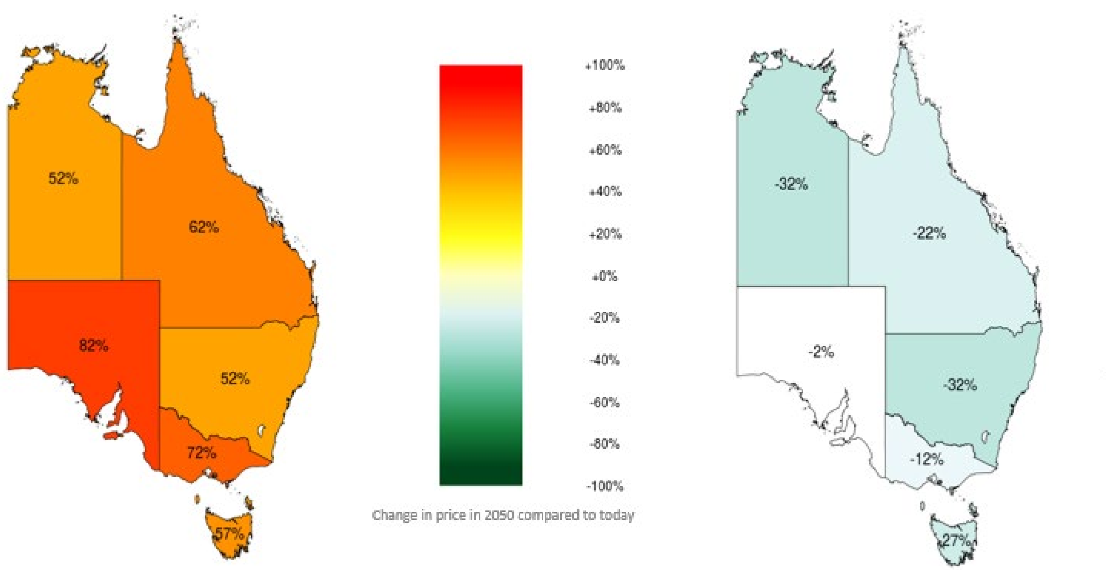
Price visualisation app

Scoping study

Dynamic Analysis

13 August 2019



Disclaimers

This project was funded by Energy Consumers Australia[1] as part of its grant process for research projects for the benefit of consumers of electricity and natural gas. The views expressed in this document do not necessarily reflect the views of Energy Consumers Australia.

This is a scoping study undertaken solely by Dynamic Analysis Pty Ltd to test the concept and technology for a price visualisation app. The app considers a range of macro variables that may influence prices in the future but does not constitute a comprehensive consideration of all potential factors. The findings have not been peer reviewed to validate the results. As such, the model does not constitute financial analysis, and should not be relied on for any purpose without undertaking independent evaluation with appropriate feedback from the networks.

In particular, we have not sought formal feedback from SAPN or Energex on the results or modelling. There may be many reasons why the data (as presented) does not reflect the future expectations of these businesses.

[1] See link below: www.energyconsumersaustralia.com.au

Contents

1. Summary

We are developing a new online app for consumer advocates that visualises network prices to 2060 under different future scenarios. In May 2019, the Energy Consumers Australia (ECA) provided us with a research grant to develop a scoping study of the app.

The purpose of the app is to improve the capacity of consumer advocates to drive positive change for energy customers. It will also influence policy development and action on the best way networks and regulators should respond to future challenges and opportunities.

The beta (concept) app

A key focus of our scoping study was to develop a concept app (also termed a 'beta app' in the IT industry) to test with key stakeholders. We have developed a functioning version of the app for South Australia Power Networks and Energex in Queensland.

Our focus has been on proof of concept, logic and technology, rather than validation and precision of results. We have provided more detail in section 2 of this document on the modelling assumptions and architecture for the concept app. We have not verified or tested outputs, and therefore it should not be used to form judgements or opinions at this stage of development. A link to the concept app is below.

https://dynamicanalysis.shinyapps.io/dabase_app/

In developing the concept app, we have also explored practicalities such as the ability for others to update the data if we were unavailable.

Feedback has been integral to developing the concept app

We have talked to consumer advocates, regulators, networks and energy stakeholders to ask if the app would be useful, and how it can be improved.

Our stakeholders loved the idea of an interactive tool that provides data on long-term electricity network prices. In particular, some consumer advocates felt that the current focus on a 5 year regulatory price cycle does not allow for constructive conversation on future challenges facing the industry.

The enthusiasm and passion of stakeholders prompted us to develop a much more complex concept app than initially conceived. Stakeholders craved data and complexity of scenarios. At the same time, they felt that the app will require 'handholding' and guidance if it is to be useful.

Further information on how our stakeholders have influenced the development of the concept app, and their views, are discussed in Section 3.

Interesting early observations

While untested, the concept app provides many interesting early observations on how key variables impact long term prices:

- Higher customer growth and increased energy sales (in off-peak periods) can dilute the impact of rising revenue and RAB and are crucial ingredients to keeping prices low over time.
- Providing rewards for people to charge electric vehicles during the day or overnight can lead to significant cost savings to customers. Time of use pricing holds the key to achieving these results, as does effective demand management.
- The networks will differ on price outcomes depending on where they are in the asset lifecycle. Networks with a low RAB and old network assets (such as South Australia Power Networks) are at most risk of higher prices in the future. These networks will need to rapidly increase investment in the medium term, and this will may lead to a spike in prices unless ambitious transformation takes place. Networks with high RABs today can drastically reduce prices for their customers through sensible transformation strategies.
- Continuous productivity has a marked compounding impact on lowering electricity prices for customers. Even 0.5% pa can result in significant reductions in prices when achieved continuously over many years. This underpins the importance of consumer advocates pursuing changes to the AER's framework on industry productivity.

Key findings and policy implications are discussed in Section 4.

Next steps

The feedback from stakeholders demonstrates that a full version of the app would greatly contribute to policy development and action to bring about the best price outcomes for customers in the long term.

We will be submitting a comprehensive research proposal to the ECA in 2019 seeking further funding to extend the model framework to all distribution networks. Our next steps are discussed in section 5.

2. The beta (concept) app

The purpose of this section is to provide background and the motivation for the app, and to describe the concept version we have produced for the scoping study,

2.1 What is the price visualisation app?

The app is a price prediction tool that can be accessed online by anyone on their mobile or computer. It is based on a very detailed model that predicts electricity network prices under different scenarios. It also provides a richness of predictive data on revenue, capex, opex, rate of return, customer connections, energy sales, and the shape of peak load profiles.

A unique aspect of the app is that stakeholders can construct their own scenarios of the future. This is a break from traditional modelling approach which can only develop a few scenarios to test the impact on consumer prices.

The driving motivation of the tool is to build capacity in the sector on the drivers of consumer electricity prices in a dynamic and changing energy landscape. This will help consumer advocates improve outcomes of engagement by giving more data and knowledge to challenge regulatory proposals, to inform policy submissions, and to communicate back to constituents. It will also prompt policy explorations on the best way networks should respond to these changes.

