DER DRAFT PROJECTIONS

FRG meeting

March 2021

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Enlightening environmental markets

Green Energy Markets

Overview

DRAFT RESULTS – MARCH 2021

Green Energy Markets

- **Methodology and adjustments to prior year's approach**
- **Draft results**
- **Model components and assumptions**

Methodology

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- **The methodology adopted for developing projections and developing assumptions this year is very similar to that employed last year, with last year's report providing further detail beyond that detailed in this slide-pack. For copy of last year's report see:** https://aemo.com.au/-/media/files/electricity/nem/planning_and_forecasting/inputsassumptions-methodologies/2020/green-energy-markets-der-forecast-report.pdf?la=en
- **We have a model that estimates payback period on a solar system and solar + battery system using an hourly break-down of solar output over a year as well as demand.**
- **This provides an estimate of revenues via:**
  - solar self-consumption avoiding power imports at retail rate
  - solar exports at feed-in tariff rate linked to wholesale energy rate
  - Avoided exports used to charge a battery and then the avoided power imports (at retail rate) provided by discharging the battery.
- **The payback model has three customer types and system configurations:**
  - Residential
  - Small business (<160MWh)
  - Large commercial customer
- **The payback model includes two tariff structures:**
  - A time of use tariff applying to small customers with 3 time periods: Peak, Solar, Off-Peak
  - A demand-based tariff applying to large business customers
- **The model covers 2020 to 2051 with power prices, capex, and government policy support varied for each year.**
- **Payback is then used as main determinant for levels of solar and battery uptake in each year in combination with other important uptake factors such as rate of new housing construction and extent of market saturation.**

Changes since last year – addressing underestimates

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- **GEM's projections developed for AEMO last year significantly underestimated solar uptake in the sub-100kW segment for which actual installations for 2020 are likely to be around 3,000MW on nation-wide basis (incl. off-grid).**
- **The underestimate was due to a combination of:**
  - One-off manual adjustments to our projections to revise projected installs downward after a request by AEMO to try to take into account the effect of the economic downturn induced by COVID-19 restrictions very early on in their implementation in late March. At this time it was apparent that employment and expenditure were being very severely negatively impacted and surveys suggested a fall in customer enquiries for solar systems over the preceding 2 weeks of around 50%;
  - An error in feed-in tariff rates based on an assumption retailer feed-in tariffs would closely follow wholesale energy market rates in unregulated residential retail markets;
  - Changes in the propensity of households to purchase a solar system for a given payback period
- **Prior to the manual adjustment to account for COVID downturn we had projected around 2,200MW of sub-100kW would be installed in 2020 (although this is only main grid-connected systems).**
- **We have since made two significant revisions to our modelling approach:**
  - We add a 3c/kWh premium on top of wholesale energy market rates in SA, NSW and QLD to reflect the fact that feed-in tariffs offered by most of the major retailers are systematically higher than what a solar generation profile could expect to receive from the wholesale electricity market. Our understanding is that power retailers use the feed-in tariff rate as a marketing tool to lure some types of customers (while for non-solar customers they offer other products with lower feed-in tariffs but also lower energy and fixed charges).
  - We now take into account the significant decline in borrowing costs (interest rates payable on loans) as another factor influencing solar purchase responsiveness to payback.

Changes to address 2020 & 2021 underestimate

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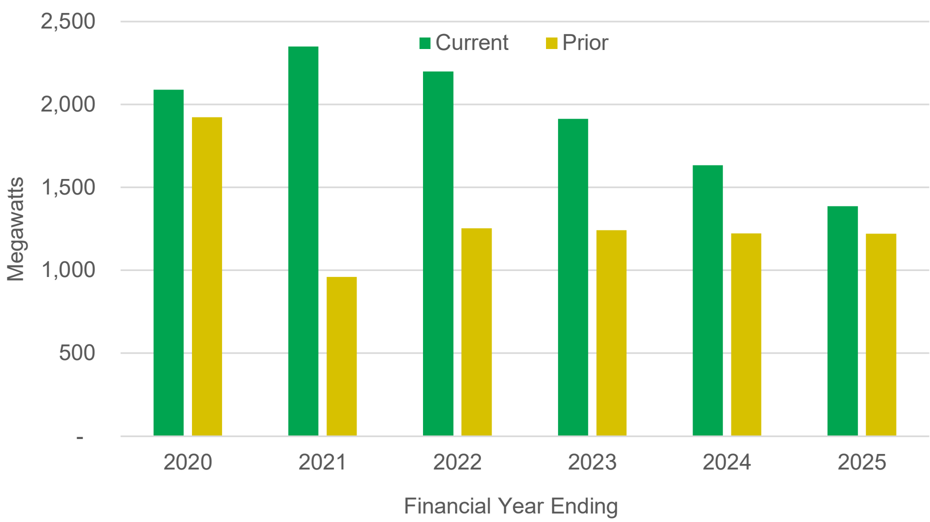
- **Our latest draft projections for AEMO which eliminate the COVID adjustment, and adjust for the feed-in tariff premium and lower cost of finance indicate much higher installations of capacity over the short-term.**
- **The aggregate difference over 2020 to 2025 is 4,400MW of which 3,750MW is for NEM states.**

