

# THE FUTURE OF ENERGY NETWORKS

DECEMBER 2013

## CSIRO'S FUTURE GRID FORUM PROVIDES WINDOW ON ENERGY SUPPLY TRANSFORMATION

A new CSIRO-led report on the transformation of Australia's electricity supply system highlights more opportunities, than threats, to better network services to customers.

Key trends in technology and consumer choices have the potential to result in very different profiles of energy consumption, onsite generation, renewable energy output and network service delivery.

These mega-shifts are uncertain in their nature and timing but are ultimately opportunities – not threats – to better service delivery by energy networks.

Embedded Generation and battery storage provide options to improve grid service delivery as much as to allow some customers to disconnect. For instance, the Report estimates peak demand management is essential to saving customers 2c/kWh by 2020, about 8% of the retail price.

Network businesses are embracing dynamic change and many of the trends in the report are extensions of the current innovation in demand-side management, advanced metering, embedded generation enabled by Australian network businesses.

## BACKGROUND TO THE FUTURE GRID FORUM

On December 6, the CSIRO's Future Grid Forum released "*Change and Choice: the Future Grid Forum's analysis of Australia's potential electricity pathways to 2050*", prepared over 18 months with the input of Australia's electricity supply industry and key stakeholders. A number of ENA's electricity transmission and distribution businesses were closely involved, including gold sponsorship by Ausgrid and Grid Australia.

The Report captures the 'mega-shifts' reshaping the electricity system and highlights four diverse scenarios, as trends in technology, consumer choices, government policy and commercial responses influence outcomes for consumers.

The report was prepared on the basis that the Forum does not endorse any particular scenario as being most likely or most desirable. **The Report is available at [www.csiro.au/future-grid-forum](http://www.csiro.au/future-grid-forum)**

**TABLE 1: KEY FIGURES SNAPSHOT - 'CHANGE AND CHOICE'; THE FUTURE GRID FORUM'S ANALYSIS OF AUSTRALIA'S POTENTIAL ELECTRICITY PATHWAYS TO 2050**

	Scenario 1 Set and Forget	Scenario 2 Rise of the prosumer	Scenario 3 Leaving the grid	Scenario 4 Renewables Thrive
Grid supplied electricity	81%	55%	68%	74%
Annual residential electricity bills (2013)	\$1771	\$1771	\$1771	\$1771
Annual residential electricity bills (2050)	\$1972	\$2569	\$1962	\$1923
Share of income spent on residential electricity bills (2013)	2.5%	2.5%	2.5%	2.5%
Share of income spent on residential electricity bills (2050)	2.4%	2.9%	2.3%	2.6%
Level of investment and running costs to required to realize this scenario by 2050	\$855 BN	\$950 BN	\$1042 BN	\$936 BN
Level of investment in networks	\$310B	\$314B	\$302B	\$349B

## KEY INSIGHTS FOR ELECTRICITY NETWORKS...

### Centrally delivered electricity will continue to play a major role...

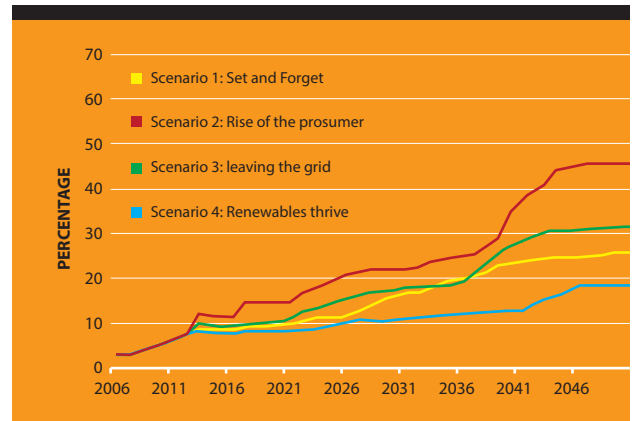
While a lower proportion of all electricity flows through the central grid as embedded generation, demand management and storage play a greater role, the grid still remains the primary source of supply in all scenarios. The Grid, which currently supplies just over 90% of supply, continues to supply over 80% of electricity until 2025. Even in the “Leaving the Grid” Scenario, a central electricity network still supplies approximately 70% of supply until 2050 and the network infrastructure required is roughly equivalent to the “Set and Forget” scenario.

