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SUSTAINABILITY OF ENERGY SUPPLY AND RESOURCES IN NSW

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STAR SCIENTIFIC Limited

INQUIRY INTO SUSTAINABILITY OF ENERGY SUPPLY AND RESOURCES IN NSW

Submission: Local technology, hydrogen and its role in the NSW energy supply

This submission reflects on the future energy supply resources of NSW and provides observations on technological advances in hydrogen, the trending growth in hydrogen energy globally; and the home-grown hydrogen opportunities that are directly beneficial to this State.

Star Scientific is based in NSW and has spent two decades researching and developing technology for a new energy economy. Our recent breakthrough, using a catalyst known as HERO®, utilises hydrogen to create steam, with the scale-up capability of generating power.

Hydrogen is being pursued globally as an essential part of the future low emission energy solution.

With the capability of HERO® to displace coal with hydrogen and continue the use of NSW electricity regeneration and transmission infrastructure, NSW should plan for the role of hydrogen in our future energy mix.

Yours sincerely,

[redacted]

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1. Hydrogen energy – our best bet for 'zero-emission' dispatchable power

In common with governments across the globe, energy policy in New South Wales faces a three-cornered challenge. First, energy must be provided reliably- meeting the demands of the grid with a consistency that can absorb any potential fluctuations and stresses. Second, energy must be abundant- resources and power must be capable of meeting the demands of a rising population and higher living standards. Third, the provision of energy must be sustainable- as the world faces up to the challenge of climate change governments have committed to significant reductions in carbon emissions.

An energy policy which is consistent with these three principles has thus far eluded policymakers. This submission proposes that an energy policy which is consistent with the need for reliability, abundance, and sustainability requires hydrogen power as a significant component.

While renewable energy technology has made substantial strides in recent decades the essential challenge remains: 38% of emissions cannot feasibly be substituted with renewables (according to the International Renewable Energy Agency). That is to say that a large portion of existing energy infrastructure is simply not capable of supporting renewable energy- and that the costs of replacing this infrastructure would be substantial.

Hydrogen is capable of overcoming this obstacle. This submission will detail how the technology we have developed can utilise repurposed coal-fired power stations, be fed into existing energy networks, and be stored and transported as fuel.

NSW, with a supportive policy framework, is poised to take advantage of this unique opportunity to create jobs and investments without impinging upon our environmental obligations.

Supporting hydrogen energy is a matter of some urgency for NSW: not only do we face a myriad of challenges including emission reduction and the looming expiration of Liddell power station, but NSW also risks missing out on significant opportunities for exports and investments as jurisdictions such as Japan, South Korea, China and the European Union.

How it works

Hydrogen has the highest energy content of any common fuel by weight, but the lowest energy content by volume. Hydrogen can be produced and stored for on-demand applications. Hydrogen is a zero emissions fuel that can be used for transportation, heating, desalination and power generation.

It typically does not exist alone, and its gas form (H2) needs to be produced by extracting it from compounds such as water (H20), methane (CH4), other hydrocarbons, wood and petroleum.

The simple chemical reaction of hydrogen in combination with oxygen creates heat - with water as the by-product. The release of energy can be achieved through devices called fuel cells (FCs) or using the HERO® catalyst- which is a device developed by Star Scientific that will be discussed further at part (2).

Sources of hydrogen include reformation of natural gas, diesel, gasified coal, or gasified biomass. Renewables such as wind and solar are a complementary energy source able to produce hydrogen for storage and later on-demand use. The production of hydrogen using electricity uses an electrolytic process where an electrical current is passed through water, separating the water molecules into oxygen and hydrogen gas.

2. Who is Star Scientific and what is the game changer called HERO®?

Recognising the promise of hydrogen technology, Star Scientific is backed by philanthropists and scientists. We have invested $85 million in Australian research and development (R&D) to develop this technology.

Our major breakthrough is the Hydrogen Energy Release Optimiser (HERO®). It produces unlimited, affordable, safe and reliable energy – with zero emissions.

How it works

When hydrogen is combined with oxygen and introduced to our HERO® catalyst, temperatures greater than 700 degrees Celsius are generated within minutes. The only other by-product is water and there are

no other emissions. Industrial steam has already been generated by our demonstration units and we have taken delivery of a 1.5 MW turbine to test the electricity generation capabilities.

The use of this turbine also entails that HERO® shows potential for being used to repurpose existing power stations. Moreover, the storage and transportation of fuel is applicable to existing power infrastructure- the European Union is currently examining the possibility of using hydrogen in the existing gas network. This will be discussed further in part (6).

