Costs and Benefits of Accelerating the Rollout of Smart Meters

AEMC Review of the Regulatory Framework for Metering Services
September 2022

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Executive summary

- As compared to a continuation of the current 'new and replacement' approach for deploying smart meters (SM), an accelerated rollout, capitalising on the economies of scale that are available by installing the meters on a door-to-door basis, would be cost effective in QLD, NSW and SA* (see table on next page).
  - This outcome is based solely on those benefits that result directly from the SM being in place - namely, reduced costs for routine and special meter reading, and the ability to remotely disconnect and reconnect the premises' electricity supply.
  - The value of those benefits is represented by the costs of those activities as documented in the DNSPs' most current RINs, as those costs would no longer be incurred once SMs are in place
- Certain other benefits that are enabled by the presence of the meter, to the extent that they eventuate, will only serve to increase the cost-effectiveness of an accelerated deployment of SMs (also shown on the table on the following page). Those that were modelled were:
  - The ability to implement more cost-reflective tariffs that can reduce costs in the electricity supply chain
  - Quicker restoration of power following unplanned outages
- 19 other benefits identified as resulting from the deployment of SMs were not quantified
  - Earlier studies indicated these would be expected to be quite small relative to those mentioned above
  - But they would further improve the net benefits of the accelerated rollout

* An accelerated deployment case was not modelled for Tasmania because it has established a policy that mandates that all accumulation meters must be replaced by SMs by 2026.

Executive summary – costs and benefits of accelerating the rollout of SMs

State	Costs ($m)	Primary non-contingent benefits	Net benefit	Selected additional benefits	Net benefit w/ additional benefits
NSW	$69.2	$212.3	$143.1	$112.8	$255.9
QLD	$30.0	$99.1	$69.1	$127.6	$196.7
SA	$21.6	$46.9	$25.3	$28.5	$53.8

- All figures are present value (in 2022$)
- Costs include the capital cost of the meters to be installed and the estimated costs of planning and administering the accelerated rollout
- Primary non-contingent benefits include the benefit to be derived from:
  - Reduced costs for routine meter reading and special reads
  - The reduction in meter installation costs due to the scale economies of undertaking the rollout geographically
  - The ability to de-energise and re-energise the premise remotely (though this feature may not be authorised in all jurisdictions)
- The selected additional benefits include:
  - Potential reductions in electricity supply costs due to the ability to deliver more cost-reflective tariffs
  - The ability to restore supply more quickly after unplanned outages

Executive summary – other potential benefits

Additional contingent (but difficult to quantify) benefits are possible from the accelerated deployment of SMs:

- More real-time data and access to apps are potentially significant intangible customer benefits. Widespread deployment of SMs could:
  - Provide the technical basis and means for accessing intelligent electricity system platforms, thereby accelerating their development and the benefits they can provide to customers
  - Accelerate innovation and uptake of new energy services, such as:
    - Home energy efficiency and energy management, eMobility, demand-side flexibility services, and CER integration and optimisation
  - Potentially bring forward a tipping point in technology competitiveness, consumer preference, and investor confidence resulting in a more competitive two-sided market

In this regard, the decision to accelerate the deployment of SMs can be seen as a deliberate choice to support the more efficient realisation of these sorts of outcomes

Executive summary – Impacts on customers

- It should be noted that the analysis was undertaken on the basis of economic costs and benefits.
  - This perspective does not consider the allocation of those costs and benefits between relevant parties.
- However, the financial impacts of the rollout will matter to customers, which means these impacts will need to be considered in the development of the rollout policy and its implementation.
- Most importantly, the financial impacts on the customer will depend primarily on:
  - How Retailers charge customers for the cost of the SM
    - It is our understanding that Meter Providers generally charge Metering Coordinators (and therefore Retailers) on an annualised basis, which should translate to an annualised charge to the customer
  - How the benefits of SM flow to the customer
    - The primary benefit of SMs as we have modelled is its impact on meter reading costs. More specifically, the total cost of reading meters incurred by a DNSP will reduce as SMs are installed (and will be zero if all meters are SMs)
    - How those cost reductions are passed through to customers in the distribution tariff will be important
    - To the extent that cost-reflective tariffs are enabled by the availability of a SM, the customer may benefit by taking up and responding to those tariffs (though the amount of benefit will vary from customer to customer)
    - The largest impacts from tariffs enabled by SMs are expected from tariffs directed at EV charging and shifting household consumption from early and mid-evenings to midday (i.e., solar sponge tariffs)

Contents

1. Introduction

- As part of its *Review of the regulatory framework for metering services*, the AEMC engaged OGW to undertake an economic cost/benefit assessment of accelerating the rollout of smart meters (SM) across the NEM (excluding VIC)
- The assessment considers the economic costs and benefits of accelerated rollout of SMs in place of existing accumulation meters as compared to the current 'new and replacement' policy in which SMs are installed when an accumulation meter fails or when a new meter is needed due to new construction or significant renovation
  - It is important to note that while an economic cost/benefit considers all relevant costs and benefits, it does not consider the allocation of those costs and benefits between relevant parties, which are essentially financial transfers between those parties
  - However, it is also important to recognise that the distributional and other impacts of those financial transfers are likely to be important considerations in policy development and program implementation
- Key Caveats/Assumptions:
  - As in any CBA, it has been necessary to make a range of assumptions and to use data developed by others. We do not warrant data developed by others, but have only used reputable sources that are fit for the purpose of this study
  - The accelerated rollout program has been derived in order to (broadly) achieve the complete replacement of legacy (accumulation) meters with SMs by 2030 or 2032
  - Based on published information from DNSPs and discussions with AEMC staff, we have assumed that Dynamic Operating Envelopes (DOEs) will be developed and implemented under the BaU case, and any accelerated SM program would not materially impact the costs of implementing DOEs (i.e., acceleration could not occur quickly enough to allow DNSPs to avoid DOE investments)
  - We have not modelled all the benefits that SMs can provide and while we have modelled the major costs associated with an accelerated rollout, we have not modelled all conceivable costs. Information on the benefits and costs that have not been modelled and the reasons for their having been left out is provided in Section 7.
  - Information on the assumptions and data input used in the modelling are provided throughout the report.

2. THE BAU AND ACCELERATED DEPLOYMENT CASES

The BAU and Accelerated Deployment Cases

- Business-as-usual case
  - Continuation of the existing new and replacement SM policy
  - Drivers of SM deployment include:
    - Customer-led (e.g., solar)
    - Replacement
    - Retailer-led
- Accelerated rollout option:
  - Accelerate rollout so as to complete by 2030
  - Assumed to be able to achieve economies of scale in terms of rollout (e.g., house-by-house, leading to more installs per day for an installer, as opposed to geographically dispersed, leading to less installs per day per installer)
- Note:
  - ACT included as part of NSW
  - Tasmania excluded from the analysis, as it has already mandated that all accumulation meters are to be replace by 2026
  - Victoria excluded, for obvious reasons.

How did we develop the BaU rollout?

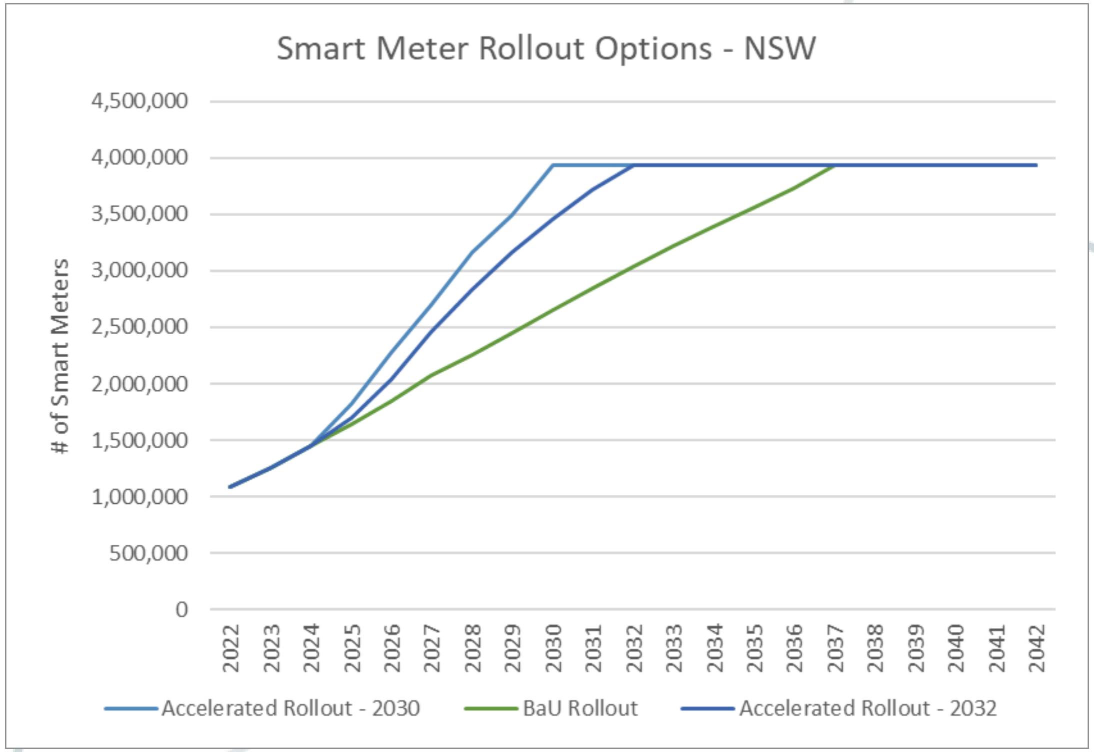
- For the impact of the uptake of PV
  - Started with the 2022 ISP forecast of annual PV (Step Change scenario)
  - Because that forecast is expressed in MW and includes all PV systems regardless of the size of the customer, adjustments were needed
    - The amount of PV (MW) expected to be installed on larger C/I facilities was removed based on information provided in the GEM *DER Forecast Report*
  - Adjust for larger PV systems installed at end of life of existing systems (CER data & assumed PV life of 15 years)
    - The amount of PV (MV) expected to be installed on newly constructed residential and small non-residential buildings was removed based on the customer growth rates in the ISP Sustainable Growth scenario
  - We then divided the remaining PV MW in each year by the average size of a residential PV system (based on CER data) to derive the number of PV systems expected to be installed on residential and small non-residential buildings – this results in the number of SMs expected to be installed each year due to PV take-up
    - Note that we did not need to adjust for older PV systems being upgraded to larger PV systems because (a) systems installed from about 2017 on would have received a SM as a matter of policy (so the upgrade would not result in the removal of an accumulation meter) and (b) systems installed prior to 2017 would not have had a SM installed, meaning these premises would remain in the legacy meter population

How did we develop the BaU rollout? (continued)

- To account for meter failure / replacement
  - The age profile of each DNSP's non-SM meter fleet was established based on information provided by the businesses to the AEMC
  - For each DNSP
    - All legacy meters over 30 years old were assumed to be replaced over the next 15 years
    - All other legacy meters were assumed to be replaced in the year they reached 30 years of age
- To account for Retailer deployment of SM not based on the installation of PV or due to meter failure
  - Established the rate of these deployments based on the last three years of data available in the AER's *Retail Performance Reports*
- The results of these three calculations were summed in each year to provide the number of SMs expected to be installed annually under BaU conditions
- The starting number of legacy meters expected to be replaced (which was provided by AEMC) was reduced over time to account for the number of SMs expected to be installed annually under BaU conditions to derive the remaining number of legacy meters going forward.

Smart Meter take-up options modelled

- These three figures show the cumulative number of SMs expected to installed in each jurisdiction under the BaU scenario (in green) and the cumulative number of SMs that would be installed under:
  - An accelerated rollout that results in the replacement of all accumulation meters by 2030 and
  - An accelerated rollout that results in the replacement of all accumulation meters by 2032
- In developing the trajectory of SM rollouts under the accelerated cases, we have given consideration to a number of factors:
  - Not commencing the acceleration until 2025, giving an appropriate lead time for any Rule change to take effect
  - Assuming installation levels reach their peak midway through the accelerated rollout timeframe, giving time for the industry to mobilise to full deployment
  - Assuming an overall deployment timeframe that should not lead to significant resourcing issues



- The maximum number of SMs forecast to be rolled out in a year under the 2030 Accelerated Rollout case is:
  - NSW: 464k in 2028 (cf with ~225k under BaU)
  - SA: 107k in 2028 (cf with ~40k under BaU)
  - QLD: 260k in 2027 (cf with ~155k under BaU)

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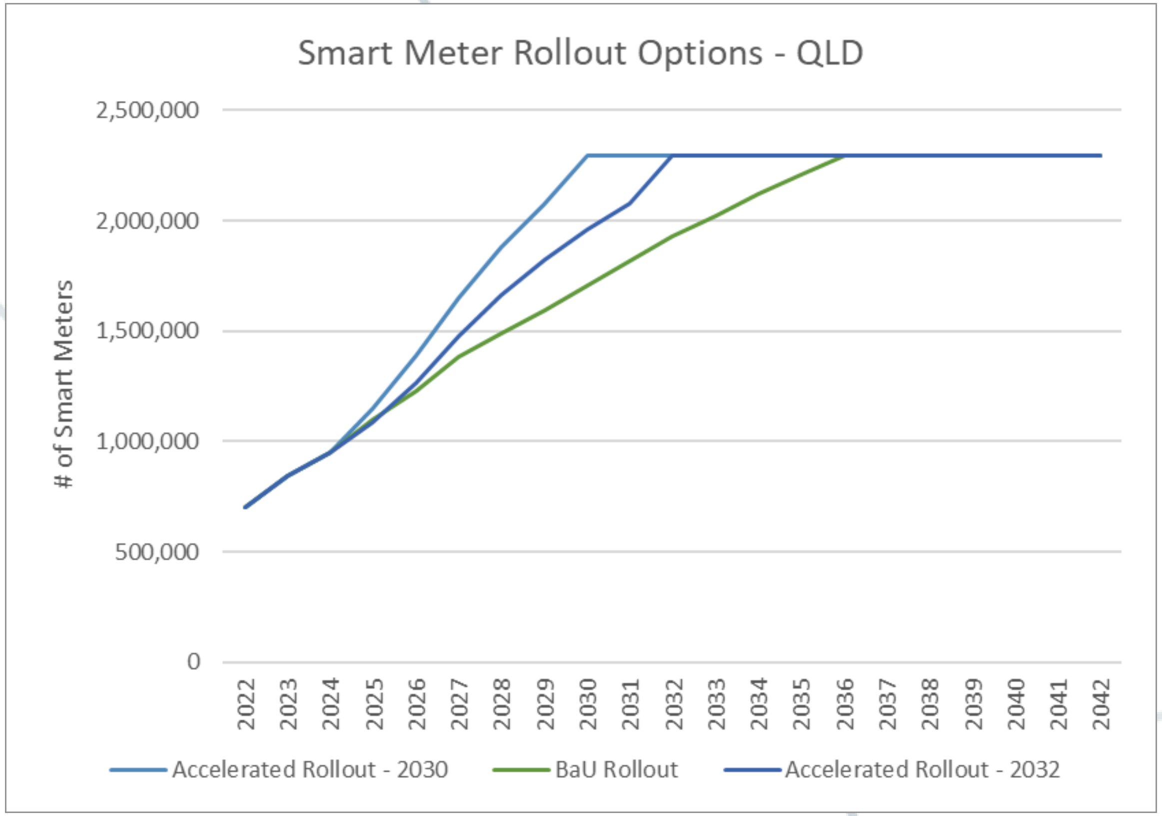
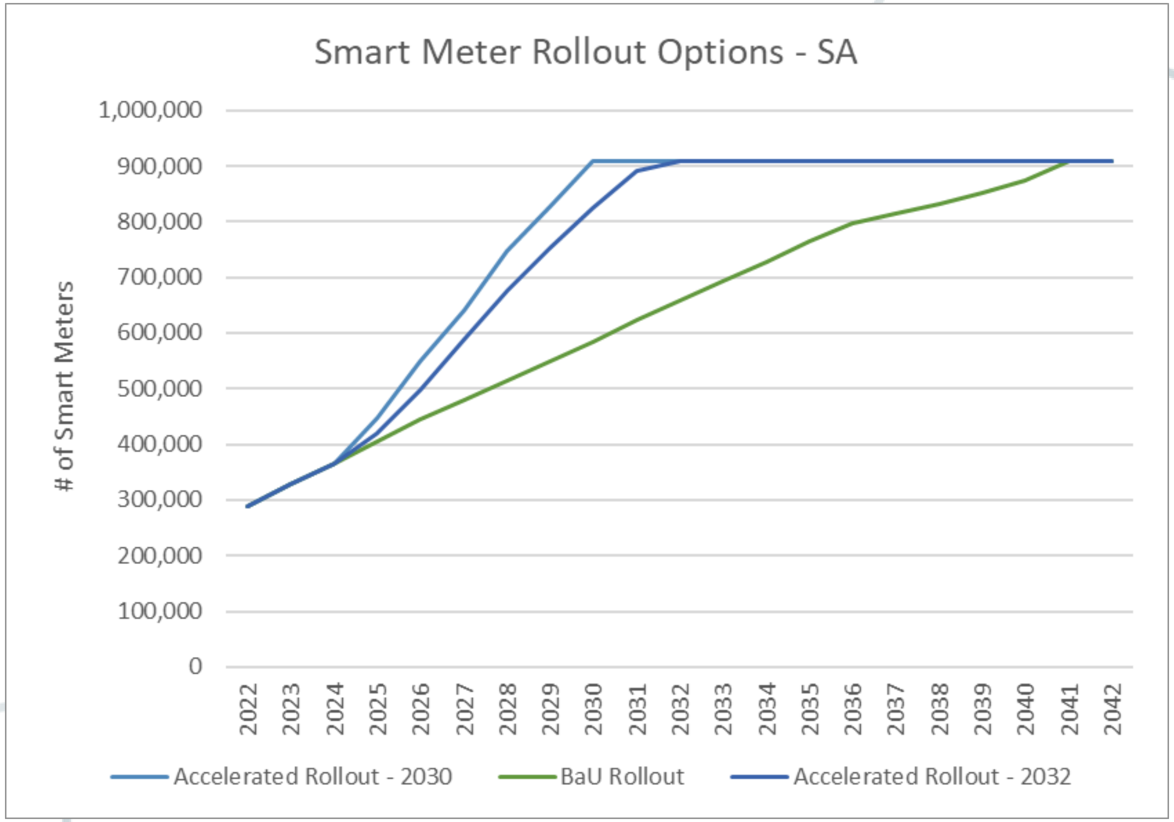
Smart Meter take-up options modelled





