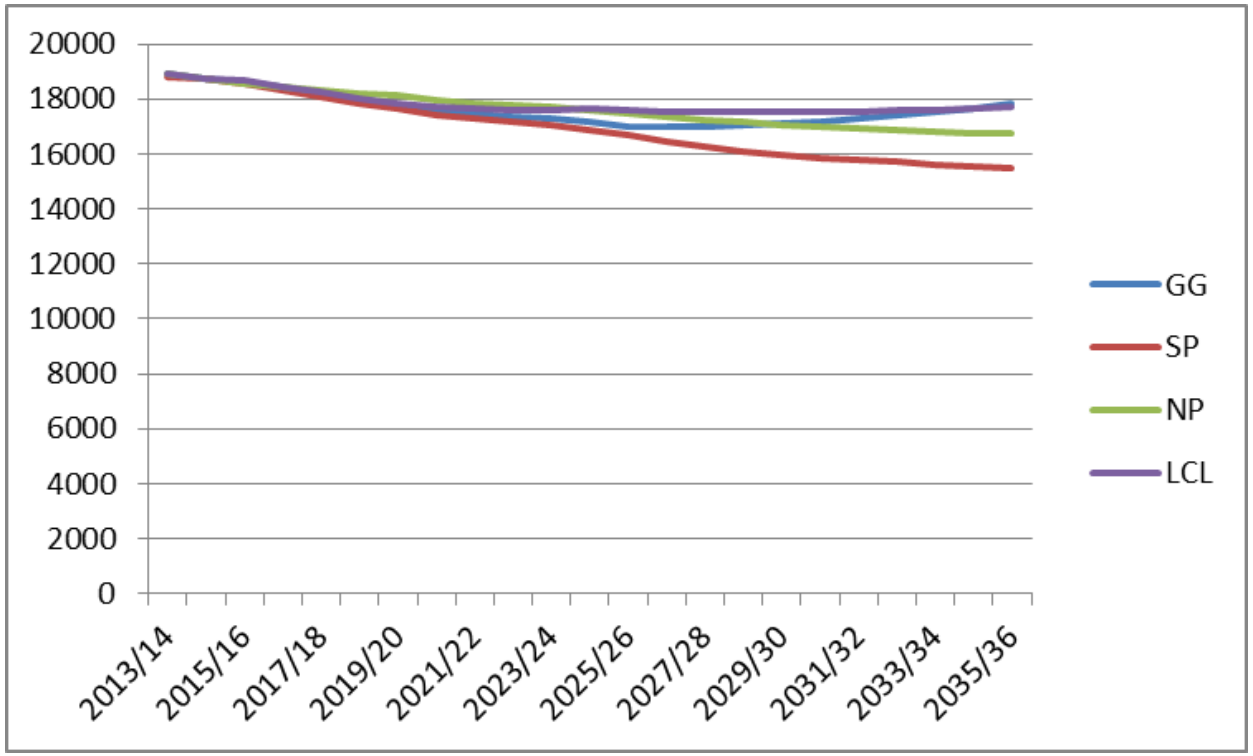
RfG – Banding; Operability context

Ben Marshall
SMARTer System Performance.

Topics.

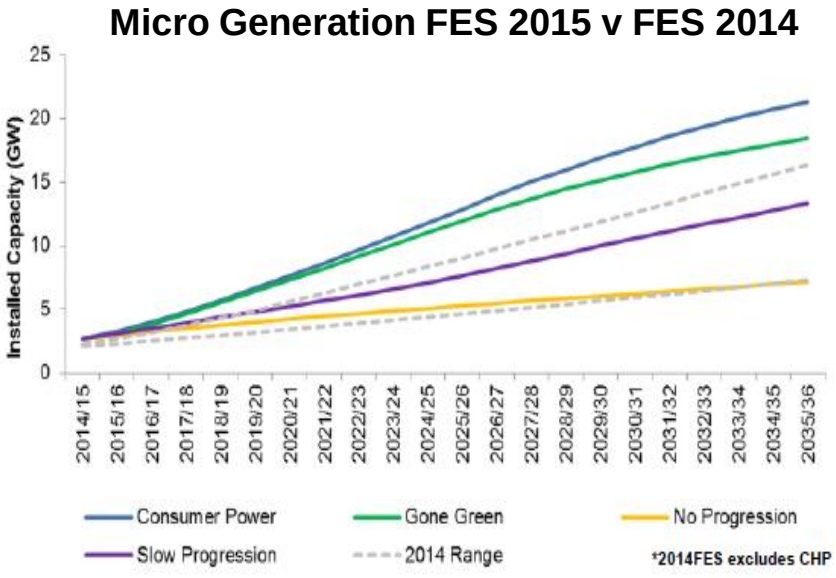
- FES 2014- what this said about minimum demand, and levels of DG & micro
- SOF 2014:- operability of these conditions.
- PV growth and challenge- is FES 2015 the end of this.
- FES 2015:- chapter 7 case study and what it means in this context.
- What this means for SOF 2015.
- Options for maintaining operability….

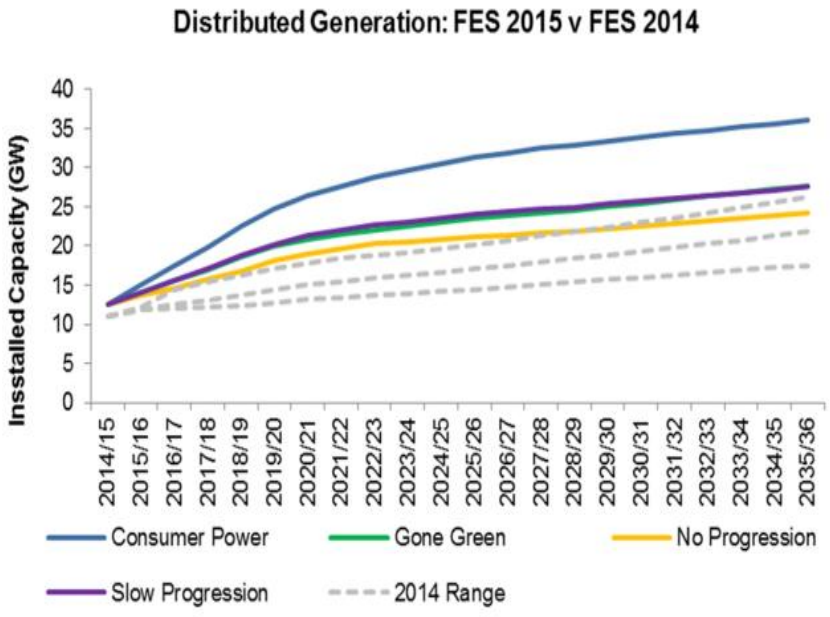
FES 2014- minimum demand.



- FES 2014-very similar demand projections…SP most onerous
- Minimum Demand 15.5GW
- All minimum period demands occur overnight as now.

FES 2014 vs 2015
DG & micro capacity comparisons.





- FES 2014- much lower range to 2015 in MG & DG levels.
- Underestimation of current year levels

The SOF 2014 impacts

- Against the context of minimum loads projected,1Hz/ s limit (GC032)could be maintained by limiting loss to worst case of 1064MW (within DMOL of nuclear)- 0.5Hz/s shows some risk.

