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10 June 2016

Mr Colin Mugglestone
Chair
Queensland Renewable Energy Expert Panel
PO Box 15456
CITY EAST QUEENSLAND 4002

Dear Colin

Submission to Queensland Renewable Energy Expert Panel – Issues Paper

Queensland, by virtue of its privileged renewable resource position, has an opportunity to secure a leading position in the renewable energy space and we are excited by this Queensland Government initiative of establishing the Renewable Energy Expert Panel and seeking stakeholder views on pathways to a 50% renewable target.

The world's electricity markets are transforming. Transitioning from fossil fuels to renewable energy, from centralised to distributed generation, from supply-led to demand-driven use: these dichotomies characterise in simple terms the change that is underway. This is reflective, not just of market dynamics more broadly, but of fundamental change at a societal level.

At Aurecon we strive to imagine what a better future looks like. We bring ideas to life by partnering with our clients and using our innovation and expertise, with technology, to solve complex problems.

We draw on the talents of our team to provide clients with diverse thinking and access to expertise in all areas of the energy sector, including project identification, development and delivery, along with energy advisory and management consulting services.

This thinking comes from a deep insight into the broader transformation and disruptive forces touching all aspects of society, by virtue of our global reach and extensive client network.

Please do not hesitate to contact me should you wish to discuss any element of this submission.

Yours faithfully

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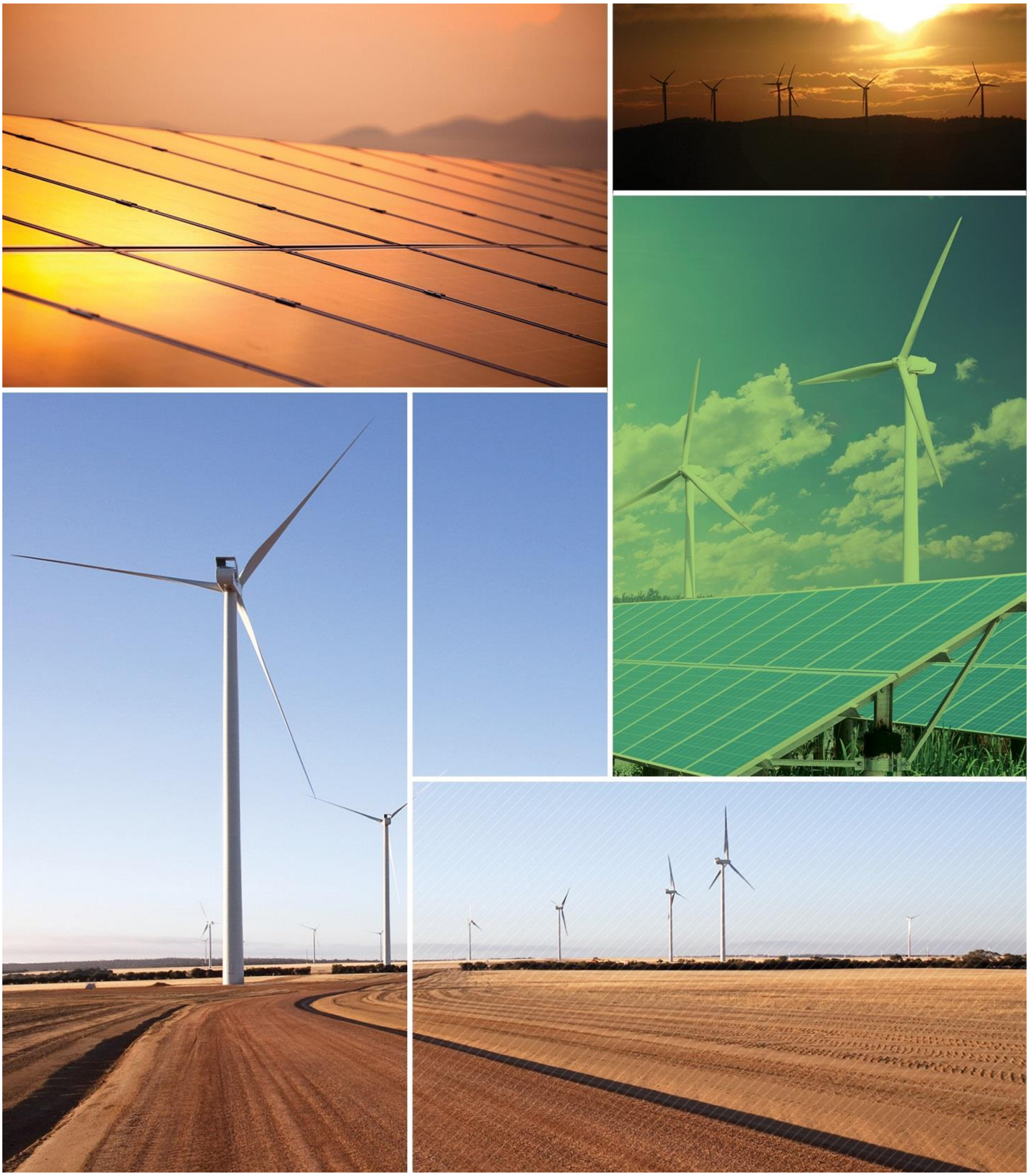

Submission to Queensland Renewable Energy Expert Panel

Response to Issues Paper

Queensland Renewable Energy Expert Panel

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Contents

1 Executive summary

At Aurecon, we work with clients who are active across the full spectrum of the energy supply chain, from generation, transmission and distribution to retail. Our work sees us engage a wide range of stakeholders from technology providers and contractors through to communities and regulators. As such, we're in a unique position that touches each of the elements that impact the transition to a renewable energy economy.

