CERAMIC FUEL CELLS

Submission

Thursday 3 May 2012

Power of choice – giving consumers options in the way they use electricity

Submission to the Australian Energy Market Commission

May 2012

1. Introduction

Ceramic Fuel Cells Limited welcomes the opportunity to make a submission to the AEMC's Directions Paper on demand side participation (DSP) and distributed generation.

For Australian consumers to be able to take advantage of distribution generation products, there are two market settings that need to be adjusted:

1. It must be simple and quick for consumers to install distributed generation and connect to the power grid;
2. The consumer must receive a fair payment for excess electricity they export to the grid.

These issues are not novel or unique. They have been overcome in many other markets and for other technologies. They can be overcome relatively easily given clear policy direction and Government implementation.

Ceramic Fuel Cells is an Australian company which has developed a world leading clean energy product. Our products use patented fuel cell technology to provide highly efficient electricity from widely available natural gas. A fuel cell is an electricity generator that converts gas into electricity and heat through an electrochemical reaction, without combustion or noise. Fuel cells can provide significant environmental benefits through high efficiency and low emissions

In August 2011 we made a submission to the previous round of AEMC's consultation process. In that submission we introduced Ceramic Fuel Cells and our BlueGen product –a small scale co-generation solution for homes and other buildings.

Ceramic Fuel Cells has received orders for more than 600 products from energy utilities and other foundation customers around the world. Over the last year our order book has increased by ten times. We have products installed and operating with customers in nine countries: Germany, the UK, Switzerland, The Netherlands, France, Italy, Japan, USA and Australia. In Australia we have BlueGen units operating in Melbourne, Sydney, Newcastle, Canberra, Adelaide and Brisbane. BlueGen units are available now for commercial customers through our distributors, Harvey Norman Commercial division and Hills Solar.

More details about BlueGen, including case studies and a carbon savings calculator, are available at www.bluegen.info. If you would like any further information please contact us.

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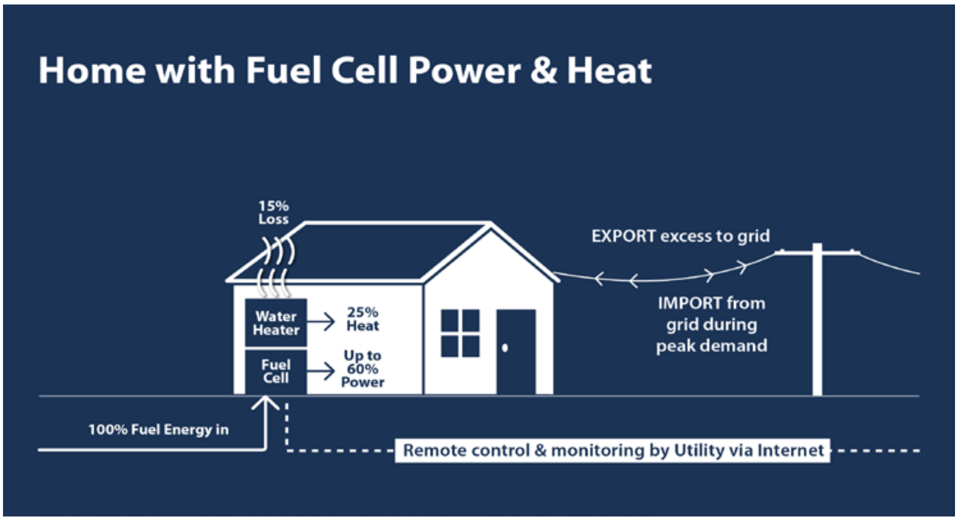
2. Comments on the Directions Paper

In this section we provide comments on some of the issues raised in the Directions Paper.

Products are Ready Now

It is important to recognise that distributed generation products are not merely an academic idea for the future – they are installed and operating today. There are now thousands of fuel cell systems installed and operating around the world, ranging in size from units for homes and small commercial and community buildings, up to large utility scale generators.



Ceramic Fuel Cells alone has almost 200 units operating with customers in nine countries. This number has gone up by almost 60 percent since the start of the year, and will continue to increase sharply as sales continue to grow – particularly in markets with supportive policy settings such as Germany and the UK.

Sydney Case Study: Fuel Cells in the Ausgrid Smart Home

Sydney, Australia
Ausgrid & Adams/Joyce Family
Installed Aug-2010

The Ausgrid Smart Home was created by Ausgrid and Sydney Water to trial the next generation of energy and water efficient technologies and distributed generation. An ordinary family home was fitted out with the latest energy efficient appliances as well as a 0.5kW thin film solar pergola, a 1kW rooftop solar panel, a 1.5kW BlueGen fuel cell unit and battery storage technology.

The Smart Home is located in Newington and was occupied by Clare Joyce, Michael Adams and their daughter Ava from July 2010 to January 2012. (A new family is due to move in from mid 2012.)

The BlueGen unit connects to the home's existing natural gas supply and converts this gas into electricity (to be used on site or sent back to the grid) and heat (providing up to 200 litres of hot water per day for the home).

When BlueGen was switched on in August 2010, the Smart Home went from being a net importer of electricity to a net exporter. During times of peak demand (i.e. more than 1.5 kW), the home imports electricity from the grid but in general, the Smart Home produces more electricity than it consumes. Average energy consumed by the Smart Home is between 17-27 kWh per day, with the average electricity generation (solar + BlueGen) of approximately 32 kWh per day.

