Going Solar: Renewing Australia's electricity options

By Laura Eadie and Cameron Elliott

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CENTRE FOR POLICY DEVELOPMENT

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About this report

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Going solar is the third in a series of reports looking at how different sectors of Australia's economy can benefit from policies that enable them to thrive in a world of resource constraints and climate change.

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1 million

The number of Australian households with rooftop solar at April 2013.

12-fold increase

The increase in NSW solar consumer complaints against electricity retailers over the last two years.

Two out of six

The number of NSW electricity retailers who offer a solar tariff below the wholesale cost of electricity. Five other retailers offer no tariff at all.

53 per cent vs 6 per cent

The percentage of Australians who believe support for solar is definitely a good idea vs those who definitely support subsidies for the coal industry. Only 14 per cent definitely support subsidies for the natural gas industry.

A$3.6 billion vs A$1.4 billion

Effective Commonwealth Government support for fossil fuel electricity in 2012-13, vs support for renewable energy.

A$250 per year

The estimated cost to an average household electricity bill from higher gas prices or water scarcity, which makes fossil fuel plants more expensive to run.

A$50 per year

The estimated amount retailers' marketing costs add to an average household bill.

A$15 per year

The estimated amount the Renewable Energy Target will add to an average household bill between 2013 and 2031.

Main points

The world's electricity market is on the cusp of a transformation from fossil fuels to renewable generation. In 2011, global investment in the renewable energy sector reached a new high of around $250 billion, almost double the pre-financial crisis levels of 2007.[1] By 2035, renewable energy is expected to compete with coal as the primary source of global energy.[2] Countries which embrace this shift will be less vulnerable to electricity price shocks, avoid the significant health costs of burning coal, and achieve lower carbon emissions. Solar electricity is projected to grow faster than other renewable energy technologies, and has the potential to reduce network costs. [3,4,5]

One in five Australian households is likely to have rooftop solar by 2020, or earlier.[6] Community support for renewable energy and rooftop solar is strong. Of 1,000 Australians surveyed in 2012, 74 per cent would prefer to have their electricity supplied by renewable energy compared to 12 per cent for nuclear and only 6 per cent for fossil fuels.[7] Of those surveyed, 53 per cent believe support for solar is definitely a good idea while less than 5 per cent say it is definitely a bad idea.[8] By comparison, the number who definitely support fossil fuel subsidies is only 14 per cent for natural gas and less than 6 per cent for the coal industry.[9]

This report finds that all Australians can benefit from rooftop solar:

» **It lowers wholesale electricity prices for all consumers,** as long as retailers pass these savings on. Australia's current level of rooftop solar could save A$300 to A$670 million a year in wholesale electricity costs, based on prices in 2009 – 2010.[10]

» **It gives consumers real choice about their electricity supply and control over their bills.** Competition between electricity retailers is meant to lower costs, but ends up adding to bills. All consumers pay higher prices to subsidise discounts used to entice customers to switch retailers.[11] Based on rough estimates, retail marketing costs add up to $50 per year to the average household bill.[12]

» **It can reduce summer peak demand, which may lead to more productive use of existing network infrastructure** that consumers have already paid so much for.[13] In some places, it may also defer or avoid network investment.[14]

» **It creates a base of consumers actively engaged in managing their energy demand**.[15,16] This will be critical to avoid expensive network investment if climate change increases peak demand from air conditioning. Extremely high temperatures are now likely every 1 to 2 years, compared to a long-run average of once every 22 years.[17]

» **It helps insure Australia against future electricity price shocks from gas price volatility and drought.** Prices for gas-fired electricity are now linked to volatile international oil prices. Drought can reduce electricity supply from water-cooled coal-fired power plants, raising wholesale electricity prices. Prices could spike by up to A$250 per year, similar to the amount network charges have added to the average annual household bill since 2007.[18]

However, consistent policy reform will be necessary to provide a level playing field for new technologies as they develop. The current political stalemate is preventing the emergence of a long-term policy vision consistent with community desires to realise the benefits of renewable energy. For example, in 2012-13, effective support for existing coal-fired electricity was $3.6 billion per year, compared to $1.4 billion for renewable energy.

Rooftop solar has a key role to play in Australia's transition to a clean, affordable and reliable electricity system. Powerful interests will resist such change. Policy makers should be guided by the future direction of our energy system, rather than what they see in the rear-view mirror.

Global electricity markets are being reshaped by renewable energy

Around the world, electricity systems are being reshaped by renewable energy technologies. In 2011, investment in new renewable energy exceeded investment in new fossil fuel capacity.[19] The International Energy Agency forecasts that renewable energy will be the second largest source of electricity by 2015, and will compete with coal as the primary source by 2035.[20]

The rapid increase in renewable energy is due to falling technology costs, rising fossil-fuel prices and carbon pricing, and significant government support.[21] It is also increasingly being demonstrated that renewable energy can reliably supply large amounts of power to electricity systems.[22] However, government support is still necessary to attract investment in renewable generation because of its upfront costs. It makes sense for governments to speed up the transition from fossil fuels to cleaner renewable energy because of the costly health impacts of coal-fired power stations.

Rooftop solar is at the leading edge of this transformation. Solar has passed a critical threshold in several countries. Over the course of its life it competes directly with the cost of electricity delivered to the home.[23] As rooftop solar reaches 'socket parity' in more countries, market forces may drive rapid uptake and further falls in cost.

Australia's electricity market is at a similar point of change

Sharp rises in electricity bills, coupled with rapidly falling costs of solar systems and generous government support, have led one million households to invest in rooftop solar.[24] By 2020, over two million households – approximately one in five – are likely to be solar consumers.[25]

The sudden popularity of rooftop solar led to perceptions of policy failure due to a 'blow out' in the cost of government support, and to claims that it benefits a few at the cost of many. Recent policy changes should bring costs back in line with expectations.

However, support for rooftop solar costs much less than investing in networks to meet surging peak demand on hot summer days. For example, an air conditioner adds $2,400 of grid costs which must be subsidized by all electricity customers.[26] Network charges added almost $300 to the average household bills over the five years to 2012.[27] Support for all renewable electricity, including large scale projects, added less than $80.[28]

Solar policies have reduced installation costs, allowing Australia to develop one of the most efficient solar service industries in the world.[29] However, rapid changes in government policies impact the industry's ability to provide reliable and responsible customer service. To develop a stable industry, the Commonwealth Government should maintain the current Renewable Energy Target, and the current small-scale scheme.

Electricity price security

Australia must provide a level playing field for renewable electricity, or risk future price shocks. If fossil fuel generation continues to dominate, electricity prices will be vulnerable to gas price volatility and droughts. Prices for gas-fired electricity are linked to volatile international fuel prices, as local buyers must now compete with gas exports. Water scarcity reduces supply from water-cooled coal-fired power plants, raising electricity prices.

These price shocks could be similar in size to the $300 rising network charges added to the average annual household bill since 2007.[30] By comparison, the Renewable Energy Target is projected to add $15 a year to the average household electricity bill between 2013 and 2031.[31]

Australia has a window of opportunity over the next two decades to replace ageing fossil fuel plants with renewable generation. By this time many fossil fuel generators will reach the end of their economic lives, and recent falls in demand and increased renewable electricity suggest that no new fossil fuel plants may need to be built before the end of this decade.[32]

Australia could spend 5% a year less on our energy by retiring around 7,000 megawatts of coal-fired power capacity and replacing it with decentralized energy, renewables and some peaking gas plants.[33] Meeting growth in peak demand through to 2020 with demand management and energy efficiency rather than additional fossil-fuel power, could avoid around $2 billion a year in network costs.[34]

Solar consumers will play a key role in transforming electricity markets, with benefits for all. Rooftop solar can help manage peak demand, which may lead to more productive use of existing network investment.[35] In some cases, rooftop solar can avoid or defer network upgrades.[36]

A smooth transition to renewable electricity is essential to avoid the risk of interrupted supply, to lower the costs of reducing carbon emissions, and reduce the impact of climate change that is already locked in. This requires predictable carbon and renewable energy policies. The Commonwealth Government should avoid further changes to the carbon price and Renewable Energy Target, or risk scaring off investors in Australia's electricity market.

Empowering consumers

Rooftop solar gives consumers greater choice over their electricity supply and more control over their bills. This introduces effective competition to retail markets for the first time. Competition between electricity retailers is meant to lower costs, but ends up adding to bills. In many states, regulatory settings allow retailers to spend large marketing budgets to entice customers to switch between identical products.[37] These costs are subsidised by all electricity consumers and contribute up to $50 per year to the average household bill.[38]

Consumer advocacy bodies need to actively consider the interests of solar consumers. Solar consumer complaints have surged 12-fold in NSW, 4-fold in Victoria and doubled in South Australia over the last two to three years.[39,40,41,42,43,44,45,46,47,48,49,50] Small solar consumers have limited market power compared to established electricity retailers. Of eleven NSW retailers, two currently pay less than the wholesale cost of electricity.[51] Rooftop solar threatens the business models of retailers and 'gentailers' by reducing electricity consumption and wholesale prices.[52]

Prices for solar electricity exports should signal the full value it provides, to make the most of benefits across the electricity system. This would include the value of exported electricity to retailers, and longer-term benefits of avoiding network upgrades. Regulatory frameworks should reflect this principle, and be designed to pay full value for solar electricity as the industry structure shifts toward decentralised energy and demand management. Solar consumers are more actively engaged in managing their energy use than other consumers,[53,54] so are likely to reduce peak demand with the right price signals.

As a safety net, regulators should set a minimum regulated tariff for solar electricity exports, with a higher price paid at peak times. Regulators should also ensure distribution businesses share the value of avoided network costs with solar consumers.

Energizing communities

Rooftop solar can benefit all consumers. In the near term, it lowers wholesale electricity prices.[55] In the longer-term, it could help avoid future network investment in some locations.[56] Solar policies should be redesigned to make the most of these benefits. In particular, the Renewable Energy Target should maintain the small-scale scheme, since rooftop solar provides benefits that complement larger renewable electricity technologies.

Australia's current electricity system should be able to accommodate more than the 2 million solar households expected by 2020. However, it is possible that real-world barriers to installation, if not appropriately managed, may lead to inequity between those who have access to rooftop solar and those who do not. Most of the take-up so far has been by middle-income households who own their homes. Possible barriers to further take-up are grid instability, lack of access to finance, and lack of rooftop access.

Current constraints on the uptake of rooftop solar will probably be overcome soon. Research and development of simple technical solutions could increase grid flexibility to support high levels of decentralised generation. Innovations in financing and community investment models could open up rooftop solar to renters, strata apartments and low-income households. Their success will depend on governments' willingness to provide networks with incentives to adopt solar, and to reduce red tape for solar consumers.

Recommendations

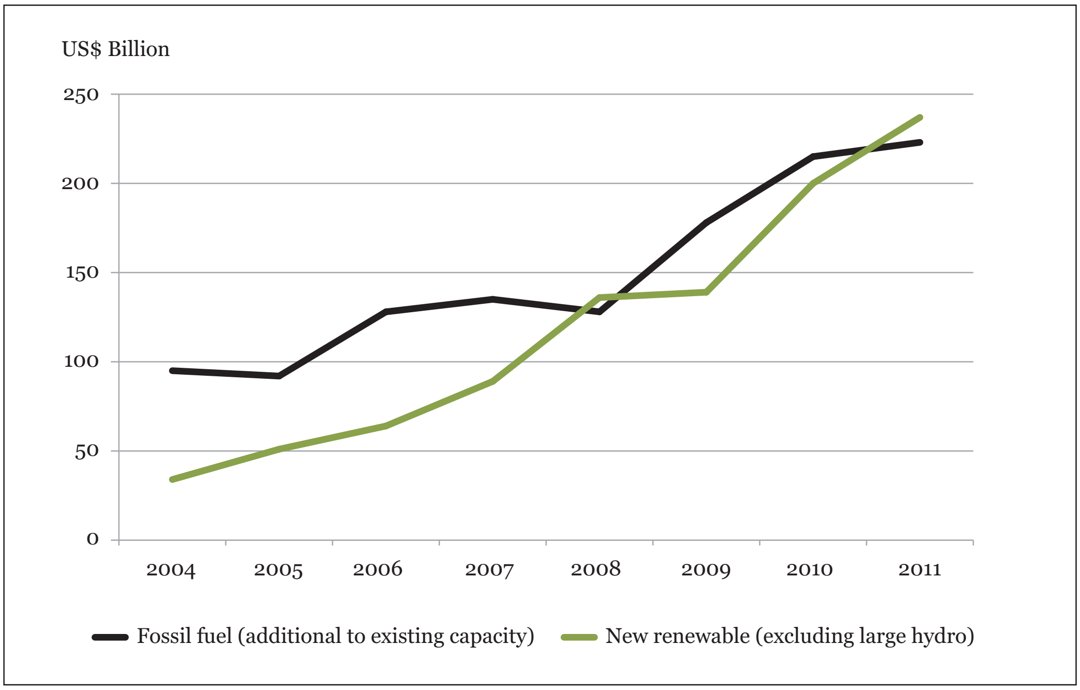
We need a tailored set of policies to maximise the benefits of rooftop solar to all Australians. In particular, we need to:

1. **Maximise uptake of rooftop solar, to make the most of its benefits**
   - The Commonwealth Government should maintain the current Renewable Energy Target, and the small-scale scheme.
   - The Australian Energy Regulator should require network operators to conduct cost-benefit analyses on integrating high levels of rooftop solar. This should consider the benefits solar could provide by deferring further spending on electricity network infrastructure.
   - State governments should ensure that solar consumers are not levied higher network charges than other consumers, unless there is clear evidence they contribute to significantly higher costs.
2. **Ensure that financial incentives send a clear signal to rooftop solar consumers to manage peak demand and network costs**
   - State governments should set minimum regulated feed-in-tariffs to ensure retailers pay full value for solar electricity exports. Rates should be higher at peak times, when wholesale prices are high.
   - The Australian Energy Regulator should require distribution companies to pass some of the value of avoided network augmentation costs on to solar consumers, where they help defer network capital costs.
   - Smart-meter standards should be designed to allow solar exports to receive real-time prices when networks are at maximum capacity.
3. **Ensure consumer advocacy bodies explicitly consider the interests of solar consumers**
4. **Invest in innovation to ensure that our electricity grids are flexible enough to support higher levels of rooftop solar**
   - Review national standards for rooftop solar inverters so they actively assist in managing voltage variations.
   - Support trials of small battery technologies for managing voltage variation and demand.
5. **Develop policy measures to support renters, apartment dwellers and low income households to access the benefits of rooftop solar.**
   - Reduce red tape for innovative financing and ownership options. For example, develop standard contracts and business models for ownership and operation of solar on strata roofs.
   - Offer low or zero-interest loans to households who can't access innovative financing.

