Draft Minimum and Maximum Demand forecasts 2020

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FRG context for today's 2020 Draft max/min demand forecasts

Meeting	ESOO related discussion	Presenter
Jan FRG	• Draft economic forecasts	BIS Oxford Economics
Feb FRG	• Assumptions, inputs and methodologies for the 2020 DER forecasts	GEM, CSIRO, AEMO
Mar FRG	• Initial COVID-19 Update • DER draft forecast update • ESOO inputs and assumptions	AEMO
Apr FRG	• Estimated COVID-19 Economic Impacts • Final DER forecast	BIS Oxford, GEM, CSIRO, AEMO
Early May FRG	• Estimating COVID-19 impact on electricity consumption	AEMO
Late May FRG	• Draft annual electricity consumption forecasts • DER forecast by region	AEMO
Today	• **Draft minimum and maximum demand forecasts**	**AEMO**

Purpose:

- Outline approach used to account for COVID-19 in the max/min demand forecasts
- Discuss Draft National Electricity Market (NEM) electricity maximum/minimum demand forecasts
- Provide feedback to AEMO on each of the above

Agenda will include:

- Recap of key Forecasting terminology
- COVID-19 impacts included in the Draft maximum/minimum forecasts
- Other changes to the 2020 forecast approach
- General insights on forecast drivers
- Key Regional Insights
- Discussion

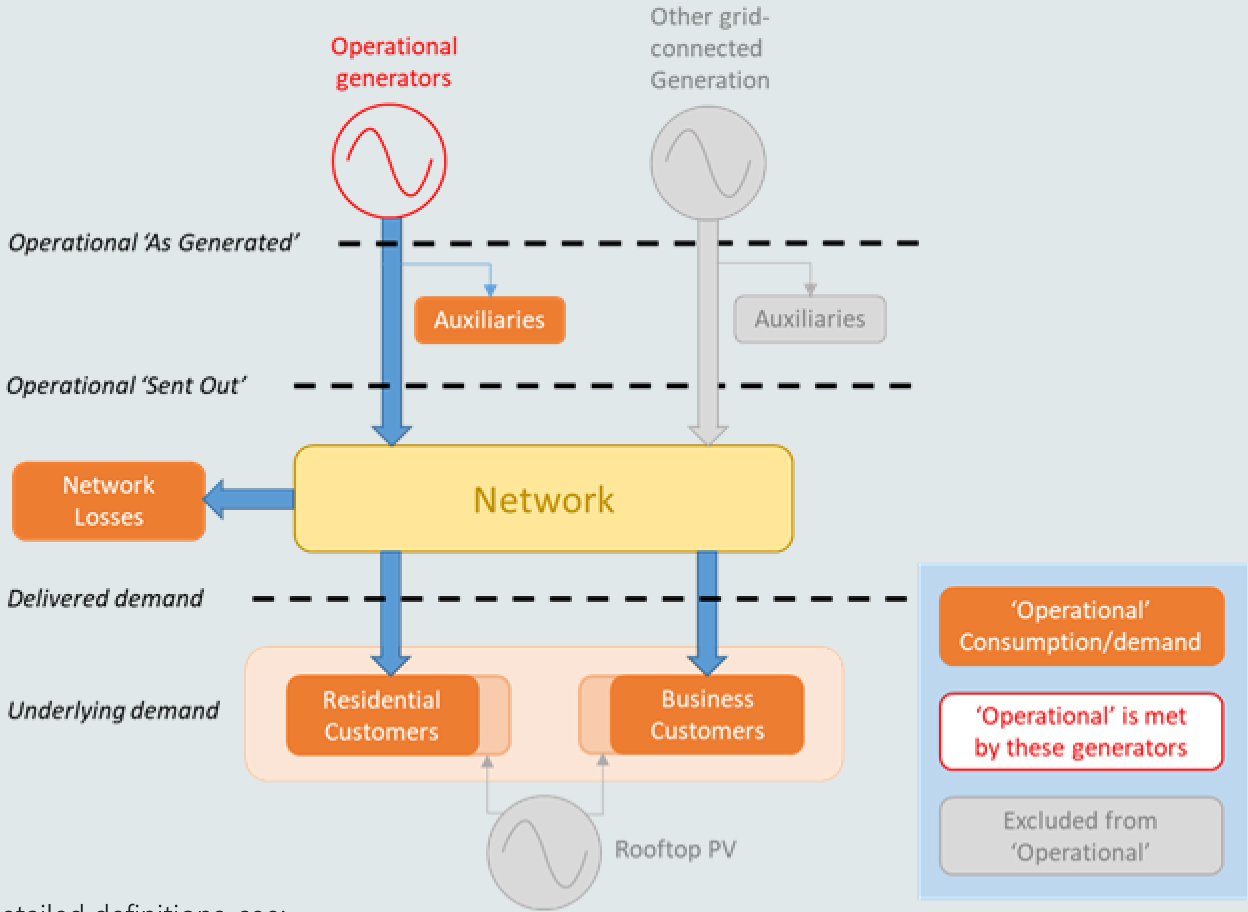
Understanding the language of forecasting electricity consumption

<u>Key forecasting definitions in use today:</u>

- **Underlying Demand:**
  - Underlying demand is the "power point" demand of consumers, irrespective of where that power is generated (from the grid or within the home).
- **Delivered Demand:**
  - Delivered demand is the demand that is met from the transmission grid, net of any distribution-generated energy such as rooftop PV
- **Operational Demand**
  - What is consumed by consumers, as supplied by scheduled, semi-scheduled and significant non-scheduled generating units >= 30MW (with some exceptions).

<u>Key demand measurement points:</u>

- **"Sent Out"**
  - Electricity supplied to the grid by scheduled, semi-scheduled and significant non-scheduled generators (excluding auxiliary loads)
- **"As Generated"**
  - As per Sent Out, but including auxiliary loads (that load which is used within a power station)



For detailed definitions, see: https://www.aemo.com.au/-/media/files/electricity/nem/security_and_reliability/dispatch/policy_and_process/2020/demand-terms-in-emms-data-model.pdf?la=en

Covid-19 adjustments

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Complex interaction of COVID-19 impacts on demand

Short to medium term impacts

↓ Lower business consumption from closures of workplaces.

↑ Increase in residential baseload consumption from more people at home (working from home, home schooling or under/unemployed).

↑ Seasonal increase in residential heating/cooling consumption from more people at home (working from home, home schooling or under/unemployed).

Profiled max/min offsets

Medium to longer term impacts

↓ Longer term decrease in immigration, increase in unemployment and consequential slowdown in consumer spending.

LT-indices

↓ Potential for reduced consumption at large industrial loads (early maintenance, part load operation) or closures longer term.

LIL forecast

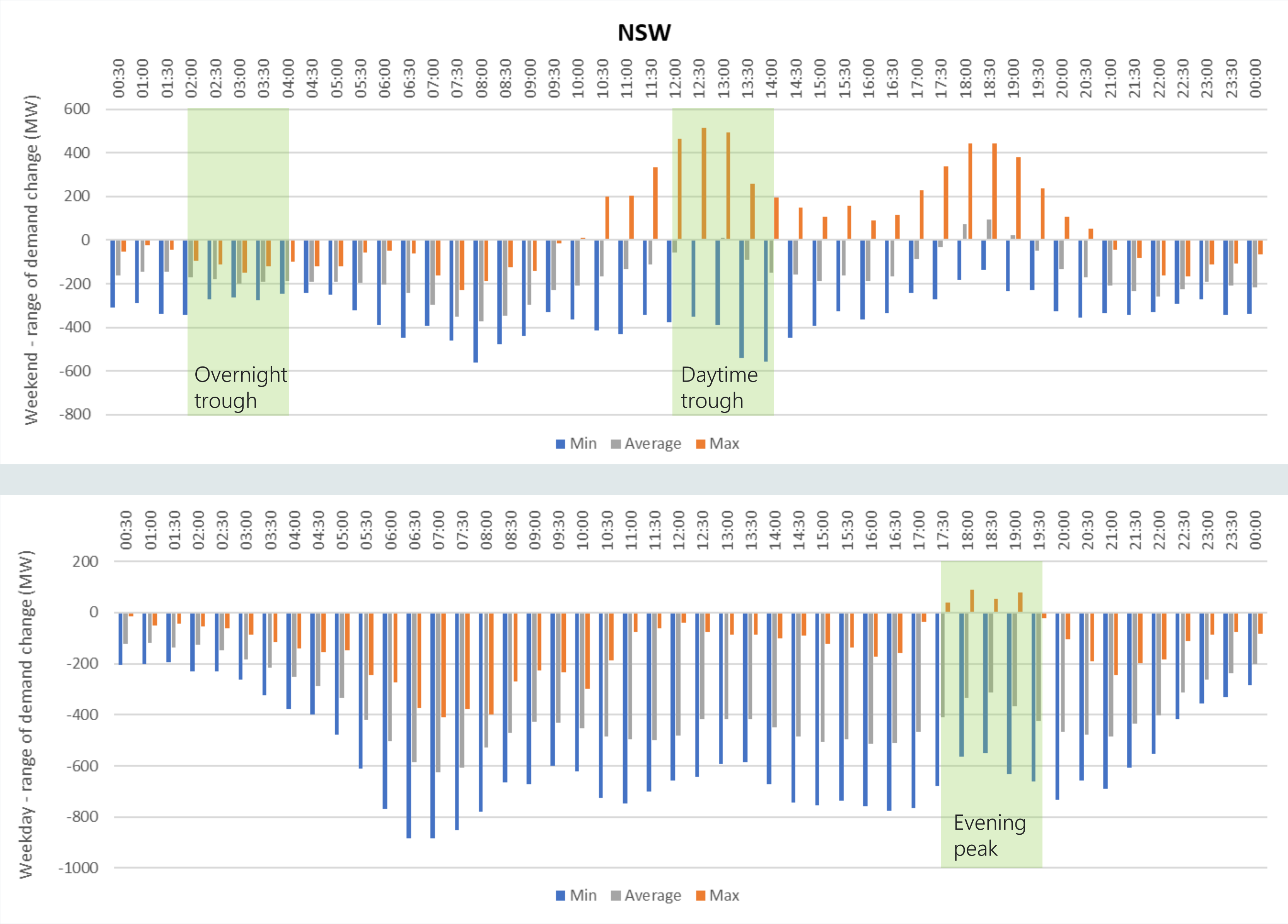
↓ Reduced spending on capital investments like rooftop PV systems. Potential for reversal, if recovery package include support for PV.

DER forecast

COVID-19 Impacts depend on type of day and time of day

- Impacts found by comparing forecast operational demand from a model calibrated to demand pre-COVID with one calibrated to post-COVID demand.

New South Wales – Estimated impact of COVID-19, April 2020



Uncertainty of impacts studied using scenarios and sensitivities

- The range shown is based on two different forecasts approaches:
  - Model difference as per slide 6
  - Using COVID-19 dummy variable
- The black dot represents the estimate used in AEMO's Central scenario. Top and bottom range values are used in other scenarios/sensitivities (as per slide 9).

