DER DRAFT PROJECTIONS

FRG meeting

September 2022
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Enlightening environmental markets

Green Energy
Markets

Overview

- **Methodology**
- **Key changes and context for this year's modelling**
- **Draft results**
- **Derivation of results – some examples**
- **Appendix – further details on model**

Methodology

- The methodology adopted for developing projections this year is very similar to that employed last year, with last year's report providing further detail beyond that detailed in this presentation.
- 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 2021 to 2055 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, economics growth and extent of market saturation.

Key changes and context for this year's modelling

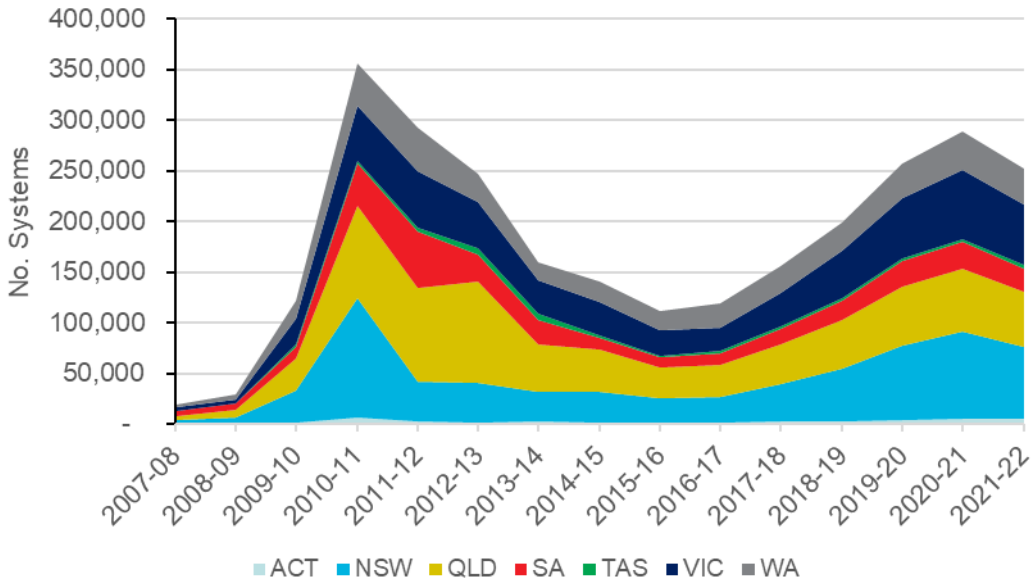
- Consistent with our estimates of deteriorating financial attractiveness and last year's projections, the second boom in solar has tailed off over the past 12 months, with noticeable falls in system installs relative to 2020-21
- However, our draft results for this year involve a substantial revision upwards in expected solar installs relative to last year for the following reasons:
  - While recent evidence supports our modelling expectation that demand for solar would decline as financial attractiveness deteriorated, it has proved to be more robust than previously assumed.
  - The spike in international coal and gas prices and flow-on impact on electricity prices (as well as the media coverage) has helped to offset the increase in solar system costs and appears to be driving another surge in customer interest in purchasing solar systems.
  - The emission reduction policy settings for this year's scenarios tend to be more ambitious.

Key changes and context for this year's modelling

DRAFT RESULTS – September 2022

- System numbers data appears to indicate that the second solar boom has peaked and the market was in the process of contracting.
- This development is consistent with GEM's modelling framework that the main driver for consumers' solar system purchasing decision is financial gain and therefore changes in investment payback time are a useful guide for overall solar market installations.
- We had been projecting such a downturn would unfold as a result of declining electricity prices and drop-away in the STC rebate. These were leading to deteriorating financial attractiveness of solar systems as measured by investment payback time.
- Further exacerbating the deteriorating financial attractiveness was an unexpected significant rise in system costs.
- However the drop in installation numbers unfolded two years later than we had initially expected due in part to a COVID-lockdown induced shift in household expenditure away from services to household durable goods.
- In addition, it appears that customer uptake is not as sensitive to deteriorating payback as we had been assuming – demand for solar does respond to payback but has held up stronger than we had expected.