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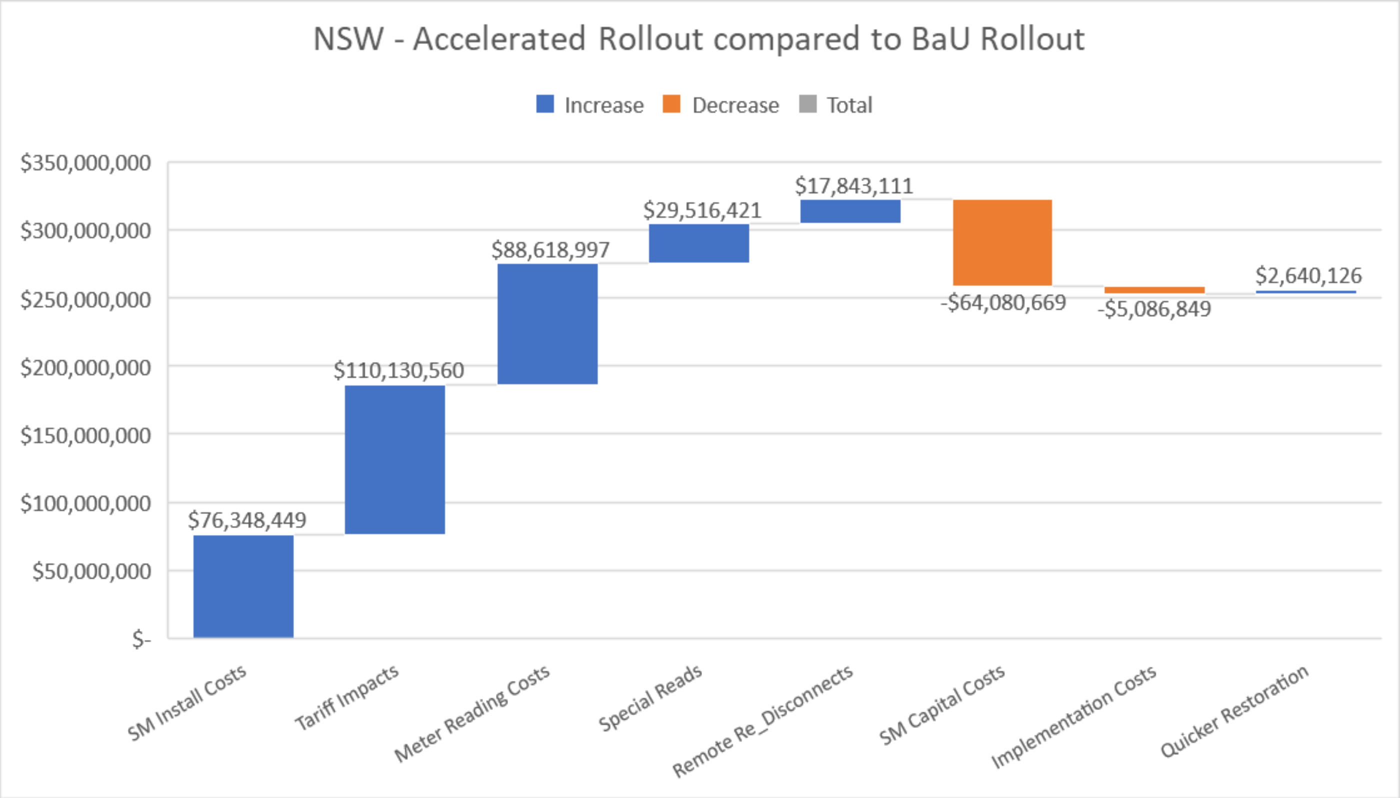
3. RESULTS – COMPLETION BY 2030

Results - NSW

- Incremental benefit of accelerated rollout c.f with BaU rollout is ~$255.9m in NPV terms, driven by:
  - Current ~$55m pa of Meter Reading, Special Read and Remote Disconnect costs (or ~$19/cust/pa) being able to be avoided once 100% SM penetration reached …and
  - Avoiding the loss of economies of scale in meter reading costs that occur under the BaU case (i.e., unit rates increasing, as scale of manual reads declines).
- SM install costs assumed to be lower under accelerated rollout (in NPV terms), as:
  - Bring forward costs are more than offset by assumed scale efficiencies under mandated rollout c.f BaU rollout; and
  - Same volumes in total over period.
- If tariff impacts (~$110m) and quicker restoration (~$5m) are removed, the accelerated case is still positive.



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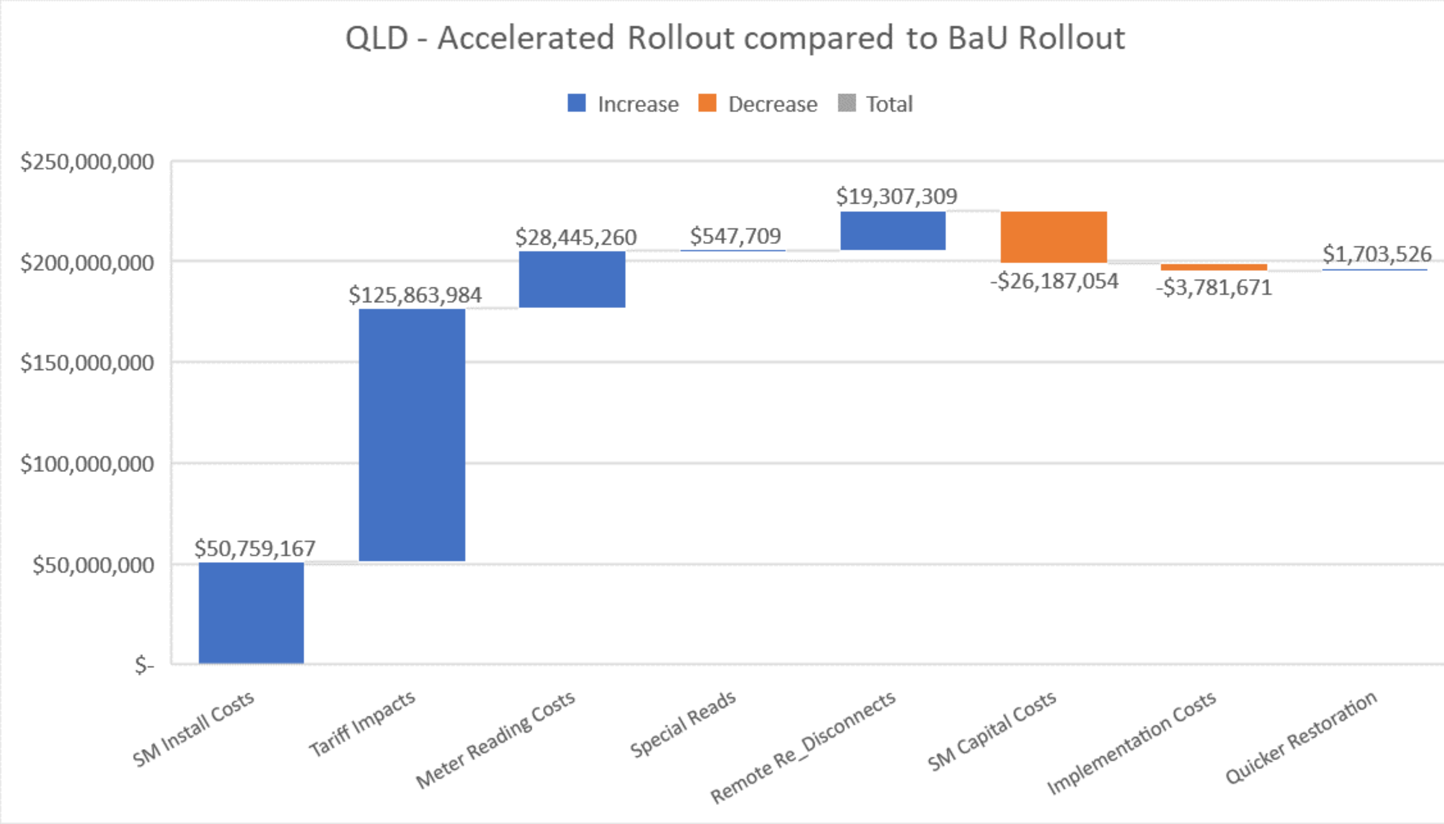
Results - QLD

- Incremental benefit of accelerated rollout c.f with BaU rollout is ~$196.7m in NPV terms, driven by:
  - Current ~$27m pa (or $20/customer/pa) of Meter Reading, Special Read and Remote Disconnect costs (as per RINs) being able to be avoided once 100% SM penetration reached; and
  - Avoiding the loss of economies of scale in meter reading costs that occur under the BaU case (i.e., unit rates increasing, as scale of manual reads declines)
- SM install costs assumed to be lower under accelerated rollout (in NPV terms), as:
  - Bring forward costs are more than offset by assumed scale efficiencies under mandated rollout c.f BaU rollout; and
  - Same volumes in total over period.
- Th accelerated case remains positive if tariff impacts (~$125.8m), quicker restoration (~$1.7m) AND even the benefits of remote disconnect/reconnect (~$19.3m) are removed .



NOTE: There is a risk that remote reconnects will not be allowed in QLD.

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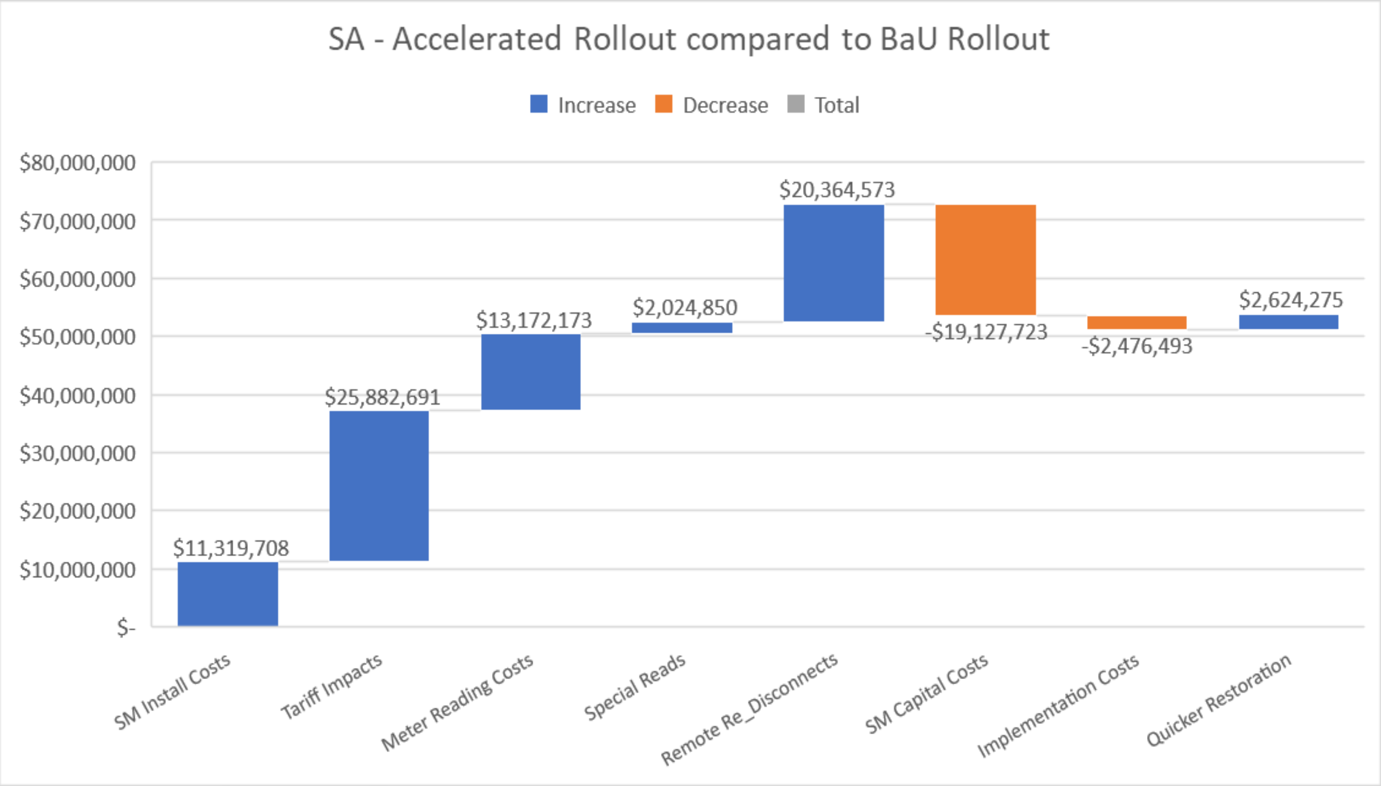
Results - SA

- Incremental benefit of accelerated rollout c.f with BaU rollout is ~$53.7m in NPV terms, which is lower than other States, driven by:
  - Current cost of Meter Reading, Special Read and Remote Disconnect costs ($11.7m pa as per RINs, or around $14 per customer pa) being lower than in other States.
  - Lower LRMC c.f many other DNSPs (hence lower tariff benefit)
- SM install costs assumed to be lower under accelerated rollout (in NPV terms), as:
  - Bring forward costs are more than offset by assumed scale efficiencies under mandated rollout c.f BaU rollout; and
  - Same volumes in total over period.
- If tariff impacts removed, results indicate case is still positive.



