +	not sig. +	not sig. +	1.062	not sig. -	0.939	0.807	0.814
EM	not sig. -	not sig. +	not sig. +	not sig. +	1.061	not sig. -	0.899	0.699	0.735
WM	not sig. +	1.033	not sig. +	not sig. +	1.08	not sig. -	0.914	0.801	0.825
WN	not sig. -	not sig. +	not sig. +	not sig. -	1.057	not sig. -	0.913	0.796	0.806
WS	not sig. -	not sig. +	not sig. +	not sig. -	1.072	not sig. -	0.955	0.818	0.795
EA	not sig. +	1.034	not sig. +	not sig. -	not sig. +	not sig. +	0.886	0.673	0.731
NT	not sig. -	1.024	not sig. +	not sig. +	1.069	not sig. +	0.95	0.826	0.825
SE	not sig. +	1.043	not sig. +	not sig. +	1.089	not sig. +	0.946	0.846	0.84
SO	not sig. +	not sig. +	not sig. +	not sig. +	not sig. +	not sig. -	not sig. -	0.878	0.828
SW	not sig. +	1.057	not sig. +	not sig. +	1.075	not sig. +	not sig. -	0.887	0.883

- The difference that we are seeing between the domestic and I&C profiles is as expected.
- Band 1 Non-PPM Domestic customers display a slight increase in demand (values greater than 1) on weekends compared to a Mon-Thu model (although in most cases this difference is not statistically significant).
- Domestic Pre-Payment customers in Band 1 appear to display a slight increase in demand (values greater than 1) on Saturdays, although Sundays show a marginal decrease in demand (although not statistically significant in most instances) on Sundays, when compared to a Mon-Thu model.
- Band 1 Non-PPM I&C customers display an overall decrease in demand (values less than 1) on all weekend days.

Small NDM Modelling Results: EUC Band 2 – Domestic Non-PPM

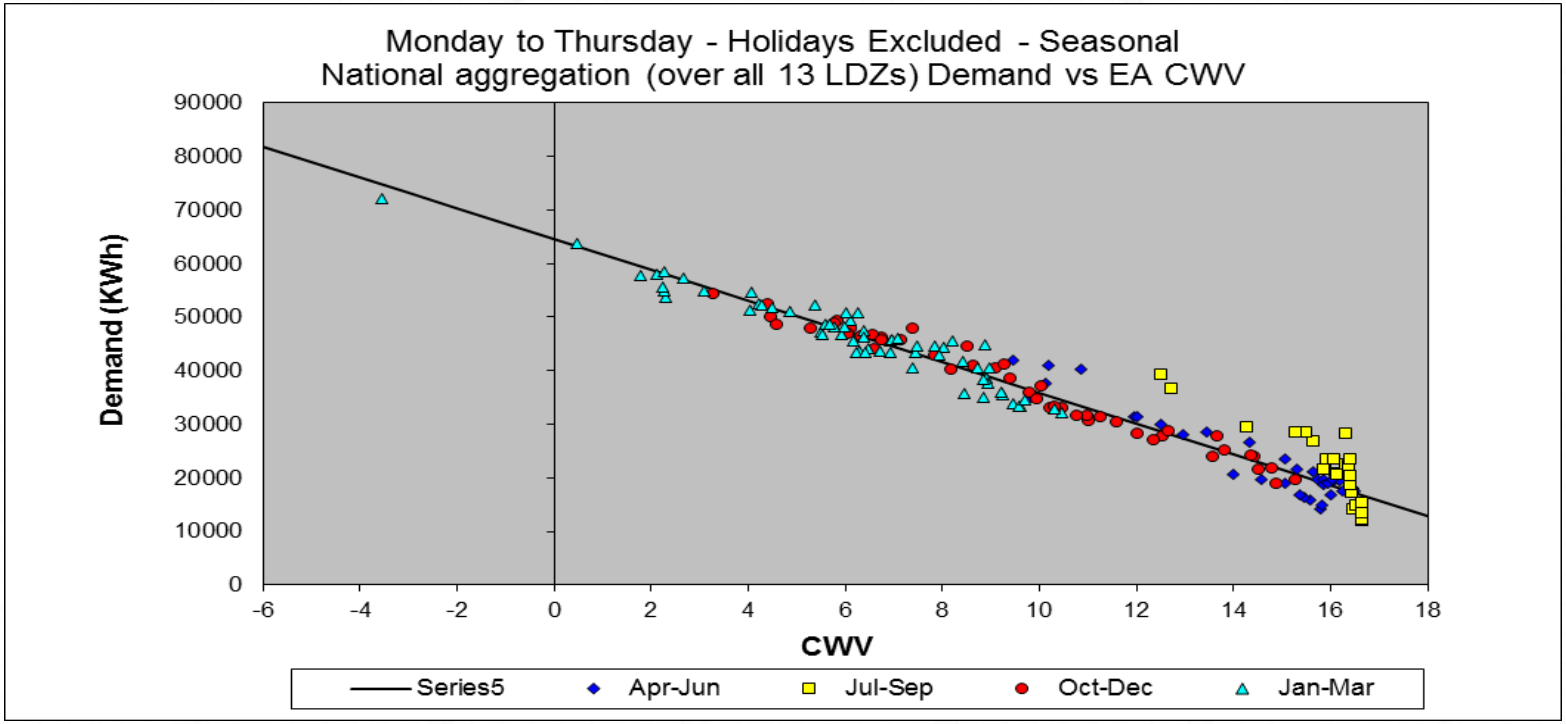
Run 1: All LDZ's				Run 2: 2 LDZ Groups			
National	37%	96%	109	(SC/NO/NW/WN/NE/EM/WM)	39%	95%	56
				(EA/NT/SE/WS/SO/SW)	36%	97%	53