2.2 What is the beta (concept) app?

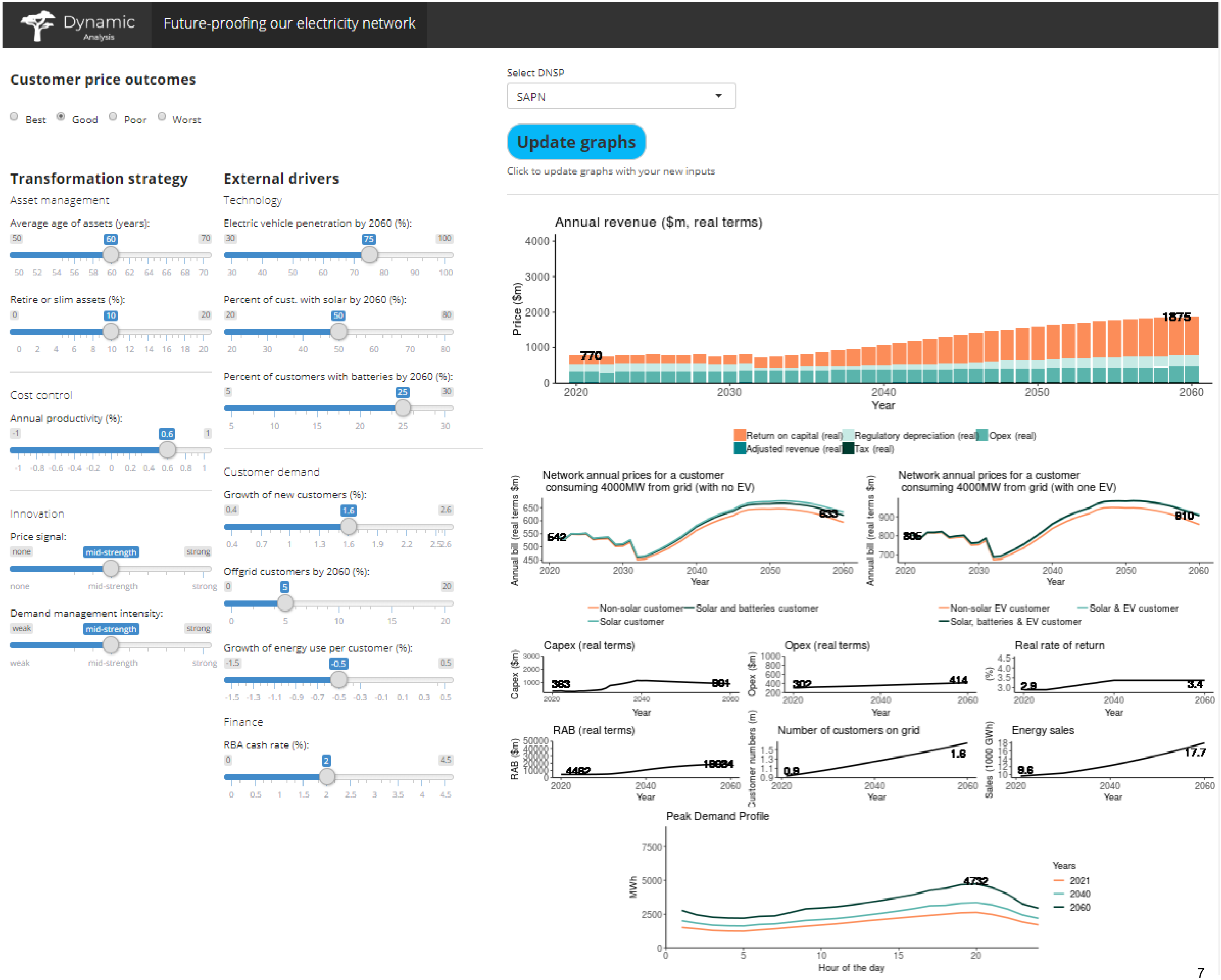
The concept app was designed to test if the technology can work with real world data. It also allows early engagement with stakeholders on what they want from the app, and the assumptions that lie behind the modelling.

Our concept app looked at 2 of the 14 distribution networks - South Australia Power Networks and Energex in Queensland. From a technology perspective, the concept app demonstrates that:

- We can take real world inputs and produce the outputs promised by the app. This includes over 500 equations.
- We can translate the modelling processing in a statistical program ("R") to an open website using a market product called "Shiny" that provides graphics and output.
- The outputs are stable and replicable.
- The concept app is accompanied by a detailed model architecture which identifies source data, modelling steps and linkages. This allows stakeholders to 'lift the lid' on what lies under the modelling, and to challenge assumptions.

The link to the concept app is below and a screenshot is provided on the next page.

https://dynamicanalysis.shinyapps.io/dabase_app/


Dynamic
Analysis
Future-proofing our electricity network
Customer price outcomes
Best
Good
Poor
Worst
Transformation strategy
Asset management
Average age of assets (years):
Retire or slim assets (%):
Cost control
Annual productivity (%):
Innovation
Price signal:
none
mid-strength
strong
Demand management intensity:
weak
mid-strength
strong
External drivers
Technology
Electric vehicle penetration by 2060 (%):
Percent of cust. with solar by 2060 (%):
Percent of customers with batteries by 2060 (%):
Customer demand
Growth of new customers (%):
Offgrid customers by 2060 (%):
Growth of energy use per customer (%):
Finance
RBA cash rate (%):
Select DNSP
SAPN
Update graphs
Click to update graphs with your new inputs
Annual revenue ($m, real terms)
Price ($m)
Year
770
1875
Return on capital (real)
Regulatory depreciation (real)
Opex (real)
Adjusted revenue (real)
Tax (real)
Network annual prices for a customer consuming 4000MW from grid (with no EV)
Annual bill (real terms $m)
542
633
Non-solar customer
Solar and batteries customer
Solar customer
Network annual prices for a customer consuming 4000MW from grid (with one EV)
806
910
Non-solar EV customer
Solar & EV customer
Solar, batteries & EV customer
Capex (real terms)
Capex ($m)
363
Opex (real terms)
Opex ($m)
302
414
Real rate of return
(%)
2.8
3.4
RAB (real terms)
RAB ($m)
4482
Number of customers on grid
Customer numbers (m)
0.8
1.6
Energy sales
Sales (1000 GWh)
9.6
17.7
Peak Demand Profile
MWh
Hour of the day
4732
Years
2021
2040
2060

2.3 What are the inputs for the concept app?

Based on stakeholder feedback, we have identified key dynamic variables that materially impact consumer network prices. These inputs can be changed by stakeholders in the app to see their impact on prices. Based on stakeholder feedback, we have separately identified external factors that a network has limited control over, and active transformation decisions a network can make.

External factors

As noted in the next section, stakeholders wanted the see the impact of technology and customer preferences on long term network prices. The concept app provides the ability for the user to vary the following external factors:

- *Technology (residential solar, battery and EV) uptake* – Solar and battery installations impact how much customers will use from the grid (energy sales) and how the grid (2-way energy flow) will be used to make full value of their investments. Electric vehicles will provide a boost to energy sales overall, but if charged in peak hours may lead to a rapid increase in peak demand - similar to air conditioners in the 2000s which prompted significant capacity investment and higher prices.
- *Customer demand* – Australia has a growing population which means more households and businesses will connect to the grid. However, energy efficiency of appliances (together with solar and battery installations) mean that the average consumer is currently consuming less energy each year. Further, new technology may prompt some customers to go off-grid altogether and self consume. In combination these factors will influence how much energy the grid will need to deliver in the future and the amount of capacity investment. Further, how much revenue can be shared among customers which impacts average price.
- *Long term interest rates* - Australia's interest rates are lower than ever due to a deflationary macroeconomic environment post the GFC. If interest rates rise in the future, the additional cost of financing past and new investments will be passed onto customers through higher prices.