### The Grid continues to be highly competitive in providing efficient, reliable and safe supply...

The Future Grid Forum analysis highlights ‘Leaving the Grid’ Scenario is not the lowest cost option. It’s the highest cost option (at \$1,042 BN), requiring about 20% more investment and running costs than the most centralised scenario (‘Set and Forget’). The “Rise of the Prosumer” scenario suggests the biggest risk to annual electricity bills for residential customers is irrational over-investment in onsite generation. In this scenario, which has the highest level of onsite generation (45%), residential bills are about 30% higher by 2050. Under all the other three scenarios (1,3,4) the annual retail bill is about the same – within 2.5% of Scenario 1.

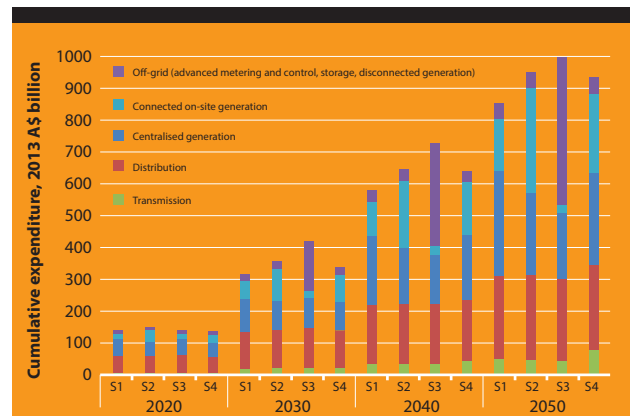
The total cost of network infrastructure required to support each scenario is relatively similar, compared to the other supply costs (eg Off grid and generation costs) which vary by up to \$200 billion between scenarios. However, the analysis also indicates that unit costs (in cents/kWh) will increase if the network delivers less energy while still requiring capacity investment to meet peak demand and support onsite generation and storage. Up to 2025, distribution unit costs are stable or declining in three out of the four scenarios.

**FIGURE 1: PROJECTED SHARE OF ELECTRICITY DELIVERED FROM ONSITE GENERATION**



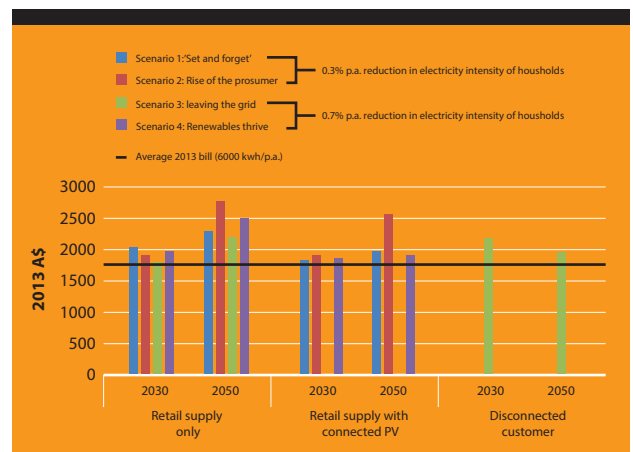
Data sourced from 'Change and Choice' Figure 16, p. 34

**FIGURE 2: PROJECTED CUMULATIVE SYSTEM COST BY 2050**



Data sourced from 'Change and Choice' Figure 23, p. 44

**FIGURE 3: PROJECTED NET ANNUAL ELECTRICITY COST**



## ... TO DELIVER OUTCOMES FOR CONSUMERS.

### Given a central grid remains essential, consumers have an interest in a stable investment environment...

As Figure 4 below indicates, all scenarios require network investment of at least \$300 billion by 2050 (or three times the current asset base), even where high levels of embedded generation and some customer disconnection eventuates. To achieve least cost outcomes for customers, it's critical this investment occurs in an environment which minimizes regulatory risk to network investors in long-life infrastructure.

Today, if network investors required the same risk premium as the electricity generation sector, the cost of finance would be about \$2.8 billion higher over a 5 year regulatory period - a hit of at least \$60 per year to household electricity bills.

### Network Tariff reform is required to ensure fairness and minimise costs...

The potential for dynamic changes in technology and customer preferences makes network tariff reform essential, to ensure network charges remain fair, sustainable and reward customers for efficient choices.

Network tariffs need to evolve to achieve fair cost-recovery from all grid customers as the use of the grid changes over time.

Without tariff reform, there will be distorted incentives for consumers making future energy choices and hidden signals to reduce peak demand, the key driver of network costs.