Indicative Load Factor (ILF) : **R^2 Multiple Correlation Coefficient (All days)** : **Sample Size (Supply Points)**

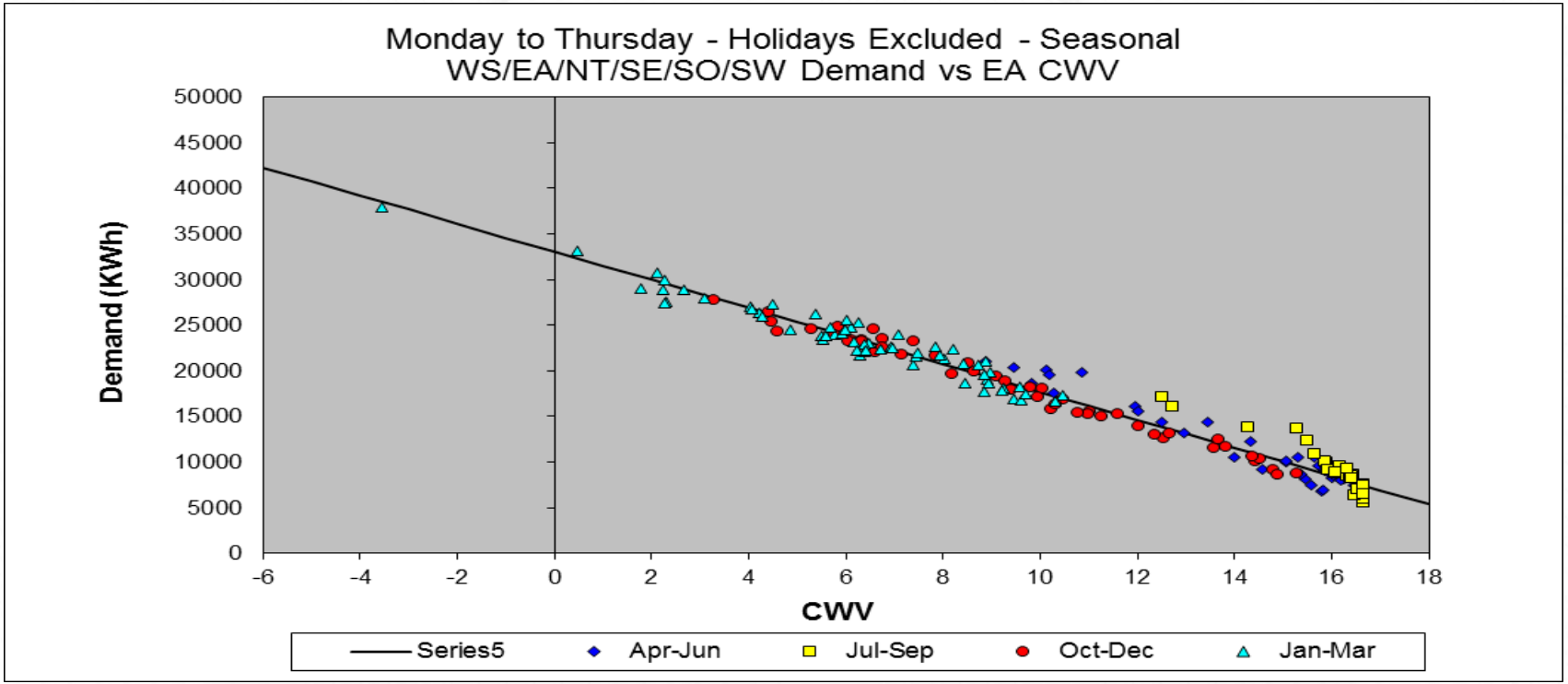
- **Decision required by TWG between the following aggregations:**
  - **ALL LDZs**
    or
  - **2 LDZ Groups**

- ILFs are marginally lower than last year.
- Sample sizes for both options are below the suggested size (numbers have reduced slightly compared to 17/18 available data).

