Genex Power

SUBMISSION TO

THE SELECT COMMITTEE INTO THE RESILIENCE OF ELECTRICITY INFRASTRUCTURE IN A WARMING WORLD

REFORM TO PROMOTE INVESTMENT IN LARGE-SCALE ENERGY STORAGE

Australia has articulated an objective to promote wide-scale deployment of renewable energy generation across the Country, whilst at the same time ensuring an efficient, secure and reliable energy system. Genex is advocating for a change in the Government's policy settings in relation to the treatment of large-scale energy storage, which will facilitate both of those objectives.

Specifically, Genex believes that Australia needs to recognise large-scale energy storage as an integral part of the renewable energy equation, and adopt policy measures to promote significant investment in large-scale electricity storage capacity in Australia. This submission summarises the case for change and sets out relevant policy options for the Government's consideration.

1. Overview of Genex

1.1 Genex Power (Genex) is an Australian public company, focused on the the development of innovative clean energy generation and electricity storage solutions. Genex is currently developing a large-scale hydroelectric pumped storage project in Northern Queensland. The project will have an installed generation capacity of 250MW, with a total energy storage capacity of 1,500MWh based on a 6 hour full generation cycle. Once operational, the scheme will have the capacity to deliver enough electricity into the grid to power over 100,000 homes at the time of day when they need it most.

1.2 Genex has received grant funding of around $2.3 million from the Australian Renewable Energy Agency (ARENA) as part of a $4 million funding facility to support the Kidston pumped storage project.

2. The Case for Large-Scale Storage

2.1 Wide-scale deployment of renewable energy generation cannot exist without large-scale storage capacity, as renewable forms of generation such as wind and solar are inherently intermittent by nature and cannot be reliably despatched during periods of peak demand.

2.2 A growing body of academic research has found that – due to the intermittency problems associated with renewable energy – large-scale storage is required to achieve penetration of renewables greater than around 30%. With the current Renewable Energy Target of 33,000 GWh, meaning about 23.5% of Australia's electricity generation will come from renewable sources by 2020, and with South Australia already exceeding 30% penetration, it is essential that large-scale storage in Australia is developed immediately.

2.3 Renewable energy provides intermittent generation due to fluctuations in solar and wind resources. This causes significant frequency and voltage control issues on the National Electricity Market (NEM) due to a mismatch between supply and demand. The issue is well summarised by the AEMC:

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> *Wind-powered generation is intermittent, meaning its installed capacity cannot be relied upon to meet demand at any given time. It delivers energy, but not firm capacity, to the market. Further, the energy it provides to the market is linked to prevailing wind speeds, and can vary substantially over short periods of time.*[1]

2.4 The closure of the Port Augusta and Hazelwood coal-fired power stations has already, and future station closures will further, expose the NEM to ever greater intermittency risks.

2.5 At present, fluctuations in power supply are managed largely through rapid response peaking power generation (typically diesel or kerosene generation, open cycle gas turbine generation, or coal-fired spinning reserve) and the interconnectors between States on the NEM. In the face of rapidly rising gas prices (principally due to the recent construction of the Gladstone LNG export terminals) and growing renewable energy generation, neither of these options are suitable long-term solutions – as demonstrated by recent events in South Australia.

2.6 A recent study by the Australian Energy Market Operator (AEMO 2013) called for the deployment of energy storage as the penetration of renewables increases:

> *Energy storage is likely to be required predominantly to meet demand after sunset and in particular to manage the evening peak. It is also used to cover periods of low wind speed or solar radiation and to provide backup in case of contingency events such as the loss of a transmission line or a large generator.*[2]

2.7 Professor Blakers from ANU has recently developed a model which predicts that, for a 100% renewable NEM, 15-20GW of hydro pumped storage capacity would be required.[3] Professor Blakers has said that hydro pumped storage is "by far the lowest cost storage technology available, which is why it comprises over 99% of all global electrical energy storage, and remarkably it has been completely overlooked in most high-renewable energy studies."

2.8 Without investment in large-scale storage, Australia's energy security – defined by the Department of Environment and Energy as the *adequate, reliable and competitive supply of energy* – will be adversely affected, as the intermittent nature of wind and solar generation directly affects the adequacy and reliability of the National Electricity Market (NEM). The Energy Security Office of the Department of Environment and Energy has stated:

> "*Increasing reliance on sources of intermittent energy could pose challenges for energy security and reliability…Recently, there has been a trend towards more intermittent generation sources and potentially more diverse generation types. These policy-driven changes to move Australia towards a lower-carbon economy could pose growing challenges to reliability, in the face of growing demand that is also likely to be peakier.*"[4]

