Managing Energy in a Changing Environment

Energy is essential to our way of life, to our standard of living. Industries require it, economies run on it and in all forms of energy transfer, a transaction takes place. This transaction up until recently has been primarily one way – sender to receiver, generator to consumer. However, this model of transactive energy is changing and historical policies, economic models and human thought processes have struggled to keep up with accelerating technology changes. One thing is certain – change is the new norm, the one absolute constant.

This précis is an overview of this change with respect to the energy environment under the National Energy Guarantee (NEG) context with the focus specifically on the electrical energy industry. The suggestions contained herein are neither 100% right nor 100% wrong, rather they are suggestions and opportunities to assist in addressing the Reliability, Affordability and Reduced Emissions commitments recommended by the Energy Security Board (ESB) and accepted by the Federal Government. These suggestions represent a great opportunity for those governments, companies and individuals willing to embrace change.

Before getting into any specifics, the benefits and positive outcomes due to older technologies must be acknowledged. These older technologies, typically fossil fuel generators, have been a vital part of Australia's continued ability to maintain a high standard of living. Indeed, they continue to perform and produce the vast majority of electricity for our nation; however, recent learnings in regards to anthropogenic (human induced) climate change, mean we know and understand that our climate is changing due to our increased Carbon emissions. We have a responsibility to act and provide leadership with our solutions. So, what can we do about this existing technology and how do we reduce our emissions in a reliable and affordable manner?

Option 1: Utilise Existing Infrastructure

The existing infrastructure includes the poles and wires, generators and easements, other electrical componentry as well as the software and perhaps most importantly – personnel. These are valuable assets and the smart option is to incorporate them as we transition to our future electrical realities (plural). For example, every grid connected, fossil fuel generator has a proven and reliable connection to the electrical grid. These generators usually come with a sizeable quantity of land (e.g. coal stockpiling, fuel source and transmission line proximities) and many include dams and lakes for cooling purposes as part of their operations.

Installing alternative generation technologies such as Solar Photovoltaic (PV), Solar Thermal, Wind, Hydro, Biomass or other, behind the meter i.e. on the fossil fuel generator site has many advantages including:

- lower initial sunk costs i.e. the grid connection and AEMO (Australian Electricity Market Operator) operational requirements are pre-existing, functional and already in place
- reliable source of electricity as per NEG requirements i.e. fossil fuel and alternative generation working in parallel and feeding electricity into the grid at the same time up to the allowable generation export capacity for each particular site
- lower source of emissions per kWh (kilowatt hour) of electricity due to the alternative generation technology installed on site
- continuity of working life for staff, operating plant, investors and local communities

- allows a gradual change from fossil fuels to alternative technologies over a longer timeframe as opposed to sudden and disruptive step changes based on policy changes and the like
- preserves finite fossil fuel resources for if/when they can be repurposed, left in the ground, needed in cases of emergency i.e. energy security purposes and to minimise sovereign fuel supply risks
- lower operating costs due to lesser quantities of fossil fuel resources needed per kWh of electricity
- allows repurposing of disused sites (such as mine sites)[1]
- allows retraining of staff at disused sites across to alternative technologies and provides a training environment in how they operate and function, which in turn means jobs remain local as well as employment continuity
- allows reallocation of energy subsidies to other areas of the economy such as education and health
- proves or disproves the reliability of alternative technologies (with the ultimate back-up of fossil fuels) in a safe and effective manner i.e. a real world experiment in a controlled environment that will enable key metrics such as percentage of allowable alternative energy technologies up to and including 100% penetration, ancillary services that can be provided and offered besides that from fossil fuels i.e. inertia, frequency response etc.
- enhances the key idea of multiple generation technologies working in parallel, transitioning from one type of system to another, to another ad infinitum (***AND*** thinking methodology), as opposed to the adversarial approach (***OR*** thinking methodology) of one type of technology or another or another
- increases the probability of investment (private and public) due to meeting any future NEG requirements i.e. provides guidance for future policies and enhances them after the fact
- provides an opportunity to test policy, rules and market changes in localised environments to determine flexibility and appropriateness of said changes before implementing any changes at local, state or national levels

Option 2: Defining Reliability in the Energy Context

Why define something? Defining a topic provides context and understanding, which in turn highlights key deliverables and focused risk management strategies i.e. a potential framework for the way forward.