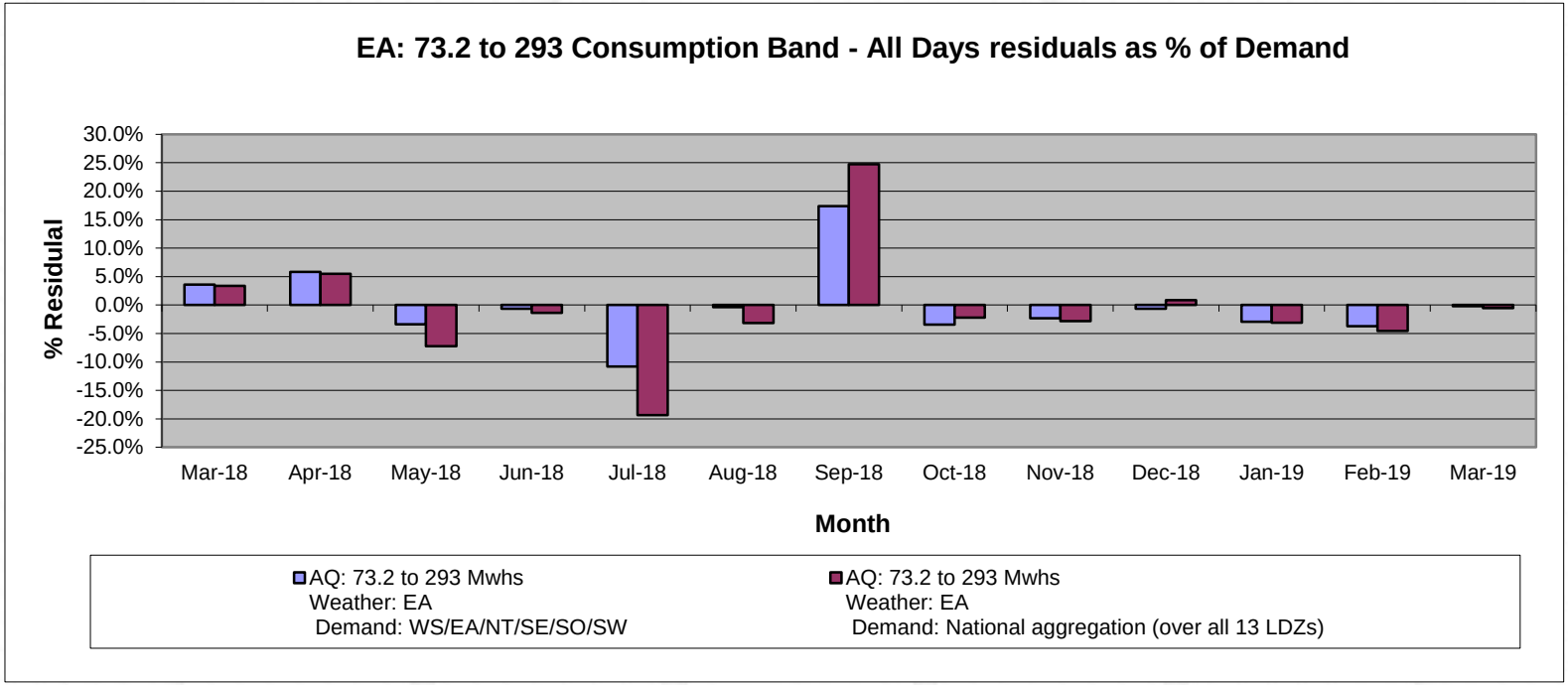
Small NDM Modelling Results: EUC Band 2 Domestic Non-PPM Run 1 (All LDZs)



Small NDM Modelling Results: EUC Band 2 Domestic Non-PPM Run 2 (2 Groups)



Small NDM Modelling Results: EUC Band 2 – Domestic Non-PPM



- Chart shows a comparison of monthly residuals (all days) for the two models tested.
- **TWG to decide on preferred model**

Small NDM Modelling Results: EUC Band 2 – I&C Non-PPM

73.2 to 293 MWh pa I&C Non-PrePayment	Indicative Load Factor (ILF)	R^2 Multiple Correlation Coefficient (All days)	Sample Size (Supply Points)
SC	36%	95%	215
NO	37%	96%	136
NW	38%	97%	273
NE	37%	97%	168
EM	33%	95%	347
WM	33%	94%	375
WN	32%	91%	38
WS	37%	96%	124
EA	30%	93%	372
NT	38%	97%	377
SE	34%	98%	300
SO	34%	97%	270
SW	35%	95%	246

- ILFs are slightly lower than those derived last year.
- R^2 values across all LDZs are in the range 91%-98%.

Analysis of weekend effects – Band 2

- Band 2 Domestic sample sites were provided by Technolog and 3rd Party.
- Spot checks were taken internally to confirm that these sites are genuine domestic sites. It appears that the vast majority that make up the profile are domestic sites.
- The following table displays the results of the weekend effects.
- The direction of the difference that we are seeing between the domestic profiles are not what we necessarily expected.

