solar analytics

Submission to the AER:

ICT Expenditure Assessment Review

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About Solar Analytics

Solar Analytics is a successful start-up, providing home energy management solutions for solar home owners. Founded by a team of passionate, world leading solar experts, Solar Analytics has developed technology that significantly enhances the lifetime value of our customer's solar systems. In less than five years we've grown from 30 to 30,000 customers and from 2 to 30 staff.

Solar Analytics is on a mission to empower people to navigate the changing energy landscape.

Shortened forms

AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
APVI	Australian Photovoltaic Institute
DER	Distributed energy resources
DNSP	Distribution network service provider
ENA	Energy Networks Australia
ICT	Information and communication technology
NEM	National Electricity Market
NPV	Net present value
PV	Photovoltaic
RAB	Regulatory asset base
RIN	Regulatory information notices
RIT-D	Regulatory investment test for distribution
RRP	Regional reference price (i.e. NEM dispatch price)

Position on the AER ICT Expenditure Review

The position of Solar Analytics on DNSPs' ICT expenditure relates to that ICT expenditure directed at transitioning the power system to a more decentralised paradigm of operation. The electricity industry continues to see a growing proportion of energy production occurring behind the customers' meter, at what were traditionally considered loads, driven primarily by the uptake of rooftop solar. Moreover, we envision, in the near future, customers' distributed energy resources (DER) providing services to power networks at a cost below conventional network solutions.

Within this context, the first step to unlocking the value of customers' DER is to develop an understanding of where that value lies. This requires *data*, which is not currently collected or accessible to the DNSPs in sufficient detail or granularity. However, a chicken-or-egg problem arises, where DNSPs are unable to accurately quantify benefits because they do not have data, so are unable to justify the corresponding part of their ICT expenditure needed to collect the data in the first place. At the same time, DNSPs operating under a revenue cap may not wish to bear the risk of self-funding the required ICT expenditure, thereby reinforcing the investment stalemate.

Despite this, our investigations indicate that there are additional benefits to energy users not currently incorporated into the AER's thinking regarding the value of ICT expenditure. For example, a conservative estimate of the NEM market benefits of improving rooftop solar yields for residential customers by 1% would have amounted to ~$7.2M last year[1]; and we expect multiples of more than 1% are available through improved distribution network management. **Guidelines or established methodologies for incorporating these market benefits into network companies' revenue proposals would clarify the matter** for all involved.

However, these are the simplest benefits to quantify. In addition, we foresee a range of benefits flowing from data-driven improvements to DNSP expenditures, for example, through enhanced power quality visibility and voltage management, preemptive fault detection, more efficient maintenance and replacement scheduling, and better load forecasting and capex planning. Many of these benefits represent risks to the DNSPs of not satisfying the regulatory requirements. As such, **the AER may wish to consider the value of data in de-risking DNSPs operations**, in addition to the realised and concrete benefits that flow from the investments.

Beyond this, industry and research bodies have quantified the value of opening distribution networks to competitive forces and third-party energy service providers. This will allow the industry to innovate, in order to create and capture new sources of value for electricity system end users. This represents a transition to the networks playing a facilitation or market-making role (e.g. the ENA-AEMO Open Energy Networks program). **Advanced ICT will play an essential part in this future transactive role for distribution networks, and DNSPs should begin to prepare now**.

[1] See Appendix A.

In summary, we reiterate our perspective that access to quality and timely data will underpin a general improvement in the efficiency of DNSP opex and capex decision-making, and will facilitate innovative, low-cost ways to provide electricity network and power system services, which are in the long-term benefit of all energy users.

In the remainder of this submission, first, we address the specific questions raised by the AER in their approach paper, and second, we detail the methodology used to quantify the market benefit available from a 1% improvement in residential rooftop solar yield.

AER Questions

Question 1

Do you agree with the RIN categories of ICT expenditure? Are there others we should request DNSPs to report? Does it make more sense to disaggregate ICT into its 'recurrent' and 'non-recurrent' components?

Ausgrid presented their ICT capex forecast into the categories 'Comply', 'Protect (cyber)', 'Maintain' and 'Adapt' that are based on purpose. Would stakeholders find these categories more useful than our suggested recurrent and non-recurrent categories?