Table 3 Loss of Infeed Tolerance 100% of Time to Maintain 0.5Hz/s Limit at All Load Conditions

Year	Gone Green	Slow Progression	Low Carbon Life	No Progression
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Table 4 Loss of Infeed Tolerance 100% of Time to Maintain 1.0Hz/s Limit at All Load Conditions

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Table 6 Percentage of time RoCoF>0.5Hz

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2024/25	5%	1%	2%	0%
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The SOF 2014 impacts

- In order to contain such events enhanced frequency response is required in excess of the ramp rates nominally requested. These equally represent either-
  - deloading of transmission connected generation
  - Demand-side services
- These are achievable base on FES 2014 data, based on the ranges of demand and inertia available

Table 7 Required Response Rate for 0.125 to 0.3Hz RoCoF and the Year It is Required

Inertia (GW.s)	RoCoF (Hz/s)	Time[8] (to reach 49.2 Hz)	Response Rate (MW/s)	Requirement			
				Gone Green	Slow Progression	Low Carbon Life	No Progression
360	0.125[9]	9	185	2014/15	2014/15	2014/15	2014/15
225	0.2	4	400	2019/20	2024/25	2024/25	2029/30
205	0.22	3.4	489	2024/25	2024/25	2024/25	2029/30
180	0.25	2.4	679	2024/25	2024/25	2024/25	2029/30
150	0.3	1.2	1148	2024/25	2024/25	2024/25	2034/35

Changes in the operational environment 2014-2015

- Greater embedded generation penetration
- Increased network forecast error
- Changes in load shape
- Limited control and visibility at low demands
- Increased downwards regulation issues

