Submission to Select Committee into the Resilience of Electricity Infrastructure in a Warming World.

17 November 2016

The Secretary,
Select Committee into the Resilience of Electricity Infrastructure in a Warming World
Department of the Senate
PO Box 6100
Canberra ACT 2600

Dear Sir/Madam,

As the successful owner-operator of a grid-connected wind farm, from 1995 to 2003, I gained valuable experience and knowledge to effectively deal with technical issues and energy trading issues. I have heavily drawn on that knowledge and experience to follow, often in dismay, industry developments over the ensuing thirteen years until now.

The following five pages are the substantive part of my submission to the Select Committee. It is my belief that the recommendations in it have a sound factual basis in the Laws of Physics, scientific method, empirical data, and repeatable experiments: recommendations that on a level playing field should stand up well to scrutiny from challengers.

I make this submission confident that it can assist the Select Committee in its important work.

Yours faithfully, (signed, Michael Gunter)

Demand-side Energy Services for Affordable Grid Resilience and Cheap CO_2 Cuts.

I am pleased for the opportunity to make this submission to the **Select Committee into the Resilience of Electricity Infrastructure in a Warming World.** ("the Committee" from here)

As the Committee's Terms of Reference implicitly acknowledge, the long-term resilience of electricity infrastructure in providing continuous energy services cannot be guaranteed solely by supply-side considerations of generation and transmission. The projected increase in the frequency and intensity of high-risk weather events requires public and private investment in broader and deeper demand-side resilience. This submission argues that the committee's final report should acknowledge the priority of three key measures:

> (i) Australia's "Electricity Infrastructure" be categorically stated to encompass all electrically mediated energy services provided on-site. i.e off-grid PV/battery systems are legitimate, integral parts of the nation's electricity infrastructure.
> (ii) Policy instruments to expand capacity in energy storage should include all forms of technology that act as economically efficient "virtual batteries" delivering time-shifted energy services to end-users. Proximity can achieve efficiency and competition.
> (iii) Electricity distribution supply voltage to be dynamically adjusted to improve resilience.

I am a retired doctor and long-time electronics hobbyist, heavily involved in renewable energy projects over the past three decades. I owned and operated the pioneering Breamlea Wind Generator, a small grid-connected wind farm on the Bellarine Peninsula, between 1995 and 2003.

My interest in community health and renewable energy informs my passion for public interest advocacy in the area of electricity generation, transmission and use. This has led to submissions to the 2009 Victorian Bushfires Royal Commission[1] and to the Victorian Government's 2014 Hazelwood Mine Fire Inquiry[2]. My submission to this inquiry is informed by practical experience in utilising a range of technologies to live off-grid, independent of gas and electricity mains.

Part 1: Reviewing the Committee's Terms of Reference...

Here the Terms of Reference are addressed, applying a scientific and technical interpretation to some key expressions used in those terms, as follows:

1.1 Regarding *1(a): "the role of **storage technologies** and **localised, distributed generation** to provide Australia's electricity networks with the resilience to withstand the increasing severity and frequency of extreme weather events driven by global warming."*

Storage technologies, from the perspectives of physics, thermodynamics and engineering, rightly

[1] ...such as this forensic restoration of a damaged unplayable U-matic videotape showing **and telling** what the SECV already knew since 1974 about bushfire ignition and civilian deaths from its distribution assets: https://www.youtube.com/watch?v=Em1br4JXEYk

[2] A key discovery to assist that Inquiry was this SEC staff training video, emphasising constant vigilance for fire prevention in open cut mines : https://www.youtube.com/watch?v=GjcHqY_OeTI

encompass not just electrochemical storage (batteries) but energy storage in all its transmutable forms. Some important and efficient energy storage technologies are outlined in Part 2.3 (@pg 4)

The Committee should adopt an inclusive understanding of energy storage when considering the excellent prospects of these disparate technologies for supplying energy services to end users.

Dovetailing alongside storage, localised distributed generation can be considered as legitimately including all technologies (including even passive technologies) that can cleanly and efficiently achieve the same purpose as grid-based electricity generation: i.e. reliably meeting the energy-service needs of the end-user. This idea of "negawatts" is key to grid resilience and pollution reduction….

1.2 Regarding 1(b)(i): *"create jobs in installation, manufacture and research of storage and* ***distribution technologies****"*

It is appropriate that the Committee consider the rewarding synergies for the broader Australian economy that naturally flow from integrating all possible technologies and market interventions on the demand-side, rather than focussing too heavily on traditional supply conduits. Embracing the negawatts concept can trigger a rapid roll-out of mature technologies; can provide meaningful jobs; can compete without subsidies; can rapidly and deeply cut Australia's carbon footprint; and is ripe for modest support and investment to commercialise exciting, existing zero-carbon technologies to the mass market: thereby providing all manner of localised energy services to small business, schools and homes within the large areas comprising NEM's footprint.