- In the '2 Groups' aggregation it shows that the Saturday behaviour for all but one LDZ is not statistically different to the Mon-Thu profile – and is showing a decrease in demand overall. It also shows a similar pattern on Sundays, where the Domestic customer has a decrease in demand in comparison to the Mon-Thu profile, with some of those being a statistical significant difference.
- In the 'National' aggregation we are seeing a similar pattern as the '2 Groups' aggregation.
- Band 2 Non Domestic customers display an overall decrease in demand on weekends, which is what we would expect for a non domestic profile. This reduction ranges anywhere between 2-29%.

Analysis of weekend effects – Band 2 cont.

	Band 2 Non-PPM Domestic (2 grps)			Band 2 Non-PPM Domestic (Nat)			Band 2 Non-PPM I&C		
LDZ	Fri	Sat	Sun	Fri	Sat	Sun	Fri	Sat	Sun
SC	not sig. +	not sig. -	not sig. -	not sig. +	0.972	0.96	0.913	0.772	0.834
NO	not sig. +	not sig. -	not sig. -	not sig. +	not sig. -	0.971	0.958	0.805	0.818
NW	not sig. +	not sig. -	not sig. -	not sig. +	not sig. -	0.966	0.961	0.892	0.883
NE	not sig. +	not sig. -	not sig. -	not sig. +	0.979	0.969	0.967	0.843	0.83
EM	not sig. +	not sig. -	not sig. -	not sig. +	not sig. -	0.972	0.898	0.715	0.768
WM	not sig. +	not sig. -	not sig. -	not sig. +	not sig. -	0.972	0.912	0.721	0.77
WN	not sig. +	not sig. -	not sig. -	not sig. +	not sig. -	0.966	0.889	0.666	0.704
WS	not sig. +	0.969	0.95	not sig. +	not sig. -	0.972	0.969	0.896	0.837
EA	1.029	not sig. -	0.964	1.033	not sig. -	not sig. -	0.883	0.617	0.723
NT	1.027	not sig. -	0.964	not sig. +	not sig. -	not sig. -	0.968	0.848	0.86
SE	1.027	not sig. -	0.966	not sig. +	not sig. -	not sig. -	0.976	0.851	0.834
SO	1.029	not sig. -	0.958	not sig. +	not sig. -	not sig. -	0.968	0.868	0.868
SW	not sig. +	not sig. -	0.959	not sig. +	not sig. -	not sig. -	0.963	0.832	0.831

Small NDM Modelling Results: EUC Band 3

293 to 732 MWh pa	Indicative Load Factor (ILF)	R^2 Multiple Correlation Coefficient (All days)	Sample Size (Supply Points)
SC	35%	94%	355
NO	42%	97%	161
NW	39%	97%	313
NE	39%	97%	187
EM	39%	97%	280
WM	38%	97%	255
WN	37%	94%	40
WS	39%	96%	73
EA	35%	96%	296
NT	38%	97%	320
SE	36%	98%	311
SO	34%	97%	237
SW	38%	96%	232

- ILFs for majority of LDZs are comparable to last year.
- R^2 values across all LDZs are in the range 94%-98%.
- Sample sizes have reduced slightly for most LDZs in comparison to 17/18.

Small NDM Modelling Results: EUC Band 4

732 to 2,196 MWh pa	Indicative Load Factor (ILF)	R^2 Multiple Correlation Coefficient (All days)	Sample Size (Supply Points)
SC	36%	97%	326
NO	38%	97%	212
NW	36%	97%	262
NE	39%	96%	286
EM	37%	98%	182
WM	35%	97%	219
WN	40%	93%	35
WS	37%	97%	74
EA	37%	97%	234
NT	38%	97%	269
SE	36%	97%	315
SO	34%	97%	302
SW	38%	96%	180

- ILFs for majority of LDZs are comparable to last year.
- R^2 values across all LDZs are in the range 93%-98%.
- There is a small reduction in sample sizes in most LDZs when compared to 17/18.

