

ASX ANNOUNCEMENT

1 March 2021

## GEV SCOPING STUDY DELIVERS ZERO EMISSION SUPPLY CHAIN FOR GREEN HYDROGEN

- **GEV has successfully completed a Scoping Study that confirms it can deliver an emission free compressed hydrogen (C-H2) supply chain.**
- **The study demonstrates GEV's C-H2 supply chain will be a competitive large-scale marine hydrogen transport solution up to 4,500 nautical miles (8,300 km).**
- **C-H2 provides a simple, efficient, zero emission supply chain for marine transport of 100% green hydrogen, considered to be the holy grail for a net-zero future.**
- **More than US\$300B in hydrogen investments globally to be made through to 2030<sup>1</sup>.**

Global Energy Ventures Ltd (ASX: **GEV**, the **Company**) is pleased to announce the results of its Scoping Study that demonstrates it can deliver a technically feasible, zero emission compressed hydrogen (C-H2) supply chain with a competitive shipping range using 100% green hydrogen, consistent with a net-zero future.

### HIGHLIGHTS:

- **C-H2 supply chain is very competitive for a distance of 2,000 nautical miles (3,700 kms, NW Australia to Singapore) against Liquefaction (LH2) and Ammonia (NH3) and remains competitive to 4,500 nautical miles (8,300 kms, Australia to Japan, South Korea and China).** Refer Figure 1.
- **Simple and energy efficient supply chain for export volumes ranging from 50,000 to 400,000 tonnes of green hydrogen per annum, produced from renewable power and electrolysis.**
- **Minimal technical barriers for commercialisation to meet hydrogen demand and export market timelines.**
- **Results provide GEV with the confidence to rapidly progress the development of the C-H2 Ship and supply chain to the next phase of development.**
- **2021 program will also include the development of GEV's own green hydrogen export project to support the construction of a pilot scale C-H2 Ship.**
- **GEV's proprietary C-H2 Ship design and engineering is progressing, with Approval In Principle expected 1H 2021.**
- **Following a successful \$6.3m placement, GEV is fully funded to advance the C-H2 program for 2021.**

**Martin Carolan, Executive Director of GEV, commented:** "GEV is delighted with the results of the Scoping Study, which confirms the C-H2 supply chain is very competitive for the marine transportation of hydrogen at 2,000 nautical miles and up to 4,500 nautical miles.

C-H2 can become a game-changing solution for the hydrogen economy and deliver a timely and energy efficient 'port to port' zero emission supply chain for green hydrogen to be produced in Australia for markets in the Asia-Pacific region.

When compared to Liquefaction (LH2) and Ammonia (NH3), we have demonstrated C-H2 is the simplest, with minimal technical barriers to achieve commercialisation in line with timelines for large-scale projects seeking a transport solution.

GEV will now accelerate its plan to address key markets for green hydrogen, alongside advancing the C-H2 Ship approvals from American Bureau of Shipping expected in 1H 2021 and define our own green hydrogen export project in Australia to support the construction of a pilot scale C-H2 Ship."

<sup>1</sup> Hydrogen Council, Hydrogen Insights A perspective on hydrogen investment, market development and cost competitiveness, February 2021

## 1 SCOPING STUDY INTRODUCTION

In 2015, the Paris Agreement was adopted by almost 200 nations as they embraced the goal to reduce greenhouse gas emissions and limit the impacts of global warming. In 2020, governments and industries reinforced this goal with a commitment to net-zero targets from ranging from 2040-2050, with the development of a hydrogen economy being a key pillar to attaining this target.

GEV has the benefit of over 20 years' experience in the design and engineering of pressure vessels, resulting in the development of its CNG Optimum ship for compressed natural gas. The move to GEV's compressed hydrogen ship is a natural progression to meet a market requirement for the storage and marine transportation of hydrogen.

GEV considers a net-zero emission supply chain using marine transport is the holy grail to meet future global demand, and doing so, does not add to the total stock of greenhouse gases in the atmosphere.

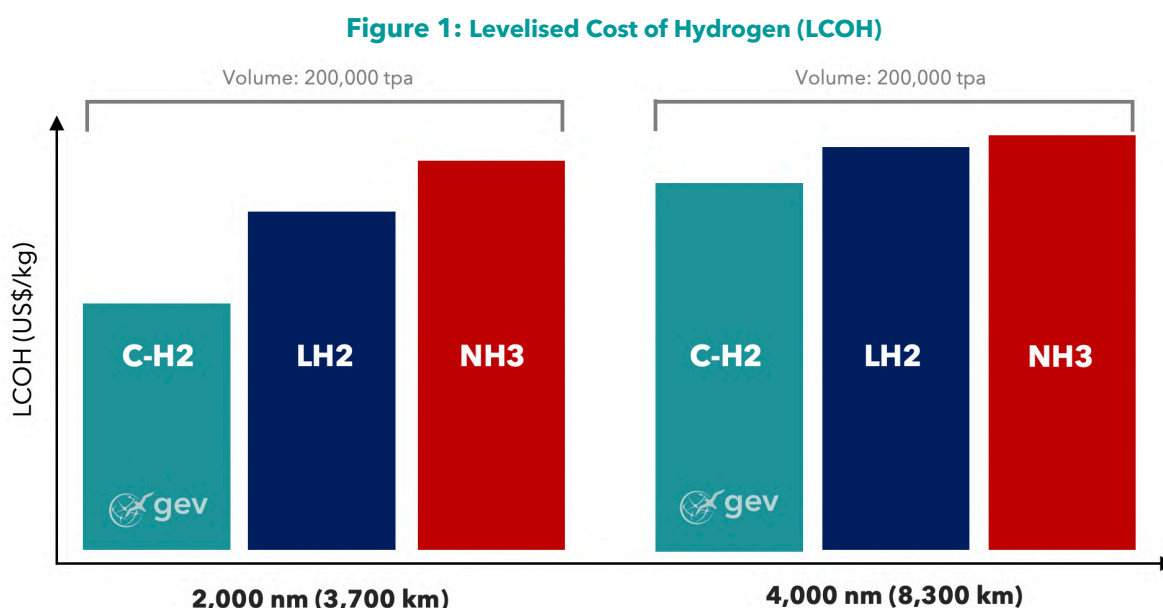
Therefore, GEV undertook a Scoping Study to determine the competitive shipping range and technical feasibility of C-H<sub>2</sub>, using a 100% green hydrogen supply chain analysis, consistent with a net-zero future.