There is an argument that it is up to DNSPs to make the case for justifying to their opex and capex, and that they should be able to do this while using the RIN categories (Client device expenditure, Recurrent expenditure, and Non-recurrent expenditure) used in the AER's benchmarking purposes.

However, there is a good case that also aligning capex with the alternative Ausgrid categories will provide deeper and more useful information to the AER going forward. Specifically, using the categories suggested by Ausgrid in their ICT capex forecast, of 'Comply', 'Protect (cyber)', 'Maintain' and 'Adapt', can both:

1) explain the driver of the costs to the DNSP, and
2) allow for better benchmarking by the AER.

For example, 'Maintain' expenditures should be easy to benchmark, both against an individual DNSP's past revealed costs and across DNSPs, given historical operations. Similarly, changes in compliance ('Comply') and cyber risks ('Protect') can be benchmarked across DNSPs, as they largely apply at the same time to all DNSPs. In contrast, the 'Adapt' category is going to impact DNSPs in different ways, due to the differing rates of DER uptake, and differences in geography and climate. The efficiency of these capex investments may be more difficult to assess, and may deserve separate treatment from capex in the more straightforward categories.

On the other hand, there is a risk that, during the RIT-D process, the AER will not be able to identify the different factors driving investment and the corresponding efficient level of investment required using the simpler, less-informative 'recurrent' and 'non-recurrent' categorisation.

Moreover, in the future, using the 'non-/recurrent' categories, the AER will not have sufficient information to benchmark later investment that would have fallen under 'Adapt,' had Ausgrid's alternative categories been used. This will inhibit the construction of efficient investment benchmarks for DNSPs that face the adaptation challenges of high DER penetration, and thereby lessen the ability of the AER to learn from earlier experience.

Question 2

What other methodologies can we use to benchmark ICT capex? What are the benefits and disadvantages of each approach? What other benchmarking normalising factors do you consider appropriate? For example, regulatory Asset Base (RAB) could be used as a proxy for asset size.

Revealed cost benchmarking is certainly a valuable tool for assessing ongoing recurrent costs. However, the increased impetus for DNSPs to invest in ICT assets that facilitate adaptation also reduces some the strengths of revealed cost benchmarking. In particular, where new sensor or data acquisition assets, or new service capabilities, are required to facilitate the integration of DER and the services they can provide, there may be no revealed cost benchmark to rely on.

On the other hand, by breaking expenditures down into Ausgrid's suggested categories, benchmarking of ongoing and recurring ICT capital expenditure becomes possible, and can be treated (somewhat) separately to adaptation. At a minimum, marginal increase in ICT capex for similar, but extended, ICT capabilities, may be justified by demonstrating that they are for adaptation. Thus, using Ausgrid's categories provides a way to assess the marginal costs of, say, adaptation or cyber security, over and above that of business as usual.

Additionally, it may be useful to the AER if the *stand-alone costs* of delivering these services and capabilities are also reported by DNSPs in their ICT capex and opex RIT-D justifications. For example, when proposing to purchase data from a third-party energy services company to improve operations and planning, a DNSP would also report an estimate of the cost of deploying an equivalent system for themselves, either off-the-shelf or developed in-house. Comparing the sum of stand-alone costs for new ICT capex and opex with the actual ICT expenditure proposal would help the AER understand the value of synergies, or efficiencies of scope, that exist in ICT expenditure for DNSPs, as they move beyond their current BAU to provide new services, capabilities and levels of security.

Nonetheless, we encourage the AER to continue to ensure that capex, in particular, is driven by economic objectives in energy users long-term interests, not technological appeal.

Question 3

We note the difficulty in assessing the efficiency of implementing a compliance driven step-change ICT projects. What information do you consider is required to assess the efficiency of these projects?

We reiterate the point from Question 2, that providing both stand-alone and business-as-usual costs can help the AER understand capex efficiencies of scope. This information should complement the standard approach of providing the costs and benefits of alternative capex options.

We also emphasise that ICT capex for monitoring equipment can help assess compliance, can increase the life of existing assets, and may allow for lower capacity (and therefore cheaper) network assets to be purchased in response to new compliance requirements.

Question 4

What do you consider a sufficient business case for an ICT project should include?

Note that our response to this question should be read with the context of ICT capex that improves DER integration into system wholesale markets and network services.