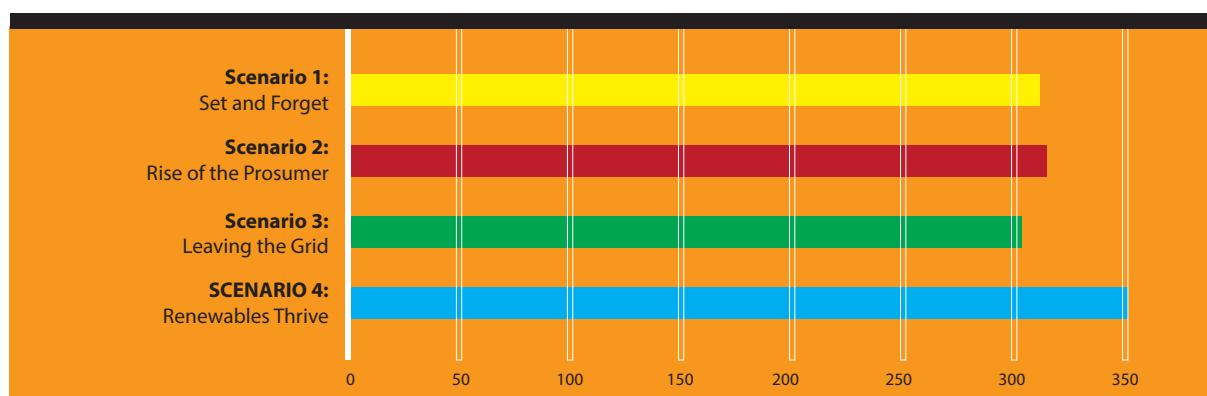
### Network businesses will meet the future with pricing and service reform...

Network businesses are embracing the potential for change in the role of networks, including new services and connections, new technologies and transformed customer relationships. This is already changing business models and services within the sector.

Network service providers are adopting innovative approaches to planning and operations, which increase network utilisation and consider the value of optionality which is particularly important in a time of uncertainty.

- » Network service providers are focussed on optimising their investment to meet demand, safety and reliability expectations. Businesses are currently required to consider alternatives to network augmentation and the opportunities for lower cost outcomes may increase as technology changes. Networks must invest in a context of some uncertainty, yet recognise the long term life of assets and the stringent safety and reliability requirements.
- » Networks businesses are seeking to reform tariff structures to better match network costs and prices and provide incentives for customers to manage their energy consumption and contribute to reducing peak demand. Cost reflective network pricing reform is a central element of the energy reform agenda approved by Australian Governments through the Standing Council on Energy and Resources (SCER).
- » With their expertise and current capacities, Network Service Providers are well placed to offer extended services beyond the network itself. For example, some network businesses could establish providers of maintenance services for on-site generation and other energy solutions in future service delivery models.

**FIGURE 4: NETWORKS EXPENDITURE TO 2050**



Data sourced from 'Change and Choice' Figure 23, p. 44

## MORE THAN JUST POLES & WIRES... THE HIDDEN VALUE OF THE GRID.

### **The Grid is already providing customer services far beyond 'capacity' and 'volume'**

Increasingly, energy users will face a wider range of energy supply options and choices. It will be important to ensure that customers make these choices with good information and transparency about what the new service means.

Energy is often described as a 'low interaction' product, so it's easy to forget the 'Grid' provides a range of often hidden services.

- » We usually won't give a second thought to whether the system has enough capacity to energise the next appliance we switch on - because the Grid takes care of it;
- » We wouldn't think of whether our air-conditioning unit being turned on creates voltage instability or requires synchronisation services - because the Grid takes care of it;
- » If we have supply interruptions, faults or our electricity connection requires maintenance - the Grid takes care of it.
- » If we build a new home, we expect grid-delivered electricity to be connected to our home because our network service providers have explicit obligations to provide services against specified standards of reliability.

In the future, energy users may make different choices; they may contract for services currently provided by the grid; or they may decide they can do away with a grid connection. However, it will be important consumers are able to make informed decisions and good information is available to support them.

### **...and as new technology and new markets provide a wider range of supply choices to consumers, the Grid will play a vital enabling role.**

In most cases in the Future Grid Forum report, even where customers have their own onsite generation and make use of storage - they still rely on the Grid for backup supply and other services.

However, there is likely to be the need for significant enabling and coordination functions in the 'smart grid' to support new customer services and new markets.

It is likely network service providers will play an integration role between the energy sector components, to maximise the overall benefits of a more diversified system. In the future, there is the potential for significant synergies to be achieved unlocking benefits to consumers. There is significant Australian and international expertise emerging in smart grids and the potential for 'transactive' energy systems.

It may be possible to enhance distribution system operations through a central optimisation service that could include: individual appliances, solar panels through inverter control, Electric Vehicle charging and discharging, addressing distribution constraints, fluctuation in renewable generation output and central generation costs.

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