The Scoping Study evaluated exporting green hydrogen volumes of 50,000; 200,000; and 400,000 tonnes per annum, to market distances of 2,000; 4,000; and 6,000 nautical miles, via C-H<sub>2</sub>, LH<sub>2</sub> and NH<sub>3</sub> supply chains. To put the studied export volumes in context, it would require very large-scale renewable energy generation such as the Asian Renewable Energy Hub, one of the world's top 10 renewable projects to produce green hydrogen, located in the Pilbara region of Western Australia. Refer to Appendix A for key assumptions of the Scoping Study.

## 2 SCOPING STUDY CONCLUSIONS

- The **Levelised Cost of Hydrogen (LCOH) for the C-H<sub>2</sub> supply chain was very competitive** as a marine transport solution for green hydrogen for distances of 2,000 nautical miles (3,700 kms) and remained competitive to 4,500 nautical miles (8,300 kms).
- C-H<sub>2</sub> was viewed as a **simple and energy efficient** supply chain (refer to Appendix B).
- C-H<sub>2</sub> had **minimal technical barriers** for commercialisation in the next 5 years (refer to Section 6: Technical Barriers).
- The Scoping Study assumed a stable and continuous base load supply of green hydrogen for export. This was viewed as challenging in reality, given both solar and wind have variable and volatile daily generation profiles. C-H<sub>2</sub> was seen as **the solution**, as it had the ability to **"load follow"** such profiles, whereas LH<sub>2</sub> and NH<sub>3</sub> could not.

Figure 1 illustrates the Levelised Cost of Hydrogen for transporting a volume of 200,000 tpa over a distance of 2,000 and 4,000 nautical miles.



Source: GEV

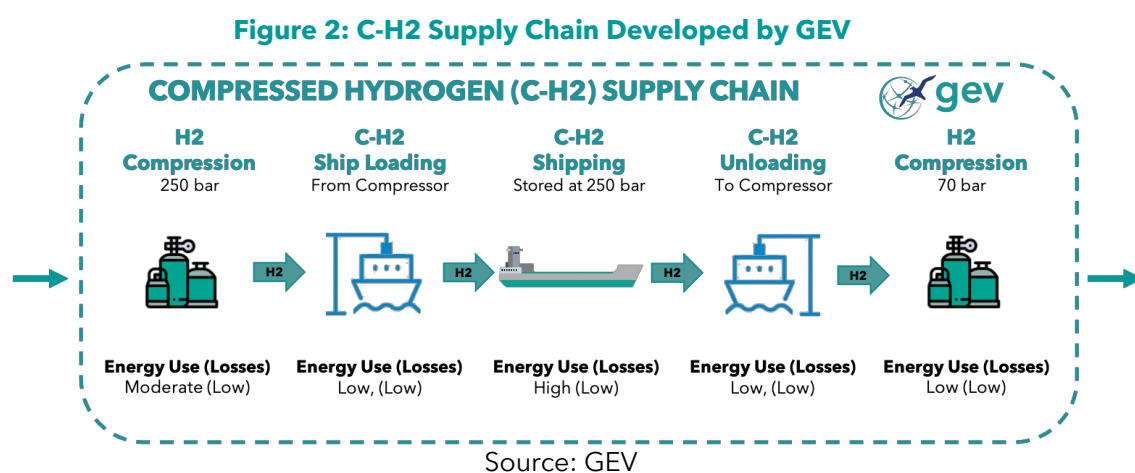
### 3 OVERVIEW OF THE C-H2 SUPPLY CHAIN

GEV's C-H2 supply chain commenced development during 2020 with the detailed engineering of a new marine pressure vessel and the associated engineering requirements to complete the full supply chain. The Company's rapid advancement of the C-H2 supply chain into 2021 leverages the application of compression, which is a proven technology in the storage and transport of hydrogen today. The application and equipment required for compression in the C-H2 supply chain is the same as GEV's CNG Optimum supply chain for natural gas, with the exception of the new C-H2 Ship.

The analysis undertaken highlights that compression is an integral component in the design and engineering of all three supply chains, with LH2 and NH3 also compressing the gaseous hydrogen prior to their respective processes. Refer to Appendix B illustrating the various stages in which compression is required for both LH2 and NH3.

