Opportunities (and Difficulties) in the Energy Transition - New Technologies - New Investments

Invited Paper - ASEAN Sustainable Energy Week - 30 July 2020

Dr Karel Nolles
Visiting Professor, Joint Graduate School of Energy and Environment
King Mongkut's University of Technology Thonburi
†Chief Investment Officer, Yamanah Investments
Sydney, Australia
Email: karel.nolles@aton.com.au

***Abstract*—The tidal wave of investment into renewables over the past 15 years is now highlighting issues of grid stability and the role of customers as "prosumers" as never before. New businesses and innovations are emerging, particularly in the thematic areas of data services and predictive analytics, asset digitisation, and traceability/provenance services. This paper explores some examples of relatively new companies within these areas, and how these themes present opportunities in the future.**

I. Introduction

When the author commenced as a Director in the (then newly established) Renewables and Climate Change team at Macquarie Bank in Sydney in 2007 it was considered innovative for a mainstream fund to propose investing into a $50M solar farm, and although the electricity supply industry discussed the issues, regulators and market participants were far from seriously worrying about issues of grid stability, transmission constraints, quality of supply, and "prosumers"[1].

By May of 2020 a request for Expressions of Interest by the government of the state of New South Wales in Australia for 3000MW of renewables in a proposed "renewable energy zone" attracted 27,000 MW of proposals, and was being reported as "attracting investment of almost [AUD] $13 billion."[1] Clearly industrial scale renewables has fully arrived in the mainstream, and no investment banker in utilities would be taken seriously without having had exposure to financing such projects. All within 15 years.

However in October 2019, when the Author found himself as an executive in the electricity grid System Control for the Northern Territory of Australia, the issues of stability, constraint, QoS and prosumers had become pressing to the point of a Australian city being blacked out for 8 hours and the Energy Minister proceeding to sack the CEO of the Government owned monopoly power provider for failing to adequately manage the energy transition.[2] [3].

Like most disasters, this event (in a stand-alone city grid in the centre of Australia with a peak demand of about 50MW) had multiple causes, only some of which would be directly traced to the immediate trigger of a sudden drop in solar production and the failure of a newly installed Battery Energy Storage System to perform as expected. It did however cause a focus to be brought to the transformation issues involved.

[1]A term I shall use as a coverall for customers connected to the grid who also - at least at times - generate electricity, be that for their own internal use or for export back into the grid.

II. An example of the difficulty

As an example of the difficulty faced by system controllers when a significant amount of un-monitored rooftop solar exists is shown in Figure 1, taken from [4], and relates to the 7th April 2019 in the Darwin-Katherine Interconnected System (DKIS).

In the DKIS, System Control is mandated (by government) to ensure sufficient gas turbines are running to have 25MW of spinning reserve (that is, instantly available power generation capacity) at all times - indicated by the red line in Figure 1. At levels of spinning reserve below this it is known that the risk of blackouts on the system dramatically increases.

Starting a gas turbine takes about 30 minutes, and costs money even if the turbine is not being used, so there is incentive to run the minimum amount of turbines possible, whilst still meeting the spinning reserve requirement.

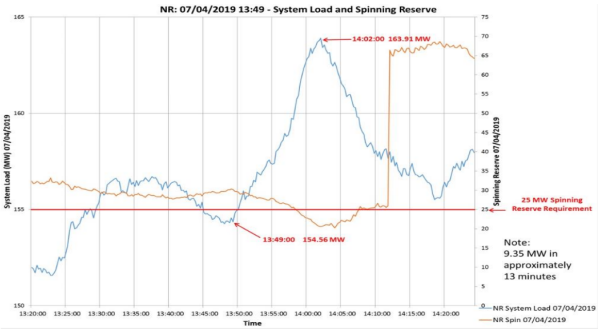

Fig. 1. An example of the difficulty controlling an electricity grid system with significant solar penetration

In this case, System Control saw a sudden spike in electrical demand over a 12 minute period, commencing at 1:49pm, and called for an extra turbine to be started at 1:55pm. The spinning reserve requirement was breached at 1:57pm. At 2:02pm the demand peaked, and started dropping sharply, and

as a result the spinning reserve requirement was met again from 2:07pm. The additional turbine came on line at 2:12pm, at which point the system had almost 3 times the required spinning reserve (at considerable cost, ultimately borne by electricity consumers).

