2013 Commercial Scale Inverter Energy System Workshops

Summary of key findings and outcomes

CLEAN ENERGY COUNCIL

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Background

Bringing together electricity industry stakeholders to discuss and understand the challenges and issues faced by the ongoing expansion of commercial scale inverter-connected energy systems across Australian distribution networks.

Initially instigated by the need to address technical challenges for the connection of commercial-scale inverter based energy systems the CEC's Inverter Energy Systems (IES) workshops have evolved into a forum for discussion on a range of complex and inter-related issues relating to the integration of renewable energy, storage and demand management into Australia's distribution networks.

The workshops have provided the CEC with a unique understanding of the issues currently faced by Australia's electricity distribution industry. Their objective was to bring together electricity industry stakeholders to discuss and understand the challenges and issues faced by the ongoing expansion of commercial scale inverter-connected energy systems across Australian distribution networks.

Each event took the form of an open and frank discussion in which the following questions were asked:

- What are the immediate priorities for the industry?
- What is controversial?
- How can the CEC or others address priorities?
- How can the industry continue to work together to drive efficient outcomes?

Over 100 industry experts took part in the workshops. The results were hours of detailed discussion and over 25 pages of agreed notes. This document provides a summary of the discussion as noted from each event.

Summary

Although technical challenges do exist there is a perception that these can be managed in time with the appropriate standards and understanding of the technology. The broader issues at play include a lack of engagement with consumers, the potential challenges and opportunities arising from declining embedded storage costs incentivising consumers to disconnect, the lack of incentives for efficient connection practices or enabling network-support from generators, and unsustainable electricity tariff structures. In addition there is a perceived failure of the regulatory and decision making frameworks to address these issues in a holistic manner.

The electricity distribution industry is rapidly approaching a cross-road at which its stakeholders are faced with two choices:

- Respond defensively in the face of rapid change by preventing adaptation with no long-

term strategy to engage with changing consumer expectations; or
- Adapt and accept the fast paced changes of consumer needs by strategically evolving to serve the long term interests of consumers.

The CEC believes that only one of these outcomes is sustainable and a permanent and irreversible paradigm shift is already underway.

The IES workshops have enabled the CEC to garner a unique cross-section of industry perspectives. While the extensive detailed outcomes from discussion, and presentations from the events, are available in the events section of the CEC's website[1] they can be collectively formed into five distinct themes:

- Theme 1: Coordination
- Theme 2: Information sharing
- Theme 3: "Energy economics 101"
- Theme 4: Understanding technology
- Theme 5: Understanding "best practice"

This document summarises these themes.

The Role of Consumers

Consumers are at the centre of our electricity market. However, the linear nature of the supply infrastructure and its surrounding regulatory framework is not readily capable to respond to rapid change. Significant reform is already underway in response to the changing expectations of consumers.

The workshop series took the approach of addressing technological integration issues. While the focus was not on consumers there was an audible concern from many participants that consumer engagement is vital for moving the industry forward. In summary the focus of industry reform is to create a resilient and flexible industry and in doing so seek to inform, educate and empower its primary stakeholders: consumers.

[1] www.cleanenergycouncil.org.au

Theme 1: Coordination

Networks are facing a paradigm shift towards a diverse embedded generation and load mix. This creates a scenario where DNSPs have to engage with new investment driven by consumer adoption of new technologies alongside traditional demand-driven investment. The reality of this new scenario is that new consumer expectations will test the technical, regulatory and economic parameters which have traditionally brought comfort to the electricity distribution industry.

Compounding this issue is a perceived conflict between industry bodies about the way to achieve the best outcome for the market. Contestability in services provision such as metering means that DNSPs are losing visibility and control of what is going on at the customer meter point. There is a perception that this outcome is believed to have occurred because the National Electricity Market's decision making frameworks tend to prioritise short term economic benefits over long term broader benefits.

This problem will now require an independent industry-led coordinated program to address challenges. This in itself comes with its own challenge of aligning objectives: no one group, business or government body has the business case or resources to address issues in a holistic manner, while emerging challenges affect all, but belong to none.