The development of a C-H2 supply chain benefits from being a simple and energy efficient process along with having minimal technical barriers for commercialisation in the next five years. In summary, the simplicity of the process as illustrated in Figure 2 (Source: GEV).

An overview of the LH2 and NH3 supply chains is provided in Appendix C and D respectively.



- > **Compression / Loading:** to compress and load the hydrogen from 20 bar up to 250 bar (C-H2 Ship operating pressure). The compressors were assumed to be electric drive, powered by renewable energy from an available grid. GEV assumed an energy requirement of 1.1 kWh/kg of hydrogen. A C-H2 Ship is always berthed at the port and therefore eliminates the requirement for storage prior to loading.
- > **C-H2 Shipping:** to transport compressed hydrogen for delivery to the customer. Each C-H2 Ship had a cargo capacity of 2,000 tonnes of hydrogen, with electric drive engine propulsion powered via onboard fuel cells (fuelled by the ship's hydrogen cargo). GEV has partnered with Ballard Power Systems to develop the onboard fuel cell system requirements. The C-H2 Ship is a closed system and does not result in any boil-off. Further details on the design principles of the C-H2 Ship are set out in Appendix E.
- > **Unloading / Decompression:** unloading the C-H2 Ship for the supply of gaseous hydrogen to the customer at the 70 bar pressure requirement. Fuel cells were assumed to power the scavenging compressors, fuelled from the ship's hydrogen cargo. The energy requirement was negligible due to the high pressure of the ship's cargo. The C-H2 supply chain eliminates the requirement for onsite storage, as the C-H2 Ship is itself the storage.

#### 4 HYDROGEN MARKET APPLICATIONS FOR THE C-H2 SUPPLY CHAIN

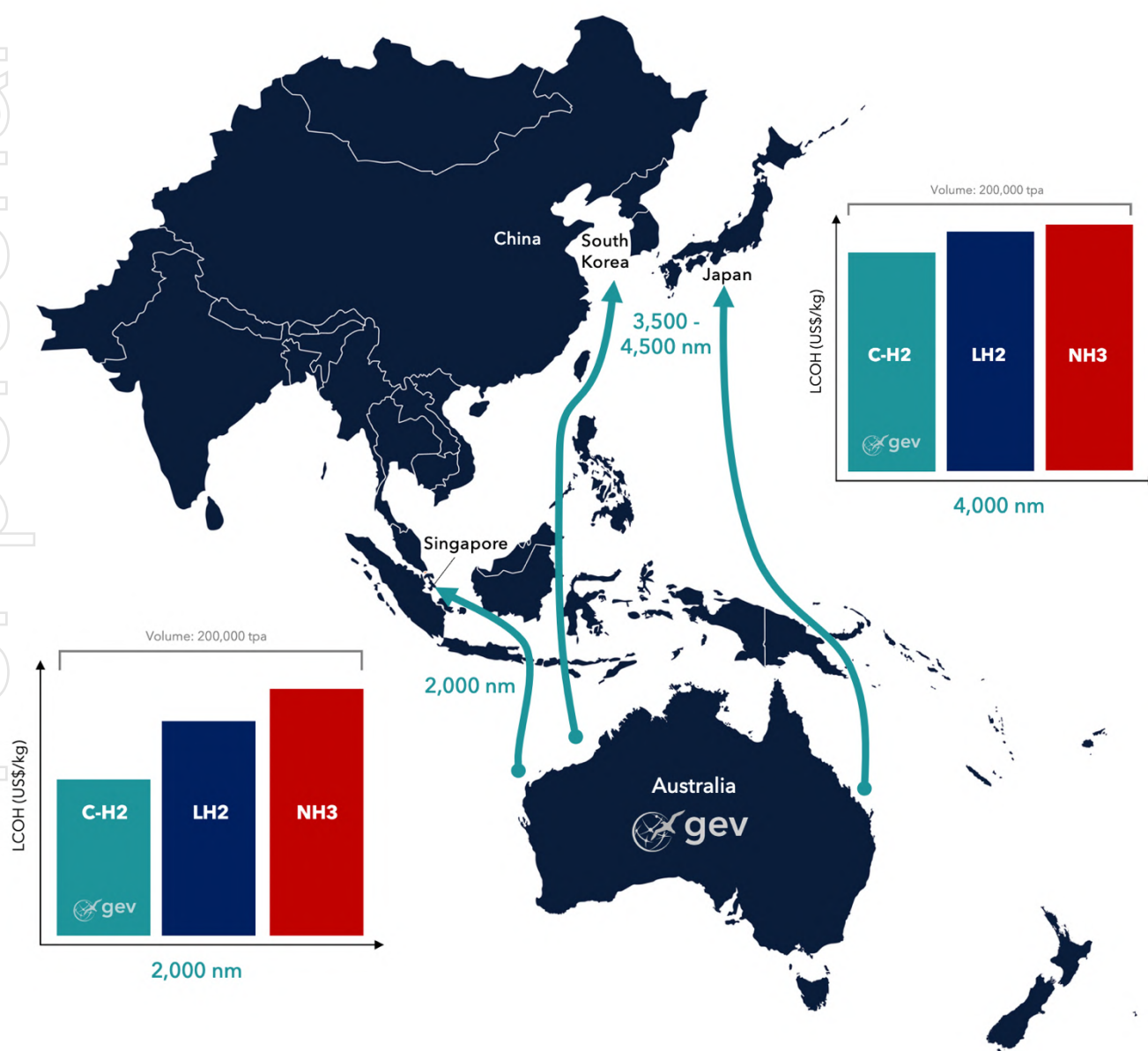
To date, the Australian hydrogen industry has seen several projects announced for the export of green hydrogen through the development of proposed renewable energy projects supported by wind, solar or hydro, and in some cases the combination of wind and solar.