What caused this ? An unexpected cloud crossed the Darwin area, and the rooftop solar panels decreased their output as the cloud passed overhead, returning to production as the sky cleared....

New systems and approaches are required. In the above case, improved localised and short term weather forecasting and solar production forecasting systems, which need to be integrated into the minute by minute operational decision making. No integrated off-the-shelf systems appear to yet exist, although clearly the issue is now obvious to vendors of system control software.

It is the Author's view that while investment opportunities in grid scale renewables will continue, the investment growth areas will be related to how to manage the new data and control issues being increasingly faced, and on the related provision of customer focused energy services. This paper explores some of the services that are now emerging as the energy sector transition pivots, but which were largely unheard of just a few years ago, particularly related to two specific themes:

- Data services and predictive analytics
- "Traceability" and "Provenence" providing new opportunities for suppliers and consumers

III. Data Services and Predictive Analytics

A. Solar Forecasting

The relatively new field of short term weather forecasting and forecasting instantaneous solar production has draw forth a range of new companies in the past 5 years, using a mix of complex weather models, sky cameras and satellite imaging to provide micro-localised weather forecasts and solar production forecasts for individual solar farms, or across broader regions. (In the Author's personal experience, a System Control managing the power supply to a major urban area is now very interested in the precise movement of clouds across that urban area, and the resulting impact on the performance of rooftop solar panels.)

Without providing any particular endorsement a couple of companies in this field established within the last few years (and both of which appear to have links out of university related research) would include:

- Solar Analytics[2]
- Proa Analytics[3]

It is interesting to observe that whilst these companies commenced with a focus on providing real-time micro weather forecasts and output forecasts to industrial scale solar facilities, they are increasingly also providing web based tools for individual householders wanting to analyses how their home solar panels are performing.

One attraction for investors in this sector is that companies providing these kinds of tools are globally scaleable and can provide white-labelled "Software As A Service" to electricity retailing companies looking to provide information to their customers. A much larger example of this approach is the recent $500M investment into Octopus by Origin Energy.

B. Origin / Octopus

On 1 May 2020 Origin Energy (one of Australia's "big 3" electricity retailers) announced they would invest "more than $500 million to take a 20 per cent stake in UK-based retail market disrupter Octopus Energy and adopt its customer platform in a move it expects to yield up to $150 million a year of savings from 2024 and could reverse a drop-off in customer accounts."[5]

The core asset at play is the "Kraken" customer platform developed by Octopus, and which is claimed to be capable of providing a "customer focused" platform for data acquisition and product development, and (at least as publicly reported) has the potential to also reduce customer management costs compared to existing systems. (The Author does note that such major software deployments - and Origin Energy is reportedly spending $80-$100M over 4 years to customise and deploy the platform - do have an unfortunate track history of running late, over, and not delivering in full the promised benefits. However what is clear is that significant potential is seen by utilities in such platforms.)

It is described by Octopus as "a cloud-based energy platform for interacting with both consumers (via the web, mobile and smart-meters) and the industry (eg data flows, consumption forecasting, trading on the wholesale market)." The example quoted by Octopus of the use to which such data can be put is the provision in the UK of a 30 minutely tariff - which by implication would advantage customers able to in some manner control the energy consumption of their homes.[6]

Clearly companies with the ability to pull in data from disparate sources, put that data into a consistent and analyzable format in near real time, and then process and apply that data for new product offerings have become valuable property.