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[1] *Review of Energy Market Frameworks in light of Climate Change Policies*, AEMC, September 2009, p80, available at http://www.aemc.gov.au/Media/docs/Review%20Final%20Report-9f02959f-0446-48ba-89a1-5882d58e11fd-0.PDF (accessed 6 December 2016)

[2] 100 Per Cent Renewables Study – Modelling Outcomes, AMEO, July 2013, available at https://www.environment.gov.au/system/files/resources/d67797b7-d563-427f-84eb-c3bb69e34073/files/100-percent-renewables-study-modelling-outcomes-report.pdf (accessed 6 December 2016)

[3] Pumped hydro, solar and wind can deliver a 100% renewable NEM: ANU, Ecogeneration, November 2016, available at http://www.ecogeneration.com.au/pumped-hydro-solar-and-wind-can-deliver-a-100-renewable-nem-anu/ (accessed 6 December 2016)

[4] Energy Security Office, Department of the Environment and Energy, National Energy Security Assessment 2011, Melbourne, December 2011 at p72, available at https://www.environment.gov.au/system/files/energy/files/National-Energy-Security-Assessment-2011.pdf

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2.9 Large-scale energy storage is the solution to these problems identified by the AMEC and the Energy Security Office. Large-scale storage will:

(a) Facilitate the broader deployment of intermittent renewable energy through storing and then having the ability to despatch renewable power to the NEM on demand.

(b) Improve the efficiency and economics of other providers of renewable energy generation by purchasing power during periods of low demand.

(c) Allow renewable energy to more closely match peak loads, thereby reducing the need for further peaking and backup generators on the grid.

(d) Reduce greenhouse gas emissions by supporting higher levels of carbon-neutral generation.

(e) Provide ancillary services to the grid, including “balckstart capability”, frequency and voltage control, load levelling, synchronous capacity and capacity deferral.

2.10 Notwithstanding these significant benefits, under the current policy framework, large-scale storage does not receive any meaningful financial or market incentives commensurate with the substantial contribution it can make towards energy security as the penetration of renewables increases.

2.11 Furthermore, large-scale storage (or peaking gas-fired generation) is arguably not sufficiently compensated through the market for its significant role in supporting network reliability. This issue has been addressed by the AEMC as follows:

> *A particular challenge for the frameworks is therefore whether the signals provided through the market are capable of supporting investment in generation which is technically able to complement the intermittent output of wind (but which might not be required to provide significant volumes of electricity on average during the year) in order to support reliability*.[5]

This perspective was put by the Energy Security Office of the Department of the Environment and Energy as follows:

> *The LRET may lead to difficulties in meeting the target for unserved energy in the NEM. This situation could arise because the LRET depresses wholesale electricity prices, which reduces the primary source of revenues for non-renewable generators. Consequential reductions in operating hours for baseload and peaking gas-fired generation, combined with projected higher gas prices, mean that it may not be economical for sufficient new gas-fired generation to develop to meet the unserved energy target.*[6]

2.12 As a result of the issues raised above, Genex believes that a policy mechanism should be introduced to compensate large-scale storage for the substantial benefits it can provide to the NEM in the face of growing renewable energy deployment and a move towards a reduction in carbon emissions.

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[5] *Review of Energy Market Frameworks in light of Climate Change Policies*, AEMC, September 2009, p80, available at http://www.aemc.gov.au/Media/docs/Review%20Final%20Report-9f02959f-0446-48ba-89a1-5882d58e11fd-0.PDF (accessed 6 December 2016)

[6] Energy Security Office, Department of the Environment and Energy, National Energy Security Assessment 2011, Melbourne, December 2011 at p76, available at https://www.environment.gov.au/system/files/energy/files/National-Energy-Security-Assessment-2011.pdf (accessed 6 December 2016)

3. Policy Options to Promote Large Scale Storage

3.1 Mechanisms to promote large scale storage could take the form of one or more of the following solutions:

(a) A financial incentive program to promote the development of large-scale storage;

(b) Investment tax credits for investment in large-scale storage;

(c) A mandate separate from the RET that requires utility providers to integrate or own large-scale storage (for example California has a 1.3 GW target by 2020);

(d) Introducing tiers or classes into the RET, with generators receiving a multiple of an LGC based on the supply and demand of electricity at the time the electricity is generated; or

(e) Allowing large-scale storage providers to be eligible to receive LGCs under the RET.

3.2 Options (c), (d) and (e) above could all be executed at no additional cost to the Government, while options (d) and (e) can also be executed at no additional cost to the taxpayer. For that reason, Genex would support the Government pursuing either options (d) or (e).

3.3 Given the complexity of option (d) – particularly for the current period of the RET through to 2020 – Genex believes that the simplest and most efficient policy approach is option (e). This approach can be achieved through a simple amendment to the Regulations, as explained below.

