

## Pathway to Green Hydrogen Production becoming clearer through Stage One Solar Energy

**Frontier Energy Limited (ASX: FHE) (Frontier or the Company)** is pleased to announce preliminary results from the Green Hydrogen Study indicate green hydrogen production could be achieved significantly earlier than originally anticipated at the **Bristol Springs Solar Project (BSS Project)**.

This opportunity is only possible due to the BSS Project's unique location near Waroona, Western Australia. The location on free-hold land, proximal to existing grid (SWIS), gas and water infrastructure, reduces overall costs when compared to projects in more remote areas. Furthermore, the proximity to an existing and emerging green hydrogen domestic market provides a pathway to hydrogen sales.

### HIGHLIGHTS

- **Preliminary findings from the ongoing Green Hydrogen Study indicate that commercial quantities of green hydrogen can be produced from the 114MWdc Stage One solar production, which is significantly earlier than originally anticipated**
  - *Ownership of a renewable energy asset (BSS Project) in addition to the surrounding existing infrastructure significantly enhances the economics of hydrogen production*
- **Early adopters of the transition to green hydrogen include the users of the Dampier Bunbury Pipeline (natural gas) as well as the long-haul transportation industry (diesel)**
- **A key initiative of the Western Australian Government is for hydrogen to replace diesel. WA currently imports 6.7 billion litres<sup>1</sup> of diesel per annum**
  - *On a direct comparison basis, today's diesel price (~\$2 per Litre) equates to an hydrogen price of \$8 per kg (1kg of H<sub>2</sub> = 4 Litres of diesel)*
- **The Australian government has allocated A\$1.3 billion in its 2022-23 budget for energy security funding, including for hydrogen<sup>2</sup>**
- **The Company's Renewable Expansion Study and Green Hydrogen Study are currently being finalised and will be released in the coming months**

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**Managing Director Mike Young commented,** "The Stage One Solar Project is an excellent foundation for the Company to move into the renewable energy sector, as we believe it will generate solid returns over at least a 30-year operating period, in a market environment of ever-increasing clean energy demand.

As part of the Green Hydrogen Study, the Xodus Group was asked to determine what size solar production, as a minimum, would be required to be able to commence green hydrogen production. We originally anticipated this would be larger than the Stage One Project (114Mwdc) to justify the additional capital costs associated with hydrogen production.

The BSS Project is, however, uniquely located around significant existing infrastructure, which is critical for the hydrogen industry, meaning our initial capital costs will be significantly less compared to more remote projects for first production. Our ability to service the most likely first adopters of hydrogen (gas pipeline and long-haul transportation) means we are also likely to have customers for our product. Given the industry remains in its infancy, the ability to target these specific customers is somewhat more important than after more widespread adoption.

As I recently saw in Rotterdam at the World Hydrogen Conference, the global market for green hydrogen is rapidly growing. It is clear hydrogen fuel cell electric vehicles (FCEV), which have actually been around since the 1960s, will be a major part of global decarbonisation, especially in the long- and heavy haulage transport industry.

Given expectations for diesel prices, on a direct comparison we believe hydrogen use in the long-haul transport industry is already an economically viable alternative."

## Bristol Springs Solar Project – Stage 1

The BSS Project is a large, utility-scale solar energy project located in the southwest of Western Australia. Development is well advanced and is designed to produce 114MWdc of renewable electricity in Stage One with land acquisition opportunities to expand beyond this. The BSS Project will utilise well-established solar panel and tracking technology to deliver clean energy. It is strategically located to connect to the backbone of the Southwest Interconnected System (SWIS), and is close to road, water, and port infrastructure.

Development approval has been granted by the Regional Joint Development Assessment Panel, and an electricity transfer access contract (ETAC) is in progress with Western Power and is expected to be completed by the end of 2022. A summary of the key metrics of the BSS Project is provided below:

These assumptions were provided by EPC Technologies.