It is expected hydrogen demand centres, including Europe, South Korea, Japan, and parts of China, will experience significant infrastructure, natural resource and development constraints to produce a sufficient security of supply of green hydrogen. Therefore, key supplier hubs such as Australia will meet this demand more effectively by supplying large volumes of green hydrogen rather than producing it locally.

The conclusions of the Scoping Study confirm that the C-H2 supply chain is very competitive as a marine transport solution for green hydrogen to markets at 2,000 nautical miles and remains competitive at 4,500 nautical miles. GEV's focus will be on those export project locations from the mid-west of Western Australia (Geraldton), across to Queensland (Brisbane).

The Company will now develop and undertake a detailed marketing plan for the C-H2 supply chain as a competitive and viable alternative for the 'port to port' export of green hydrogen from Australia. The illustrative map in Figure 3 outlines the possible locations for export of green hydrogen along with the key markets available within a 2,000 nautical mile and 4,500 nautical mile range.

**Figure 3: Illustrative example of hydrogen customers within 2,000 to 4,500 nautical mile range of Australia**



## 5 SENSITIVITY ANALYSIS

As outlined in Appendix A, there are various inputs that GEV has used to complete its techno-economic analysis of the three supply chains for the marine transportation of green hydrogen. The analysis also looked at the sensitivity of possible 'pessimistic and optimistic' deviations from the model's base case assumptions. It was noted that the levelised cost of hydrogen was highly sensitive to the internal energy requirements of each supply chain. Table 1 below highlights the areas where such deviation had a +/-10% change to the LCOH. GEV will now concentrate its efforts on the C-H2 areas tabled below in order to further benefit the cost competitiveness of the C-H2 supply chain.

Table 1	C-H2	LH2	NH3
<b>Key areas of LCOH sensitivity (+/-10% swing)</b>	Ship Propulsion System Ship Capital Cost	Price of reliable, base load renewable energy Boil Off Gas (BOG)	Price of reliable, base load renewable energy Cracking/Purification Efficiency

## 6 TECHNICAL BARRIERS

A key conclusion of the study was that a C-H2 supply chain had **minimal technical barriers** to achieve commercialisation in the next 5 years. This timeframe can align with the development milestones of large-scale green hydrogen export projects located in Australia. Table 2 outlines the material technical barriers to commercialisation for C-H2, LH2 and NH3.

Table 2	C-H2	LH2	NH3
<b>Technical Barrier(s)</b>	ABS Approvals for the C-H2 Ship Construction	Liquefaction at Scale LH2 Storage (BOG)	Cracking/Purification at Scale

The **C-H2** supply chain is considered to have a lower technical risk, with final ship design and classification approvals being key.

- The C-H2 supply chain consists of compressors, pipework, loading infrastructure and C-H2 Ship Fleet.
- Hydrogen compressors (designed for pressure as high as 700 bar) have been in operation for decades with the associated piping and loading equipment having already been developed for various onshore applications.
- The only material barrier is for GEV to achieve American Bureau of Shipping (ABS) C-H2 Ship approvals, with Approval in Principle expected in the 1H 2021.

The **LH2** supply chain is considerably more complex with additional energy intensive processes as well as onshore storage requirements. The **NH3** supply chain uses predominately mature and well-developed technologies with the synthesis, storage and shipping of ammonia having occurred at industrial scale for over a century. However, if the end user requires pure hydrogen, then major technical barriers exist.

Further detail on the technical barriers of LH2 and NH3 is provided in Appendix C and D respectively.