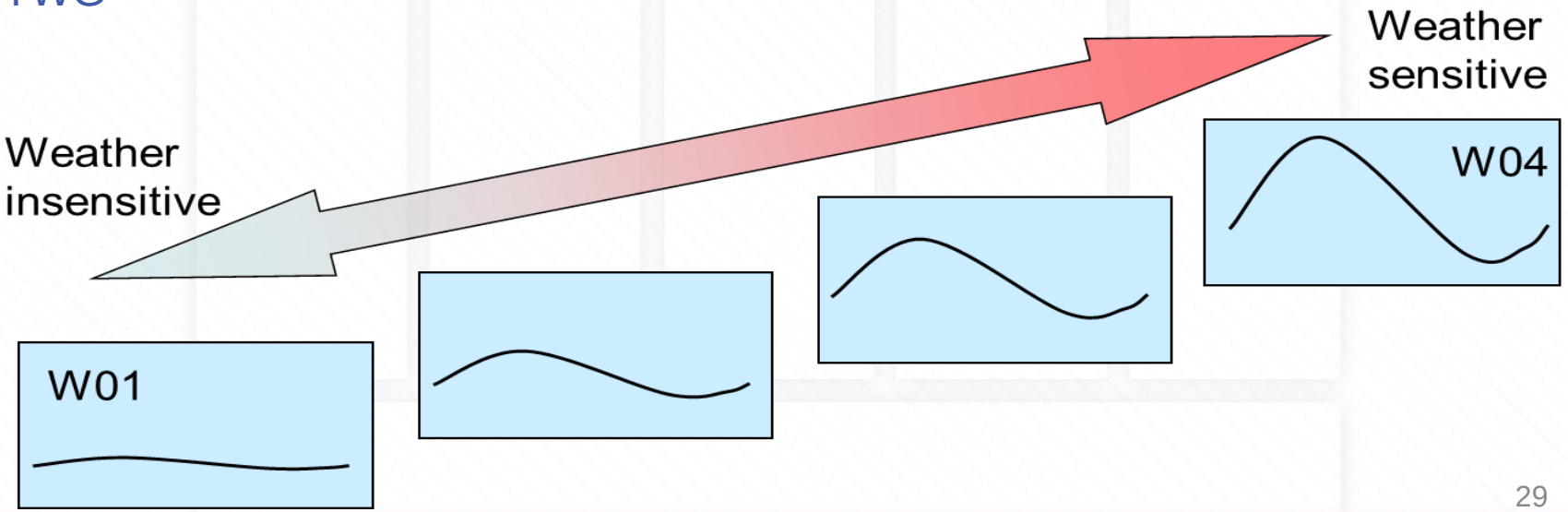
Section 3 – Part 2

Small NDM WAR Bands: 3 to 4
AQ Range: 293 to 2,196 MWh pa

Single Year Results for 2018/19 sample data

Winter Annual Ratio (WAR) Bands

- Higher AQ Bands where meter points are monthly read have a consumption band EUC plus 4 differential EUCs based on ratio of winter consumption to total annual consumption. Sites with adequate read history allocated automatically to a WAR Band based on system calculation during AQ review
- WAR Band limits for Spring 2019 analysis were discussed and agreed at April TWG



Small NDM WAR Bands: Agreed Modelling Runs

EUC Bands: Range	Comments on 2018/19 data TWG Agreed Modelling Runs
Band 1: 0 to 73.2 MWh pa	Not generally Monthly read – no WAR Bands
Band 2: 73.2 to 293 MWh pa	Not generally Monthly read – no WAR Bands
Band 3 and Band 4 (combined): 293 to 2196 MWh pa	**Individual LDZ analysis (NW/WN combined)** **or** **Individual LDZ analysis (NW/WN and WS/SW combined)** Agreed WAR Ratios: 0.405; 0.463 and 0.535

- Modelling Runs agreed at April TWG.
- Sufficient data available to allow individual LDZ analysis except for NW/WN and possibly also WS/SW which are combined.

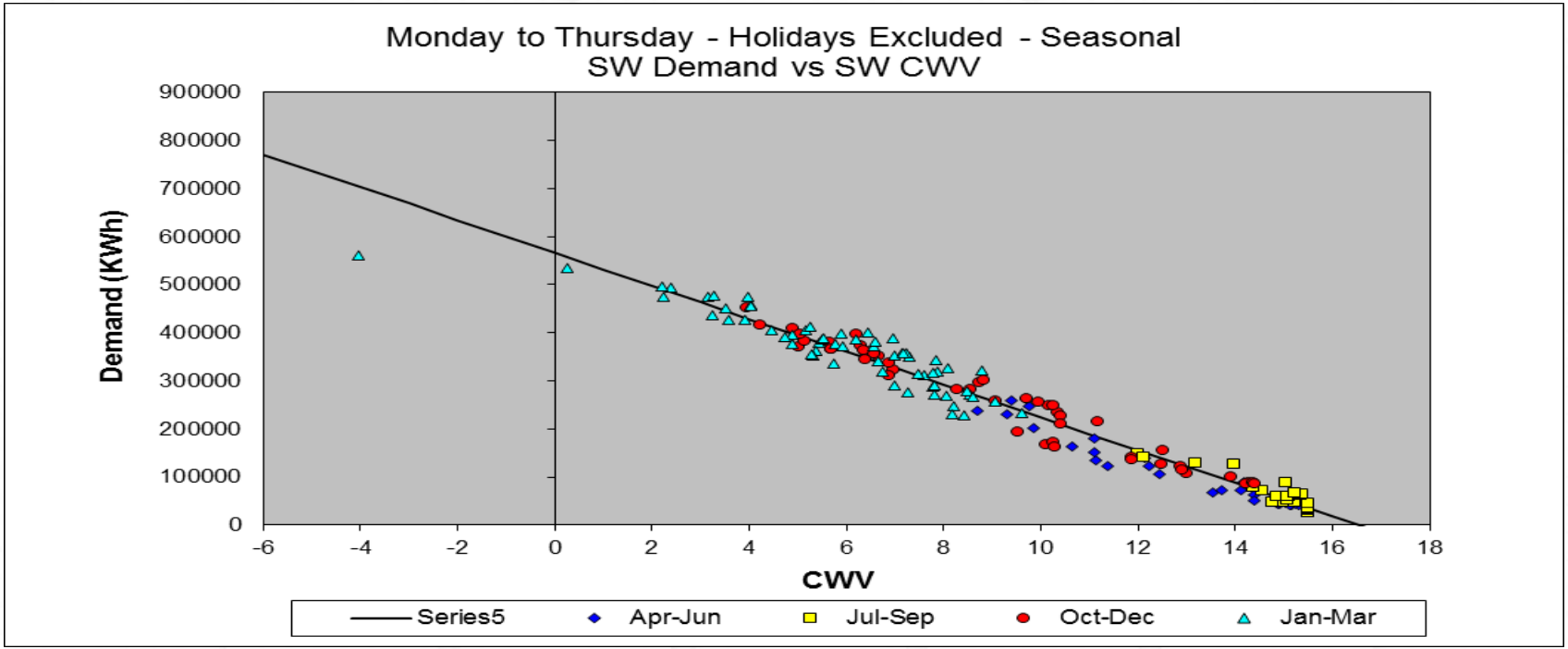
Small NDM Modelling Results: EUC Band 3 and 4 WARs