Number of New Residential Solar System Installs by year

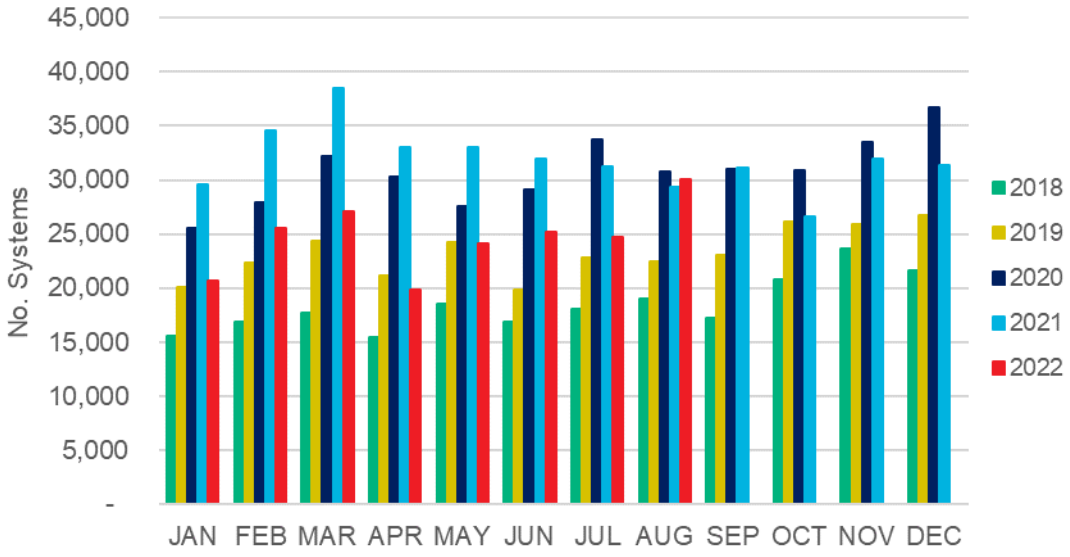


Key changes and context for this year's modelling

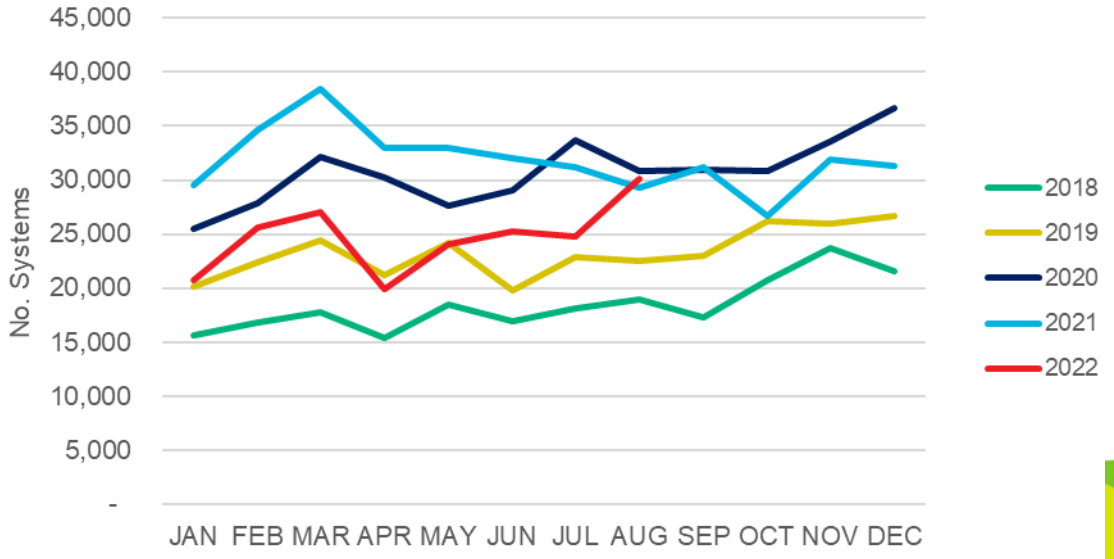
DRAFT RESULTS – September 2022

- Comparing system registration numbers for the same month across different years shows clear growth all the way until July 2021, after which numbers began declining (although complicated by NSW/VIC lockdowns restricting installations as well).
- By 2022 (shown in red) we can see numbers clearly down on both 2020 and 2021.
- Although with an interesting anomaly being the dramatic revival in system registrations in August this year.
- Interviews with industry participants at the customer acquisition end of the value chain indicate that there was a large surge in customer quote enquiries in the immediate aftermath of the intense media coverage of wholesale power price surge and market suspension that reached a head in late May and early June. Again this would be consistent with our model's linkage of demand for solar with financial payback.

Residential Solar Systems by STC registration month-National



Residential Solar Systems by STC registration month-National



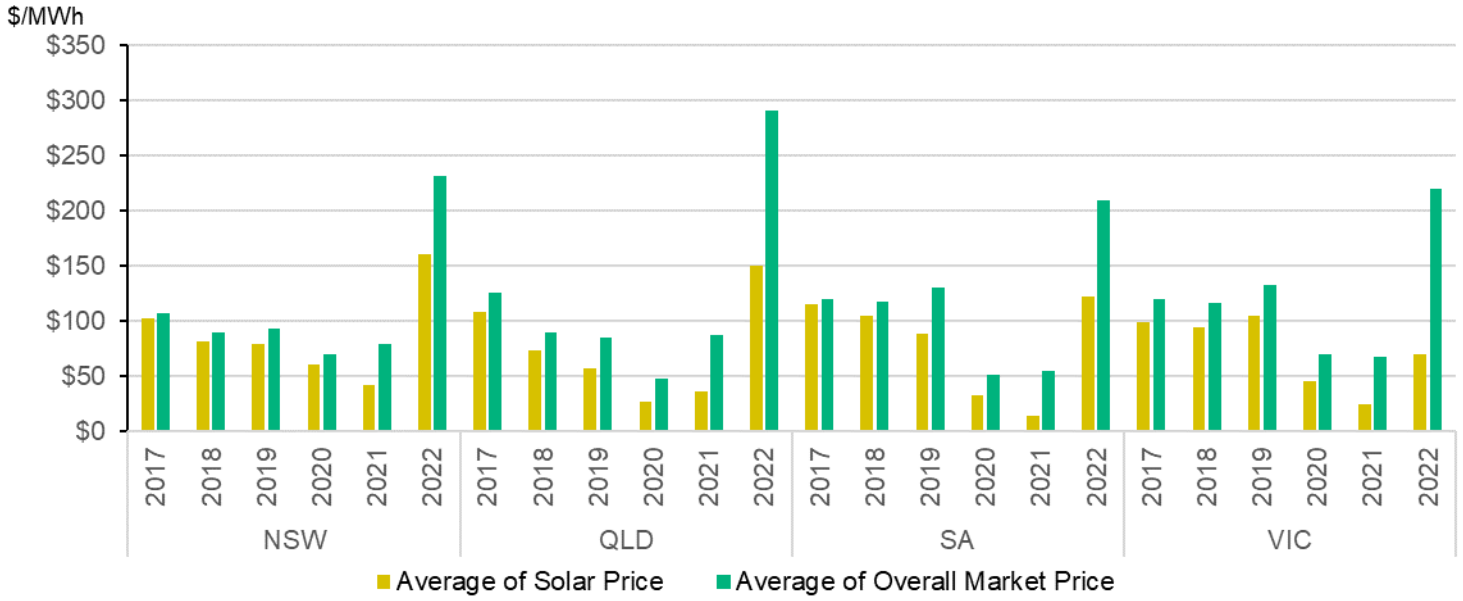
Note: STCs are a form of financial policy support provided to solar systems below 100kW under the Federal Government's Small-scale Renewable Energy Scheme. Solar systems are typically registered with the Clean Energy Regulator to receive STCs within a few weeks after installation.

Key changes and context for this year's modelling

DRAFT RESULTS – September 2022

- Consistent with forecasts published by the Australian Energy Market Commission in their Residential Price Trends reports, we had previously assumed that both retail and wholesale electricity prices would continue to decline in the short-term and that daytime wholesale prices (and therefore feed-in tariffs) in particular would reach extremely low levels.
- However, the huge surge in international gas and coal prices which have flowed through to higher costs for marginal Australian power generators has substantially altered the situation.
- Also, while solar generation continues to see a large discount in wholesale spot prices relative to overall generation, it has still experienced a very substantial lift in market value (at least up until mid-way through 2022).