Global electricity markets are being reshaped by renewable energy

Around the world, electricity systems are being reshaped by renewable energy technologies, which have become much cheaper and more widespread in recent years. In 2011, global investment in the renewable energy sector reached a new high of around $250 billion, more than double the pre-financial crisis levels of 2007.[57] As Figure 1 shows, more money was invested in new renewable capacity than in new fossil fuel generation capacity in 2011.The International Energy Agency (IEA) forecasts renewable energy will be the second largest source of electricity by 2015, and compete with coal as the primary source by 2035.[58]

Figure 1: Investment in new renewable energy vs new fossil fuel generation, 2004—2011



Source: Frankfurt School of Finance and Management, 2012[59]

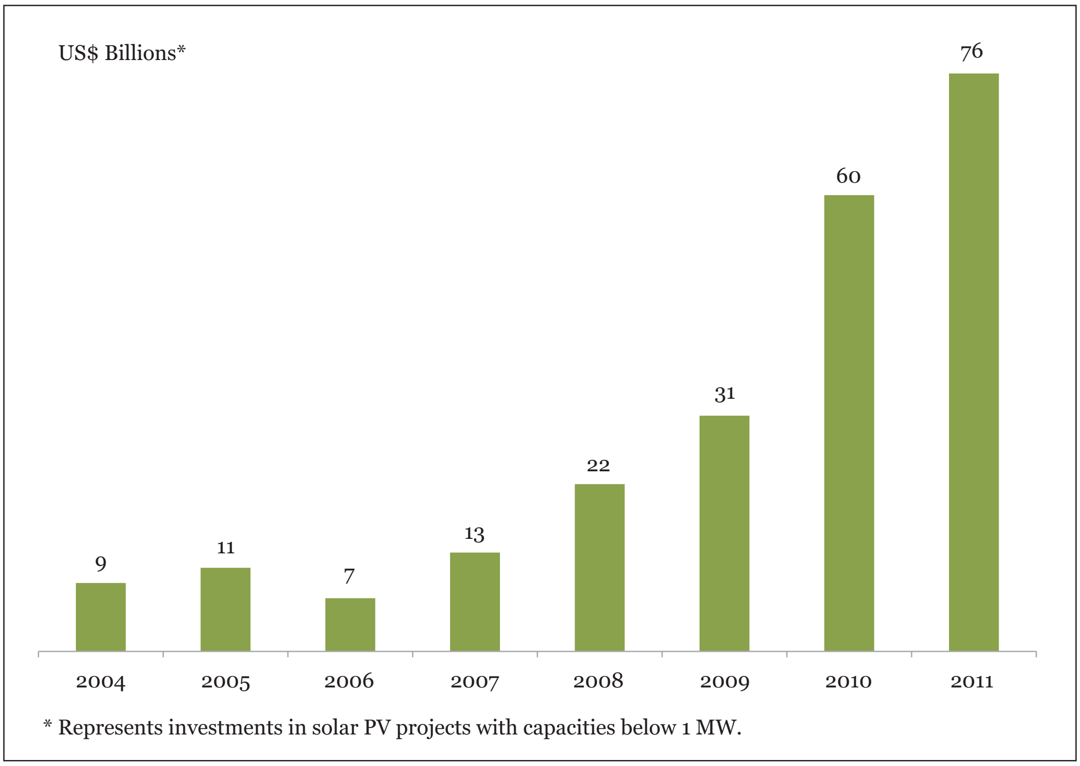
Renewable alternatives are rapidly becoming cheaper than new fossil fuel plants, over the life of an investment in generation[i].[60] New fossil fuel plants are becoming less attractive investments due to rising costs of fossil fuels, and carbon costs.[61] Banks are charging higher risk premiums on money lent to projects which may have future carbon liabilities, as government policies to reduce emissions are expected to tighten over time. Some banks are also nervous about lending to projects which may negatively impact their reputation. However, renewable technologies still face hurdles such as higher upfront investment costs, access to capital, and lack of information about wind and solar resources.

i Based on the levelised cost of electricity, which spreads all expected costs over the life of the generation unit. This includes costs for capital, operations and maintenance, fuel and carbon emissions, and network investment to deliver electricity produced to the consumer.

Renewable technologies are also proving to be able to reliably supply large amounts of energy to electricity systems. Current electricity systems have a greater capacity to support variable renewable electricity wind, solar, tidal and wave power than is commonly believed.[62] For example, a comprehensive study by the US Department of Energy recently showed that renewables could supply up to 80 per cent of the energy needs of the USA, with as much as 50 per cent being sourced from variable renewable technologies such as wind and solar photovoltaics (PV).[63]

Globally, solar photovoltaics (PV) is projected to grow faster than all other renewable energy technologies.[64,65] Between 2005 and 2010, the amount of installed solar PV grew at almost 50 per cent a year.[66] Wind, which started from a higher base of installed capacity, grew closer to 25 per cent a year.[67] As Figure 2 shows, investment in small scale solar projects has grown rapidly from $9 billion in 2004 to $76 billion in 2011, when it reached a new high of 30 per cent of overall investment in renewable power and fuels worldwide.[68]

Figure 2: Annual small scale solar investment, 2004—2011

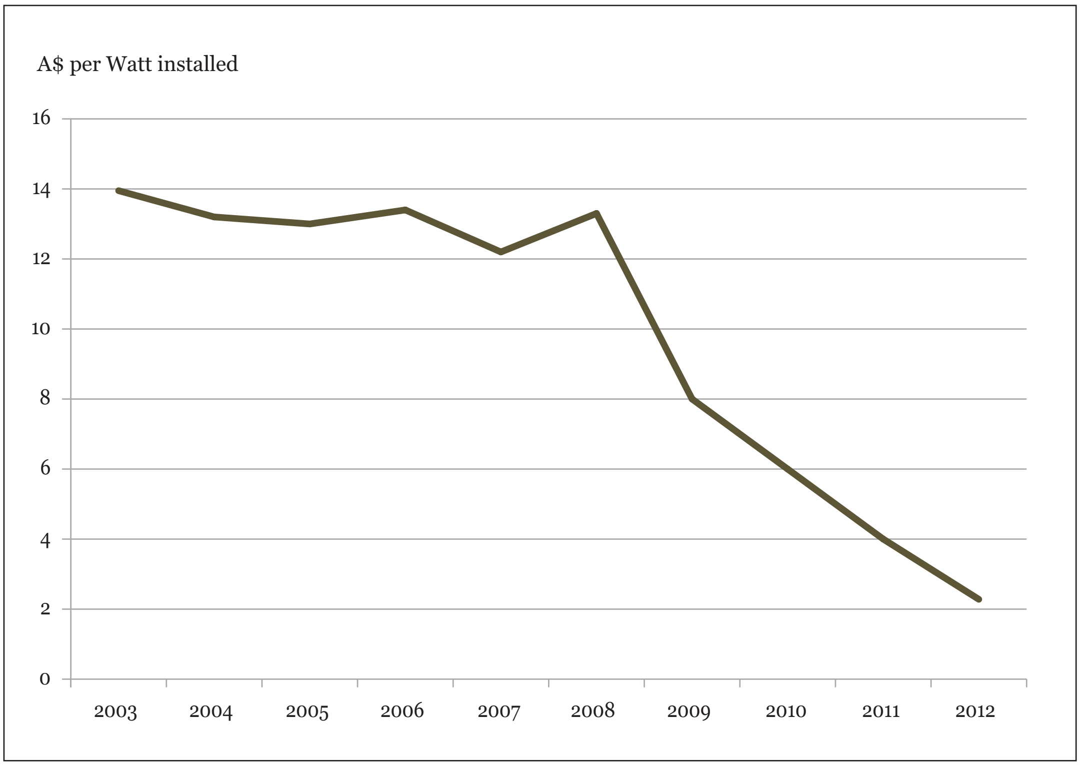


Source: Frankfurt School of Finance and Management, 2012[69]

Rapidly declining technology costs have been the main driver of the recent growth in solar installation, although government support, carbon pricing and rising fossil-fuel prices have also been important.[70] In the last four years the cost of PV cells (the device that converts the energy of sunlight into electricity using the photovoltaic effect) has fallen from around $US4 per Watt to around $US0.85 per Watt.[71] This drop in cost was caused by an increase in the supply of silicon used to make them, price competition, innovation in materials, advances in manufacturing processes and an oversupply of cells driven by the rapid expansion of Chinese production and the decline in demand in Europe driven by a reduction in government support.[72] Small advances in materials and innovations in manufacturing processes also contributed to falling technology costs.

The price paid by solar consumers for rooftop solar systems has also fallen rapidly. For example, over the last four years the installed price of rooftop PV in Australia has dropped by 85 per cent (see Figure 3 below). The plunge in price was largely driven by a fall in the cost of producing PV cells and the higher Australian dollar. Other drivers included a decrease in the cost of other system components and the increasing scale, competition and thus the efficiency of Australia's installation industry.[73]

Figure 3: Price of installed rooftop solar, Australia



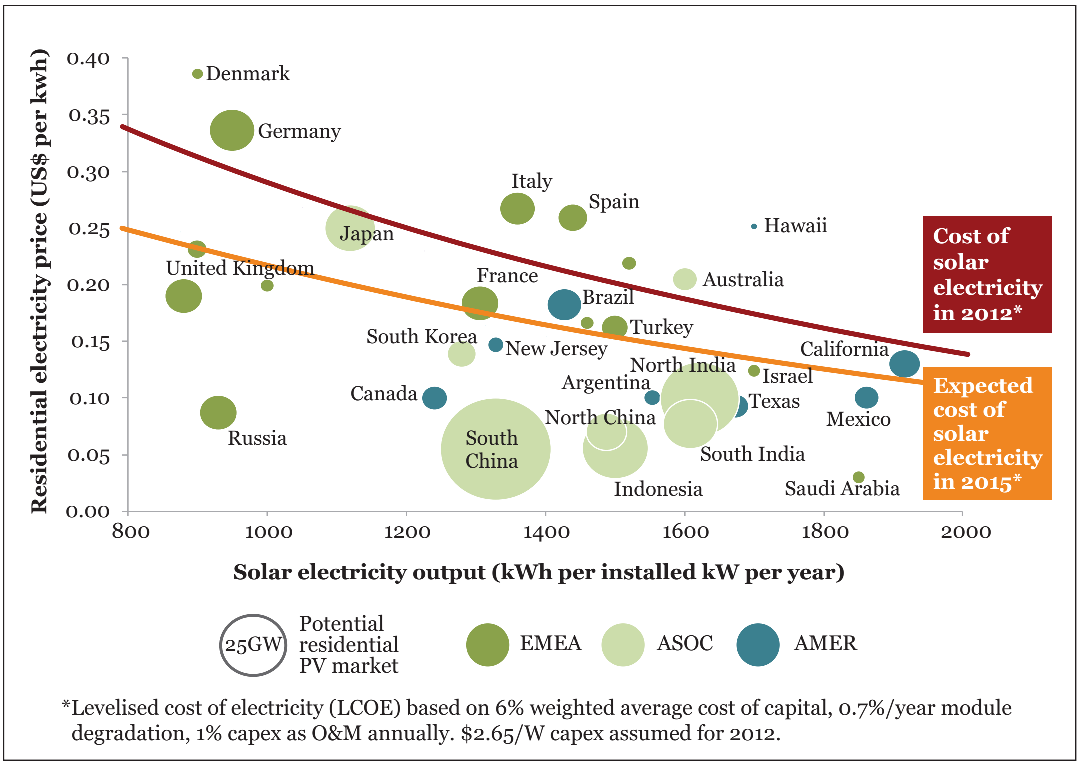
Note: The price per watt excludes government subsidies and is a national average derived from prices paid for 1.5, 2, 3, 4, and 5 kilowatt systems.

Source: CPD analysis using data from Climate Spectator[74], AECOM[75], and ACIL Tasman[76]

There is debate over whether the historically low installed prices can be maintained in the short-term. One argument is that supply will exceed demand, driving some producers out of business and raising prices, but that would surely be only a short-term phenomenon. Others argue that prices will continue to drop as technology improves, leading demand to catch up with supply.

However, it is likely that long-term prices will continue to fall. As Figure 4 shows, in 2012 rooftop solar was competitive with the retail electricity price in six countries or regions without any government support. If prices continue to fall over the next 20 years at the rates predicted by organisations such as the International Energy Agency (IEA)[77], large markets such as India and China may open to rapid investment. This could lead to a positive feedback loop where rapid global uptake of solar PV drives prices down further, leading to even faster uptake.

Figure 4: The global march towards socket parity



Source: Bloomberg New Energy Finance[78]

In Figure 4, each bubble represents the potential size of the residential solar market in a country. The downward sloping red line shows the upfront cost of a rooftop solar system spread over its lifetime in 2012 (referred to as levelised cost of electricity or LCOE – see Box 1). The vertical axis shows the cost of grid supplied retail electricity and the horizontal axis shows the amount of electricity produced by rooftop solar. Countries which sit above the red line have already reached 'socket parity', the point when electricity produced by rooftop solar matches the price of electricity delivered to the home. By 2015, a further five countries or regions (those between the red and orange lines in Figure 4) are predicted to reach 'socket parity'.

In the medium term, global demand for solar PV will depend on the level of government support around the world. As a renewable technology reaches 'socket parity', it is widely believed that market forces will drive rapid uptake. However, this assumes that households have enough money lying around to invest in rooftop solar. Where this is not true, rapid withdrawal of government support can lead to a 'bust' in the domestic industry. A more gradual withdrawal of support can avoid this. Several European countries have now begun to scale back or remove support as rooftop solar reaches 'socket parity' while other countries not yet at 'socket parity' are beginning to offer support to encourage the uptake of rooftop solar.

Box 1: Comparing the cost of electricity technologies

Electricity technologies can be compared using a single measure of cost, despite differences in their upfront and operating costs. This number, called the 'levelised cost of electricity' (LCOE) indicates the cost per unit of electricity over the life of the generation unit.

The LCOE spreads all expected costs over the life of the generation unit, including costs for capital, operations and maintenance, fuel and carbon emissions, to arrive at an estimate of cents per kilowatt hour. The LCOE for rooftop solar varies depending on the assumptions used to calculate it. Common assumptions used in the calculation include the amount of sunlight available onsite, maintenance costs, cost of capital, cost of installation, component technology used, and expected system lifespan.