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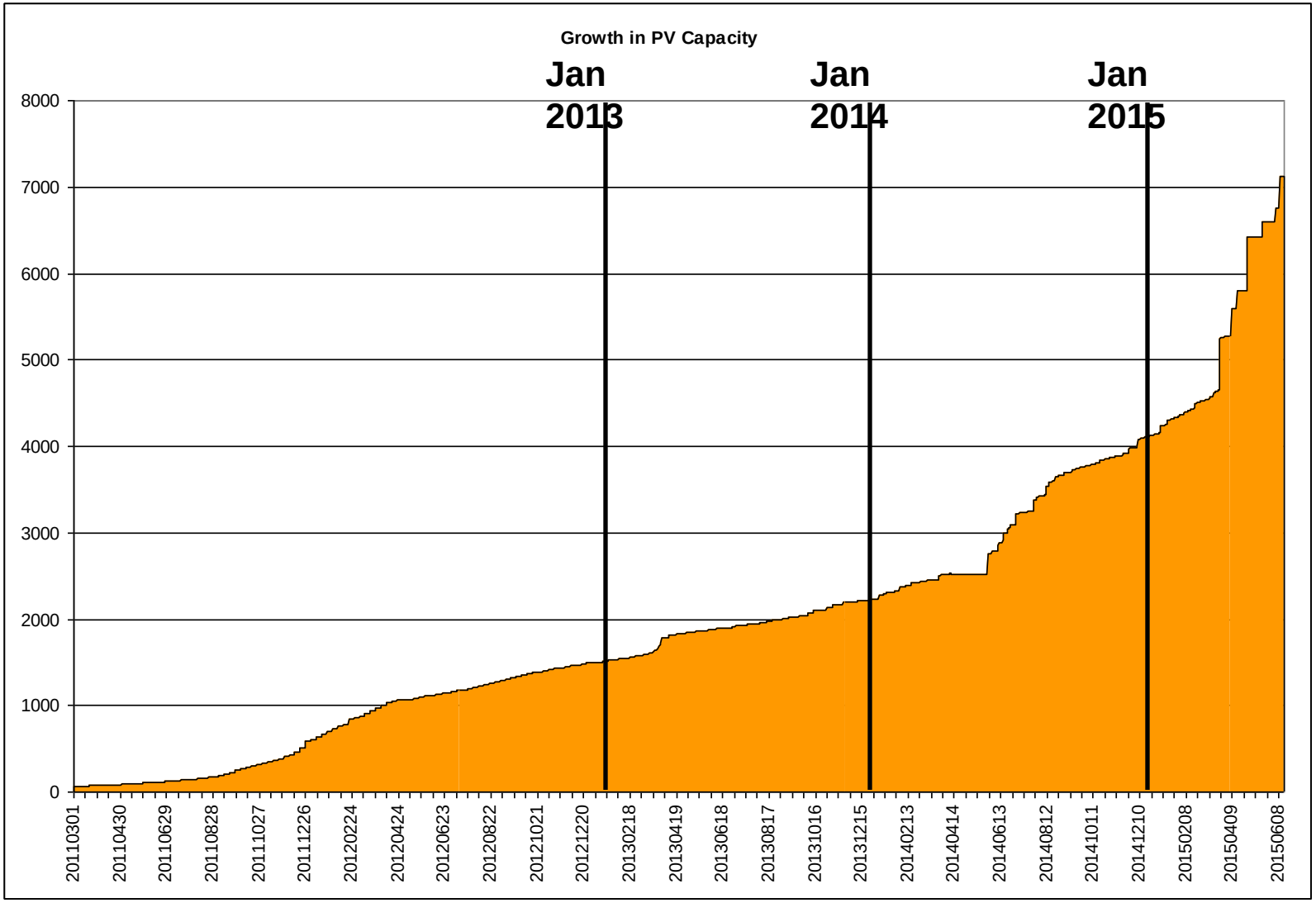
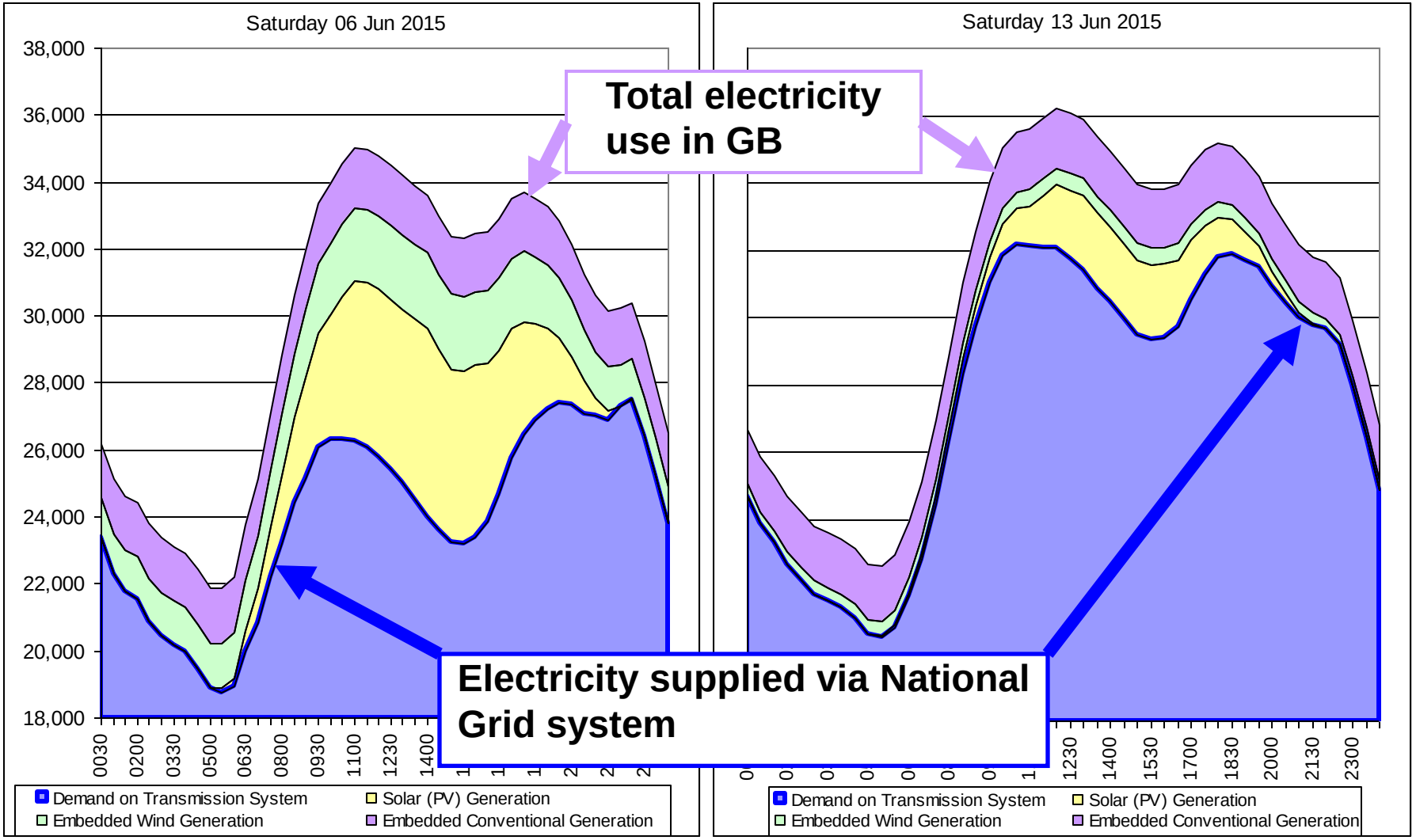
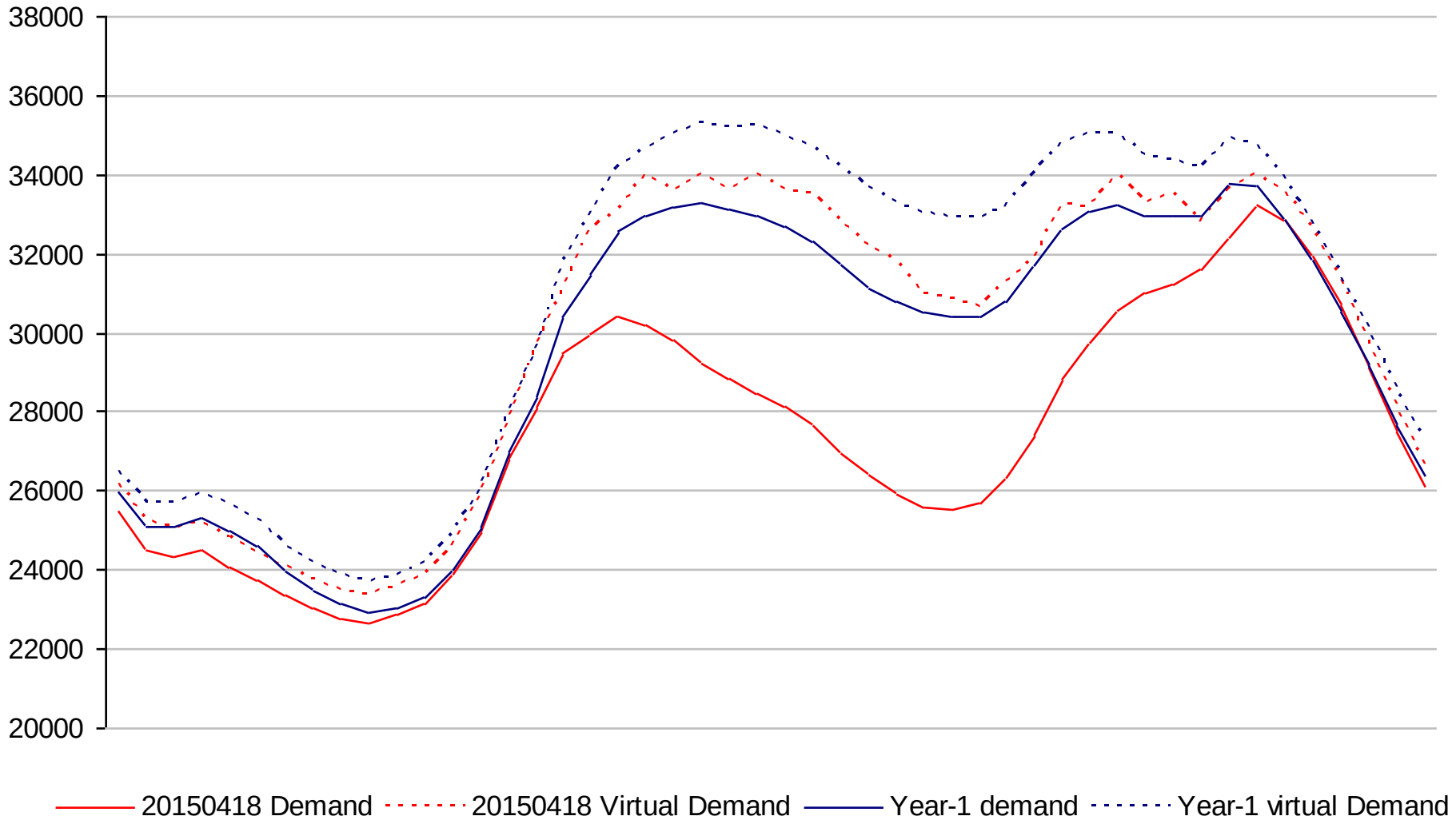
Growth in Solar Generation