Average wholesale spot market value of overall generation vs rooftop solar generation (Calendar years with 2022 only for Jan-June)



Draft Results

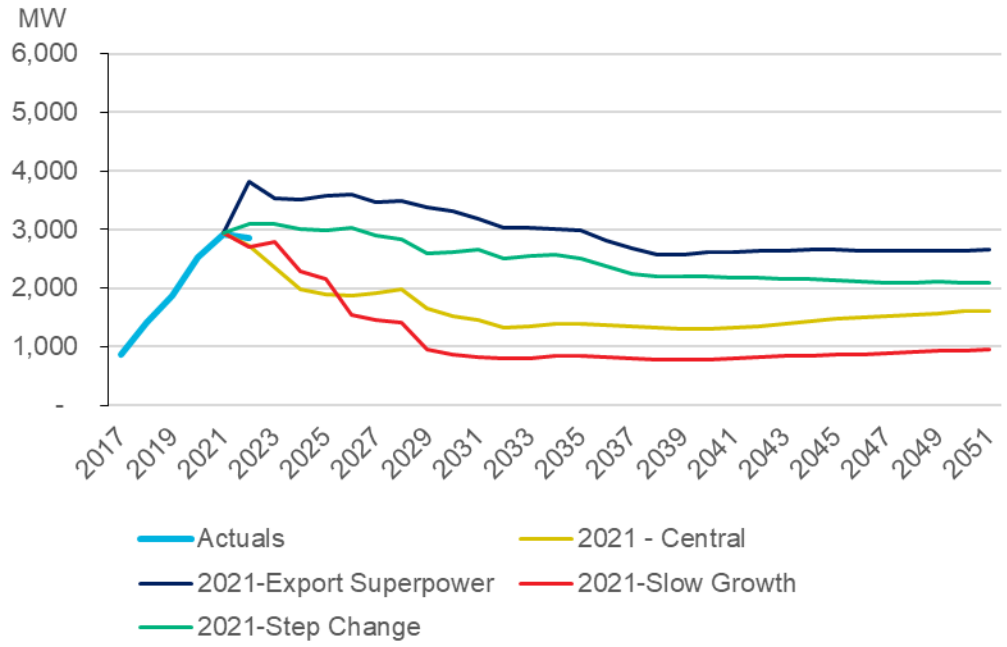
Solar Results – Annual MW Additions

DRAFT RESULTS – September 2022

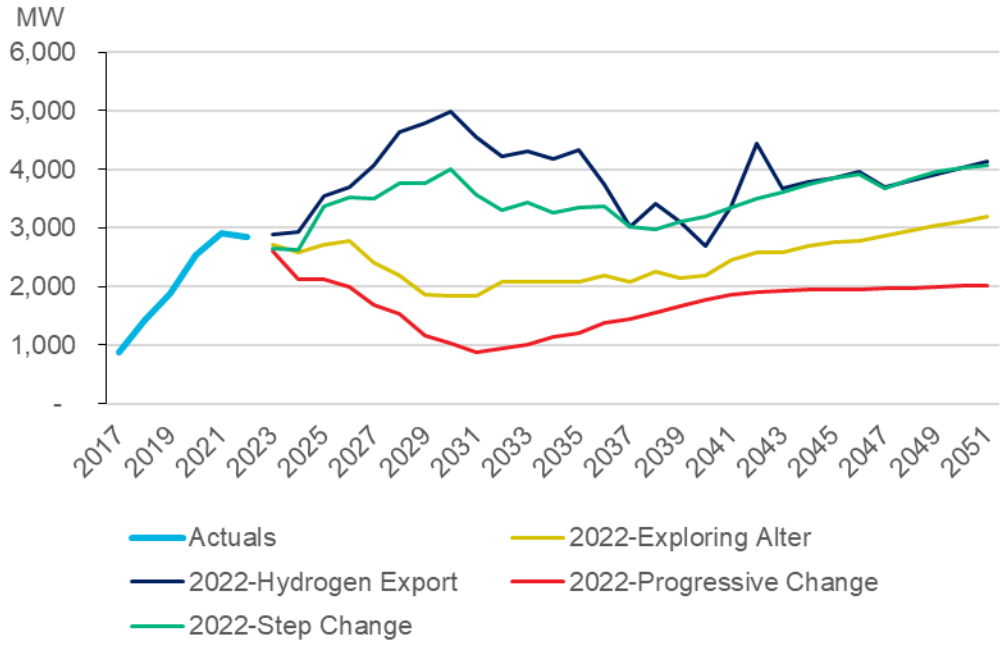
- The megawatts of solar additions projected in our 2022 modelling are generally higher than 2021.
- This is a function of the factors discussed in prior slides:
  - demand more robust than previously assumed to deteriorating payback
  - Short-term spike in electricity prices
  - Adjustments to emission reduction policy settings to be more ambitious in line with new scenarios

Annual additions to solar MW capacity NEM & SWIS (DC panel basis)

2021 Projection Results



2022 Projection Results

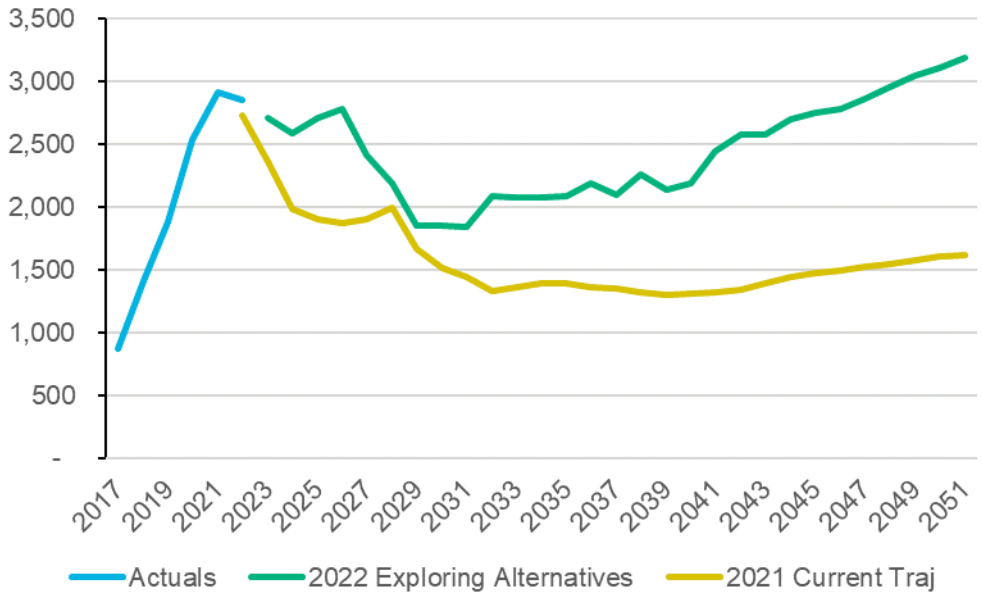


Solar Results – Annual MW Additions
Example – 2022 Exploring Alternatives vs 2021 Central