- Installed solar panels 114MWp
- Capacity Factor 25%
- Expected energy production 247GWac
- Generation technology Single axis tracking, bifacial solar panels
- Operating life 30 years

Costs	\$ (M)	Unit cost
Capital – Initial	147	\$1.29m/MWp
Operating Costs pa	3.0	\$12.15/MWh

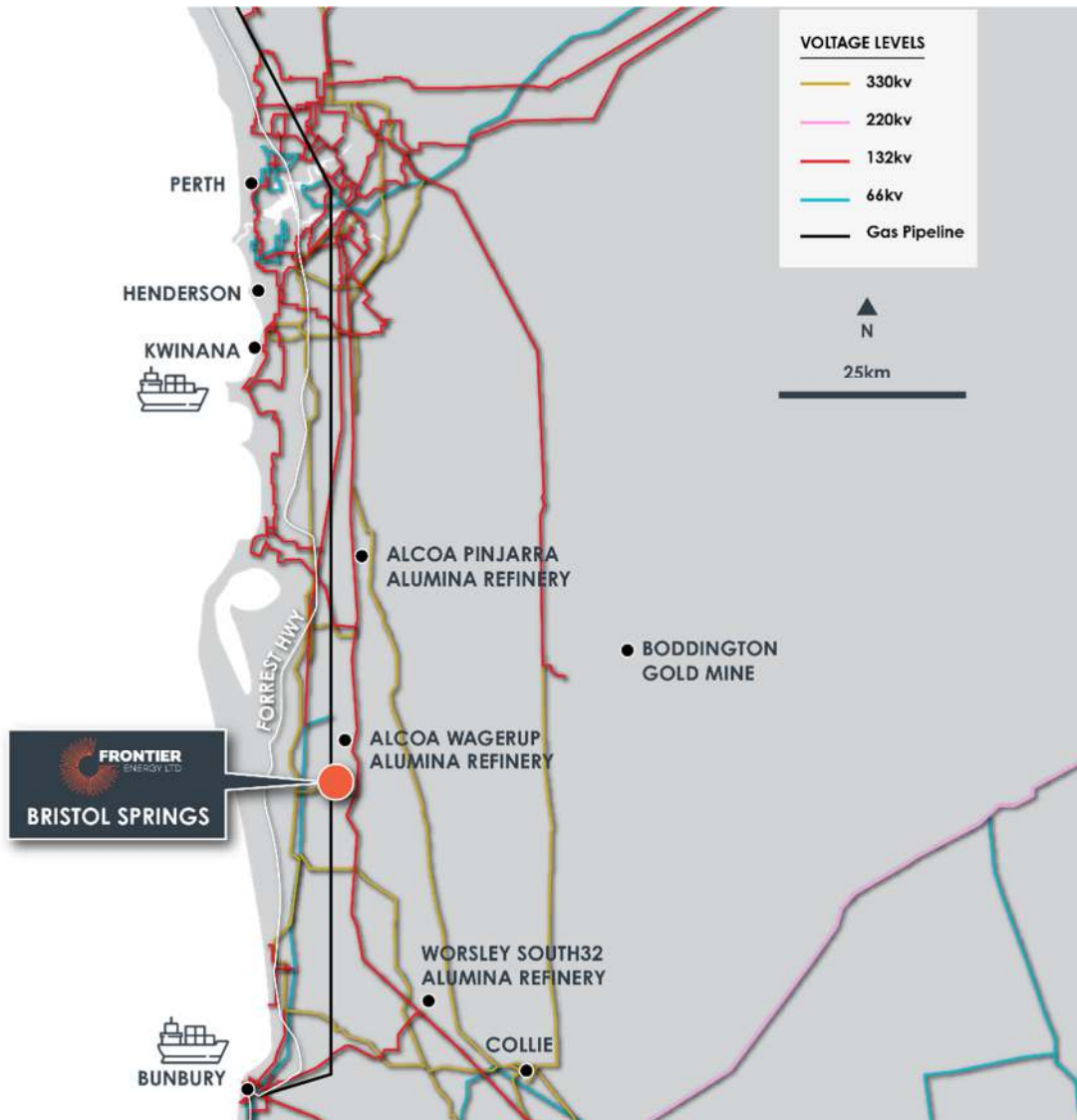
**Table 1: Summary of Production and Cost assumptions**

### Renewable Electricity Sales

The BSS Project is located approximately 3.5km from the Landwehr Terminal, a major connection point into the SWIS, the electricity grid covering the southwest of Western

Australia. The SWIS provides power to over 2.3 million customers over an area 1,000km north to south and more than 600km east to west.

The Landwehr terminal is on a major 330kV power line which provides the BSS Project with connection to many large industrial customers in the Southwest from Bunbury and Collie in the south, to Kwinana to the north. Almost all of the companies in this region (Figure 1) have committed to decarbonisation of their operations providing an ideal pool of potential customers for Frontier's clean energy.