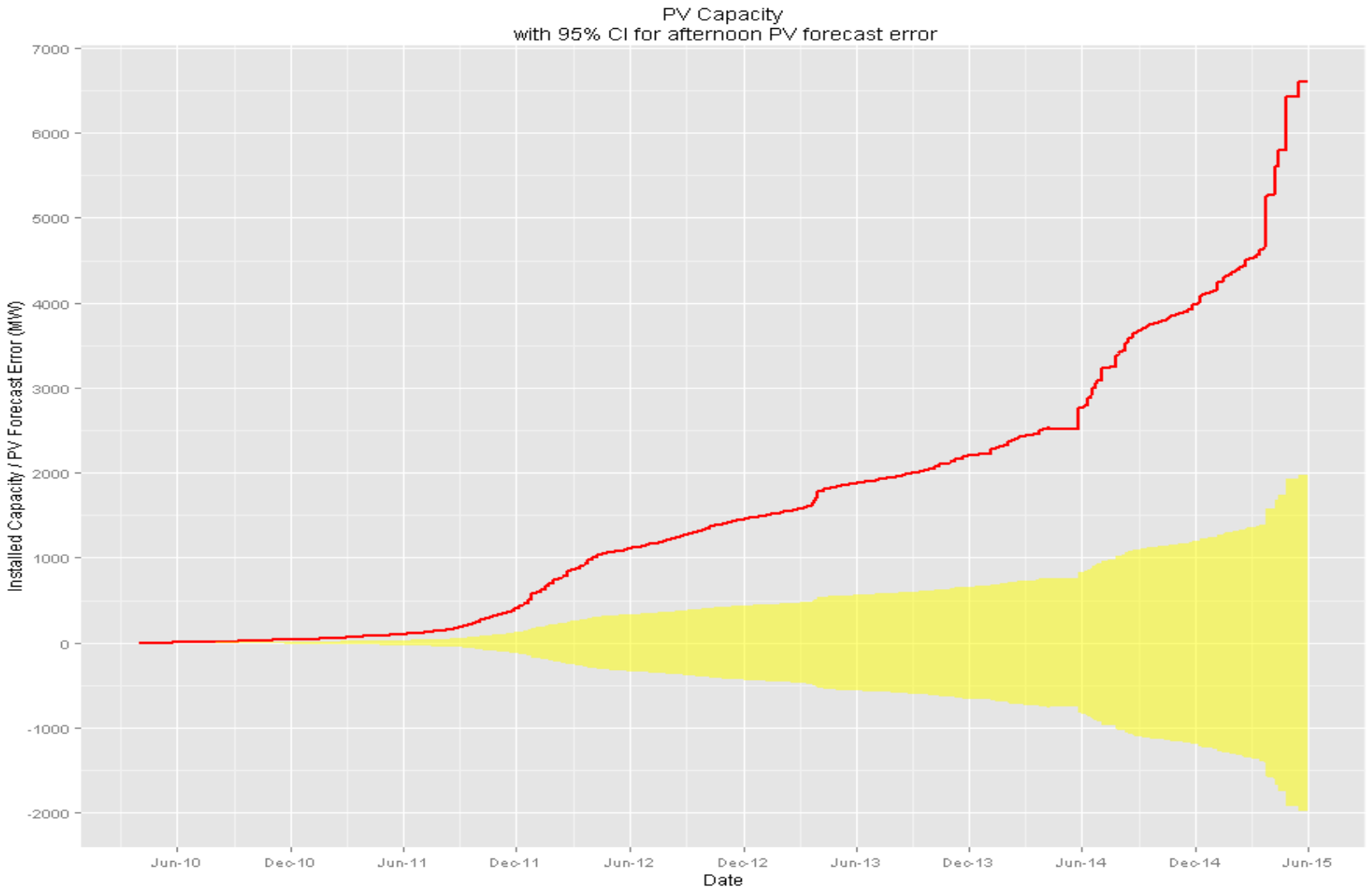
Difference between sunny and cloudy Saturdays



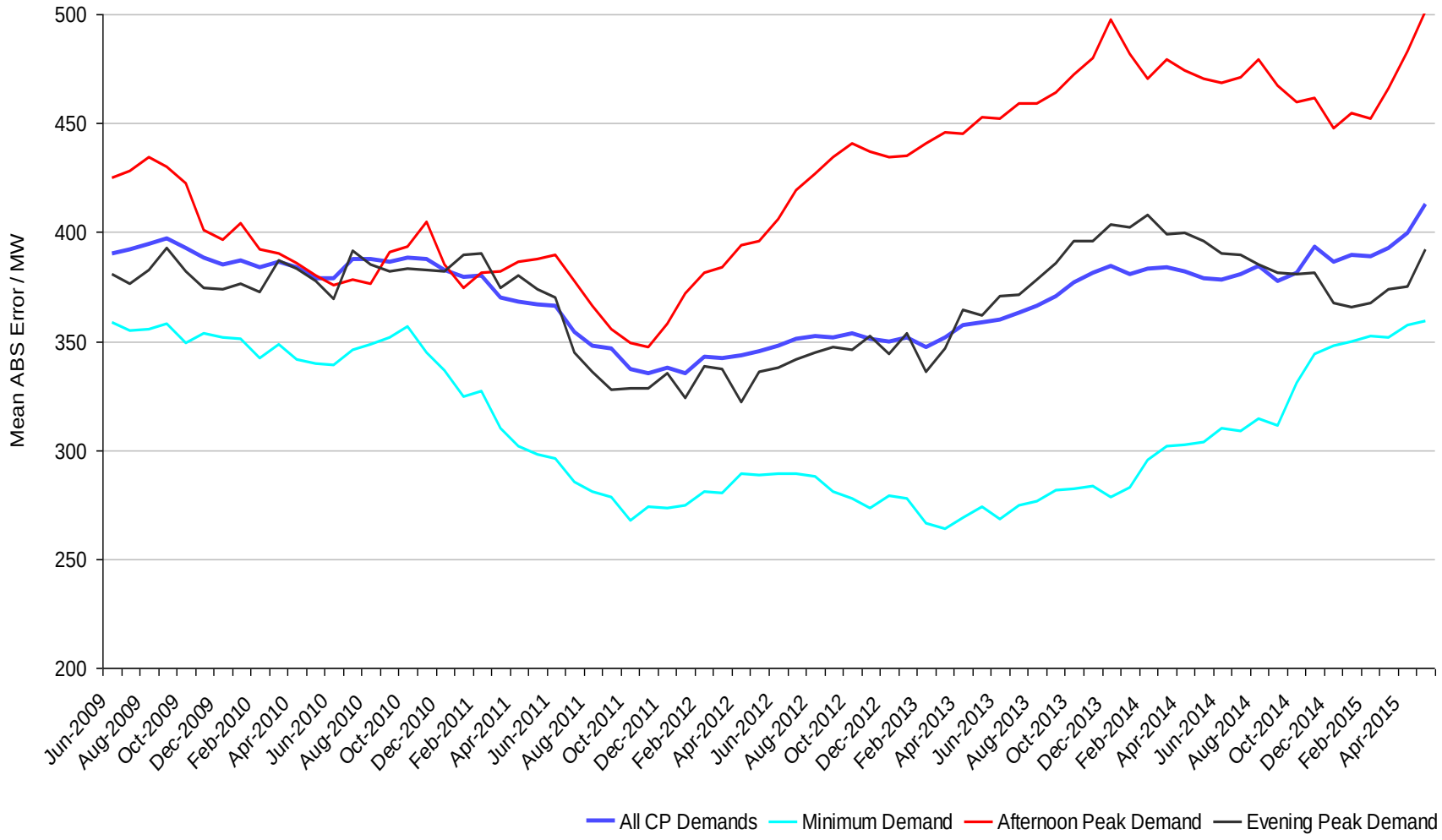
Saturday 20150418



Unmetered solar generation (estimate)



Demand Forecasting Accuracy



The FES 2015

- Recognises increase in embedded generation.
- Recognises impacts on daily load curve.
- Projects minimum transmission demands 30% of the minimum of 2014.