Transformation strategies

The tool shows how the strategic actions of networks can reduce prices for customers. This includes:

- *Asset management strategies* – Our previous research showed that networks may need to significantly increase capex in the long term to address ageing networks. We examined the impact of two strategies. The first relates to how long a network can keep network assets in service on average without negatively impacting reliability and safety. The longer an asset can safely and reliably stay in service, the lower the average price in the long term. We also examined the impact of networks retiring or slimming their networks at the time of replacement. For example, rural networks may efficiently utilise stand-alone power systems to avoid replacing single earth wire return conductors. Further, with generation and storage deep in the grid, networks may be able to streamline sub-transmission assets at the time of replacement.
- *Cost productivity strategies* – The app shows that customer prices will be significantly lower by 2060 if networks deliver annual efficiency improvements in opex and capex programs. While small productivity improvements may seem trivial in the short run, the compounding impact is significant over the long term.

- *Price signals and demand management strategies* – In recent years, networks have been able to use existing capacity to meet more moderate peak demand growth. Looking forward, we see that electric vehicles and compounding customer growth could significantly increase peak demand. We look at how strong price signals could shift demand to off-peak periods including the middle of the day when solar is strongest. We also model how demand management strategies (such as using batteries) could meet peak demand without investing in new network.

2.4 What are the outputs of the concept app?

In the original conception of the app, we only had a single output – average price change for a customer. We have responded to feedback from stakeholders to include more outputs including expenditure, revenue, energy sales, customer growth and peak demand profiles. In all cases we have presented the data in real terms (ie: excluding CPI and real cost escalation)

The key outputs of the concept app are explained below:

- *Revenue* - We have shown how the key components of revenue change over time in response to the input variables. This includes financing components (return on and depreciation), opex and tax. We have used the AER's Post Tax Revenue Model calculations and extended this beyond 5 years. This is one of the first times such as approach has been used in the NEM and is a significant contribution to the sector.
- *Network prices paid by residential customers* - In the original research proposal, we had used average price change as the key metric for measuring the impact of change in input variables. Stakeholders wanted us to compare how much a typical customer would pay for network charges. We used 4000MW delivered from the network (ie: excluding self consumption) as a proxy for a typical residential customer. We also compared what a customer would pay if they had solar, batteries or an EV. This showed that people with solar would pay more for electricity under strong price signals because they already shift consumption to the middle of the day. Customers with EV would pay more due to the additional consumption above 4000MW.
- *Expenditure* – We have shown the impact of external factors and transformation strategies on capex and opex to 2060 (in real terms).
- *Rate of return* – We have assumed that the WACC is only impacted by changes in market conditions. Based on feedback from the AER, we have used changes in the domestic interest rates as a proxy for changes to return on equity and debt.
- *RAB* – The RAB is impacted by the relative forces of capex and depreciation profiles. If capex rises significantly it swamps the impact of depreciation, increasing the RAB over time. However, we show that RAB should not be the sole metric that customer advocates need to monitor. Prices could fall even if RAB increases provided there is strong customer growth and energy sales in off peak periods.
- *Customer numbers and energy sales* – We examine the impact of customer growth and off-grid alternatives on customer numbers. This also has a big impact on energy sales, together with energy efficiency, solar, and battery. We show that energy sales is greatly impacted by EVs.

- *Peak demand profile* – The peak demand profile is vital for knowing when significant new capacity investment will be required. We show how peak demand could change in 2040 and 2060 in response to changes in energy sales, and how strong price signals could flatten the daily profile resulting in less investment.

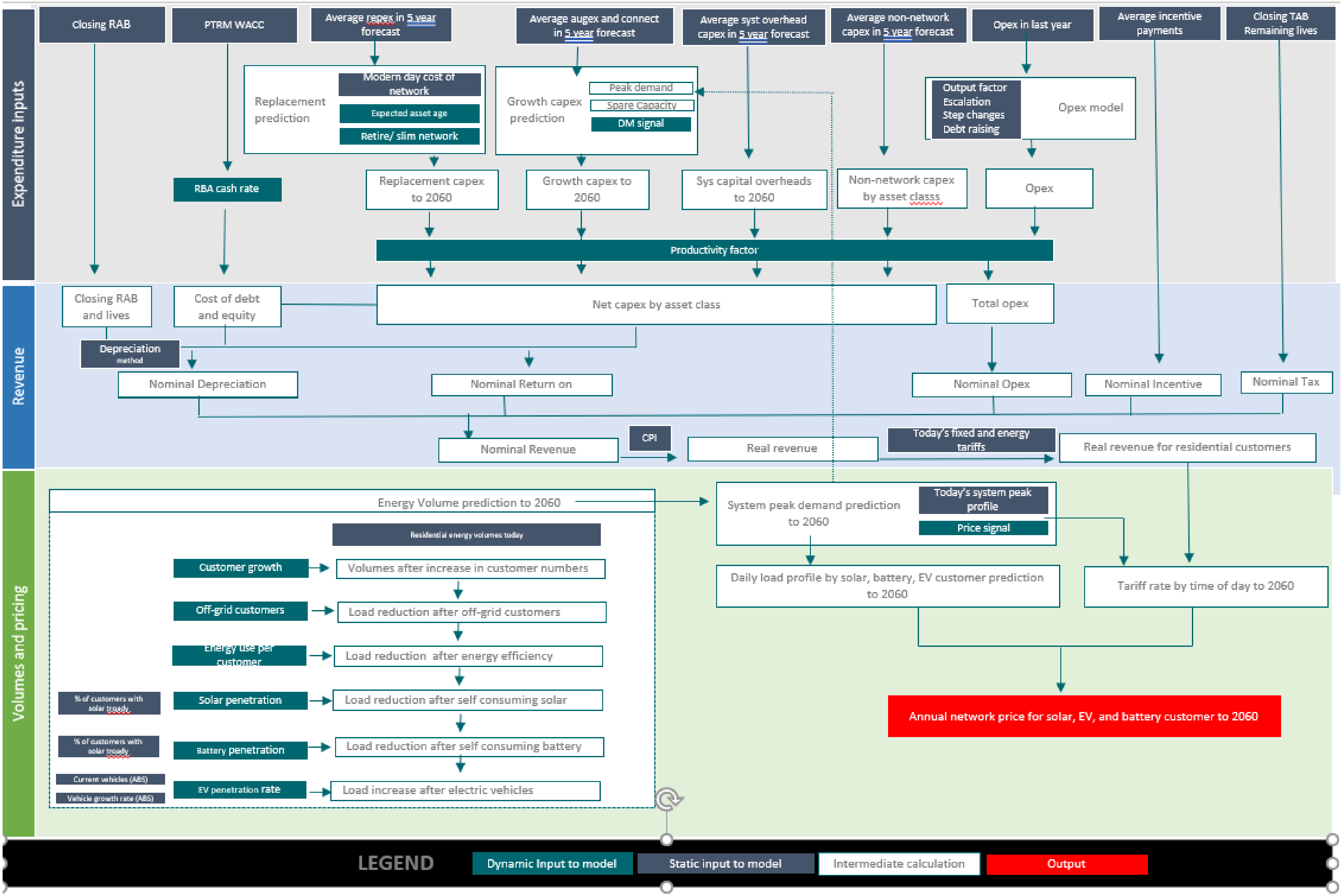
2.5 What broad scenarios have we developed?

Given the diversity of options available, we have provided four scenarios to make it simpler and less overwhelming for a user to first engage with the app.

The scenarios are designed around customer outcomes in terms of price.