3.4 This submission therefore proposes that the Government recognises hydroelectric pumped storage as an eligible generator of Large-scale Generation Certificates (LGCs) under the *Renewable Energy (Electricity) Regulations* 2001, on the basis that large-scale storage supports the Act's objectives:

(a) to encourage the additional generation of electricity from renewable sources;

(b) to reduce emissions of greenhouse gases in the electricity sector; and

(c) to ensure that renewable energy sources are ecologically sustainable.

3.5 Although hydroelectric pumped storage is the focus of this submission, other forms of large-scale energy storage, such as solar thermal, could also be encouraged to promote storage capacity.

4. About Pumped Hydro Energy Storage (PHES)

4.1 The primary source of large-scale energy storage is hydroelectric pumped storage, which represents 99% of the world's electrical energy storage capacity.[7] The central estimate of total global hydroelectric pumped storage capacity at the end of 2010 was approximately 136 GW, up from 98 GW in 2005 (IHA, 2011).[8]

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[7] Opportunities for Pumped Hydro Energy Storage in Australia Arup-MEI Research, Melbourne Energy Institute, University of Melbourne, February 2014, p12, available at http://energy.unimelb.edu.au/__data/assets/pdf_file/0007/1526587/Opps-for-pumped-hydro-in-Australia.pdf (accessed on 6 Decembe 2016)

[8] Renewable Energy Technologies: Cost Analysis Series, Hydropower, Volume 1: Power Sector Issue 3/5, International Renewable Energy Agency, June 2012, p16, available at: http://www.irena.org/documentdownloads/publications/re_technologies_cost_analysis-hydropower.pdf, (accessed on 6 December 2016)

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4.2 Hydroelectric pumped storage plants allow off-peak electricity to be used to pump water from a lower reservoir up to an upper reservoir to allow its release during peak times. hydroelectric pumped storage allows for renewable energy to become "dispatchable", which results in increased value; broader deployment; more efficient use; and increased stability. hydroelectric pumped storage has a round-trip energy efficiency of around 80-85%.

4.3 Australia has 1,490 MW of hydroelectric pumped storage schemes in operation. The largest of these facilities include:

(a) Tumut-3 (part of the Snowy Scheme), 600MW; commissioned in 1973

(b) Shoalhaven (NSW), 240MW; commissioned in 1977.

(c) Wivenhoe (QLD), 500MW; commissioned in 1984.[9]

4.4 No hydroelectric pumped storage scheme has been built in Australia in last 30 years. Genex is proposing to build Australia's fourth scheme, which will be Australia's third largest.

4.5 The US has over 40 pumped storage schemes in place, and is planning another 60. China has 17 PHES schemes, and is currently developing 6 schemes over 1,000MW, currently 23,000 megawatts.

4.6 Pumped storage is facilitating broader deployment of renewable energy projects, particularly in Europe, where more than 17 schemes over 1,000MW operate.

4.7 Pumped storage has the potential to support grid stability through inertial spinning reserve and very fast ramp rates from zero to 100 per cent in minutes.[10]

4.8 Pumped storage is significantly preferable to batteries given it is large scale; has up to a 100-year life cycle; poses no fire risks; and is a clean form of energy storage – no chemical hazard or environmental issues.

5. Treatment of Hydroelectric Pumped Storage under the RET

5.1 Hydro is an 'eligible renewable energy source' as defined in section 17(1)(a) of the Renewable Energy (Electricity) Act 2000 (the Act). This expressly extends to pumped storage hydro (Schedule 1, clause 6.1 of the Regulations). Clause 14 of the Regulations to the Act (Regulations) requires, however, that the 'auxiliary loss' of an accredited power station is to be deducted from the total amount of electricity generated by that power station, clause 3B of the Regulations defining auxiliary loss as follows:

3B Definition of auxiliary loss

(i) For a power station, auxiliary loss means the amount of electricity used in generating electricity, and operating and maintaining the power station, but does not include any electricity used for network control ancillary services.

(ii) For a hydro-electric power station, auxiliary loss also includes the amount of electricity that is used to pump or to raise water before its release for hydro-electric generation.

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[9] Opportunities for Pumped Hydro Energy Storage in Australia Arup-MEI Research, Melbourne Energy Institute, University of Melbourne, February 2014, p12, available at http://energy.unimelb.edu.au/__data/assets/pdf_file/0007/1526587/Opps-for-pumped-hydro-in-Australia.pdf (accessed on 6 December 2016)

[10] Media Release, *Old dog, new tricks: the oldest form of clean energy could be key to increasing renewables in our national grid*, Australian Renewable Energy Agency, November 2016, available at http://arena.gov.au/files/2016/11/161102_-JOINT-MEDIA-RELEASE-ARENA-ANU_Old-dog-new-tricks.pdf (accessed on 6 December 2016)

5.2 Pumped storage hydro is therefore not currently eligible for LGCs under the RET, as the electricity consumed in the pumping process ('auxiliary loss') always exceeds total electricity generated.