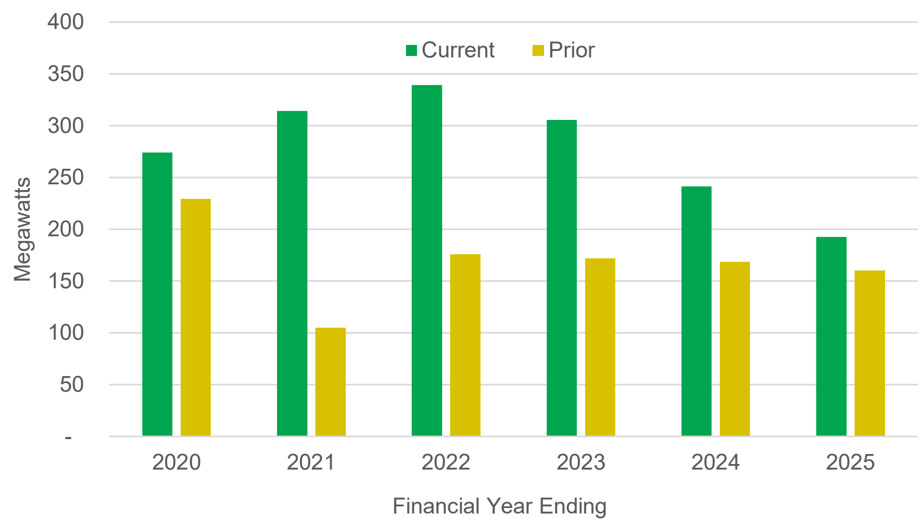
Prior (yellow) versus current (green) forecast

(annual MW additions to stock – Current Trajectory)

NEM



WA SWIS



NEM cumulative results - Solar

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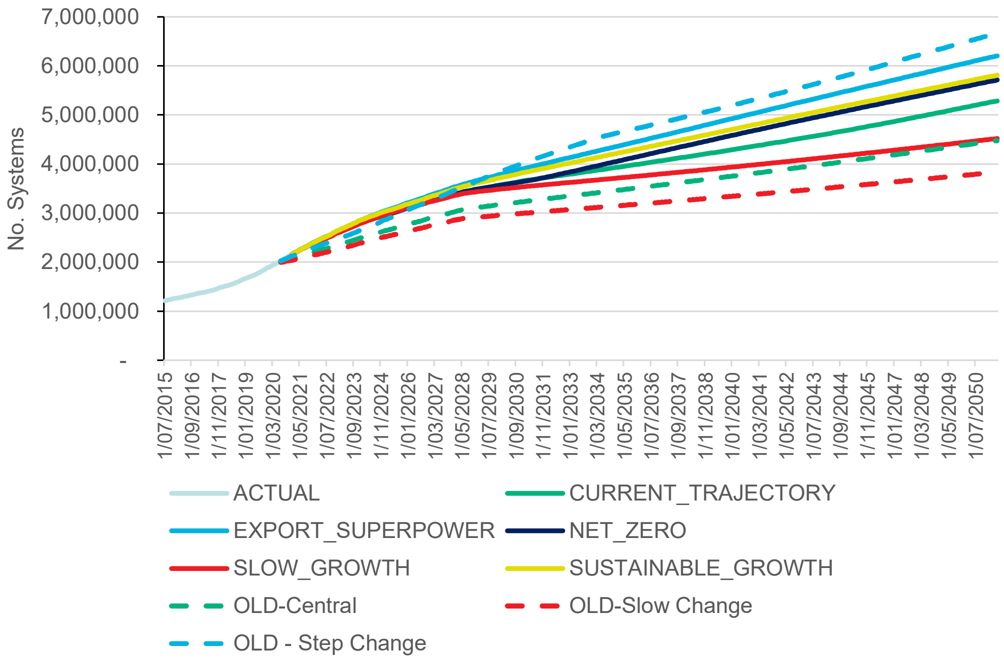
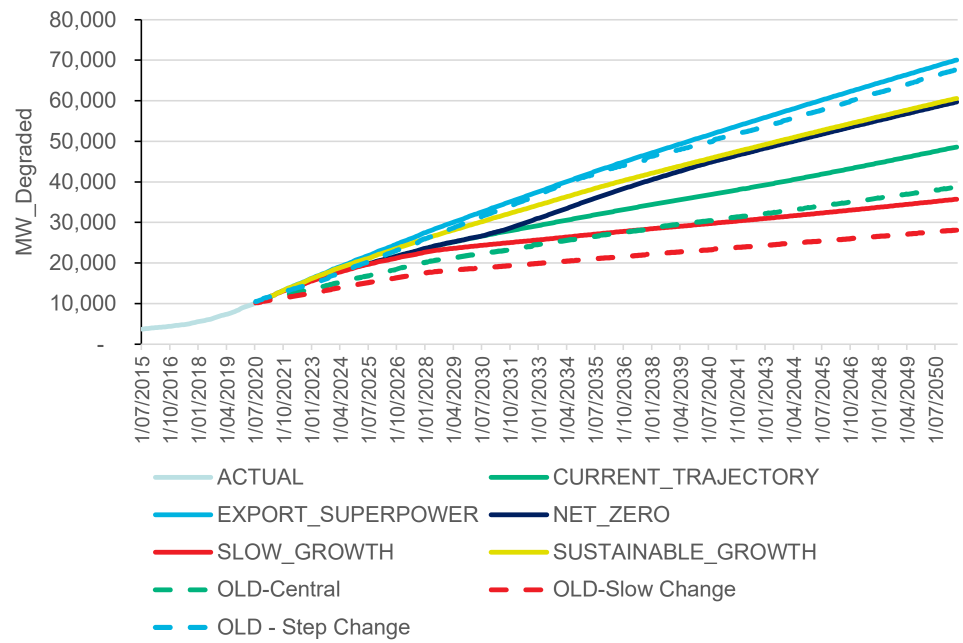
- **For the NEM the cumulative number of solar systems under Current Trajectory grows from the current level of 2.1m to just under 5.3m by 2051. The high point under Export Superpower is 6.2m and low under Slow Growth is 4.5m.**
- **The megawatts of degraded capacity in the NEM expands from 11.3GW to reach 48.6GW by 2051 under Current Trajectory. It peaks at 70GW under Export Superpower and is down to 35.7GW in Slow Growth.**
- **By 2051, under Current Trajectory 39% of residential connections would have a solar system while under Export Superpower it would be 41%.**