- *Best scenario* – This scenario is premised around a network developing a comprehensive transformation strategy that sets the business up to deliver lowest costs and to maximize utilisation of its assets. In this scenario, the business is also aided by good fortune in respect of developments outside of their control such as low interest rates, high energy sales from EVs, and strong customer growth.
- *Good scenario* – This scenario represents effective transformation strategies of the business but which is not as ambitious as the best scenario. Under this scenario, interest rates are slightly higher than the best scenario, and EV and customer growth is not as strong.
- *Poor scenario* – This scenario shows the potential price outcomes under reactive transformation strategies that fail to keep costs under control and which do not use some of the important levers to minimise price. Customer growth is lower than the good scenario, and interest rates are higher.
- *Worst scenario* – This is where networks fail to transform their networks, thereby increasing costs and failing to maximise utility of their assets. In this scenario, customer growth and energy sales are weak, and interest rates are high.

We have provided a visual of the model architecture on the next page.



Expenditure inputs
Closing RAB
PTRM WACC
Average repex in 5 year forecast
Average augex and connect in 5 year forecast
Average syst overhead capex in 5 year forecast
Average non-network capex in 5 year forecast
Opex in last year
Average incentive payments
Closing TAB Remaining lives
Replacement prediction
Modern day cost of network
Expected asset age
Retire/ slim network
Growth capex prediction
Peak demand
Spare Capacity
DM signal
Output factor
Escalation
Step changes
Debt raising
Opex model
RBA cash rate
Replacement capex to 2060
Growth capex to 2060
Sys capital overheads to 2060
Non-network capex by asset classs
Opex
Productivity factor
Revenue
Closing RAB and lives
Cost of debt and equity
Net capex by asset class
Total opex
Depreciation method
Nominal Depreciation
Nominal Return on
Nominal Opex
Nominal Incentive
Nominal Tax
Nominal Revenue
CPI
Real revenue
Today's fixed and energy tariffs
Real revenue for residential customers
Volumes and pricing
Energy Volume prediction to 2060
Residential energy volumes today
Customer growth
Volumes after increase in customer numbers
Off-grid customers
Load reduction after off-grid customers
Energy use per customer
Load reduction after energy efficiency
% of customers with solar ready
Solar penetration
Load reduction after self consuming solar
% of customers with solar ready
Battery penetration
Load reduction after self consuming battery
Current vehicles (ABS)
Vehicle growth rate (ABS)
EV penetration rate
Load increase after electric vehicles
System peak demand prediction to 2060
Today's system peak profile
Price signal
Daily load profile by solar, battery, EV customer prediction to 2060
Tariff rate by time of day to 2060
Annual network price for solar, EV, and battery customer to 2060
LEGEND
Dynamic Input to model
Static input to model
Intermediate calculation
Output

3. Feedback from stakeholders in developing concept app

A key purpose of the scoping study was to ask energy industry stakeholders how to make the app useful and practical. This is because we want more than an austere academic piece – our goal is to influence positive change in the energy sector.

Our feedback sessions were open-ended rather than a formal set of questions. We wanted stakeholders to free-play with the tool first before we asked questions. We then wanted to hear what they think before asking directed questions. Finally, we asked whether the tool would have any use in their everyday activities or could be useful more broadly in the industry.

Based on this initial conversation, we asked how the app could be improved. Where the stakeholder had specific expertise, we also sought direct feedback on whether the assumptions and outputs seemed reasonable. For example, we sought AER staff feedback on PTRM outcomes given their expertise in this area.

3.1 Who did we talk to?

We talked to key participants working the sector from a cross sector of organisations. In some cases, the conversations were short and in passing. For example, we had email and linked-in feedback from some consumer advocates. In other cases, we had formal meetings with a set agenda. We recognised that the more people we talked to (even if briefly) would provide us with a richness of perspectives.

The diagram below identifies the key people we talked to over the last three months.

Consumer Advocates

- PIAC
- Customer Challenge Panel
- St Vincent De Paul
- QCOSS
- Total Environment Centre
- Energy Consumers Australia

Regulators

- Australian Energy Regulator
- Australian Electricity Market Commission

Networks

- Essential Energy
- NT Power and Water
- SA Power Networks
- Endeavour Energy
- TransGrid
- Energy Networks Australia

Industry participants

- Battery company
- Infrastructure fund
- Energy Networks Australia
- Macquarie University

3.2 Incorporating stakeholder feedback

We have grouped the feedback from our stakeholders into 8 themes. Below we identify what stakeholders said, and how we have responded.

a. Concept

In our initial research proposal, we said the primary purpose of the tool was to show that networks face repex challenges in the future due to ageing assets, and this may lead to higher prices. Stakeholders have told us there would be value in broadening the exercise to examine other factors that influence price such as building blocks and interest rates.

Stakeholders were generally positive about the concept and were very interested in the initial findings. Most stakeholders valued the ambition of looking to long term impacts on energy customers. Some stakeholders were sceptical on the accuracy of long term predictions given the fluidity in the energy sector. But the overwhelming majority felt that the exercise was 'worthwhile' and 'vital' for identifying the key drivers of prices and responding to the challenges in the future.

How we incorporated feedback
▪ We have broadened the 'problem/solution' lens in response to feedback from stakeholders.
▪ Our app now looks at more variables (previously just asset age) and shows the impact on building blocks.
▪ As such, the concept has expanded from a simple model to something more closely aligned to future changes in the energy landscape. This has strengthened the robustness of the app.

b. Practical use of app

While stakeholders agreed the app was interesting, some felt we needed to do more thinking on how the app could be practically used to prompt policy debate and discussion on transformation strategy. Some consumer advocated noted that they did not have the funding or time to 'dig deeper' and reflectively consider what it means for the future. Some ideas proposed by stakeholders to widen the practical use of the app included:

- Using the tool to guide discussion between networks and consumer advocates in regulatory determination stakeholder workshops.
- Publishing the app on the ECA's website to allow for more traffic.
- Partnering with universities and government agencies to guide research direction and agendas.
- Paying consumer advocates to participate in workshops or training sessions, as without this dedicated time, the important learnings would not be digested.

The AER were positive about the tool being useful to guide conversation and engagement between networks and stakeholders. They noted that their focus is 5 year determinations, so some of the long term predictions were not precise enough to be used as evidentiary material. They were encouraged by innovations such as the capability to automate their revenue model, but also encouraged us to undertake peer review and checks.

How we incorporated feedback

- The concept app has been laid out differently so that actions in control of the business (transformation strategies) are distinct from factors that are external (such as technology developments). This will help conversations between advocates and networks during regulatory determination workshops. For example, advocates will be able to ask if networks have modelled the impacts of a slow transition to cost reflective prices.
- We have established a partnership with Macquarie University economics and sustainability team who are very keen to work with us. This should broaden the use of the app to academic research.
- As part of next steps, we will be designing posters and accompanying material to help explain the scenarios and implications. This will help give direction to the app.
- We will seek funding to pay consumer advocates to attend workshops and one-on-one training sessions as part of our next ECA grant application. We intend to co-fund this stream of the proposed grant.

c. Interactive design

The best thing stakeholders liked about the app was its interactivity. They noted that they don't have time anymore to 'read and learn' from dense reports. They found that the ability to 'play and learn' was much more useful, particularly when the pricing results did not meet their previously held ideas. This led to more inquiry on what could be behind the results.

How we incorporated feedback
▪ We have maintained the essence of the initial design of the app which promotes interactivity.

d. Balancing complexity and workability

Stakeholders craved complexity – they wanted us to model multiple scenarios. This was especially the case for the networks, who wanted us to have even more dynamic variables such as economic growth and capital contribution policy. These networks do not have the interactive tools to perform such analysis, and noted their Boards were also asking for instant and interactive information.