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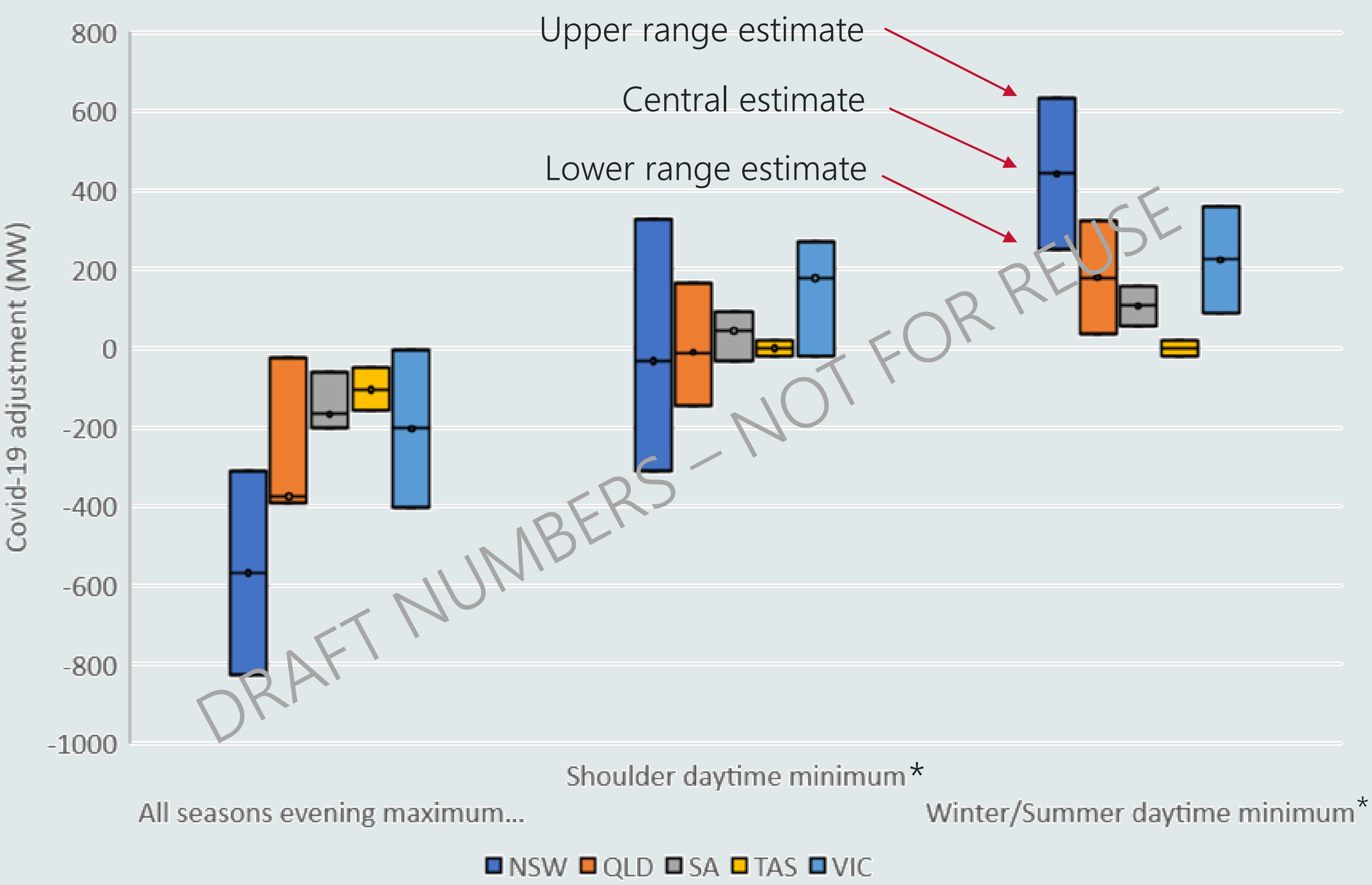
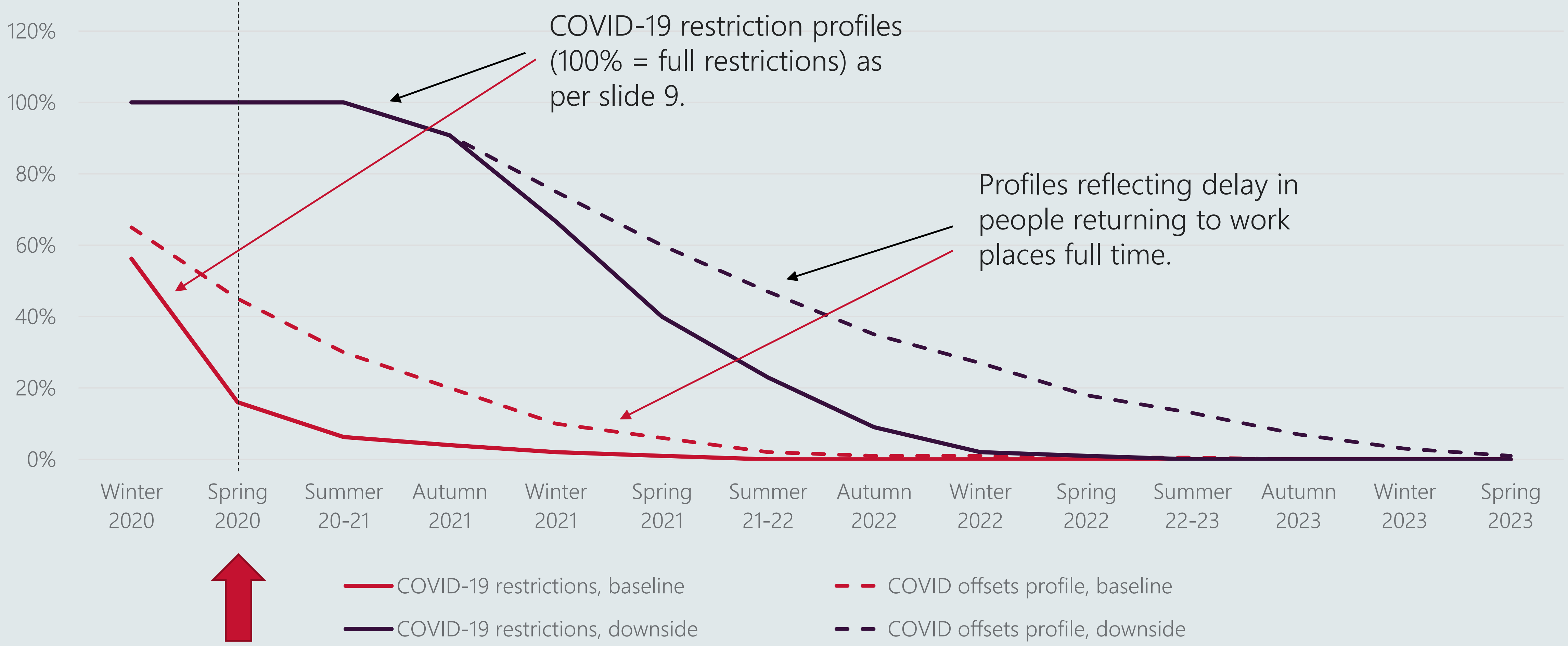
Maximum/minimum demand offsets



*Tasmanian range represents an overnight minimum

Scaling profile applied to COVID-19 maximum/minimum demand offsets

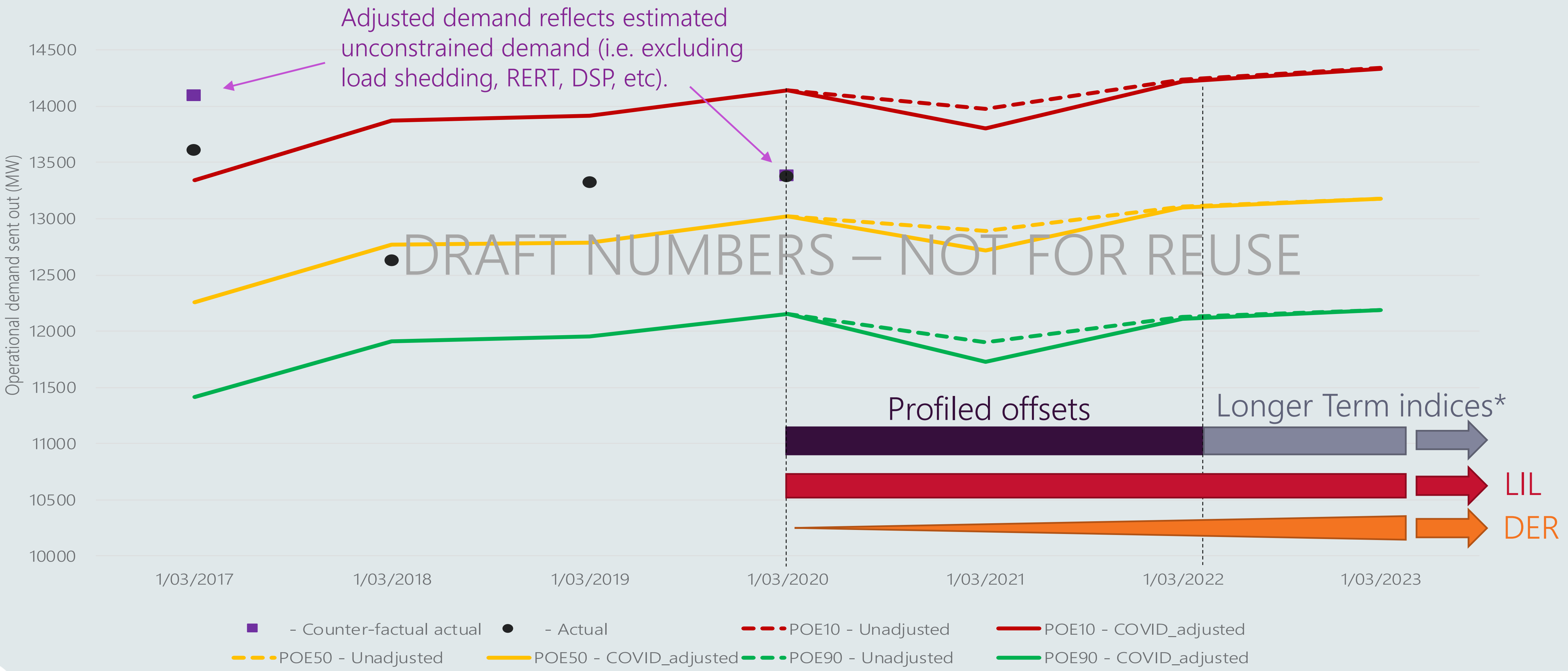


Scenarios/sensitivities to highlight the uncertainty of possible outcomes

Scenarios and sensitivities to explore impacts on both consumption and max/min demand from different recovery trajectories.

	Step Change	Central (Baseline)	Central (Downside)	Central (Downside, with DER uplift)	Central (Downside, DER uplift+ industry closures)	Slow Change
Economy	Higher growth	Central (Baseline)	Central (Downside)	Central (Downside)	Central (Downside)	Slow Growth
Commodity Outlook	Strong	Neutral	Neutral	Neutral	Weaker	Weak
COVID-19 restrictions	6-9 months	6-9 months	15-18 months	15-18 months	15-18 months	15-18 months
DER uptake	High	Central	Central	High	High	Low
Business	Quick recovery	Quick recovery	Slow recovery	Slow recovery	Slow recovery	Slow recovery
Industrial	No impact	Limited impact	Limited impact	Limited impact	Early closures	Later closures
COVID offsets profile	Baseline	Baseline	Downside	Downside	Downside	Downside
Max demand offset	Upper	Central	Central	Upper	Central	Lower
Min demand offset	Upper	Central	Central	Lower	Lower	Lower

Applying impacts of COVID on New South Wales summer maximum demand



*Longer term (LT) indices are based on the underlying growth in consumption forecast

Minimum and Maximum demand

Changes to methodology and inputs

- Methodology as in 2019, with minor changes with respect to:
  - Growth indices (calibrated to reflect historical energy efficiency improvement rates at time of peak). This is to recognise saturation of energy efficiency during peak demand events.
  - EV VPP (Dynamic EV charging). From 2030 onwards, a proportion of EV has been removed from minimum and maximum demand for the purpose of VPP EV charging.
    - Reported minimum and maximum demand will be lower than the true OPSO demand from 2030 because a proportion of EV charging is modelled separately as part of the load traces. This will be added back onto reported demand, but it has not yet been completed.
- Consumption forecasts for the central scenario are now approximately 3% higher than what was presented at the May FRG (by 2040). This is mainly due to:
  - Rebasing of the forecast to latest actuals for all regions
  - Revision of chock factor impact of COVID-19 on business consumption
  - Reduction of the forecast Energy Efficiency in New South Wales following feedback from the New South Wales Government.
- After feedback from the FRG a Central sensitivity wedge has been produced that covers down-side risks to consumption. This has not yet been completed for maximum demand.