Future Energy Scenarios 2015 - Daily balancing challenge

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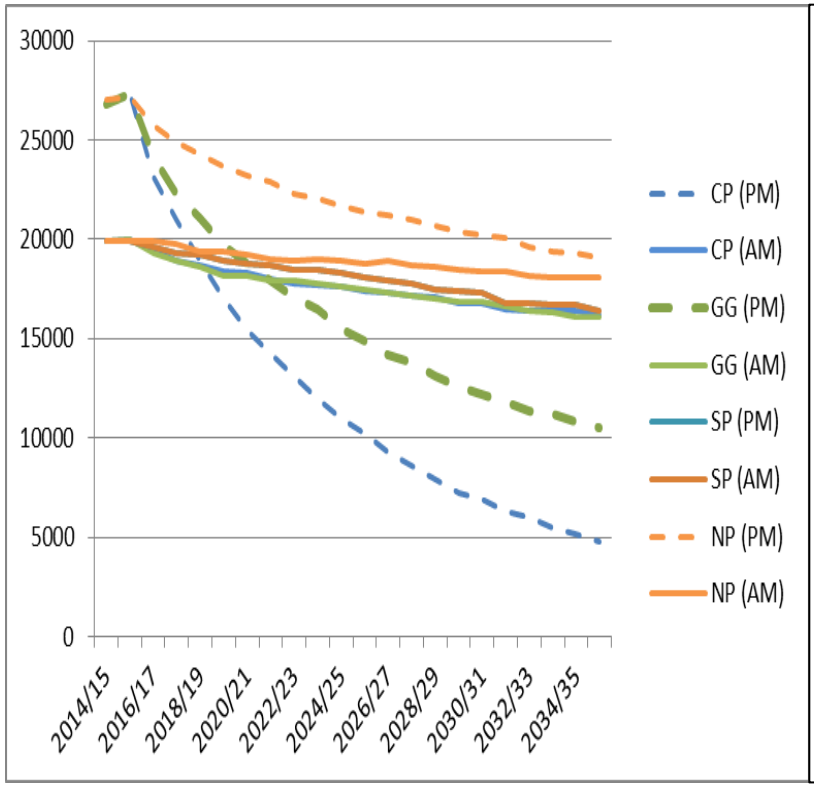
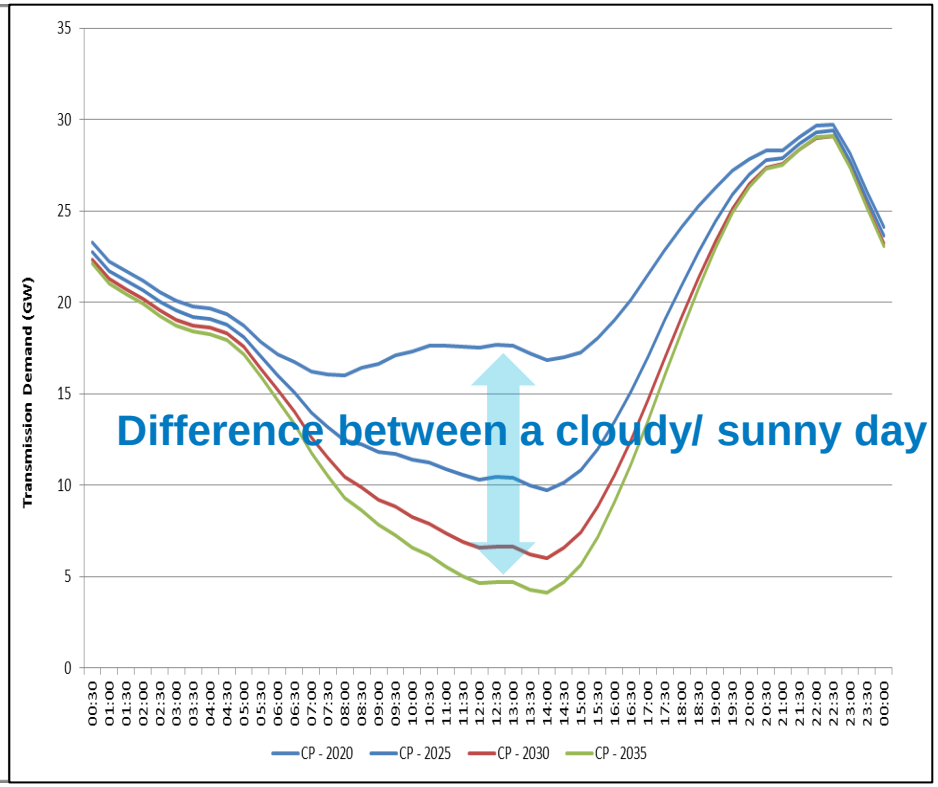
1. Decline in minimum demand and the times of minimum is changing-





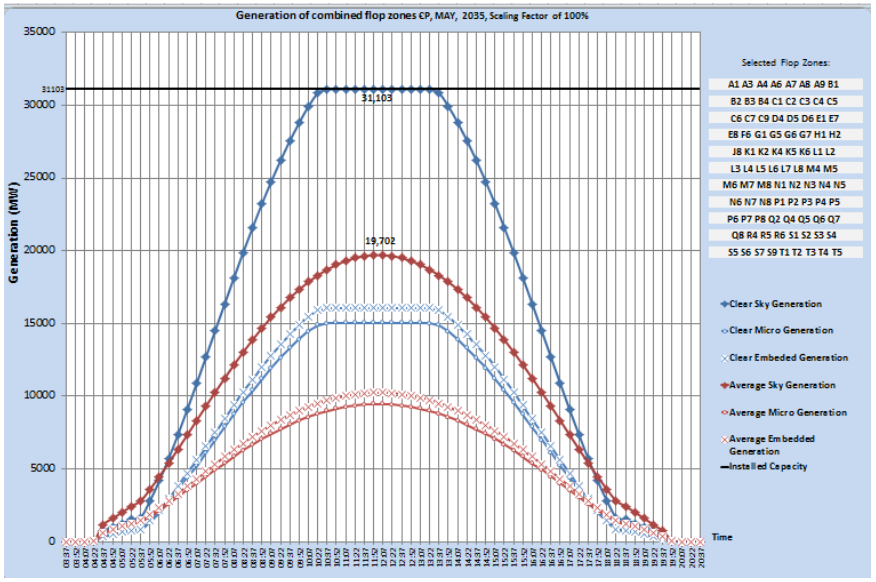
- Effect of High solar penetration- but could be higher!
- Potential limited period of peak load.
- Huge demand forecast volatility
- Shift from AM (overnight) to PM minimums

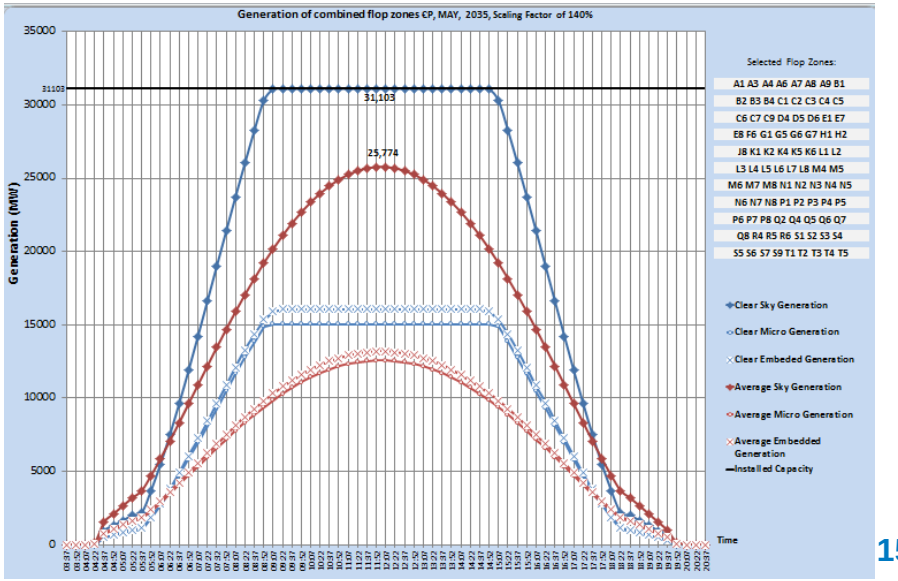
Solar PV
- These are conservative estimates

- FES 2015 reference stakeholder engagement and DECC data received across consultation period- since then embedded solar growth has increased significantly- see revised estimate below..