In this transition, we imagine a future where the customer is at the centre of an energy services market, not the end of a supply chain. We believe the future providers of energy services will characterise themselves as technology companies, not resource owners, power generators or electricity retailers.

The transition itself will be challenging. Those businesses that foster a culture of innovation will be able to adapt and to succeed. Governments that create the space for innovation and facilitate efficient allocation of capital will attract investment and grow new industries.

Many of our clients anticipate a future electricity market that consists of increasingly distributed sources of supply. In defining a renewable energy target, this compelling industry thematic needs to be understood in the customer centric context.

Feedback from technology developers in this space provides increasing confidence that this vision of the future can be realised by 2030. Analogues abound for such a transition: the decline of traditional media consumption in favour of digital from a demand perspective, and the transition from fixed line to wireless communication networks from the point of view of supply. These are two powerful examples of industries rapidly transitioning across similar time horizons.

At Aurecon, we believe that the transition is not just limited to residential customers but to commercial and industrial customers as well, driven by an increasing desire for value beyond price alone. Future energy service providers will make things:

- **Simple** – customers have as much or as little engagement with their 'energy service provider' as they desire. Engagement in any case will be set by 'preferences' that are automated.
- **Sustainable** – customers want low or zero carbon solutions and, irrespective of attitudes to climate change, responsible supply chains, ethical raw materials, recyclability of components etc.
- **Predictable** – customers do not want 'bill shock', so will tend towards different service offerings in line with, for example, telecommunications.
- **Independent** – customers want to use their property assets to generate additional return on investment, independent of the current incumbents (retailers, networks, etc) whom they may not trust.
- **Digital** – customers live in a digital social world and want to share their energy via peer to peer (P2P) at a neighbourhood/commercial level. Virtual Net Metering presents a significant opportunity.

For Queensland to develop a successful pathway to up to 50% renewable energy generation and attract greater investment by 2030, tariff and regulatory reform go hand in hand with a focus on technology. To enable the future we advocate pursuing a suite of measures based on the following principles:

- **Incentivise technology companies** – establish a focus on technology as the enabler to a renewable energy economy, along with digitisation of infrastructure, data collection and predictive analytics

- **Facilitate collaboration in execution** - the inefficient duplication of resources and effort between parallel and competing projects has become somewhat of a hallmark in Australia's recent history of developing and delivery major energy projects. Where these major projects have failed is in a coordinated and unified approach focussing on optimum long term market outcomes over short term milestones.
- **Aim to reduce net demand –** as a means to more efficient use of capital and reduced costs to consumers, incentivise overall net demand reduction on the system and in particular peak demand through deployment of storage technologies in conjunction with renewables under the target.
- **Favour local supply closest to the customer** – this is as much about practicality as efficiency. Incentivise commercial and industrial uptake of renewables equally if not more than utility scale.
- **Assist remote communities** – prioritise fringe of grid and remote locations to deliver efficient outcomes by lowering line losses and displacing any local liquid fired generation.
- **Be mindful of stranding assets** – this does not just include existing generators, but the fleet of large renewable generators and transmission and related infrastructure that may itself be deployed under a target. A 50% renewable target should take into account the momentous potential for change in global energy markets with the advent of low cost solar, ever cheaper large scale batteries and, in the transport sector, electric vehicles.
- **Coordinate the policy approach** – an effective pathway to a 50% renewables target must see a meeting of industrial, agricultural and climate policy to create a seamless and long term plan for a prosperous Queensland well beyond 2030.

2 Section 2 – Policy options for increasing renewable energy

2a) What policy options are likely to deliver increased renewables in the most effective and efficient manner under a Queensland renewable energy target, taking into account existing schemes such as the Federal LRET?

The existing Federal Government LRET

The LRET target is forecast to require approximately 5 GW of additional large scale renewable generation between now and 2020. After growth rates slowed in recent years due to uncertainty with the target level, which has now been agreed at 33 TWh by 2020, the emerging issue facing the industry now is that the 2030 end date for creation of renewable certificates (LGCs) is a hard end date on any power purchase agreements (PPAs) that developers can negotiate. Given the small number of retailers in Australia who are able to enter into these long term agreements, strong competition for these agreements is putting downward pressure on pricing. Queensland could look at measures to provide policy certainty to projects planned under the LRET beyond 2030, conscious of the limits under the Renewable Energy (Electricity) Act 2000.

From a technology perspective, the rapidly declining price of solar photovoltaics (PV) has seen many developers of wind farms pivot their business towards developing solar projects. Whereas a few years ago the expectation was that the bulk of Australia's LRET would be built out with existing, approved or under-development wind farms, with perhaps a small and growing portion of large scale solar, general consensus among many of our clients and the broader industry today is that the bulk of the target will be fulfilled by large scale solar photovoltaics and only the highest quality wind projects taking a small and diminishing share. Solar thermal, biomass and hydro are not expected to fulfil a material volume of the target without separate and additional support.

This presents an opportunity for Queensland, which is expected to capture a significant share of the solar capacity given its privileged resource position.