NEM cumulative number of behind the meter solar installations by scenario



NEM cumulative degraded megawatts of sub-30MW solar by scenario



SWIS cumulative results - Solar

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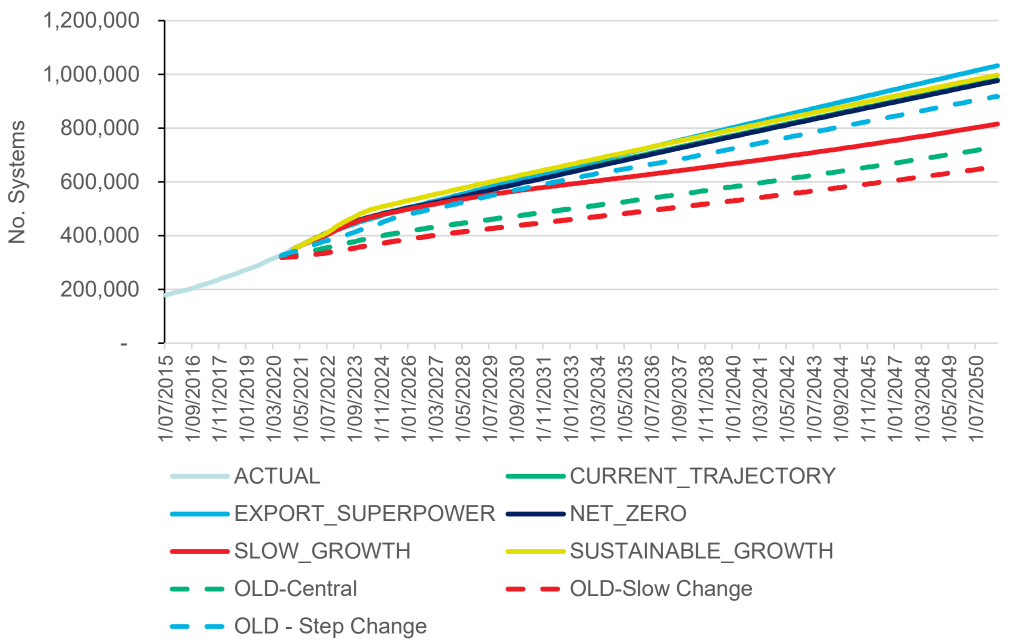
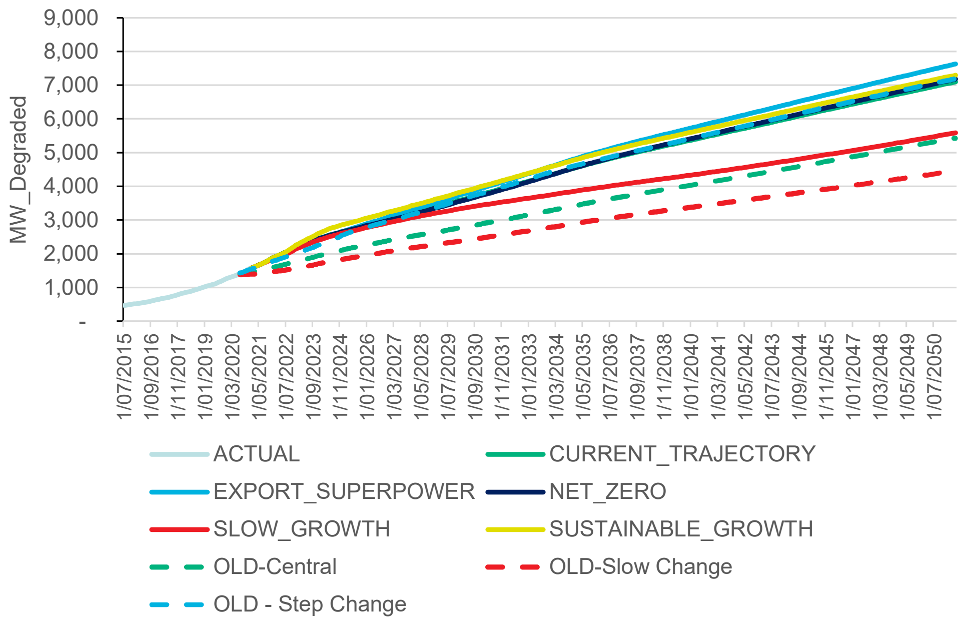
- **For the SWIS the cumulative number of solar systems under Current Trajectory grows from the current level of 348,000 to 980,000 by 2051. The high point under Export Superpower is 1.0m and low under Slow Growth is 815,500.**
- **The megawatts of degraded capacity in the SWIS expands from 1.6GW to reach 7.1GW by 2051 under Current Trajectory. It peaks at 7.6GW under Export Superpower and is down to 5.6GW in Slow Growth.**
- **By 2051, under Current Trajectory 57% of residential connections would have a solar system, with a similar level of penetration under Export Superpower (which is assumed to have a higher number of connections).**