	WAR Band: 293 to 2196 MWh pa											
	Band 1 0.00 – 0.405			Band 2 0.405 – 0.463			Band 3 0.463 – 0.535			Band 4 0.535 – 1.00		
SC	59%	91%	92	43%	95%	218	31%	95%	264	26%	96%	107
NO	61%	85%	95	46%	97%	120	32%	96%	111	25%	95%	47
NW / WN	60%	86%	134	47%	95%	196	34%	96%	180	24%	93%	140
NE	59%	90%	114	45%	95%	159	33%	96%	125	26%	93%	75
EM	59%	94%	104	47%	94%	139	34%	97%	123	25%	95%	96
WM	56%	91%	98	44%	96%	153	32%	96%	149	24%	95%	74
WS	56%	86%	26	46%	95%	50	34%	96%	47	26%	92%	24
EA	60%	90%	86	45%	92%	142	34%	96%	166	25%	96%	136
NT	62%	84%	162	44%	95%	150	34%	96%	160	25%	96%	117
SE	63%	88%	101	46%	95%	207	34%	96%	169	25%	97%	149
SO	58%	81%	86	42%	96%	139	33%	97%	194	23%	96%	120
SW	63%	83%	92	46%	94%	121	35%	93%	107	25%	96%	92
WS / SW	61%	87%	118	46%	95%	171	34%	95%	154	25%	95%	116

Indicative Load Factor (ILF) : **R^2 Multiple Correlation Coefficient (All days)** : **Sample Size (Supply Points)**

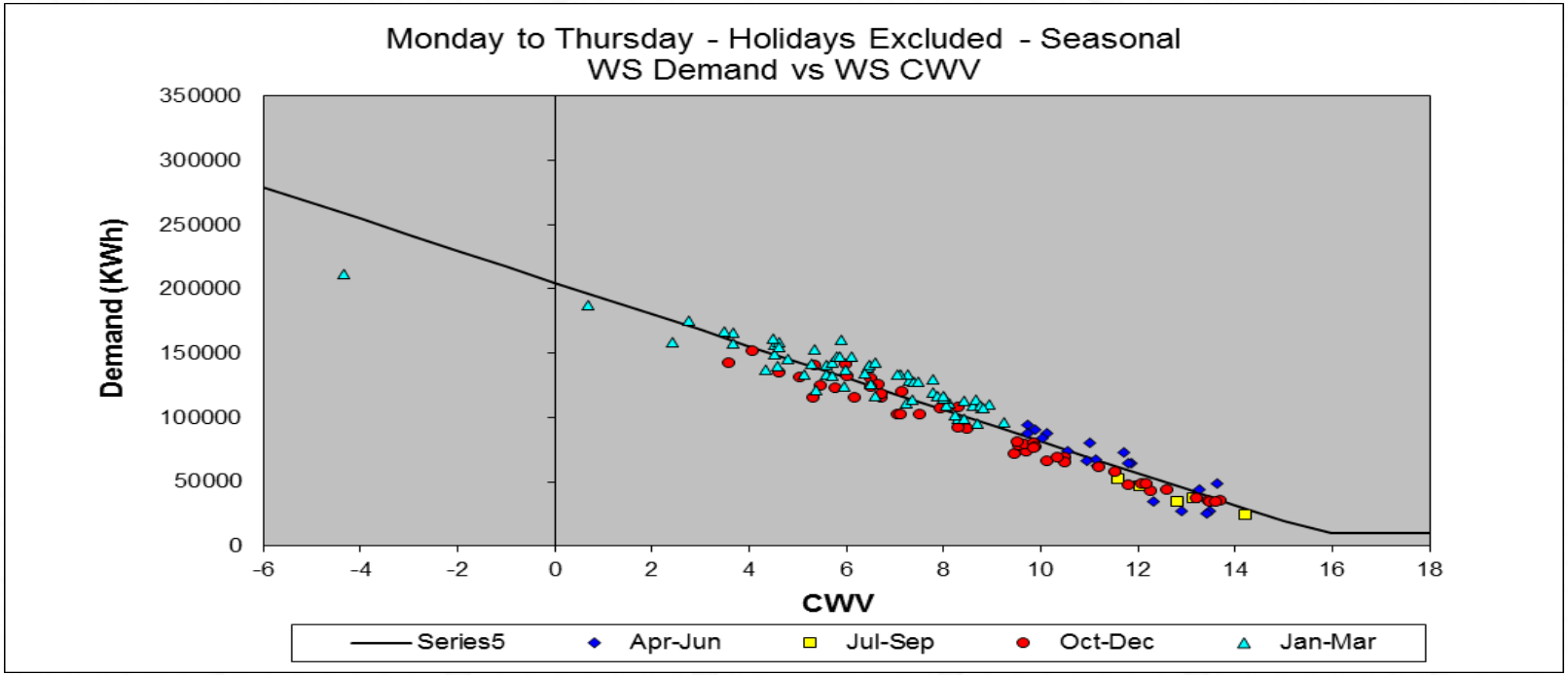
- ILFs and R^2 are generally in line with last year (R^2 values range from 81% to 97% over all LDZ / WAR bands)
- **Decision required by TWG:**
  - **1) Ind. LDZ analysis (NW/WN combined) or**
  - **2) Ind. LDZs analysis (NW/WN and WS/SW combined)**