DRAFT RESULTS – September 2022

- As an example to help illustrate how the model has dealt with changes to scenarios, relative to last year's Current Trajectory/Central, the Exploring Alternatives scenario projects around 40% more megawatts by 2050 on a cumulative basis, however it still projects that annual capacity additions will decline substantially over the next decade relative to recent highs, before resuming growth after 2030 as battery price declines and new emission reduction policy support help to improve financial attractiveness.
- The higher uptake in Exploring Alternatives relative to last year's Central/Current Trajectory is heavily influenced by the fact this new scenario assumes far more ambitious emission reduction ambitions. This is incorporated in the model through assuming new policies are implemented consistent with the International Energy Agency's Announced Pledges Scenario that would improve the financial attractiveness of solar and battery systems.

Annual additions to solar capacity – DC panel basis



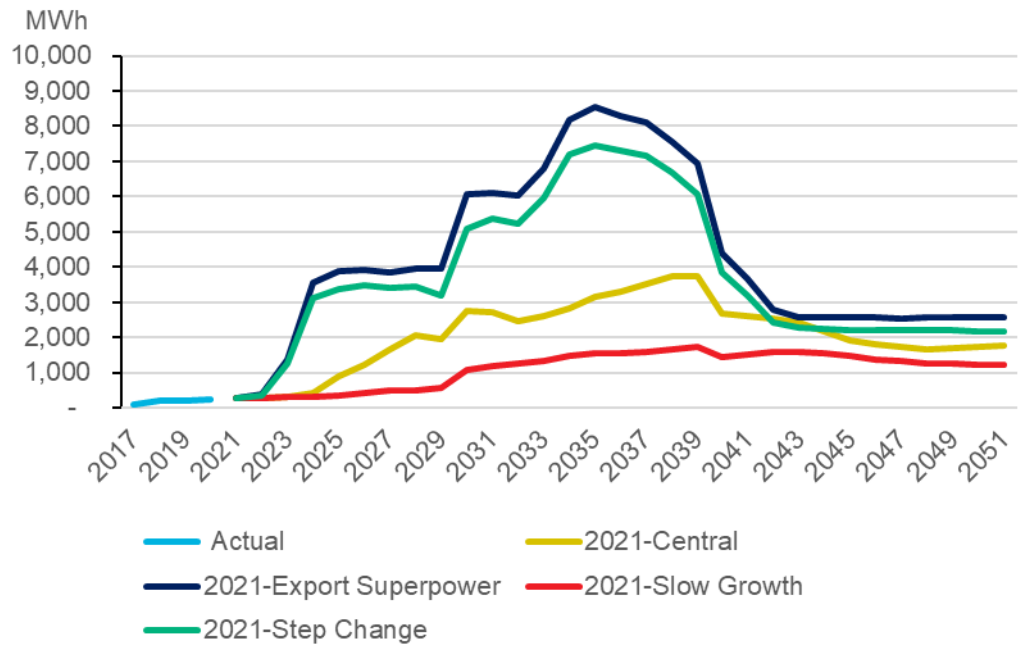
Battery Results – Annual MWh Additions

DRAFT RESULTS – September 2022

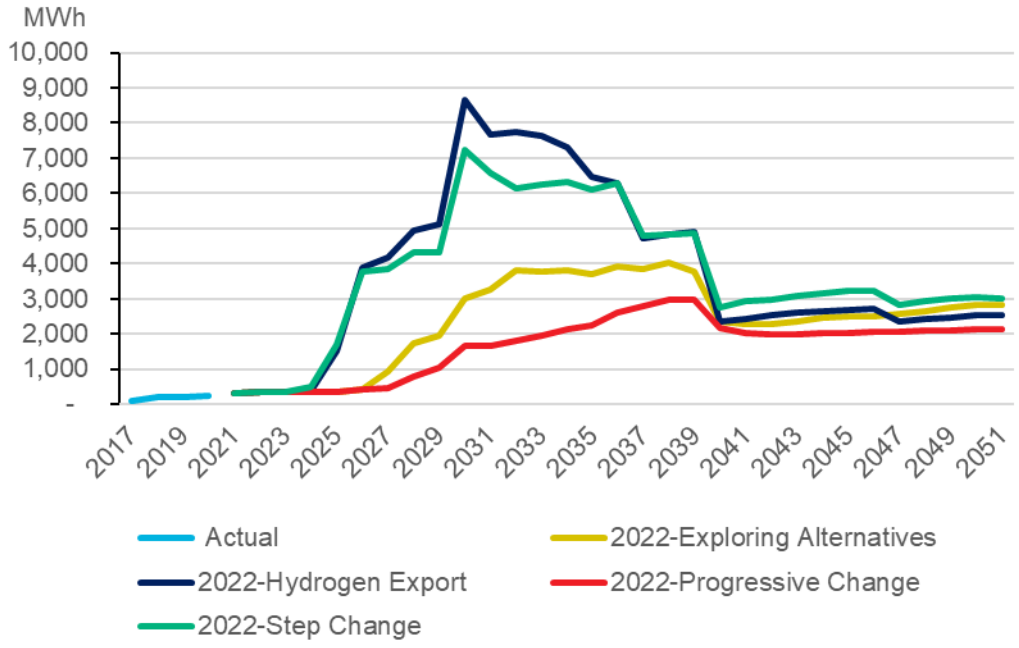
- The megawatt-hours of battery additions projected in our 2022 modelling relative to the 2021 results tend to be lower in early years of the projection due to higher estimated capital costs.
- However, battery additions then rise faster close to 2030 and then finish higher in the 2040's.