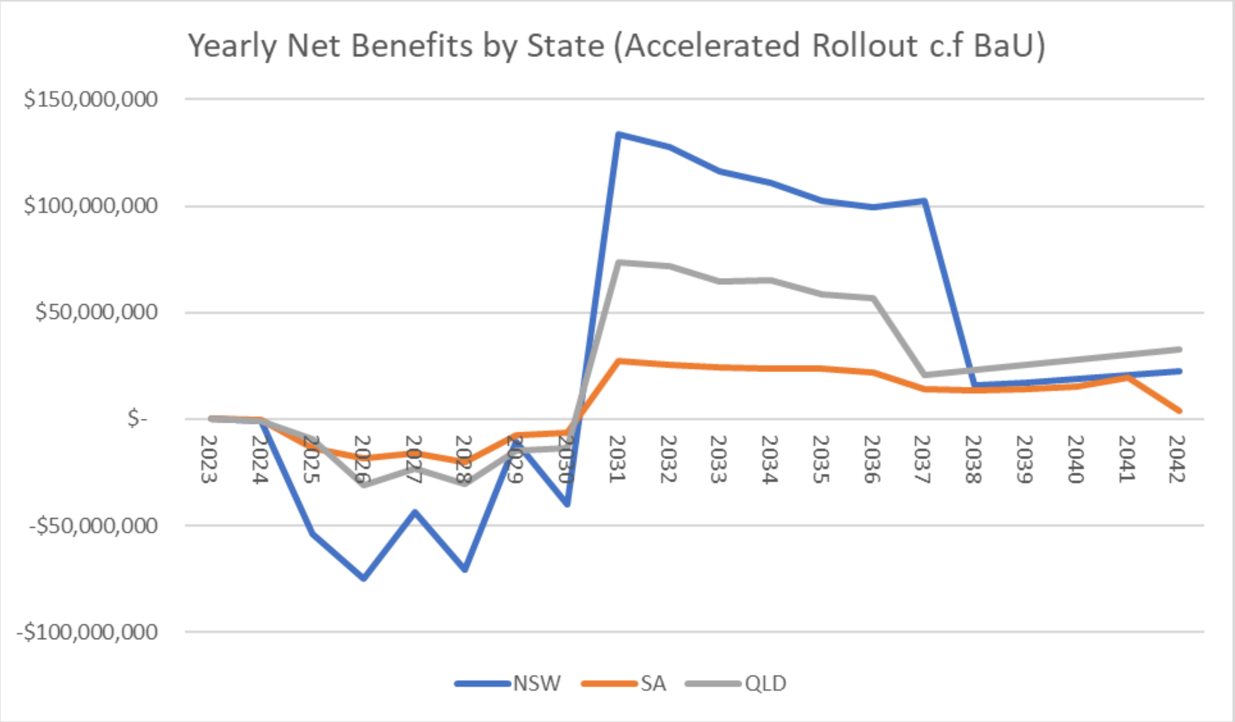
Results – Other Comments

- We have not included any '2nd replacement' of existing SMs in the base modelling. However, we tested the likely order of magnitude impact of including this by assessing the different NPVs of replacing all SMs installed under the accelerated rollout case in 30 years as compared to 35 years (so an average bring forward of 5 years). The results are:
  - $56.7m for NSW
  - $31.8m for QLD
  - $12.4m for SA

  The inclusion of these costs would not change the net benefits of the accelerated case in any of the jurisdictions, even if the benefits of more cost-reflective tariffs and quicker restoration are also excluded
- We have assumed that the accumulation meters that are replaced have no economic value (i.e., no scrap value). To the extent that they do, and that value is correlated with the age of the meter, this would improve the economic case.
- We have used a WACC of 5% and a modelling period of 20 years. If we assumed a 7% WACC of capital, the results decline, but are still positive.
  - $177.3m for NSW
  - $143.9m for QLD
  - $34m for SA
- We tested the sensitivity of changing the completion date of the accelerated rollout
  - See Section 4: 'Sensitivity of a 2032 Completion'

Results – Year by Year (NSW, QLD & SA)

- The profile of costs and benefits by State is fairly consistent:
  - Net benefits decline in the early years, as the program accelerates (because more costs are incurred under the accelerated rollout as compared to the BaU)
  - Once the accelerated rollout program has been completed, net benefits accrue year-on-year. This results from: (a) having more SMs installed, allowing things such as more meters to be read remotely; and (b) the business avoiding the SM capital and install costs that they would have otherwise incurred under the BaU case in those later years.
- The drop off in later years (2037 for QLD, 2038 for NSW and 2042 for SA) reflects when each State's BaU rollout is expected to be completed (and hence those costs are now *not* avoided).
- The overall profile of net benefits may have implications for funding arrangements, and how the benefits of SM are communicated to customers (as customers are unlikely to be able to 'see through' cost increases in early years to the benefits that will accrue over the longer term)



- That said, the per annum increase seen by the customer <u>will not</u> be the full installed cost of the meter (i.e., the economic cost), as Metering Providers are likely to recover the costs of the meter as an annuity.
- And depending on the original timing, this annuity may in fact be less than what the customer would have originally incurred (see next page)

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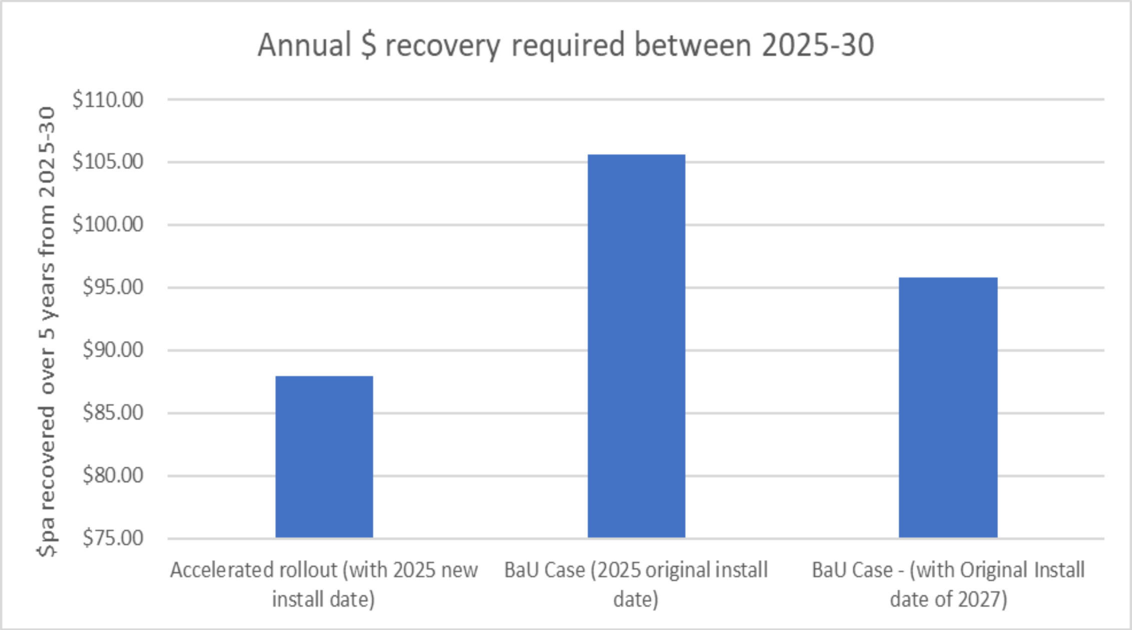
Results – Potential impact on customers

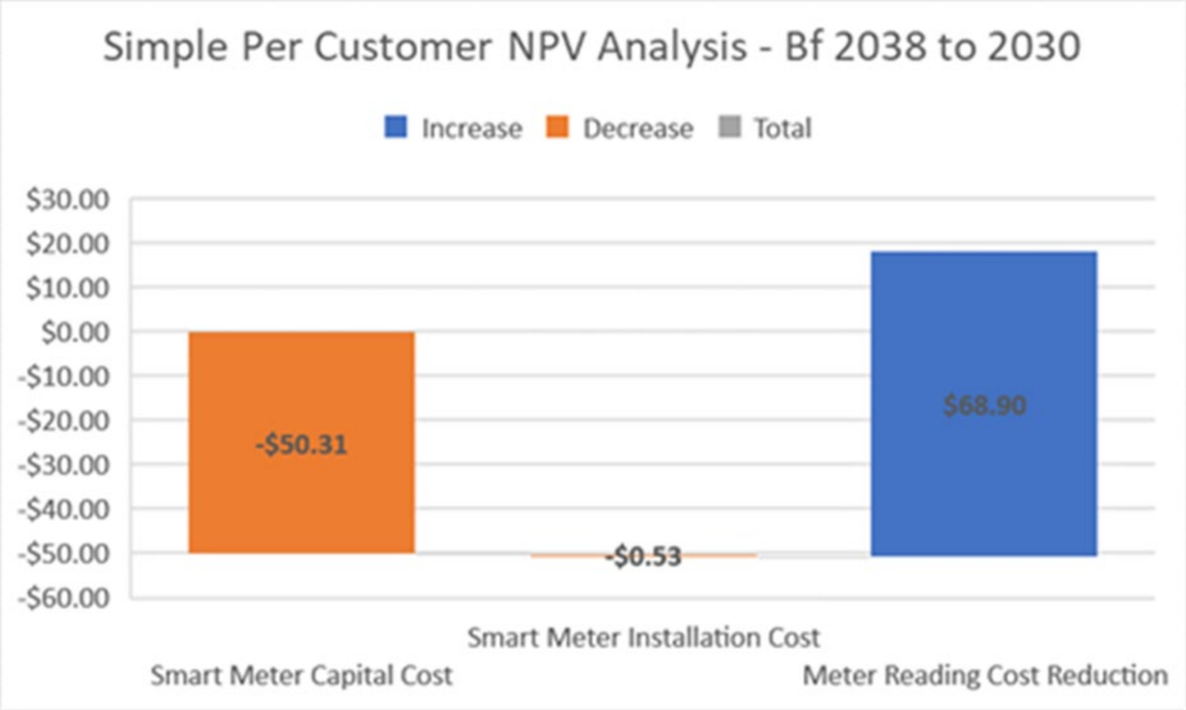
- The costs recovered from customers will be affected by various factors:
  - When the meter was going to be installed under the BaU case
  - Over what period the MP/Retailer recovers the meter cost.
- To test this, we modelled several simple examples:
  1. Accelerated rollout (assuming a 2025 install date, with the cost reflecting the capital and more efficient SM install costs associated with the accelerated rollout)
  2. BaU Case (assuming 2025 install date, along with our BaU capital and SM install costs)
  3. BaU Case (BaU costs, but with original install date assumed to be 2027, hence the annuity reflects this later timing)
- All annuity-related costs are assumed to now be recovered from 2025, through to 2030.
- Results:
  - The annualised cost is $88pa for 5 years if the meter is installed in 2025 at the (more efficient) rates assumed under the accelerated rollout case (Option 1).
  - The annualised cost increases to just over $100pa for 5 years under Option 2 (a BaU install in 2025).



- Even if that meter was expected to have been installed in 2027 under the BaU case, the annuity cost over 2025-30 would have been higher (@$95) than if the meter is installed in 2025 at the more efficient accelerated rollout install costs.
- Only once the meter is brought forward from beyond 2030 does the annuity amount pa (over the 2025 – 2030 period) reduce below the amounts under the accelerated rollout case.

Per-Customer impact - Bring forward the rollout from 2038 to 2030 @ WACC 5%

- Following on from the previous annuity slide, and to further demonstrate the concept affecting what is happening in the model (at an aggregated level), the figure to the right shows what is happening on a per-customer basis in simplified form.
- This is based on bringing forward the rollout of a SM to a customer from 2038 to 2030.
- The orange bar indicates that a cost has increased in NPV terms (i.e., so there is a negative economic benefit), and the blue bar indicates that a cost has declined in NPV terms (i.e., positive economic benefits).
- If the rollout of a smart meter to a customer is brought forward from 2038 to 2030:
  - The capital cost of the smart meter itself is brought forward, which (quite logically) imposes an economic cost on a per-customer basis.
  - The cost of installing that smart meter is brought forward, which:
    - In and of itself, imposes an economic cost on the customer, however
    - In this case, this is offset in NPV terms by the fact that we are assuming that the earlier installation is done in a more efficient manner (~$170/meter cf. ~$250/meter).

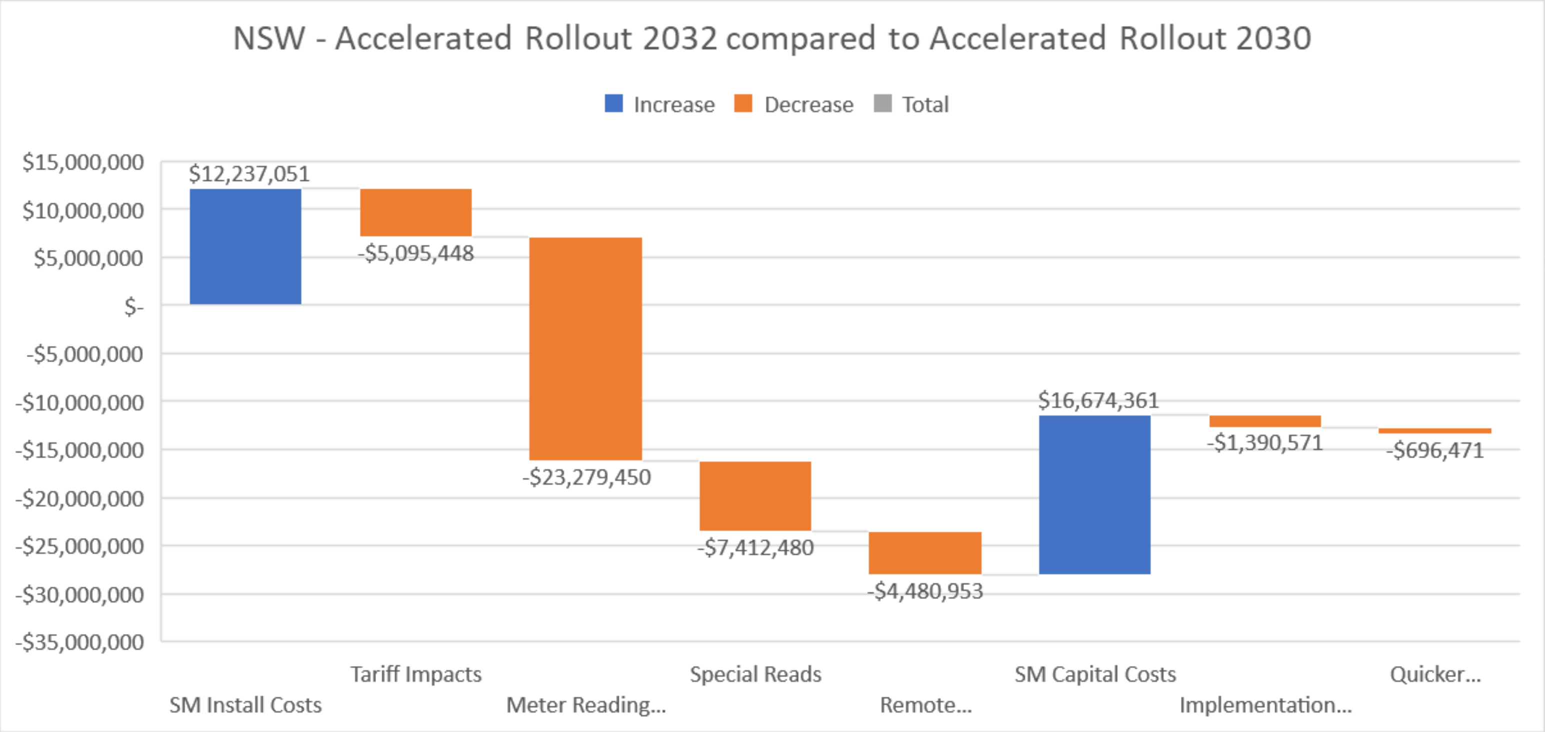


  - Once the SM is installed, the costs of having to manually read that meter are avoided, as are any costs of having to provide special reads and/or remote dis/reconnects (in a probabilistic sense).
    - These cost savings accrue from when the SM is installed under the accelerated case (2030) to when the smart meter would have been installed under the BaU case (2038).
    - In this analysis, these savings more than offset the costs of bringing forward the smart meter capital costs (which we have assumed to be $15/customer/yr in this simplified modelling).