SW LDZ War Band 4: 293 – 2196 MWh pa



Run	ILF	R^2 (All days)	Sample
SW	25%	96%	92
WS/SW	25%	95%	116

WS LDZ War Band 4: 293 – 2196 MWh pa



Run	ILF	R^2 (All days)	Sample
WS	26%	92%	24
WS/SW	25%	95%	116

SW LDZ War Band 4: 293 – 2196 MWh pa

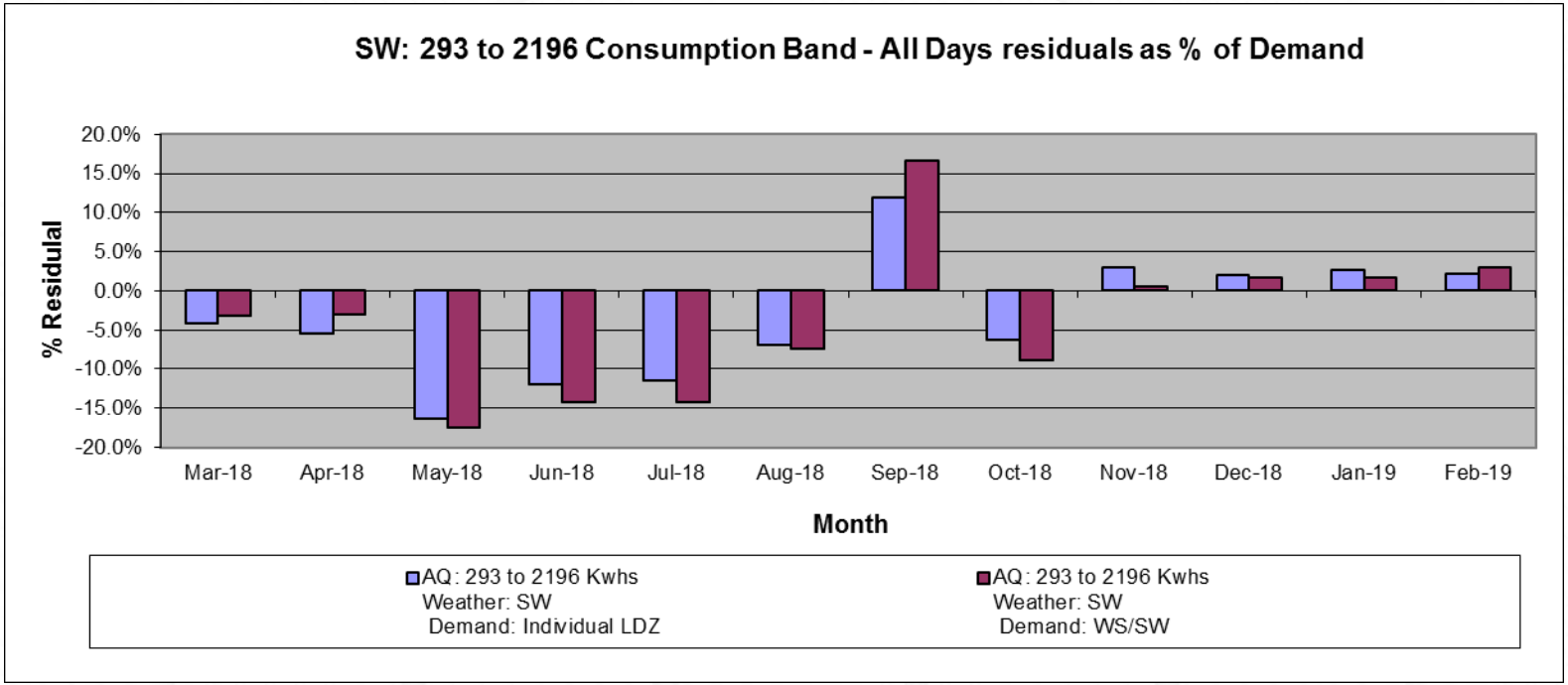


Chart shows a comparison of monthly residuals (all days) for the two models tested

TWG to decide on preferred model

WS LDZ War Band 4: 293 – 2196 MWh pa

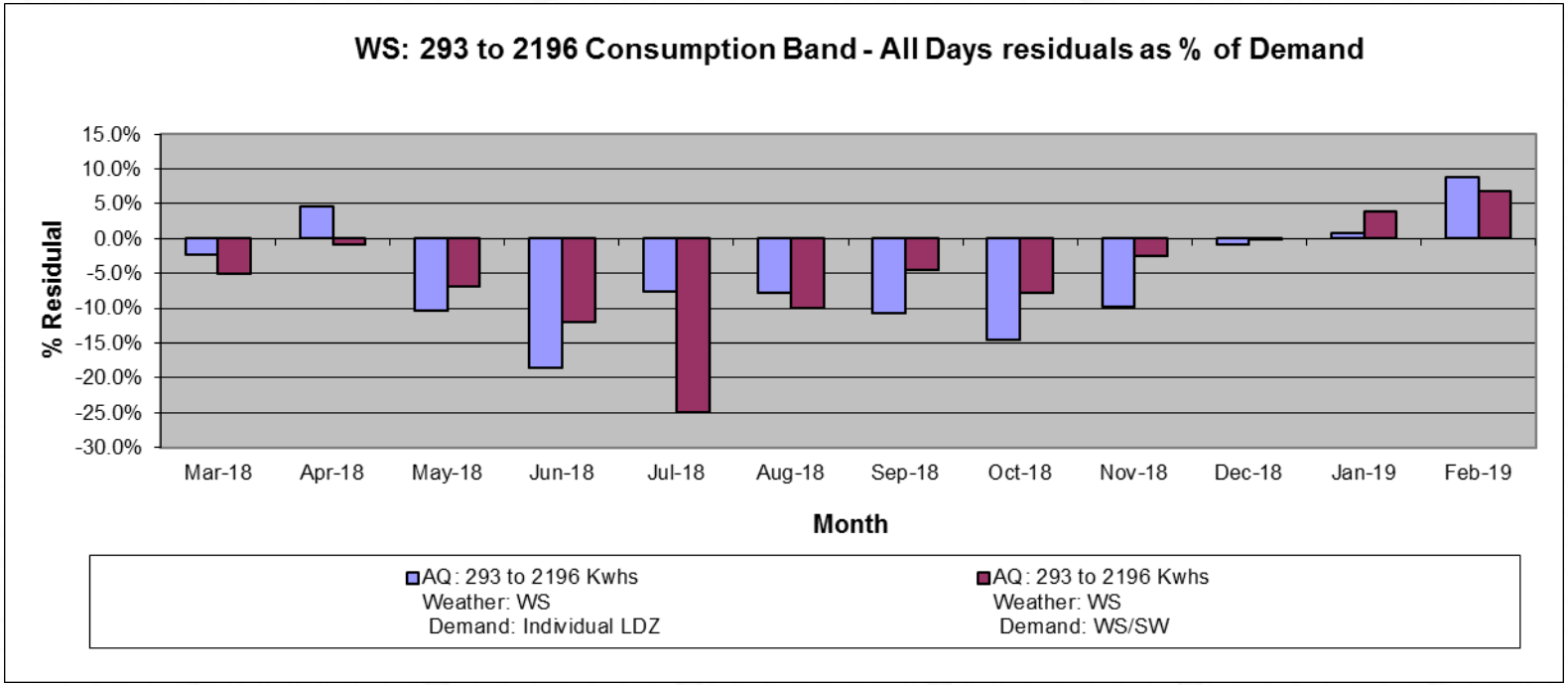


Chart shows a comparison of monthly residuals (all days) for the two models tested

TWG to decide on preferred model

Small NDM Modelling Results: Summary

- Good R^2 Coefficients for majority of Consumption Band and WAR Band models

- An overall increase in sample numbers compared to previous years has enabled:
  - Development for three of the six newly proposed models in Bands 1 and 2
    and
  - Individual analysis for LDZ WN for the majority of proposed models

- Are TWG happy to move to model smoothing phase with the Small NDM modelling results presented today ?