SWIS cumulative number of behind the meter solar installations by scenario



SWIS cumulative degraded megawatts of sub-30MW solar by scenario



NEM cumulative results - Batteries

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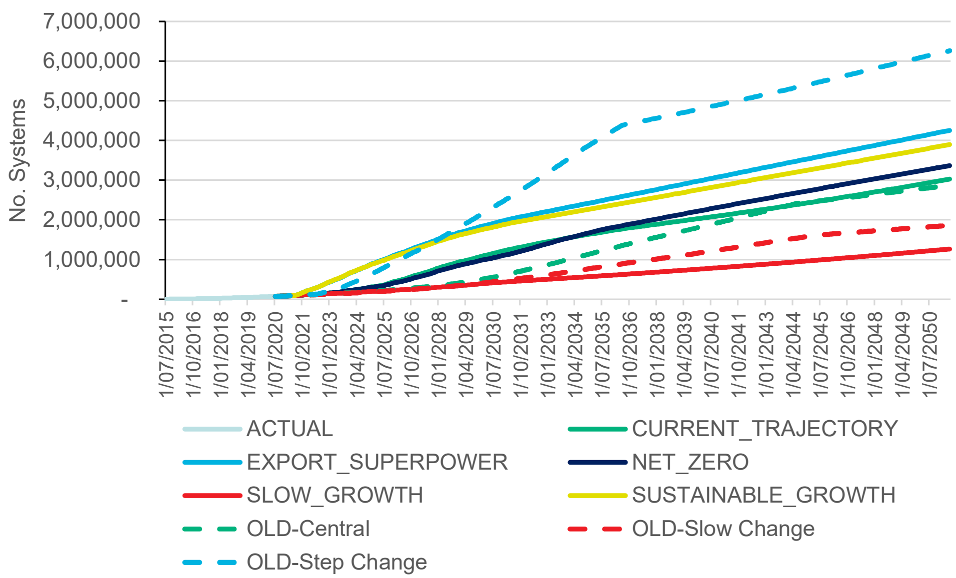
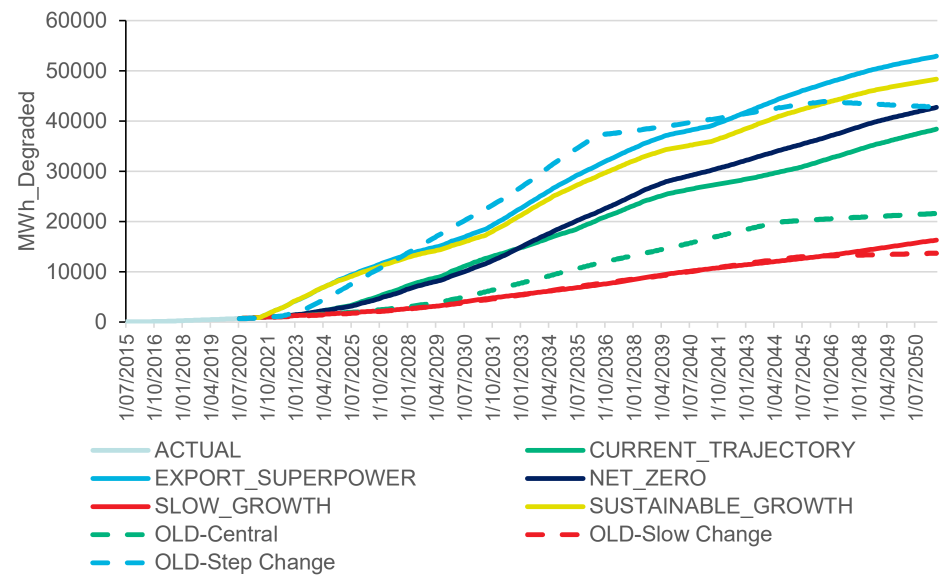
- **For the NEM the cumulative number of battery systems under Current Trajectory grows from the current level of close to 85,000 to reach slightly over 3m by 2051. The high point under Export Superpower is 4.3m and low point under Slow Growth is 1.3m.**
- **The NEM megawatt-hours of degraded battery capacity expands from 790MWh to reach almost 38,400MWh by 2051 under Current Trajectory. It peaks at 52,900MWh under Export Superpower and is down to 16,300MWh in Slow Growth.**
- **The NEM megawatts of battery capacity reach 18,900MW in 2051 under Current Trajectory; 26,700MW under Export Superpower; and just under 8,000MW in Slow Change.**