Minimum/Maximum demand - Key points

Maximum demand:

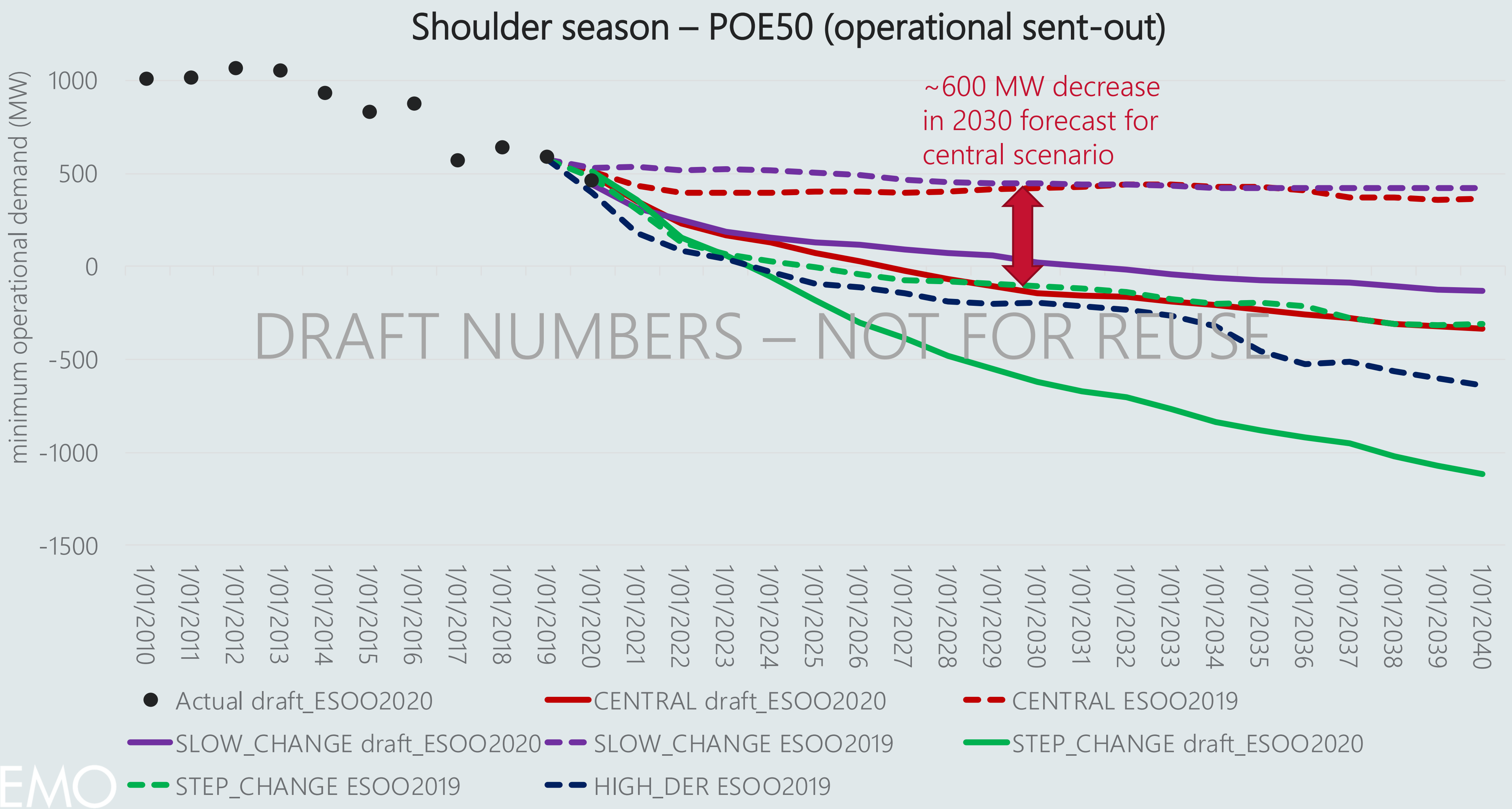
- In the short-term (0-3 years)
  - Maximum demand is lower in some regions due to COVID-19 reducing demand
  - Aside from COVID-19 maximum demand is similar to the ESOO2019 in most regions
  - A number of regions experience Large Industrial Load (LIL) growth in the first few years
- Longer term (10-20 years)
  - Is either similar (New South Wales and Tasmania) or higher (Queensland, Victoria and South Australia) than last year's forecast in the long term
  - Excluding PV, the annual growth drivers are generally higher on an underlying basis pushing up maximum demand
    - Connections growth is higher
    - Appliance usage higher (fuel switching)
    - Retail prices are lower
    - Electric vehicle penetration slightly up long term
  - The longer term growth has been recalibrated to reflect historical energy efficiency improvement rates at time of peak generally lifted demand.

Minimum demand:

- In the short-term (0-3 years)
  - PV and Non-scheduled PV (PVNSG) capacity forecast is higher in the Central scenario (in line with the step change from last year)
  - A 1 MW increase in PV results in around a 0.7-0.8 MW decrease in minimum demand (all else being equal)
- Longer term (10-20 years)
  - Net impact of DER results in lower minima's across all regions
  - PV and PVNSG capacity forecast is higher (negative demand driver)
  - Battery is higher (positive demand driver at time of minimum)
  - EV charging at time of minimum is lower due to a proportion of EV being VPP, with charging modelled dynamically in the load trace process

Minimum demand case study

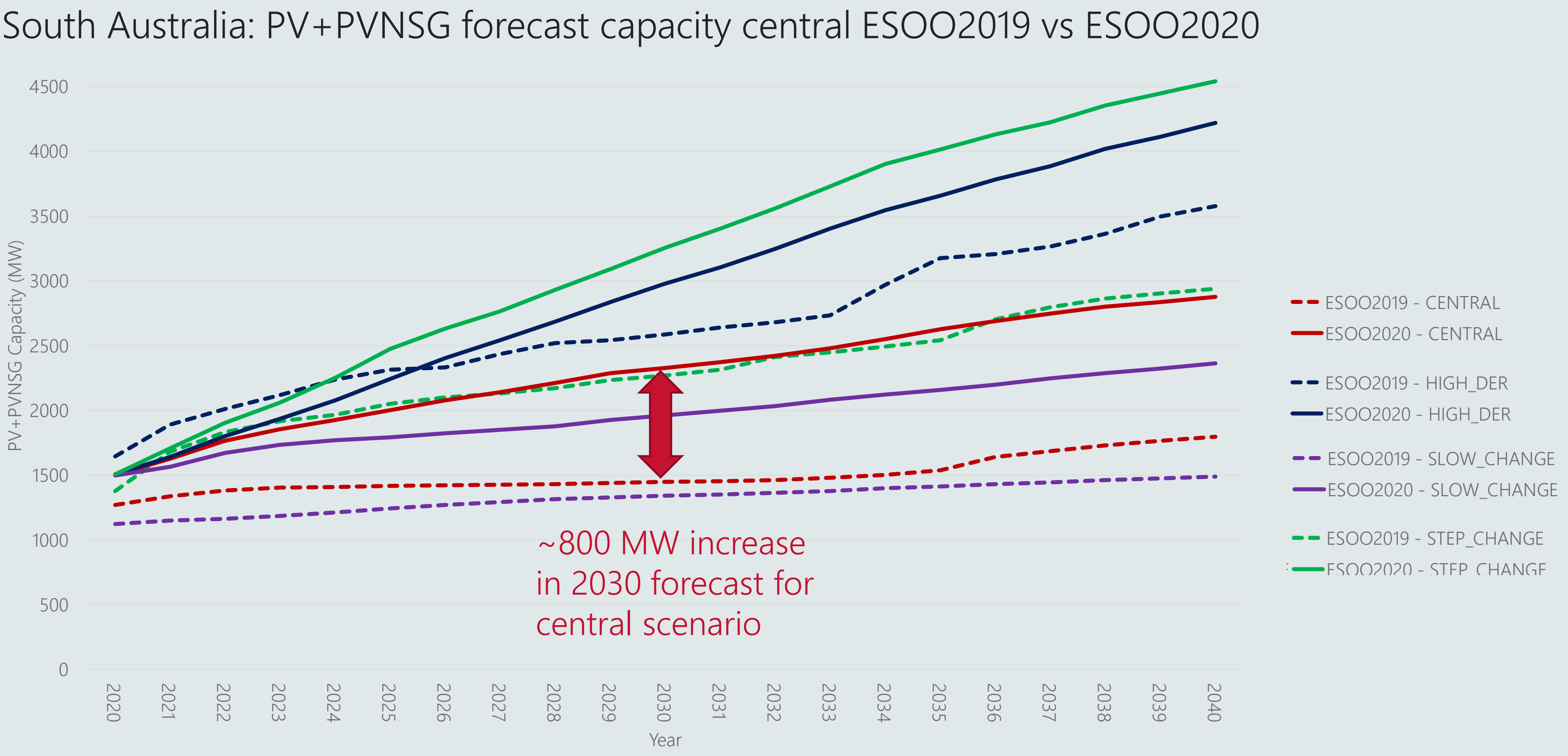
Minimum demand – SA scenarios



Minimum demand – Distributed Energy Resource (DER) impacts

- There are a number of DER levers that can affect minimum demand (such as PV capacity, residential battery storage capacity or charge profiles for business electric vehicles (EV).
- Each lever has increasing or decreasing importance depending on the time of day which itself is a function of the combinations of levers. (The combination of levers this year has changed how quickly minimum demand approaches midday in some regions)
- Below is the DER drivers: ↓ indicates a negative demand driver, ↑ indicates a positive demand driver. PV growth is currently the most important driver of minimum demand with batteries and EV ranked and equal second in the medium to long term. EV was second most important last year but relative changes has made it equally as important as batteries this year.
- ↓ PV capacity
- ↑ Battery capacity (Residential has a greater impact than Business at time of min due to charging profile)
- ↓ Battery Virtual Power Plant (VPP) proportion
- ↓ ↑ Battery charge profile (Business and Residential)
- ↑ EV vehicle count (Business has a greater impact than Residential at time of minimum due to charging profile)
- ↓ EV VPP proportion
- ↓ EV charge profile (Business and Residential)
- ↑ EV transition from Convenience charging to Day charging (Business and Residential)