5.3 Pumped storage hydro is unique amongst the list of eligible renewable energy sources (section 17 of the Act) as requiring a specific additional step (the pumping of the water) before the generation from the renewable energy source (water) can occur.

6. Policy Solution

6.1 Genex believes that hydroelectric pumped storage schemes should be eligible for LGCs under the RET, in order to promote the expansion of large-scale storage capacity in Australia as the deployment of renewable energy generation expands.

6.2 A possible solution to this problem could involve a minor amendment to Section 3B(2) of the Regulations, which would have the effect of allowing hydroelectric pumped storage schemes to benefit from LGCs for all electricity stored (and subsequently dispatched) when required by Australia's National Electricity Market (NEM).

6.3 To accommodate the unique circumstances of hydroelectric pumped storage, we propose the following new definition of auxiliary loss in the Regulation:

3B Definition of auxiliary loss

(i) For a power station, auxiliary loss means the amount of electricity used in generating electricity, and operating and maintaining the power station, but does not include any electricity used for network control ancillary services.

(ii) Subject to clause 3B(iii), for a hydro-electric power station, auxiliary loss also includes the amount of electricity that is used to pump or to raise water before its release for hydro-electric generation.

(iii) For a pumped storage hydro-electric power station that is accredited under section 15 of the Act on or after [a nominated future date] auxiliary loss does not include the amount of electricity used to pump or to raise water before its release for hydro-electric generation.

6.4 The proposed amendment will place pumped storage hydro power stations on the same footing as other non-hydro renewable power generation stations accredited under the Act.

6.5 There are a large number of accredited hydro power stations in Australia, although there are only three hydro pumped storage schemes: Shoalhaven (240 MW), Wivenhoe (500 MW), and Tumut 3 (600 MW).

6.6 In order to preserve the current arrangements under the Act and Regulations for existing accredited hydroelectric power stations, the proposed amendments to clause 3B of the Regulations are intended to apply only to new pumped storage hydroelectric power stations that are accredited after the nominated future date (being either the date of commencement of the amendments or a future date nominated in the Gazette).

6.7 This proposal has the merit of simplicity, and could be implemented quickly with an immediate and direct benefit in terms of investment certainty.

7. Capacity for Investment in PHES

7.1 Genex has completed the technical feasibility study for the Kidston hydroelectric pumped storage project, to be constructed off-river utilising the two former Kidston Gold Mine pits.

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Genex will soon be seeking to secure debt and equity funding for the development of the project.

7.2 The Melbourne Energy Institute of the University of Melbourne has reported on the opportunities for other hydroelectric pumped storage schemes in Australia, and has identified key sites that are suitable for further feasibility studies.[11]

7.3 The Australian Renewable Energy Agency (ARENA) is providing $449,000 of funding to The Australian National University (ANU) to map potential PHES sites.[12] ANU is partnering with ElectraNet and VTara Energy Group to conduct the Atlas of hydroelectric pumped storage and develop a blueprint and cost model to integrate the technology into the electricity grid on national, state and regional levels.[13]

8. Conclusion

Hydroelectric pumped storage is a highly efficient, truly sustainable and immediately deployable large-scale energy storage solution, and requires immediate investment.

From initial soundings conducted by Genex, the proposition to accommodate new hydroelectric pumped storage schemes under the *Renewable Energy (Electricity) Regulations* is likely to enjoy strong cross-party support.

We would be most grateful if you would consider the proposal set out in this submission, which will have the effect of making large-scale pumped hydro energy storage schemes more economically viable and potentially deployable across Australia. We trust that such a change would represent a major step on the path to building a more energy secure Australia.

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[11] Opportunities for Pumped Hydro Energy Storage in Australia Arup-MEI Research, Melbourne Energy Institute, University of Melbourne, February 2014, p12, available at http://energy.unimelb.edu.au/__data/assets/pdf_file/0007/1526587/Opps-for-pumped-hydro-in-Australia.pdf (accessed on 6 December 2016)

[12] Media Release, *Old dog, new tricks: the oldest form of clean energy could be key to increasing renewables in our national grid*, Australian Renewable Energy Agency, November 2016, available at http://arena.gov.au/files/2016/11/161102_-JOINT-MEDIA-RELEASE-ARENA-ANU_Old-dog-new-tricks.pdf (accessed on 6 December 2016)

[13] Ibid.