NEM cumulative number of behind-the-meter battery installations by scenario



NEM cumulative battery megawatt-hours by scenario



SWIS cumulative results - Batteries

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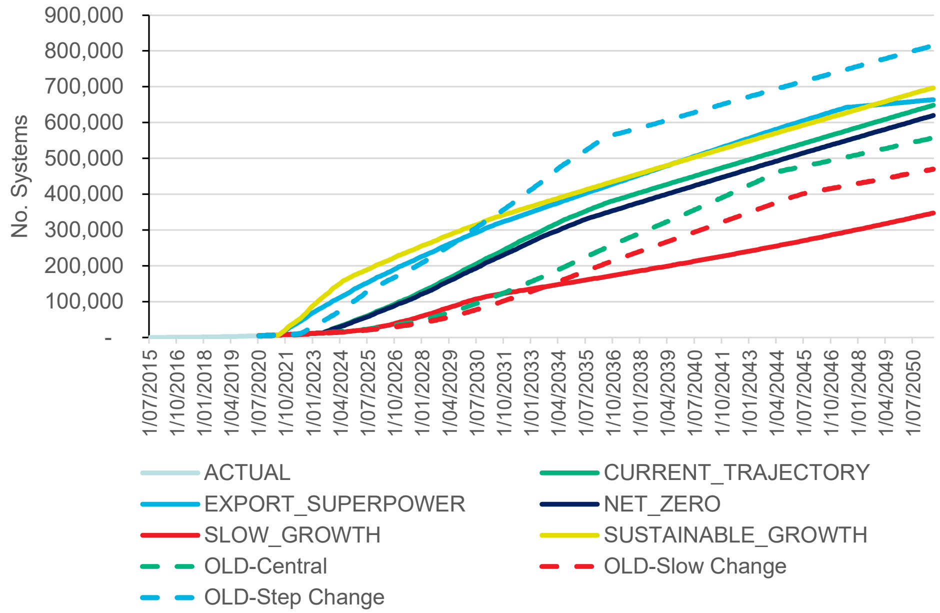
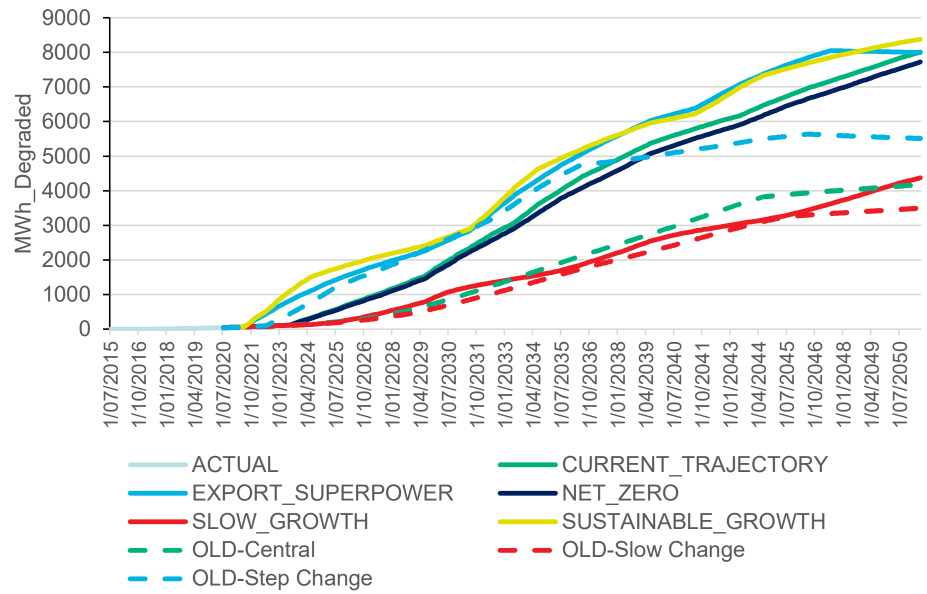
- **For the SWIS the cumulative number of battery systems under Current Trajectory grows from the current level of close to 6,000 to reach slightly over 648,000 by 2051. The high point under Sustainable Growth is 697,000 and low point under Slow Growth is a bit below 348,000.**
- **The SWIS megawatt-hours of degraded battery capacity expands from 56MWh to reach 8,000MWh by 2051 under Current Trajectory. It peaks at 8,400MWh under Sustainable Growth and is down to 4,375MWh in Slow Growth.**
- **The SWIS megawatts of battery capacity reach 3,960MW in 2051 under Current Trajectory; 4,276MW under Sustainable Growth; and just under 2,116MW in Slow Change.**

SWIS cumulative number of behind-the-meter batterv installations bv scenario



SWIS cumulative battery megawatt-hours by scenario



Battery charge-discharge profiles

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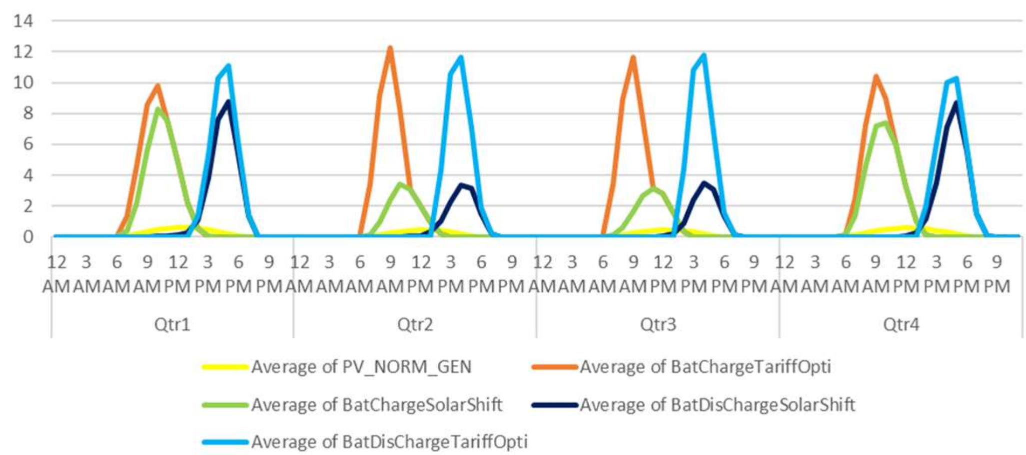
- **For large commercial the tariff optimised battery behaves very differently to the simple solar shift battery in Qtr 2 and Qtr 3 of the year because the optimised battery seeks to charge (orange) not just from solar that would otherwise be exported but also via grid imports during off-peak periods. This means the battery is fully charged irrespective of whether there is high or low solar output and therefore it can displace imports from the grid during peak priced periods and keep the demand charge lower as illustrated by its light blue discharge line being far higher in Q2 and Q3 than the solar shift's dark blue line.**
- **Almost identical patterns are displayed for the small business customer type.**

Large commercial battery charge and discharge profile (light blue and orange is tariff optimised)



Battery charge-discharge profiles

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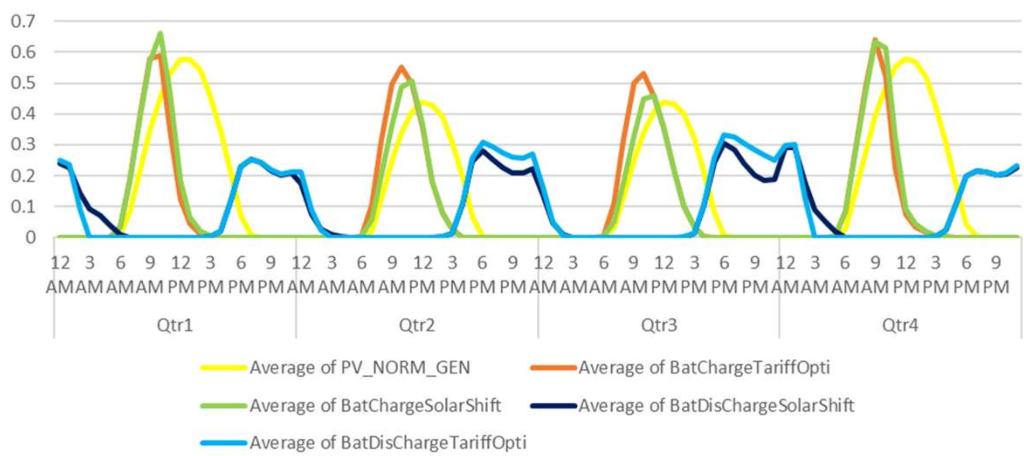
- **For Residential the difference is much less noticeable between a tariff optimised battery and one that simply seeks to minimise exports and minimise imports irrespective of time. This is because households, unlike businesses, tend to install solar systems that generate vastly greater electricity than they can self-consume. This provides plenty of excess solar that can fully charge-up the battery with much less need to charge from the grid to fill the battery.**