Cashflow assessments and NPV calculations should incorporate the standard considerations, such as:

- Network opex effects. These include: improvements in asset maintenance and condition monitoring (e.g. through predictive fault detection and maintenance); reduced unserved energy through better maintenance and fault recovery; reductions in joule losses on distribution networks; changes in data acquisition/provision costs; reduced reliance on distributed diesel generation at fringe-of-grid locations; etc.
- Network capex effects. These include better planning for greenfield developments and upgrades/augmentation, better asset monitoring leading to improved scheduling of asset replacement and maintenance, etc.
- Estimates of spillover into transmission network cost savings.
- Wholesale market effects (energy and services markets). Moreover, there may be a case for the AER to provide guidance on acceptable methodology and assumptions (e.g. on wholesale market prices) for appropriately accounting for market benefits that arise from improved DER contributions to wholesale markets and the corresponding system cost reductions.

Beyond this, however, there are benefits for allowing real options valuations to be also incorporated into the capex case. Specifically, there is value in making current investment decisions that facilitate future investment paths contingent on uncertain future technology costs and capabilities, and for placing a value on the capex investment flexibility this entails. This is a similar idea to “least-regrets”” investment options.

For synergistic capex or opex, stand-alone costing provides a yardstick to assess the value of capturing the multiple benefits available with one expenditure item.

Question 5

What is your opinion on us requesting DNSPs provide post-implementation reports from historical ICT investments?

This request seems justified, as they could conceivably be used to improve benchmarking for future RIT-D expenditures, and experience and knowledge can be shared across DNSPs as they face future ICT demands at different times.

However, if capex is predicted to be efficient ex-ante, but found to be ex-post inefficient in post implementation reporting, this can't reasonably be used to penalise a DNSP.

Question 6

What do you consider is required to demonstrate that DNSPs have incorporated benefits into its overall proposal?

DNSPs have to show the material benefit of ICT expenditure. They can do this using forecasts.

However, with respect to ICT expenditures that improve network visibility, there are a series of "unknown unknowns" that may or may not be uncovered. These include: pre-existing violations of regulated power quality standards (i.e. voltage levels, harmonic distortion); faults that are causing higher losses than previously identified; opportunities for network reconfigurations, and; improved maintenance and replacement planning and scheduling.

In many cases, it must be understood that it is difficult to quantify improvements in these expenditure classes in general, because installations of the same assets in different locations may realise quite different benefits in different locations, even on a single DNSP's network. Since it is not possible to quantify these benefits, DNSPs should be allowed to rely on specific case studies, trials or instances where these benefits can be quantified, either within their own experience or gleaned from the experience of other DNSPs, including international experiences. Generalising these quantified benefits across the full range of DNSP activities to which ICT expenditures generate value may provide the AER with a way to assess the opex productivity adjustments or capital efficiency adjustments in DNSP proposals.

However, beyond this, for genuinely unknown value streams, it may be prudent for the AER to approve expenditures that allow DNSPs to reduce the risk that they are in violation of regulatory requirements, or to open opportunities for new value streams to be exploited by third parties. Similarly, for highly-uncertain value streams, least-regrets analysis of investments that improve the capacity of ICT to deliver new value to the system and customers should also be considered.

Looking further into the future, it would be sensible for the AER to expand its methodology to consider the value of opening the network to competitive forces that allow third-party energy service providers to innovate, and create and capture new sources of value for electricity system end users. This aligns with industry moves to open energy networks to greater third party involvement in operation and management, and to transition to the networks playing a facilitation or market-making role (e.g. the ENA-AEMO Open Energy Networks program).

Question 7

Which scenario - self funding or productivity improvement - would you prefer and why? Are there other scenarios we should consider?

A key value stream that DNSP capex in ICT investment facilitates is services traded between other system participants (i.e. solar homes, DER owners and distributed generation). In this sense, DNSP adaptation ICT expenditure is essential to allowing them to participate more fruitfully in the entire energy system, and it is very likely that it will unlock additional investment in assets that act in contestable parts of the power system. These are *private* investments that realise *market benefits*, which do not appear as DNSPs expenditures or benefits, but arise as a result of DNSP investment activity nonetheless. In other words, the multiplier effect of DNPSs' ICT expenditures do not seem to be captured by the AERs scenarios.