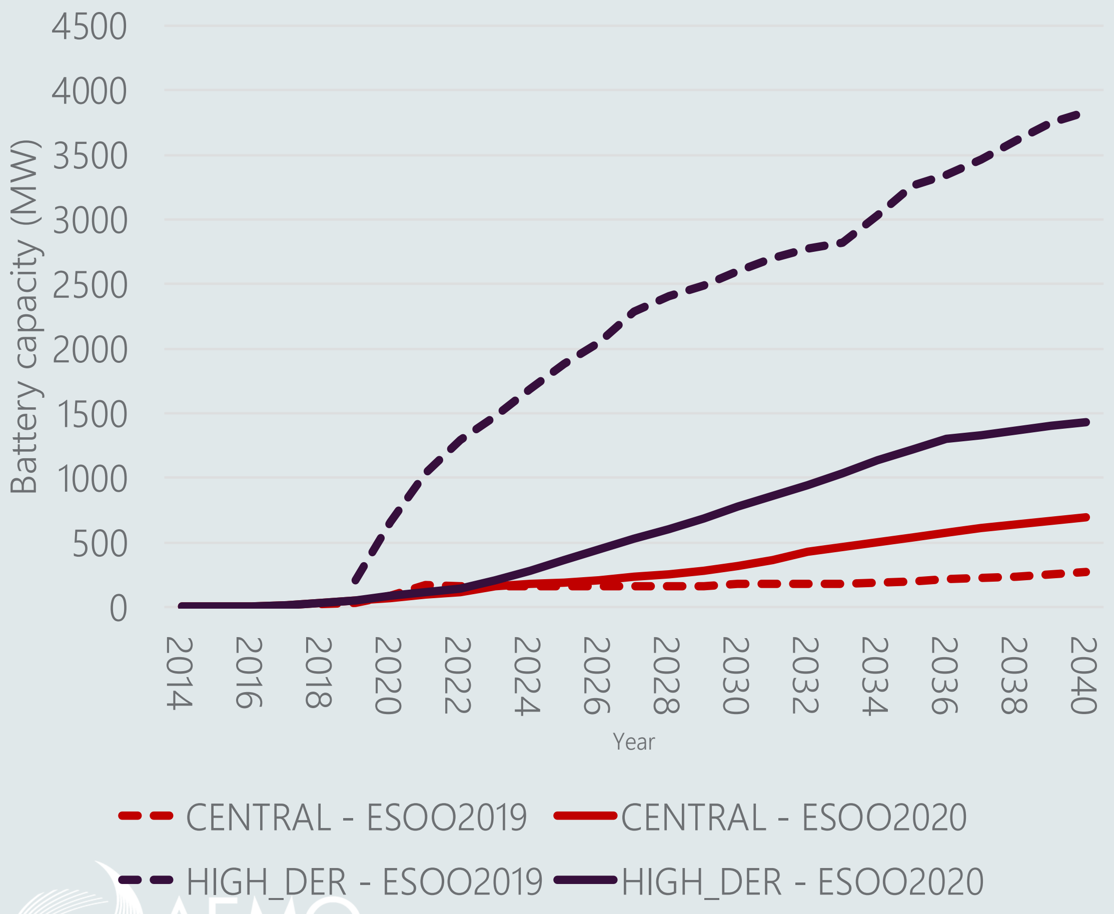
Minimum demand – PV capacity



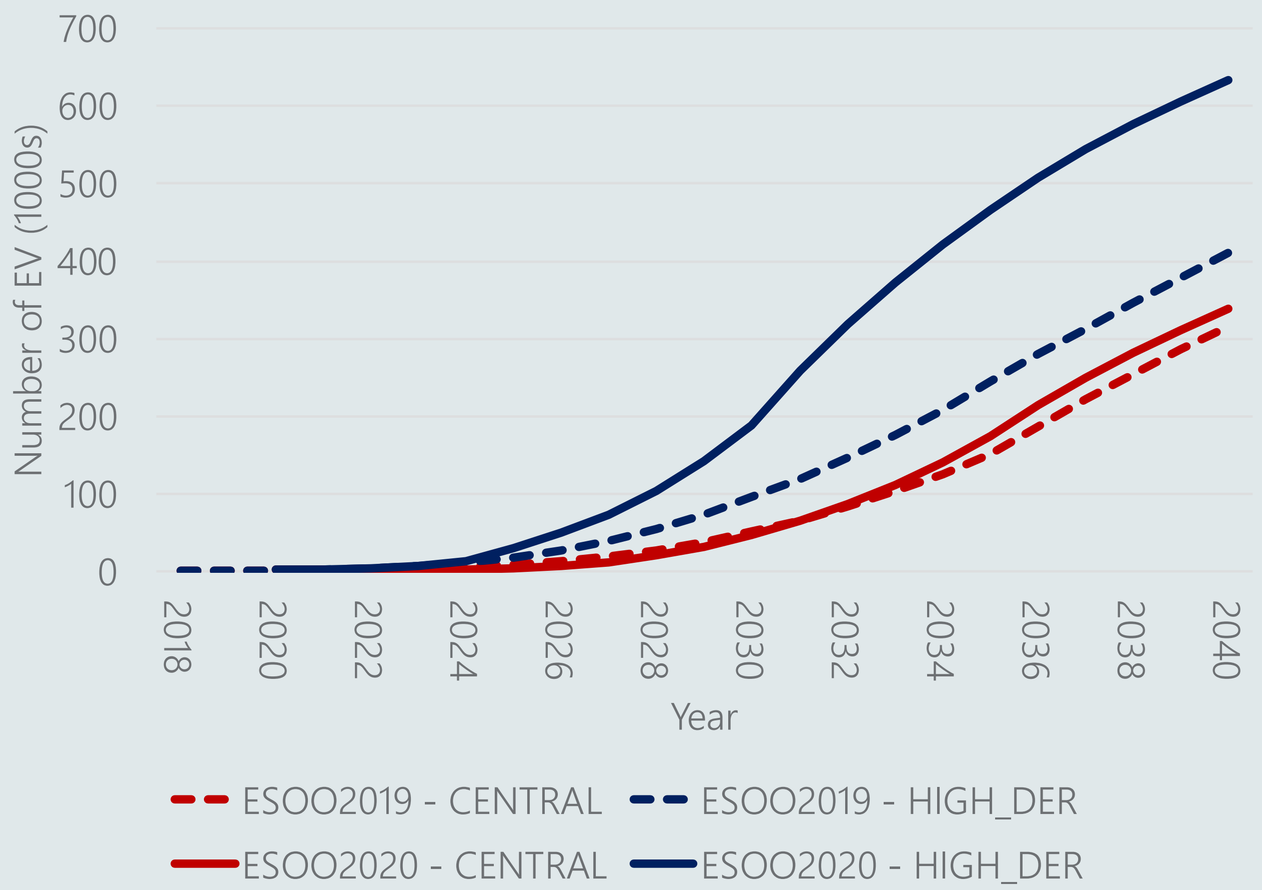
Consultant forecasts available under supporting material at: https://aemo.com.au/en/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/scenarios-inputs-assumptions-methodologies-and-guidelines