## APPENDIX A - SCOPING STUDY ASSUMPTIONS

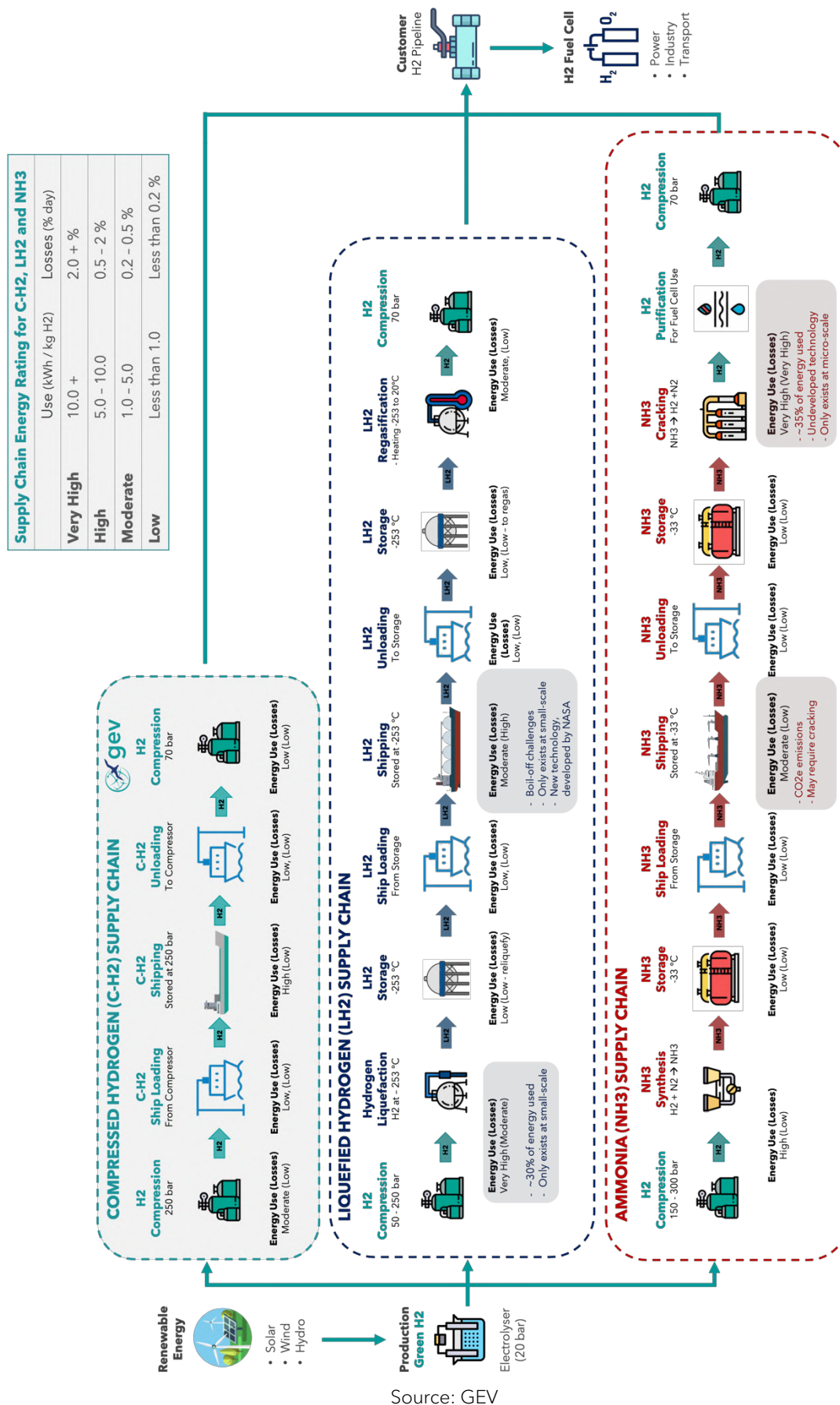
- A constant supply of green hydrogen was provided by a third party at a price of US\$2.00/kg and at a pressure of 20 bar (from the electrolyser).
- At the loading location, a certified green power grid met the electricity requirements for compression (C-H<sub>2</sub>), hydrogen liquefaction (LH<sub>2</sub>), and ammonia synthesis (NH<sub>3</sub>) at an electricity price of US\$0.15/kWh. It was noted that this represented a significant premium to the local renewable energy price due to the requirement of a 100% reliable, base load supply, essential for both the LH<sub>2</sub> and NH<sub>3</sub> facilities.
- Port facilities at the supply and customer points were made available by a third party at no cost for all three supply chains.
- The power requirements for ship propulsion and auxiliary power was supplied via a fuel cell, powered by the ship's hydrogen/ammonia cargo. A 50% fuel cell efficiency HHV was assumed at this scale.
- At the customer's unloading location, the power requirements for scavenging compression (C-H<sub>2</sub>), regasification (LH<sub>2</sub>) and cracking/purification (NH<sub>3</sub>) was supplied via a fuel cell, powered by the hydrogen/ammonia cargo.
- The hydrogen delivered to the customers distribution pipeline was assumed to be at a pressure of 70 bar, and at a purity suitable for fuel cell use.
- The key energy use and loss assumptions are outlined for each supply chain in Appendix B below.

In order to determine the competitive range and advantages of GEV's C-H<sub>2</sub> supply chain, the Scoping Study analysed the levelised cost and energy efficiency of C-H<sub>2</sub> against that of LH<sub>2</sub> and NH<sub>3</sub>.

The techno-economic evaluation of alternative hydrogen supply chains of liquefaction (LH<sub>2</sub>) and ammonia (NH<sub>3</sub>) was prepared by the Company along with internal cost data and references made available by an external consultant engaged. GEV has also obtained several third party references available in the public domain to complete its analysis. The model includes number of assumptions for the capital, operating and internal energy requirements.