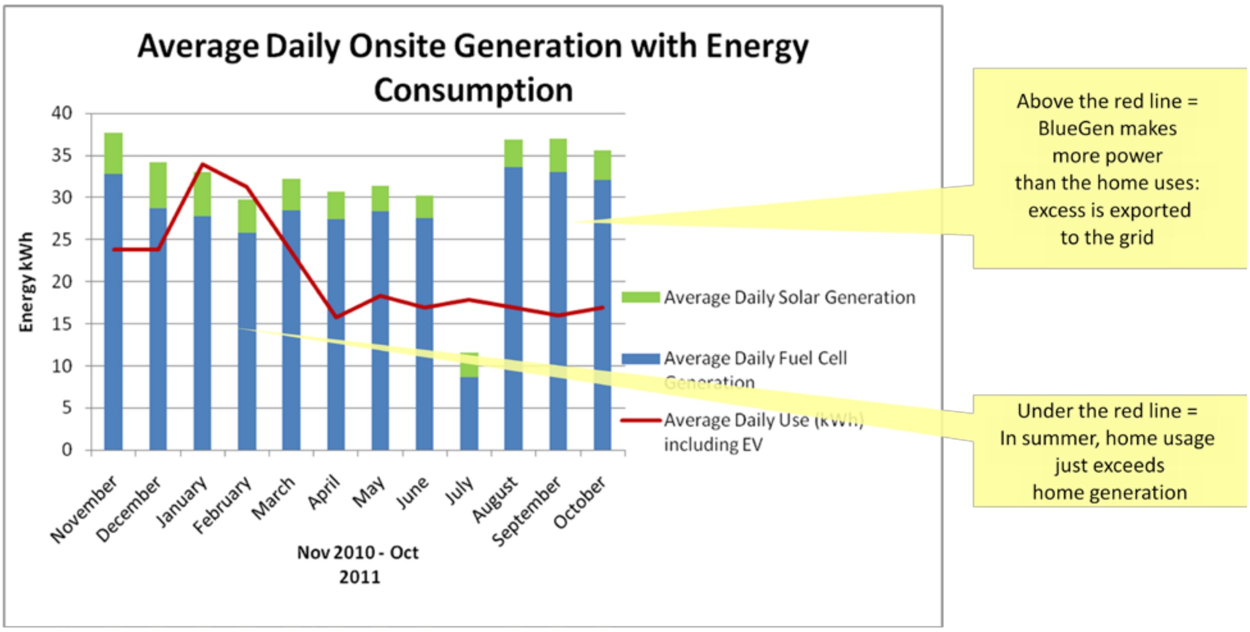
In February 2011 Ausgrid released the BlueGen results after six months:[1]

- Run time = 4,260 hours
- Electricity generated = 5,860 KWh
- Emissions saved (compared to NSW grid as per the National Greenhouse Accounts):
  - Carbon dioxide reduction = 4.22 tonnes (67% reduction)
  - SOx reduction = 120kg (88% reduction)
  - NOx reduction ` = 10kg (66% reduction)
  - Ash and soot reduction = 280kg (88% reduction)

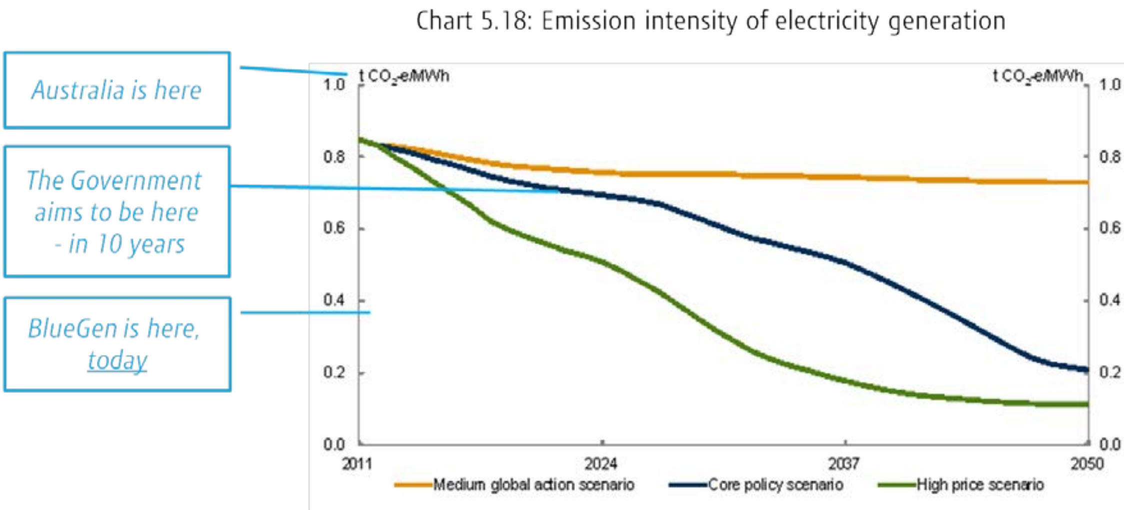
[1] http://www.smarthomefamily.com.au/blue-gen-cutting-down-carbon-emissions

In January 2012 Ausgrid published an overview of the Smart Home's energy performance over approximately a 12 month period.

- The BlueGen unit generated an average of 28 kWh of electricity per day, plus hot water.
    - This is **enough electricity for two average homes per year**.
- BlueGen **cut carbon emissions by 65 percent**, saving 6.9 tonnes of carbon
- The 1.5 kW solar PV unit generated 4 kWh per day and saved 1.4 tonnes of carbon.



As the following chart shows, the emissions from BlueGen are about one third of the current national grid:



http://www.treasury.gov.au/carbonpricemoelling/content/report/09chapter5.asp

The Ausgrid report concluded: *"For the vast majority of time, embedded generation at the Smart Home was able to produce much more electricity that needed by the family inside the home. In fact, it was on average producing almost twice the electricity used in a typical home. The fuel cell was the biggest contributor to on-site generation. However, there were some months when the home was still importing electricity from the grid. Typically, this was during summer and winter peak periods. However, the home was becoming close to attaining the goal of self-sufficiency towards the end of the trial period, after several modifications to battery systems and cooling system."*[2]

Following the Newington trial, Ausgrid has now installed 25 BlueGen units in homes in Newcastle as part of the *Smart Grid Smart City* project.