However, confusion often arises over whose costs are included. For end consumers, the full cost of electricity must include network charges. These are based on the annualised cost of capital invested in electricity poles and wires. However, investors often compare the partial cost of electricity produced by generators without considering the cost to deliver it to end consumers.

From an investor's, perspective, a gas generator built to meet peak electricity demand could look more cost-efficient than decentralised energy. Decentralised energy includes distributed generation, energy efficiency and demand management.

The consumers' perspective is more relevant when comparing options for supplying consumption and peak demand. This means including the cost of extra network investment when calculating the LCOE of different technologies. These full LCOE numbers are needed to inform smart policy decisions about matching future electricity supply and demand.

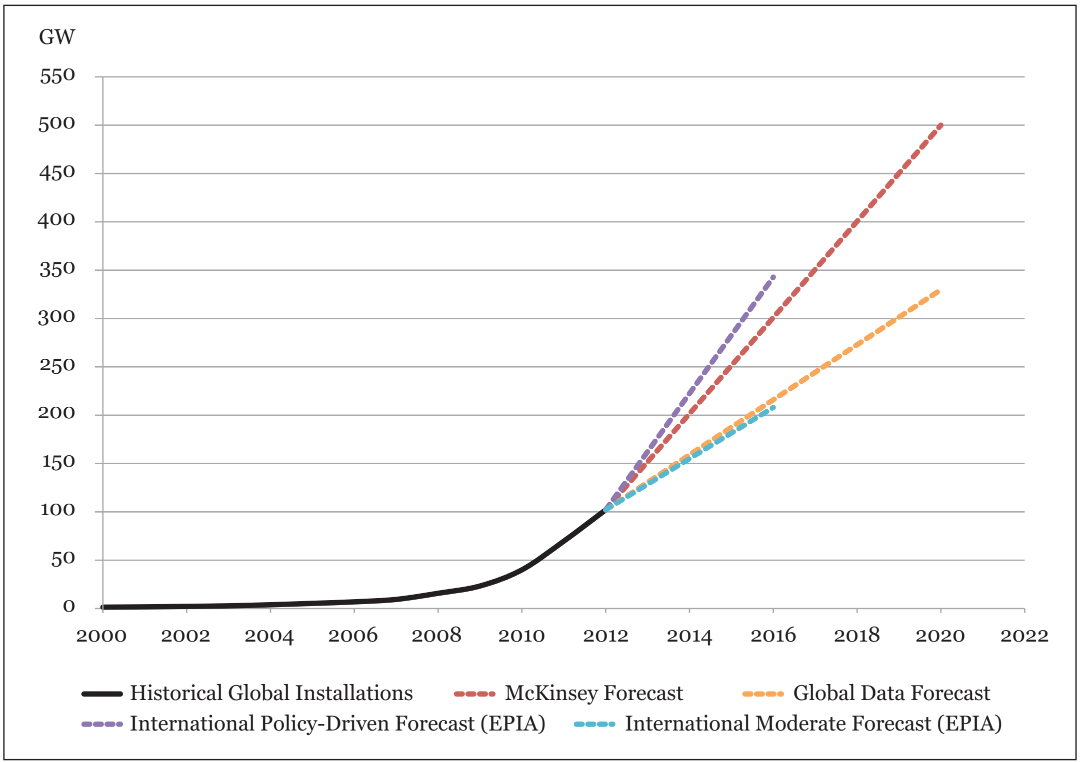
A mix of decentralised and centralised energy can improve the capital efficiency of the overall electricity system by avoiding or delaying investment in new network infrastructure and centralised generation.[79] This reduces electricity costs for all consumers.

The optimal amount of decentralised energy, particularly rooftop solar, will depend on how quickly the costs of various technologies fall and whether least-cost options for network investment are fully considered. In some areas, short-term network investment may be needed to accommodate high levels of renewable technologies. The principle for making such decisions should be to opt for solutions with the greatest net benefits across the electricity system over time, rather than simply the least upfront cost.

This report refers to all costs, including network costs, when considering the cost of electricity technologies.

While it is too early to tell what impact government policies will have on global demand for solar PV, modelling suggests growth will remain strong over the next four to eight years. As Figure 5 shows, even moderate estimates suggest rooftop solar will double by 2016.

Figure 5: Global installed capacity of small scale solar



Note: includes household, commercial and ground-mounted installations.
Source: Analysis by CPD using data from EPIA[80,81], Solar Novus Today[82], GlobalData[83], and McKinsey[84]

The rapid growth in installed rooftop solar capacity is reshaping electricity systems globally. In most traditional electricity systems, a large amount of electricity is produced in a centralised location such as a coal-fired power station outside of a major town or city. It is then transported tens or hundreds of kilometres along high voltage transmission lines to the town, where it is delivered to domestic and commercial properties through a distribution network. The rapid uptake of rooftop solar is shifting these distribution networks away from this 'centralised' model to a 'decentralised' model of electricity production and consumption. For example, extra electricity produced by households with rooftop solar can be fed back into the grid and used by other households in the area. This has created a need for more flexible distribution networks that allow electricity to flow to and from the home.

The following chapter looks at how these changes are playing out in Australia's electricity market.

Box 2: Common electricity terms

A *watt (W)* is a unit of power that represents the rate at which electricity is generated or consumed. A *kilowatt (kW)* is a thousand watts, a *megawatt* (*MW*) is a million watts, and a *gigawatt* (GW) is a billion watts. To give some meaning to the numbers used in this report, a clock radio uses about one watt, a window-installed airconditioner uses just over one kilowatt, a wind turbine produces around a megawatt, and a large coal-fired power station would produce around a gigawatt.

A *kilowatt hour (kWh)* is a unit of energy and represents the amount of power (kilowatts) used over an hour. For example, if a one kilowatt airconditioner is switched on and run for one hour it would consume one kilowatt hour of electricity. If a one watt clock radio was left on for 1000 hours it would also use one kilowatt hour of electricity. If a one megawatt wind turbine spins at full speed for one hour it would generate one *megawatt hour (MWh)* of electricity while a large coal-fired power station operating at full capacity for an hour would produce a *gigawatt hour (GWh)*. The total amount of electricity consumed in Australia in a year is around 190,000 gigawatt hours.

Rooftop solar is a system of solar photovoltaic panels, an *inverter* (which converts solar electricity so it matches grid supplied electricity), and other equipment installed on the roof of a house or other building. The average size of a rooftop solar system in Australia is just over 2 kW (eight x 250 watt rooftop panels). The amount of energy produced by a system of this size varies according to the angle of the panels, the amount of sunshine falling on the roof, and the geographic region. However, as a rough guide, a 2KW system would produce about 8 kWh per day.[85] This would be enough energy to power a one kilowatt airconditioner for 8 hours, or around 45 per cent of an average Australian households' daily consumption.[86]

Peak demand is the maximum amount of power, or watts, used within the electricity system. In Australia, *summer peak demand* is around 30 GW.[87] This is the maximum amount of power used in the year. It usually occurs on a hot day when everyone switches on their airconditioners, often between 12pm and 4pm. Demand also varies from low to high levels during the day. In most states of Australia, *daily peak demand* occurs around 5pm to 6pm, when many people come home from work.

A *electricity network*, or *grid*, refers to the poles and wires that deliver electricity to the home. The capacity of the grid is driven by the *summer peak demand*. Increasing grid capacity raises the network cost to service demand that may only occur a few times a year.

Smart meters digitally record electricity usage at regular intervals throughout the day and relay this data back to electricity retailers. This allows retailers to implement *time-of-use* pricing in which electricity tariffs vary hour by hour instead of by peak and off-peak. Smart meters can also be designed to provide customers with detailed and real-time usage and pricing information. It is hoped that smart meters, coupled with time-of-use pricing, will encourage customers to shift more of their usage to low-demand periods, reducing the network costs associated with reliably servicing peak demand.

Smart grids are "computerised" electricity grids which allow utilities to remotely control the amount of electricity used or fed into the grid by a household or business at any given moment to maximise network stability and reliability, reduce peak demand and minimise costs for consumers. It is hoped that automation technology could allow appliances which generate high demand, such as airconditioning and heating units, to be managed centrally by a utility to reduce peak demand and network costs.

Australia's electricity market is at a similar point of change

Sharp rises in electricity bills, coupled with the falling cost of solar systems and generous government support, have led Australian households from all regions and levels of income to install rooftop solar. One million households had installed a rooftop solar system by April 2013 – more than 10 times 2009 levels.[88]

With solar prices predicted to fall over the long-term and electricity prices forecast to rise, the number of solar households is likely to keep increasing. Official forecasts predict 2.1 million Australian households will have installed a rooftop solar system by 2020 (see Table 1). This means around one in five detached and semi-detached houses will have installed rooftop solar by the end of this decade.

Table 1: Current and forecast solar uptake

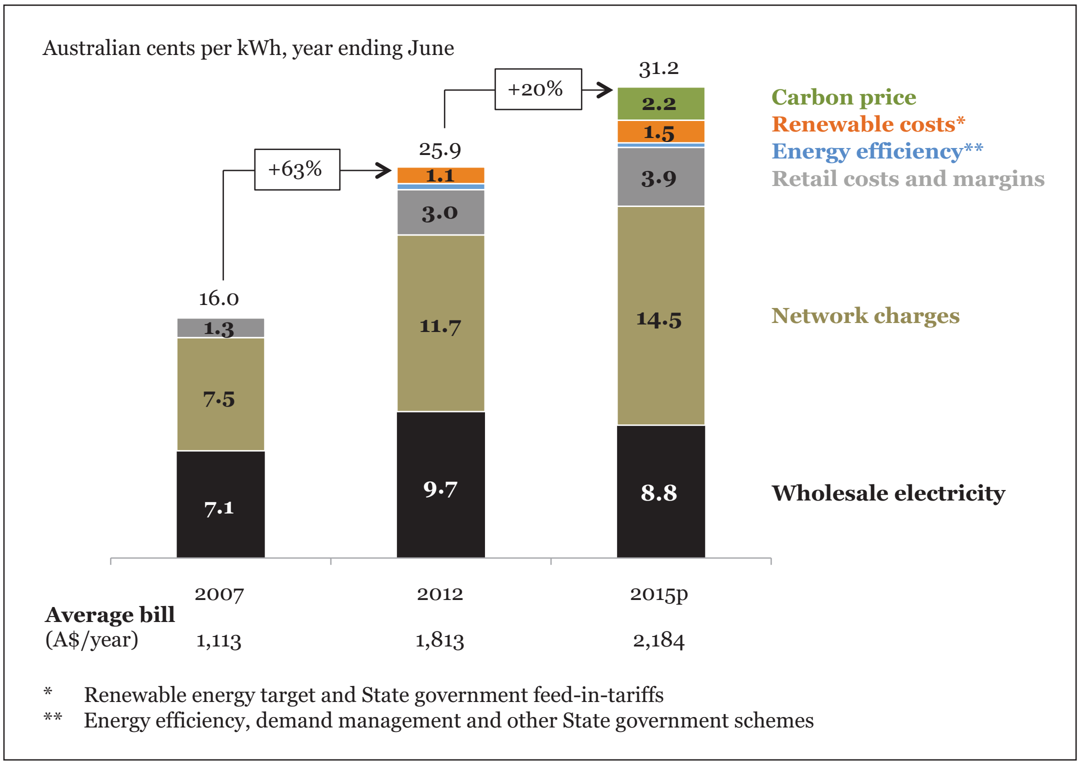
	Current (2012)	Forecast (2020)	Change
Capacity of rooftop solar (GW)	2.3	5.1	+120%
Number of solar households	0.9 million	2.1 million	+120%
Uptake (% of households with solar)	12.5%	22.9%	

Source: CPD analysis based on Clean Energy Regulator and AEMO data (see Appendix)

Australia's household electricity prices surged by over 60 per cent between 2007 and June 2012, and are projected to rise a further 20 per cent by June 2015 (Figure 6).[89] Adjusting for different currencies and costs of living, Australia's residential electricity prices are now higher than in the United States or Canada.[90] Further increases will take them above Japan and Europe by 2014, assuming exchange rates and other factors stay the same.[91]

Network investment was the largest driver of this increase in household retail prices. The back story is $42 billion worth of electricity network upgrades in the pipeline over a 5 year period.[92] Electricity regulation guarantees distribution businesses a generous return on whatever new capital investment they make. It also lacks incentives for the efficient use of existing network assets, and has encouraged extra investment to reduce the already small chance of blackouts. Prompted by a surge in summer peak demand – an air conditioner adds an estimated $2,400 of grid costs which must be subsidized by all electricity customers - billions of dollars have been spent to cope with demand that is confined to only a few extremely hot days each year.[93]

Figure 6: Australian retail electricity prices



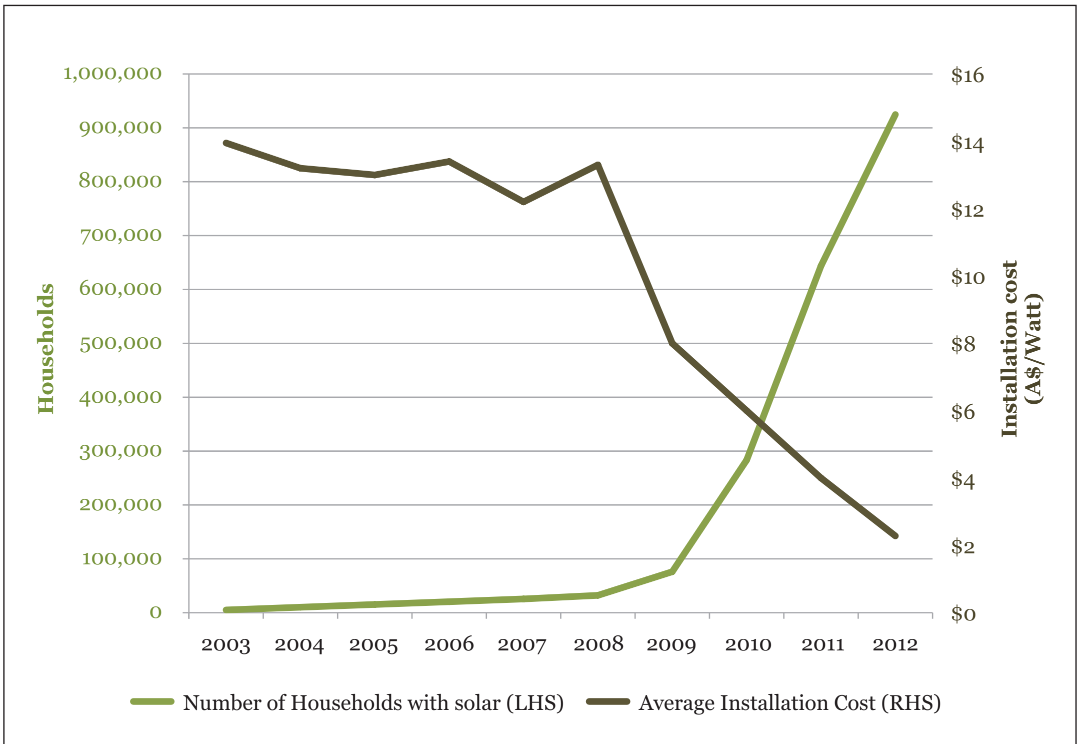
Source: CPD analysis using data from O'Young, 2011[94]; AEMC, 2011[95]; AEMC 2013[96]; CCA, 2012[97]

Support for renewable energy costs much less than investing in networks. As Figure 6 shows, the average household bill jumped $700 - or 63 per cent - between 2007 and 2012. Network charges added almost $300 per year. The Renewable Energy Target and state government feed-in-tariffs were responsible for only $77, or 7 per cent of the overall increase. Large increases in network costs, rising wholesale prices and more than a doubling in retail costs and margins all added more to electricity prices than support for rooftop solar and other renewable energy technologies.