Further, the Committee should warmly embrace the healthy competitive tension between new storage technologies, new distributed generation options and traditional top-down energy supplies…..

1.3. Regarding 1(b)(iii) *"anticipate the rapid deployment of localised distributed generation through changes to* ***market rules****"*

The Committee's consideration of market rules should include not only codified rules but all government policies, regulatory regimes and industry practices that shape the actuality of how the electricity market operates. All policy measures taken by governments for the roll-out of clean generation, distribution and storage technologies should work to fully realise COAG's longstanding principles for the disaggregation of the old vertically-integrated energy industry, namely to bring efficiency and competition into the energy marketplace, including by promoting effective demand-side competition.[3] When non-codified industry practices and cultures are found, these must be condemned and eliminated if they are against this broadest of public interest considerations: not pushing Earth over 2 degrees Celsius to a runway overheating catastrophe.

[3] See COAG's official Communique text of 8th June 2001 "[the NEM Forum we are setting up] will also address regional boundaries and **demand side participation**." – paragraph 4, page 3 at http://ncp.ncc.gov.au/docs/Councilof%20Australian%20Governments%20Meeting%20-%208%20June%202001.pdf

1.4. Regarding 1(b)(iv) *"drive the reduction in technology costs through economies of **scale.**"*

Consideration of achieving economies of scale, whether competitively supply-side or demand-side in nature, should also include time scale: namely the need to meet emission reduction targets in line with existing commitments, along with the likelihood of more stringent obligations under future international agreements. While there are good arguments in general against governments seeking to pick future winners, the Committee should recommend priority being given to the rapid deployment of established technologies with proven capability to both add resilience to energy supply, and to reduce greenhouse gas emissions at low-cost – technologies already known for their efficiency and competitive edge, but only partially implemented or deployed to date.

Strong government leadership and investment in nation-building projects has historically delivered both short- and long-term economic benefits, for example the Snowy Mountains Scheme. A similar nation-building ethos, using policy settings that promote the rapid roll-out of demand-side solutions, as well as more traditional top-down investment in large infrastructure projects, is likely to be the only way to achieve economies of scale within the necessary time scale.

Part 2: Four Key Recommendations

2.1. Following on from the discussion re the Terms of Reference in Part 1 above...

Demand-side technologies, some new and some quite old, blur traditional distinctions between producers and consumers. In the course of its deliberations and decision-making, therefore, it is important that the Committee views its Terms of Reference according to science-based concepts, and considers the electricity grid as a means to an end – the provision of resilient energy services. To be consistent with the Paris Agreement at COP21, all investment for energy services in future must be very low or zero-carbon. The task is enormous, so clean, least-cost pathways are vital for success, and deserve to be prioritised..

2.1.1 RECOMMENDATION 1: The Committee should adopt a firmly science-based interpretation of key expressions in the Terms of Reference, as outlined in Part 1 of this submission. This approach will greatly facilitate the achievement of two essential objectives: resilient provision of economically efficient energy services, and cost-effective emission reduction.

2.2. Resilience through diversity

From a resilience/reliability perspective, off-grid supply of energy services, whether the energy user is permanently isolated or temporarily islanded, deserve equal status alongside the electricity grid. Building energy self-reliance enables (i) continuity of vital energy services during times of grid blackout (either due to transmission/distribution failure caused by storms, or by design, such as during times of catastrophic bushfire risk); and (ii) reduction of the oft-recurring need for costly

network augmentation, traditionally triggered by peak demand load growth.

Given the growing risk from more frequent extreme weather events, achieving at least temporary energy self-sufficiency in vital public and other key infrastructure (emergency services buildings, hospitals, nursing homes, schools, businesses, petrol stations, and perhaps one-in-ten households in any neighbourhood) should be regarded as the new norm to enhance community resilience and public safety.

In South Australia on 28th September we saw the inherent resilience of households not dependent on the grid. These households carried on pretty much as usual.[4] Their own independent power reserves, whether achieved by temporary "islanded" capability or by a longer-lasting full off-grid configuration, were able to keep lights on, safely cook meals, keep fridges or freezers cold and charge mobile phones. Widespread adoption of grid-interactive battery technologies – and of independent "off-grid" technologies – can provide crucial support to the existing poles and wires network at at peak usage times, by reducing the risk of a power grid becoming overloaded. Home-based batteries, without adequate (or any) associated solar PV panels, have the potential to be charged at night from cheap but carbon-intense baseload coal power: this should be deprecated.