Consumer advocates were more interested in capturing external variables such as technology take-up and customers going off-grid. The people we spoke to had a very good understanding of networks and pricing, but they cautioned that making the app too complex could limit the ability for more generalist consumer advocates to participate in discussions. A central idea put forward was to have a simple app to accompany a more complex approach.

How we incorporated feedback

- We have included far more dynamic variables than originally conceived in our simple app including uptake of solar and battery, customer growth, energy efficiency, off-grid customers, peak demand signals, and demand management actions.
- We have modelled the impact on peak demand, as this was seen as a really interesting output by most stakeholders given electric vehicles are on the horizon. We looked at how price signals impact peak demand.
- We have also considered a richer and more complex model architecture that models growth capex as a function of peak demand, EV charging, 2 way energy from solar exports, and customer growth.

- This has added significant complexity to the user, but we believe provides a richer prediction of prices, and makes the tool more practical and useable. To respond to the issue of complexity, we will prepare more accompanying notes and PDF posters explaining what the different scenarios mean, and how the variables fit together. We will also consider collapsing the variables so users can choose greater complexity if they want, but not requiring everyone to do so.

e. Look and feel

Stakeholders were sympathetic to teething issues with the technology and were comfortable with the limited speed and lack of sophisticated formatting. They understood that this would improve as the project advanced but were also surprised at how quick it was given the number of equations being churned. We were asked to consider many different features such as excel output of scenarios.

How we incorporated feedback
▪ In future versions, we will consider engaging an IT developer to improve performance and formatting although we are mindful of keeping costs to a minimum. This may be something that we contribute funds in our research proposal.

f. Is it worthwhile to look at the long term

All stakeholders noted that the future energy landscape was difficult to predict. A small minority of participants considered we should look ahead to a shorter time span such as 2040 as technology changes were too hard to predict. Most however considered that stopping at 2040 ignored the expected uplift in electric vehicles between 2040 and 2050.

Most participants however felt that the app provided the platform for clear policy direction and network transformation strategy. They noted that uncertainty makes the exercise even more important. Some stakeholders felt that networks were not being innovative, and this would hurt all consumers in the long run. They felt that consumer advocates could not drive change as they had no solid and objective data to support their case for innovation.

How we incorporated feedback
▪ The overwhelming feedback we have received from stakeholders is that it is worthwhile to look out beyond 2040, as this is when electric vehicles are likely to 'kick off' and we should prepare ourselves. ▪ This gave us confidence that our forecast should go all the way out to 2060, but that we make clear that this is a price visualization tool, and that predictions become less precise as time horizons increase.

g. Transparency and 'black box'

The AER and networks noted that the app would be more credible if the supporting architecture, equations and assumptions were transparent and open source.

Some of the networks noted that this would allow for customized 'tweaking' of the app to reflect unique drivers such as connection policy and large housing developments.

How we incorporated feedback
▪ We recognise our stakeholder concerns that the sheer complexity and assumptions may lead people to believe that the results are in a 'black box'. We agree this perception would reduce the credibility of the app and may not lead to open conversations between networks and advocates. ▪ The next stage of the project will include an instructions and documentation manual (similar to the AER's repex model) that shows the assumptions, sources, and workings to get to the answer. This will allow interested stakeholders to dig deeper, and apply alternative assumptions that may impact the result. In this way, we see this type of information as improving the quality of conversation between advocates and networks. ▪ However, at this stage we think the formulae, spreadsheets and R equations should remain the intellectual thinking of Dynamic Analysis. ▪ We will also be paying for an independent consultant to review all our models and workings, and provide a view on the robustness of the approach. The consultant would sign a confidentiality agreement.

h. Updating and longevity

In reviewing our research application, the ECA requested further information on how the app would be updated for regulatory proposals, and whether a third party would be able to perform the updates if we were not available.

How we incorporated feedback
▪ We consider the app will be valuable for the next round of distribution resets commencing in 2021 through to 2026. We therefore feel the app should have a lifespan of 5 years minimum. ▪ The final version of the app will contain data that is current as at 2020 based on PTRM forecasts, updated for actual expenditure and rate of return forecasts. The modelling architecture (and equations) will not require any changes. But to be as current as possible, we may need to update the data at the time a network submits its regulatory proposal (or beforehand if this information is provided in stakeholder engagement). We consider that even if the information is not updated, the basic results of the model will still be credible for the lifespan of the product. ▪ Our intention would be to update the model for each reset process between 2021 and 2026. We would seek the costs for updating as part of the grants application. If some other contingency occurred that made us unavailable, we consider that the R scripts can be provided to the ECA alongside with an instruction manual. ▪ We have also anecdotally sought views from a university as to whether there are students capable of updating the model if we provide the R scripts and instructions on where to source the data. The costs of such a contingency would not be expected to be very significant given a university student could be capable.

4. Interesting early observations

While the results are yet to be validated, the concept app shows the variety of ways the tool can be used to explore important policy issues. This is the first time that anyone has been able to mathematically derive revenue based on dynamic input scenarios beyond 10 years. Ultimately the price a customer pays is the most useful lens to analyse policy issues.

4.1 Policy questions

Stakeholders consistently told us that the app will help with policy direction and action. In our interactions we tried to draw some of these policy issues out:

- What are the big ticket drivers of network prices in the future?
- Will electric vehicles have a positive or negative impact on electricity price, and the overall hip pocket?
- How long can assets remain in service?
- Does the revenue model have any anomalies such as unanticipated price shocks?
- What is the tip-off point when off-grid customers could cause a death spiral?
- Is it better to give some large customers a discount (at the expense of other customers) if they are at risk of going off-grid?
- How will batteries impact the price eco-system?
- When should we implement strong cost-reflective prices?
- How does underlying population growth impact prices?
- Will all networks face the same pressures?
- Does energy efficiency increase or decrease prices?
- Is RAB optimization a valid long term strategy?
- Would a solar customer pay more for electricity under strong price signals?

4.2 Case studies

In the following sections we identify some case studies to demonstrate how the tool could be used to further conversation on the right transformation strategies and policy direction.

As noted elsewhere, the data has not been validated and therefore should not be used to draw conclusions at the early stage of app development.

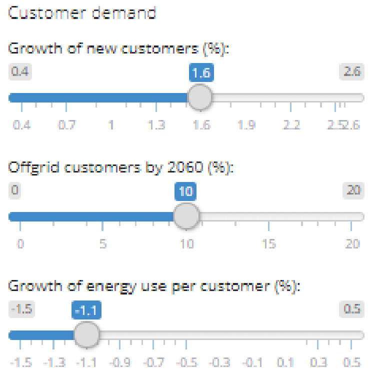
Case Study 1 – The power of customer and energy growth

Lower prices can still be achieved with higher RAB and revenue

Our early analysis shows that customer growth and energy sales can dilute the impact of significant growth in RAB and revenue. In this case study, we show that revenue requirements can increase as a result of strong customer growth, but that the price can still fall.