Annual additions to battery MWh capacity NEM & SWIS

2021 Projection Results



2022 Projection Results

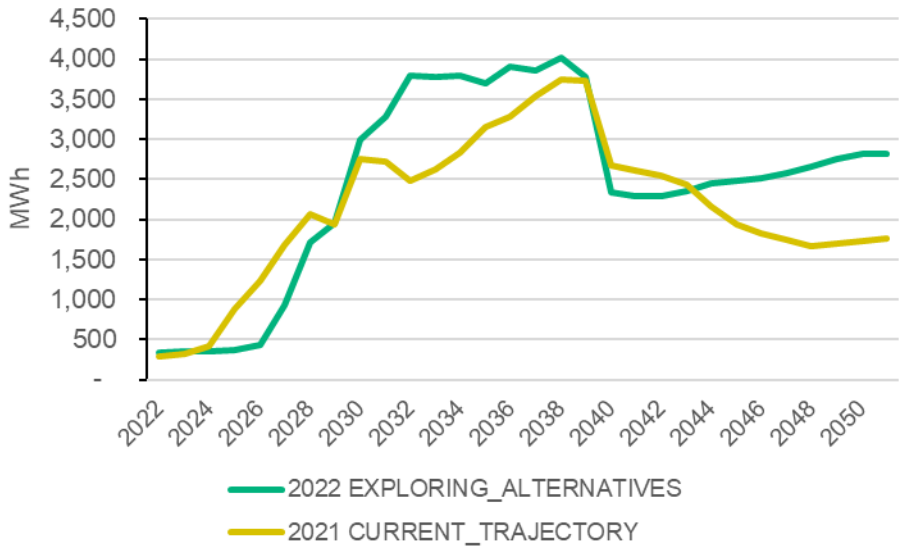


Battery Results – Annual MWh Additions
Example – 2022 Exploring Alternatives vs 2021 Central

DRAFT RESULTS – September 2022

- As an example to help illustrate how the model has dealt with changes to scenarios, relative to last year's Current Trajectory/Central, the Exploring Alternatives scenario projects around 14% more megawatt-hours by 2050 on a cumulative basis.
- However uptake of batteries is much lower in the 2020's under the 2022 draft projections relative to last year's Central due to the fact that supply constraints affecting battery scale-up appear more challenging than we had previously expected, with substantial material input price rises evident since our last projections work.
- By the latter end of the decade these constraints are assumed to be resolved and battery uptake is then higher over the 2030's compared to the 2021 Current Trajectory projection due in part to the fact that Exploring Alternatives is assumed to involve greater policy intervention to support batteries as part of its more ambitious emission reduction settings. In 2040 there is a fall away in additions to stock due to batteries having penetrated close to the full installed base of solar systems, with ongoing growth in the stock needing to come from greenfield installations.

Annual additions to battery megawatt-hour capacity



Solar Results – Cumulative MW and household penetration

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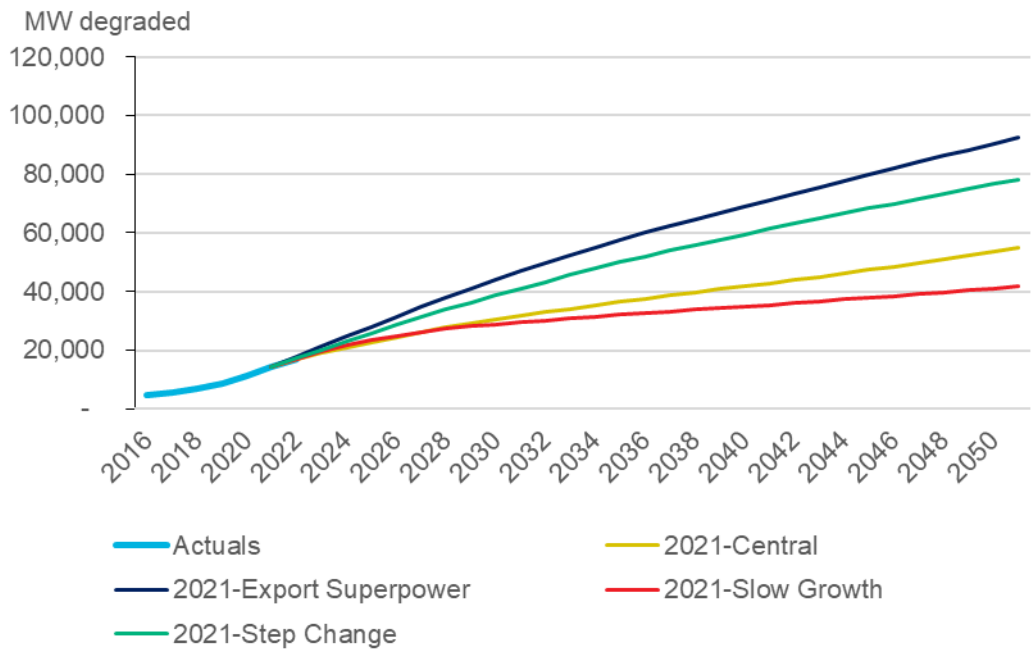
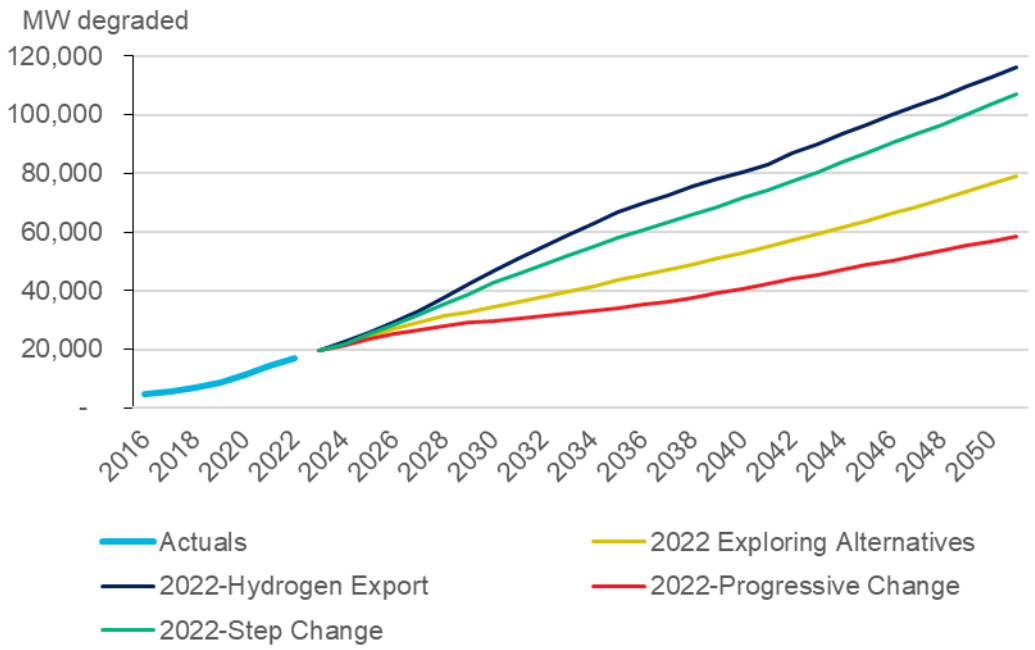
- Comparing 2022 scenarios to 2021 in cumulative solar megawatt degraded terms provides results that are between 26% and 44% higher depending on the scenario compared.
- By the end of the projection period 81% of houses have a solar system under Step Change at the high end, while at the low end under progressive change 58% of houses have a solar system.