Looking forward, prices are expected to rise a further 20 per cent by June 2015, some of which is due to normal inflation. Higher network charges and retail costs and margins add an extra 10 per cent, as does the introduction of the carbon price and slightly increased renewable costs. However, households are fully compensated for the carbon price.[98] The costs of support for renewable electricity are also offset by lower wholesale costs, since once it is built renewable generation produces electricity more cheaply than fossil-fuel plants. [99]

Solar costs also fell dramatically at the same time as electricity prices jumped. As Figure 7 shows, prices fell from $13 per Watt to around $2 per Watt between 2008 and 2012. This was a major driver of the rapid growth in the number of households with rooftop solar.

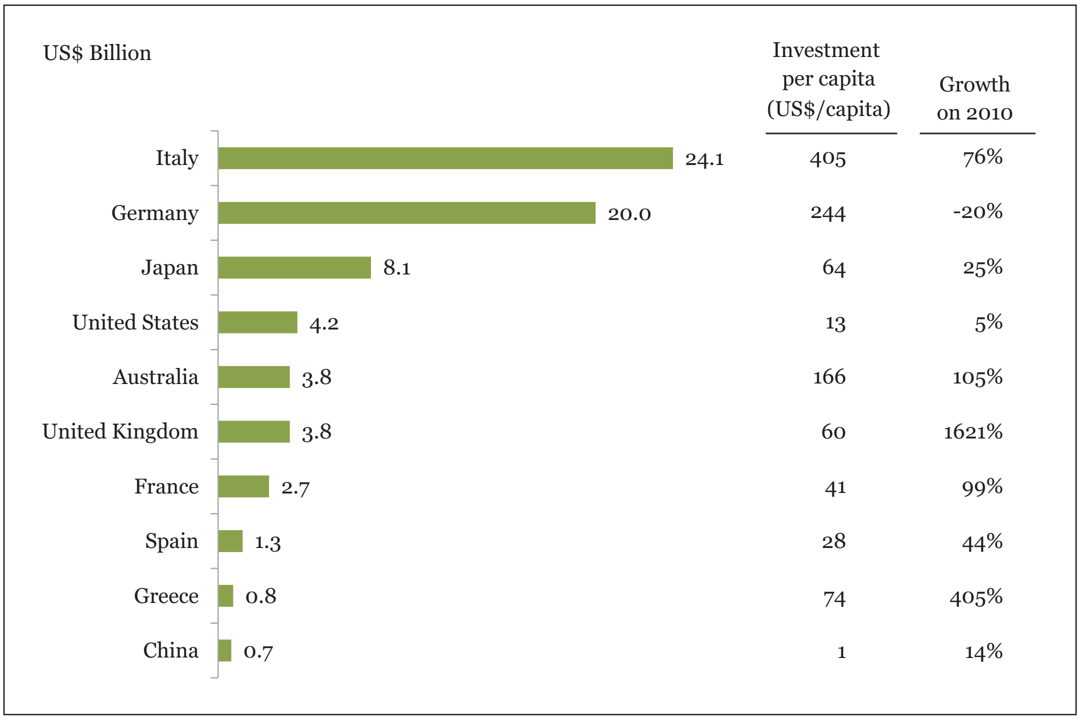
Figure 7: Average installed price and number of households with rooftop solar



Source: CPD analysis using data from Climate Spectator[100], AECOM[101], ACIL Tasman[102], EPIA[103], Clean Energy Regulator[104]

Governments in Australia were surprised by the popularity and falling costs of solar, as were others around the world. As Figure 8 shows, Australia has followed the global trend of rapid rooftop solar uptake and is now one of the world's largest markets. In 2011, Australia ranked fifth in the world for the level of total investment in rooftop solar capacity – topped by four countries with much larger populations.[105]

Figure 8: Annual small scale solar investment by country, 2011



Source: Frankfurt School of Finance and Management, 2012[106]

The unexpected popularity of rooftop solar has led to perceptions of policy failure due to a 'blow out' in the cost of government support – and claims that it benefits a few at the cost of many. Yet, when compared to their original objectives, Commonwealth and State policies have been a victim of their own success. Government support for solar was intended to develop a large enough market to overcome barriers to financing and reduce transaction costs.[107] Designed at a time when today's low solar costs could not be foreseen, these policies offered very generous levels of support. Recent policy changes should bring their costs back in line with expectations.

Commonwealth Governments incentives were designed to incentivise rapid uptake of rooftop solar, and have now been scaled back. The Commonwealth Government's Renewable Energy Target (RET) provides an effective upfront rebate through certificates which reduce the capital cost of investment in renewable. Within the RET, the number of certificates for which each MW of rooftop solar was eligible under the Small-scale Renewable Energy Scheme (SRES), was temporarily increased by a multiplier in July 2010. The multiplier was designed to be reduced over time, and has now been phased out.[108]

State level support for rooftop solar was initially more generous than the Commonwealth scheme. Mandatory feed-in tariffs are payments made by retailers to small-scale generators of renewable electricity on either a net basis (payment for electricity exported) or gross basis (payment for all electricity produced). Those introduced by Labor and Coalition governments in the late 2000s ranged from 44 – 60 cents per kilowatt hour, which is around 1.8 to 2.5 times the retail price of electricity. In the last two years they have either been scaled back dramatically or removed entirely by newly elected governments who felt they were too generous and underestimated the popularity of rooftop solar.

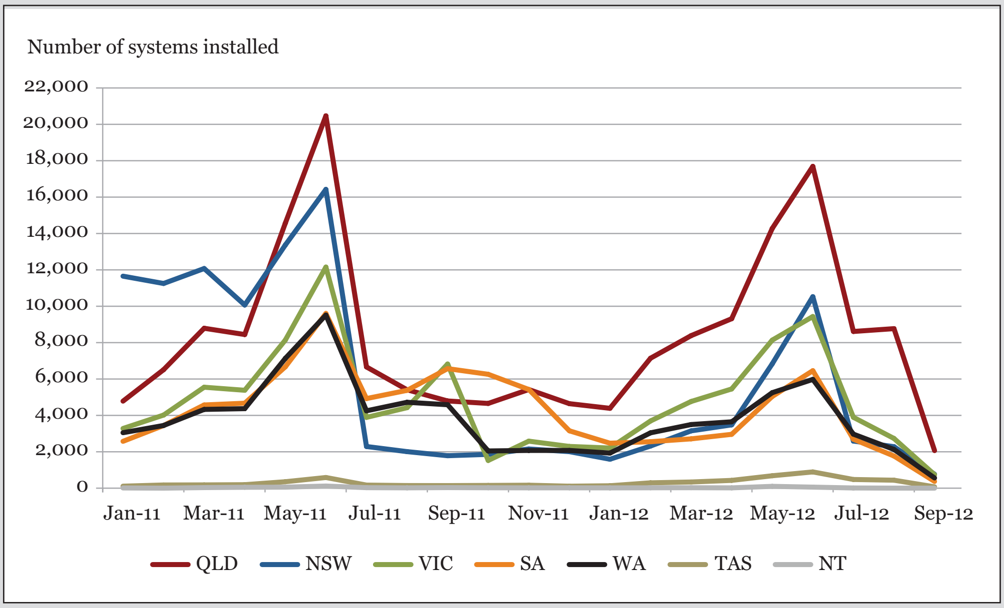
Electricity retailers, not just solar consumers, benefitted from the Commonwealth Government's support for solar. Regulators assume that retailers pay $40 for each RET certificate produced by rooftop solar, and allow this to be passed on to all consumers in states where there is a regulated retail electricity price. However, retailers can purchase certificates below this price through long-term contracts with solar installers, or on a spot market. While the price negotiated through long term contracts is confidential, it is likely to be lower than the spot price which was $25 in early 2012 and $31.70 in early 2013.[109] This means retailers in some states have been pocketing $8.30 to $15 for each certificate. Last year, in NSW alone, this would have amounted to a cost to consumers of between $118 and $214 million dollars.[110] This oversight adds upward pressure to retail electricity prices, and could be removed if regulators adjusted retail electricity prices to reflect the actual cost of certificates in the previous year.

Box 3: Policy instability undermines a responsible solar industry

Australia's solar industry has been through boom and bust cycles over the past few years, driven by rapid changes to prices and government incentives (see Figure 9). Government incentives have reduced some of the local costs of solar systems and installation, allowing Australia to develop one of the most efficient solar service industries in the world.[111] Some commentators suggest the industry is now entering a stable phase, in which it is less exposed to knee-jerk changes in government incentives.[112]

Yet rapid policy changes undermine the industry's ability to provide reliable and responsible customer service. Unfortunately, rogue operators are enticed into the market during upswings, and even good operators come under financial pressure during downswings. Consumers pay in the end.

Figure 9: Volatility in solar system installation rates by state and territory



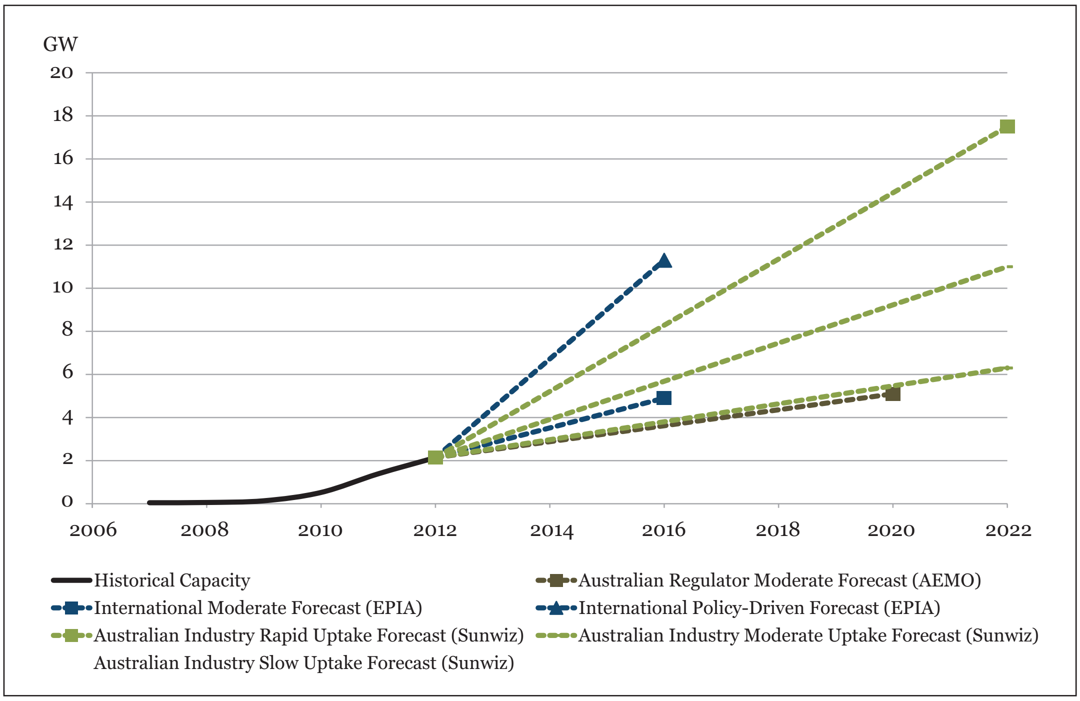
Source: CPD analysis of data from Clean Energy Regulator[113]

Providing policy certainty is a challenge when prices for solar are changing so fast. While it is clear that the long-term trend is for falling solar costs, predicting the rate and timing of changes is impossible. The twin policy objectives of providing predictable support for an emerging industry, and managing budget costs as solar prices drop, tend to conflict. This leads to pendulum swings between high and low levels of policy support.

To provide stability, the Commonwealth Government should maintain the Renewable Energy Target (RET) for small-scale solar systems. Recently suggested changes to manage the risk of a sudden jump in installations should be planned out well ahead of being introduced.[114] To maximise the benefits of the RET, governments should also assist network businesses to identify areas where solar has particularly high benefits for the whole electricity system – such as the ability to avoid future network upgrades.

Rooftop solar is likely to keep growing as it is now cheaper than retail electricity. At the end of 2012, the lifetime cost of a rooftop solar system was 22 cents per kWh, compared to retail electricity price of almost 26 cents per kWh[ii].[115,116] As Figure 10 shows, official forecasts are for 5GW of solar photovoltaics (PV) by 2020[iii].[117] Other forecasts suggest this may be reached by 2016. If all this is installed by households, Australia will soon have twice as many solar consumers as we do today. If electricity prices keep rising, this is point is likely to be reached sooner rather than later.

Figure 10: Australian total installed capacity of rooftop solar, history and forecasts



Source: CPD analysis using data from EPIA[118,119], Climate Change Authority[120], Clean Energy Council[121], AEMO[122], Sunwiz[123]

The following chapter considers the risk of future electricity price spikes, with a focus on Australia's exposure to rising gas prices and more frequent and severe droughts.

ii Before considering government support.
iii This assumes moderate increases in retail electricity prices, moderate reductions in the cost of solar systems, and a moderate level of government support for the technology.