**Figure 1: Project location showing SWIS and major industries nearby**

Once on the grid the power can either be sold via:

- Bilateral agreements with industrial users connected to the grid under Power Purchase Agreements (PPA), or
- Traditional sales into the balancing market onto the grid through the Market Operator.

Other revenue mechanisms include:

- Reserve Capacity Credits; and
- Large-Scale Generation Certificates (i.e. "Carbon Offset Credits"); and
- Essential System Services.

Expressions of interest for PPAs have been sent to a number of major companies in the region with a view to developing term sheets for power offtake agreements. The Company is also investigating the possibility of green hydrogen offtake agreements.

As the BSS Project progresses, these term sheets could provide the basis of binding offtake agreements which will form the foundation of funding mechanisms and a final investment decision. Furthermore, the Australian government has allocated A\$1.3 billion in its 2022-23 budget<sup>1</sup> for energy security funding, including funding specifically for the development of hydrogen projects.

## Green hydrogen as an alternative to solar energy sales

As an alternative to selling solar power into the SWIS, the Company is assessing green hydrogen production using clean energy produced from the Stage One 114MWp solar farm. Given the Company's unique location, surrounded by existing world class infrastructure, the initial capital required for this development is lower. This includes from the following:

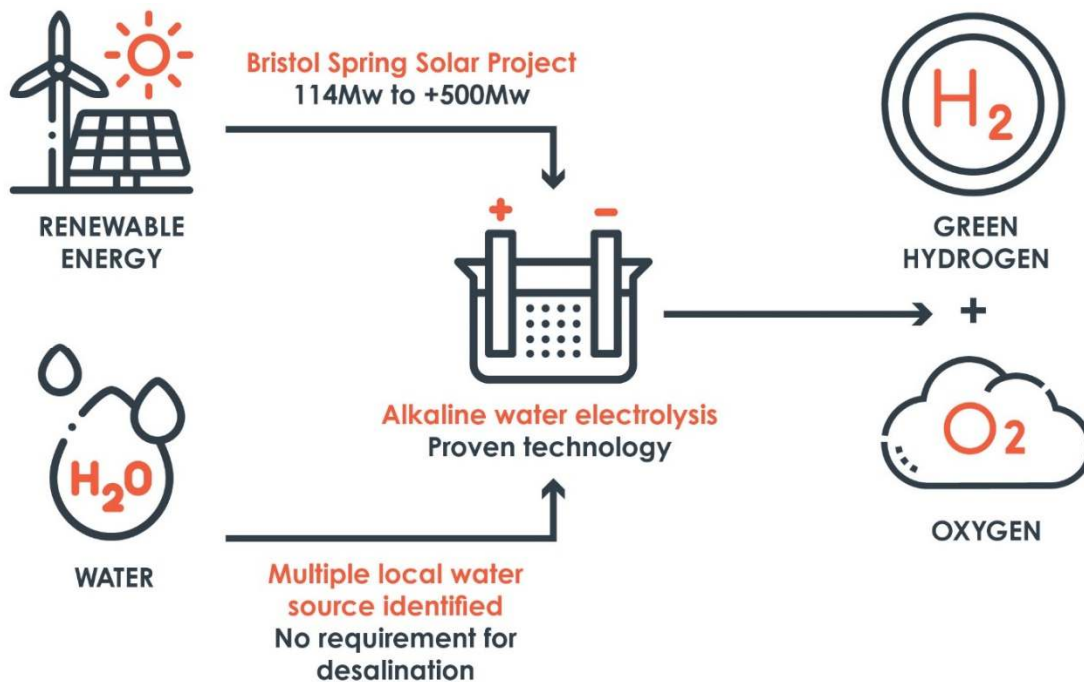
- **Multiple fresh water sources** exist in the region avoiding the need for a desalination facility. The requirement for desalination materially increases capital and operating costs and involves significantly more complex approvals extending timelines to production.
- **Connection to the SWIS** – access to this power grid, only 3.5km from the Stage One site, allows the Company to sell power in excess of requirements for green hydrogen into the SWIS.

Importantly, it also provides the opportunity for the Company to purchase renewable energy from other providers (eg. wind energy) during low or no-sun periods when the solar plant is not generating power. Using other sources of clean energy and power arbitrage or swaps, the SWIS may be able to provide a 'virtual' battery for the project. Capex for a (now abandoned) battery for Stage One was estimated at \$60m.