Minimum demand – EV and battery storage capacity

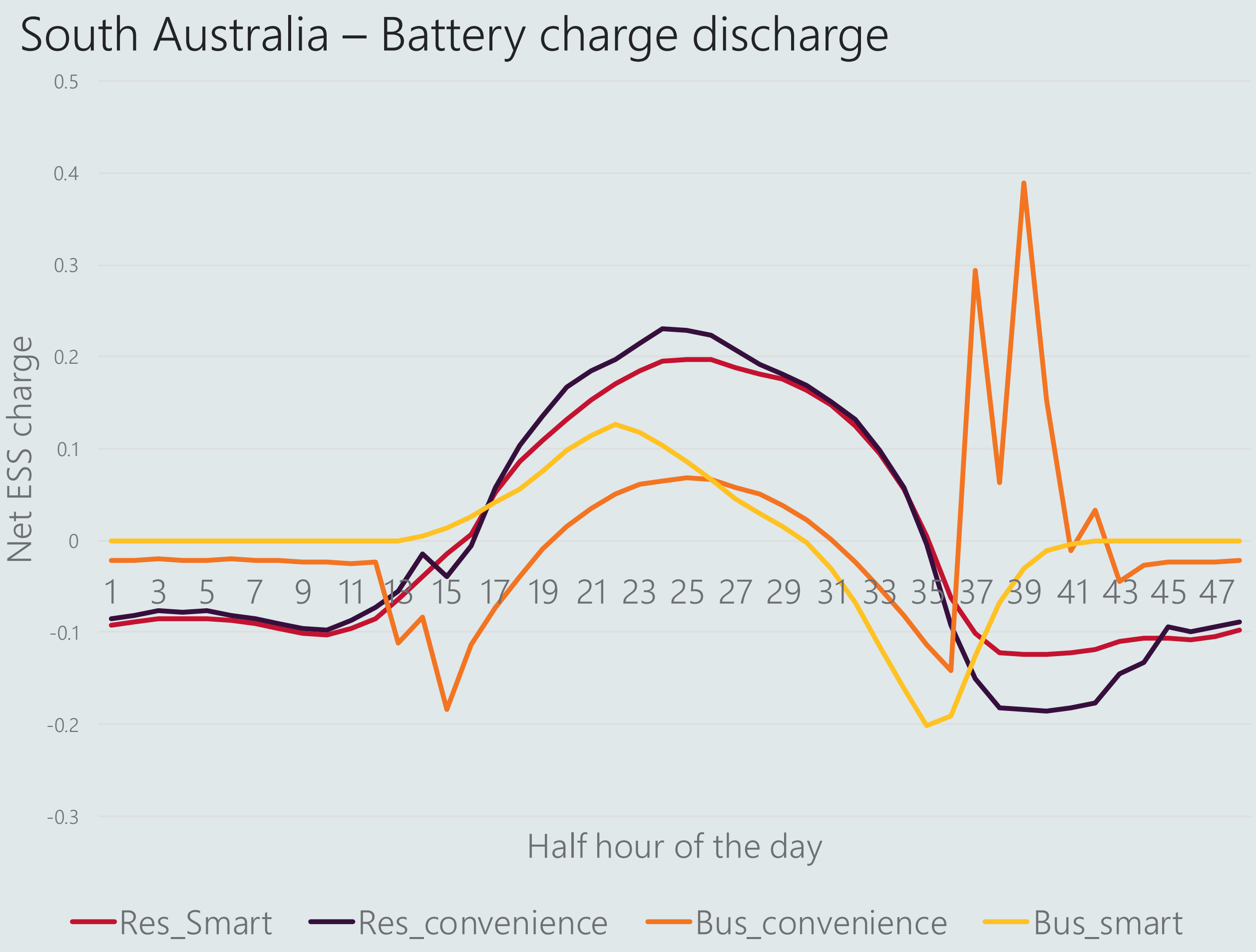
South Australia – Battery forecast

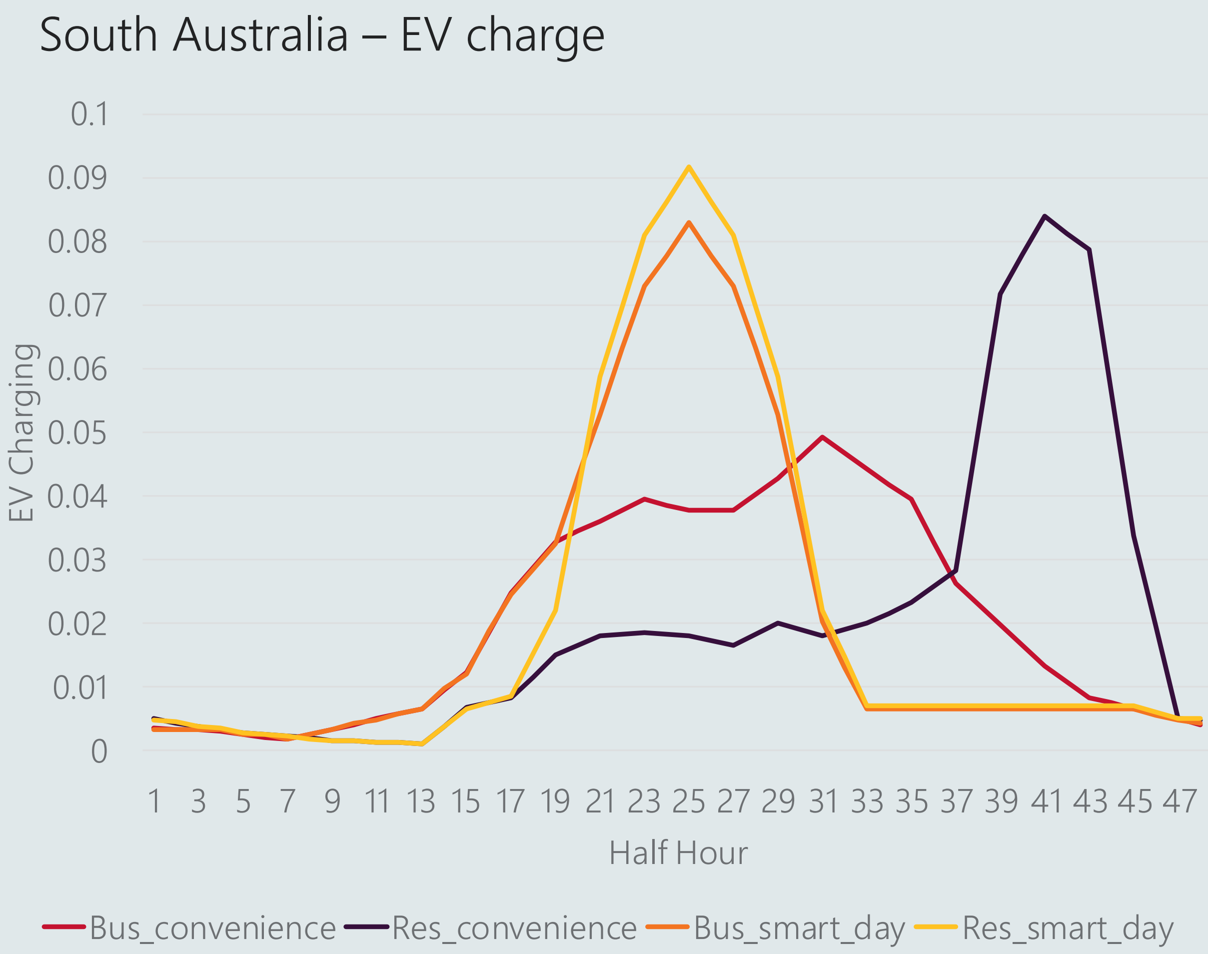


South Australia – EV forecast



Minimum demand – EV and battery storage profile



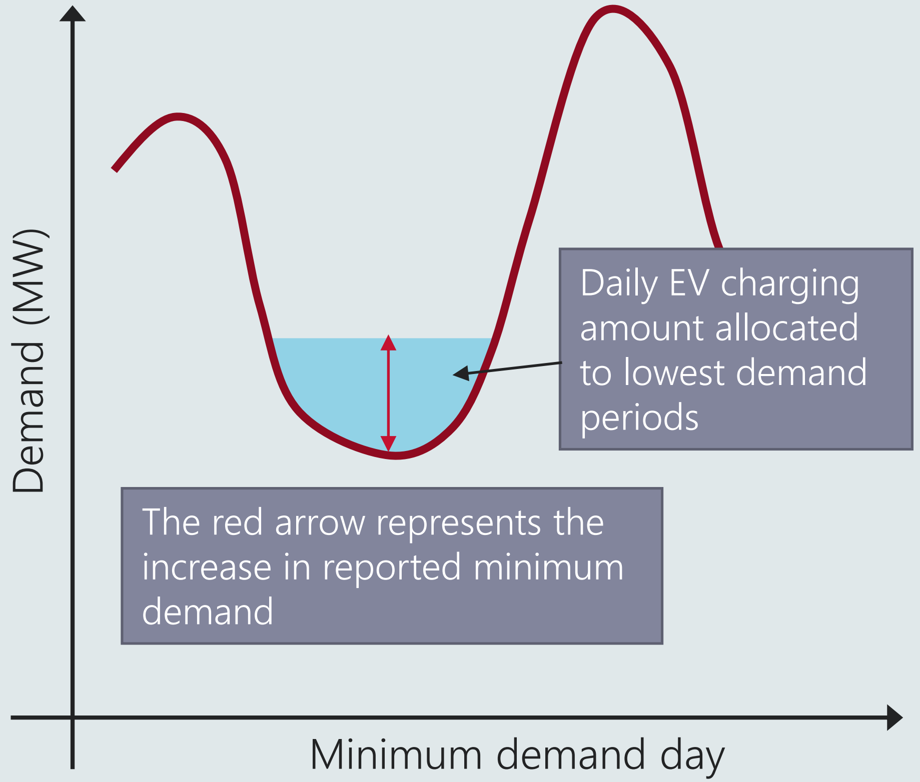


RES = Residential
BUS = Business

Minimum demand – EV and battery storage optimised VPP operation

- For very large uptakes of EV or battery storage, even the smarter fixed profiles as shown on the previous slide can unintentionally create new peaks. In reality network operators and retailers would act to incentivise some of these units to dynamically adapt to system conditions at any point in time.

- To reflect that, in 2019 AEMO assumed a proportion of all battery storage units being aggregated and operated as VPP and excluded them from the demand forecast; instead accounting for them as a supply source.
- In 2020, this was extended to VPP EV charging (in particular to ensure reasonable outcomes for step change scenario which moves towards a 100% electrification of transport).
  - The dynamic EV VPP charging is assumed to start from 2030 and the ratio of VPP EV grows moderately to 2040 and stronger thereafter.
  - This is currently ***not reported*** in the following slides, but it is planned to be added later.
    - The presented *raw* minimum demand forecast are slightly lower from 2030 onwards than if this consumption had been added back on. There is no impact on maximum demand.



Regional overview

New South Wales maximum

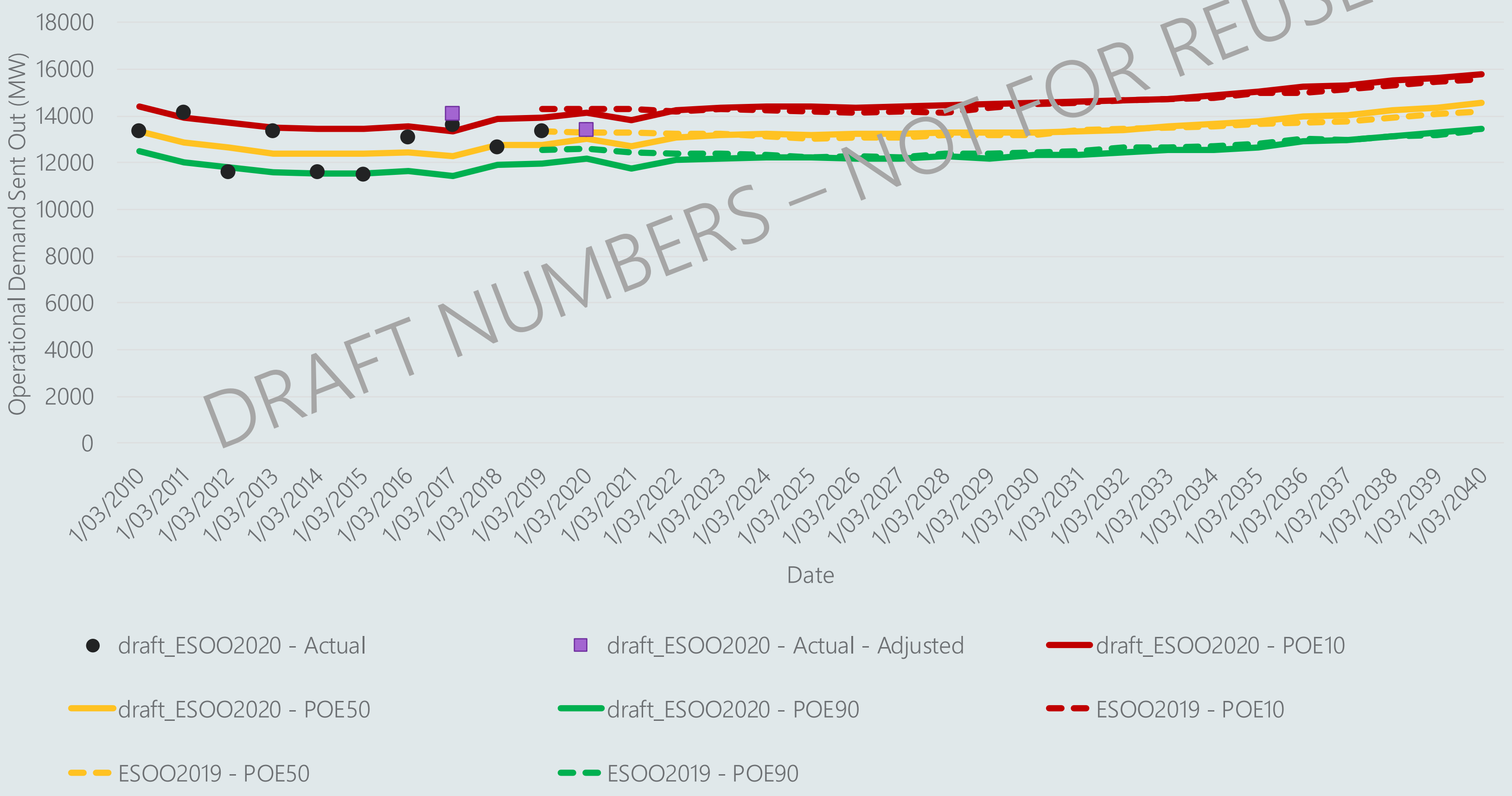
Short term (0-3 years)

- Occurring around 19:00 (an hour before sunset) in Summer
- The observed COVID-19 impact is the largest of the NEM regions (around -570 MW during April to May 2020)
- By Summer 2021, the estimated COVID-19 impact is reduced to -170 MW

Long term (10-20 years)

- In spite of the lower start, maximum demand is broadly in-line with last year's forecast
- Changes to energy efficiency lowers the forecast relative to ESOO 2019, but growth in other long-term drivers (slides 12-13) offsets this decline

New South Wales summer maximum demand



POE10: 10% probability of exceedance – one in ten year forecast
POE50: 50% probability of exceedance – one in two year forecast
POE90: 90% probability of exceedance – nine in ten year forecast

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New South Wales minimum

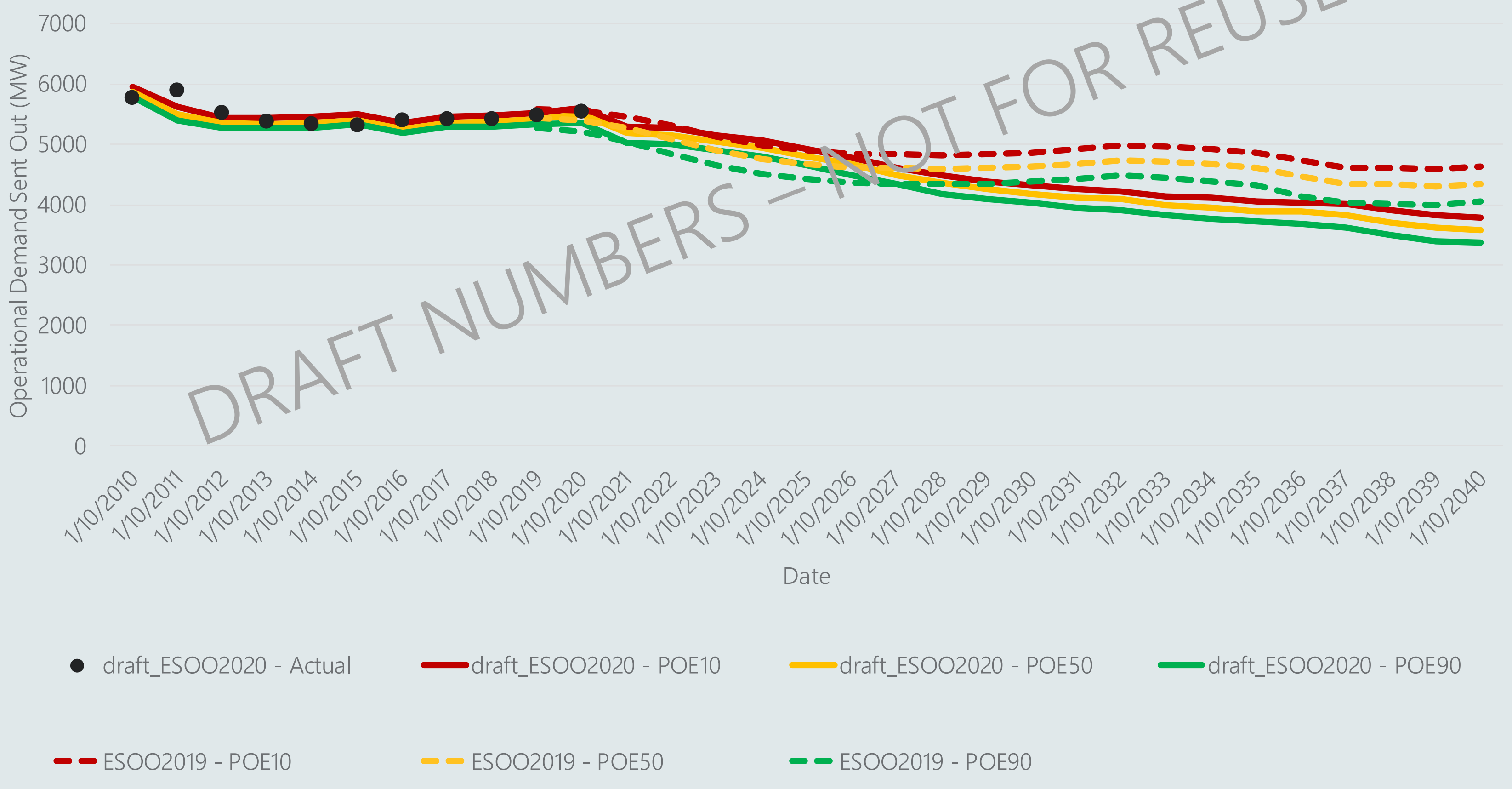
Short term (0-3 years)