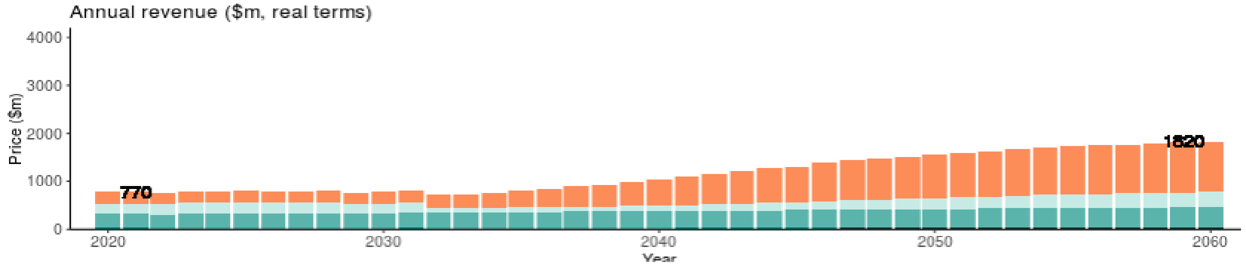
Scenario A - Low customer growth and strong energy efficiency (SAPN*)

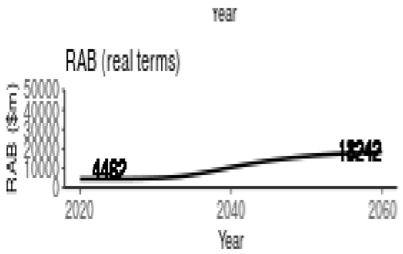
* Based on SAPN good scenario adjusted for no price signals and alternative customer demand scenarios

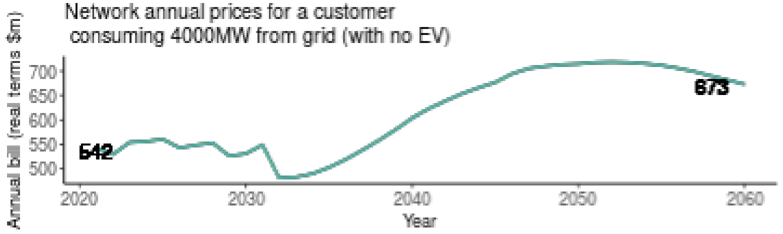


	Revenue	Network price*
Today	$770m	$542/year
2060	$1820m	$673/year

* Based on 4000MW customer with no EV

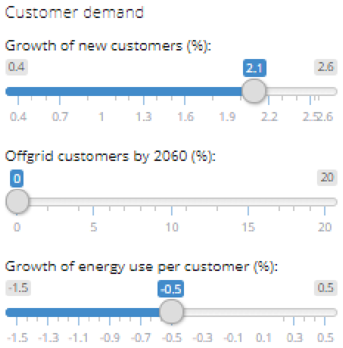






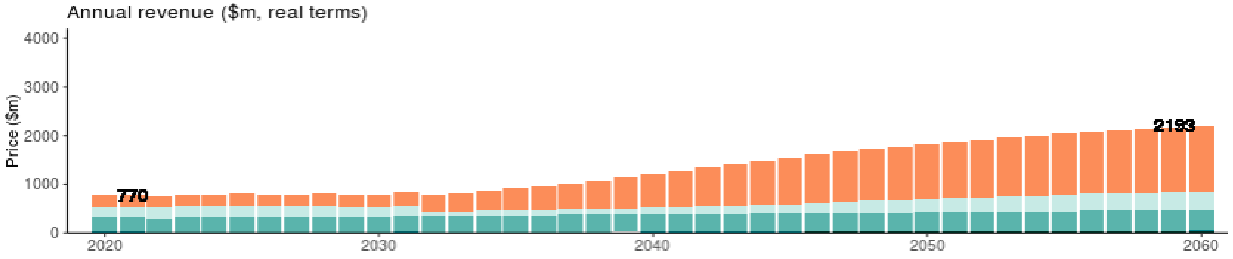
Scenario B - High customer growth and weak energy efficiency (SAPN*)

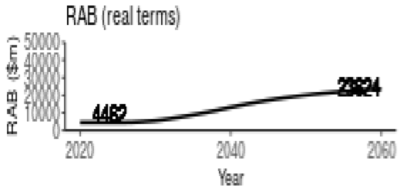
* Based on SAPN good scenario adjusted for no price signals and alternative customer demand scenarios

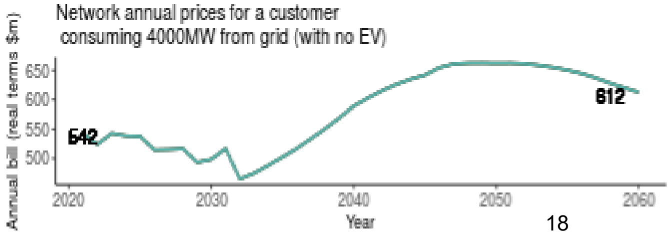


	Revenue	Network price*
Today	$770m	$542/year
2060	$2193m	$612/year

* Based on 4000MW customer with no EV







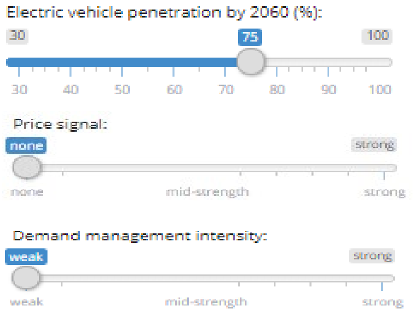
Case Study 2 – Electric Vehicles: Magic potion or poison pill?

Electric vehicles need to be supported by price signals and demand management to minimise network prices

Electric vehicles will increase demand for energy from the grid. If we can reward customers for using electric vehicles outside of peak hours, we will be able to flatten peak demand, thereby reducing the need to invest in new assets. This will improve utilization of the grid benefitting all customers.

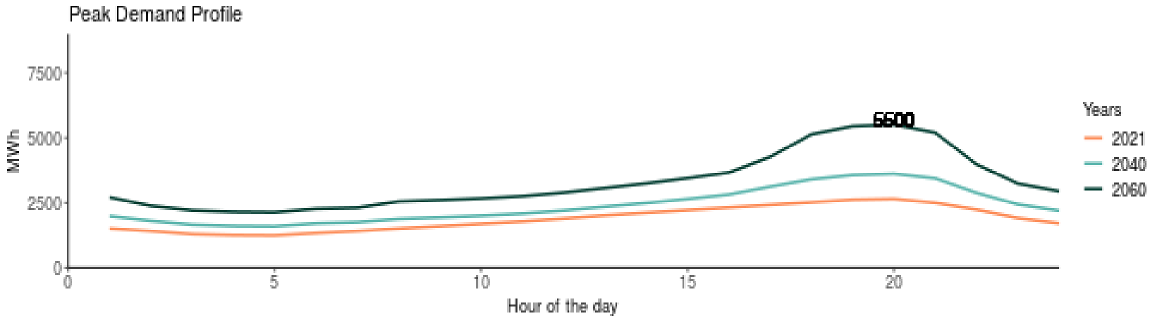
Scenario A – High EV take up without price signal and DM (SAPN*)

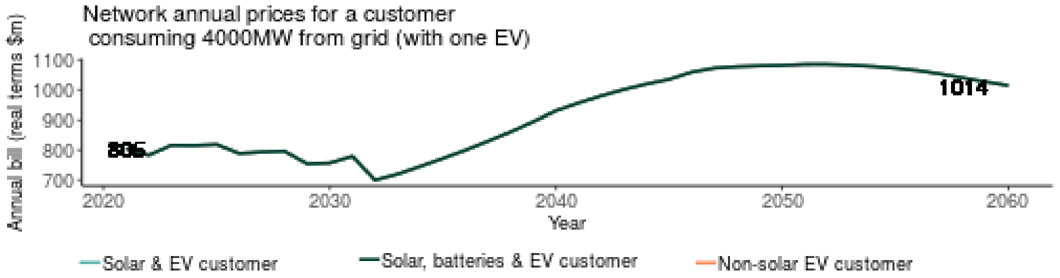
* Based on SAPN good scenario adjusted for no price signals and no DM signal