The CEC must liaise directly with Energy Networks Association, DNSPs, retailers, governments and other stakeholders to continue dialogue and coordinate influence at policy and decision making levels to address the challenges ahead.

1.1 Emerging challenges

There are numerous emerging challenges facing distribution networks and the stakeholders which integrate with them. The underlying trend driving change however is primarily new consumer expectations stemming from the implementation of new technologies. At the technological level some comfort can be gained from the fact that technical solutions exist now. They must however, be applied with innovative thinking.

Technology evolution is in fact moving much faster than industry adaptation is familiar with. This is resulting in a need to focus on the overarching industry frameworks in a technology-agnostic way as legacy settings are rapidly outdating.

In addition, rules and regulations need to ensure that the services offered by DNSPs remain fit for purpose. A key aspect of this will be widespread standardisation of technical requirements, practices, and ideally costs which is subsequently anticipated to promote a greater understanding of technical issues, efficient costs and reduced uncertainty, and facilitate standardisation of technologies being utilised by third parties.

1.2 Coordination

Although emerging challenges are customer-driven rather than network-driven, DNSPs can provide economies of scale through the existing network asset base. This inherently requires DNSPs to remain a key player in the development of solutions with defined partnerships between DNSPs and customers.

The industry must work collectively to engage on stakeholder reference groups such as the Standards Australia embedded generation group, or the IEA Storage Working Group, while also identifying the appropriate bodies to channel policy reform options.

There is also a need to learn from other industries which have had to retrofit to adapt to new technologies in order to provide long term solutions to new challenges, and how these costs are spread (Germany's automotive industry could be a good example).

1.3 Capability

Amongst these challenges a "new normal" is emerging for the industry. Renewable energy, storage and demand management are the next wave of emerging technologies with which consumers can assert more energy independence.

The industry has demonstrated capability to tackle significant challenges before – a comparison can be drawn to the rapid uptake of air-conditioning to demonstrate that challenges are not insurmountable. However, the inherent time lag in regulatory response means that DNSPs are not yet embracing the full offerings from technology providers. A staged, industry-led, response is required to get the industry there.

Theme 2: Information Sharing

The solar industry is currently in a consolidation phase where the number of industry players with a focus on volume is reducing, leaving those focused on quality and industry sustainability remaining in operation. These remaining players will need to be more organised and equipped to deal with the new challenges and complexities of continued deployment of both larger capacities and deeper penetration of embedded generation.

At the same time technical requirements for grid connection are also consolidating as DNSPs start to gain clarity on their own limitations as well as being able to convey them to generators.

This consolidation process is crucial for the continued growth in embedded generation and demand management and it is important for all parties to continue to recognise that the resolution of challenges is progressive and takes a combined effort. This new market cannot operate without transparency and a consistent understanding of needs through clear information sharing channels, including:

2.1 Engagement challenges

The goal of engagement is to ensure mutual understanding of issues and challenges with the intended outcomes of reduced information barriers being increased satisfaction on all sides, while providing a transparent path towards agreed outcomes.

Engagement will require heightened information flow and transparency from DNSPs along with active collaboration and communication between customers and DNSPs. The CEC and others should continue to run sessions and forums on a regional basis in order to ensure continued dialogue and a mutual understanding of requirements, issues and outcomes.

2.2 Training

Training is essential to ensure that customers are well prepared to enter into the grid connection process. If third party providers are well organised at the start of the process and have a clearer understanding of what they want and need to do, the process of integrating with the grid will be greatly assisted.

Training could be facilitated by the CEC providing grid-connection ‘preparation training’ along with extending the accreditation process up to larger generating systems, or by distribution businesses conducting training on their individual expectations. In either case this will require close coordination between industry and DNSPs to deliver.

2.3 Transparency

All parties will be assisted by enhancing transparency. On one hand the benefit to third parties from having timely access to information is that they should subsequently be able to clearly understand issues and assist in developing solutions. On the other hand DNSPs will benefit from a more comprehensive understanding of the capabilities of technologies used for generation, storage or demand management.