What is reliability in the energy context? Reliability in general can be thought of as the ability of a machine, system, device, person, team or other to consistently perform its task or duty, on demand, time and time again with minimal failure or degradation in the desired output. In the energy context, reliability can be thought of as the ability of the electrical network to consistently provide quality electricity.

The AEMC "Fact sheet: the NEM reliability standard" states that 'Reliability of the power system relates to ensuring there is enough capacity to generate and transport electricity to meet all consumer demand'[2]. The present reliability standard is set at 0.002 of a per cent i.e. 0.002%, which is the upper limit for the amount of energy that is required, but cannot be supplied. This level of reliability has been in place since 1998 and based on this metric, the Australian electricity network is

[1] http://reneweconomy.com.au/bhp-sees-500mw-solar-storage-potential-disused-mines-20836/?utm_source=RE+Daily+Newsletter&utm_campaign=712f6496fb-EMAIL_CAMPAIGN_2017_11_15&utm_medium=email&utm_term=0_46a1943223-712f6496fb-40317533
[2] http://www.aemc.gov.au/getattachment/2f4045ef-9e8f-4e57-a79c-c4b7e9946b5d/Fact-sheet-reliability-standard.aspx

already reliable. An equivalent amount of time would be an allowable upper limit of 11 minutes of outage per year, per region. This has been meet in most cases, in most regions since 1998.

So if reliability is already being met, what property is actually being asked for or wanted within the NEG? The answer lies in the ability of the network to respond and recover i.e. how quickly it can provide electricity and by what means, its *resilience* and *flexibility*. The quicker a network recovers from an outage, the more resilient it is, and the more options a network has to provide electricity, the greater its flexibility for response. This is where other electricity generation and transmission options come into play.

Generation options such as batteries or hydroelectricity or batteries and hydroelectricity or floating solar PV, batteries and hydroelectricity systems etc. all provide the means and ends to increasing network resilience and flexibility. Providing storage closer to the loads increases reliability too, as in cases of wide scale black-outs, a micro grid can be activated to provide essential and/or emergency loads. This approach increases the ability of the network to recover and respond quickly and from multiple generation options i.e. a resilient and flexible network.

Further to this, increasing transmission line options is another method for maintaining network reliability, increasing resilience and providing flexibility. Cross border interconnectors (transmission lines) provide:

- long term infrastructure projects and planning
- increased energy security i.e. widely dispersed generation sources interconnected in several different places and from multiple directions
- increased network supply and/or stability in times of weather events in different areas or at different times of the day, for e.g. a series of cross continent transmission lines could supply electricity to both sides of the Australian mainland during peak demand times at sunrise and sunset
- on the go electric vehicle charging stations i.e. electric vehicle charging via induction coils set in the road and on the vehicle, that are directly provided with electricity via these continental transmission lines
- the total increased electricity capacity and ability to deliver (and receive) electricity in a bidirectional manner that will be required with increasing numbers of electric vehicles and electricity usage

Option 3: Defining Affordability in the Energy Context

Affordability means many things to all members of society. In terms of energy, it is commonly understood to mean the ability to pay for the service of electricity (or gas or other energy source) in undertaking both essential and non-essential tasks, while maintaining a particular standard of living. If the costs of electricity rise, then the proportional costs of this service also rise and if this impinges on the current standard of living, this service can become too expensive to maintain and a cycle of decreased services comes into play, leading to lower standards of living. This is part of the bigger issue of energy affordability.