International and local policy measures

Historically, investment in large scale renewable energy projects has been achieved by policy intervention that addresses the two major risks of such projects: relatively high up-front capital costs with low and predictable ongoing operating costs when compared with fossil fuel and; seasonally predictable but hourly variable energy output that can be sold under long term off-take agreements. This section provides examples of policy interventions, both international and local, and discusses the relative merits and shortcomings of each.

- **High up front capital costs**: programs that provide capital grants and promote access to capital may assist in addressing the high (absolute) capital costs of renewable generation.
  - Feedback from our clients, and anecdotal evidence across our global infrastructure and transport business, indicates that capital grants are most effective in deploying new technology that has yet to achieve commercial competitiveness with existing generation. This usually involves a small (kW to MW) scale demonstration plant that can prove the viability of either the energy/resource collection mechanism (in the case of say, solar thermal receiver technologies) or the conversion of that energy to electricity reliably. In Australia, the CEFC and ARENA currently fulfil an important role in this space.
  - In terms of capital grant programs for utility scale projects, industry feedback more generally is that these competitive processes can be burdensome from the point of view of applying for funds and have high degrees of administration on both the developer side (compliance with funding agreements) and significant levels of bureaucratic oversight on the government side. This adds significantly to the true cost of such programs and the time taken to achieve the desired outcome.

It also gives the perception of government ‘picking winners’ rather than taking a portfolio approach by taking multiple, small bets. For example, it took the Federal Government’s 2009 Solar Flagship over 6 years to facilitate two solar PV projects totalling 155 MW.

  - In terms of access to investor funding, several of our clients have expressed the view that significant volumes of capital, particularly international capital, is accessible for high quality, de-risked and ‘shovel ready’ projects are attracting high levels of interest from investors. As a broad principle, we do not believe that deployment of concessional loans, beyond the scope of the CEFC, is required for large scale projects. However, for renewable projects providing ancillary services or system support in remote areas, for technologies that are not yet as commercially proven, and for small scale projects, such loans have been critical in facilitating investment.

- **Power off-take agreements**: programs that provide ‘revenue certainty’ to project proponents are likely the most relevant for large utility and commercial or industrial scale projects. These can come in a number of forms:
  - During the 2000s, widespread deployment of wind and solar (both PV and concentrating solar thermal) in Europe was driven by Feed in Tariffs (FiTs): guaranteed prices per unit of energy produced that enabled project proponents to secure debt financing for projects. At their most effective, FITs provided a powerful incentive to technology providers and drove manufacturing economies of scale, providing much of the early project ‘volume’ that enabled the development of renewable industries in Europe (turbine manufacturing, PV module factories etc). At their least effective, FITs failed to provide effective price signals, resulting in inefficient allocation of capital to marginal or in some cases, uneconomic projects and technologies, ultimately creating significant budget issues for governments precisely because of the incentives provided[1].
  - Procurement of large scale renewable energy on behalf of consumers by government or other utility providers is a policy option increasingly seen as effective based on experience both in Australia and internationally. The Australian Capital Territory reverse auction process has attracted significant interest, facilitated the construction of large scale renewable projects, and achieved competitive pricing outcomes for consumers. This model has also been successful in Chile and India, for example. In Chile however, the reverse auction process is not designed to favour one technology over another, with time based ‘blocks’ of energy on offer. This has encouraged renewable and fossil fuel developers to collaborate and bid as consortia offering dispatchable or ‘firm’ energy blocks.
  - Renewable Energy Tax credits have been employed in the United States to facilitate the development of renewable energy. While these have been prone to partisan politics, and historically created a boom-bust market for wind by frequent expiry and renewal, the Production Tax Credit (PTC) and Investment Tax Credit (ITC) have worked in conjunction with state based Renewable Portfolio Standards that determine required levels of renewable generation. The credits are equivalent $/MWh incentives that enable developers a more secure revenue stream.

At the commercial and industrial scale, access to capital may be an issue

Third party ownership financing (where the homeowner leases the solar system on their roof from a third party) has been a key driver for growth in the United States residential solar market over the last several years. This model has not achieved the same success in Australia. This may be a product of the current low interest rate environment making it relatively easy to finance installation via household equity at mortgage rates, in addition to an attractive payback given state based feed in tariffs.

[1] Robinson, David, “Pulling the Plug on Renewable Power in Spain”, The Oxford Institute for Energy Studies, December 2013

Research from the United States suggests that residential solar leasing market has peaked and direct ownership is expected to surpass the leasing arrangement by 2020[2]. One of the main factors driving this change is the falling costs of rooftop PV systems – as systems become more affordable, the value proposition for direct ownership becomes more compelling to a homeowner. Many solar developers now offer loan financing options in partnership with banks and new 'fintech' business models related to solar financing are emerging to unlock even greater access to capital.

Also in the United States, the Advanced Energy Manufacturing Tax Credit (MTC) awards tax credits to new, expanded, or re-equipped domestic manufacturing facilities that support clean energy development. In terms of meeting both climate, energy and industrial policy goals, these types in the US have driven wind and solar technology company investment in manufacturing facilities[3].

2b) What, if any, are the key policy barriers in Queensland preventing renewable energy investment?

Aurecon is not of the view that specific policy barriers exist in Queensland which are currently deterring renewable energy investment. Given its privileged renewable resource position, in terms of solar, wind to a lesser extent, but also resources such as biomass, feedback from our clients is that Queensland could play a leading role in driving the next phase of Australia's renewable energy growth. This will require a clear integration of energy policy with agricultural, industrial and climate policy outcomes.