## APPENDIX B

FIGURE 4: COMPARISON OF THE C-H<sub>2</sub> SUPPLY CHAIN WITH LIQUEFACTION (LH<sub>2</sub>) AND AMMONIA (NH<sub>3</sub>)

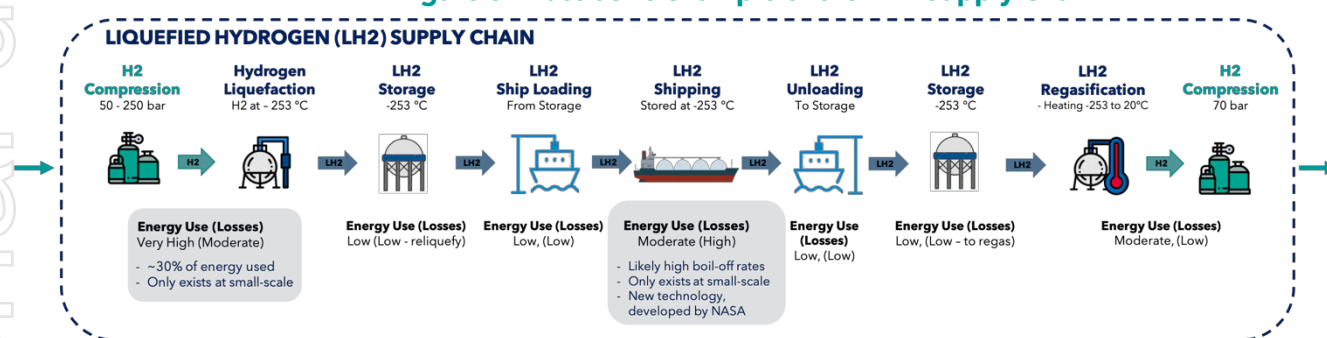


## APPENDIX C

### OVERVIEW OF THE LIQUEFIED HYDROGEN (LH2) SUPPLY CHAIN

- Liquefaction / Storage / Loading:** liquefy the hydrogen to  $-253^{\circ}\text{C}$  / 1 bar for storage prior to loading the LH2 Ship. All facilities were assumed to be electric drive, powered by renewable energy from an available grid. The energy requirement of the liquefaction process (including compression) was assumed to be 11 kWh/kg of hydrogen<sup>2</sup> (~28% of the hydrogen energy HHV).
- LH2 Shipping:** to transport liquefied hydrogen for delivery to the customer. Each LH2 ship had a cargo capacity of 20,000m<sup>3</sup> (1,425 tonnes of hydrogen), with electric drive engine propulsion powered via onboard fuel cells (fuelled by the ship's hydrogen cargo). The size of the LH2 ship was based on the Approval in Principle recently granted to Hyundai for its 20,000 m<sup>3</sup> liquefied hydrogen carrier<sup>3</sup>. This being significantly larger than the existing Kawasaki Heavy Industries demonstration LH2 ship (1,500 m<sup>3</sup>).
- Unloading / Storage / Regasification:** unload and store the liquefied hydrogen prior to regasification for the supply of gaseous hydrogen to the customer at the 70 bar pressure requirement. An energy requirement of 2 kWh/kg for the vaporiser/regasification was assumed. Fuel cells were assumed to power the pumps/compressors and vaporisers, fuelled from the ship's hydrogen cargo.

Figure 5: Illustrative example of the LH2 Supply Chain



Source: GEV

### TECHNICAL BARRIERS:

- The largest liquefaction unit currently in operation is 35 tonnes per day (12,800 tpa), which is 4 times smaller than the unit required for the Scoping Study's minimum volume of 50,000 tpa.
- The process of liquefying hydrogen typically involves multiple phases (compression, pre-cooling, catalytic cryogenic cooling, expansion, and separation). The combination of these processes is both energy intensive and technologically complex. Although conceptual liquefaction plants with reduced energy consumption and improved exergy efficiency have been considered, but not yet implemented<sup>4</sup>.
- The most significant technical barrier for LH2 is the efficacy of the  $-253^{\circ}\text{C}$  storage system (both onshore and on the LH2 ship). Boil off is caused by heat ingress from the atmosphere ( $\sim 20^{\circ}\text{C}$ ) into the stored liquid hydrogen at  $-253^{\circ}\text{C}$ . This heat causes a percentage of the liquid hydrogen to convert into vapour (gas).
- Commonly referenced boil-off rates of 0.2% were viewed by GEV as ambitious long-term targets. The 0.2% target is to simply match the fuel consumption of the LH2 ship and avoid handling of excess boil off gas.
- It was noted that if LH2 was stored in a modern LNG ship (designed for  $-162^{\circ}\text{C}$ ), the boil off rate would be 5% per day<sup>5</sup> and that while the use of double walled vacuum insulated tanks may be practical for onshore storage, marine tanks would require internal supports and anti-sloshing baffles, that may be mechanically impractical<sup>6</sup>. Significant research and development of the current NASA level technology is required. For these reasons, the Scoping Study assumed a boil off rate of 1.0%.

2 Pg 14 <https://www.lngfutures.edu.au/wp-content/uploads/2019/10/Munro-S.-Al-Ghafri-S.-Liquid-Hydrogen-in-Australia-requirements-of-future-technical-research.pdf>

3 <https://www.rivieramm.com/news-content-hub/news-content-hub/aip-for-largest-liquid-hydrogen-carrier-yet-61898>

4 Pg 14, <https://www.lngfutures.edu.au/wp-content/uploads/2019/10/Munro-S.-Al-Ghafri-S.-Liquid-Hydrogen-in-Australia-requirements-of-future-technical-research.pdf>

5 <https://escolaeuropea.eu/news/environmental-news/from-lng-to-hydrogen-pitfalls-and-possibilities/>

6 [https://cryogenicsociety.org/34991/news/bulk\\_storage\\_and\\_shipping\\_of\\_liquid\\_hydrogen\\_is\\_hazardous/](https://cryogenicsociety.org/34991/news/bulk_storage_and_shipping_of_liquid_hydrogen_is_hazardous/)