For example, certain ICT expenditure may support DER investments and improve returns by removing or relaxing unnecessarily conservative constraints, thereby allowing more distributed generation to offset costly generation at the wholesale level, or by allowing DER to provide network support or frequency stability services (typically via virtual power plants).

Question 8

We welcome stakeholder comments on the practical application of a productivity adjustment. If we were to include a productivity adjustment on the basis of ICT expenditure, how should it be incorporated? If so, how should we determine how large should this adjustment be? What aspects of a DNSP's forecast should it be applied to?

Please refer to our answers above on specific suggestions, particularly regarding stand-alone costs and making use of relevant case studies.

Appendix A: Market benefit of improved solar yield from existing rooftop PV installations

In this appendix, we describe the methodology used to estimate the market benefit of a 1% increase in solar yield from existing rooftop PV installations in the NEM regions: NSW+ACT, QLD SA, TAS, and VIC. This does not include benefits from improvements in WA or NT.

Data

The calculation makes use of the following data:

- Solar Analytics customers' rooftop generation time-series data, for sites less than 10kW capacity, at 30 minute intervals,
- publicly-available AEMO 30 minute NEM regional reference prices (RRP) for energy[2],
- Solar Analytics customer rooftop PV capacity, and
- total installed rooftop PV capacity data from the Australian Photovoltaic Institute (APVI)[3], which itself is collected by the Australian Clean Energy Regulator.

Assumptions

- We note that the private (i.e. householder) capital costs for this incremental improvement in solar yield is nil, because the rooftop PV installations are already in place, and are therefore sunk costs and not included in the RIT-D calculations.
- Conversely, we assume that investments facilitating the improvement are all to be born by DNSPs using improved ICT capabilities, which are added to their RAB. This expenditure by the DNSPs is to be compared to the wholesale market benefit and other benefits arising from improved visibility and management of low- and medium voltage networks, as part of the RIT-D process.
- We assume that the effects of a small increase in solar output have no impact on dispatch prices, but that it does impact AEMOs operational demand, which realises a market benefit.
- This implicitly assumes that marginal generators, which set the dispatch price, would be dispatched at lower level, thereby reducing system costs.
- The Solar Analytics data is assumed to be a representative sample of all rooftop PV customers in the NEM.

Calculation methodology

For each region, half-hourly Solar Analytics PV generation (for sites less than 10kW capacity) and AEMO RRP data are multiplied, and then summed over the year, to give a *sample_regional_benefit*:

$$sample\ regional\ benefit = \sum_{timesteps} RRP * PV\ generation$$

2 https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Data-dashboard#aggregated-data

3 https://pv-map.apvi.org.au/historical#4/-26.67/134.12

This figure is effectively a sample of the total rooftop PV energy production. The *sample regional benefit* is scaled to the full size of the rooftop PV stock using the ratio of the total NEM installed rooftop PV capacity (*total capacity*) over the Solar Analytics customers' capacity (*sample capacity*):

$$total\ regional\ benefit\ =\ regional\ benefit\ *\ (total\ capacity\ /\ sample\ capacity)$$

This is the total market benefit of PV systems less than 10kW in each region, marked-to-market.

Market benefit values

Market benefit values by region are given below:

Region	**Annual total benefit**
NSW	$179M
QLD	$227M
SA	$115M
TAS	$6M
VIC	$196M
NEM total	**$723M**

We do not claim that this $723M value is an accurate estimate of the actual market benefit of rooftop PV, because the size of the installed stock of PV generation is large enough to have price effects (i.e. change dispatch and suppress wholesale market prices). That is, the amount of the rooftop PV generation is large enough to regularly alter NEM dispatch, specifically, at the marginal generator, and thereby change both system-wide costs and wholesale market prices.

However, as noted above, a small increment on the *total_regional_benefit* should have a very small price effect. Therefore, it can form the basis of an estimate of the market benefit of improved solar yield from existing rooftop PV installations. Accordingly, we can assume that a 1% increment of solar yield from existing rooftop PV installations results in an approximately 1% increase in the NEM total market benefit. This results in **$7.23M per annum in energy market benefits from improving residential rooftop solar PV yields by 1%.**

A final caveat is that this estimate depends on the current generation mix, and in particular, is sensitive to the cost of natural gas, which typically sets the market dispatch price. As such, the value calculated here is subject to change as the generator mix and generator fuel costs change in the future.