The degree to which future investment in renewable energy is successful will depend on the extent to which lessons from other industries such as coal seam gas and mining can be heeded to ensure the orderly development of resources, stable and targeted deployment of human capital, and sustainable long term returns on that investment. This is discussed in Section 6 of this paper.

2c) How might the Queensland Government expedite the delivery of renewable projects (eg regulations and development approvals)?

Addressing the 'demand' or sell side of the equation

In the course of the last decade, public debate regarding energy policy in Australia has tended to focus intensely on the supply side to lower emissions and drive investment.

The following points outline specific actions the Queensland Government could take to help unlock renewable energy demand to provide the necessary 'pull' on the market side. The Government could:

- Lead by example and facilitate the procurement of renewable energy contracts by:
  - Setting itself a target for its own usage at 50% and procuring large and long term power purchase agreements across its many operational sites. This could be done via a reverse auction process, including the negotiation of a range of demand side measures such as Virtual Net Metering (VNM), demand management, site energy storage etc.
  - Assisting local and particularly regional governments in securing more competitive energy supply. The Government could facilitate a number of commercial processes on behalf of local government in order to 'aggregate' a significant volume of demand and secure the most competitive long term power purchase agreements. These would be expected to help underwrite the construction of new projects, with priority given to projects located near or at demand centres.

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[2] Litvak, Nicole. "U.S. Residential Solar Financing 2015-2020", GTM Research, Greentech Media, Inc, 29 July 2015

[3] http://www.ey.com/Publication/vwLUAssets/Advanced-energy-manufacturing-tax-credit/$FILE/Advanced-energy-manufacturing-tax-credit-YY2397.pdf

- Work with distribution network service providers to examine possibilities of further incentivising on site renewable generation at government owned facilities to decrease net demand
  - Almost 60% of Australian schools participated in the National Solar Schools Program (NSSP), which closed in 2013[4]. Solar system costs having decreased significantly since the closure of the program in 2013, therefore now may be an excellent opportunity for a Queensland State initiative coupled with energy efficiency measures, to examine further investment in solar and storage across its extensive portfolio of school properties. A similar program run by the Adelaide City Council to incentivise local businesses, residents, schools and community organisations to install batteries, among others, has been in place for almost one year[5].
- For 'remote' or regional locations away from the major east coast population centres
  - Sponsor efforts to reduce demand on the transmission network via local generation, thereby reducing transmission line losses out to fringe of grid locations.
  - Explore the possibility of a 'renewable energy credit' to owners of remote generation, including mine sites and other remote commercial enterprises, to the extent they install renewable energy systems to reduce fossil fuel usage.
  - In conjunction with the above two points, set targets for the long term reduction of the Community Service Obligation (CSO) payment. By incentivizing capital investment in localised renewable projects, rather than subsidising transmission, the Government can foster job creation and other regional benefits. For 2015–16, the total CSO to support regional and rural Queenslanders is budgeted at $438.2 million. By leveraging third party funding, this could represent a significant opportunity for budget savings.
- Master planned communities and new dwellings provide a significant opportunity to deploy micro and mini grids as well as mandated energy efficiency.
  - Raise mandatory energy equivalence ratings for new dwellings from six stars to seven. When combined with other energy efficiency options and demand response enabled devices, this requirement has been shown to reduce the after diversity maximum demand (ADMD) of new residential connections. This in turn lowers the peak load growth in the network which has the potential to reduce infrastructure requirements and costs, which are ultimately passed on to the home buyer.
  - Incentivise solar and battery integration in new homes or new developments by providing lower cost financing options, or up front assistance paired with grants for first home owners.

Addressing the 'supply' or resource side of the equation

The following points outline specific actions the Queensland Government could take to expedite large utility scale renewable project delivery. Consideration should be given to minimise the key risks already highlighted in this paper that large, stationary generators face in the evolving technology landscape that is likely to favour a distributed and decentralised market construct.

- Identify preferred locations for renewable energy development close to load centres, along similar lines to State Development Areas. South Australia passed a Bill in 2014 to provide renewable energy investors with access to 40% of South Australia's land mass that is Crown land subject to pastoral lease[6].
  - This would identify specific regions where the confluence of renewable resources, transmission and distribution infrastructure and willing investors exist. These should include as a priority industrial and commercial estates close to load centres or regions where master planned communities are being planned.

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[4] www.industry.gov.au/ENERGY/PROGRAMMES/SOLARSCHOOLSPROGRAM/Pages/default.aspx
[5] www.adelaidecitycouncil.com/your-council/funding/sustainable-city-incentives-scheme
[6] http://www.renewablessa.sa.gov.au/proponents-guide/pastoral-crown-land

- Given that renewable resources such as solar, wind and biomass are not associated with a Government resource right, and are associated with ownership of the land or other commercial arrangements, the Queensland government could seek to prioritise development of state owned land by existing generators.

- For ‘remote’ or regional locations away from the major east coast population centres, work with transmission and distribution network service providers to streamline the connection application and agreement process and proactively address network issues
  - In conjunction with the creation of preferred locations for renewable energy development, identify premium connection locations for remote generators identifying where new supply is needed for network stability or other purposes.
  - Sponsor and publicise network studies, in conjunction with transmission and distribution networks, to understand the Marginal Loss Factor implications for edge of grid projects and make so as to educate developers on optimum project siting and sizing.
- Assist developers in de-risking site approvals early in the development phase
  - In a similar way to the assistance provided to the CSG industry, examine ways to streamline environmental studies, or provide funding to regional environmental studies and community engagement programs, to help facilitate the most efficient and effective project approvals and community engagement processes.