C. Digitization services

The requirement for detailed modeling of how electrical assets are performing at both a technical and a commercial level has been booming. The overarching theme is "digitization" of assets - that is - the now standard practice by asset owners (for example a fund which has invested into a network asset) to have their own detailed models about how the asset is likely to perform in both a technical and an economic sense.[4]

This area is hardly new, with reports being prepared by the International Energy Agency[7] and the World Economic Forum[8] just in the last couple of years.

[2]https://www.solaranalytics.com/

[3]https://proa.energy/about/our-story/

[4]https://www.power-grid.com/2019/10/08/smart-electric-how-digitalization-brings-new-value-to-aging-power-infrastructure/#gref

However those outside the industry are often surprised at the thirst for digitization. This can extend from the much discussed Internet-Of-Things through to detailed combined economic/commercial/asset management models.

Companies that are in the business of developing and maintaining these models (which includes the major consulting companies such as PWC, EY and Deloittes, and major engineering firms (Siemens, GE, etc) as well as many smaller specialist consulting groups) - have all struggled to meet demand for their services. (It has been the Author's recent experience of having to be in a bidding war to secure the required consulting services.)

The CSIRO and Energy Networks Australia [9] produced an interesting report in 2017 discussing the transformation of the electricity networks, and which assumed as its underlying base case a future where up to 45% of all electricity is generated by customers in 2050. The report particularly notes the demand for developing every more real time and detailed digital models of all elements of the electricity grid.

IV. Traceability and Provenance

Whilst the "cryptocurrency" bubble has peaked, the underlying block-chain technology (and the related focus on traceability and provenance) has been continuing to provide transformative innovation.

For example, many major stock exchanges around the world - including the London Stock Exchange, The Singpore Stock Exchange, and the Australian Securities Exchange, are all moving to blockchain based clearing and settlement systems.

In the energy sector, Ledger[5] (best known for their crypto currency hardware encryption wallets) have an initiative targeting the renewable energy sector in particular. It is understood to involve the potential to put a cheap cryptographic chip with network connectivity embedded into solar panels at the point of production, thus allowing the individual output from every solar panel in a solar farm to be recorded, audited, and at least potentially separately sold.

The commercial opportunities for "securitisation" of such output are significant. For example, in much the same way that on an aircraft each jet engine is often owned by different investors who lease the engine to the aircraft owner/operator, one could in principle imagine consumers leasing output from individual panels within a given solar farm, and these cashflows being used to finance the construction of the solarfarm itself.

Some other relatively new companies/organizations that have made news in respect of traceability services over the past few years would include:

- Energy Web Foundation [6]
- Power Ledger [7]
- Enosi [8],[9]

[5]https://www.ledger.com/
[6]https://www.energyweb.org/
[7]https://www.powerledger.io/
[8]The Author is a minor shareholder in Enosi, and is on their advisory board.
[9]https://enosi.energy/

As an example, Enosi has partnered with an electricity retailer to providing a mechanism by which a manufacturing facility that has installed solar panels on their roof is able to offer the surplus power (typically at weekends when the facility isn't operating) to their employees for use against their own personal electricity accounts.[10]

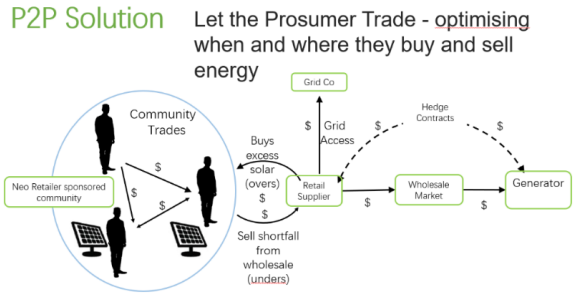

Fig. 2. The "Prosumer" trading model. (Enosi)

There have been significant data and regulatory barriers to these kinds of arrangements, but it is clear that these are being progressively solved. One can easily imagine the above arrangement being extended to cover providing a mechanism for the company's employees to charge their Electric Vehicles cheaply using the surplus power, and possibly event to pay EV owners prepared to provide some battery support back to the supplier.