These BlueGen units were recently featured on a Today Tonight story about how consumers can take control of their energy bills.[3]

Other case studies are included with this submission and also available at http://www.bluegen.info/Case_studies. They include:

- Adelaide City Council installing a BlueGen as part of an Electric Vehicle (EV) charging station at Adelaide's Central Markets.
- 30 BlueGen units installed in public housing properties in metropolitan Melbourne and regional Victoria by the Victorian Government Office of Housing.
- German and Dutch utility Alliander installing BlueGen in Germany to complement intermittent solar and wind energy.

[2] http://www.ausgrid.com.au/Common/About-us/Newsroom/Discussions/~/media/Files/About%20Us/Newsroom/Discussions/Smart%20Home%20energy%20analysis.pdf
[3] http://au.news.yahoo.com/today-tonight/latest/article/-/13501222/power-saving-breakthrough

Integration with other DSP tools

Whilst BlueGen and similar products can create value for consumers on their own – by providing on-site power and heat for hot water – they can also be integrated with other DSP technologies to provide additional benefits.

Some examples are:

- On-site generation plus energy storage
  - For example in the Ausgrid home mentioned above, the BlueGen unit and the solar generators are integrated with a flow battery, to store power on-site. The generators charge the battery and a smart controller decides whether the power is used on-site, sent back to the grid, or used to charge the electric car.
  - This type of "home energy system" combining intermittent renewable power plus 24/7 low emission power, will become more widespread particularly as electricity tariffs become "peakier". The home energy system can import power from the grid at times of low tariffs, and then use the power during times of peak tariffs (or else export to the grid, to earn feed in tariffs).
- EV charging
  - As an extension of the home energy system, electric vehicles provide another form of energy storage (and load). Charging electric vehicles using low emission distributed generation provides far more social benefits (such as emissions reductions and higher efficiency) than using centralised high emission generators and placing more strain on the transmission and distribution network.
- Virtual Power Plants
  - A Virtual Power Plant is a cluster of distributed electricity generation units, controlled and operated by a central entity using integrated software systems. A Virtual Power Plant allows power generation to be modulated up or down to meet peak loads and balance intermittent power from wind or solar, with higher efficiency and more flexibility than large centralised power stations.
  - Energy companies in Germany and The Netherlands are well advanced in projects to deploy fuel cells and other controllable distributed generators to balance intermittent solar and wind power.
  - According to report from US analyst firm Pike Research, virtual power plant capacity will increase by 65 percent between 2011 and 2017, rising from 55.6 gigawatts (GW) to 91.7 GW worldwide during that period. In a more aggressive forecast scenario, the capacity growth is up to 126 percent during the same period. Releasing the report in November 2011, Pike Research senior analyst Peter Asmus said: "*Virtual power plants essentially represent an 'Internet of Energy', tapping existing grid networks to tailor electricity supply and demand services for a customer. They maximize value for both the end user and distribution utility, primarily through software innovations.*"[4]

[4] http://www.pikeresearch.com/research/virtual-power-plants

Installation and Grid Connection

For consumers to be able to receive the benefits of distributed generation, it must be simple and quick for them to install distributed generation and connect to the power grid.

One specific barrier in Australia is the process for having a new meter installed or re-programmed.

Physically installing a BlueGen unit is reasonably straightforward. Each unit can be installed by a qualified and trained plumber and electrician in less than a day.

BlueGen (like other distributed generators) needs a net meter to be able to measure the amount of electricity exported back to the grid. If the site does not have a net meter, one must be installed. If the site does already have a net meter, typically it must be re-programmed to correctly measure the power export. (Specifically, it must be programmed to allow a "B-stream" data feed, in order to measure credits on the electricity bill for power exports. Without this re-programming, the meter will treat the power being exported as a debit and not a credit on the customer's bill.)

Currently in Victoria net meters can only be installed or re-programmed by the local distribution network provider. (Our comments are based on experience in Victoria. Whilst the details may vary slightly in other States the central premise is the same.)

From our experience of installing BlueGen units in Victoria, the current process is:

1. BlueGen unit physically installed at the site by licensed and trained plumber, and connected to the grid by licensed and trained electrician.[5]
2. Electrician provides a certificate of electrical safety to the customer.
3. The customer asks their energy retailer to initiate a work request with the network provider.
4. The retailer gives the customer a work request form to complete and sign and return to the retailer, together with the certificate of electrical safety.
5. The customer returns the paperwork to the retailer.
6. The retailer submits this form to the network provider.
7. The network provider puts the work request into its system and gives the retailer a reference number.
8. The network provider attends the site to install or re-program the meter.
9. The network provider confirms to the retailer that the work has been done.
10. The retailer tells the customer.
11. The customer tells CFCL, and we can start up the BlueGen unit remotely.

This process is unnecessarily cumbersome, long and inefficient.

The connection process can be dramatically simplified and shortened by removing the monopoly on network companies installing or programming meters.

We suggest any electrician who has the appropriate grid-connect certification should be able to install or program a meter. Naturally they would need to co-operate with the network company and notify them of the work done, but this is not difficult or complex. At the truly small scale, e.g. 2kW, the network company is not adding any value or unique technical skill to the connection process. There is nothing needed from the network company which could not be done by a suitably trained and qualified 3rd party service provider.

[5] BlueGen is approved by the Australian Gas Association as an ordinary domestic "type A" gas appliance; and includes a grid connect inverter which complies with AS 4777 and is approved by the Clean Energy Council.