2d) How can the existing framework better support alternative energy solutions, particularly in fringe-of-grid and isolated locations?

For many of our developer clients, how transmission and distribution networks function at a technical level is opaque and complex. The competitive advantage of developers is generally in finding and acquiring resources, and subsequently de-risking the social, environmental and community elements of generation technology. In many instances, the best renewable energy resources are in locations where the network is simply unable to accommodate injections of large amounts of energy without either significant upgrades or without incurring high levels of transmission line losses. For these reasons, we advocate a role for the Queensland Government in providing greater transparency for developers, in coordination with transmission and distribution network service providers, so as to understand Marginal Loss Factor and other technical implications for edge of grid projects, and to educate developers on optimum project siting and sizing. This will have the flow on effect of giving financiers and other investors greater confidence in long term revenue and demand forecasts.

For remote and edge of grid applications, the size of potential installations is critical to their economic performance. At the 100 kW to 5 MW size, solar PV, for example, does not achieve its optimum scale in terms of economic efficiency. Feedback from our clients is that solar PV is its cheapest at scales beyond 10 MW. This is not only because of efficiencies in the design or construction process, but in securing panel supply. There could be a role for the Government in facilitating large scale procurement on behalf of regional or remote communities to ensure the best price is achieved for equipment, along with helping industry have visibility on opportunities in construction and the provision of balance of plant equipment. The beauty of many renewable energy technologies is that the local/regional skilled labour and cost elements can in many cases be material for those local businesses.

This example regarding scale is equally applicable to biomass power generation opportunities, perhaps an area in which regional and northern Queensland could create a competitive advantage. An abundance of fuel exists that might supply existing generators, in the case of co-firing with coal, and in the case of new generation as stand-alone projects. However, the inability to achieve the optimum scale for fuel supply because of a lack of centralised collection raises the fuel supply and cost risk to unacceptable levels for many developers and investors. Along with the up-front capital intensity of biomass boilers, digesters for production of biogas, as well as smaller scale engine or turbine-generator equipment, biomass opportunities have historically been much more difficult for developers to pursue, for investors to finance and for off-takers to contract energy. Biomass opportunities could be viable renewable energy ‘firming’ options in the right locations.

2e) Are there any other considerations that should be taken into account when defining a renewable energy target for Queensland (eg concurrent progress in energy efficiency, hybridisation, the use of renewables in industrial processes)?

Demand management and energy efficiency

The changes envisaged by the Demand Management Incentive Scheme, as proposed by the COAG Energy Council to the AEMC, are comprehensive in listing the changes required to the NEM design to bring forward optimum outcomes for consumers[7]. Many of these outcomes may in fact limit the opportunity for significant new additions to Australia’s large scale generation fleet.

The key to making this work will be tariff and regulatory reform that makes it economic to remain connected to the grid and enables various energy trading arrangements. New business models are likely to emerge.

As detailed above, the Government could assess the opportunity to raise the mandatory energy equivalence ratings for new dwellings from six stars to seven. When combined with other energy efficiency options and demand response enabled devices, this lowers peak load growth in the network and has has the potential to reduce infrastructure costs.

Government could consider mandating the installation of solar PV in new residences. This could also include master planned communities, to an extent where a certain percentage of the maximum electricity demand level is to be met on-site. We expect that developers of master planned communities are examining the potential for distributed generation and micro-grids to create business opportunities and also differentiate their product in the new housing market.

Once a household or commercial property is responsible for producing its own energy, or becomes able to trade that electricity to other consumers, energy efficiency measures are expected to proliferate to enable those ‘prosumers’ to maximise their tradeable energy and return on investment.

Encouraging generation at the point of demand in remote areas

In order to facilitate remote and off-grid deployment of renewables, the Queensland Government could consider a renewable energy credit type arrangement for installations that off-set diesel or other liquids generation in those circumstances. This could include the entire suite of renewable energy options, including various storage options, with the level of credit sized according to technology. More detailed analysis of the total size of the market, and therefore size of the subsidy, needs to be undertaken, however this could present an opportunity to promote minerals exploration and production and other remote industry support.

[7] www.aemc.gov.au/getattachment/f866b41b-753b-471c-91cf-4f558ca130b2/Final-rule-determination.aspx

Industrial processes, an example

In South Australia, near the site of the recently closed coal fired generator at Northern Power Station, a $175 million solar powered greenhouse facility is nearing completion. This project attracted a CEFC commitment for cornerstone debt financing, which in turn has enabled the project proponent to secure private equity funding and a 10-year supply contract with a major supermarket for its product[8]. Queensland could explore these types of direct investments to facilitate industrial and commercial activity in specific regions.

[8] www.farmweekly.com.au/news/agriculture/horticulture/general-news/seawater-tomatoes-set-new-glasshouse-farming-benchmark/2752850.aspx

3 Section 3 – Funding renewable energy

3a) If subsidies for renewables are required, how should they be funded (eg paid by electricity consumers, funded from the state budget, funded through social bonds, etc)?

It is widely accepted that the costs of large scale renewable targets, in the case of mandated percentage generation from non-fossil fuel sources, are best born by consumers. As a principle, we would expect the Queensland government to adopt this approach.

There are circumstances where direct subsidies may be preferable in facilitating specific objectives, for example in remote and off-grid installations, for technologies that are in an early phase of commercialisation or where access to sufficient capital is challenging for a particular commercial venture. In these instances, such funding could come from the state budget, a dedicated investment fund established by the state or be in the form of concessional loans.