Electricity price security: meeting Australia's future needs

Clean, affordable and reliable electricity for everyone is essential for Australia's economic performance. Over the next two decades, Australia has a window of opportunity to improve the price security and reduce the carbon intensity of our electricity system. By this time many ageing fossil fuel power plants will reach the end of their economic life, and recent falls in demand and increased renewable electricity suggest that no new fossil fuel plants may need to be built before the end of this decade.[124] Electricity produces more carbon emissions than any other sector of Australia's economy.[125] So replacing legacy assets with cleaner alternatives is important if Australia is to play our part in ensuring a safe future climate. Renewable alternatives are rapidly becoming cheaper than new fossil fuel plants. However, they still face the hurdle of higher upfront investment costs. The carbon price and Renewable Energy Target (RET) are essential policies for a smooth transition to more renewable electricity.

Electricity prices are expected to rise with or without carbon pricing and the Renewable Energy Target. Assuming changes in regulations to contain network costs is effective, household prices are expected to rise by an average of around 1 per cent a year more than inflation through to 2030.[126] Including the carbon price takes this to around 2 per cent a year.[127] The costs of the RET are largely offset by lower wholesale costs, since once it is built renewable generation produces electricity more cheaply than fossil-fuel generators.[128] This means wholesale electricity prices can drop significantly at times when renewable electricity is generating a lot of power. Known as the 'merit order effect', this has already reduced the profits of coal-fired generators in South Australia where wind accounted for 26 per cent and solar for 2.4 per cent of electricity produced in 2011-12.[129] After considering this downward pressure on electricity prices, the RET is projected to add $15 a year to the average household electricity bill over 2013 to 2031[iv].[130]

Electricity prices could unexpectedly spike due to fuel price volatility and water scarcity, if fossil fuels continue to dominate our electricity system. The price of electricity from gas-fired power plants is now exposed to international fuel price volatility. Gas prices on the east coast have recently doubled as the development of an export industry links domestic prices to international prices.[131] Coal-fired power plants are exposed to water scarcity, as they need cooling water to operate efficiently. In 2007, short-term wholesale prices jumped to 5 times their previous level, as severe drought reduced the amount of electricity supplied by coal-fired power plants and others which rely on water resources[v].[132,133,134]

Looking forward, the size of these risks for household electricity bills could be similar to the jump in prices driven by network investment over the past few years, as Table 2 shows. While such price spikes are not likely every year, they could lead to unexpected changes in electricity bills that are hard for some households and businesses to adjust to.

iv Average cost to an average residential customer over the period 2012-13 to 2030-31, compared to a scenario with no Renewable Energy Target.

v Hydro-electric plants may also have to reduce electricity production due to water scarcity.

Table 2: Drivers of price risks

Cost to average household, $ per year

Driver	Cost	Comment
Inefficient use of network capital	~300	Regulatory rules set up in 2006 led to unprecedented levels of investment, with more than $42 billion of infrastructure spending on the electricity network approved in 2009 for the following 5 years.[135] These rules were intended to promote network investment by distribution businesses, but have recently been changed to focus on the efficiency of investment.[136]
Fuel price risk (gas prices now linked to international fuel prices)	80 - 160	Estimates if gas price rises to $12 per GJ and gas–fired generators contribute 20 to 40 per cent of electricity production, compared to around 20 per cent today. Gas prices on the east coast of Australia have recently doubled from $4 per GJ to $8 per GJ[vi].[137] This is still below the $14 per GJ price in Japan[vii].[138]
Water constraint risk (drought reduces water available for cooling power plants)	140 - 250	Estimates based on wholesale price increases observed during last severe drought. Climate change increases the risk of drought and high temperatures. The area over which exceptionally hot years occur has doubled over the last 40 years.[139] By 2040, years with exceptionally low rainfall may occur twice as often and over twice as large an area.[140]

Source: CPD analysis (see Appendix for method)

Renewable alternatives can reduce this risk, and provide reliable electricity supplies. Established technologies like wind and solar photovoltaic power have no fuel costs, or need for cooling. Some newer technologies, like concentrating solar thermal power, do need cooling but can be designed to use air rather than water.[141] Experience in South Australia shows that large amounts of renewable electricity can be managed reliably if interconnected to adjacent power systems.[142] In the long term, with lots of renewable electricity, we may need to pay higher prices during peak demand to ensure reliability.[143] However, this would be offset by lower prices when the sun is shining and the wind is blowing.[144]

vi A gigajoule (GJ) is a measure of energy content. One gigajoule is similar to the amount of energy released when burning a million matches.

vii This price includes shipping costs which would not be relevant for gas produced and consumed in Australia.

The idea that Australia's coal-fired power could be replaced with renewable energy is an increasingly mainstream concept. A recent report from the Bureau of Resources and Energy Economics found that renewable energy sources like wind and solar could be among the cheapest sources of electricity in Australia by 2030[viii].[145] The old assumptions that 'renewables can't do baseload' or 'renewables will always be too expensive' have been comprehensively debunked. [146, 147] Even Australia's National Energy Market Operator is developing planning scenarios that consider the implications for energy markets and networks of 100 per cent renewable electricity generation in 2030 and 2050.[148]

The likely direction of the electricity industry is toward more renewable and decentralised energy generation, and demand management. The 'Decentralised Energy Roadmap', produced through the CSIRO Intelligent Grid Research Cluster, modelled a scenario in which growth in peak demand through to 2020 is met with demand management and energy efficiency rather than additional fossil-fuel power, and found it would avoid around $2 billion a year in network costs. They also found that Australia could spend 5% a year *less* on our energy by retiring around 7,000 megawatts of coal-fired power capacity and replacing it with decentralized energy, renewables and some peaking gas plants.[149]

Australians would benefit greatly from reforms that minimise spending on network infrastructure and big new power plants, and which prepare the grid and the market for the rise of decentralised energy generation. A number of reviews may provide the federal and state governments with impetus to make some major changes. The AEMC's 'Power of Choice' review looked at options for encouraging demand management. The AEMC has also been reviewing reliability standards to see if it's worth paying such a high price to avoid the risk of blackouts.[150] Changes to the way that spending is approved for network companies have been proposed,[151] and the Productivity Commission is currently assessing the efficiency of electricity distribution companies.[152]

Stable policies are essential for a smooth transition to a clean, affordable and reliable electricity system. The arrival of cheaper new technologies will change the structure and organisation of the industry. Since the disruptive effects largely impact powerful established interests, it is almost inevitable they will resist such change. Policy makers should be guided by the future direction of our energy system, rather than what they see in the rear-view mirror. Governments which back old technologies will eventually face political fallout when ageing fossil fuel plants become too old to run, or the risk of rising carbon prices lead their owners to skimp on maintenance. To avoid the risk of supply interruption, Australia needs to provide clear signals to attract investors in new low-carbon generation.

Continued uncertainty about the carbon price and the RET increases the risk of electricity supply interruption, and the risk that Australia will have to make deeper and more expensive cuts in carbon emissions in the future. As Table 3 shows, Australia effectively still provides more support to existing fossil fuel generators than to renewable electricity. Without a greater effort to rapidly decarbonise our electricity system, we cannot expect other countries to reduce global emissions enough to avoid significant climate change impacts in Australia.

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viii Based on a carbon price of approximately A$50 per tonne in 2030. This is less than the UK Government's valuation of approximately £60 per tonne in 2030, which is based on a peer reviewed methodology consistent with domestic and international targets.

Table 3: Government interventions and effective subsidies in 2012—2013

	2012—2013	Comment
Fossil-fuel electricity		
Free carbon permits & cash	$1.0 billion	Transitional assistance over 6 years to assist highly emissions-intensive coal-fired generators to adjust to the introduction of a carbon price.
Unrecognised health costs (an effective subsidy)	$2.6 billion	Burning coal to produce electricity imposes health costs on nearby communities. This is essentially a subsidy as the costs are not paid by the electricity industry.
Total fossil-fuel	**$3.6 billion**	
Renewable electricity		
RET - Large scale	$0.8 billion	Acts as insurance against risk of price shocks due to rising fuel costs, drought and future carbon liabilities.
RET - Small scale	$0.6 billion	As above. Expected to drop to $0.3 bn by 2020—21.
Total renewables	**$1.4 billion**	

Sources: Commonwealth of Australia[153]; Biegler, 2009[154]; SKM, 2012[155]

Climate change highlights the importance of curbing seasonal peak demand to avoid higher costs for all consumers. Extremely high temperatures are now likely every 1 to 2 years, compared to a long-run average of once every 22 years.[156] Electricity grid capacity is built to cater for the four or five extremely hot days a year when demand peaks, but its costs are charged across all electricity consumption. From 2000 to 2009, peak demand rose faster than average demand, increasing costs for all users.[157] More recently, summer peaks have fallen, reducing any immediate need for new network investment.[158] However, the sunk investment costs still need to be paid for, and peak demand could increase again if we see more extreme heatwaves like those in January 2013.

Encouraging more productive use of sunk network investment requires flattening out seasonal peak demand, by shifting some of it to other times of the day. Current government initiatives to do this are unproven.[159] They assume that smart meters (which can measure electricity consumption minute by minute) will allow higher electricity prices to be charged during times of peak demand, leading consumers to reduce consumption at these times. However, investing in smart meters requires co-operation between Commonwealth and State governments, which is difficult without financial incentives. Getting smart meters and time-of-use pricing to reduce peak demand also depends on consumer being actively engaged in managing their electricity use, or allowing someone else to manage this for them. So far, the benefits to consumers have been poorly explained, making their engagement unlikely, unless there is a big improvement in the way these schemes are designed and implemented.

Rooftop solar has a critical role to play in managing peak demand. Official forecasts for rooftop solar to more than double to 5 GW by 2020 are equivalent to almost 20 per cent of the 30 GW summer peak demand seen in 2012.[160] A 100 per cent renewable electricity system could theoretically include around 30 GW of rooftop solar without battery backup.[161] Such large amounts of rooftop solar could help manage peak demand in three distinct ways.

First, it can reduce summer peak demand in many states, which may lead to more productive use of existing network assets. In mainland states, summer maximum demand typically occurs in the late afternoon, but before the usual daily 5pm to 6pm peak which occurs as people come home for the evening.[162] It is likely that summer peak demand puts greater demand on network capacity than daily peak demand, but data on where and when this happens is not readily available. Nevertheless, on preliminary estimates, rooftop solar is producing at 28 to 38 per cent of its capacity at times of summer maximum demand.[163] This has contributed to a softening of summer peaks, which have fallen for each of the past four years in Victoria, the past three in Queensland, and the past two in New South Wales and South Australia.[164]

Second, it creates a pathway to engage consumers in managing their electricity demand, as long as pricing incentives are set right. Solar consumers on net tariffs have an incentive to change the shape of their electricity consumption to use as much of the output from their own solar panels as they can.[165] Net tariffs mean solar consumers avoid paying the retail price for any electricity they produce and use themselves, and are also paid for any extra electricity they export to the network. Under gross tariffs, on the other hand, retailers buy all electricity produced by the solar panels, and charge consumers the retail price for all electricity they use. This removes the incentive for consumers to actively manage the shape of their consumption. As discussed in the chapter 'Empowering consumers', time-of-use pricing should be designed so solar consumers have an incentive to minimise their own consumption and maximise their electricity export at times of local peak demand.

Third, small scale solar can defer network investment in some situations. A 2011 regulatory study found that forecast uptake in rooftop solar over the next 20 years would help reduce maximum demand to the point where network investment could be delayed, particularly in areas with high uptake.[166] Solar can be particularly valuable in rural areas if it defers the need to upgrade poles and wires that serve only a few households. However, as discussed in the chapter 'Energizing consumers', in some areas networks investment is needed to support a high uptake of solar. Little information is currently available on where these costs occur, how they can be minimized, and how much the broader benefits of rooftop solar in those areas outweigh them.

Innovation in grid management is essential to maximize the benefits of high levels of rooftop solar, and other renewable electricity technologies whose power output varies predictably over time. Electricity systems with more 'flexibility' can incorporate higher levels of variability while balancing supply and demand. Improving grid management and introducing energy storage capacity are two key ways to increase system flexibility. Innovation for these technologies lags behind renewable research globally yet is becoming important as more countries set targets to rapidly decarbonise their electricity systems.[167,168]

The following two chapters discuss these and other issues Australia will need to address to ensure a fair go for solar consumers and maximise net benefits for the whole community as the penetration of rooftop solar increases.

Empowering households: giving solar consumers a fair go

Rooftop solar gives consumers greater choice over their electricity supply and more control over their bills. This introduces effective competition to retail markets for the first time. However, small solar consumers have little market power compared to established electricity retailers and 'gentailers', whose business models are threatened by reduced electricity consumption and lower peak wholesale prices.

Consumer advocacy bodies need to actively consider the interests of solar consumers. This is particularly important where a few vertically integrated retailers and generators dominate the market.[169] For example, two retailers with contracts over large generation assets control 70 per cent of the NSW electricity market. Of the eleven NSW retailers, only six offer any feed-in-tariff. Two of these pay less than the wholesale cost of electricity, and only one offers more than the minimum rate recommended by the regulator.

Regulatory frameworks should be designed to pay full value for solar electricity as the industry structure shifts toward decentralised energy and demand management. As a safety net, regulators should set a minimum regulated retail tariff for solar electricity exports, with a higher price paid at peak times. Regulators should also ensure distribution businesses share the value of avoided network costs with solar consumers.

Rooftop solar introduces effective competition to retail markets

In many states, regulatory settings allow retailers to charge large marketing overheads for selling an identical product.[170] In Queensland for example, 5 per cent is added to the regulated tariff as 'headroom' on top of retail margins to allow retailers to compete for customers[171] Australia wide, some 20 to 25 per cent of customers switch to a new electricity retailer each year, attracted by discounts of nearly $200.[172,173]

This increases marketing costs, which are passed on as higher prices for all consumers. The average consumer is likely to be too overloaded with complex information to choose the best deal.[174] Those who do get discounts by switching retailers are subsidised by all other consumers. Based on rough estimates, current retail marketing costs contribute up to $50 per year to the average household bill.[175]

Rooftop solar introduces effective competition to retail markets for the first time. By providing consumers with real choice over where their electricity comes from, it competes with electricity volumes previously sold by retailers.[176] This threatens the business models of stand-alone retailers, and those which also own or control generation assets.

Solar consumers have limited market power

Solar consumers have the right to a fair contract with electricity retailers, and one that is not to their financial disadvantage, under the Australian Consumer Law.[177] However, the structure of the electricity industry, and relationship between retailers and customers, means that solar consumers have limited market power. Where this constrains consumer choice or creates an uneven playing field for solar compared to other sources of electricity, governments may need to intervene to protect consumer rights.