The Company has previously announced that it has selected the well-established alkaline electrolysis technology for hydrogen production (ASX Announcement 25 May 2022). Details on the incremental capital and operating costs will be provided with the final Renewable Expansion and Green Hydrogen Studies.

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<sup>1</sup> *Spglobal.com - 29 March 2022*



**Image 2: Flows sheet for green hydrogen production**

Frontier believes that the industries most likely to transition from their current fossil fuel energy sources towards green hydrogen in the near term, and provide an early market for the BSS Project include:

**Hydrogen blending in natural gas networks** - The Dampier to Bunbury Natural Gas Pipeline (DBNGP) is Western Australia's most significant gas transmission asset and provides natural gas to Western Australia.

The Western Australian government announced in May 2022 that to support the renewable hydrogen industry in Western Australia they have commenced investigating the implementation of a Renewable Hydrogen Target<sup>1</sup>. This would involve setting targets for retailers to procure a certain percentage of energy fuelled by renewable hydrogen. This would create the first local market which would support emerging hydrogen projects and improve energy grid stability. The work is targeted for completion by late 2022.

Importantly a possible connection point to the DBNGP is located approximately 3km from the BSS Project where the pipeline branches off to provide gas to Alcoa's Wagerup Alumina Refinery.

<sup>1</sup> [www.mediastatements.wa.gov.au/Pages/McGowan/2022/05/Renewable-hydrogen-target-to-be-investigated-for-Western-Australia.aspx](http://www.mediastatements.wa.gov.au/Pages/McGowan/2022/05/Renewable-hydrogen-target-to-be-investigated-for-Western-Australia.aspx)



**Image 3: A DBNGP connection point**

**Replace diesel in the long-haul transportation industry** - Given advancements in hydrogen fuel cell electric vehicles (FCEV), most notably in long-haul vehicles, it is likely that long-haul transportation will be an early adopter for the hydrogen industry.

The Western Australia government also identified domestically produced green hydrogen as a key part of the strategy to reduce the reliance on diesel, which is all imported. Currently WA imports approximately 6.7 billion litres of diesel per year<sup>1</sup>. The importance of energy security has been accelerated during 2022, most notably in Europe due to the Russia – Ukraine conflict.

Operating a hydrogen FCEV such as a truck or bus is comparable to a conventional vehicle, offering similar (or faster) refuelling rates, payload and operational range. Some truck manufacturers like Daimler, which owns Freightliner in the U.S., Toyota Motor Corp., Volvo AB and others strongly back the evolution of this industry and each is developing new fuel cell engine technology to be powered by hydrogen.

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<sup>1</sup> The West Australian – 6 June 2022



**Image 4: Hyzon Class 8 operates on hydrogen (source: Hyzonmotors.com)**

**How do you convert diesel into kilograms of hydrogen?**

In simple terms, 1 kilogram of hydrogen is equivalent to 4 Litres of diesel. A litre of diesel fuel comprises 35.9 MJ (megajoules) of energy. In comparison, a kilogram of hydrogen comprises 142 MJ of energy. Thus, on the basis of energy equivalence, one kilogram of hydrogen is equivalent to 4 litres of diesel<sup>123</sup>. The table below illustrates the key assumptions as well as highlights the cost to fill a vehicle.

General	Hydrogen	Diesel
Measurement	kg	L
Energy (MJ) <sup>123</sup>	142 <sub>(HHV)</sub>	35.9
1kg hydrogen equivalence <sup>123</sup>	1	4
1 Litre of diesel <sup>123</sup>	0.25	1
Price of diesel (03/06/22)		\$2.00
Equivalent price of hydrogen	\$8.00	
Price when fuel excise is added back		\$2.22
Equivalent price of hydrogen	\$8.88	
Total cost to fill a vehicle (A\$)	\$336 <sup>4</sup>	\$333 <sup>5</sup>

**Table 2: Conversion of diesel to hydrogen**

1 - <https://www.sciencedirect.com/topics/engineering/specific-energy-content>;

2 As part of the Federal Government’s 2022 Federal Budget unveiling, the government’s excise on fuel will be halved, saving motorists 22.1 cents per litre of unleaded and diesel fuel. The initiative was announced and came into effect at midnight on 29 March 2022, and will stay in place for six months to 28 September 28 2022.