In this scenario a modified process would be:

1. BlueGen unit physically installed at the site by licensed and trained plumber, and connected to the grid by licensed and trained electrician.
2. Electrician installs or re-programs the net meter. (If the site does not have a net meter - electrician obtains one from the network company or direct from an approved supplier).
3. Electrician notifies the network company that the work has been completed (site address, size and type of the generator etc).
4. Electrician provides a certificate of electrical safety to the customer.
5. The customer tells CFCL, and we can start up the BlueGen unit remotely.

This is the process used in the United Kingdom. Under the UK's "G83/1" process, microgenerators (up to 50kW) can be connected to the grid with prior *notification* – not *approval*. In the UK, the BlueGen installer or electrician helps the customer to fill out a G83 form (or does it on their behalf) and registers the form with the network operator. As it is a notification and not an approval process, the BlueGen can then be commissioned immediately.

Feed in Tariffs

Policy Objectives

Once the consumer has installed distributed generation, to maximise the benefits the consumer must receive a fair payment for excess electricity they export to the grid.

In our view the problem that feed-in tariffs should address, in simple terms, is that ordinary homes and businesses who have excess electricity to sell cannot efficiently participate in the energy market. There are many reasons for this, which are well known from other markets – high transaction costs, imperfect and asymmetric market information, imbalance of market position etc. This is the core market reality that a feed-in tariff is designed to address- and a well designed feed in tariff is a very effective tool to address this problem.

Where feed-in tariffs have become clouded is that the design and rate of the tariff have been set to achieve other objectives, notably to support the solar PV industry as a form of industry development (and as a subsidiary goal, to reduce greenhouse gas emissions).

The most appropriate objective for a feed-in tariff is to allow ordinary homes and businesses to receive a fair and reasonable price for excess electricity they generate and export to the grid.

This policy holds true regardless of whether the technology is solar PV, other renewables or other small scale low emissions technologies.

This point has been recognised by several reviews and reports:

- The UK Government extended its feed in tariff to low emissions technologies (including small scale fuel cells using natural gas) for this reason:

  One of the prime reasons for introducing [feed in tariffs] is to remove the need for individuals and organisations whose primary business is not energy to participate in the electricity market.

  For small generators, finding buyers for their exported generation and achieving a reasonable price for it can be difficult and creates an extra burden that is disproportionate to the value of their exports. It is inefficient for non expert generators at the small scale to negotiate [power purchase agreements.[6]

- The Victorian Competition and Efficiency Commission, *Inquiry into Environmental Regulation in Victoria* 2009[7], recommended:

  That the Victorian Government in responding to challenges in a carbon-constrained economy, commit to the principle of providing for neutrality among renewable energy sources and those with low carbon emissions, particularly in the area of electricity generation and distribution.

  Specifically that Division 5A of the Electricity Industry Act 2000 be amended to extend the requirement for energy retailers to publish prices, terms and conditions for the purchase of electricity from a broader range of low-emission technologies.

- In January 2010 the Australian Academy of Science report on *Australia's Renewable Energy Future*[8] recommends a feed-in tariff for natural gas combined heat and power (CHP) domestic generation.

Dropping down to the next level of detail, the objective can be refined as follows:

- The policy should be targeted at *small scale* generators.

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[6] http://www.decc.gov.uk/en/content/cms/consultations/elec_financial/elec_financial.aspx
[7] http://www.vcec.vic.gov.au/CA256EAF001C7B21/0/C1FCD09796F81E39CA2576B300116152?OpenDocument
[8] http://www.science.org.au/reports/documents/AusRenewableEnergyFuture.pdf

- The rate must be fair and reasonable. It must reflect the full social value (positive externality) of the extra low emission electricity available in the low voltage network but conversely should not impose a cross-subsidy.
- The excess electricity must be lower in emissions than the grid, otherwise the tariff would perversely reward a negative externality rather than a positive externality.

This objective is economically defensible and has nothing to do with underwriting or subsidising a particular technology. It is, or should be, neutral among small scale low emissions technologies.

A regulated feed-in tariff is an efficient way of achieving this objective.

This objective also continues to be valid – and a feed-in tariff the necessary policy tool - regardless of whether a carbon tax or trading scheme is in place. They are different policy tools addressing different problems.

This has also been recognised in Germany and the UK (and many other markets), where feed in tariffs continue to operate well after the EU emissions trading scheme came into force.

Feed-in Tariffs in Other Markets

Many governments have recognised the benefits of expanding feed in tariffs to include *low emissions* technologies as well as renewable energy. Two notable markets where CFCL's BlueGen product is eligible for feed-in tariffs are Germany and the United Kingdom. The feed in tariff regimes are summarised below:

	Germany	**United Kingdom**
Size	Up to 50 kW	Up to and including 2 kW
Minimum Efficiency standard	Total efficiency of 70% or more	mCHP product must have at least 10% less carbon emissions than grid electricity plus a condensing boiler Independent testing and certification (Microgeneration Certification Scheme)
Design	Gross	Gross
Rate	~13-17 cents (~€0.11 – 0.14€) Generation tariff of 5.11 Euro cents per kWh generated For exported kWh: additional 4 to 7 Euro cents (quarterly average wholesale price) plus "avoided" grid usage fees of ~1.55 Euro Cents per kWh Plus: Energy tax exemption for gas used in BlueGen (0.55 Euro Cents per kWh of natural gas)	~ 21 cents (14.3 pence): Generation tariff of 11 pence per kWh generated; plus Extra 3.3 pence per kWh exported Rates are indexed to inflation.
Total benefit for electricity consumed on-site, including the avoided retail cost	About 45 cents (€0.37) per kWh	About 35 cents (24 pence) per kWh
Timing, caps	Started 2002 10 years per unit Current commissioning period until Dec 31, 2020	Started April 2010 Review after 12,000 units, cap of 30,000 units
Comment	In February 2012 the German Federal Parliament announced a proposal to **increase** the feed in tariff, including a bonus tariff for products like BlueGen with electrical efficiency above 50%. (~9-11 Euro cents per kWh instead of 5.11)	In February 2012 the UK Government announced plans to **increase** the generation tariff from 11p to 12.5p from October 2012 and committed to providing a level of feed in tariff support *after* the 30,000 cap is reached.