As Ledger and securitisation of the output of panels, Octopus with realtime customer data, and Enosi with "buy direct" trades all demonstrate, with the growing ability to track energy flows at short timescales with independent assurance about the data quality, a significant vista of new business models is opened.

It is the Author's view that working on this interface of how to seamlessly integrate the optimal provision of energy services to consumers will be a fruitful area for new companies for some years into the future.

References

[1] Australian Financial Review, "New England set for $12.9b renewables investment," Jul. 2020, library Catalog: www.afr.com Section: energy. [Online]. Available: https://www.afr.com/companies/energy/new-england-set-for-12-9b-renewables-investment-20200709-p55agw

[2] N. T. Utilities Commission, "Alice Springs System Black Independent Investigation," Dec. 2019, last Modified: 2019-12-10T16:08:55+09:30 Library Catalog: utilicom.nt.gov.au Publisher: https://utilicom.nt.gov.au/news/2019/alice-springs-system-black-independent-investigation. [Online]. Available: https://utilicom.nt.gov.au/news/2019/alice-springs-system-black-independent-investigation

[3] Australian Broadcasting Commission, "NT utilities bosses sacked over 'unacceptable' Alice Springs blackout," Dec. 2019, library Catalog: www.abc.net.au. [Online]. Available: https://www.abc.net.au/news/2019-12-09/alice-springs-blackout-sees-territory-generation-boss-sacked/11779246

[4] Power Water Corporation NT, "Review of the Northern Territory Generator Performance Standards - Consultation paper," Tech. Rep., Jun. 2019. [Online]. Available: https://www.powerwater.com.au/__data/assets/pdf_file/0022/26077/GPS-review_consultation-overview-paper.pdf

[5] Australian Financial Review, "Origin inks $507m UK alliance to revamp retail," Apr. 2020, library Catalog: www.afr.com Section: energy. [Online]. Available: https://www.afr.com/companies/energy/origin-inks-507m-uk-alliance-to-revamp-retail-20200501-p54ovh
[6] Octopus Energy, "Kraken Platform," library Catalog: octopus.energy. [Online]. Available: https://octopus.energy/careers/back-end-developer/
[7] International Energy Agency, "Digitalization and Energy – Analysis," Nov. 2017, library Catalog: www.iea.org. [Online]. Available: https://www.iea.org/reports/digitalisation-and-energy
[8] World Economic Forum, "Electricity: uncovering value through digital transformation," library Catalog: reports.weforum.org. [Online]. Available: http://wef.ch/2jmQvsW
[9] CSIRO and Energy Networks Australia, "Electricity Network Transformation Roadmap," Apr. 2017, library Catalog: www.energynetworks.com.au. [Online]. Available: https://www.energynetworks.com.au/projects/electricity-network-transformation-roadmap/
[10] S. Vorrath, "Rooftop solar trading platform cuts out energy market middle man," Mar. 2019, library Catalog: reneweconomy.com.au. [Online]. Available: https://reneweconomy.com.au/rooftop-solar-trading-platform-cuts-out-energy-market-middle-man-48806/

Dr Karel Nolles held various academic positions in the Faculty of Commerce and Economics at the University of New South Wales and in the School of Agricultural and Resource Economics at the University of Sydney from 2004 to 2016. He was a Director in the Utilities and Climate Change team with Macquarie Bank from 2007 to 2013, and subsequently was Head of Strategy for the Clean Energy Derivatives Corporation (a hedge fund), a consultant with the Australian Energy Markets Commission, and Manager Electricity Reform for the Northern Territory Power and Water Corporation. He is currently Chief Investment Officer for Yamanah Investments (a venture capital firm) and a Visiting Professor with the JGSEE/KMUT. In 1995/96 he spent 2 years based in Bangkok working as a consultant to EGAT and NEPO, and as a result speaks Thai very very badly....