Cumulative installed MW capacity of solar NEM & SWIS (DC panel basis - degraded)

2021 Projection Results



2022 Projection Results



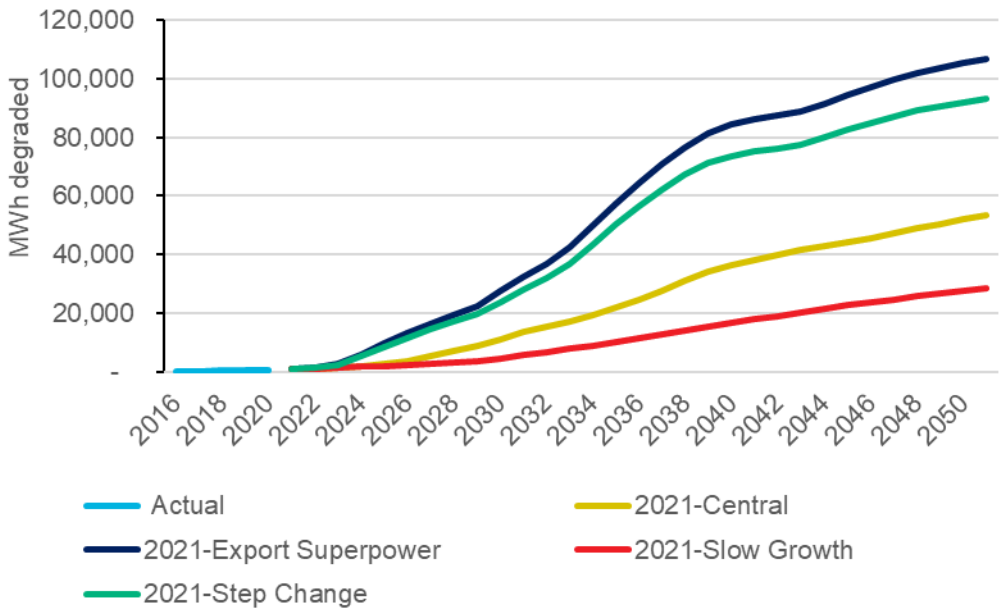
Battery Results – Cumulative MWh

DRAFT RESULTS – September 2022

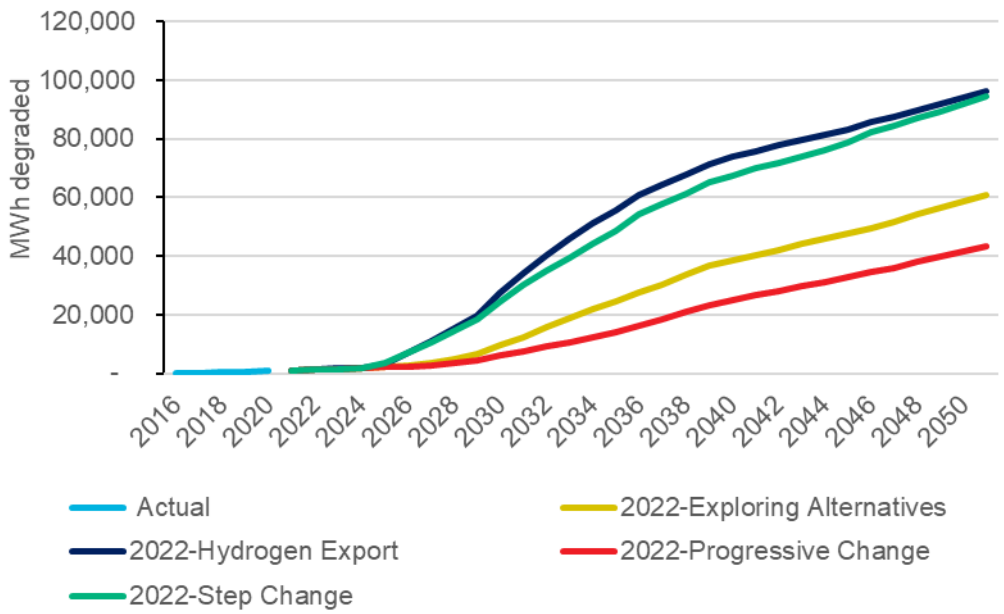
- The more ambitious emission reduction scenarios (Step Change and Hydrogen Export) deliver similar level of cumulative battery capacity by the end of the projection as similar scenarios from 2021, in part due to the delay in mass market uptake caused by supply constraints leading to delayed capex reductions relative to our prior year's forecasts.
- 2022's Exploring Alternatives delivers 14% more capacity by 2051 than 2021's Central and Progressive Change delivers 51% more battery capacity compared to 2021's Slow Change.

Cumulative installed MWh capacity of batteries NEM & SWIS (degraded)

2021 Projection Results



2022 Projection Results



Derivation of results

What is driving the results - Capex and Revenue Example: Step Change vs Exploring Alternatives