Installed Capacity	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26
Solar PV Sensitivity (MW)	5709	8879	12099	15193	18337	21295	23839	25739	27595	29399	31140	32778
2015 CP	4753	7039	9401	11672	13978	16145	18001	19376	20716	22018	23273	24452

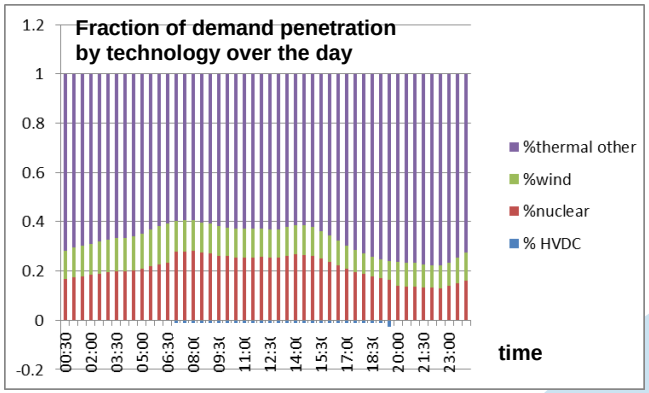
- FES 2015 estimates are average sunny day figures- an 84% scaling assumption.
- not maximum, or 95% confidence levels (akin to NETSQSS scaling factors- would give 90% effectiveness). Note also that PV at a developer scale tends to over install panels c. 140% of convertor rating. Combined assumption would give 100% contribution from DG….



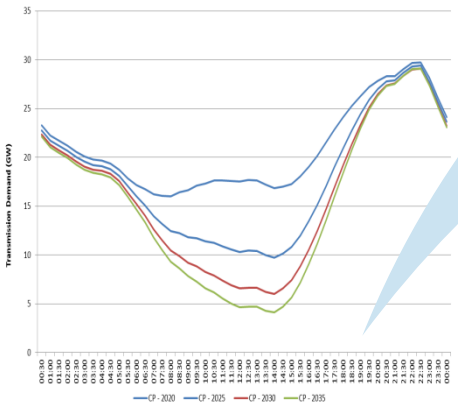


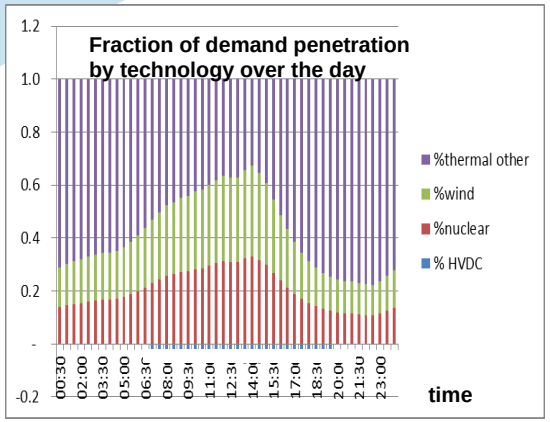
What this means for transmission generation resource availability

Decline in available & in merit Synchronous Generation (CP):-



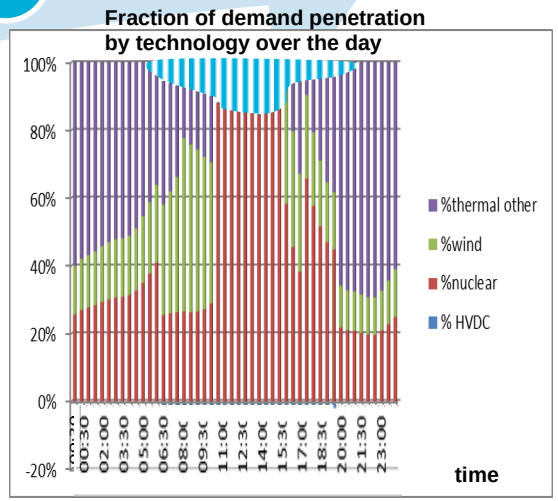
2020





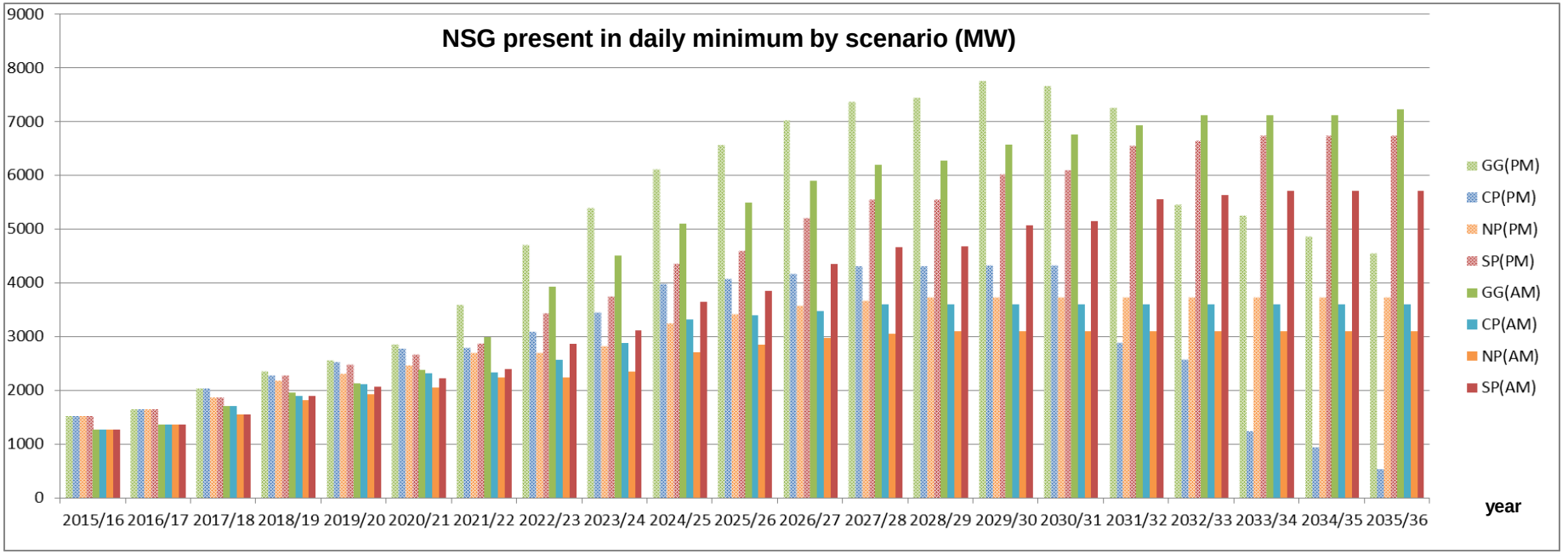
2025

2035



- Large decline in synchronous generation availability- system inertias running at record lows in future years.
- Lower max infeed loss than today (hard given nuclear DMOL) or hold more response
- Downwards regulation issues.