As already mentioned, the only by-product of this process is water, and the only inputs are a catalyst (which is reusable) and hydrogen (which is one of the most abundant chemicals in the world). As a result, the process of generating electricity from the heat the HERO® device provides does not produce any greenhouse-gas emissions.

This cutting-edge source of dispatchable power and heat can propel Australia and the world to overcome the challenge of creating affordable, clean, and reliable energy.

We're currently scaling HERO® and continuing our R&D to add to the list of applications for this breakthrough technology. We would be delighted to host committee members at our Research Facility to demonstrate our technology.

3. How does hydrogen complement renewables?

By creating a source of power which is storable and not dependent on external factors (such as weather and wind), hydrogen can complement renewable technologies by compensating for gaps in power generation and demand.

Sources of renewable energy such as solar and wind face the so-called 'duck curve challenge'. This means, the typical peak demand of evening power lags the peak production of energy by six hours. Hydrogen and HERO® can store energy which can fill this gap between generation and demand.

This could be enhanced by co-locating hydrogen power generators with renewable plants. For example, if a solar plant was co-located with a HERO® device and a turbine, power could emanate from that plant that would be continuous and responsive to demand- with minimal transportation and fuel costs. All with no emissions.

4. How does hydrogen extend life for traditional power stations and their communities?

A transition from an energy source will entail a degree of social change in the communities which depend on power generation for employment. The transition from fossil fuels to renewable energy is no exception. Hydrogen can ease this transition for the involved communities by repurposing existing coal powered stations and encouraging investment in manufacturing and other energy-intensive purposes.

As an example, Liddell power station, located in the Hunter Region, is surrounded by post-industrial towns which face an uncertain future beyond the expected decommissioning of the power station in 2023.

AGL estimates the cost of replacing Liddell power station to be $1.4 billion. Alternatively, repurposing the existing power station with modern HERO® technology (which includes wind and solar power fed into hydrogen generation and storage at the site) could keep the power station workable for longer, retaining employment, and utilising the existing transmission infrastructure.

There is substantial scope for hydrogen and HERO® to be a practical means of repurposing coal powered stations. This could ensure a transition to zero-carbon energy generation without negating from the jobs and industry that current methods support in regional areas. In practice, the development of hydrogen power shows vast potential for revitalising regional areas and enabling a more seamless transition to a low-carbon future.

5.What should NSW be doing in hydrogen energy?

A recent report from the Australian-based international law firm Minter Ellison, *Renewable Energy Trends and Outlook*, has found that whilst 68% of investors planned to increase investment in renewable energy (including 95% of Australian investors), only a third of Australian investors saw the domestic policy framework as 'supportive'. In particular, the report noted hydrogen's 'potential as a zero-carbon fuel is vast', with two-thirds of surveyed investors agreeing with the view that 'Australia's hydrogen economy will cross an inflection point in the year ahead, allowing the country to become a primary supplier in energy markets'.

Realising the vast potential of hydrogen power requires capital investment. This requires confidence in the regulatory framework and the support of government in the R&D space.

Regulatory Reform

Australia requires a coordinated strategic and regulatory plan across governments - expanding on the National Hydrogen Strategy. We acknowledge the progress made thus far and are monitoring the NHS consultation process. The progress of policy implementation in jurisdictions such as Europe, Japan and Korea (See part 7) entails that it is imperative that Australia accelerate its positioning and readiness.

Star Scientific has hosted delegations from some of the largest and most advanced energy companies in the world. A common theme emerging from visitors is the vast potential of Australia in the hydrogen economy - and frustration with Australia's haphazard regulatory and policy responses to these opportunities.

Government Support

Australia and NSW have the potential to become a major player in exports and investments in this space. However, without sufficient government support in R&D, we run the risk of missing out on a major opportunity in the near term.

We would encourage the NSW government to take the initiative in examining the opportunity and capability of hydrogen power as an energy source.

6. What are the hydrogen challenges?

Policy

Government advocacy and clear policy is required to enable in certainty for industry. Some leading jurisdictions such as the EU have stronger policy direction whereas Australia could benefit from a nationally coordinated approach pulling together disparate approaches from individual States. The National Hydrogen Strategy is a helpful start.

Storage and transport of hydrogen

The properties of hydrogen present a challenge in its storage and movement. Its low density means it must be stored at pressure, and therefore cooled to become a liquid should it need to be moved long distances. Because hydrogen also has a relatively low volumetric energy density, its transportation, storage, and final delivery to the point of use comprise a significant cost and result in some of the energy inefficiencies associated with using it as an energy carrier.