4. SENSITIVITY OF A 2032 COMPLETION

2032 completion - NSW

- The incremental cost of deferring the completion of the rollout to 2032 (as compared to 2030) is ~$13.5m in NPV terms, driven by:
  - Reduced SM install costs and SM Capital Costs (NOTE: blue bars indicate an improvement in the NPV, relative to the 2030 case)
    - NOTE: We assumed the same level of efficiency benefit under both cases. In actuality, there may be some loss of efficiency if the rollout is extended by 2 years.
  - Significant reduction in benefits associated with Meter Reading Costs (due to retention of a manual meter reads, at reduced scale, for longer)
  - Reduction in other benefits that are otherwise assumed to accrue in proportion to the SM rollout.



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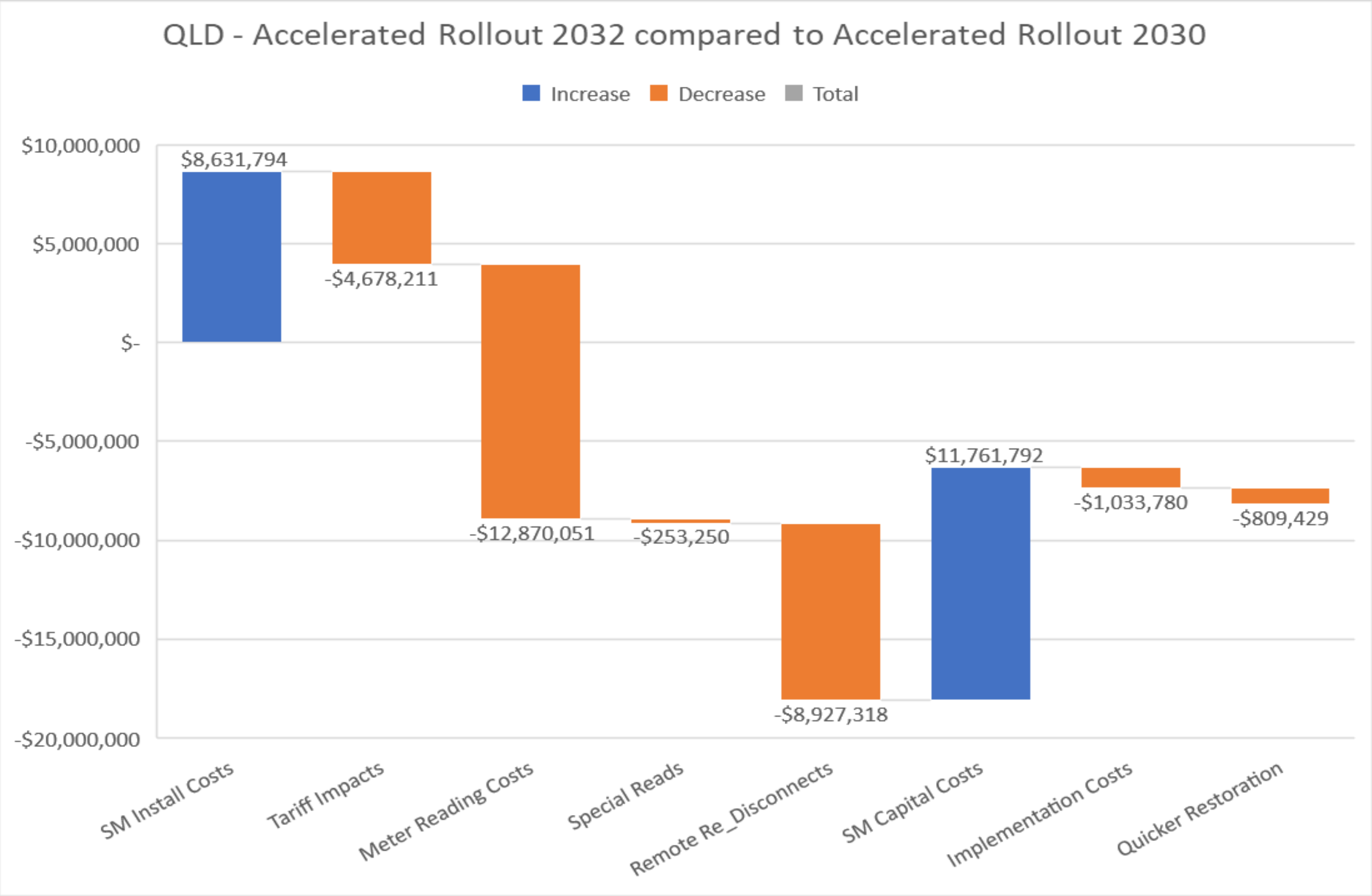
2032 completion - QLD

- The incremental cost of deferring the completion of the rollout to 2032 (as compared to 2030) is ~$8m in NPV terms, driven by:
  - Reduced SM install costs and SM Capital Costs (NOTE: blue bars indicate an improvement in the NPV, relative to the 2030 case)
  - Significant reduction in benefits associated with Meter Reading Costs (due to retention of a manual meter reads at reduced scale, for longer)
  - Reduction in other benefits that are otherwise assumed to accrue in proportion to the SM rollout.



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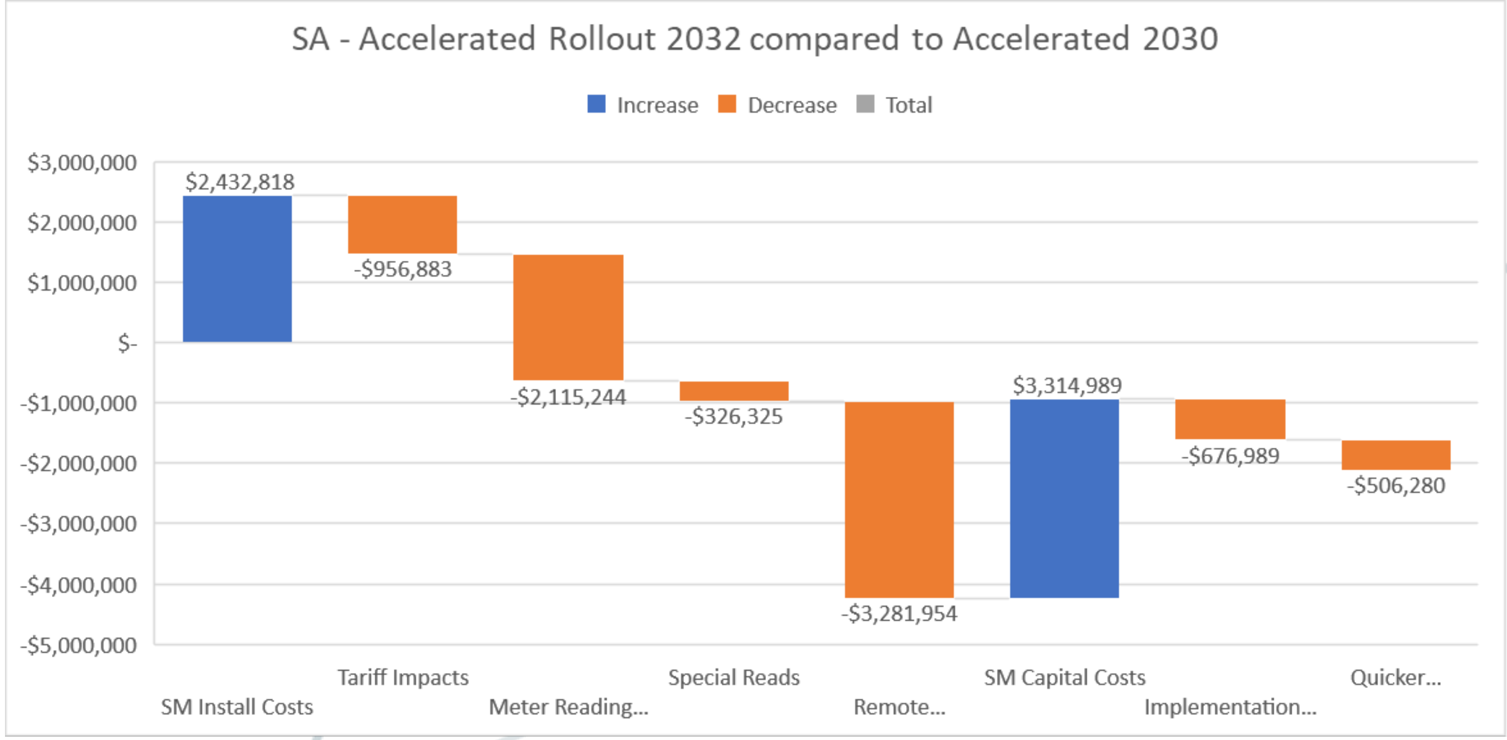
2032 completion - SA

- The incremental cost of deferring the completion of the rollout to 2032 (as compared to 2030) is ~$2.1m in NPV terms, driven by:
  - Reduced SM install costs and SM Capital Costs (NOTE: blue bars indicate an improvement in the NPV, relative to the 2030 case)
  - Significant reduction in benefits associated with Meter Reading Costs (due to retention of manual meter reads at reduced scale, for longer)
  - Reduction in other benefits that are otherwise assumed to accrue in proportion to the SM rollout.
- Results are more marginal than in other states.



5. CONCLUSIONS AND NEXT STEPS

Conclusions and next steps

- The results indicate that accelerating the rollout of SMs is economic in all States.
- This is predominately driven by:
  - The significant expenditure in manually reading of meters (scheduled reads, special reads) and remote dis/reconnections that will be avoided, if the rollout is accelerated,
  - The expected deterioration in the scale efficiency associated with reading accumulation meters, as the number of SMs increases under the BaU case, and
  - The expected reduction in installation costs that would come from a more streamlined, geographically concentrated rollout. Evidence from the Victorian rollout (and underlying logic) suggests that accelerating the rollout in a manner that achieves scale efficiency and increases geographic concentration for installers, should, everything else being equal, reduce the costs per install.
- Other factors influencing the result include:
  - The fact that the BaU case is the installation of SMs on a new and replacement basis (not the use of SMs instead of accumulation meters), which means that the results (in NPV terms) are less affected by assumptions around the capital cost of the SM itself (and their installation costs), and more due to the benefits SM provide.
- Tariff reform is an important contributor to the overall benefits case, however, the case stacks up, even if they are excluded. Moreover, the main tariff-related benefits modelled are from:
  - Solar sponge tariffs for customers without solar/battery (which we believe is a reform that is likely to be relatively appealing to end customers, networks and retailers); and
  - Using the SM to deliver price signals directly to EVs.

6. DETAIL ON THE KEY BENEFITS MODELLED

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Key benefits modelled

In this section:

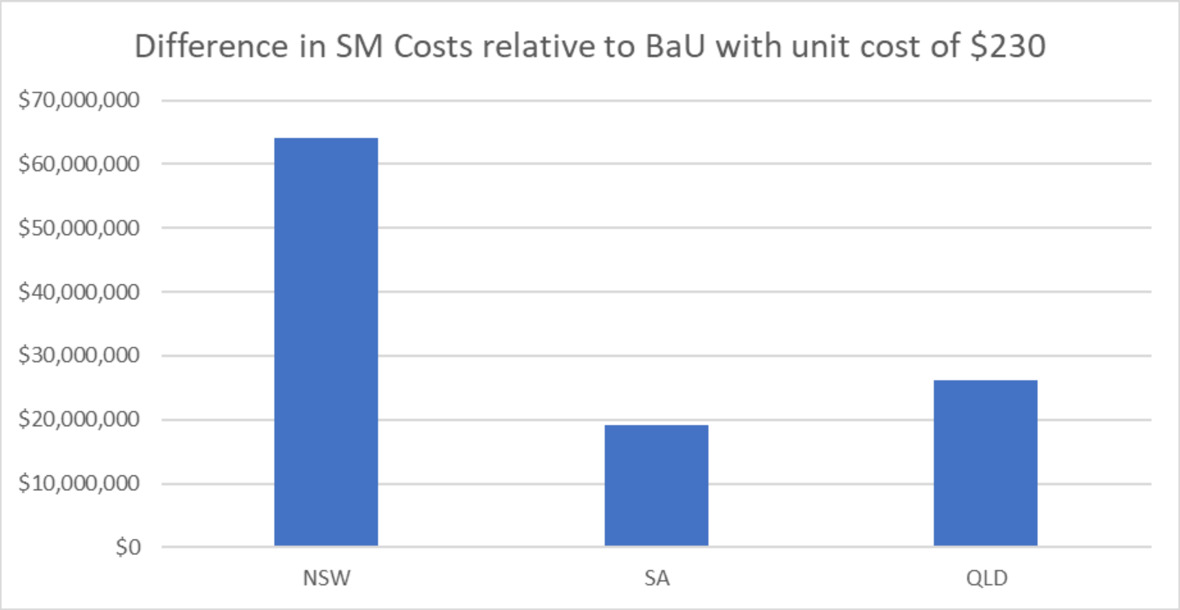
1. Smart meter costs
2. Smart meter installation costs
3. Meter reading costs
4. Special reads
5. Remote disconnect / re-connects
6. Tariff impacts
7. Restoration of supply after unplanned outages
8. Implementation costs