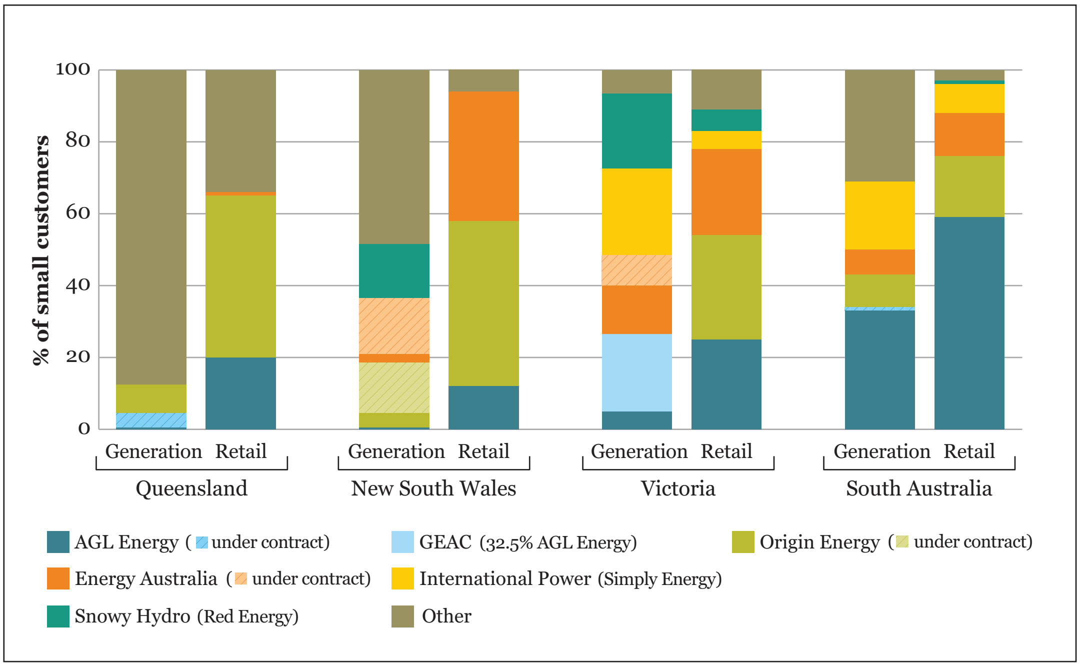
'Gentailers' dominate markets

Many electricity companies, often called 'gentailers', own or control both generation assets and retail operations, as Figure 11 shows. Origin, AGL and Energy Australia jointly supply 80 percent of small retail electricity customers and control close to 30 percent of mainland National Electricity Market generation capacity.[178] These big 'gentailers' are jointly responsible for 58 percent of the new generation capacity commissioned or committed to since 2007.[179]

However, it is not just the big retailers who co-own generation assets. A number of new entrant retailers have integrated with stand-alone generators to reduce their exposure to wholesale price volatility. For example, the retailer Simply Energy has partnered with generator company International Power, and the retailer Lumo Energy with generator company Infratil.

This trend suggests that new entrants are unlikely to reduce the dominance of 'gentailers'. New retailers have done deals with large generators in the past, and stand-alone generators have sought to expand into retail markets. While new entrants may enhance general competition within the retail market, it does not necessarily increase competition to buy power from distributed generators, such as rooftop solar.

Figure 11: Vertical integration - generation and retail market share by utility



Source: AER[180]

The increasing penetration of rooftop solar is acting to significantly reduce the profits of 'gentailers' through the merit order effect. On hot summer afternoons when demand would traditionally spike, taking the wholesale price of electricity with it, the peak is flattened by the large amounts of electricity being produced by rooftop solar. The consequence is that the wholesale price is much lower than it once would have been during critical peak periods and generators' profits have fallen as a result. Modelling suggests Australia's current level of rooftop solar could have reduced wholesale electricity revenues by A$300 to A$670 million, based on prices in 2009 – 2010.[181]

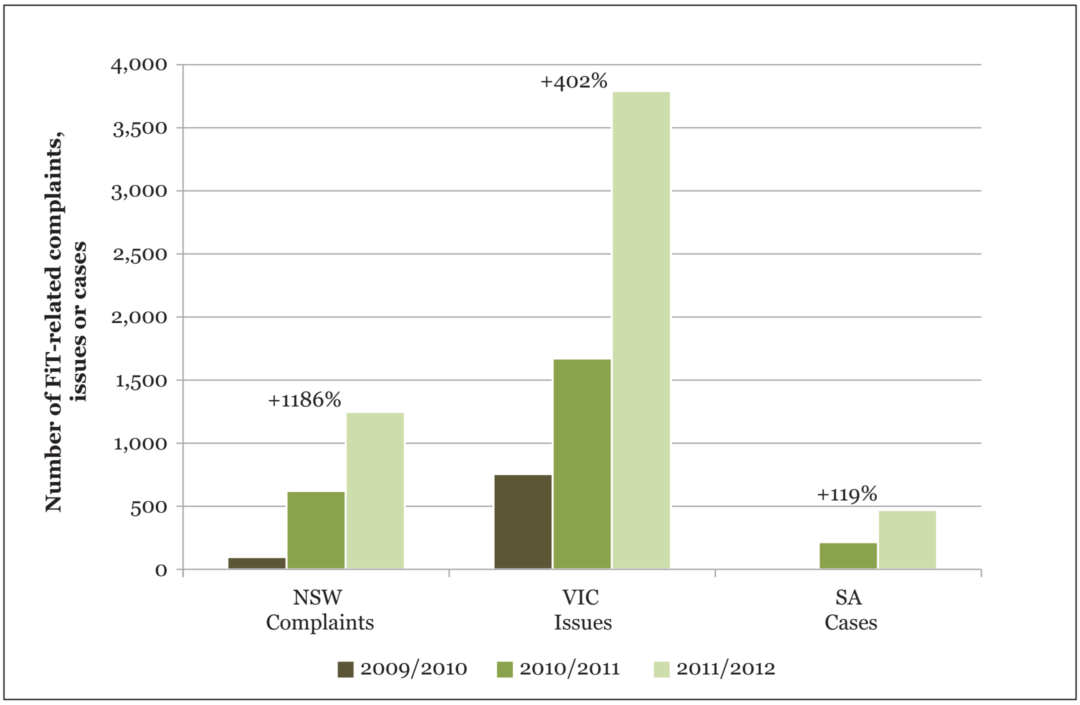
It is therefore unsurprising, in a market dominated by retailers who own or control generation assets, that we should see low prices offered for electricity generated by rooftop solar, and a reluctance by retailers to pass on the benefits of lower wholesale prices to consumers.

Solar consumer complaints have surged

A dramatic increase in consumer complaints about solar feed-in tariffs raises further doubt over whether the retail market is competitive enough to provide solar consumers with choice.

As Figure 12 clearly illustrates, the number of solar related complaints, issues and cases recorded by state energy and water ombudsmen have increased dramatically over the past three years. Between 2009—10 and 2011—12 the NSW ombudsman recorded an almost 12-fold increase in complaints, while the Victorian ombudsman recorded a 4-fold increase.[182,183,184,185,186,187,188,189,190,191] In South Australia the number of cases more than doubled between 2010—11 and 2011—12.[192]

Figure 12: Increase in solar consumer complaints
Number of solar related complaints, issues and cases recorded by ombudsmen



Source: CPD analysis using data from EWOV[193,194,195,196,197,198,199], EWON[200,201,202] and EWOSA[203]

Consumer advocacy bodies need to consider solar consumers

In light of the low market power of solar consumers it is important that they are considered as a distinct group by consumer advocacy bodies. Federal and State governments are developing two new consumer advocacy bodies. However, neither has yet explicitly considered solar consumers.

At the request of the federal government, the Australian Energy Regulator is in the process of establishing the Consumer Challenge Panel to ensure the needs of all consumers are considered in decisions on the energy networks' revenue determinations.[204] While it remains to be seen whether the unique needs of solar consumers will be represented by this panel there is very little evidence to suggest this will be the case.

Through the Council of Australian Governments, the Standing Council on Energy and Resources (SCER) has also commissioned a proposal to set up a National Energy Consumer Advocacy Body.[205] Its purpose is to ensure consumers are able to effectively engage with governments, market bodies and the energy industry at a national level, and to have their interests considered in energy market decision-making processes.[206] At present these processes are often too complex, technical and time consuming to be accessible to consumers and existing advocacy bodies.

At this stage it is not possible to determine what form this new advocacy body will take but it is likely to resemble the model proposed by an alliance between the Consumer Action Law Centre, Consumer Utilities Advocacy Centre, Public Interest Advocacy Centre, Australian Council of Social Service, and the Alternative Technology Association.[207] Their proposal makes no explicit mention of solar consumers and it is therefore uncertain whether their unique needs will be championed by a new body crafted around such a proposal.[208]

Even if solar consumers are adequately represented by these new advocacy bodies, it may not be enough to protect their interests. As discussed previously, the threat posed to 'gentailer' profits by rooftop solar is significant and the level of market power and access to information is so heavily weighted in the utilities' favour that it would be challenging for any consumer advocacy body to get traction.

If this proves to be the case, a stronger regulatory approach may be required – particularly if around a million new solar households become disenchanted with the status quo. A recent poll by Essential Media suggests this is more likely than not – power companies are considered the least likely industry to act in the public interest, falling well behind the Banking, Mining and the Media industries, with only 18 per cent of those polled indicating they trust the industry.[209]

Regulators should set minimum regulated feed-in tariffs, with higher peak prices

As old feed-in-tariffs expire and new households install solar, an increasing number of consumers will be negotiating the price they receive for exported electricity directly with their retailer. The current one million solar households are guaranteed a feed-in-tariff (FiT) for power exported to the grid until at least 2016 in NSW, VIC and SA, and 2028 in QLD. New solar consumers fall under different regulations.

Some state regulators are now setting optional, or benchmark, feed-in-tariffs that retailers are not required to comply with. In a perfectly competitive market, consumers would be free to keep switching to the highest bidder until they got a fair price. However, some markets are failing to price solar electricity competitively.

In New South Wales, the retail market is falling short of delivering a competitive price on electricity exported by solar consumers. Feed-in tariffs are set by the market, but guided by a recommended benchmark of 7.7 to 12.9 cents per kilowatt hour determined by the Independent Pricing and Regulatory Tribunal (IPART).[210] By comparison, the value of wholesale electricity purchased by retailers from the National Electricity Market is between 6.5 to 7.5 cents per kilowatt hour[ix].[211]

As Table 4 shows, of the eleven retailers operating in NSW, five do not offer a FiT payment to new solar consumers for any electricity exported. Of the six that do offer a FiT, two offer prices below the wholesale cost of electricity, three offer the lowest recommended rate and one offers a rate marginally above the low end of the benchmark rate.

Table 4: Feed-in tariffs offered by NSW electricity retailers

	Value (cents per kWh)
Regulator's benchmark	7.7 to 12.9
Retailer's offerings	
AGL Sales	8.0
Energy Australia	7.7
Lumo	7.7
Power direct	7.7
Origin Energy Electricity	6.0
Red Energy	5.0
ActewAGL Retail	-
Australian Power and Gas	-
Dodo Power and Gas	-
Integral Energy	-
Momentum	-
Wholesale cost of electricity	6.5 to 7.5

Sources: IPART, no date[212]; Frontier Economics, 2012[213]

As a safety net, regulators should set a minimum regulated tariff for solar electricity exports, with a higher price paid at peak times. This would recognise that solar produces electricity at times when wholesale electricity prices are high.

ix This wholesale energy value was calculated using a market-based approach including hedging costs.

Regulatory frameworks should provide incentives for managing peak demand and network costs

Prices for solar electricity exports should signal the full value it provides, to make the most of benefits across the electricity system. This would include not just the value of exported electricity to retailers, but any longer-term benefits of avoiding network upgrades. Regulatory frameworks should reflect this principle, and be designed to pay full value for solar electricity as the industry structure shifts toward decentralised energy and demand management.

Solar consumers are more actively engaged in managing their energy use than other consumers. [214,215] They are therefore likely to respond well to incentives to minimise their own consumption and maximise their electricity export at times of local peak demand. These incentives should recognise that rooftop solar exports electricity during hot sunny periods when demand is likely to push some networks to capacity. They should also recognise that rooftop solar can help avoid the costs of network upgrades in some locations.

The current electricity industry structure makes it difficult for feed-in-tariffs to reflect the full value of rooftop solar. In all states but Western Australia, the separation of retail, distribution and generation means that no single business in the supply chain can capture the full value of distributed generation and energy efficiency.[216] The introduction of smart meters and time-of use pricing may partly overcome this, making it easier to pay full value for solar electricity. Regulatory frameworks should be prepared for an inevitable shift to cost-reflective pricing.

However, specific regulatory changes could immediately send clearer price signals to solar consumers to manage peak demand and reduce network costs. For example, retailers could be required to pay a higher feed-in-tariff for solar electricity exported on hot summer afternoons, and other times of peak demand, to reflect the higher wholesale value of electricity provided to the grid.[217,218] Periodic reviews of network costs and demand for increased capacity could also identify where rooftop solar can help avoid grid upgrades, and require distribution companies to pass some of this value on to solar consumers.[219]

The following chapter looks at issues Australia will need to address to maximise the benefits for the whole community as the penetration of rooftop solar increases.

Energizing communities: making rooftop solar work for all

Rooftop solar can benefit all consumers. In the near term, it lowers wholesale electricity prices, particularly on hot summer afternoons.[220] In the longer-term, it could help avoid future network investment in some locations.[221] Solar policies should be redesigned to make the most of these benefits. In particular, the Renewable Energy Target should maintain a separate small-scale scheme, since rooftop solar provides benefits that complement larger renewable electricity technologies.