- On the cusp of shifting to midday (POE90 during the day POE10 still over night)
- By 2021 the COVID-19 impact is around -15 MW

Long term (10-20 years)

- Minimum demand is lower than the ESOO 2019 due to net DER impact of:
  - Higher PV capacity (negative driver)
  - Higher battery (positive driver at time of minimum demand)
  - Higher VPP captured in OPSO (negative driver at time of minimum demand)
  - Similar EV numbers but with a proportion of EV's VPP charging (negative demand driver)

New South Wales shoulder minimum demand*



*Excludes VPP demand assumed to ramp up from 2030 onwards

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Queensland maximum

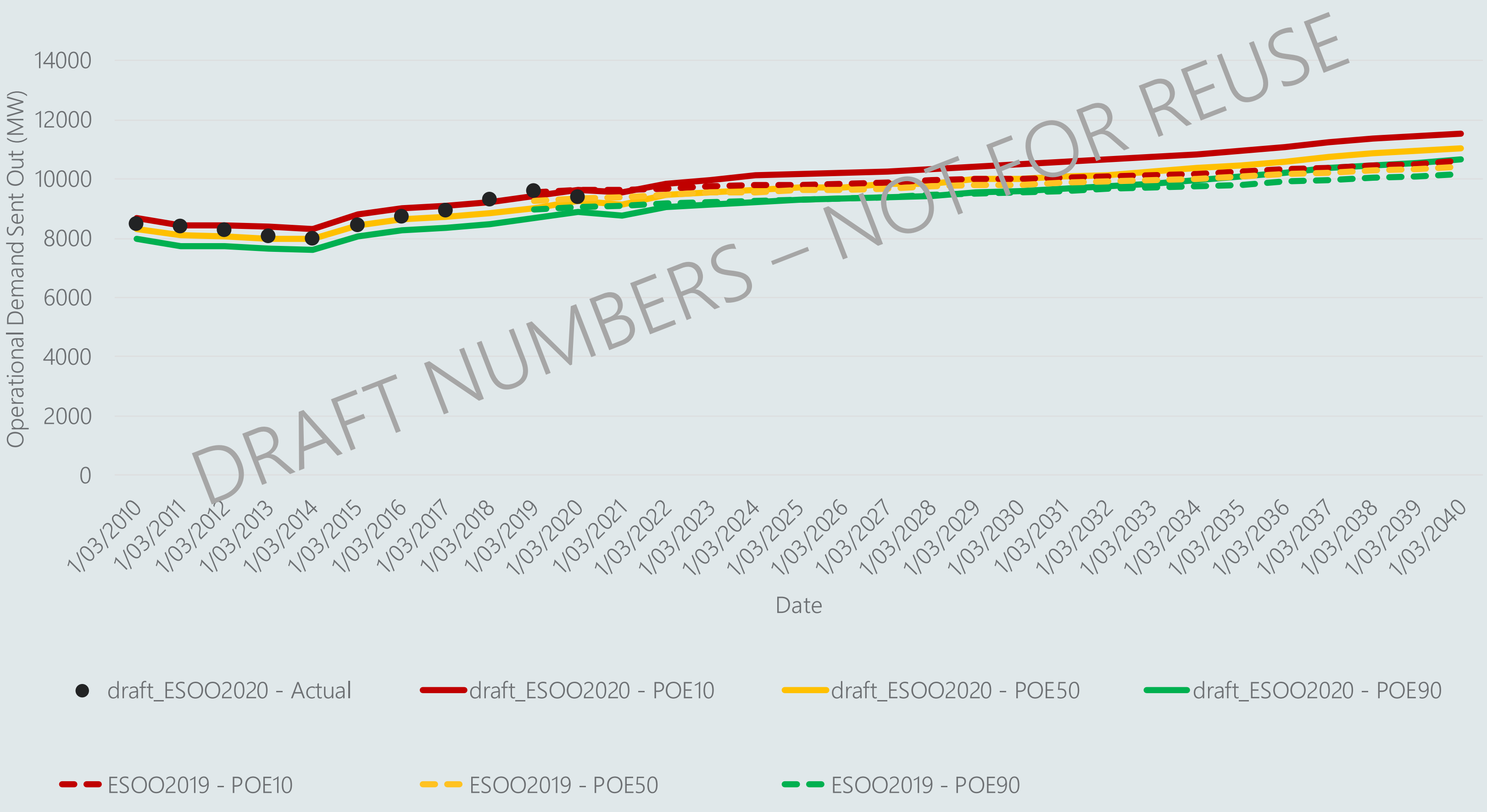
Short term (0-3 years)

- Occurring around 18:00 in Summer (45 minutes before sunset)
- Second largest observed impact of COVID. By Summer 2021 the COVID-19 impact is estimated at approximately -120 MW
- Includes increase in CSG/LNG in 2021 and LIL in 2022

Long term (10-20 years)

- Queensland is forecast to experience higher growth due to the longer-term drivers of demand (slides 12-13) and slightly higher forecast consumption from the CSG/LNG sector.
- Relative to ESOO 2019, modelled energy efficiency slightly less effective at time of maximum longer term.
- The ESOO 2020 also forecast higher EV uptake
  - A portion of this is reserved for VPP

Queensland summer maximum demand



Queensland minimum

Short term (0-3 years)

- Has been occurring at noon for 2 years
- By 2021 the COVID-19 impact is around -5MW
- ESOO 2020 forecast slightly higher than ESOO 2019 initially due to:
  - PV capacity forecast slightly lower than ESOO 2019
  - Higher LIL and CSG/LNG forecast for 2021-22 and onwards.

Long term (10-20 years)

- ESOO 2020 rate of decline is similar to the ESOO 2019 due to the net impact of higher growth in long-term drivers offset by higher PV capacity forecast
- Higher EV forecast beyond 2035 further reduces the rate of decline.

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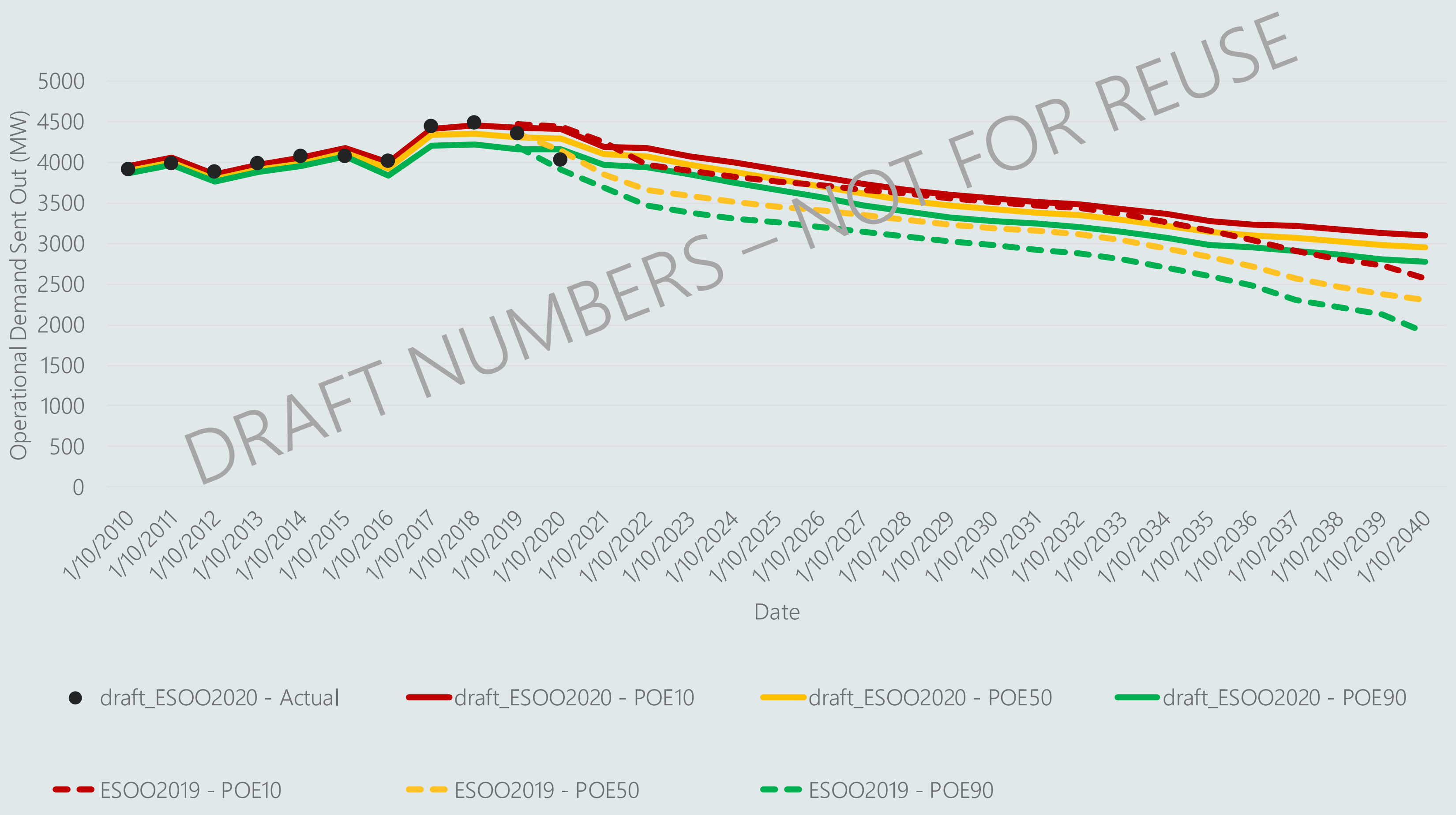
Queensland shoulder minimum demand*



*Excludes VPP demand assumed to ramp up from 2030 onwards

South Australia maximum

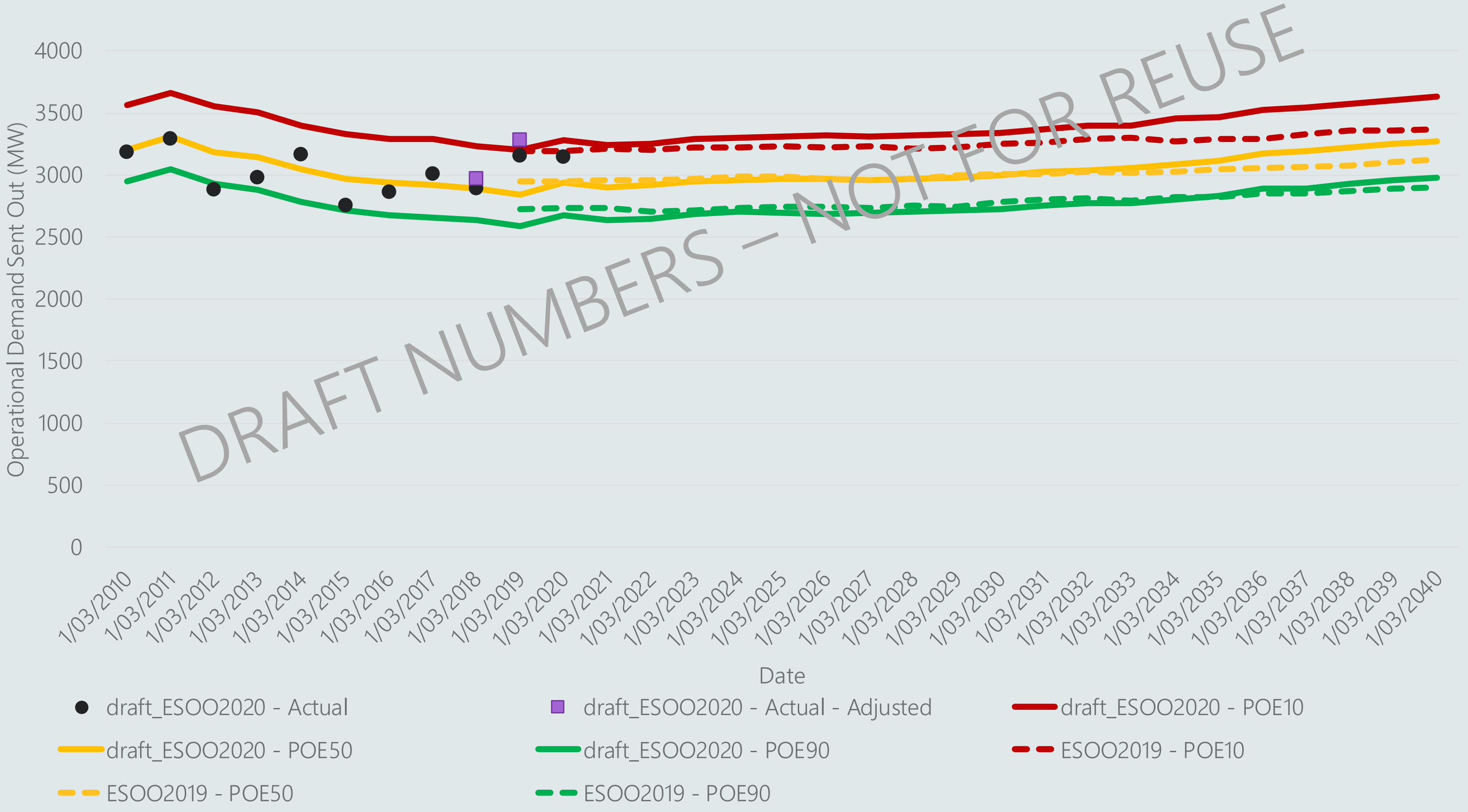
Short term (0-3 years)