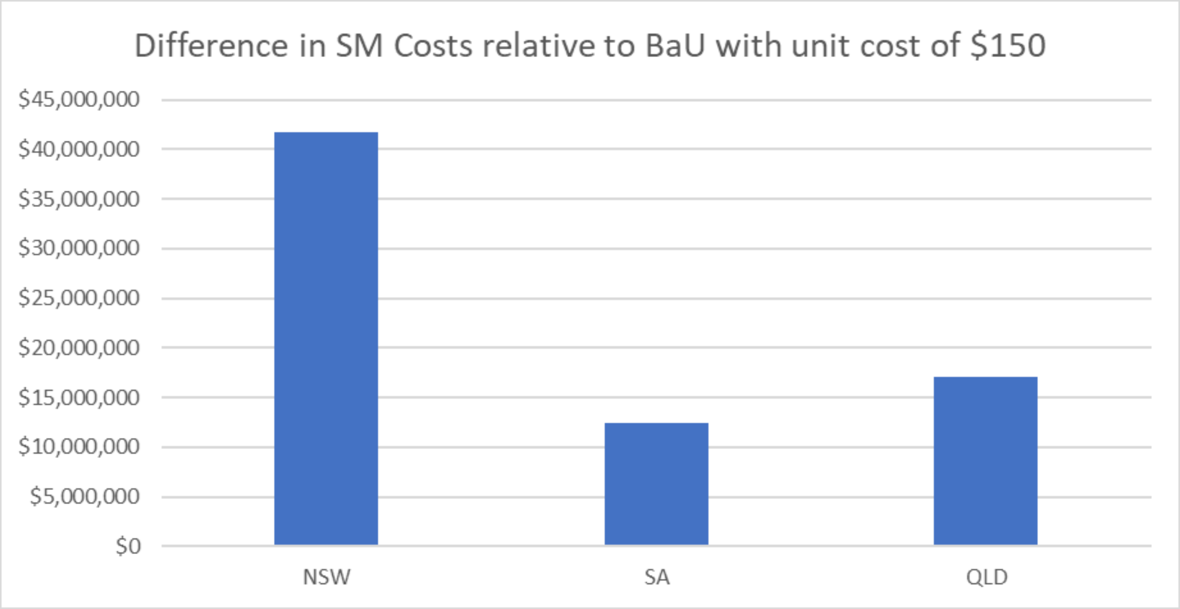
Key Smart Meter Cost Assumptions

Parameter	Value	OGW Comment
Meter Capital Cost	$230	United Energy, *2017 AMI Transition Charge Application*, page 19, inflated @2.5% for 7 years
Meter Install Cost (BaU)	$247	AER, *Final Decision: AMI Transition Charges Applications*, page 32, inflated @2.5% for 7 years
Meter Install Cost (Accelerated)	$169	United Energy, *2017 AMI Transition Charge Application*, page 16, inflated @2.5% for 7 years
Productivity Factor	0.5% pa	OGW assumption

Smart meter costs

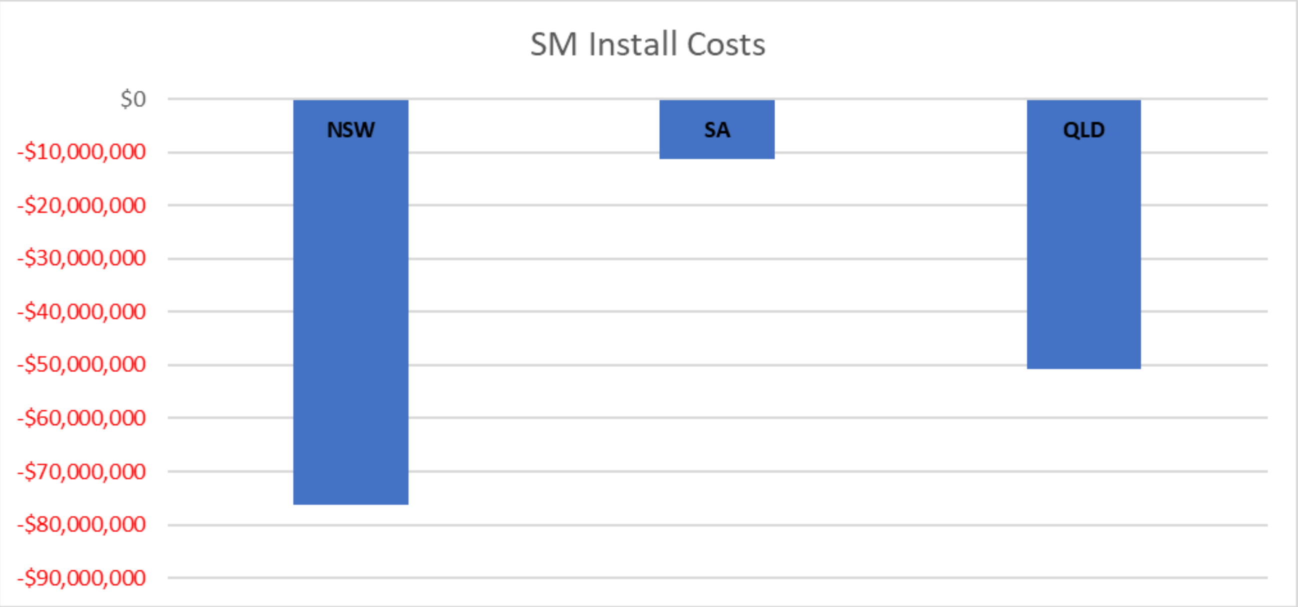
- Accelerated rollout option brings forward capital cost of SM, hence cost increases in NPV terms.
- Assumed Meter cost => $230/meter (UE approved cost of $193 in 2017 AMI Transition Charges Application, inflated to $2022), with small (0.5% pa) productivity improvements over time.
- No scale efficiency associated with accelerated rollout.
- The results are not as sensitive to this assumption as one might think, as it impacts both the BaU and the accelerated option (so the only cost is the bring forward costs).
- Results improve if the cost of the meter assumed to be $150/meter (as compared to $230/meter).
  - NSW improves ~$22m
  - SA improves ~$6.6m
  - QLD improves ~$9m





Smart meter installation costs – with geographic efficiency

- Accelerated rollout brings forward cost of installing SMs, however NPV of install costs depends on:
  - Efficiency of rollout – geographically focused versus geographically dispersed; and
  - Number of meters installed over evaluation period
- Meter installation cost:
  - Geographically focused: $168/meter (based on 'United Energy's 2017 AMI Transition Charge Application“, Page 16, inflated to $2022)
  - Dispersed: $247/meter (based on Jemena’s actual costs under BaU rollout, as per AER, Final Decision: AMI Transition Charges Applications, page 32, inflated to $2022).
- Both assume a small (0.5% pa) productivity improvement over time.
- <u>Scale efficiency assumed under the accelerated rollout, as it is assumed to be more geographically focused</u>.



They go down in all States because the accelerated program provides lower unit costs due to assumed geographic efficiency, but with the same volumes.

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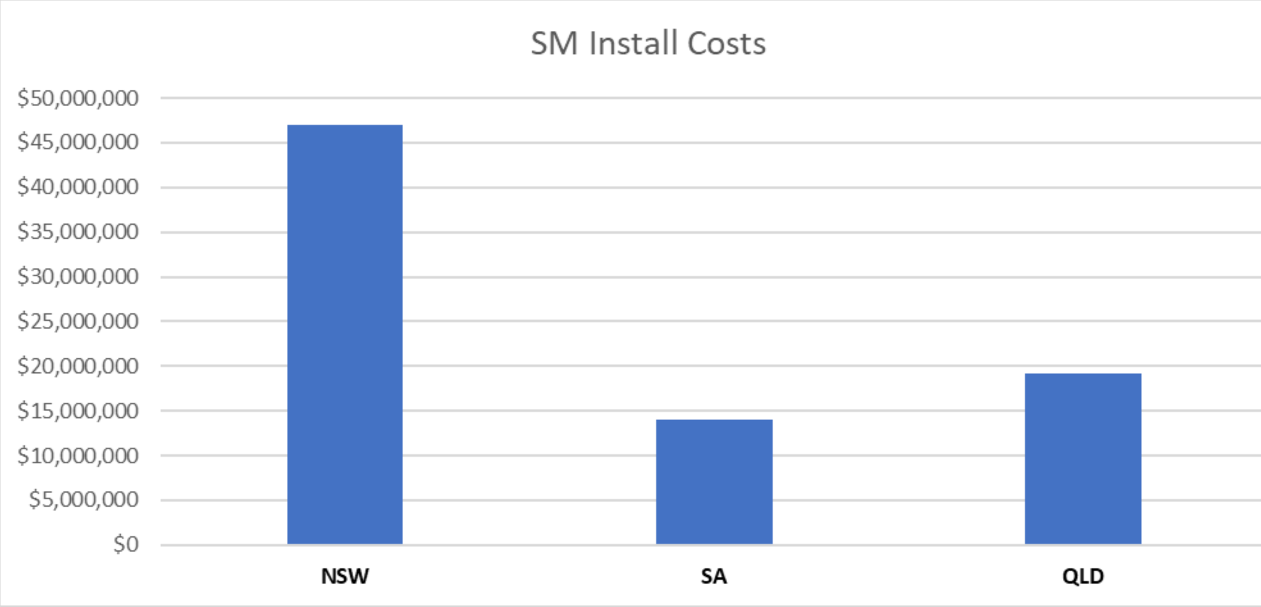
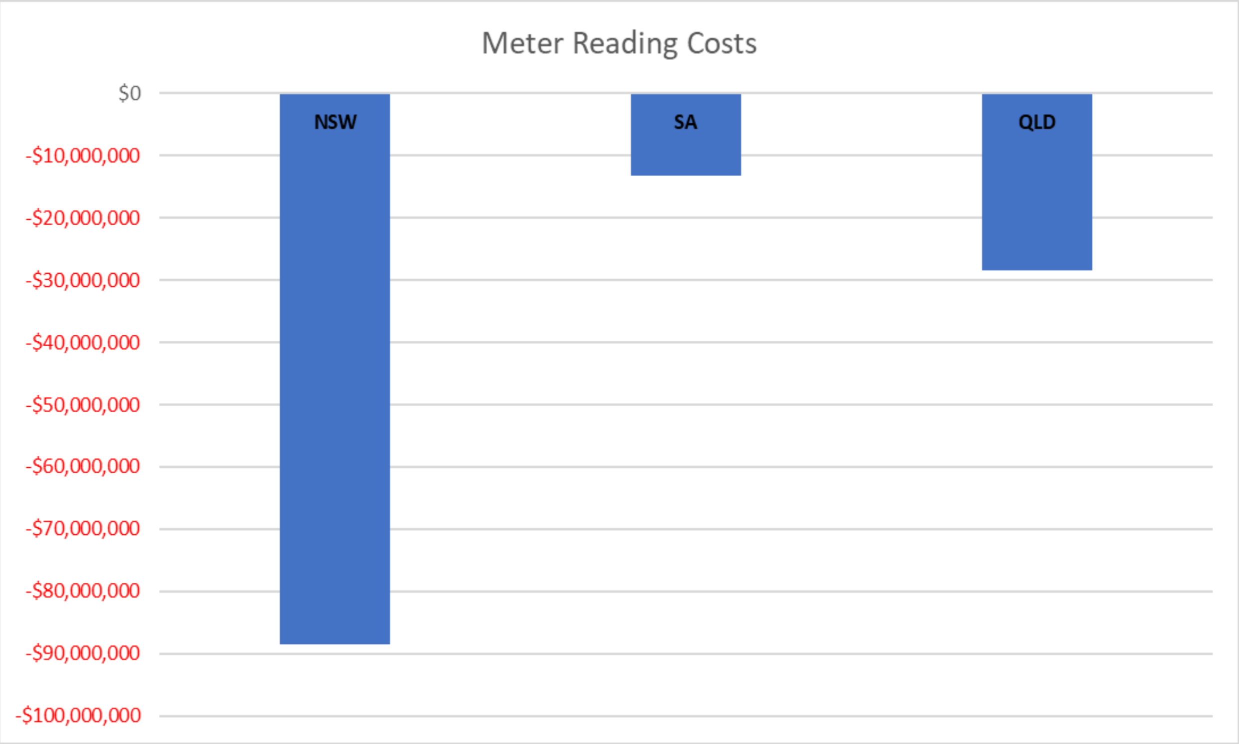
Smart meter installation costs – without geographic efficiency

- If we assume no scale efficiency in install costs under the accelerated rollout c.f. the BaU case, the overall difference in install costs increases due to:
  - Bring forward effect,
  - No offsetting efficiency improvements.
- The additional costs in NPV terms (without geographic efficiency) are:
  - NSW = $123m
  - SA = $25m
  - QLD = $70m
- Everything else being equal, this leads to the following overall differences between the accelerated case and the BaU in NPV terms:
  - NSW = $132m
  - SA = $28.4m
  - QLD = $126.6m
- Hence, the accelerated program is still economic



Meter reading

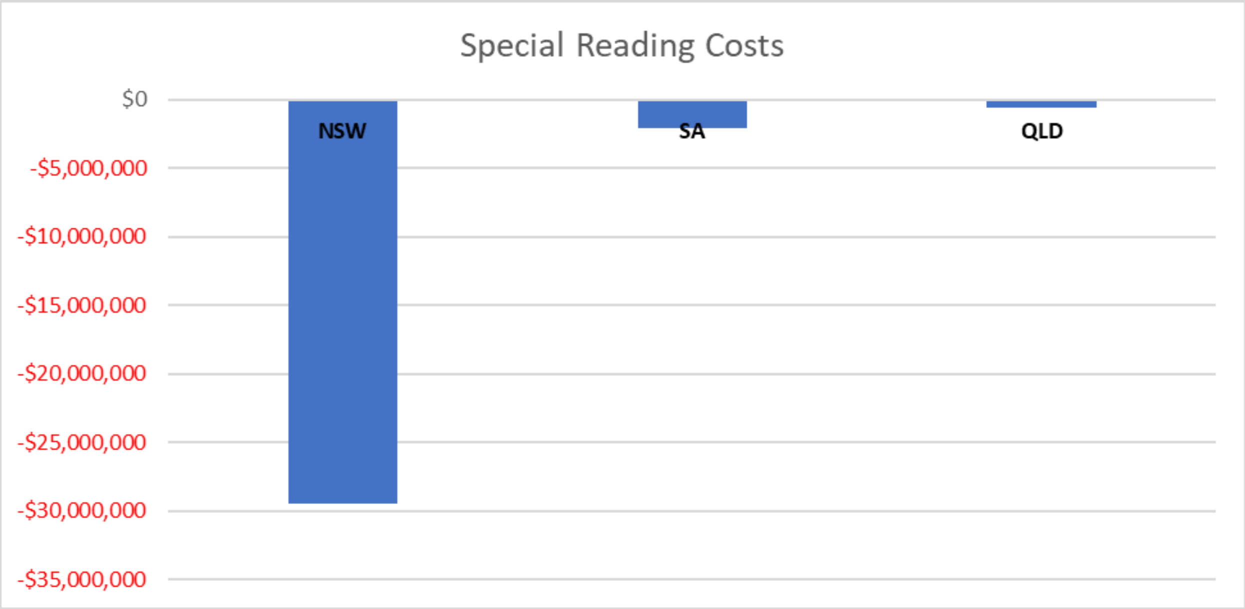
- Meter reading costs decline in NPV terms over the period
  - NSW = $88.6m
  - SA = $13.1m
  - QLD = $28.4m
- Declines occur due to the impact that more SMs have on:
  - Raw meter reading costs (e.g., less meter reads); &
  - Declining scale efficiency associated with remaining meter reading ‘runs’ under the BaU case (aligned to AER formula used in recent decisions for DNSPs in NSW and SA). This approach is considered conservative:
    - Particularly towards the end of the BaU rollout, where diseconomies of scale are likely to be even more impactful under the BaU than in the early years.
    - Our modelled per annum manual meter reading costs (per legacy meter) reach ~$30/customer, well below some VIC businesses’ ‘manual meter reading costs’ (e.g. Citipower charges over $30/manual read).



- Declines differ across States due to different starting meter reading costs (QLD and NSW ~$10/customer/pa; SA ~$4.5/customer/pa)
- Current meter reading costs derived from RINs and/or Metering PTRM models (SA)
- We have assumed that the marginal cost of remotely reading a meter is immaterial.