We have also flagged situations where renewable generation may provide other benefits, in addition to energy, to the network. In these situations, concessional loans may be available to bridge the gap between the forecast cost of generation to provide those ancillary services and the cost of alternative measures (such as diesel generation). More detailed analysis needs to be undertaken in conjunction with the transmission and distribution network service providers to understand the size of this opportunity and therefore the absolute levels of subsidy that might be required.

We have also flagged setting targets for reducing the CSO. For 2015–16, the total CSO to support regional and rural Queenslanders is budgeted at $438.2 million. By leveraging third party funding, this could represent a significant opportunity for budget savings, rather than a simple transfer of funding from an annual subsidy to capital expenditure on infrastructure.

3b) Should any consumers be exempt or have their contribution discounted on either efficiency or equity grounds (eg trade exposed sectors, low income consumers, etc)?

As the Issues Paper highlights, the impacts are forecast to be low under the existing Federal LRET, and from a wholesale market perspective, the impacts of greater renewable generation are forecast to be favourable to large consumers.

As the energy market evolves in the next decade, with the customer at the centre of an energy services model versus the end of a supply chain, more efficient outcomes are expected to lead to lower energy prices in the longer term.

4 Section 4 –Impact on the electricity system

4a) What factors should the Queensland Government consider when assessing power system reliability and stability outcomes from policy options?

Supply should be co-located as near as possible to demand

Queensland's population is spread over a significant geographical area, while large scale generation is concentrated in particular regions. Geographically diverse generation is expected to enhance the network's overall reliability. Projects that are closer to the end user and that do not require network augmentation or extension should be prioritised. For example, projects on fringe of grid should not be designed to transmit significant volumes of energy to the centralised network, but should be designed to reduce line losses on that portion of the network. Queensland is in a unique position, being the owner and operator of the transmission and distribution networks, to clearly drive this outcome through coordinated planning and, where required, direct investment via these network businesses (ring-fenced where appropriate as the case may be).

Diversity of resource mix

Scenarios may occur where a reliance on renewable energy sources could be significantly affected by natural disasters including prolonged wet seasons and flooding, cyclones and bushfires. The recent experience in Tasmania with the inability of hydro generators to dispatch due to dam levels highlights the need to maintain an overall system reliability in the face of resource shortages, and facilitate the need for a more diverse energy resource mix.

As outlined in Section 2, while several years ago the expectation was that most of the Federal LRET would be filled by wind with a small portion of energy from solar, now the inverse view is widely held. Solar thermal or biomass generation are not widely expected to capture a significant portion of the market, given their high up front capital costs and site specific characteristics, without additional support in the next 3-5 years.

Pumped hydro energy storage may however be feasible at select locations in Queensland.

Converting existing coal units to synchronous condensers

In a market with high renewables penetration, the need for reactive power at discrete locations in the grid is imperative. Unlike the energy that generators are paid for, which is active power, the reactive power that a synchronous generator such as steam and gas turbines produce is required to maintain grid voltage stability. It does not have an explicit value in the current market, given it has been an element of stable grid design since the NEM's inception.

In the United States, a market is emerging for the conversion of coal fired generators into synchronous condensers in order to provide a market service that can compensate for system reactive changes and maintain the required system voltage set point with high penetration of renewables and withdrawal of coal generation[9].

Queensland's existing fleet of fossil fuel generators, as they reach the end of their economic life and cease generating electricity, could play a role in providing system reliability and stability if converted to synchronous condensers. The value of reactive power in this instance will need to be recognised by the network and subsequently the cost of conversion would be passed onto consumers.

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[9] Stein, J., Electric Power Research Institute (EPRI), "Turbine-Generator Topics for Power Plant Engineers, Converting a Synchronous Generator for Operation as a Synchronous Condenser", 3002002902, March 2014

4b) How might the policy options affect the efficiency of the current NEM design?

Policy options that set a 'top down' figure for the portion of generation from renewables are expected to result in investment in centralised power stations can affect the efficiency of the current NEM design.

- By encouraging development of large, stationary, remote generators policy may not lead to the most efficient outcome for consumers if additional transmission infrastructure is required to connect them to the grid.
- Significant volumes of daytime solar energy are likely to lower the overall average spot price for generation, in the same way that the spot price during the night in South Australia has been lowered by high penetration of wind generation. This pushes gas out of the merit order and makes it difficult to cycle aging coal plant.
- Policy options that drive the outcome of 'lowest cost energy', without valuing the other benefits that various forms of generation bring to the grid, like frequency regulation, spinning reserve, power quality, etc, will not of themselves lead to the most efficient outcome in the market, where these services must be provided by other means (and costs passed on to consumers).

Policy options that result in greater penetration of distributed generation and lead to greater decentralisation of generation at a commercial, industrial and residential level, are also likely to have an impact on the efficiency of the current NEM design.

- Reducing overall net demand on the grid and facilitating greater independence from the grid is forecast to leave transmission and distribution companies with an asset base on which the absolute revenue for transmitting and distributing energy diminishes. This puts upward pressure on network charges as a percentage of customer bills.
- In the case of large distributed solar, this reduces the overall daytime net demand leading to a greater requirement from the network to supply the balance of load from mid-afternoon to evening as solar generation declines while the evening peak demand increases. This ramp rate may be difficult to achieve pending what intermediate load or interconnection exists.