- Typically occurring around 19:30 (an hour before sunset) in Summer
- By Summer 2021 the COVID-19 impact is estimated at approximately -50 MW
- Forecast growth in LIL in 2020 and 2021, higher than was forecast in ESOO 2019
- The variance of max demand is slightly wider relative to ESOO 2019

Long term (10-20 years)

- ESOO 2020 growth slightly stronger towards the end due to long-term drivers (slides 12-13)
- Relative to ESOO 2019 modelled energy efficiency slightly less effective at time of maximum demand longer term.

South Australia summer maximum demand



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South Australia minimum

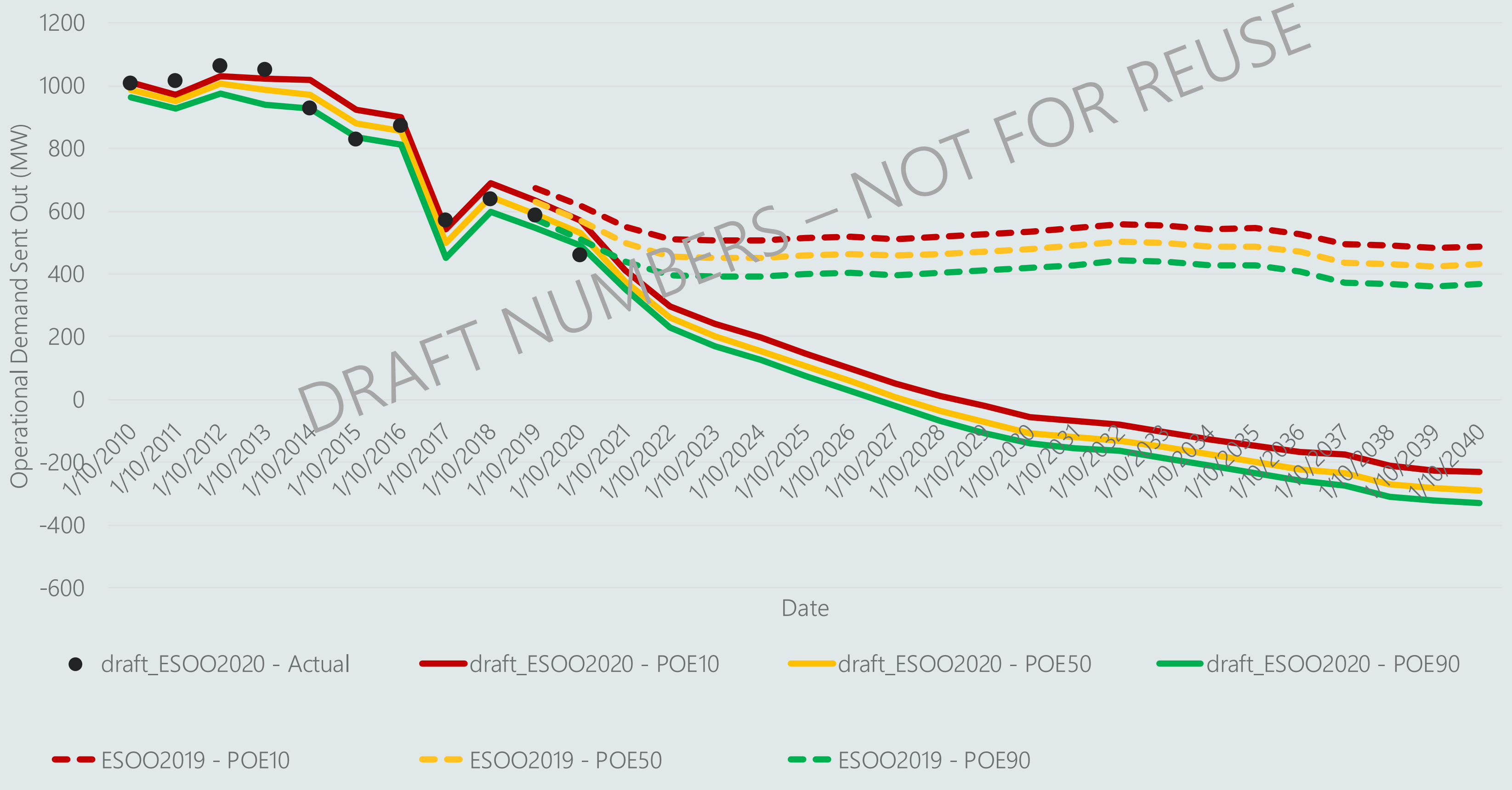
Short term (0-3 years)

- The ESOO2020 is more in-line with the ESOO 2019 High DER scenario
- By 2021 the COVID-19 impact is around 20MW

Long term (10-20 years)

- ESOO 2020 is below zero by 2028-2029 for the POE50
    - Expect voltage and frequency issues by 2023 if not sooner
- ESOO 2020 is lower than the ESOO 2019 due to net DER impact of:
    - Higher PV capacity (negative driver)
    - Higher battery (positive driver at time of minimum demand)
    - Higher VPP captured in OPSO (negative driver at time of minimum demand)
    - Similar EV numbers but with a proportion of EV's VPP charging post 2030 (negative demand driver)

South Australia shoulder minimum demand*



*Excludes VPP demand assumed to ramp up from 2030 onwards

Victoria maximum

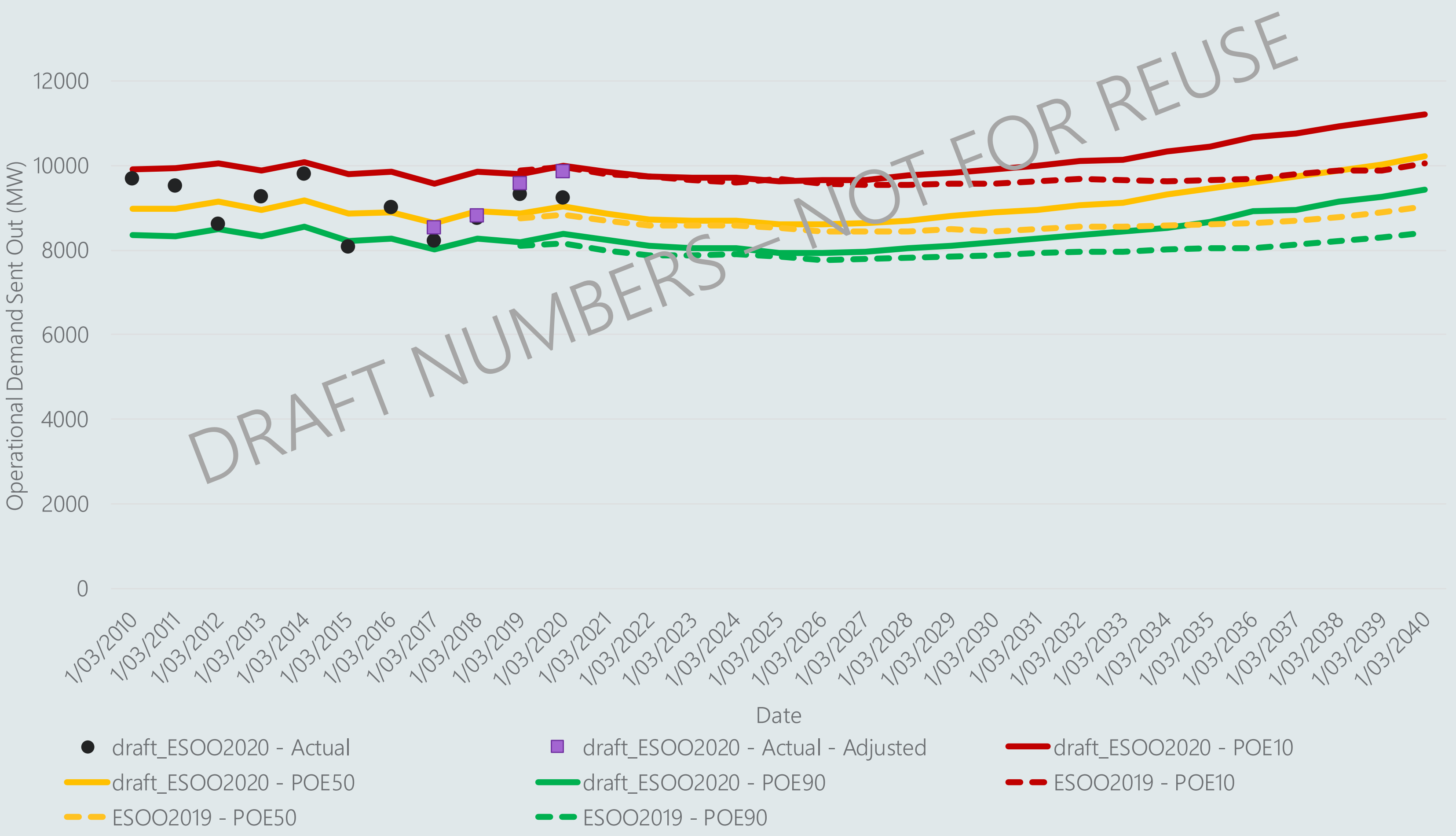
Short term (0-3 years)

- Occurring around 18:30 (two hours before sunset) in Summer. Some maxima in recent years at around 14:00 to 15:00
- By Summer 2021 the COVID-19 impact is estimated at around -60MW
- The distribution is slightly narrower than the ESOO 2019 with POE50 and POE90 up slightly.