Residential battery charge and discharge profile (light blue and orange is tariff optimised)



Model components/assumptions

Capex assumptions

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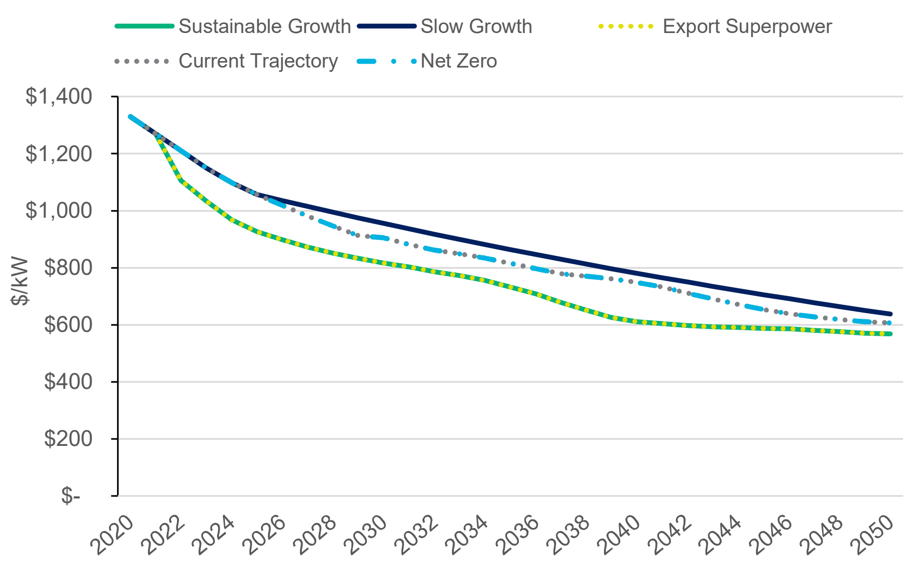
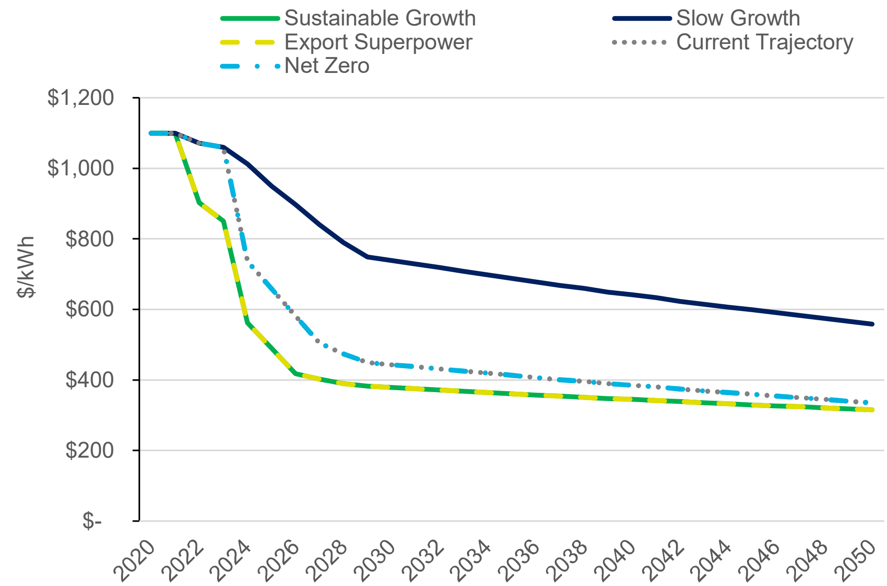
- **Capex assumptions are similar to those provided by CSIRO's GenCost but with modifications particularly in short term**

Cost per kilowatt for a residential solar system without battery (excluding government subsidies)



Price per kilowatt-hour for residential battery system (excluding government subsidies, incl GST)



Cost - Battery subsidies

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- **Under Central we assume the SA and VIC Gov't rebates continue to their scheduled end date at their current rebate levels for residential sector only. Our view is that both states will achieve levels of uptake that exceed the allocated budget for the rebate. Victoria's restrictions over which postcodes could receive the rebate have been removed and we are led to believe that uptake of the rebate is on track to use up the allocated budget.**
- **In addition NSW through its legislated peak demand reduction initiative is also expected to provide support to batteries (across all customer sectors) for which we attribute a value of around 50% of the estimated capital cost in 2023 with the dollar value declining as the cost per kWh of battery systems decline. In Central the scheme is assumed to end in 2030 while under Slow Growth it assumes the program is not implemented. For Sustainable Growth, Net Zero and Export Superpower it is assumed the peak demand reduction program continues throughout the projection period.**
- **Under Sustainable growth and Export Superpower it is assumed the Federal Government steps in with their own battery support program which matches the level of financial support provided by the NSW scheme and this supplants the Victorian and SA rebate programs leading to a nationally consistent level of battery support per kWh across all states.**
- **Under all the other scenarios other than Sustainable Growth and Export Superpower we assume no government support that makes a noticeable difference to battery uptake across WA, QLD and TAS.**