4c) What changes to the NEM design might need to be considered with the implementation of the various policy options?

Demand Management Incentive Scheme

The changes envisaged by the Demand Management Incentive Scheme, as proposed by the COAG Energy Council to the AEMC, are comprehensive in listing the changes required to the NEM design to bring forward optimum outcomes for consumers[10]. Many of these outcomes may in fact limit the opportunity for significant new additions to Australia's large scale generation fleet.

- A significant change that would address demand management relates to open access to third parties in transmission and distribution, that is, parties who are able to provide an alternative to the networks. Third party alternatives to networks, including demand management, local storage, the operation of micro-grids, will provide powerful incentives.
- Cost reflective pricing is also likely to drive changing consumer behaviour which will significantly impact peak demand levels.

[10] www.aemc.gov.au/getattachment/f866b41b-753b-471c-91cf-4f558ca130b2/Final-rule-determination.aspx

- An intelligent grid enables all sorts of energy trading to occur in the future. One such concept is peer to peer (P2P) electricity trading, whereby consumers and generators can trade energy over local parts of the distribution network (ie one neighbour selling excess energy to another neighbour). This means all of the energy generated by the PV systems is used somewhere in the network and none is spilled by the inverters. The interest in how blockchain technology may enable this future is gaining momentum and should be the subject of further investigation.

The key to making this work will be tariff and regulatory reform that makes it economic to remain connected to the grid and enables various energy trading arrangements. For example, kW tariffs for residential customers should be considered, providing customers with a clear price signal as to the value of their total peak demand. New business models are likely to emerge that will rapidly and fundamentally change the current competitive landscape for energy retailing. The disruption that has occurred in the retailing of consumer goods, wrought by companies like Amazon on traditional 'bricks and mortar' retailers, is an example of the challenges facing the traditional retailers of energy in Australia.

Valuing 'firm' capacity

The current NEM design classifies generators as dispatched or semi-dispatched. Semi-dispatched generators are 'must run' and are in all cases scheduled to deliver energy to the grid in line with their 'natural' generation profile ie when the wind blows, wind generators are dispatched ahead of other generators. Consequently when there is too much wind generation and not enough demand, prices trending to zero or below zero to the price floor.

Energy storage technologies are expected to become cheaper over time and how generation from energy storage technologies interacts with the wholesale market will need to be addressed.

Renewable energy such as solar thermal with storage, eligible biomass generation and hydro or geothermal, which can dispatch on demand can bid into the ancillary services market. While retailers may recognise this under long term PPAs, as part of their own risk mitigation strategies, generators are not able to fully capture it for any portion of the off-take for they accept 'merchant' risk. Valuing 'firm' capacity may also assist wind and solar projects in justifying investment in applicable forms of electrical storage, depending on the site specific requirement for other services such as frequency regulation and power quality, in addition to the benefits that are usually associated with energy storage such as load shifting, spinning reserve or peak shaving.

4d) What capabilities should be considered as requirements for new renewable generators of different technologies?

As outlined above, incentivising new renewable generators on the basis of 'lowest cost energy' does not recognise that certain supply options have advantages over others. The following list does not constitute a definitive list of requirements, nor are we of the view that these are all required, but the following should be considered when evaluating how best to build a more diverse portfolio of options.

- Impact of the technology on the grid voltage
- Thermal limits of grid components (mainly electric lines)
- Frequency fluctuations
- Impact on protection systems

Various combinations of energy storage, such as battery, thermal, flywheel, etc, have the potential to significantly contribute to grid stability and address issues that arise through high penetration of variable renewables. Different storage technologies are more applicable to different grid support services, at various timescales and operating conditions. Smart inverters are also very beneficial in the interface of technologies such as solar PV with the grid. In some cases, renewable sources employing smart inverters can even improve grid power quality beyond what it would be in the absence of renewables through for example, providing reactive power when the grid needs it. The impact of distributed and variable generation on particular grid systems, and the necessary grid support infrastructure requires detailed analysis of each specific system.

5 Section 5 – Commercial and investment issues

5a) How might Queensland better leverage existing Federal support schemes, including attracting additional investment under the LRET?

Queensland might better leverage the existing Federal LRET by exploring other mechanisms that offer developers a level of revenue certainty beyond 2030. In any case, the Queensland Government through the COAG Energy Council, could seek to lobby the Federal Government to extend the scheme expiry until at least 2035.

Queensland might also be able to better leverage funding through the CEFC and ARENA by offering additional financial incentives to projects that are Queensland based. These could be as simple as land access for commercialisation testing of new technologies.

5b) What role might the Queensland Government play when existing support schemes cease, and how might the Government attract increased private sector investment in renewable energy?

In our response to Question 2.c, we outlined a number of measures that Queensland could take to drive investment in renewables. One of the most powerful incentives that the Queensland Government can offer project proponents is to purchase energy under long term agreements. Competitive procurement processes that specific discrete criteria for the energy purchased (such as, percentage 'firm capacity' or time based pricing) could be powerful incentives for investors seeking to harness Queensland's resource competitive advantage.

In our response to Question 6.a and 6.b we have outlined other measures that may attract investment and could add value to the wider economy.

5c) Are there any key barriers to funding renewable energy projects in Queensland and, if so, how might these be overcome?

In our response to Question 4.a we outline our belief that the barriers preventing deployment of certain renewable technologies are not Queensland specific but related to technology and resource characteristics. If Queensland wants a diverse mix of generation type, beyond solar PV and wind, then additional support for other technologies such as solar thermal and biomass will likely be required. The potential for pumped hydro energy storage is also relatively unexplored and this could be a significant opportunity in the context of increasing renewable penetration.