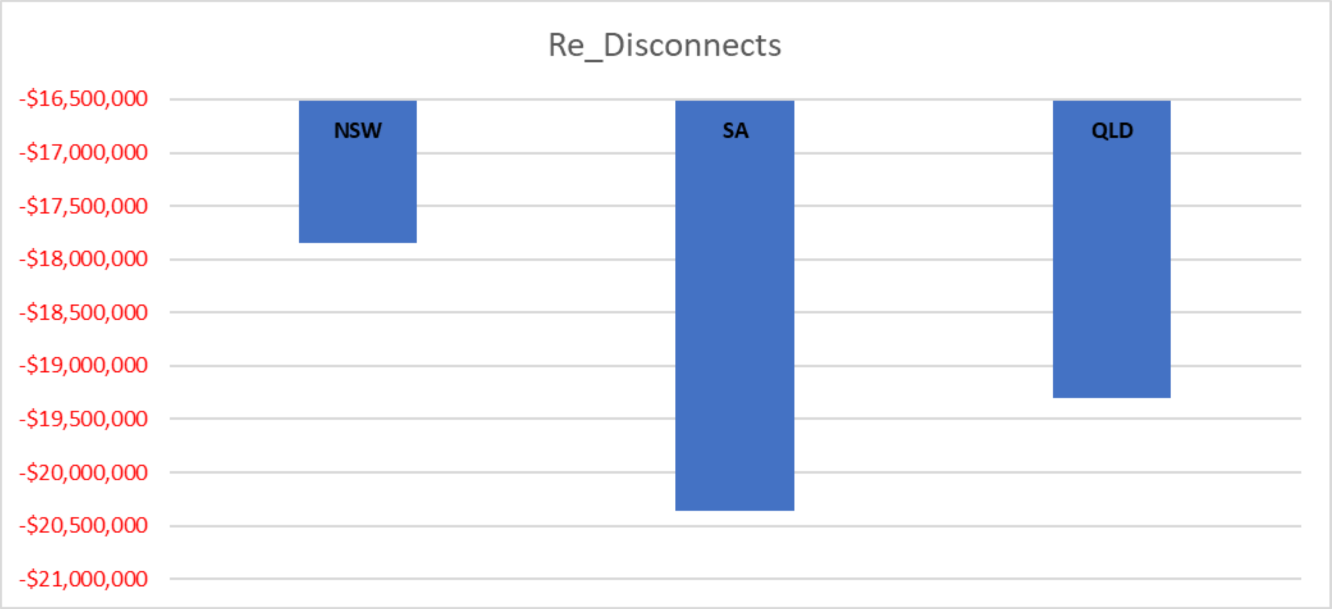
Special reads

- Special read costs decline materially in NPV terms over the period in NSW
- Declines occur due to the impact of more SMs (e.g., fewer special reads, as more remote reads)
  - No decline in scale efficiency assumed under BaU (as special reads are assumed to already be geographically dispersed).
- Declines differ across States due to:
  - Different current special read costs
    - NSW ~$4/customer/pa
    - QLD and SA <$1/customer/pa).
  - Difference could be due to reporting of costs in RINs
- Current special read costs derived from RINs
- We have assumed that the marginal cost of undertaking a remote special read is immaterial.



Remote disconnects / reconnects

- Remote disconnect/reconnect costs decline materially in NPV terms over the period, particularly for SA and QLD
  - Driven by higher reported per customer costs in RINs
- Declines occur due to impact of more SMs
  - No decline in scale efficiency assumed under BaU (as remote dis/reconnects are assumed to already be geographically dispersed).
- We have assumed for the purposes of these results that all States implement remote re/disconnects, however there is some uncertainty as to whether remote reconnects will be allowed (e.g., QLD)
  - Whilst impactful in NPV terms, this does not change the overall result for QLD
- It is not possible to split out current disconnects from reconnect costs, as not all businesses clearly separate these costs out in their RINs



NOTE: There is a risk that remote reconnects will not be allowed in QLD.

- Current costs have been determined based on RIN information
- We have assumed that the marginal cost of undertaking this task remotely is relatively immaterial (although we acknowledge that is unlikely to be costless).

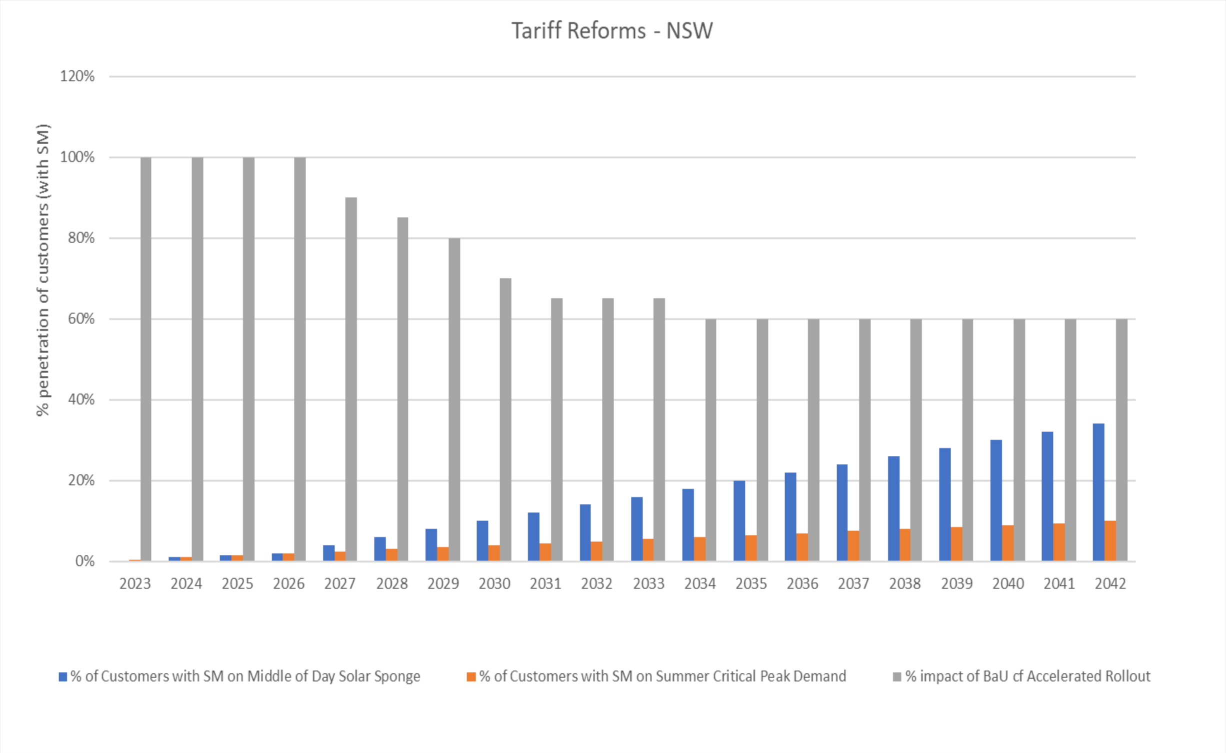
Tariff impacts

- The accelerated rollout provides the means for facilitating more efficient tariff structures, earlier in the evaluation period
- The key tariff reforms that are assumed to be facilitated by SMs and which have been modelled are:
  – Solar sponge (SS) tariffs;
  – Critical peak demand (CPD) tariffs; and
  – Better pricing of EV peak demands.
- Conceptual economic benefits of a SS tariff include:
  – Incentivising customers (without solar)* to move consumption from high-priced, late afternoon / early evening periods to the middle of the day
  – And as a result, reduced levels of PV curtailment in the middle of the day.
- Conceptual economic benefits of a CPD tariff include:
  – Reduced network augmentation costs due to peak demands
  – Reduced generation augmentation costs due to peak demands
  – Reduced generation dispatch costs (during peak periods)
    - NOTE: The magnitude of the impact on peak demand (and hence the above costs) will depend in part on how EVs are assumed to be managed under the BaU case (i.e., are they 'unconstrained', with EV owners relying predominately on 'convenience' charging, or are they 'managed' / 'incentivised' by way of interruptible tariffs, not requiring a SM)

* Customers with a solar system are assumed to get a SM under the BaU rollout when their solar panel is installed. As a result, accelerating the rollout is not assumed to affect customers with these types of DER.

Tariff impacts – Take up of tariffs

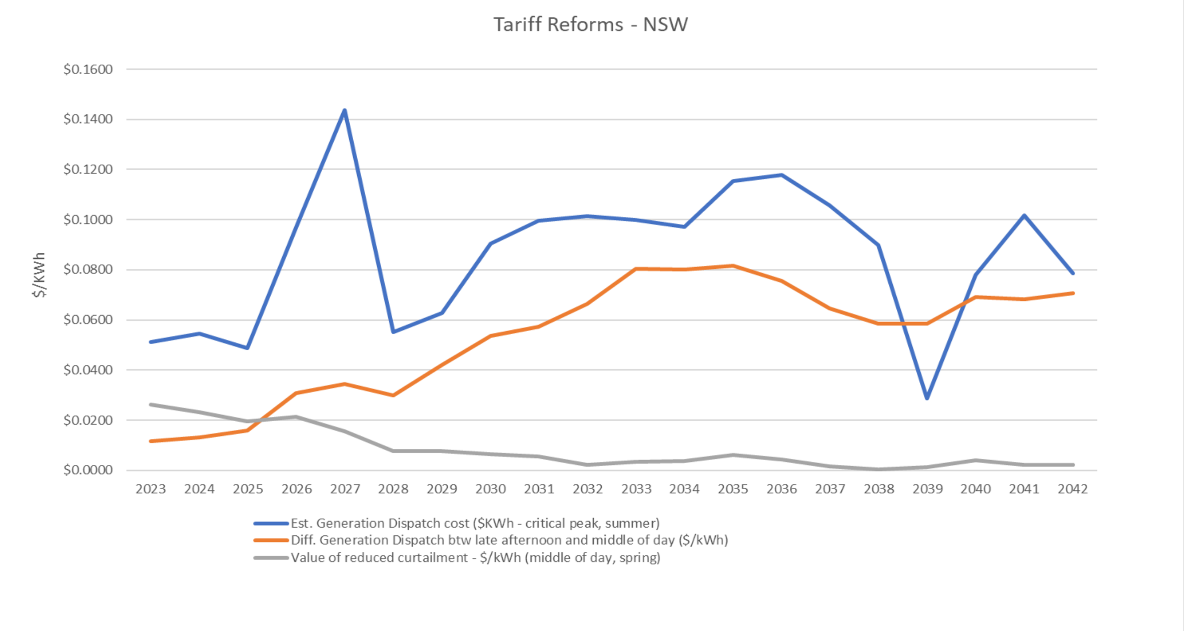
- Clearly, there is significant uncertainty around the take-up of these types of tariff. The assumptions we have made are as follows:
- The impact the accelerated rollout has on EV charging (via allowing tariff reform) compared to the BaU case is assumed to be minimal throughout the 2020s, but increasing in latter years (grey) as:
  - EV take up is assumed to be highly correlated with the SM rollout in the early years under the BaU (NB: hence any tariff reform, if it were to occur, has the same impact), and
  - The ability to affect EV charging by way of tariff reform under the BaU rollout case in the longer term is assumed to be adversely impacted by the slower rollout of SMs under the BaU case (e.g., tariff reform is more limited in the longer term, as customers are less likely to accept differential charging arrangements being applied based on metrology).
- We have assumed a modest uptake in solar sponge tariffs over time (blue), due to:
  - Greater likelihood of customer acceptance of this type of tariff structure, and therefore, to the retailer's interest to offer; and
  - Commercial incentives for retailers to adopt to manage risk and potentially support wholesale positions.

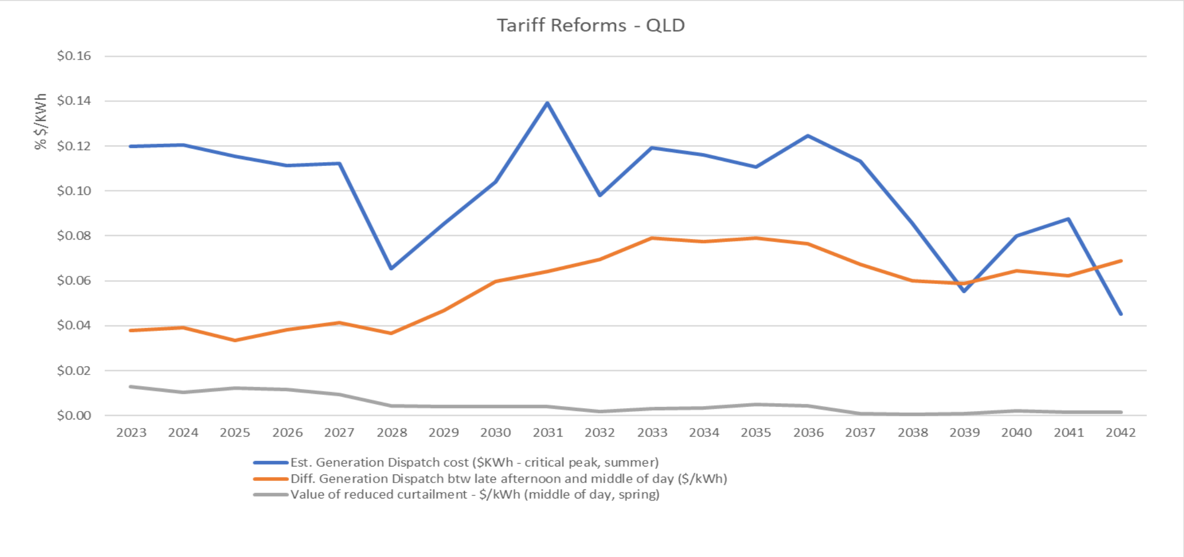


- We have assumed a limited appetite for CPD type tariffs, so a slow uptake (red) over the period
- Modelling assumes no variation in take-up across the States.