Future Energy Scenarios 2015 - the NSG penetration..



- Whilst high, Represents a curtailment position from the potential available, particularly over the minimum
- Embedded NSG prioritised over transmission connected NSG in FES2015, as no market mechanism exists to do otherwise. This declines available response options further.

What this means for SOF 2014 impacts

- Min demand drops below FES 2014 SP minimum in CP by 2020, GG by 2025, SP approaches this by 2035- as such across these scenarios, not only pace of change but extent of impact is likely to be broader in SOF 2015 than was noted in SOF 2015
- At 15.5GW a max loss of 900MW (equiv max DMOL at that time of connected plant) was possible; not the case in the 2015 scenarios.
  - Nuclear curtailment for the 10hr trough shown in chapter 7 is a probability without other action (as de-loaded the option for frequency response may be alternatively explored) .
  - As Nuclear is at these times the only source of generation inertia available, SG replacement would be needed ahead of NSG unless a wide range of inertial replacing services could be identified, developed and technologically validated.
  - Extensive NSG curtailment.
- Forecast error will further increase contingency reserve holding against imbalance adding to downwards regulation challenge.
- Total system Demand is c. 20GW by 2035; total net transmission system demand sees less than a fifth of the demand against which balancing and other services could be defined.

SOF 2014 results

Table 3 Loss of Infeed Tolerance 100% of Time to Maintain 0.5Hz/s Limit at All Load Conditions

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The SOF 2014 impacts

- At the lower demands in order to meet such losses, lower inertia than shown in the table 7 conditions would arise.
- This would increase the levels of enhanced frequency control services required to contain system disturbances increasing the deload required, exacerbating the downward regulation challenge.

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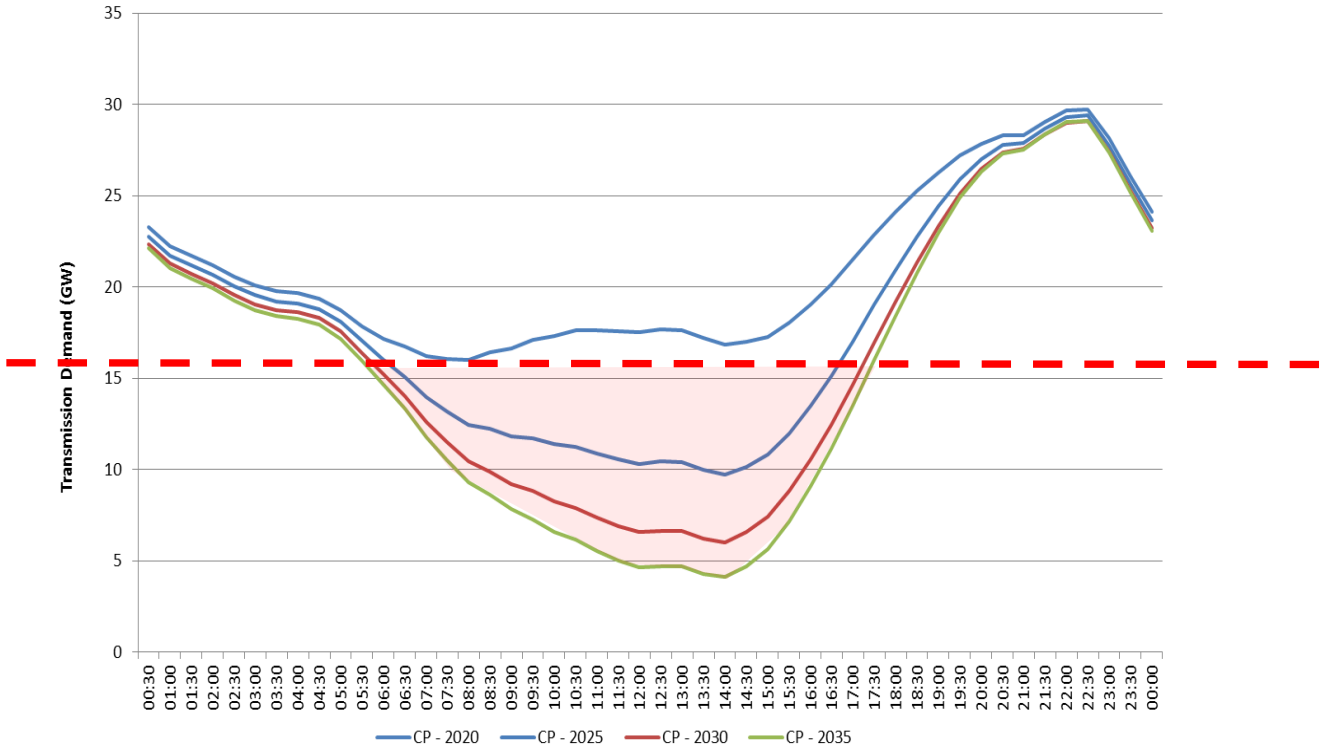
150	0.3	1.2	1148	2024/25	2024/25	2024/25	2034/35