6 Section 6 – Supporting economic development

6a) What renewable services could Queensland look to specialise in and export from?

In our introductory comments, we outlined a vision of the future that envisaged the existing energy supply chain – generation, transmission, distribution, retail – evolving into an integrated energy services model where the customer is at the centre of a technology driven market. The renewable energy economy has digital transformation as one of its core enablers. Digital transformation and the digitisation of infrastructure are key macro themes our clients see as both impacting their existing business and driving them to innovation.

We believe that the future energy service providers will be technology companies, not resource owners, and Queensland could seek to position itself as the digital energy technology investment destination of choice.

6b) Outside of the energy supply chain, what areas of the economy might need to develop in order to transition to a renewable energy economy?

Transport sector offers significant potential

There is a significant opportunity to support growing electricity demand through increasing adoption of Electric Vehicles (EVs), while overall net demand from the grid continues to decline as generation becomes more decentralised. However it will be essential to incentivise the timing of EV charging to avoid increasing peak demand in the same way that consumer-led installation of air conditioning contributed to very high growth in peak demand.

Ergon's recently announced Electric Super-Highway concept has a stated aim of understanding the most valuable locations in the grid to invest in renewable energy and demand management.

Taking a leading position in driving demand growth through deployment of electric vehicles could be one particular area of focus for the Queensland Government.

Agriculture

The recent Queensland Government announcement of a $20 million 'biofutures' hub, following from the mandated biofuels standards in late 2015, is an example of targeted intervention that supports a broader industry outcome.

In order to transition to a renewable energy economy, opportunities exist to target support to the agricultural industry, to ensure large scale renewable energy and agriculture co-exists and that farmers and landowners – renewable resource owners – are not only passive beneficiaries of a renewable economy but fierce advocates.

6c) How much, if any, Queensland Government assistance might be required to support the development of these other areas in a timely fashion?

In October 2015, the New South Wales Government announced its intention to create Australia's first technology precinct as a tech and innovation hub. Queensland could seek to establish a start-up incubator with a specific energy focus, not in the traditional sense of researching generation technology options, but with a focus on customer, demand and market management. Given the progress already being made by its state owned utilities in exploring networks of the future, further 'open' investment to drive innovation and attract technology investment (smart meters, inverters, virtual net metering trials, etc), such a concept could be explored in conjunction with existing key energy market stakeholders and be funded jointly by industry and government.

We understand that other initiatives to drive investment in agriculture are already in progress. Facilitating collaboration across sectors is key at the research and development and early commercialisation level.

6d) How might Queensland ensure the renewables sector is resilient and sustainable, and avoid boom-bust cycles that typify capital intensive investment programs involving market intervention?

Two specific examples of major capital intensive investment programs that have followed a boom-bust cycle in Queensland are the coal seam gas to LNG industry and the mining industry.

Rather than market intervention being the cause of these cycles, the root cause appears to be a lack of effective collaboration leading to inefficient allocation of capital by duplication of effort, competition for scarce labour, and therefore cost blowouts and consequently asset impairments.

Therefore policy options that the government is considering should be designed to:

- Ensure a 'smooth' build program, regardless of policy mechanism, to avoid the risk of heightened competition for construction labour, materials, expertise and capital causing cost blowouts. For example, an annual target for renewable generation, set say two years out, auctioned to the lowest price bidder, could create a sufficiently competitive process to achieve the best outcome for consumers and minimise the risk of oversupply longer term.
- Prevent over-investment in transmission infrastructure to connect large generators long distances from demand. Price signals for transmission upgrades must be ahead of time to ensure that renewable projects coming online do not result in network congestion and consequently poor market pricing outcomes.
- Assist developers in locating and developing the most appropriate renewable resources, avoiding land speculation by project proponents or poor engagement outcomes with regional communities.

The risks of a boom-bust cycle at the small and medium scale tends to be exacerbated by overly generous capital grants or market pricing. At the small and medium scale, demand management and battery storage initiatives must be carefully crafted to ensure sufficient equipment and installation standards along with safety training measures are in place in advance of the programs being rolled out.

6e) What policies might need to be developed to support communities and individuals that might suffer losses as a consequence of the transition to greater renewable energy including the potential premature closure of power station facilities?

Across the world, the transition from fossil fuel to renewable generation is yet to fully address the impending need to decommission and rehabilitate many of the ageing energy assets and associated infrastructure. As the existing fleet is retired, the decommissioning, dismantling and site remediation processes will require an extensive effort on the part of both asset owners and government.

This process will require extensive engagement with the local communities well in advance of any closure. The Government is in a unique position, as the owner of its fleet of generation assets, to undertake this engagement in an open and transparent way ahead of time so as to ensure clear expectations among both the employees of existing generators and the surrounding communities.

As indicated above, a market is emerging in the United States for the conversion of coal fired generators into synchronous condensers in order to provide a market service that can compensate for high penetration levels of renewables. This opportunity needs to be quantified both in terms of the actual requirement and also the ongoing employment opportunities.

One of the many attractions of renewable energy is its low ongoing operations costs. This is generally the result of limited human intervention in the maintenance of renewable assets. How the skillset of the communities that will be affected by the retirement of coal generators might be transferred to other industries may assist in defining where Government support for renewable energy is focussed.

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