Tariff impacts – Wholesale Market

- Impact of tariffs on wholesale market costs differ by State (only NSW and QLD figures shown)
- General observations:
  - The difference in the marginal cost of the marginal generator in the evening vs midday (red) increases over time, increasing the benefit of incentivising customers to move consumption away from early evening to the middle of the day
  - Marginal cost of the marginal generator in the middle of the day in Spring (grey) declines over time, reducing the benefits of alleviating curtailment (which is assumed to predominately occur in Spring)
  - Marginal cost of the marginal generator during peak demand periods (blue) is volatile over time horizon, but generally around $0.10/kWh ($100/MWh)
- Input assumptions have been derived from published Customer Economic Curtailment Values (by AER)





Tariff impacts – Impact on peak demand (kW) and cost ($/kW/pa)

- Published LRMCs differ by network

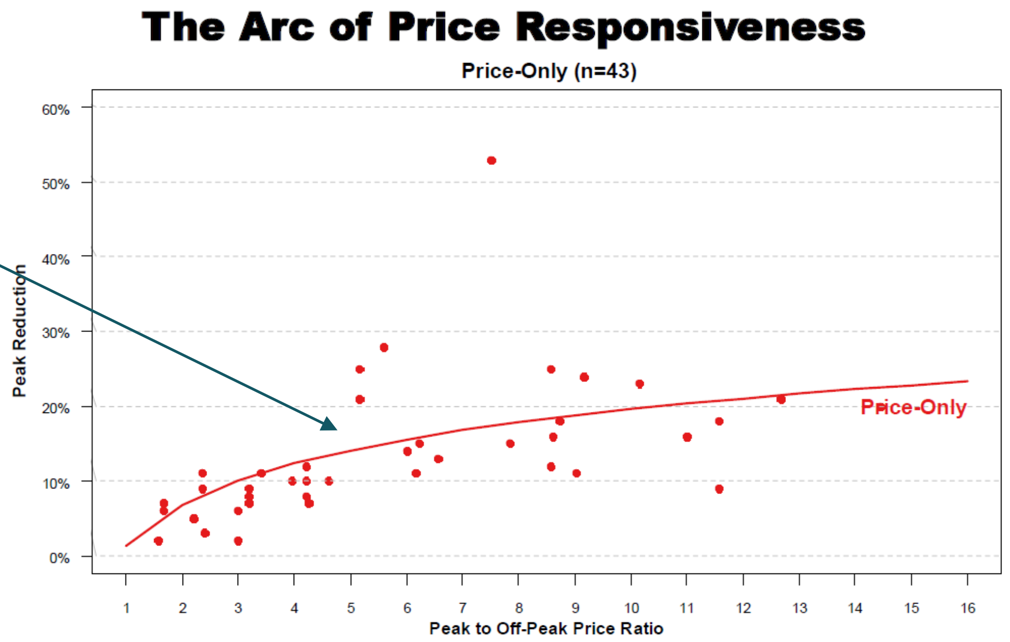
DNSP	Network LRMC $kVA/pa	Est. Res Coincident Peak Demand (kW), ex Evs	Generation Investment Cost ($kW/pa)	Residential EV demand (kW/vehicle)
Ausgrid	$56.20	1.6	105	0.7
Endeavour	$97.04	1.6	105	0.7
Essential	$113.00	1.6	105	0.7
Energex	$140.00	1.6	105	0.7
Ergon	$262.30	1.6	105	0.7
SAPN	$62.90	1.6	105	0.7
EvoEnergy	$60.00	1.6	105	0.7
TasNetworks	$147.00	1.6	105	0.7

- LRMCs used are based on Annual Pricing Proposals or Tariff Structure Statements
- Estimated coincident peak demand (1.6kW) of a residential customer (excluding EV demands):
  - OGW assumption based on information from DNSPs
- Estimated annualised Generator Investment Cost ($105/kW/pa)
  - Based on the marginal cost of a GPG as per ISP ($1,500/kW), annualised over 25 years
- Average residential EV coincident peak demand (0.7 kW/vehicle)
  - Based on OGW analysis of AEMO ISP information
  - Assumes a high proportion of convenience charging (see following pages for more detail).

Tariff impacts – Quantum of impact resulting from tariff changes

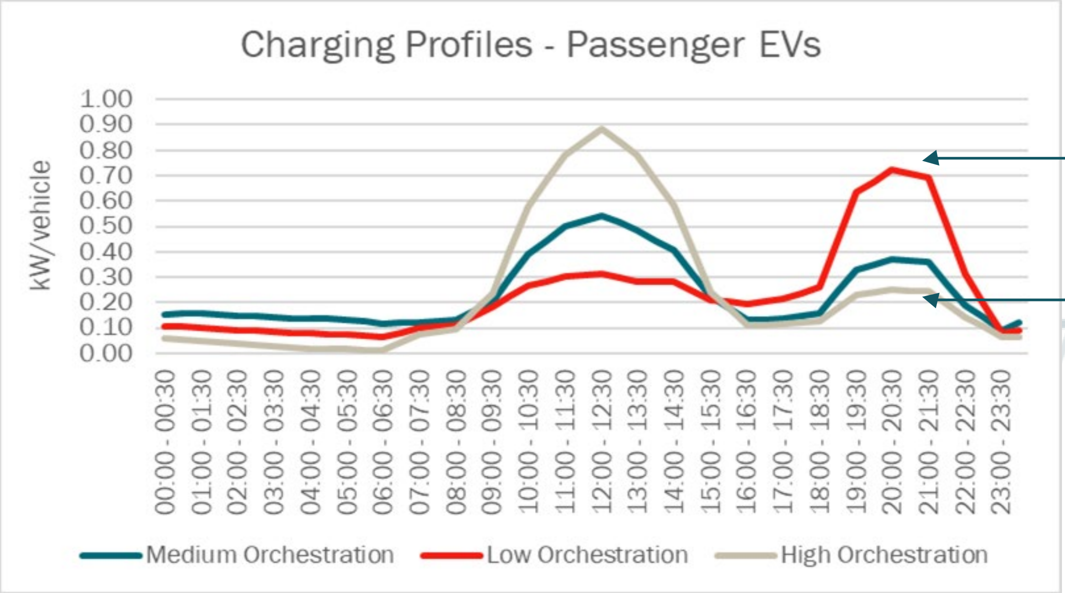
Input	Value
Impact (%) of CRNP (per customer) - Peak Demand	15%
Impact (kWh) of Retail Solar Sponge (per customer) - Middle of Day (year round)	700
Impact (kWh) of Retail Solar Sponge (per customer) per Day of Curtailment	131.25
Reduction in EV demand due to better pricing	36%
Duration of peak reduction due to CPD (hours)	2
% of EV Customers with SM either on a CPD (or interruptible EV) tariff	75%
Proportion of Evs that are Residential	80%

- Impact of critical peak demand (15% reduction)
  - From Brattle Group, *Managing the Benefits and Costs of Dynamic Pricing in Australia*, 2012 (Slides 12 and 13)
- Impact (kWh) of solar sponge across the year (OGW estimate of 700kWh pa)
- Impact (kWh) of solar sponge on levels of curtailment (131.25kWh)
  - ¼ of the year-round figure (700kWh), reflecting the fact that curtailment predominately happens in spring, with a discount of 25% applied to that figure to reflect the fact that curtailment does not occur every day in spring.



Tariff impacts – Impact on EV Demand

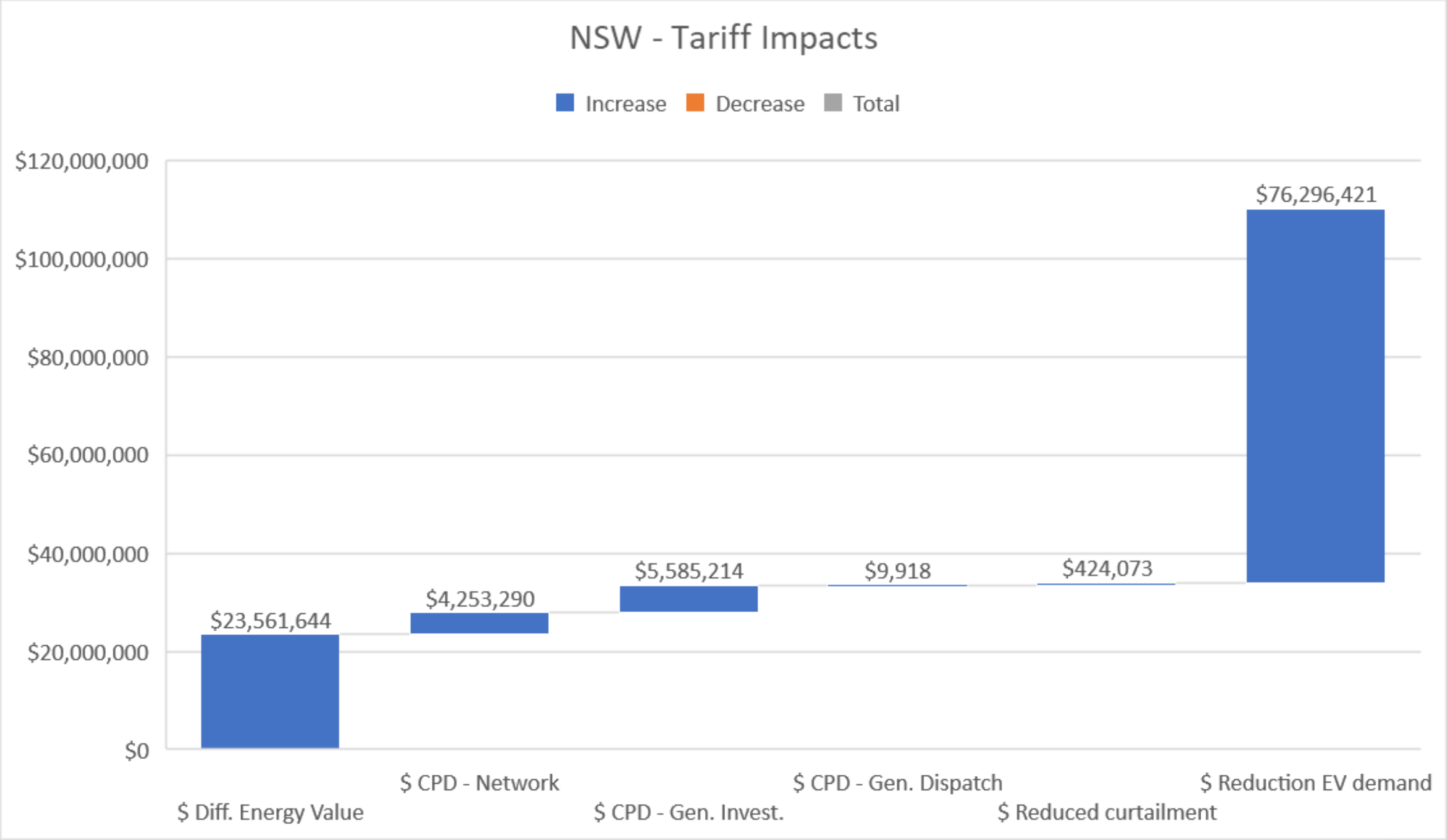
- We have assumed that 75% of EV customers that get a SM earlier under the accelerated program are on an EV tariff that requires a SM
- We have assumed a ~66% reduction in EV demand (0.7kW/vehicle under BaU, down to ~0.25 kW/vehicle) as a result of being exposed to that tariff
  - 0.7kW/vehicle based on high proportion of convenience charging
  - 0.25kW/vehicle based on a high proportion of daytime charging.
- As noted earlier, we have assumed tariff reform under the BaU case is affected in the longer term due to the slower rollout of SMs.



Scenario	Convenience	Night	Day	Total
Low peak demand impact (High Orchestration, focus on Pricing)				
Residential	20%	0%	80%	100%
Medium peak demand impact				
Residential	35%	20%	40%	100%
High peak demand impact (Low orchestration, limited pricing)				
Residential	75%	12.5%	12.5%	100%

Impacts of Tariff Reform by States

- The key drivers of the benefits of tariff reform are:
  - The difference in the energy value in the midday period versus early evening (which relates to the Solar Sponge tariff); and
  - The reduction in network and generation costs stemming from being able to better manage EV demand via tariffs that require a SM (with the benefit being particularly high in QLD due to, amongst other things, it having a much higher LRMC than SA or NSW)
- Given our input assumptions, the other tariff reforms (e.g., CPD tariffs) only make a very minor contribution to total benefits.



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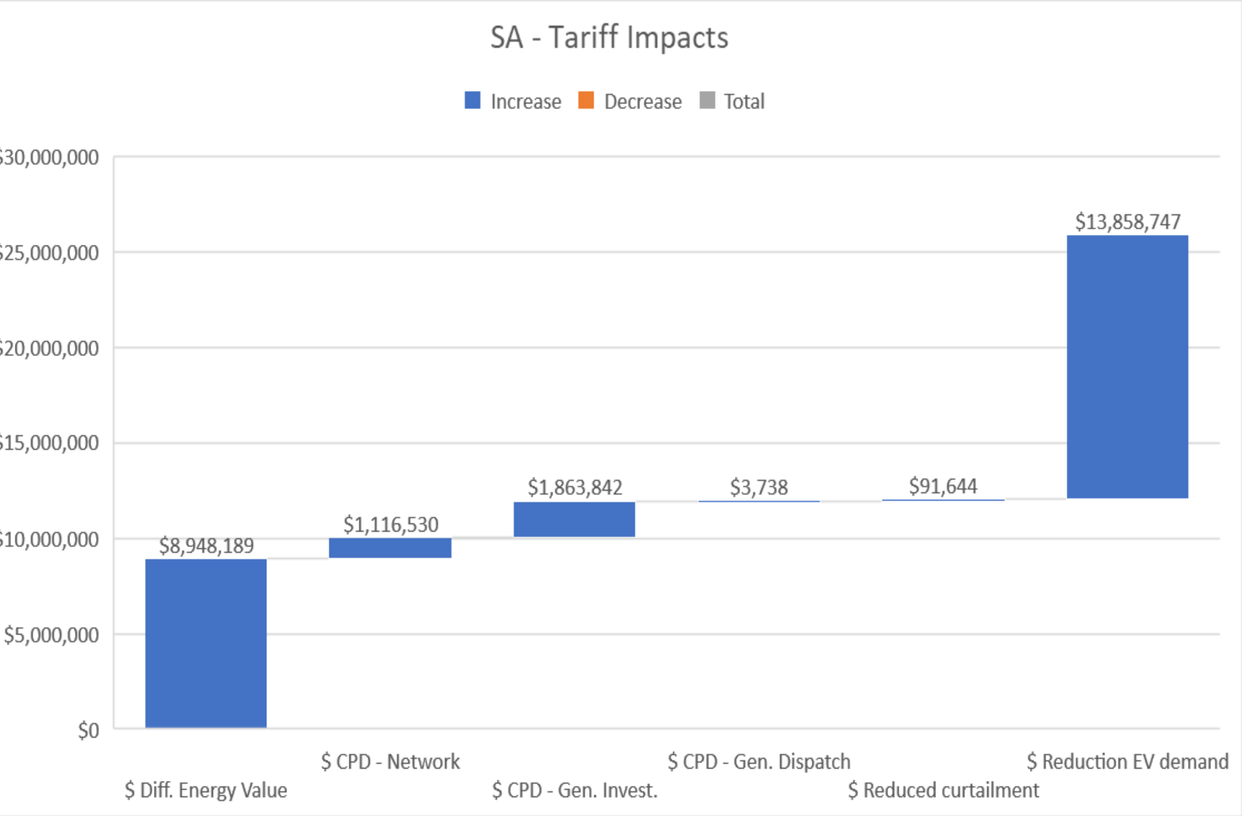
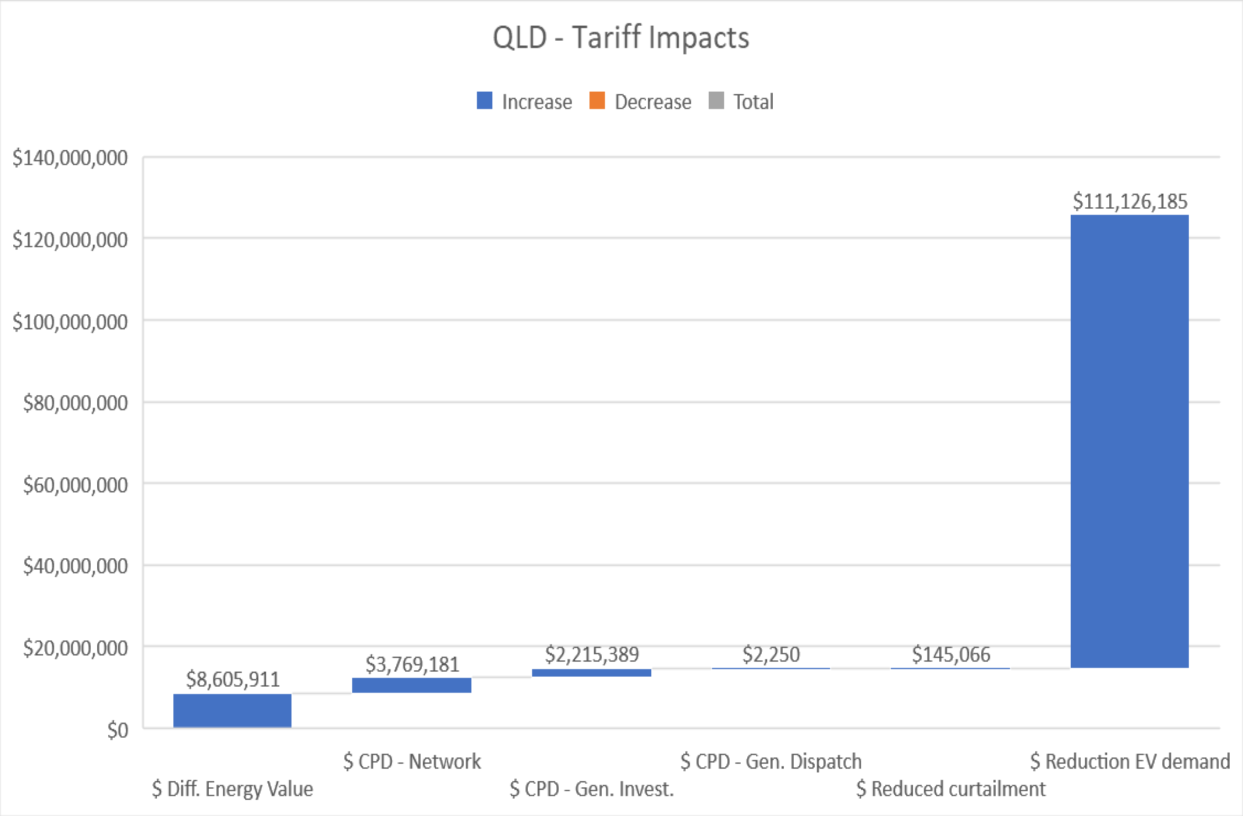
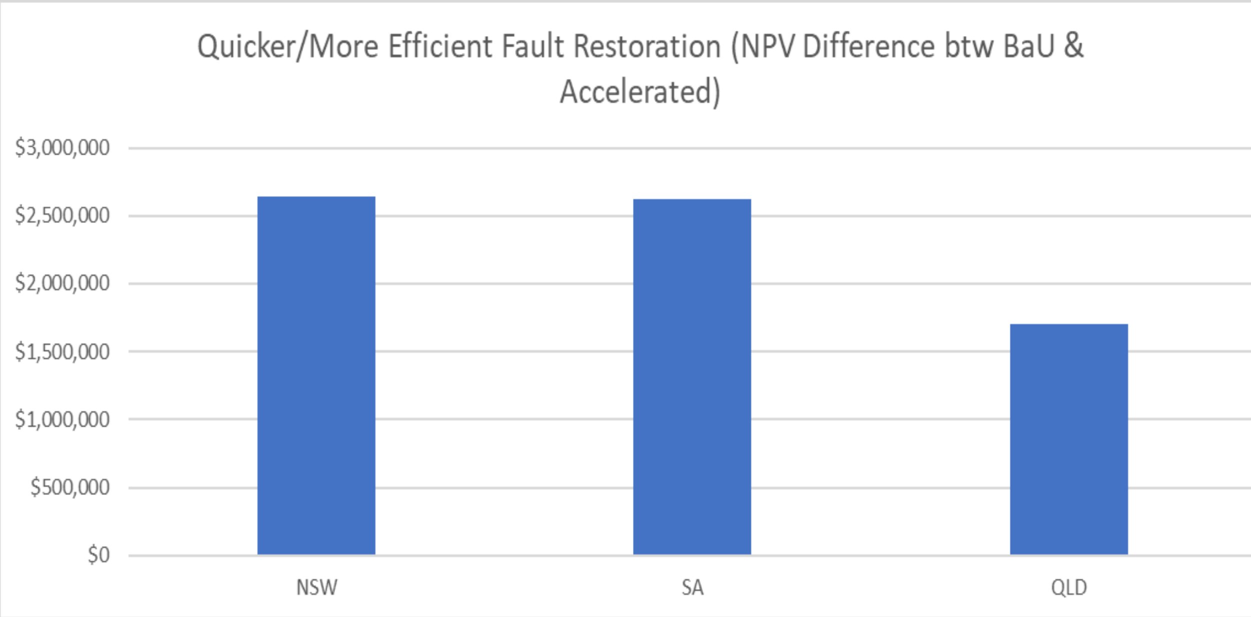
Impacts of Tariff Reform by States