Factors to take into account

We suggest the following factors should be taken into account when assessing and designing feed-in tariffs:

- Clear Policy Objective:
    - The objective of the policy should be to allow ordinary homes, businesses and community groups to participate in the energy market and be paid a fair rate for the low emission power they export to the grid.
    - This applies regardless of whether a carbon tax or trading scheme is in place.
- Transparent, Certain and Simple:
    - A feed-in tariff policy should be transparent to give certainty over the long term, rather than be susceptible to 'boom and bust' cycles.
    - The policy must give certainty and be simple for ordinary consumers to understand. Any overly complex policy will not achieve its objective.
- Technology Neutral:
    - Any technology which is *small scale* and *lower emission* achieves the same valid policy objective and should qualify for a feed-in tariff.
    - The carbon tax and trading scheme – not a feed-in tariff -is the appropriate tool to distinguish between low and zero emissions energy.
- Minimise Costs:
    - Most States already have the regulations, systems and tools in place to implement and administer feed-in tariffs. We should piggyback off what we already have in order to reduce costs: for instance, using systems, tools and processes already in place for electricity distributors and retailers.
    - A feed-in tariff rate should be a fair and reasonable rate and should not impose costly cross-subsidies on other electricity consumers.

Our suggestions

Given these factors, we propose the following:

1. A uniform national feed-in tariff scheme should be put in place for small scale low emissions technology. The tariff can use the systems already in place in most States for solar PV systems.
2. The tariff should be a net tariff, paid on net exports to the grid.
3. *Small scale*: There are various definitions used by different tariff regimes, for example:
   a. 2kW UK tariff for small scale CHP including fuel cells
   b. 5kW Victorian solar tariff
   c. 50kW German tariff for small scale CHP including fuel cells
   d. 100kW Victorian "standard" tariff

   We propose 100kW or less as the definition of small scale.

4. *Low emissions*: We suggest that "low emissions" can be simply defined by reference to the existing emissions intensity of the national grid, which is already measured and reported in the National Greenhouse Accounts. Similar figures are already used in State Government energy regulations.[9] So long as a small scale generating technology has an emissions intensity of 50 percent less than the national grid, it should be classed as "low emission".
   The expert review panel advising the Federal Government on the set up of the Clean Energy Finance Corporation (CEFC) has adopted this measure as the definition of what low emissions technologies are eligible for CEFC funding. This threshold is currently 0.416 tonnes of carbon dioxide equivalent per megawatt hour of electricity generated.

   Commenting on this threshold, the CEFC expert report notes:

   > *This threshold is substantially less than the current intensity of the grid and represents a fair and appropriate cut off for low-emissions technology. The rationale for setting the threshold at 50 per cent is to encompass **fuel cells**, distributed electricity generation, cogeneration and trigeneration using gas. Where distributed generation produces both heat and power (cogeneration and trigeneration) an allowance will be made for the usable heat that is produced when calculating the emissions intensity. Alternatively, these could be funded as an energy efficiency project.* [10] *[Expert Review Panel report, page 7, emphasis added]*

   The report also comments specifically on feed in tariffs for residential distributed generation:

   > *Distributed low-emissions generation, such as cogeneration and trigeneration, has the potential to reduce peak demand on the grid because it is located near to energy users and its power output can be controlled by the owner of the unit. To deliver this outcome distributed generation must be able to export to the grid. The electrical capability of the grid and the lack of appropriate feed-in tariffs for distributed generation are inhibitors to the generation of electricity from these sources.*
   >
   > *The Garnaut Climate Change Review –Update 2011 observed that 'when the network company can profit from investing less rather than more, then it will seek ways to foster distributed generation and to set economically efficient tariffs.'*
   >
   > *Without the ability to export to the grid, smaller scale distributed low-emissions generation is limited to owners of buildings and businesses that can use the heat and*

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[9] For example retailers use this figure to calculate emissions on electricity bills under Guideline 13 of the Victorian *Electricity Industry Act*.

[10] The full report and submissions to the Expert Review panel, including Ceramic Fuel Cells' submission, are available at www.cefcexpertreview.gov.au.

power that these units generate on their own premises. The CEFC will be open to proposals from these parties.

However, for those parties that require the ability to export to the grid to make their projects economically viable, <u>a price for this generation would need to be secured</u> as economic viability is a prerequisite for CEFC funding. [Expert Review Panel report, page 34, emphasis added]

Translating this threshold into policy would require a product to meet certain minimum efficiency or emissions standards to be eligible: for instance, total efficiency of at least 70%. This is not overly difficult or costly: regulation already requires minimum performance or efficiency requirements for many products. This criteria could be administered by State Government bodies or approved industry groups (e.g. Clean Energy Council) or regulators (e.g. Australian Gas Association, Energy Safe Victoria etc).

5. *Technology Neutral*: We suggest a single rate is set for all eligible small scale low emissions technologies - this is far simpler to implement and administer than varying rates based on emissions intensities or abatement (which is already tackled by the carbon tax).

7. *Rate*: We suggest a fair and reasonable feed in tariff is the retail rate less an allowance of 20 percent for the retailer's cost and margin.

   Where States have existing one-for-one feed in tariffs (ie equal to the retail rate), the simplest option is to continue this policy and extend the one-for-one rate to other technologies.