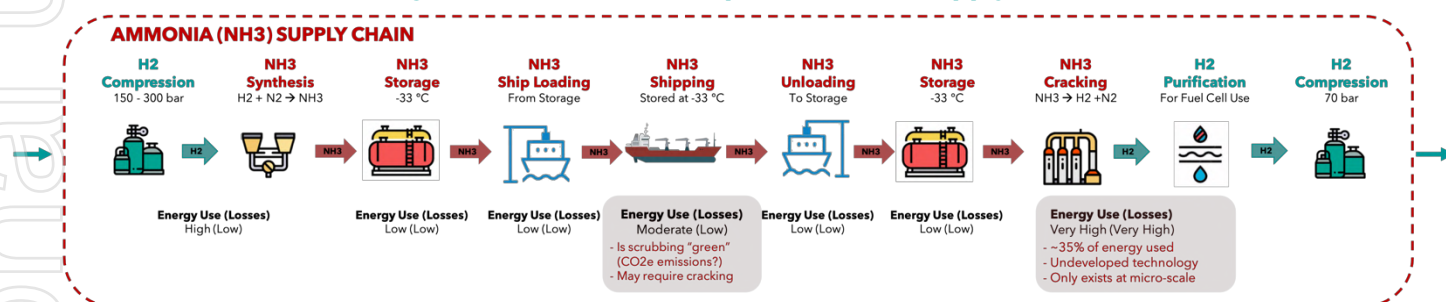


## APPENDIX D

### OVERVIEW OF THE AMMONIA (NH<sub>3</sub>) SUPPLY CHAIN

- Ammonia Synthesis / Storage / Loading:** combined gaseous hydrogen (H<sub>2</sub>) and gaseous nitrogen (N<sub>2</sub>) to form liquid ammonia (NH<sub>3</sub>) at -33.4°C / 1 bar for storage prior to NH<sub>3</sub> ship loading. All facilities were assumed to be electric drive, powered by renewable energy from an available grid. The energy requirement of the ammonia synthesis process (including compression) was assumed to be 9.0 kWh per kg of hydrogen<sup>7</sup> (~23% of the hydrogen energy HHV).
- NH<sub>3</sub> Shipping:** to transport liquid ammonia for delivery to the customer. Each NH<sub>3</sub> ship has a cargo capacity of 25,600 tonnes of ammonia (~4,500 tonnes of hydrogen), with electric drive engine propulsion powered via onboard fuel cells (fuelled by the ship's hydrogen cargo post cracking/purification).
- Unloading / Storage / Cracking / Purification:** unload and store the liquid ammonia prior to cracking (decomposing of NH<sub>3</sub> to H<sub>2</sub>), and purification for the supply of gaseous hydrogen to the customer at the 70 bar pressure requirement. Fuel cells were assumed to power the pumps, compressors, cracking and purification facilities, fuelled from the ship's hydrogen cargo (post-cracking and purification). The overall efficiency of the cracking, purification and compression process was assumed to be 68.5% LHV<sup>8</sup> (~35+% of the hydrogen energy HHV).

Figure 6: Illustrative example of the NH<sub>3</sub> Supply Chain



Source: GEV

### TECHNICAL BARRIERS

The **NH<sub>3</sub>** supply chain uses predominately mature and well-developed technologies with the synthesis, storage and shipping of ammonia having occurred at industrial scale for over a century. However, if the end user requires pure hydrogen, then major technical barriers exist.

- There are no available or known process to crack (the process of dehydrogenation or decomposing NH<sub>3</sub> to H<sub>2</sub>), most commercially available options offer an electric-based furnace solution at a production capacity ranging from 1 to 2 tpd<sup>9</sup> (being 1% of the Scoping Study's minimum volume of 50,000 tpa).
- Cracking of NH<sub>3</sub> is very energy intensive and usually produces a forming gas (H<sub>2</sub> and N<sub>2</sub> mixture) meaning additional purification is required to prevent fuel cell poisoning.
- The overall efficiency of the cracking/purification and compression process was assumed to be 68.5%<sup>3</sup> Lower Heating Value (LHV) equivalent to ~35+% of the hydrogen energy Higher Heating Value (HHV).

Therefore, significant research and development surrounding cracking and purification is critical for the commercialisation of NH<sub>3</sub> for hydrogen end-user applications.

<sup>7</sup> Based on the current electricity consumption of NH<sub>3</sub> production via electrolysis (p5) minus the electricity consumption of the electrolysis at 64% LHV efficiency (p3), <https://www.iea.org/reports/the-future-of-hydrogen/data-and-assumptions#abstract>

<sup>8</sup> Figure 10, [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/880826/HS420\\_-\\_Ecuity\\_-\\_Ammonia\\_to\\_Green\\_Hydrogen.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/880826/HS420_-_Ecuity_-_Ammonia_to_Green_Hydrogen.pdf)