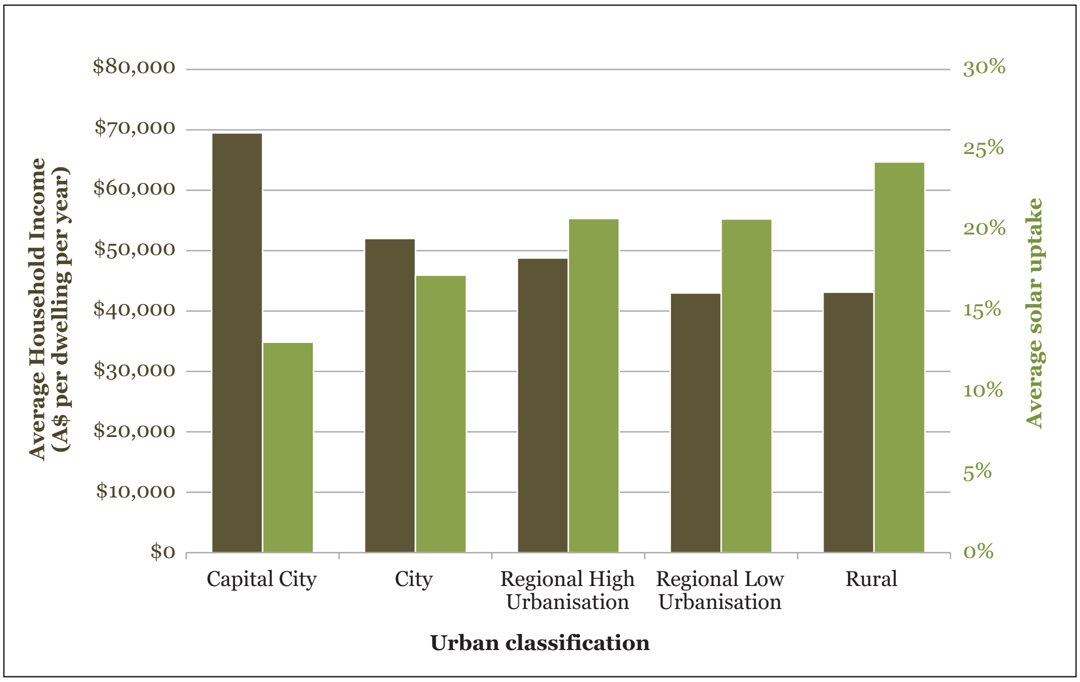
In theory, Australia's current electricity system can accommodate more than the 2 million solar households expected by 2020. However, it is possible that real-world barriers to installation, if not appropriately managed, may lead to inequity between those who have access to rooftop solar and those who do not. Most of the take-up so far has been by middle-income households who own their homes. At present, hurdles are grid instability, lack of access to finance, and lack of rooftop access.

There are unlikely to be binding constraints to the uptake of rooftop solar. Research and development of simple technical solutions could increase grid flexibility to support high levels of decentralised generation. Innovations in financing and community investment models could open up rooftop solar to renters, apartment dwellers and low income households. Their success will depend on governments' willingness to provide network businesses with incentives to adopt solar, and to reduce red tape.

Rooftop solar buys mortgage-belt insurance, not inner-city votes

Contrary to popular belief, the rapid uptake of rooftop solar has not been limited to urban greenies (see Figure 13). In fact, uptake (defined in this instance as the percentage of dwellings with rooftop solar installed) has been much higher outside urban areas. This is due to the fact that electricity prices tend to be higher outside urban areas and supply can be less reliable. Uptake has also been higher in mortgage belt areas than higher-income areas.

Figure 13: Income and solar uptake by urban classification[x]



Source: CPD analysis of data from RAA[222]

The typical household living in an area with high solar uptake resembles Julia Gillard's 'working family' – one or two parents over the age of 35 supporting several children under the age of 15 on an income around the national average whilst paying off a mortgage on a house in a low-density area (see Table 5). These households are often financially stretched and are particularly sensitive to any increase in their cost of living (see the case studies on page 38). Investing in rooftop solar is an opportunity for such households to hedge against rising electricity prices.

In contrast, low solar uptake tends to have occurred in densely populated areas where average household incomes are either in the top three deciles or the lowest decile.[223] Although some households on low incomes have installed rooftop solar, for many the upfront cost of investing in solar is too great.

x Urban classification is as per the following ATO criteria: Capital City (capital cities of each state), City (>50,000 people), Regional high urbanisation (10,000 to 50,000 people), Regional low urbanisation (3,000 to 10,000 people), Rural (<3,000 people).

Table 5: Characteristics of postcodes associated with high and low levels of solar uptake

Postcode characteristics	High solar uptake	Low solar uptake
Population density (people per square kilometre)	Low	High
Weekly household income (gross)	$1,000 - $1,700	>$1,700
Population age	A high proportion of the population is between 35 and 74 years of age.	A high proportion of the population is between 20 and 34 years of age.
Homes owned or mortgaged	Higher	No relationship
Population with poor English	No relationship	Higher proportion

Source: Seed Advisory, 2011[224]

Tom goes solar to save

When his quarterly electricity bill arrives, Tom takes a deep breath before opening the envelope. "It's always going up and there's always some excuse we're given for that," says Tom, who works in detention security. "Power bills are taking such a big slice of our budget that we decided we had to reduce our electricity bills to save money."

Tom and his wife, aided by a State Government rebate, installed solar panels on the Brisbane house they share with two adult children. "That seems to be working. It helps us afford it. But we probably wouldn't have got the solar if we hadn't had the subsidy."

Tom says households on modest incomes should receive government support to install solar panels and other cost savers.

Source: United Voice, 2012[225]

Western suburbs power pain

For an average middle-income household in the Sydney's Western suburbs, with three kids and the usual appliances such as heaters and air conditioning, each electricity price increase is painfully felt. That's why George Vatis decided to invest in a solar system powerful enough to eradicate his bills forever.

"The reality is that we are facing ever increasing power costs", said Mr Vatis.

With a typical consumption of around 20kW per day, Mr Vatis was receiving bills of around $370 a quarter. While the kids are at school, one adult is generally home during the day.

Since the system was switched on in November 2010, the panels have generated close to 4,000 kilowatt hours and Mr Vatis has received a cheque for over $2,000, income generated from NSW's gross feed in tariff, under the old rate of 60 cents (there have been changes to the feed in tariff since then).

"I think a net feed in tariff is more sustainable and the state government should raise the tariff again. Solar system owners should get paid the same amount for every kilowatt hour they feed back to the grid as what electricity retailers charge. It's only fair."

"We're your average working family, we don't earn enough to absorb these price rises. I went solar because I never wanted to pay another electricity bill again."

Source: Energy Matters[226]

Rooftop solar benefits all consumers

As with all renewable electricity, rooftop solar can reduce wholesale electricity prices. Firstly, adding extra generation capacity to the electricity system puts downward pressure on wholesale electricity prices simply by increasing the amount of supply compared to demand. Secondly, once the initial investment in renewable generation is made, it produces electricity at virtually no cost. This can cause wholesale electricity prices to drop significantly at times when a lot of rooftop solar is producing electricity.

Known as the 'merit order effect', this has already significantly eaten into the profits of coal-fired generators. For example, in South Australia, reduced demand for electricity from midday to mid-afternoon reduced generator revenues by almost 90 per cent between 2007-09 and 2011-12.[227] This contributed to a 90 per cent decline in the annual wholesale revenue generators receive from retailers.[228] Modelling suggests Australia's current level of rooftop solar would have reduced wholesale electricity revenues by A$300 to A$670 million, or 4 to 7 per cent based on prices in 2009 – 2010.[229] These reductions should benefit all consumers, if they are passed on by retailers.

Declining demand has also contributed to lower wholesale prices and generator revenues. As recently as 2008, the electricity industry would have been banking on 2 per cent growth a year, yet average demand has since been falling at around 2 per cent a year.[230] Summer peak demand has also softened in the last few years.[231] Wholesale electricity prices have dropped to record lows, down around 40 per cent from just a few years ago.[232] Rooftop solar has contributed to these trends, as it not only adds extra supply to the electricity system, but reduces demand for centralised, grid supplied electricity. However, reduced manufacturing activity and increased consumer energy efficiency are also likely drivers.

Both declining electricity demand and rooftop solar also affect network costs. Some fear that these trends will lead to a 'death spiral' in which rising network charges drive falling electricity consumption, leading to further rises in network charges.[233] Once investment is sunk into networks, its costs have to be paid by consumers. As electricity consumption falls, the charge per kilowatt hour for poles and wires rises. Because of networks high fixed costs and low variable costs, lower demand leads to higher prices. Consumers would then have a greater incentive to improve energy efficiency and invest in their own supply of power, making it even harder for distribution businesses to forecast how much to invest in poles and wires.

An unjustified fear is that some solar households will disconnect from the grid, leaving other consumers to pay higher prices. While some consumers in remote locations will choose solar as a way of achieving energy independence, this is unlikely for most of Australia. The cost of battery storage for extended winter electricity needs is likely to remain too high to justify going entirely 'off grid'. A more plausible outcome, if network costs rise, is that some solar consumers will use the grid as a ''battery' to back up their own supply. This would mean effectively 'logging on' to the grid only when needed, and would reduce their utilisation of the grid below that of other consumers. Queensland's electricity regulator has suggested solar consumers should be levied with higher per kilowatt hour network charges to reflect their lower use of the grid.[234] However, this would send a perverse signal to solar consumers to further reduce their use of grid supplied electricity. It would also mean missing an opportunity to encourage solar consumers to export electricity at times of high local demand, which could help defer future network upgrades. From an equity perspective, it is unreasonable to levy solar consumers with higher network charges unless there is clear evidence they contribute to significantly higher costs – particularly as this is not done for owners of airconditioners.

In fact, rooftop solar can avoid or defer the cost of network upgrades, particularly in rural areas. In rural areas, a lot of poles and wires are needed to service relatively few households, leading to high network costs and high electricity losses during transmission and distribution. Upgrading these networks to cope with increased demand, particularly peak demand, is expensive. Rooftop solar can help defer some of these costs by providing localised electricity generation that doesn't need extra grid capacity. As discussed below, the benefits of avoided network upgrade costs may well outweigh the cost of integrating solar into the grid in some locations.

Australia can avoid an eventual 'death spiral', if we get the policy settings right. Recent reviews to encourage demand management, changes to the way network capital spending is approved, and assessments of the efficiency of distribution companies are all good steps toward more efficient use of capital investment. However, they will need to be combined with better forward planning and cost-benefit assessment of network upgrades that consider the long-term benefits of demand management and decentralised generation, rather than just the upfront costs. Distribution companies and other players will also have to recognise that profit-making must shift from increasing the volume of electricity sales to improving the quality of electricity services.

However, there is a danger that governments will respond to all these reviews with an ad-hoc mix of reforms that tinker at the edges of our electricity market, adding complexity without realising the full benefits of demand management and decentralised generation.

Networks should be able to accommodate more than 2 million solar households

In theory, Australia's current electricity system can accommodate more than the 2 million solar households expected by 2020. Australia has a flexible electricity market able to manage fluctuations in demand and supply. If rooftop solar is distributed over a wide area, its output will be smooth and predictable. There has been no significant impact on the operation of the wholesale market due to rooftop solar to date.[235]

However, physical constraints in some areas of the grid may limit the uptake of rooftop solar as installed capacity increases. For example, where many houses on the same street have solar, voltage can fluctuate leading solar systems to shut down suddenly.[236] Networks may also need to support electricity flowing out of local areas when the sun is shining but demand is low. Information on where this constrains solar uptake, at what level of installed capacity, and the costs of augmenting networks to remove constraints is limited.[237]

We need to better understand where the real-world barriers to rooftop solar are, and the lowest cost options for overcoming them. For example, innovation in simple technical solutions to enable networks to cost-effectively support higher levels of decentralised generation lags behind research into renewable technologies. [238] Given our high levels of rooftop solar, focusing research on this area could be an industry development opportunity for Australia.

As a start, a review of standard connection requirements for rooftop solar could consider how the components which convert electric currents into grid power can reduce network voltage fluctuations. Another promising area of research is integrating household batteries with rooftop solar. This could avoid voltage fluctuations, and may allow stored solar electricity to be exported at times of high demand.

Grid instability in rural areas

Innovation in reducing network barriers to high levels of rooftop solar should focus first on rural areas. Rural networks are most likely to constrain solar uptake in the short-term. Yet as discussed above, the long-term benefits of avoiding or deferring rural network investment can be high.

Modelling conducted by the CSIRO found that in urban areas, networks could tolerate up to 40 percent solar penetration with a change in voltage too small to be noticed by customers (+/- .35 volts).[239] The same study found rural networks could tolerate 10 percent penetration with voltage fluctuating by only 0.8V, which the CSIRO believed would 'probably go unnoticed by customers'. However at 40 percent solar penetration the voltage fluctuated by up to 4 volts.[240] This variation is high enough to negatively affect the stability of the grid.

Currently rooftop solar in rural areas is at 24.2 percent solar penetration on average, which sits between the safe level of 10 percent and the unstable level of 40 percent (see Appendix for calculations). However, this will be higher in areas where a lot of rooftop solar has been installed. Anecdotal evidence suggests some distribution businesses are already restricting the size of rooftop solar systems to prevent voltage fluctuation.[241]

To ensure potential solar customers in rural areas are not disadvantaged by being refused access to the grid, technical solutions need to be rapidly developed. Some examples of measures suggested by the CSIRO report include network storage, load management, and generation curtailment at different levels of solar penetration.[242] They also recommended high resolution solar data be collected to enable more accurate forecasting systems to allow for long- and short-term network management.

One utility leading the charge in this area is Horizon Power. They have introduced location-based feed-in tariffs and feed-in management systems to ensure solar is installed where it is most needed without compromising the stability of the grid (see Box 4 below). Horizon Power is an integrated electricity utility which manages power generation, electricity transmission, distribution and retail customer services. Unlike electricity businesses in many other parts of Australia, Horizon Power can capture the benefits rooftop solar provides by deferring or avoiding expensive network investment in rural areas.

Box 4: Horizon Power - location-based tariffs and generation management systems

Western Australia's Horizon Power is the first utility to price solar-generated electricity based on the location of generation. Most remote communities in WA are powered by diesel generators with expensive fuel costs, while rural communities often place high loads on long feeder lines resulting in large transmission and distribution losses. Rooftop solar offers a means of supplying electricity to these areas at a lower cost in the long-term than the incumbent power supply options.

In mid-2012 Horizon Power introduced new location-based feed-in tariffs ranging from 10c per kWh in metropolitan areas to 50c per kWh in remote areas as a way of incentivising rooftop solar uptake where the need is greatest – in rural and remote communities.[243]

Horizon Power is also leading the way in resolving the issues of voltage fluctuations and variable supply. The utility has begun approving applications for 'generation managed' systems in rural and remote communities where solar was previously restricted to protect the grid from the effects of variable supply on network stability and security.

Generation managed systems resolve supply variability by controlling and/or storing the power produced by solar systems either remotely or onsite. Horizon Power install a feed-in management subsystem behind the meter which communicates via a two-way radio link with their "power control system" to control the amount of electricity fed into the grid by the solar system to maximise capacity and network stability.[244] When solar generation output varies, the power control system communicates with the feed-in management subsystem which then prevents excess electricity from passing into the grid.

Horizon Power may also require that customers install onsite battery storage to enhance network stability.[245] During sunny periods, Horizon Power can divert rooftop solar electricity to batteries which can then be drawn into the grid when the sun is not shining.