3 <http://www.h2data.de/>

4 Based on HYZON HYMAX Series, 400 km driving range, <https://www.hyzonmotors.com/vehicles/hyzon-hymax-series>

5 Based on average 46 tons diesel truck with fuel tank capacity of 150L

## Next steps

The Company is continuing to work with Xodus Group to complete both the Renewable Expansion and Green Hydrogen Studies in the near term.

The Company has commenced a process seeking expressions of interest for PPA's for renewable electricity offtake from Stage One at Bristol Springs. This data will form the basis for the final investment decision for construction of the 114MWdc solar farm. As part of this process, the Company will also gauge preliminary interest for hydrogen offtake agreements.

**Authorised for release by Frontier Energy's Board of Directors.**

### ENDS

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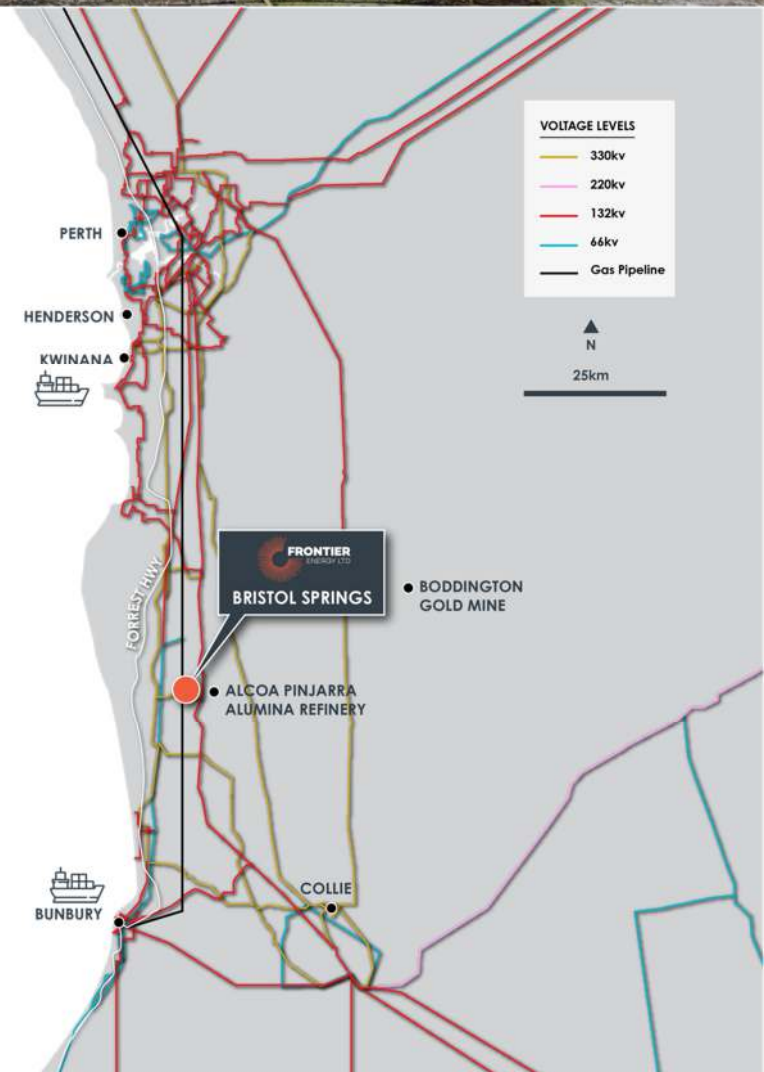


## About Frontier Energy

**Frontier Energy Ltd (ASX: FHE)** is a clean energy company developing the Bristol Springs Solar Project (BSS Project) near Waroona in Western Australia.

The BSS Project will provide enough power for 45,000 homes and abate 180,000t of CO<sub>2</sub> emissions per year.

The Project is located 120 km south of Perth, and importantly is within the “Golden Triangle” of Kwinana-Bunbury-Collie, which provides both supporting infrastructure and potential offtake customers.



### Directors and Management

**Mr Grant Davey**  
Non-Executive Chairman

**Mr Mike Young**  
Managing Director

**Mr Chris Bath**  
Executive Director

**Ms Dixie Marshall**  
Non-Executive Director

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For a comprehensive view of information that has been lodged on the ASX online lodgement system and the Company website, please visit [asx.com.au](http://asx.com.au) and [frontierhe.com](http://frontierhe.com), respectively.