Integration processes should ensure that proponents are able to discuss issues openly with the DNSP and understand the issues from the DNSP's perspective. Timelines and detail for information provision should be sufficient to prevent undue risk and costs, while the relevant personnel should be accessible on both sides. In addition the level of publicly available information should be maximised to the greatest extent practicable.

Theme 3: Energy economics 101

The introduction of large volumes of embedded generation, storage or demand management reduces the volume of energy transported across the distribution network, often in conjunction with reducing peak demand. While this is a seemingly positive outcome, energy volume transported to customers is a critical aspect of cost recovery for network investment.

While the regulatory reset cycle means that benefits have to focus on long term outcomes – as changes to investment may add cost to the short term – compounding this problem is the treatment of generation-related investment as distinct from demand-related investment. As a DNSP's investment cannot be recovered from generated energy volumes the full cost to connect a generator must be borne by each individual connection, despite the expectation of long term benefits from reduced capital costs.

Thus the changing nature of consumption is exposing gaps in the economic model on which DNSPs have been established.

Technological change is also expected to emerge as a new challenge for these business models. Smart-grid concepts are aimed at deferring capital investment, while energy storage technologies are rapidly declining in cost and will enable consumers to defer consumption to minimise their exposure to high energy prices.

Barriers to innovation in embedded generation and demand management are economic and not technological. Significant declines in storage costs could be detrimental if widespread customer disconnections take place. Increased costs for the remaining customers will lead to increased incentive to follow suite. In this so called "death spiral" scenario stranded network assets could result in a government directed burden on taxpayers.

The sustainability of incumbent business models must be considered with holistic solutions. Innovation is now needed to address new ways to invest in network augmentation, set tariffs and provide appropriate incentives.

3.1 Network investment

Traditional solutions to demand-driven network investment may no longer be adequate as opportunities for demand management and generator connections reveal themselves. Modern generation and storage equipment suppliers are adept to changing to meet requirements. However, the solutions they can offer must be properly integrated into the planning and investment cycles for distribution networks in order for long term benefits to prevail.

In addition the opportunity for cost sharing of generator connections should be explored and better understood along with other innovative investment options.

3.2 Tariffs

Development and setting of “cost-reflective” tariffs is possibly the most challenging aspect of electricity economics. Even within the current context of significant investment to meet peak demand (mostly driven by air-conditioning load) volume-based tariffs have been rapidly losing context, with significant cross-subsidisation resulting in inequity between a network’s customers.

In addition the introduction of embedded generation, storage and demand management technologies increases the challenge. Short-term fixes such as preventing export of generated energy will rapidly lose context as network utilisation changes and new technologies provide effective support to the network.

Tariffs need to be structured appropriately in order to provide incentives for efficient use of energy, encourage proper integration of generation, storage and demand management and value the benefit these technologies bring while remaining sustainable in the long term. In short however there are, and always will be winners and losers. The setting of tariffs should focus on balancing outcomes across stakeholders.

3.3 Business models and regulatory frameworks

Current frameworks intend that consumers pay for the infrastructure needed for the delivery of electricity to their meter, while generators pay the full cost associated with the connection. This arrangement means that while DNSPs need to identify ways of benefiting from increased distributed generation, this benefit has historically been identified and quantified on a case-by-case basis.

In addition the business models which have evolved under the current regulatory framework have little to no incentive to facilitate generator connections or demand management. As these options conflict with revenue recovery the need for a more effective scheme increases.

This problem must be addressed by taking a holistic view of reform of distribution network businesses and the surrounding regulatory environment with the aim of ensuring that sustainable operation of networks can be achieved while remaining flexible to consumer expectations.

Theme 4: Understanding technology

The long term view of network management focuses on genuinely measurable real time constraints rather than potential future problems. In order to achieve this however a level of confidence is needed in the behaviour of technologies integrated within distribution networks. This will require laboratory based analysis of generating, storage and demand response plant performance under a range of specific network conditions, including fault and other dynamic conditions.

4.1 Understanding capability

The capabilities and subsequent potential benefits of inverter-based energy systems are poorly understood. To date the applicable standards have made an assumption of low penetration which led to simplistic operating characteristics becoming the norm. In practice however modern inverter-based energy systems can provide enhanced solutions to 'traditional' generation systems.