	Peak demand	Network price*
Today	2100 MWh	$806/year
2060	6600 MWh	$1014/year

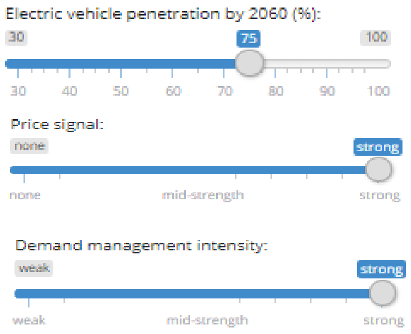
* Based on 4000MW customer with 1 EV and no solar





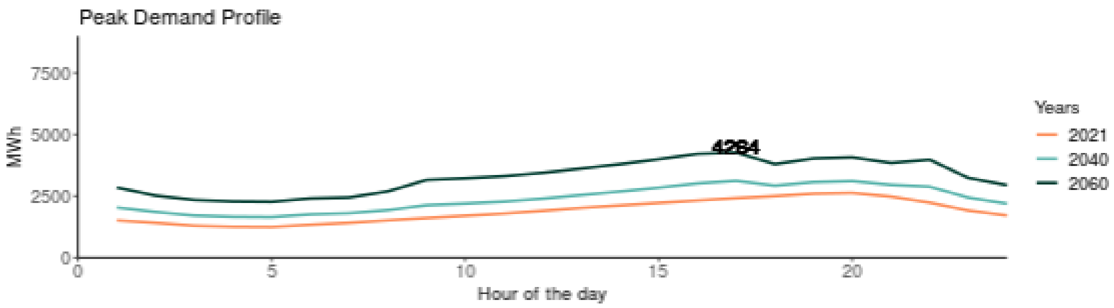
Scenario B - High EV take up with strong price signal and DM (SAPN*)

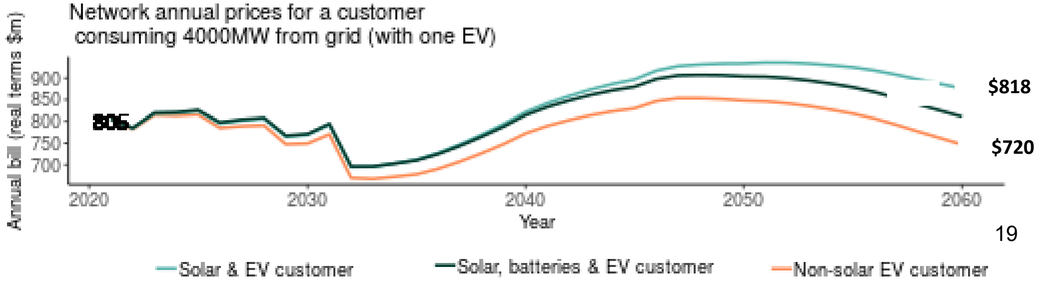
* Based on SAPN good scenario adjusted for strong price signals and strong DM signal



	Peak demand	Network price*
Today	2100 MWh	$806/year
2060	4284 MWh	$720/year

* Based on 4000MW customer with 1 EV and no solar





Case Study 3 – Customers will face very different outcomes across states

There is no ‘one size fits all’ outcome – even under the same scenarios, the outcomes for customers will be very different

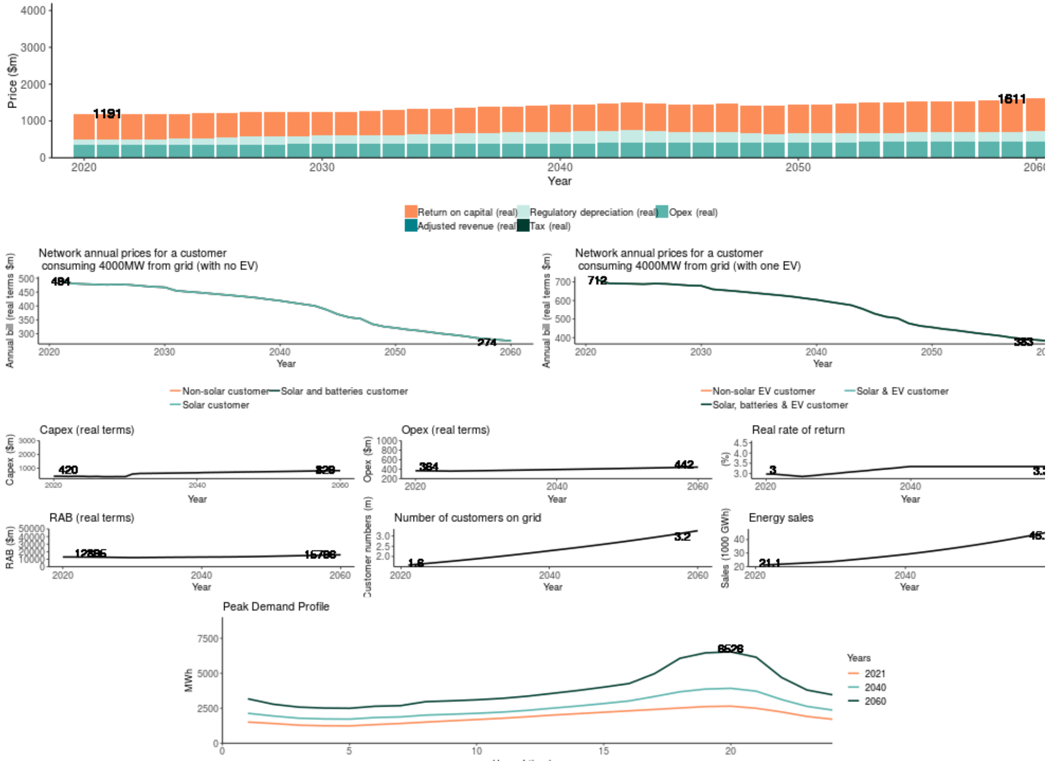
Energex is in an inherently better position to deliver lower customer prices over the next 40 years, compared to SAPN. SAPN has a very low RAB, and very old network. This means that replacement will be much higher and the RAB will escalate quickly, leading to high prices.

Scenario A – Energex under a ‘good scenario’*

* Based on Energex good scenario adjusted for no price signals and 2% customer growth