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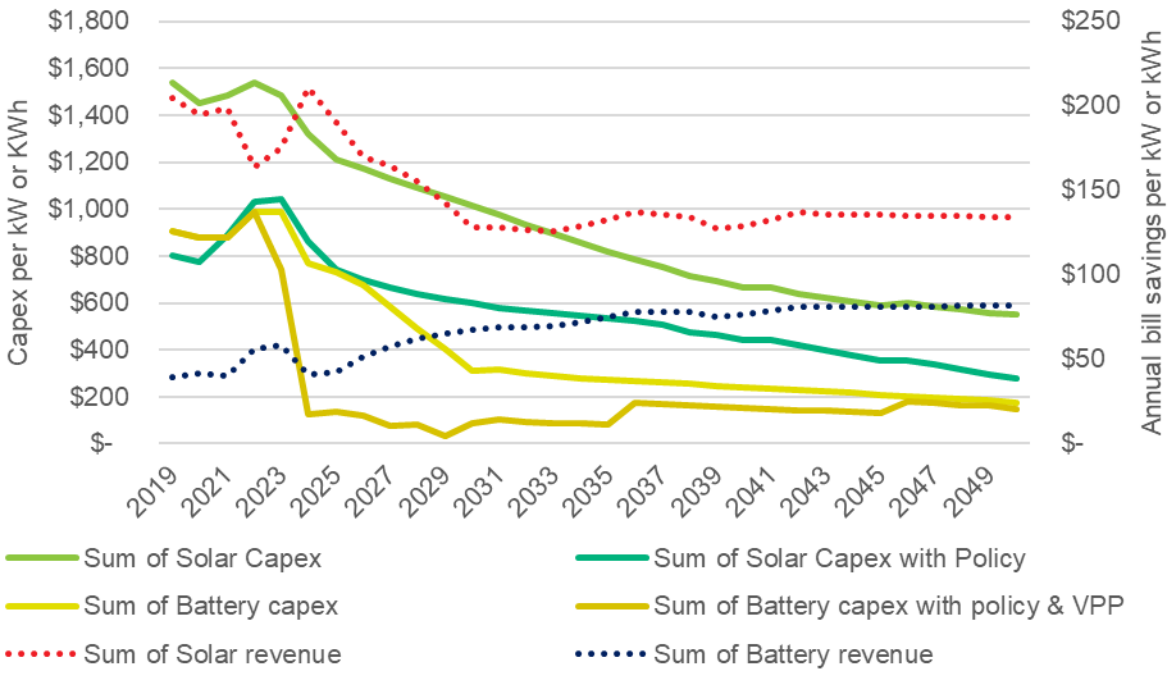
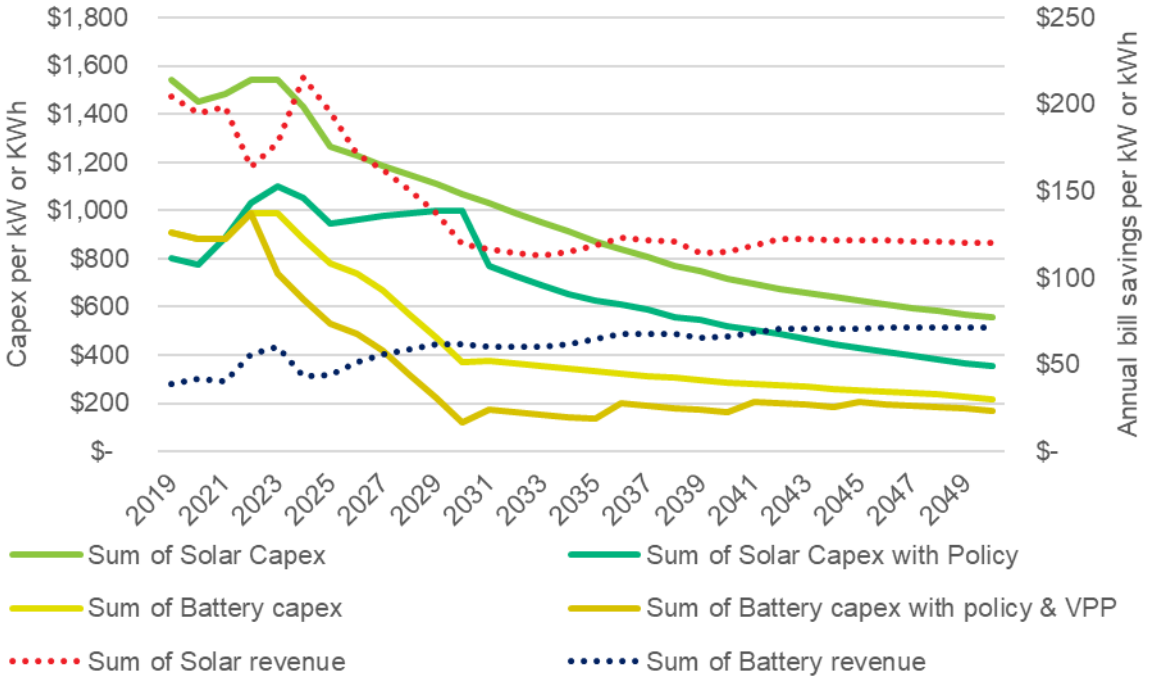
- Across all scenarios capex for both solar and batteries reduces substantially over the outlook, however the speed of reductions is adjusted depending on the scenario.
- But in addition there are also large differences in the level of policy support which then flow through to even more significant differences in modelling capex.
- Revenue delivered by solar systems falls significantly while battery revenue increases over time in all scenarios.

Capex vs Revenue for solar and battery system per unit of capacity (Residential system in NSW)

Step Change Scenario



Exploring Alternatives Scenario



Appendix

Revenue – Wholesale energy

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Green Energy Markets

- As adopted in prior modelling exercises, 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 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 reflect an average of current offers from major retailers by state (or the regulated rate) for present year. 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. Although in Progressive Change this retailer premium is removed.

Revenue – Wholesale energy

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- Due to the large spike upwards in wholesale electricity prices after December 2021, the AEMC's Residential Price Trends projections are now longer valid and so unlike prior years they couldn't be used for deriving wholesale prices.
- Instead we have relied on AEMO guidance surrounding underlying cost structures and supply-demand balance (price index) to derive an overall average price path for wholesale energy costs.
- This overall average is then turned into a total 24 hour value which is then apportioned into the following time categories:
  - Solar (9am to 3pm) where the hourly value is tied to the CSIRO Gencost LCOE for new entrant solar farm.
  - Peak (3pm to 9pm) which based on historical patterns is expected to capture 53% of remaining value left over after deducting solar period value.
  - Off-peak (all other times) which based on historical patterns is expected to capture 47% of remaining value left over after deducting solar period value.

Revenue – Network charges

- 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 costs for large commercial are derived from network tariff statements while those for residential are derived from the AEMC Residential Price Trends Report with adjustments to reverse out fixed daily supply charges.
- 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.
  - In initial years there is substantial smearing/averaging across the time periods but this gradually transitions towards more sharply delineated prices across the peak/solar/off-peak period to 2030.
- This approach to incorporating network charges is unchanged from the approach taken in past modelling exercises.

Capex and incorporation of carbon abatement schemes

- Just like last year, 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.
- 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.