Revenue – carbon abatement

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- **The model takes into account the potential for solar systems to receive a discount on purchase price through a range of government programs established to achieve greenhouse gas abatement:**
    1. The Large-Scale Renewable Energy Target – applicable to systems larger than 100kW being installed by customers assumed to be on Large Commercial (Low Voltage) tariff, the subsidy value per MWh is derived from current forward prices for LGCs.
    2. The Small Scale Renewable Energy Scheme – applicable to customers classified as small consumers with systems smaller than 100kW. Provides an upfront discount of about $38 per MWh the system is forecast or deemed to produce over a series of future years (via STCs). The deemed period drops by a year between now and 2030 after which no subsidy is provided.
    3. Australian Carbon Credit Units (ACCUs) – via the Industrial Electricity and Fuel Efficiency Methodology solar systems located behind the meter are eligible to create ACCUs for the abatement they deliver in offsetting/avoiding the use of fossil fuels over a 7 year project crediting period.
    4. Similar to ACCUs, the Victorian Energy Upgrades scheme (an obligation on electricity retailers) allows for behind the meter solar systems to create Victorian Energy Efficiency Certificates (VEECs) for the abatement they deliver in offsetting/avoiding the use of fossil fuels via a method known as project impact assessment. Under this method activities interventions are awarded VEECs for 10 years worth of energy saving abatement.
    5. It also conceivable that other energy efficiency abatement schemes that obligate energy retailers such as the NSW Energy Savings Scheme and the South Australian Retail Energy Efficiency Scheme could in the future recognise and reward the abatement delivered by solar systems.
- **At present if a solar system elects to create LGCs or STCs they become ineligible to also create either ACCUs or VEECs. Double dipping or switching between schemes is not allowed.**

Revenue – carbon abatement

- **How the model incorporates carbon abatement revenue**
  - Because there are actually several different mutually exclusive options for carbon abatement revenue of which a system owner needs to commit to one in advance of system installation, the model needs to determine and select the scheme which will maximise abatement revenue for the system over its lifetime.
  - To simplify calculations and also to reflect how we expect the real market to evolve, abatement revenue over the next ten years (or seven in the case of ACCUs) is assumed by the model to be delivered as an upfront payment which is deducted from the capital cost of the solar system. Effectively it functions via a deemed abatement estimate similar to how STCs work.

Revenue – carbon abatement

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- **Revenue per MWh**
  - The tables below provide assumed carbon abatement revenue per MWh for solar systems by scenario for Victoria as an illustrative example. While certificate prices are anticipated to reach very high levels relative to historical levels in several scenarios as we get to the later years of the projection, at the same time the emissions intensity of the grid falls to low levels and so the value captured by a solar system per megawatt-hour is actually lower than what has been provided by abatement schemes in the past.

Alternative carbon abatement deemed abatement discounts for a Victorian Solar System

Abatement certificate	Scenario	Crediting/ deeming period	2020	2025	2030	2035	2040	2045	2050
Deemed LGC Value per deemed MWh	ALL	Up to 2030	$ 181	$ 34	$ 5	$ -	$ -	$ -	$ -
Deemed STC Value per deemed MWh	ALL	Up to 2030	$ 437	$ 247	$ 57	$ -	$ -	$ -	$ -
ACCU Value per deemed MWh	Current Trajectory	7 year	$ -	$ 88	$ 47	$ 22	$ 18	$ 18	$ 18
ACCU Value per deemed MWh	Slow Growth	7 year	$ -	$ -	$ -	$ -	$ -	$ -	$ -
ACCU Value per deemed MWh	Net Zero	7 year	$ -	$ 88	$ 137	$ 198	$ 181	$ 106	$ 62
ACCU Value per deemed MWh	Sustainable Growth	7 year	$ -	$ 146	$ 151	$ 110	$ 66	$ 49	$ 44
ACCU Value per deemed MWh	Export Superpower	10 year	$ -	$ 245	$ 195	$ 108	$ 83	$ 77	$ 74
VEEC value per deemed MWh	Current Trajectory	10 year	$ -	$ 183	$ 47	$ -	$ -	$ -	$ -
VEEC value per deemed MWh	Slow Growth	10 year	$ -	$ -	$ -	$ -	$ -	$ -	$ -
VEEC value per deemed MWh	Net Zero	10 year	$ -	$ 183	$ 47	$ -	$ -	$ -	$ -
VEEC value per deemed MWh	Sustainable Growth	10 year	$ -	$ 174	$ 126	$ 88	$ 64	$ 66	$ 73
VEEC value per deemed MWh	Export Superpower	10 year	$ -	$ 147	$ 86	$ 45	$ 38	$ 43	$ 48

Green Energy Markets

Assumptions – Wholesale energy

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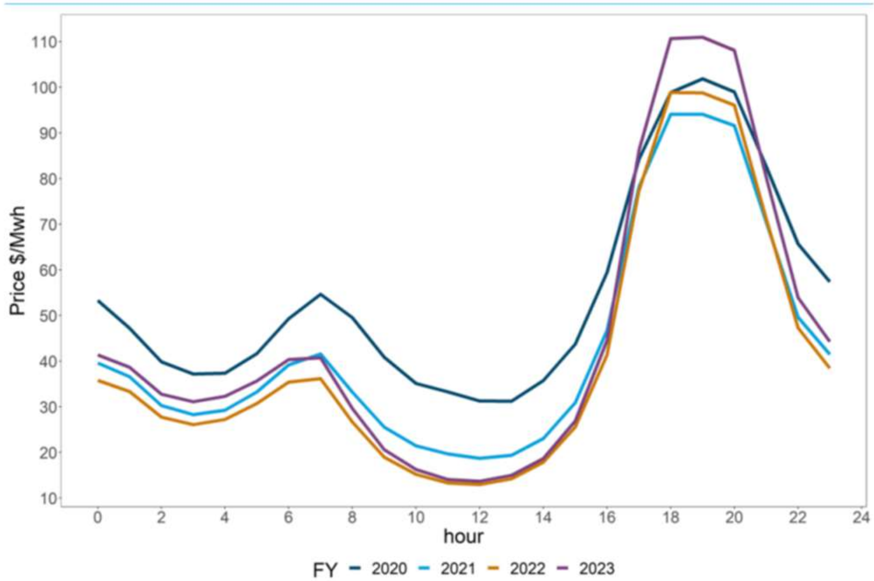
- **Wholesale energy is divided up into the following time categories:**
  - Peak (3pm to 9pm) weekdays
  - Solar (9am to 3pm) all days
  - Off-peak – all other times
  - This is based on new patterns of wholesale energy costs which reflect influence of solar in hollowing-out prices in the middle of the day as illustrated from AEMC projections for wholesale prices in Queensland.