Options for operability

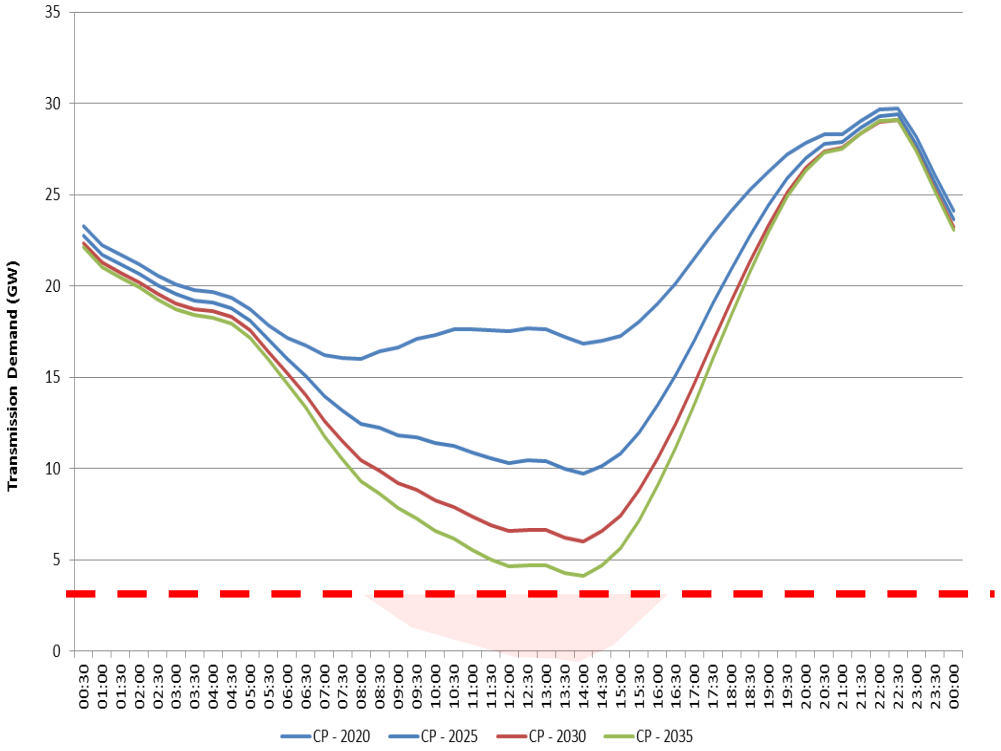
- Option 1 – Market curtailment

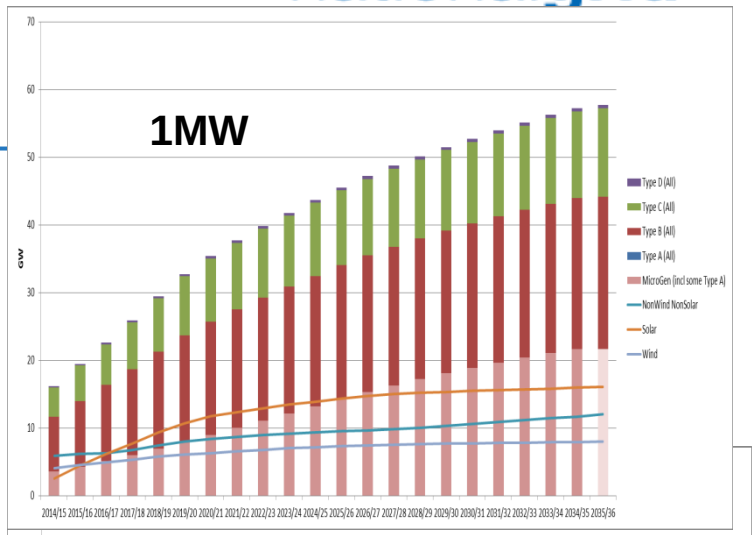


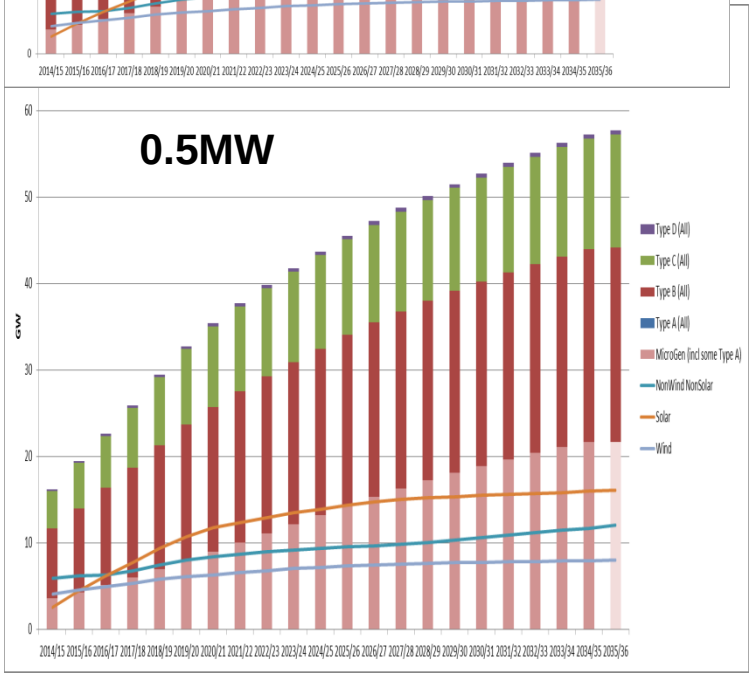
- BC2.6 emergency disconnections- applied April- Oct, up to 10hrs per day dependent on weather.
- Do we really want this- is this really an emergency?

Options for operability

- Option 2 – Banding definition modification



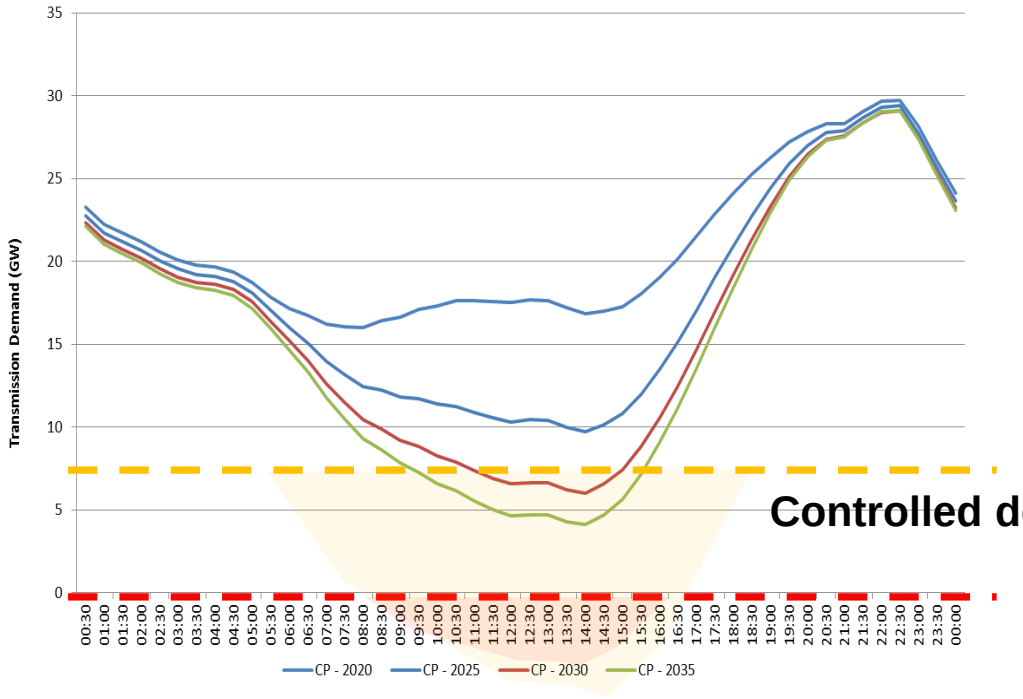




- Likely to represent low B-C transition- c. 500kW- 1 MW
- BC 2.6 powers reserved for higher than average embedded output conditions.
- Consideration technically to defining how Services achieved by aggregation. Consideration of diversity & reliability factors over the increased DG+ potl micro volumes.

Options for operability

- Option 3 – Banding definition + controlled modification



Controlled deload of DG/ micro without services

- Additional capabilities beyond BC 2.6 to effect a controlled removal of DG for balancing purposes,
- Applying for all DG & micro below the B-C transition point. Options for aggregators to present alternative service options avoiding such curtailment.
- Banding between B-C set higher to reflect generic point of practical service capability to deliver obligation
- BC 2.6 powers reserved for higher than average embedded output conditions.