Innovations now allow for hydrogen to be converted into both methanol and ammonia which can leverage existing industrial transport infrastructure and in turn reduce transportation costs.

Given the current pace of innovation in the hydrogen space, it is not impossible to imagine that these obstacles could be overcome with further research and experimentation. Capital investment and R&D support both accelerate the process of innovation. To that effect, government and regulatory support has a powerful role to play in this process.

7. Globally, hydrogen is an important part of the future energy mix

With the development of HERO® and the hydrogen economy, NSW has the capacity to become a significant exporter in hydrogen-based energy markets. Below is a survey of some of the major global developments in hydrogen energy.

The European Union, California and Japan are leaders in hydrogen policy. Their governments have taken action developing and implementing a forward-thinking policy to tackle greenhouse gas emissions, improve air quality, and boost their domestic manufactures of hydrogen applications. The International Renewable Energy Agency (IREA) has found that on current technology, over one-third of energy-related emissions have no economically viable options for deep decarbonisation. The IREA continued to report that hydrogen power has the potential to close this gap, because of its capability to repurpose existing energy infrastructure.

European Union

In 2018, 25 European countries pledged to increase research into hydrogen technology and accelerate its

everyday use to power factories, drive cars and heat homes; and use existing gas grids to distribute hydrogen produced with renewable energy.

Germany, UK and the Netherlands are already mixing hydrogen into some of their gas networks. A Joint Initiative for hydrogen vehicles across Europe (JIVE) strives to advance the commercialisation of hydrogen buses through large-scale deployment of vehicles and infrastructure. This will deploy 300 buses in 22 cities across Europe by early 2020.

A report from the European Commission stated that 'hydrogen could be the missing link in the energy transition'. In June 2019, 23 industry and government partners published the findings of the 'HyLaw' project, which sought to change the European regulatory framework to remove barriers to hydrogen investments and create a single European hydrogen sector. Gas is currently one of the largest sources of power in Europe, with European governments concerned about the geopolitical implications of over-dependence on gas supplies. This report stated that hydrogen had the capacity to replace the use of natural gas without significant changes to the existing infrastructure.

The European Union is also leading in providing incentives for private investment in renewable energy. The European Carbon market is well established, and European governments have committed to supporting renewable energy as a means of achieving the Paris targets.

Japan

Japan's approach centres on its plans to use the 2020 Tokyo Olympics to showcase the city's 'hydrogen society' with hydrogen – electric vehicles, a network of filling stations, and a hydrogen-powered athletes' village. It forms part of the country's national strategy towards achieving an emissions-free society and increasing its 'hydrogen economy'.

Eleven companies backed by the Japanese government - including Toyota, Honda and Nissan - announced a venture in 2018 to pool resources to build 80 hydrogen filling stations in the next four years.

South Korea

Hyundai and Kia have announced they will boost annual fuel-cell production to more than 700,000 by 2030. Hyundai and its suppliers will invest $9.2 billion over the next 12 years on hydrogen technology that will see the Korean car maker become a key global player in the zero-emission fuel.

The South Korean government is underwriting 310 new hydrogen filling stations in South Korea by 2022.

China

China has announced plans to put in place 300 hydrogen filling stations by 2025 and 1,000 by 2030. This hydrogen infrastructure will be able to support about 50,000 fuel cell electric cars by 2025, expanding to one million by 2030. In addition, leading Chinese local and regional governments including Wuhan, Rugao, Shanghai, and Guandong have put in place their own ambitious roll-out plans.

California

California 2018 has a mandated goal of 100% carbon-free energy by 2045. The state is thus aggressively pursuing a renewable hydrogen economy as part of a range of renewable sources with high state governmental support. The state has funded a network of at least 100 hydrogen filling stations to support the successful launch of the commercial HFCEV market in addition to state tax incentives, income-eligible rebates and other benefits.

8. Conclusion

This submission commenced by outlining the classic three-part challenge for policymakers in energy: reliability, abundance, and sustainability. The inclusion of hydrogen in the energy mix is vital for ensuring that we achieve a balance between these principles for generations to come.

Hydrogen technology is capable of performing the essential function of complementing renewable energy and ensuring a seamless transition to a renewable economy. As a result, the hydrogen sector is on the cusp of a boom in investment and exports. Governments across the world have recognised this by the initiative they have demonstrated in supporting research and development and providing financial incentives to producers. Investors - let alone our investors - also recognise this in the capital support that they have provided.

The challenge for NSW is to take advantage of this enormous opportunity. This begins with recognising hydrogen technology and the science that demonstrates its capacity as an energy source. We welcome further inquiries and would be delighted to host the committee at our Research Facility.

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