   Intuitively, a 'fair and reasonable' rate is usually taken to mean a one for one tariff equal to the retail price. In Victoria, the Essential Services Commission, which oversees the feed in tariff regime, has confirmed that the fair and reasonable rate required by the *Electricity Industry Act* means a 'one for one' rate equal to the retail electricity tariff.[11]

   However a one-for-one rate does involve some cross-subsidies, because the electricity retailer which pays the rate needs to recover some costs and margin – which it passes on to other customers.

   Therefore the alternative is for a fair and reasonable rate to be set at something less than the retail rate, to reflect the retailer's costs and margin.

   Where a customer is on a standard retail tariff regardless of time of use, the discounted feed in tariff would also apply at all times. For example a standard rate of 22 cents per kWh less 20 percent would give a tariff of 17.6 cents.

   Where a customer is on 'time of use' rates (ie higher rates during peak times and lower off-peak rates) the tariff would be calculated as a 20 percent discount to the then-current retail rate, as already measured by net meters.

   Recent reviews of solar PV tariffs in NSW and South Australia have produced draft recommendations for lower feed in tariff rates: 5-10 cents per kWh in NSW (increasing from 2012), and 9.1 cents in South Australia (increasing to 11.2 cents from June 2013).

   We believe a higher rate is fair and reasonable because, firstly, most retailers are also generators, particularly the three largest retailers (AGL, Origin, TRU) who between them control the vast majority of retail electricity customers. These gen-tailers can trade on the wholesale market (with very high marginal prices at times of peak demand) – homes and businesses cannot have access to these very high wholesale prices. For this reason a tariff which reflects only the wholesale price is unfair.

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[11] Essential Services Commission 2008, Guidance Paper - Methodology for Assessment of Fair and Reasonable Feed-in Tariffs and Terms and Conditions, March

Secondly, small scale distributed generators do not impose costs on the high voltage transmission network and arguably should not have to pay for transmission costs – or at least should not have to pay full prices. Small scale distributed generation also does not impose costs on the low voltage distribution network and in some cases can deliver savings to the network. (We note that we are referring to truly small scale generation, e.g. 2kW units.) We accept that distributed generators should pay something to access the distribution network, but again we believe they should not pay the full usage fees.

The current market rules recognise (at least in theory) that distributed generators should receive some discount for avoided TUoS and DUoS charges. Trying to quantify and negotiate the avoided fees for very small scale generation is simply impractical and inefficient – meaning those distributed generators are over-paying.

We note that IPART considered this issue as part of its recent review (section 7.3, pages 66-69 of the draft report from November 2011). IPART noted that in theory distributed generators are entitled to a rebate on some TUoS charges, but it is impractical to implement with small scale generators. Rather than individuals trying to negotiate avoided TUoS and DUoS discounts, we suggest it may be more efficient for the retailers (who would have to pay the tariff to the distributed generator) to receive a partial rebate on network fees from the transmission and distribution network providers.

We recognise that a one-for-one tariff requires retailers to increase costs to other customers, because there are some costs retailers cannot avoid, and they need to make a margin. In order to avoid cross- subsidies, a feed in tariff should allow for these unavoidable costs and a margin. We believe 20 percent is a reasonable allowance.

IPART studied the components of NSW retail electricity prices and concluded that the retail price is made up of:[12]

• Network costs (transmission and distribution)	52%
• Energy costs (generation cost plus network efficiency losses)	31%
• Retail costs and margin	11%
• Green scheme costs	6%

These figures will be slightly different for other States (for instance the costs of 'green' schemes in other States are much lower than in NSW) however we believe 10 percent is a reasonable assessment of the retail costs and margin component. This is the figure used in the Garnaut Review.[13] Even allowing for variation, we believe an allowance of 20 percent is more than reasonable to cover retail costs and margin.

8. *Location*: a minimum tariff should apply regardless of location. Retailers may choose to offer higher feed in tariffs for consumers in specific areas of the distribution network (for instance to reflect network cost savings or DSP bonuses offered by the local network operator).

9. *Duration*: We believe a feed in tariff for small scale low emissions generators should not be limited in time or subject to caps on the number of units or generating capacity. The policy objective of allowing participation in the energy market and paying a fair rate for local power continues to be valid regardless of time or number of units installed; and as the rate is not a premium there is no costly cross-subsidy to control.

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[12] IPART, *Solar feed-in tariffs*, draft report November 2011, figure C1 page 115. In 2010 IPART concluded that retailer margins typically constitute 4-7% of retail tariffs: *Review of regulated retail tariffs and charges for electricity 2010-2013*, March 2010, p135.

[13] Garnaut Review, *Update Paper No 8*, 2011, page 8: http://www.garnautreview.org.au/update-2011/update-papers/up8-transforming-electricity-sector.pdf

Living the dream...

Newington, Sydney, Australia
Ausgrid and the Adams & Joyce family
Installed August 2010

Combating climate change. Increasing comfort. Lowering energy costs. Welcome to the Smart Home, powered by BlueGen.

A BlueGen focus on…
- → **Consumers & end users**
- Distributors & installers
- → **Energy utilities**
- The environment

"Things are looking sunny at the Smart Home. We are using much less energy than we produce thanks to the ceramic fuel cell and the solar panels."
Clare Joyce

Overview

Created by Sydney Water and Ausgrid (formerly EnergyAustralia), the Smart Home showcases the latest energy and water solutions helping communities face the challenges of the 21st century. Located in Newington, NSW, the Smart Home was originally built for the 2000 Sydney Olympics as part of the athlete's village. Ausgrid acquired the house in 2009 and transformed it into a real-life 'laboratory' to test technology and environmental solutions.

A real home. A real family

The Smart Home is a fully functional suburban home that's full of new and innovative water and energy solutions. Most importantly, it's recently been 'road tested' by a family of three. Clare Joyce, Michael Adams and their daughter Ava, Australia's first Smart Home Family, were living in the home, experiencing exactly what it's like to embrace the power of environmental design, hi-tech appliances, and new energy technologies in a domestic setting and writing about their experiences. They were chosen from 160 families from as far away as New York and Sweden to live in the Smart Home.