Policies should support equitable access to rooftop solar

Attention should also be directed to giving lower-income households, renters and apartment dwellers access to solar. Most of the take-up so far has been by middle-income households who own their homes. Low income households, renters and strata apartments have been under-represented.

Equity considerations will become increasingly important should governments fail to address the drivers of rising network costs, and risks of price spikes. Low income households and renters are most exposed to bill shocks, yet face barriers to investing in rooftop solar to hedge against sudden electricity price rises. Apartment dwellers also face barriers due to lack of rooftop access and complex strata arrangements and requirements for retailing electricity.

Innovations in financing and community investment models could open up rooftop solar to consumers within these groups who have a good credit rating. The success of such schemes will depend on governments' willingness to reduce red tape. As the uptake of rooftop solar spreads, the Commonwealth Government should also direct attention to ensuring low-income households, who may not otherwise be eligible for finance, are able to participate.

Lack of finance and lack of rooftop access

Households on low incomes may lack the funds required to purchase a rooftop solar system outright, and those who are either renting or own a dwelling without access to a sunlit roof may be prevented from installing a system. Approximately a quarter of all dwellings in Australia are rented[246] and just over a fifth of all households are classed as low income (see Table 6).[247] It is likely that there is a significant overlap between these groups, nonetheless, this means a large proportion of Australian households are currently unable to take advantage of rooftop solar.

Table 6: Renting and low income households[xi]

	Renting Households	Low Income Households
Total number	2.3 million	1.7 million
Percentage of all households	24.7%	20.4%

Source: ABS[248, 249]

As Box 5 explains, some of these households are the most vulnerable to rising electricity prices.

xi The number of low-income households was measured in 2009/10 while the number of renting households was measured in the 2011. The "percentage of all households" was calculated using the number of total households recorded in 09/10 and 2011 respectively.

Box 5: Hardship caused by rising electricity prices

Cost of living is a concern for many Australians. In a recent survey, twice as many people put rising utility bills as their greatest concern, compared to job security, the global economy or economic management[xii].[250] More than half of all consumers surveyed said they had dipped into their savings to help make ends meet.[251]

The perception that rising electricity costs are hard to keep up with is true for renters and low income households, but less of a problem for average Australians. While electricity price rises have been well above inflation of other consumers goods, they still take up a relatively small proportion of disposable income for most households. The real household budgeting issue is that double digit increases in prices, year on year, comes as an unexpected change.

Low income households are most vulnerable to rising electricity prices. As Table 7 shows, the percentage of total weekly expenditure spent on electricity is two times higher in low income households than high-income households.

Table 7: Household expenditure on domestic energy by income, 2009—2010
A$ per week

Household income	Weekly expenditure on domestic electricity	Total weekly expenditure on all goods and services	Change
Lowest 20 per cent	17	559	3.0%
Second	21	815	2.6%
Third	23	1,169	2.0%
Fourth	27	1,479	1.8%
Highest 20 per cent	33	2,160	1.5%
All households	24	1,236	1.9%

Source: ABS[252]

Energy bills can come as a shock to many households. Low income households spend more per week on electricity than they do on other household essentials including petrol ($16), clothing and footwear ($15), and personal care ($11).[253] A quarterly bill of $286 is a large sum to find on a tight budget[xiii].

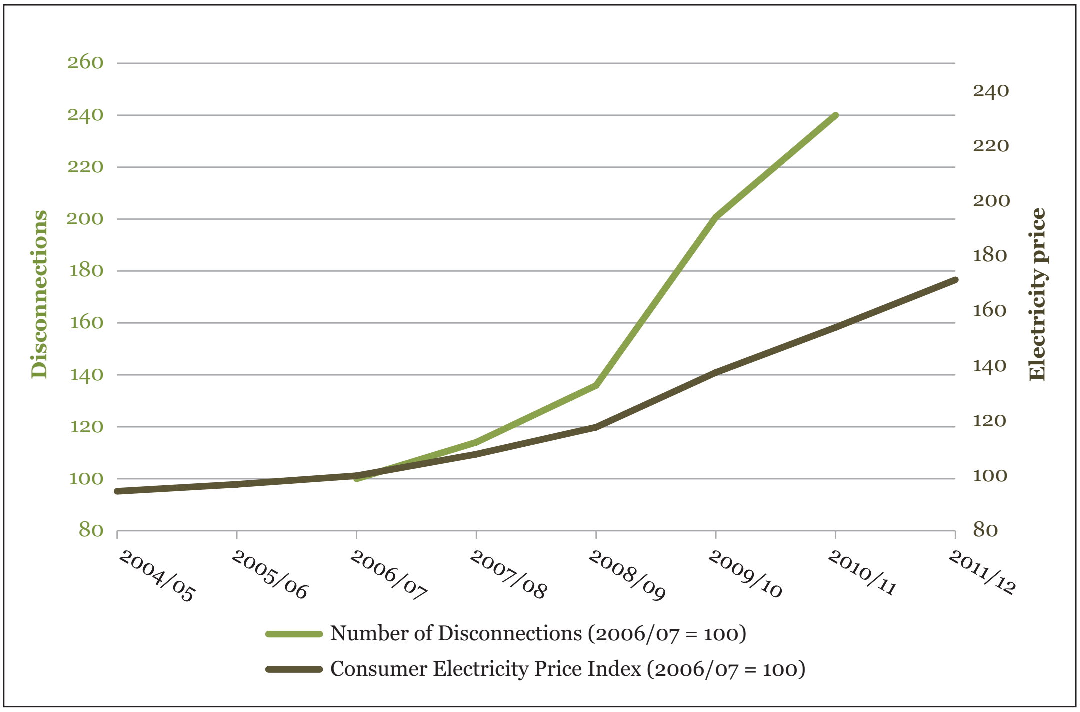
This 'bill shock' is reflected in the significant increase in the number of electricity disconnections recorded by state ombudsmen. As Figure 14 illustrates, the rise in electricity disconnections has closely followed the steep rise in electricity prices.

Over 7,000 electricity customers were disconnected in 2010-11, twice as many as in 2007—08.

xii Of 1,000 people surveyed, 22 per cent put rising utility prices first compared to 11 per cent for job security, the state of the global economy or economic management by the Commonwealth Government.

xiii CPD estimate based on $22 weekly expenditure on energy by the 20 per cent of households with lowest incomes.

Figure 14: Australian disconnections and electricity prices



Source: CPD analysis using data from ABS[254] and Consumer Action Law Centre[255]

Innovations in financing and community investment could be the solution

The barriers to investment caused by low income and lack of rooftop access may be overcome through financing innovations. 'No-money-down' solar-leasing schemes underwritten by large financing deals by big banks such as Goldman Sachs and US Bancorp have financed the majority of rooftop solar installations in the United States. These schemes allow customers to install a solar system and insulate themselves from rising electricity prices without incurring the up-front cost. One of the leaders in this area, US company Sungevity, recently established a scheme in Australia and a few local companies have followed suit. If these schemes are as successful in Australia as they have been in the US, they are likely to open up the low-income market and accelerate solar uptake.

Virtual metering could bring the benefits of rooftop solar to renters and other households without access to a sunlit roof. Virtual metering - or "community solar" as it is often known - allows multiple customers to invest in solar panels installed on the roof of their apartment, or on the rooves of nearby buildings. The electricity produced by these panels is fed back to the grid and the customers receive credits on their electricity bill for this electricity.

However, both new financing and virtual metering will require some level of government policy support to overcome potential hurdles. This could include reducing red tape for innovative financing and ownership options. For example, standardising contracts and business models could speed industry development and support consumer protection. Reducing complex strata arrangements and requirements for retailing electricity could allow apartment dwellers to invest in rooftop solar. To address equity concerns, governments could also offer low or zero-interest loans to low-income households which lack sufficient credit ratings to access finance.

Recommendations

We need a tailored set of policies to maximise the benefits of rooftop solar to all Australians. In particular, we need to:

1. **Maximise uptake of rooftop solar, to make the most of its benefits**
   - » The Commonwealth Government should maintain the current Renewable Energy Target, and the small-scale scheme.
   - » The Australian Energy Regulator should require network operators to conduct cost-benefit analyses on integrating high levels of rooftop solar. This should consider the benefits solar could provide by deferring further spending on electricity network infrastructure.
   - » State governments should ensure that solar consumers are not levied higher network charges than other consumers, unless there is clear evidence they contribute to significantly higher costs.
2. **Ensure that financial incentives send a clear signal to rooftop solar consumers to manage peak demand and network costs**
   - » State governments should set minimum regulated feed-in-tariffs to ensure retailers pay full value for solar electricity exports. Rates should be higher at peak times, when wholesale prices are high.
   - » The Australian Energy Regulator should require distribution companies to pass some of the value of avoided network augmentation costs on to solar consumers, where they help defer network capital costs.
   - » Smart-meter standards should be designed to allow solar exports to receive real-time prices when networks are at maximum capacity.
3. **Ensure consumer advocacy bodies explicitly consider the interests of solar consumers**
4. **Invest in innovation to ensure that our electricity grids are flexible enough to support higher levels of rooftop solar**
   - » Review national standards for rooftop solar inverters so they actively assist in managing voltage variations.
   - » Support trials of small battery technologies for managing voltage variation and demand.
5. **Develop policy measures to support renters, apartment dwellers and low income households to access the benefits of rooftop solar.**
   - » Reduce red tape for innovative financing and ownership options. For example, develop standard contracts and business models for ownership and operation of solar on strata roofs.
   - » Offer low or zero-interest loans to households who can't access innovative financing.

Appendix: Methodology

Number of solar households and uptake rates

The current capacity of rooftop solar, and number of solar households were obtained from figures published by the Clean Energy Regulator.[256]

The current uptake was calculated by dividing the current number of solar households by the total available market which was estimated as the combined number of separate houses and semi-detached houses (7,637,578) as identified in the 2011 Census.[257]

The 2020 forecast capacity figure of 5.1 GW was taken from the AEMO Rooftop PV Information Paper.[258]

The 2020 forecast number of solar households was calculated by dividing the forecast total capacity by the historical average installation size of 2.413kW, giving 2.1 million households.[259]

Finally the forecast 2020 uptake was calculated by dividing the total projected number of solar households by the projected available market (9,190,765) which was estimated by plotting the number of houses and semi-detached houses recorded in the past three Censuses and extrapolating along the trendline to the year 2020.[260][261][262]

Solar penetration rates

To calculate the rural and urban penetration rates we relied on the CSIRO definition of penetration as 'the total nameplate capacity of solar PV installed in an area expressed as a percentage of the total load in that area.'[263] With the exception of the average historical size of installations figure, which was obtained from the SGU register[264], all the figures relied on for our calculations came from the RAA's 'Geographical analysis of solar systems under the Renewable Energy Target'.[265]

Total urban nameplate capacity was calculated by multiplying the total number of systems installed in urban Australia (853,763) by the average historical size of installations (2.413 kW)266 to produce a total capacity of 2,060,130kW.

To calculate the total urban load we multiplied the total domestic load by the percentage of all households living in urban areas. Total domestic load was calculated by converting the annual demand of 185,938 GWh into kilowatts by dividing it by the number of hours in a year (8765) and then multiplying the resulting figure by 1000000 to convert gigawatts into kilowatts. This calculation follows the following formula P(kW) = E(kWh) / t(hr)

This results in a total domestic load of 21,213,690 kW which was then multiplied by the percentage of all households living in urban areas (30.3%) resulting in a figure of 6,427,748 kW.

Urban solar penetration is therefore the total urban solar PV nameplate capacity (2,060,130kW) divided by the total urban load (6,427,748 kW) which is approximately 32.1%.

The rural solar penetration rate was calculated in the same manner as urban penetration. First, we calculated rural nameplate capacity of solar PV by multiplying the total number of systems installed in rural Australia (221,584) by the average historical size of installations (2.413 kW) to produce a total capacity of 534,682 kW.

To calculate the total rural load we multiplied the total domestic load of 21,213,690kW(as calculated above) by the percentage of all households living in rural areas (10.4%). This produced a total rural load of2,206,223kW.

Rural solar penetration is therefore the total rural solar PV capacity (534,682kW) divided by the total rural load (2,206,223 kW) which equals 24.2%.

Retailer windfall profits from RET

To estimate the windfall profits retailers made from small-scale renewable energy certificates in NSW, we multiplied the number of certificates retailers would have purchased by the difference between the spot price and the clearing house price.

The number of certificates was arrived at by multiplying the 2012 Small-scale Technology Percentage (23.96%) by the total electricity consumption in NSW in 2011/12 (59,434,000 MW) to determine the number of STCs that retailers would have purchased.

This figure was then multiplied by the difference between the spot prices of $25 and $31.70 and the clearing house price of $40 ($8.30 and $15).

Average household bills

To estimate the impact of changes in electricity price on an average household bill, we assumed a consumption of 7,000 kilowatt hours per year. This is based on the assumption used by the Climate Change Commission in their RET Review.[267]

To estimate the cost of retailer marketing expenses, we estimate 25 per cent of customers switching retailer per year[268], at a cost of $200 per customer.[269] Since this is spread across all customers, each would see an impost of $50 (25 per cent x $200) on their bill.

To estimate the increase in network charges we multiplied the change from 7.5 cents per kWh in 2007[270] to 11.7 cents per kWh by June 2012[271] by average household consumption of 7,000 kWh per year.

Drivers of price risks

To estimate possible future price risks, we developed scenarios for rises in electricity prices and multiplied this by average household consumption.

Gas
We considered a medium and high scenario for both gas prices, and the percentage of electricity provided by gas-fired generators:

» Medium scenario - $12/GJ gas price, 20 per cent of electricity from gas in 2020
» High scenario - $16/GJ gas price, 40 per cent of electricity from gas in 2035

We then estimated an increase in the cost per MWh of gas fired electricity, assuming a current gas price of $4/GJ and a gas heat rate of 7GJ/MWh.

This increase in the cost per MWh of gas fired electricity was multiplied by the percentage of electricity from gas to estimate the average electricity price increase.

Drought
We analysed the increase in wholesale electricity prices from 2005—06 to 2006—07 or 2007—08 for each National Electricity Market region to identify two scenarios for changes in electricity prices:

» Medium scenario – increase in prices in Queensland 2006—07 vs 2005—06
» High scenario – increase in prices South Australia 2007—08 vs 2005—06

Data was taken from AEMO's Average Price Tables.[272]

Notes

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4. Krister Aanesen, Stefan Heck, and Dickon Pinner, *Solar Power : Darkest Before Dawn,* 2012, http://www.mckinsey.com/client_service/sustainability/latest_thinking/~/media/5E847C563A734F148B5F3A6EFBD46E39.ashx.

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