One method to increase affordability and thus maintain or increase the standard of living, is to provide choice. Choice of retailer, choice of supply or even choice of time of use are several ways to increase the options for the service of electricity and thus increase the affordability of energy. Choice is enhanced by providing options and options can be increased by improving the ability of the network to become smarter. Increased monitoring, shared transmission and distribution lines, peer to peer trading, smarter metering are all options and opportunities to improve the service of

electricity and in turn increase the affordability of energy. Smarter networks are predictive and flexible and can assist network planners and suppliers to supply electricity on a just in time basis, which means; less redundancies, less wastage (i.e. spinning reserves and dump loads), less risk mitigation strategies and lower safety net requirements, leading to lower prices and an increase in energy affordability – a positive feedback loop.

These smarter technologies are available and ready to be implemented on a wider scale when the right policies, markets, investment signals and information present themselves.

Option 4: Defining Reduced Emissions in the Energy Context

Reducing emissions is a key driver for many organisations and governments based on the majority of accepted scientific, financial engineering and health based knowledge that; human-induced, anthropogenic climate change is real and is affecting our climate i.e. our way of life, emission reduction opportunities improve energy based economics and minimising emissions improves health across the wide spectrum of health and safety parameters. There are numerous articles and publications surrounding this topic with many more opinions to suit. The one topic that most/all opinions agree on however, is that the climate is changing and our species needs to adapt. Defining what reduced emissions means in the energy context is a starting point for what our adaptation/s might mean.

In the energy context, reducing emissions and what it means, entails many opportunities and options and some of these include:

- lowering the chances and possibilities of security issues such as drought wars, climate refugees i.e. refugees from countries with low lying land impacted by sea level rise and invasive species invasions in different regions e.g. increased regions of malaria from amassed, viable mosquito ranges
- lower operation and maintenance costs i.e. alternative technologies tend to have lower operation and maintenance costs due to the nil or minimal costs of their fuel sources i.e. sun, wind, biomass, hydro etc.
- lower marginal cost of energy i.e. the costs to deliver the electricity from alternative energy sources[3]
- lower health and safety costs, as reduced emissions entails reduced particulate emissions, leading to reduced health impacts such as air borne diseases like asthma and the minimisation of the length and severity of common cold and flu viruses[4]

Option 5: Provide Clear Guidelines and Policies Based on Sound Politics

An analysis on why the electricity sector and energy provision industries within Australia have been in disarray for at least the previous decade, will highlight many different ideologies, personalities, brinkmanship, political divisions and in general, competing interests across multiple factions and sectors. A sanity check of these divisions and disorder, indicates that the energy industry, including the delivery of electricity, is broken. In simple terms, it needs fixing. The NEG is a first and vital step in this transition and the provision of clear guidelines and sound policies can start this dynamic progression and a ramping up of technology transfer.

[3] https://www.pc.gov.au/inquiries/completed/greenhouse
[4] https://www.omicsonline.org/open-access/impact-of-climate-change-on-air-and-water-borne-diseases-2167-7719.1000e126.php?aid=22137

The transition to a smarter, reliable, resilient, cost effective and reduced emissions energy network will not be easy. However, just because this transition maybe hard, does not mean it should not be attempted i.e. the provision of stable, flexible, national energy policies. These policies cannot be set and forget as the nature of the newer technologies and the speed of change of complementary technologies (e.g. smart meters), means that periodic reviews will be necessary. Indicative timelines for review could be every six (6) to twelve (12) months depending on policy and market impacts.

The speed of change of technology and the interconnectedness of multiple items also highlight the outright need to base policy decisions on sound technological parameters as opposed to any ideological political leanings. This approach would encourage unbiased outcomes based on qualified real data, from respective professionals (e.g. engineers), in turn enabling policy stability and market transparency – a key outcome. The question isn't whether the industry and government should work together – it's how[5].

Final thoughts

There is some way to go to improve and tidy up our energy industry, including the provision of electricity. Clear guidelines and sound policies are key to this transition and providing the opportunity for all energy sources to perform in all facets of the energy market (i.e. ancillary services provision) means the NEG can be the catalyst to achieve the Reliability, Affordability and Reduced Emissions commitments, everyone desires.

[5] https://www.energyaustralia.com.au/about-us/media/news/energyaustralia-statement-queensland-affordable-energy-pledge