In order to properly integrate these solutions however DNSPs will be required to accept new operating characteristics such as ramping of output relative to voltage, and reactive power control with which there is limited experience in the Australian setting.

4.2 Testing and certification

Australia's market is relatively immature which creates uncertainty in the performance of new technologies against (and above) technical requirements. Compounding this is the increased need to understand the reliability and maintenance obligations of equipment as generating, storage and demand management penetration deepens and interactive networks gain greater dependences on these systems. Particularly when considering these new technologies against long life network investments.

In order to fully understand these technologies a testing and certification process may be needed to capture their operation and responses under a range of relevant dynamic network conditions.

Theme 5: Understanding "best practice"

The fundamental issue with the integration of new technologies is not the technologies themselves, but the application of innovation to the problem. In order to set the framework for innovation however there is a need to ensure that technical parameters are defined within appropriate standards.

There is widespread support for the development of such standards as their absence is widely cited as one of the key challenges for the industry moving forwards. However, standards must be balanced against a need for connection processes to remain flexible enough to allow proponents to tailor outcomes to their needs, while appreciating the location specific and jurisdictional nature of networks.

5.1 Standards for grid connection/interaction

Recent work by the Department of Resources, Energy and Tourism has identified the need and willingness of the industry to develop technical standards for the connection of embedded generation.

While perceptions of costs and benefits will be crucial to gaining support for the process, a standard would have to be usable and practical while providing a framework that facilitates the safe, fit-for-purpose installation, connection and operation of grid-connected energy systems.

These standards should balance the restrictions of constraints, which could have a stifling impact on innovation, against sufficient freedom for innovation. In addition an Australian standard should be as closely aligned with international standards (IEC) as possible in order to align international expectations and encourage market entry.

In summary the aim of such a standard would be to address safety, reliability, quality of supply on local level and system security overall, while also enabling innovation.

5.2 A pathway to "Best Practice"

While the CEC strongly supports, and can advocate for, the establishment of a Standards Australia process to develop nationally consistent standards, the lead times for this outcome are insufficient to meet rapid expectations for technology integration and adaptation.

The most significant driver of the lead time for a new standard is the need to harmonise acceptable technical requirements at a national level. Current industry needs require the development of best practice guidelines in the short term. These can provide a "stepping-stone" to standards in the longer term and a staged approach to harmonising requirements.

These guidelines should consider that technical requirements are not always based on network limitations. In some cases – particularly in relation to protection and communications

requirements – it is the DNSP's risk appetite which has led to individual requirements. Initial focus areas for these guidelines should target these aspects as they can impose high costs while being the least understood aspect of integration.

While published examples already applied by individual DNSPs may be a useful platform to build from, the guidelines must also look beyond practices which limit electricity export and focus on longer term proper technology integration techniques.

Workshop series attendees

Please note duplications have been omitted where attendees participated in multiple workshops, and CEC staff have also been omitted.

#	Company	Representative
1	ABB Australia	Juergen Zimmerman
2	ABB Australia	Michael Jansen
3	AECOM	Angela Rozali
4	AECOM	Noel Robinson
5	AECOM	Louis Naidoo
6	AECOM Australia Pty Ltd	Colin Watson
7	AECOM Australia Pty Ltd	Mark Lampard
8	AEG	Mark Kibby
9	AGL Energy Ltd	Brian Riordan
10	AGL Solar	Chad Floyd
11	AGL Solar	Sam Ielo
12	AGL Solar	Vaughan Buckingham
13	Aquatec-Maxcon	Cheng Lim
14	ARENA	Lara Olsen
15	Aurora Energy	Peter Milbourne
16	Ausgrid	Mitchell Zinsli
17	Ausgrid	Paul Brownlee
18	Ausgrid	Terry Mcgovern
19	Avant Solar	Ian Milne
20	Belectric Australia	Anthony Anderson
21	Canadian Solar (Australia) Inc.	David Barshevski
22	Clean Technology Partners	Lachlan Bateman
23	Cleantech Partners	Matthew Haddad
24	Commsolar Pty Ltd	Hammad Khan
25	Conergy	Inka Heile
26	Conergy	James Jamieson
27	Deparment of Resources, Energy and Tourism	Michael Whitfield
28	Department of Primary Industries	Dylan Thomas
29	Economic Regulation Authority	Michael Reid
30	ElectraSol Pty. Ltd.	Paul Russo
31	Endeavour Energy	Len Blair-Hickman