Quicker/more efficient restoration

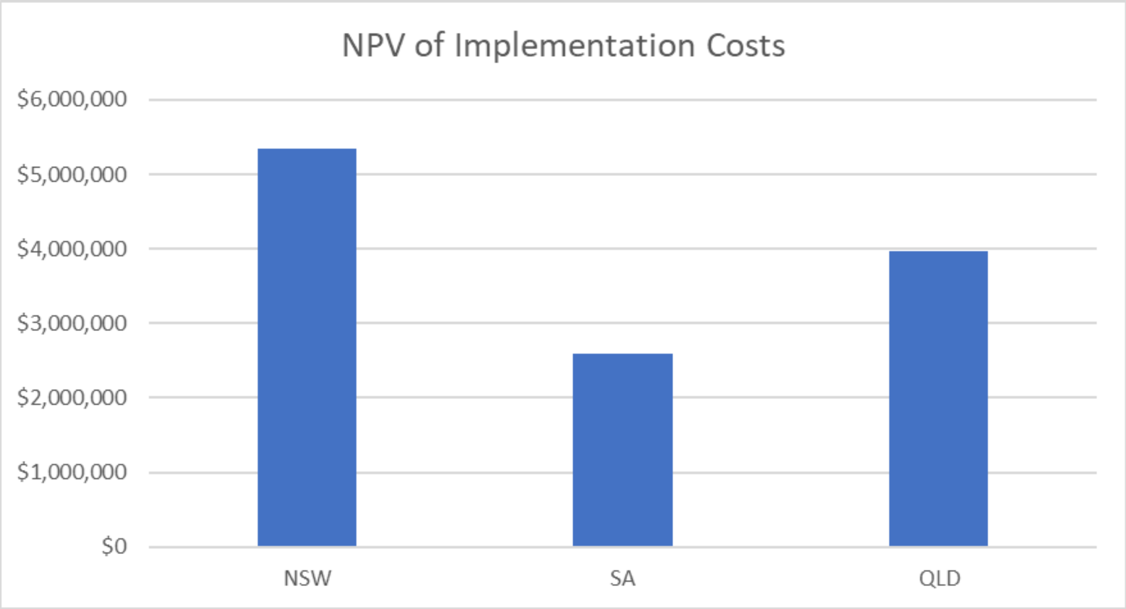
- Smart meters are assumed to allow:
  - Quicker restoration times, leading to a reduction in economic costs associated with loss of supply events (VCR * GWh energy not supplied (unplanned) * % improvement)
  - More efficient identification of the location/source of outages, leading to lower emergency response costs ($ emergency response * % improvement)
- Key assumptions:
  - Current levels of energy not supplied (GWh) due to unplanned outages:
    - ~2GWh through ~10GWh pa depending on DNSP (based on RIN data).
    - Discounted to reflect the proportion of energy consumed by non-residential customers:
      - Approximately 60% of usage assumed to be consumed by non-residential customers (based on analysis of RINs)
      - This 'discount' factor reflects an assumption that while loss of supply events impact all customer types in proportion to their usage levels, the accelerated rollout (cf with BaU) will predominately affect areas with high residential customer penetration.



  - VCR:
    - As published by AEMO 2021
  - Est. maximum improvement in restoration times:
    - 5% (OGW Estimate)
  - Penetration when maximum improvement is achieved:
    - 80% (NOTE: Reflects assumption that minimal incremental benefit once high threshold penetration achieved)

Implementation Costs

- Estimated the incremental cost of the resourcing required to develop the Accelerated Rollout Plan (cf with BaU).
- General assumption:
  - $/pa remuneration per FTE = $180k
- DNSPs
  - Resources: 3 FTEs per DNSP:
    - 1 Metering Analyst – to analyse, for example, ,meter age profiles, locations, forecast BaU replacements by geographic area.
    - 1 Financial analyst – to analyse impact on meter reading routes/costs, forecast installer costs, etc.
    - 1 Manager oversight – for oversight and participation in meetings, communications, etc.
  - Level of effort per annum (% of yr): 50% of each FTE
- Retailer/MC (by State)
  - Resources: 20 (across various Retailers/MCs)
  - Level of effort (% of yr): 5.77% (Assume 120 hours per annum per resource for interacting on meter rollout)



- Others (e.g., Gov't, AEMO)
  - Resources: 10
  - Level of effort (% of yr): 1.92% (Assume 40 hours per annum per resource for interacting on meter rollout)

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7. COSTS AND BENEFITS NOT MODELLED

IT Costs

- Our initial position is that the bring forward of IT costs is unlikely to be overly material, in the context of the overall CBA.

1. It is likely that the capital costs for the development of systems to process interval data <u>have largely been made</u>
   - All of these parties should be aware that under the new & replacement policy, SM numbers will grow over time and ultimately constitute the entire meter stock
     - For example, Ausgrid in their 2018 regulatory submission (ICT Project Justifications, page 5), stated that "w*e expect that up to half our existing customers may take advantage of this rule change in the 2019-24 regulatory period. This is by leaving our type 5 and 6 metering service in favour of a retail offering inclusive of an advanced meter. With such a large volume of customers set to leave our metering service, there will be increased complexity in how we handle data relating to the accuracy of the meters we have installed. This creates a need to invest in better systems, as issues arise in the 2019-24 regulatory period*".
   - All of these parties will already be dealing with a certain proportion of their customers having SMs and therefore will have undertaken billing/settlement system development to manage this data
     - All retailers operating in Victoria will have systems that allow them to process and operationalise interval meter data in Victoria.
     - Most retailers operate across most parts of the NEM.
   - The advent of 5-minute settlement will have been another development that would have likely required these parties to undertake IT system development
     - For example, SAPN proposed and had approved an $8m expenditure on IT systems to accommodate 5-minute settlement, with the following explanation:

       "*After the implementation of the Five Minute Settlement Rule Change: (a) customers will be able to access to 5-minute meter reads via the customer access to billing data portals; (b) bills will be calculated using 5-minute meter reads; and (c) customers will be able to take advantage of tariffs that are enabled by 5-minute meter reads"*.
     - AEMO have almost certainly built systems to accommodate 5-minute settlement.

IT Costs

2. Bringing forward the number of SMs in the market may theoretically increase the speed at which existing systems (primarily for data storage and processing) reach capacity:

   - However, DNSPs are likely to have built in advance of their forecast uptake of smart meters over their next regulatory period to achieve economies of scale, given:

     - They have certainty around 'the end point' and

     - The limitations pertaining to 5-year regulatory re-sets, meaning DNSPs are unlikely to build just for a forecast penetration as at the end of their regulatory period.

   - To the extent that systems need to be scaled, presumably the incremental cost is significantly lower than the average cost. This affects both the marginal cost of the module, and the economic cost of the accelerated program (which is represented by only the bring forward amount of this marginal cost).

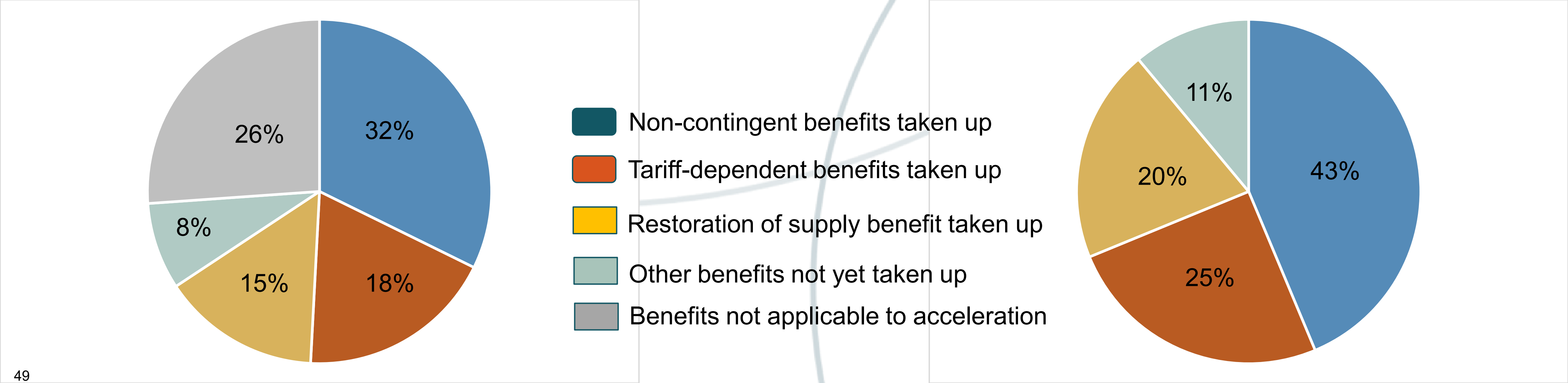
3. There are likely to be offsetting cost reductions as a result of not having to operate/maintain their accumulation metering and related IT systems.

Other benefits that could have been included

- 39 benefits were assessed in the various CBAs conducted on the VIC AMI rollout
- Based on the results of a 2010 re-assessment of that rollout's likely benefits:
  - The non-contingent benefits we have taken up so far represented 32% of the expected benefits
  - Quicker restoration of supply after unplanned outages represented 15% of the expected benefits
  - Tariff dependent benefits represented18% of the expected benefits
  - Only about 8% was expected from 19 other benefits (see tables on following pages)
  - About 22% of the benefits expected in the VIC mandated rollout are not appliable to the accelerated case
    - Almost all of this was the avoided cost of replacing accumulation meters (19% of total expected benefits)

Compared to all VIC benefits (accumulation meters as the alternative)

Compared to VIC benefits (new/replacement vs acceleration)



Benefits not taken up

VIC benefit no	Benefit	Experienced first by	% total VIC benefits
4	Reduced cost of network loading studies for network planning	DNSP	0.2%
10	Avoided cost of setting demand limits for customers to promote fair sharing and defer augmentation capex	DNSP	0.2%
11	Ability to set emergency demand limits to share limited supply at times of network stress or supply shortage	DNSP	0.0%
12	Avoided cost of supply capacity circuit breaker	DNSP	0.2%
13	Avoided cost of replacing service fuses that fail from overload	DNSP	0.2%
14	Avoided cost of investigation of customer complaints about voltage QoS, including equipment cost and cost of reporting to regulator	DNSP	1.5%
16	Reduction in calls to faults and emergencies lines	DNSP	0.5%
17	Avoided cost of investigation of customer complaints of loss of supply which turn out to be not a loss of supply	DNSP	0.6%
18	Avoided cost of end of line monitoring	DNSP	0.2%

Benefits not taken up (continued)

VIC benefit no	Benefit	Experienced first by	% total VIC benefits
20	Avoided cost of communications to feeder automation equipment	DNSP	0.1%
21	Avoided cost of proportion of HV/LV transformer fuse operations on overload	DNSP	0.2%
22	Avoided cost of a proportion of transformer failures on overload	DNSP	1.1%
23	Reduction in calls related to estimated bills and high bill enquiries	Retailer	0.2%
24	Reduction in energy trading costs through improved wholesale forecasting accuracy	Retailer	0.3%
25	Reduction in the administration cost of bad debt incurred on non-payment on move outs	Retailer	0.1%
26	Customer benefit of being able to switch retailer more quickly and more certainly. Note: this is not the bill saving	Customer	0.3%
27	Reduction in MDA costs - putting I&C customers on DNSP AMI networks	DNSP	1.0%
28	Ability for customers to move to monthly billing on the basis of electronic bills, reducing, admin costs, collection costs etc	Retailer / Customer	0.0%
37	Avoided cost of other communications to manage customers' loads for renewable generation tracking, electric vehicle charging and local generation management	Retailer / DNSP	1.4%

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