Figure 2.5: Average wholesale electricity prices by hour of day in QLD



Source: AEMC analysis

Note: Total committed generation is only that category of generation sourced from AEMO that has reached financial close before the modelling was undertaken. Other new capacity may have been included as new generation within the modelling period. Since the modelling was undertaken, additional projects have been committed to across the NEM which would impact these results.

Revenue – Wholesale energy

- **Up until 2022-23 we use AEMC projections for wholesale energy by time of day except for WA where prices reflect current retail pricing.**
- **After 2022-23 wholesale energy prices then follow a linear path towards prices set from 2030 onwards based on CSIRO GenCost LCOE estimates and in some scenarios also short-run marginal cost of existing coal. These are adjusted to suit themes within each scenario for differing levels of emission reductions and technological advancement.**
- **NEM assumed to have uniform prices across all states, while WA has a different wholesale price path.**
- **For first five to ten years of projection wholesale price differences across time periods are smeared/averaged in final retail prices in line with current retail pricing practices. The degree of smearing is greater for small customers and less for larger customers. Model assumes the smearing is gradually unwound between 2020 to 2030 as a result of requirement to move those with smart meters to "cost reflective" network tariffs in several states, the growing differential between wholesale prices during solar period and other times, and increasing need to expose end consumers to wholesale market signals.**
- **Feed-in tariffs for exported generation for the 2020-21 year reflect an average of current offers from major retailers by state (or the regulated rate). For the following years these are then assumed to align with our projected wholesale prices by time of day. In Victoria this is then adjusted upwards by 2.5c/kWh to reflect the Vic Government social cost of carbon premium. In states with unregulated feed-in tariffs (SA, NSW and QLD) this is adjusted upwards by 3c/kWh to reflect a common practice by major retailers to offer products with a feed-in tariff substantially higher than prevailing wholesale energy market rates. While these are usually accompanied by higher import energy charges and fixed daily charges they generally deliver a superior financial outcome for solar system owners than other products with lower energy and fixed daily charges.**

Revenue – Network charges

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- **Network costs are aligned with 2 tariff structures per state:**
  - Large commercial customer with demand charges (typical of a low voltage customer)
  - Small customers with charges only recovered based on kWh consumption (plus fixed daily charge)
- **Network charges vary by three time periods across all states:**
  - Peak. For businesses on demand charges the peak covers the period 11am-8pm weekdays. For small customers it is 3pm-9pm weekdays.
  - Solar: Only applicable to small customers from the period 9am to 3pm every day.
  - Off-peak: For businesses on demand charges this covers the period 8pm to 11am on weekdays and all weekend.
  - The use of a solar period is a recent phenomenon that SAPN has introduced as a result of the need to encourage load shifting into the middle of the day to soak up solar generation that is starting to reach levels that are pushing voltage to upper limits. We expect that such an approach will spread to other networks as solar penetration rises.
  - For small customers network charges until 2021/22 will follow current pricing practices in each state of substantial smearing/averaging across the time periods. In the years between 2022/23 and 2029/30 prices then gradually transition towards more sharply delineated prices across the peak/solar/off-peak period.

Revenue – avoided import rate

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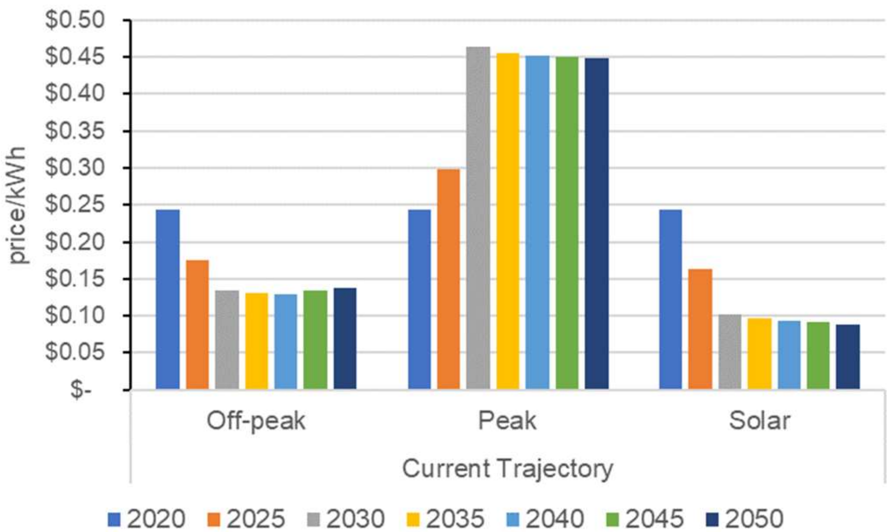
- **The chart below provides an example of how the time of use structure flows through to end retail rates for small residential consumers in NSW.**

NSW retail rate per kWh by each time period under Current Trajectory



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