32	Energex	Mike Swanston
33	Energex	Viji Krishnaratnam
34	Energy Matters	Geoffrey Mill
35	Energy Networks Association	Simon Bourke
36	Ergon Energy	Blake Harvey
37	Ergon Energy	Dean Comber
38	Ergon Energy	Donald McPhail
39	Ergon Energy	Ian Reid
40	Ergon Energy	Michelle Taylor
41	First Solar	Nicole Ghiotto
42	Frog Solutions	Max Willarth
43	Fronius	Rod Dewar
44	Fronius Australia	Adrian Noronho
45	Fronius Australia	Klaus Kramler
46	FRV	Chris Wilson
47	GBH Industries	Ken Greaves
48	GE	Gitanjali Jain
49	Global Sustainable Energy Solutions Pty Ltd	Reneil Sabater
50	Global Sustainable Energy Solutions Pty Ltd	Susan Neil
51	Greenbird	Sintat Liew
52	GreenBird / ComAp	Brett Caspers
53	GreenBird / ComAp	Petra Piclova
54	Greenwiring	Kenny Marpole
55	Griffin Renewable Energy	Nigel Griffin
56	Griffin Renewable Energy	Louisa Palumbo
57	Horizon Power	Laurie Curro
58	Infinite Energy	Michael Dichiera
59	Infinite Energy	Steven Richards
60	Ingenero	Nathan Moore
61	Ingenero	Rodger Whitby
62	IT Power	Nic Jacobson
63	Jemena	Ashley Lloyd
64	Jemena Ltd	Philip Thomson
65	Madison Australia Pty Ltd	Astrid Herber
66	Mojarra	Cameron Gardiner
67	MPower Group Pty Ltd	Dwayne Lange
68	Murdoch University	Martina Calais
69	Murdoch University	Simon Glenister

70	Next Power	Kieron D'Arcy
71	NHP	Damian Jones
72	NHP	Michael Santin
73	Office of the Technical Regulator	George Nesic
74	Power One	Adrian Amato
75	Power One	Joesph Kassouf
76	Powercor Australia/Citipower	Neil Gascoigne
77	QLD University of Technology	Prof. Gerard Ledwich
78	Rainey Electrical Services	Nathan Rainey
79	RATCH-Australia	Anil Nangia
80	RATCH-Australia	Joe Hallenstein
81	ReneSola Australia Pty Ltd	Frank Unferdorben
82	ReneSola Australia Pty Ltd	Samir Jacob
83	RGP Engineering	Bob Pritchard
84	RMIT University	Grahame Holmes
85	SA Power Networks	Joe Caruso
86	Save Energy Aus	Sean Scanlon
87	Senergy	Tony Morton
88	Si Clean Energy	James Sturch
89	Si Clean Energy	Peter Bulanyi
90	SMA	Anna Brazil
91	SMA	Prateek Chuordia
92	Solar Edge	Eyal Saar
93	Solar Edge	Yair Aviad
94	Solar Matrix	Raoul Abrutat
95	SP AusNet	Max Rankin
96	Standards Australia	Julia Dropmann
97	Sun City Solar	Scott Phillips
98	SunPower	Jane Bond
99	SunPower	Alex Flores
100	Suntech Power Australia P/L	Eric Koh
101	SunTrix	Jason Hua
102	Sustainable Energy Association	Kirsten Rose
103	United Energy	Ian Norris
104	United Energy	Steve Oh
105	Western Power	Ian Gibb
106	Western Power	Dave Lowry
107	Western Power	Aidon Thomas

108	Western Power	Nigel Wilmot
109	Wilco Electrical	Russell Wilson
110	Wood & Grieve Engineers	Mark Price