	Revenue	Network price*
Today	$1191m	$484/year
2060	$1611m	$274/year

* Based on 4000MW customer with no EV

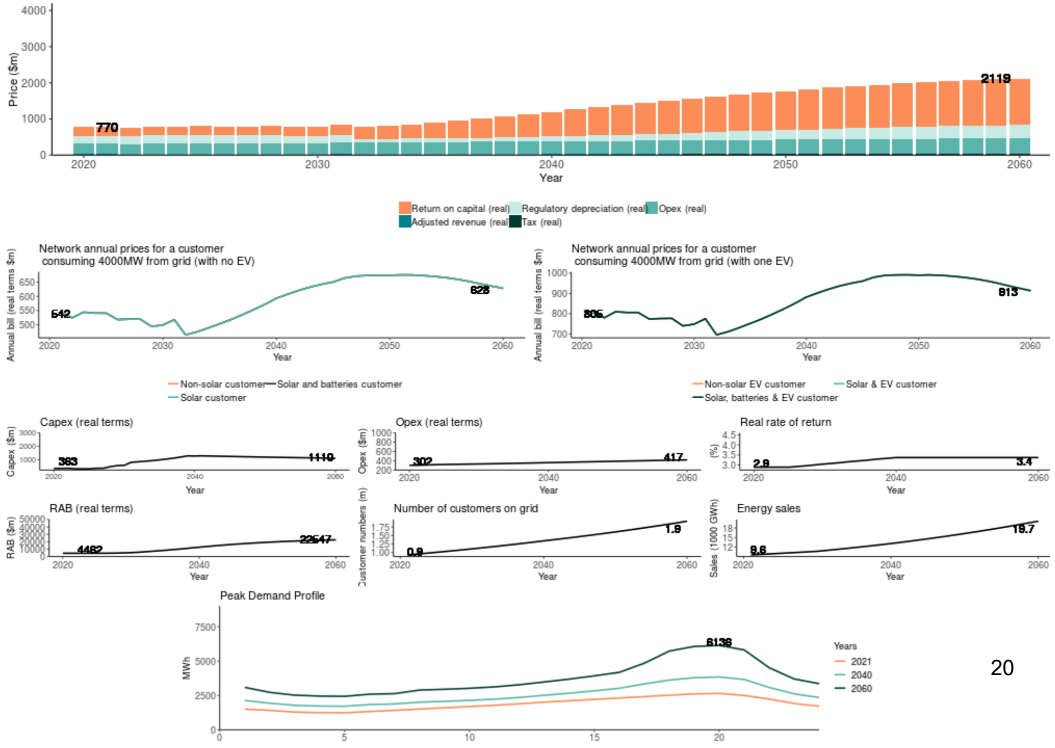


Scenario B – SAPN under a good scenario*

* Based on SAPN good scenario adjusted for no price signals and 2% customer growth

	Revenue	Network price*
Today	$770m	$542/year
2060	$2199m	$628/year

* Based on 4000MW customer with no EV



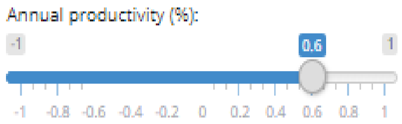
Case Study 4 – Continuous productivity unlocks lower prices

Productivity reduces expenditure significantly over time, reducing network prices for customers in the long run

While productivity improvements may seem trivial in the short term, the compounding impacts are one of the most sensitive drivers of prices in the long term.

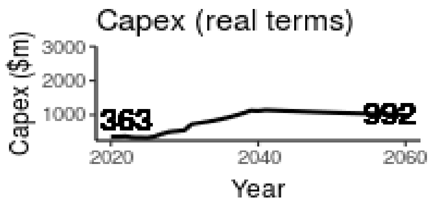
Scenario A – Improved productivity (SAPN*)

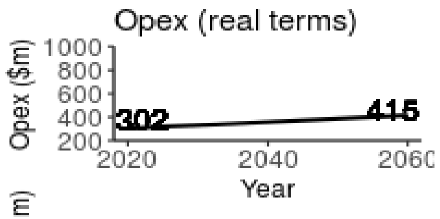
* Based on SAPN best scenario adjusted for no price signals and productivity of 0.6%

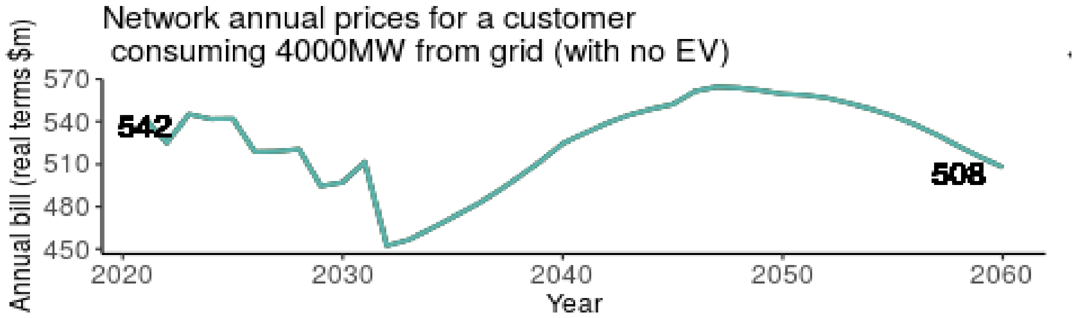


	Network price*
Today	$542
2060	$508

* Based on 4000MW customer with no EV

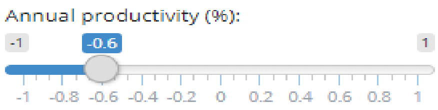






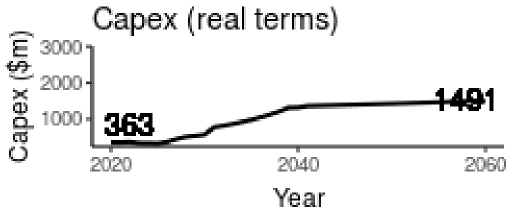
Scenario B – Falling productivity (SAPN*)

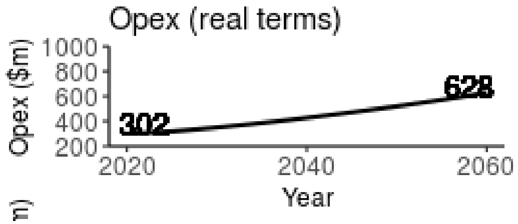
* Based on SAPN best scenario adjusted for no price signals and productivity of -0.6%

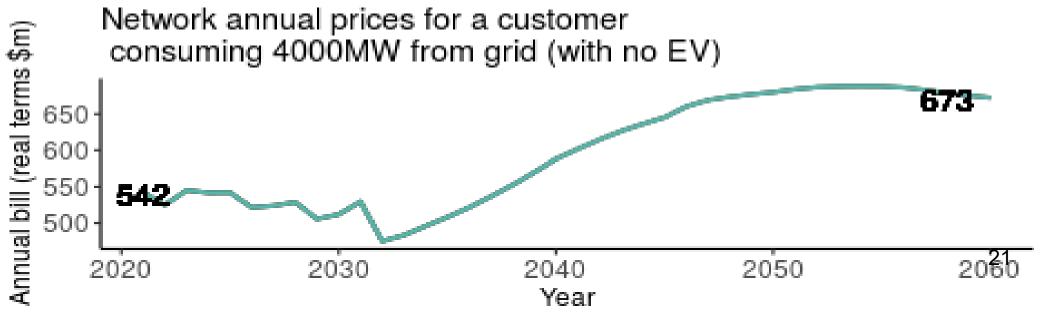


	Network price*
Today	$542
2060	$673

* Based on 4000MW customer with no EV







5. Next steps

We have been extremely happy with the feedback received on the concept app. Stakeholders have told us that the concept is unique and cutting edge. Further, most stakeholders think that the project will improve capacity of consumers to engage in regulatory proposals and policy discussions, including more knowledge on the interaction between complex variables, and a better sense of where time and resources should be spent in regulatory processes.

Following on from this scoping study we intend to seek funding from the ECA to develop a full version of the app that is capable of peer review. We will:

- Extend the model framework to all distribution networks.
- Consider improvements to elements of the model which still require further work: growth capex prediction, split of residential and commercial customers, impact of batteries, using real data on consumption response to time of use tariffs.
- Develop an internal reference committee consisting of consumer advocates, networks and regulators to help shape the future versions of the app, and help in its broader dissemination and communication.
- Undertake a process of validation and sanity testing with networks to ensure the app is credible.
- Work with universities such as Macquarie to help in establishing research agendas that lead to lower electricity prices for customers.
- Potentially seek expert IT development assistance (subject to cost) to improve the processing power and formatting of the document, together with security of the website.
- Develop specifications and instructions to allow updating of the app and modelling by other parties in the future.