Capex and incorporation of carbon abatement schemes

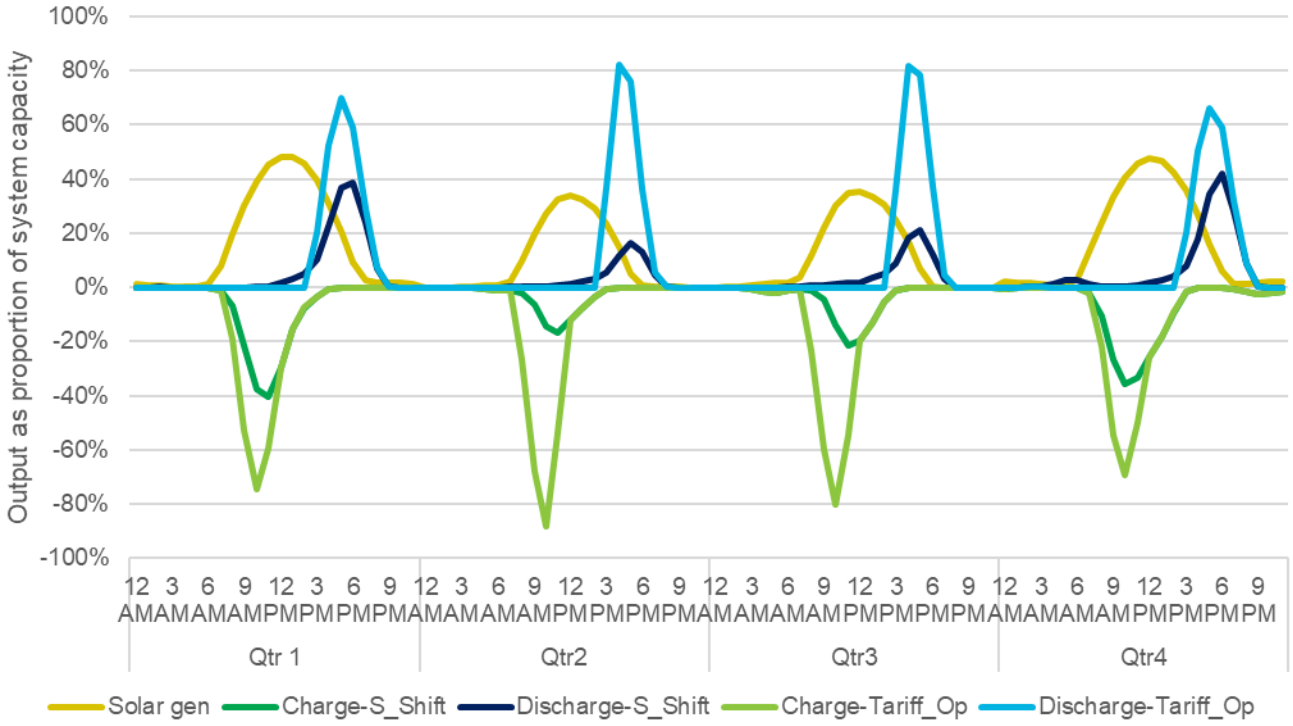
- How the model incorporates carbon abatement revenue
  - Because there are actually several different mutually exclusive options for carbon abatement revenue of which a system owner needs to commit to one in advance of system installation, the model needs to determine and select the scheme which will 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.

Battery charge-discharge profiles

DRAFT RESULTS – September 2022

- 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 (green) 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 green is tariff optimised)

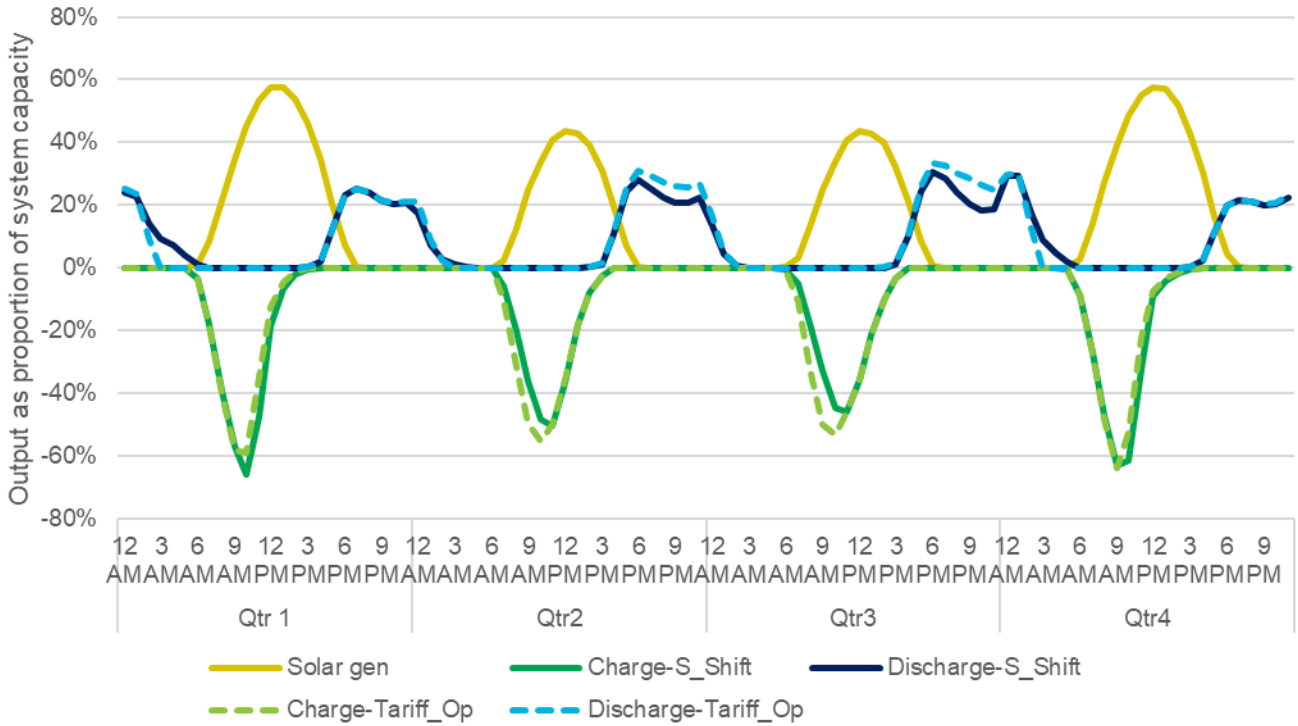


Battery charge-discharge profiles

DRAFT RESULTS – September 2022

- 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 green is tariff optimised)



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