2.2.1 RECOMMENDATION 2: That the Committee recognise distributed PV/battery systems, whether grid-connected or off-grid, as legitimate elements of Australia's electricity infrastructure, delivering greater resilience to the national grid.

2.3. A broader array of "non-electric" energy storage technologies add to the resilience of electricity infrastructure.

Cost-effective competition from many forms of demand-side negawatts will reduce the load on the power grid at critical times of high demand. The examples (a) to (d) below are all applicable, and must be considered on the dual grounds of improved grid resilience and COAG's competition objectives.[5] In the list below, some are already commercial realities and **others cry out for fast-track introduction into the mass market.** All of them – for as long as the grid is propped up wholly or partly by baseload fossil fuelled generators every night – will also act to reduce Australia's carbon emissions. These technologies are generally cost-competitive per kilowatt-hour of energy savings. Their development, commercialisation and uptake, by efficiently providing energy services, add resilience to the existing grid.

(a). Solar hot water from traditional solar thermal panels. Anti-monopolist by default, whenever the sun is shining. Unequivocally a baseload energy service after sunset each day;

(b). Hot water provided by electric heat pump systems – excellent if run from on-site PVs from 9am to 3pm each day. Not so good if run on a cheap night-time tariff by default. Utterly dependent on mains power in the vast majority of existing installations, even where sufficient kilowatts of PVs are on the roof above.

[4] ReNew magazine reports on the experience of SA off-grid household during the September blackout: http://www.ata.org.au/news/couple-beats-sa-outage-with-solar-battery-storage
[5] See footnote 3 above (p2)

(c). Solar ice chest – can be as simple as a standard domestic fridge, modified to freeze 10 litres water to 10kg of ice during the day, and being configured to operate by default from rooftop PVs during the brightest/sunniest part of the day. My DIY retrofit of a 55-litre camping fridge has proven the concept works. It is unfortunate that Australians cannot go to a mainstream white goods vendor and buy such a solar ice chest or solar freezer. Upscaled, this concept could provide bulk ice stores for air-conditioning services;

(**d). Thermal mass** is a basic, ultra long-life, energy storage technology. Masonry walls and concrete slab floors provide enormous buffering of external temperature fluctuations when they are given appropriate shading, draught-proofing and insulating of a building's envelope. Regrettably Australia's housing stock has far too many poorly insulated "inside out" brick veneer dwellings, and far too many of them fit the description of "glorified tents".[6]

2.3.1 RECOMMENDATION 3: That the Committee recognise all forms of energy storage (e.g. hot water, ice, or thermal mass) as scientifically valid "virtual batteries" meeting the ToR's definition of energy storage technology.

2.4 Conservation Voltage Reduction (CVR) can efficiently provide virtual spinning reserve, in South Australia and elsewhere…

Spinning reserve under existing NEM rules is a commercial ancillary service. It is a very important operational measure to maintain the generally excellent reliability (resilience) of mains electricity supply. It is there to provide sufficient reserve power idling on the sidelines to very quickly step in if the single largest generating unit (perhaps up to 500MW of electricity generation) in a region was to unexpectedly fail ("trip offline"). However, demand-side voltage dropping to customers can closely mimic the real spinning reserve of big fossil- or hydro- generators, and does not consume any fossil fuels. On basic theoretical grounds it can be automated at every zone substation across NEM to respond, within a second or two, to frequency fluctuations (e.g. below 49.5 Hertz) by dropping customers' voltage down to 220 volts AC.

I commend CVR to the Committee as a critical tool in this nation's battle to make real and almost instantaneous inroads on the NEM's carbon footprint. CVR can be an effective tool for providing extremely cost-effective, zero-carbon – even emissions-saving – **spinning reserve services** to maintain, even strengthen, the grid's stability, reliability and resilience.

2.4.1 RECOMMENDATION 4 : That the Committee empanel independent experts to report on the feasibility of deploying ***and using by default*** fast-response Conservation Voltage Reduction as a virtual spinning reserve technology at all zone substations across the NEM, to efficiently improve the resilience of mains electricity supply.[7]

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[6] … see "Australian houses are just glorified tents in winter" SMH, 8th June 2015

[7] CVR-for-spinning-reserve appears to be well suited to regions with lots of wind farms, especially during strong gales and storms when some turbines may have to automatically shut down for self protection.