Long term (10-20 years)

- ESOO2020 growth stronger towards the end due to long-term drivers (slides 12-13).
- Growth from around 2025 is when business energy efficiency programs assumed to levels off.
- Relative to ESOO 2019 modelled energy efficiency is slightly less effective at time of maximum demand longer term.
- From 2035 slightly higher EV forecast
    - A portion of this is reserved for VPP

Victoria summer maximum demand



Victoria minimum

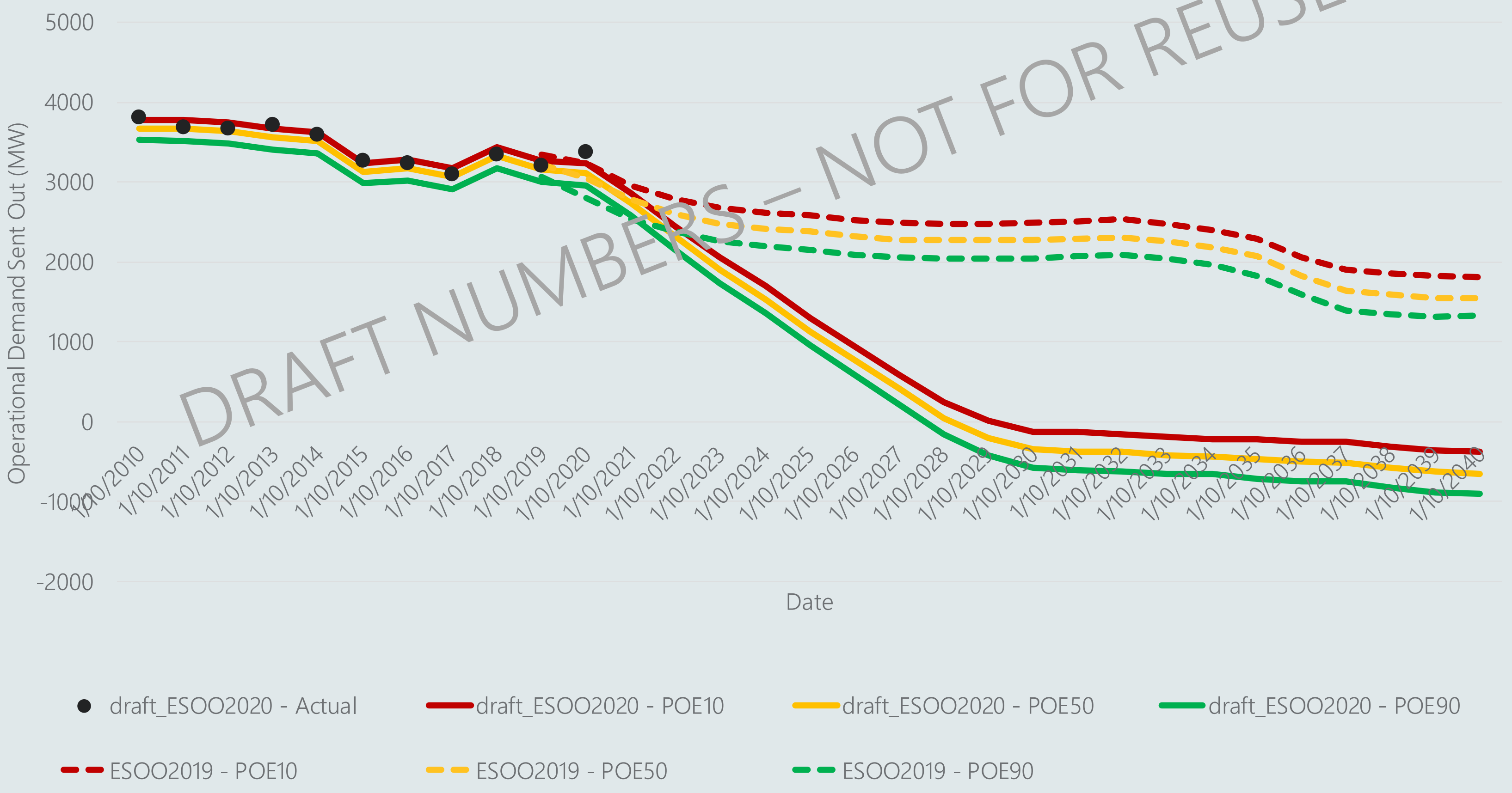
Short term (0-3 years)

- By 2022-23 the ESOO 2020 minimum is roughly 500 MW lower than the ESOO 2019 minimum for the same POE due to the ~600 MW difference in PV capacity
- By 2021 the COVID-19 impact is around 10 MW

Long term (10-20 years)

- ESOO 2020 is below zero by 2028-2029 for the POE50 central scenario. This is significantly lower than ESOO 2019 due to a much higher forecast PV uptake across all scenarios.
- Apart from PV, the ESOO 2020 forecast is lower than the ESOO2019 due to net DER impact of:
  - Higher battery (positive driver at time of minimum demand)
  - Higher VPP captured in OPSO (negative driver at time of minimum demand)
  - Similar EV numbers but with a proportion of EV's VPP charging (negative demand driver)
- Plateaus post 2030 due to slower growth in PV and increased growth in EV and battery storage

Victoria shoulder minimum demand*



*Excludes VPP demand assumed to ramp up from 2030 onwards

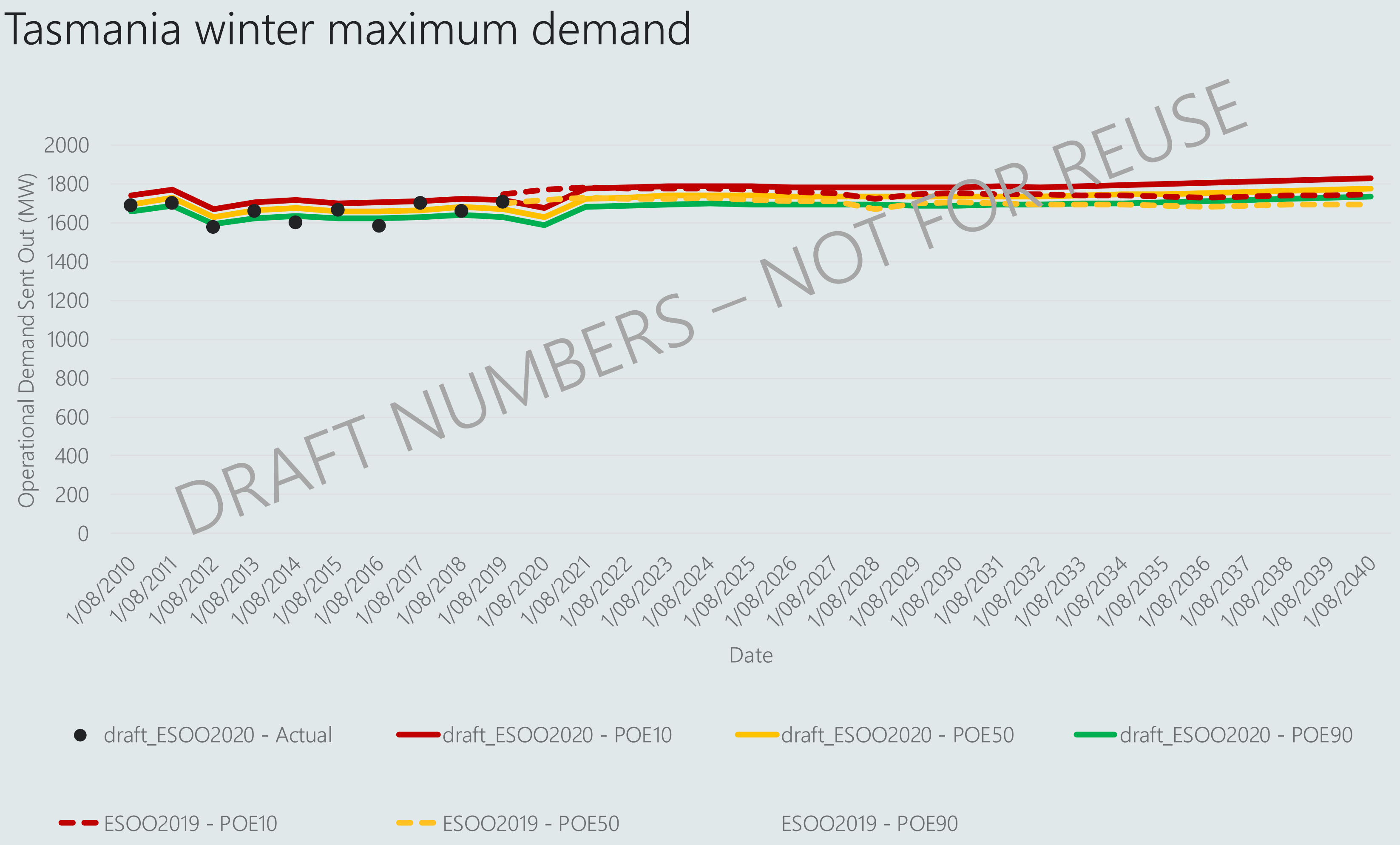
Tasmania maximum

Short term (0-3 years)

- Typically occurs around 08:30 in winter
- By winter 2020 the COVID-19 impact is estimated at approximately -70 MW
- LIL reduction in 2020 then ramping back up in 2021

Long term (10-20 years)

- ESOO 2020 growth slightly stronger towards the end due to long-term drivers (slide 12-13)



Tasmania minimum

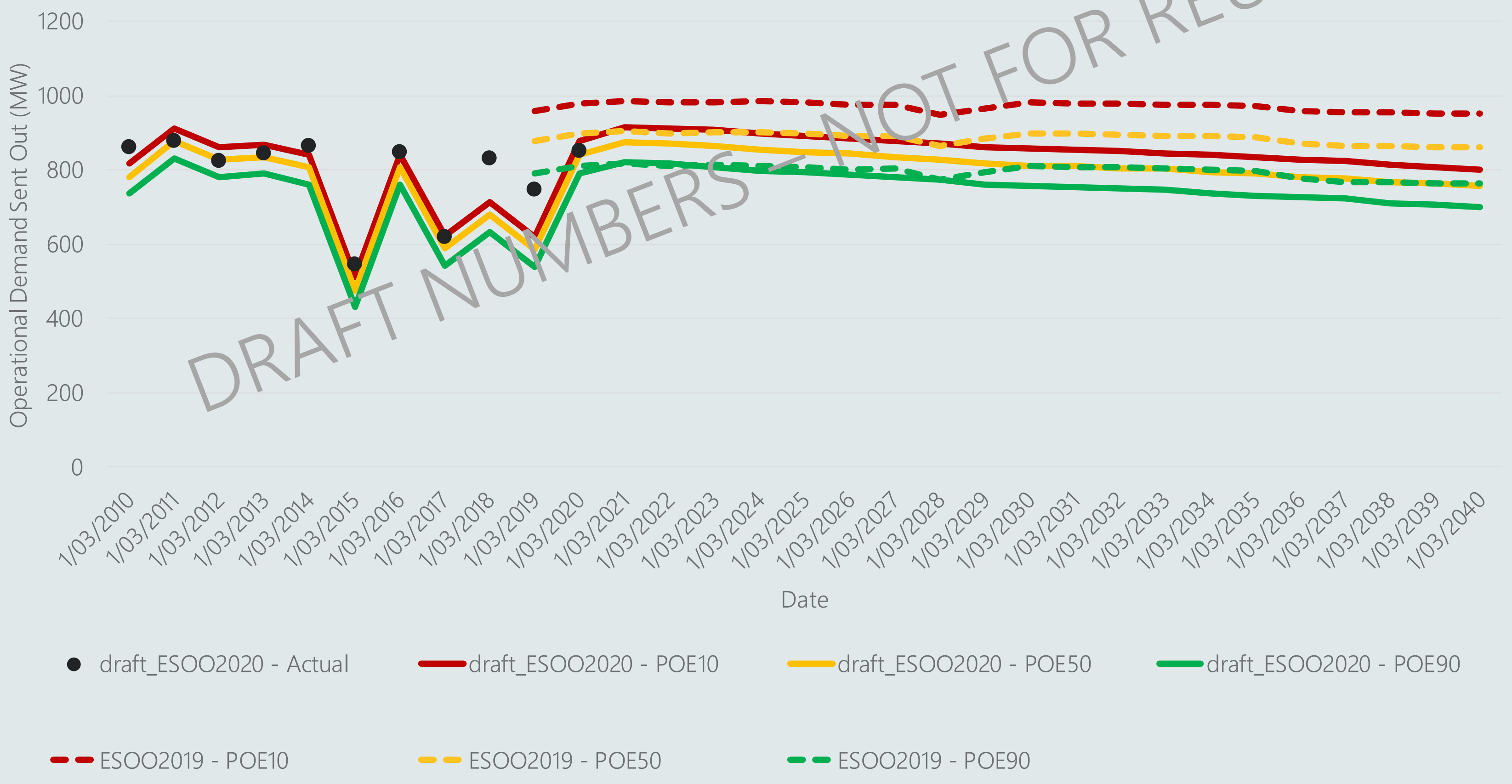
Short term (0-3 years)

- Typically occurs overnight in summer, but shifting to daytime minimum in the near term
- By summer 2020-21 the COVID-19 impact is estimated at around -30 MW
- LIL makes up 60% of minimum demand. Growth in LIL from 2020 to 2021

Long term (10-20 years)

- ESOO 2020 forecasts faster decline than last year due to higher forecast PV uptake

Tasmania summer minimum demand*



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