The Smart Home is tested in real time, with information broadcast via the internet. The information gathered by the Smart Home family is the key to informing and engaging the public in the way we might live in the future. You can read more about the future home at: www.ausgrid.com.au/smarthome

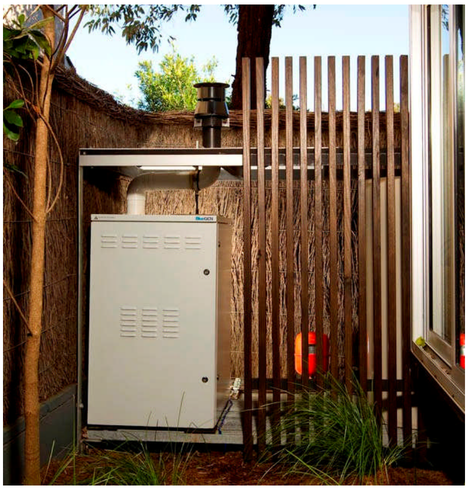
Clever energy consumption

The Smart Home uses the latest technologies to produce power on-site, with surplus electricity exported back to the grid. It integrates both renewable and low-carbon generation technologies via Solar PV panels on the roof, a solar pergola and a BlueGen® unit that converts natural gas into electricity 24/7.

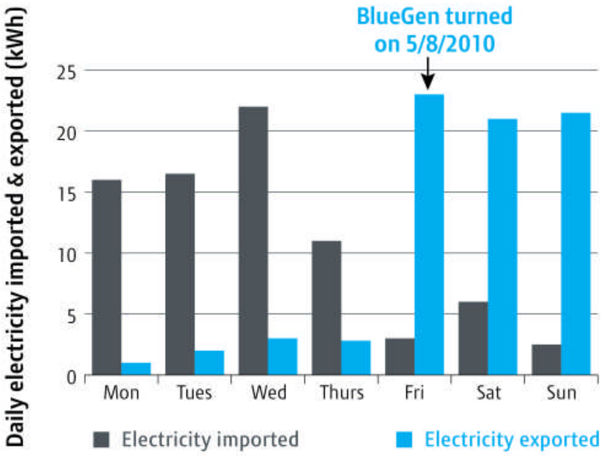
The BlueGen unit was installed during the retrofit of the building and is located discreetly in the courtyard. Heat from BlueGen is recovered and utilised for sanitary hot water. For the trial, BlueGen operates at 1.5 kW power export for maximum efficiency, generating around 13,000 kWh per year. A typical Sydney home consumes approximately 7,000 kWh.

Above image: Cameron Richardson © Newspix

The Smart Home was built for the 2000 Sydney Olympics and renovated in 2009



Using existing infrastructure, the BlueGen and hot water system is discreetly installed in the courtyard



When the BlueGen was turned on, the house went from a net importer of electricity (including solar PV) to a net exporter

Other Smart Home innovations include:

- A RedFlow battery storage unit that stores the solar power generated during the day for use in peak demand periods

- Furnishings made from recycled and sustainable materials

- Over 20 energy and water efficient appliances

- State-of-the-art LED lighting and power management

- Extensive use of recycled water within the house

- A Mitsubishi Electric Vehicle with home charging facilities

Switching from importing to exporting

When BlueGen was switched on in August 2010, the Smart Home went from being a net importer of electricity to a net exporter. During times of peak demand (i.e. more than 1.5 kW), the home needs to import electricity from the grid but in general, the Smart Home produces more electricity than it consumes. Average energy consumed by the Smart Home is between 17-27 kWh per day, with the average electricity generation (solar + BlueGen) of approximately 32 kWh per day.

Significant carbon savings

After 18 months , the Smart Home Family examined BlueGen and the data they'd collected for the reduction in emissions. Compared with information from the Department of Climate Change & Energy Efficiency National Greenhouse Accounts (NGA), the vital stats were:

Run time:
12,565 hours (approx. 18 months)

Electricity generated:
16,459 kWh

Emissions saved compared to the New South Wales grid (as per the NGA), calculated with average electrical efficiency of 55%:

Carbon dioxide
-11.54 tonnes (66 % reduction)

Sulphur dioxide
-320 kg (88 % reduction)

Nitrogen oxides
-34 kg (68 % reduction)

Ash and soot
-770 kg (88 % reduction)

The carbon intensity of the New South Wales electricity grid is relatively high by world standards (i.e. 1.06 kg CO2-e / kWh) highlighting the potential to accelerate carbon savings from BlueGen.

What the family think

"the really impressive stuff is interconnected and all but invisible. It's less "sexy" but much more substantial. The BlueGen fuel cell, which converts gas to electricity, is the core of the house. It supplies a whopping amount of electricity, which powers the Smart Home and charges the i-MiEV electric car."
Clare & Michael Joyce

Smart Grid, Smart City project

In May 2011, the solid performance of BlueGen in the Smart Home was highlighted by Ausgrid's decision to order an additional 25 BlueGen units as part of the Ausgrid's *'Smart Grid, Smart City'* project. The project, funded by the Australian Government, is Australia's largest smart grid project.

More details?

Ausgrid
www.ausgrid.com.au

Smart Home Family Blog
www.smarthomefamily.com.au

Sydney Water
www.sydneywater.com.au

Clean power for your home...

Since 1992, Ceramic Fuel Cells Limited is a world leader in fuel cell technology providing highly efficient and low-emission electricity from widely available natural gas.
Ceramic Fuel Cells is listed on the Australian Securities Exchange and the London Stock Exchange, AIM market (code CFU).
Offices located in The United Kingdom, Germany, and Australia.

CERAMIC FUEL CELLS

www.cfcl.com.au

→ BlueGen right at home...

Hampton East, Victoria, Australia
The State Government of Victoria
Installed October 2010

In April 2010, Ceramic Fuel Cells received an order for 30 BlueGen units from the Victorian Government.

A BlueGen focus on…
Consumers & end users
→ **Distributors & installers**
Energy utilities
The environment

This project demonstrates the domestic operation of the units and the real benefits to tenants as they produce electricity from BlueGen and generate heat for domestic hot water.

Installation underway

These units have been installed in public housing properties in metropolitan Melbourne and regional Victoria by the Office of Housing. One of the first installations was at a house in Hampton East, Melbourne.
The existing gas storage water heater was replaced with a BlueGen®, 200 litre Chromagen tank and gas booster heater.
The BlueGen unit was installed in two hours, with the entire installation completed within a day.

Typically beforehand, the installer undertakes a pre-inspection on-site, ensuring quick and easy installation later on. Ceramic Fuel Cells has created an Installation Guidelines manual to help installers and customers understand the requirements of installing a BlueGen.

Meeting the standards

BlueGen is now certified as a 'Type A' gas appliance, allowing BlueGen units to be installed by a licensed and trained plumber/gasfitter, as with any other typical gas appliance in Australia.

The product has been certified for both indoor and outdoor installations. Previously, installations were restricted to 'Type B', meaning that the respective State Technical Regulators, such as Energy Safe Victoria, were required to inspect and approve each installation.

In Australia, BlueGen needs to be installed to the applicable Australian Standards, like any gas appliance. Installations must comply with the Australian New Zealand Standard AS/NZS 5601. This standard outlines the general requirements for BlueGen installation and assists installers with the placement and connection of services.

For electrical connection, the same standard for connecting a Solar PV system also applies to BlueGen. The Australian standard AS 4777 ensures that in the event of a grid failure (blackout) or where mains grid is outside of tolerance (brownout), BlueGen automatically detects this and disconnects from the grid.

Electrical connectivity

The BlueGen unit is wired back to the electrical switchboard. This installation required a new smart meter which is commonly installed with embedded generation devices such as Solar PV.

Conserving water

The ceramic fuel cells inside BlueGen use internal steam reforming. This means a source of water is required to produce electricity. The input or process water for BlueGen is connected via a simple John Guest quick connector. These connectors are like the push-in style tubes found on most domestic water purifiers.

The balanced flue acts as an inlet and an exhaust for BlueGen allowing indoor or outdoor installation

Connections to BlueGen are standardised and straightforward – gas, water and heat recovery

Electrical connection is via a junction box located on BlueGen and hardwired back to the electrical switchboard

BlueGen's water consumption depends on the heat recovery. If the heat recovery system isn't connected, BlueGen can consume up to 1.6 litres of water per hour. By connecting the heat recovery system, water vapour in the exhaust gases can be condensed, treated, and fed back into the BlueGen, ensuring even less water is used.

Balanced flue benefits

Commonly used in Europe, a balanced flue consists of two lengths of aluminium concentric tubing which act as the inlet and exhaust for BlueGen. The inner tube is for the exhaust and the outer tube delivers the input or process air. The balanced flue is always vented to atmosphere, meaning BlueGen is ideal for indoor installations where exterior air is drawn in, used in the electrochemical process and then expelled. BlueGen's exhaust emissions consist of water vapour and low levels of carbon dioxide.

The maximum flue length for BlueGen is up to 12 metres and can be exhausted vertically or horizontally for maximum flexibility. For many Victorian Government installations, a vertical flue installation meets the requirements of the site.

Simple, natural gas installation

Connection of the mains gas is just like any other gas appliance. In most installations, BlueGen uses the standard gas mains connections and ½" BSP connection. However, certain installations specifying a larger instantaneous gas booster heater may require gas mains with a greater diameter.

Typically, when operating at normal capacity and generating 1.5 kW of electricity, BlueGen uses about 9.5 MJ of gas per hour – much less than the average water heater.

Heat recovery

BlueGen generates heat during operation and this thermal energy can be recovered for hot water. Its air to water heat exchanger captures thermal energy from the exhaust stream. Typical BlueGen exhaust temperatures range from 120-160°C. At 1.5 kW output power, BlueGen provides approximately 540 W of 'useful' thermal energy. This low amount of high quality heat means BlueGen can provide up to 200 litres of 'free' hot water daily - another benefit for tenants.

Streamlined service and management

BlueGen requires an internet connection for three reasons:

1) BlueGen alerts the local service agent when service or maintenance is due. If BlueGen encounters any abnormal operating conditions it can alert service personnel immediately.

2) Remote control capability allows a number of BlueGen units to be managed centrally and remotely. This is perfect for locations where multiple BlueGen units may be installed within a cluster – e.g. in aged care homes, apartments, schools etc.

3) Using BlueGen-net, (a web-based reporting portal) owners or end-users can log onto the internet and view the performance of their BlueGen unit.

The result so far

After 12 months operation at Hampton East, BlueGen has produced 11, 300 kWh of electricity and saved approximately 11.4 tonnes of carbon dioxide compared to grid power. As part of the installation, leading energy retailer Origin Energy is offering a Feed-in Tariff to each home's tenant for any excess electricity exported to the grid.

Tenants who benefit from BlueGen as part of the program are offered a package by Origin Energy. This includes Green Gas plus a one-for-one Feed-in Tariff for excess electricity generated by the BlueGen. This means that tenants who export power to the grid receive a credit on their bill, equal to the normal retail rate of electricity and that means:

Lower electricity bills, lower emissions and 'free' hot water.

More details?

Victorian Government
www.vic.gov.au

SAI Global
www.saiglobal.com.au

Energy Safe Victoria
www.esv.vic.gov.au

EN - BlueGen right at home - Rev.2
Doc. #002-DO 010975_02