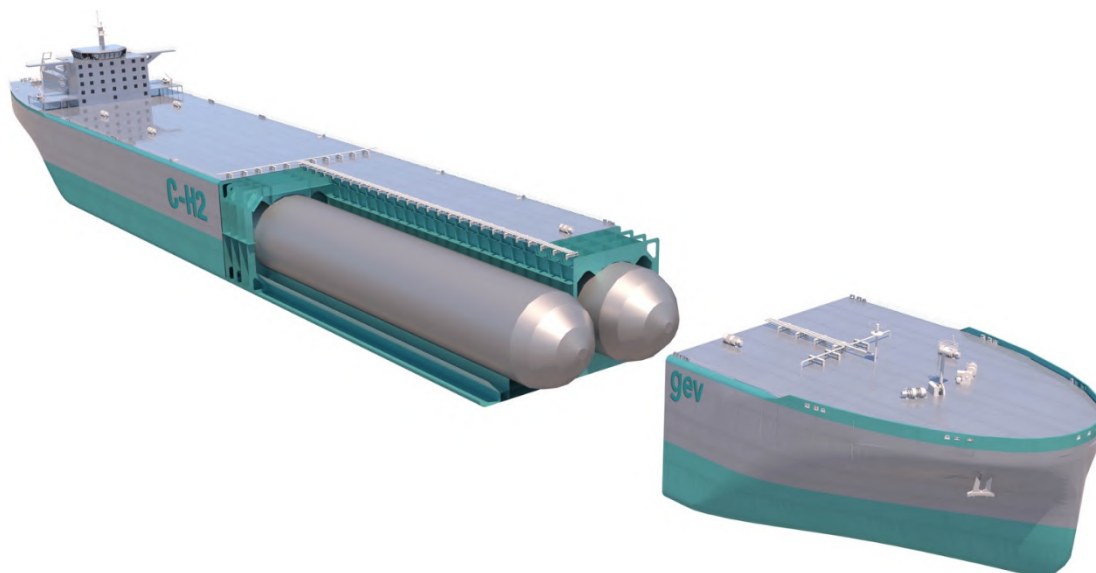
<sup>9</sup> Section 3.1, [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/880826/HS420\\_-\\_Ecuity\\_-\\_Ammonia\\_to\\_Green\\_Hydrogen.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/880826/HS420_-_Ecuity_-_Ammonia_to_Green_Hydrogen.pdf)

## APPENDIX E

### C-H2 SHIP SPECIFICATION & ZERO EMISSION SHIPPING SOLUTION

GEV's unique C-H2 Ship has a large hydrogen carrying capacity of 2,000 tonnes. This vessel will be key to establishing an economic and energy efficient shipping link between hydrogen producers and customers given it represents a significant allocation of the overall cost of the supply chain. Figure 2 is an illustration of GEV's C-H2 general arrangement.

**Figure 7: C-H2 Ship General Arrangement**



Source: GEV

#### The key specifications of the C-H2 ship are as follows:

- The proprietary design for the containment system is made up of two large (20 metre diameter) tanks, contained within the hull of the ship, that will store ambient temperature hydrogen at an operating pressure of 3,600 psi (250 bar) and will have a combined storage capacity of 2,000 tonnes of hydrogen.
- The design of the C-H2 Ship will also allow for the evaluation of smaller capacity ships, which would be optimised to scale of the demonstration / pilot export project.
- One of the key considerations in designing a steel tank for storing hydrogen, is that the hydrogen molecule is so small it can enter the steels molecular structure and over time can cause the steel to suffer from embrittlement.
- A practical way to avoid hydrogen embrittlement is to provide a liner that prevents migration of hydrogen into the steel.
- Technical requirements for such a large tank mean that it needs to be constructed in layers. Stainless steel will be used as the innermost layer, being resistant to hydrogen embrittlement, with six surrounding layers of ductile high-strength alloy steel to meet strength and fatigue requirements.
- One significant advantage of a tank made from multiple discrete layers is that should a crack form in one layer it will not naturally proceed through to the adjacent layer. This greatly improves the safety of the tank.
- With the rapid advancements in hydrogen fuel cells, GEV intends to fuel the ship with hydrogen from the storage tanks, providing a 'zero-carbon' shipping solution.

#### US PROVISIONAL PATENT FILED FOR THE C-H2 SHIP

In December 2020, GEV filed a provisional US Patent application relating to the apparatus for the marine storage and transport of hydrogen. The provisional application has been made to protect multiple ideas that arose during the design work undertaken in support of the American Bureau of Shipping (ABS) approval process. The inventor is GEV Canada's Chief Technical Officer, John Fitzpatrick. The Company will now work with its advisors on the detailed filing over the coming 12 months. The Company has a successful track record of patent applications with two granted for the CNG Optimum vessel.

## CLASS APPROVALS PROGRAM ON TRACK FOR 1H 2021 TO DEMONSTRATE NO SHOWSTOPPERS

With the completion of the C-H2 Ship specification, the Company remains on track with the first stage of class approvals with ABS to achieve Approval in Principle (AIP) anticipated for the first half of 2021.

The achievement of AIP will be a critical step to advancing the technical feasibility of the proposed C-H2 Ship, the first of its kind for the marine transport of large-scale volumes of hydrogen. AIP materially de-risks the C-H2 supply chain as identified in Table 2 above.

The successful outcome of the AIP will demonstrate that there are no identified showstoppers that would prevent construction and operation of the ship. The program includes a preliminary Hazard Identification (HAZID) analysis to agree the significant potential hazards and the future design work to mitigate these risks.

Following the successful achievement of AIP, the Company will commence discussions with suitable shipyards for an external confirmation of capital cost and schedule for construction.

The follow-on development phase for the C-H2 Ship will include further engineering and design work in parallel with prototype testing, with the target for ABS Final Class Approval in 2022

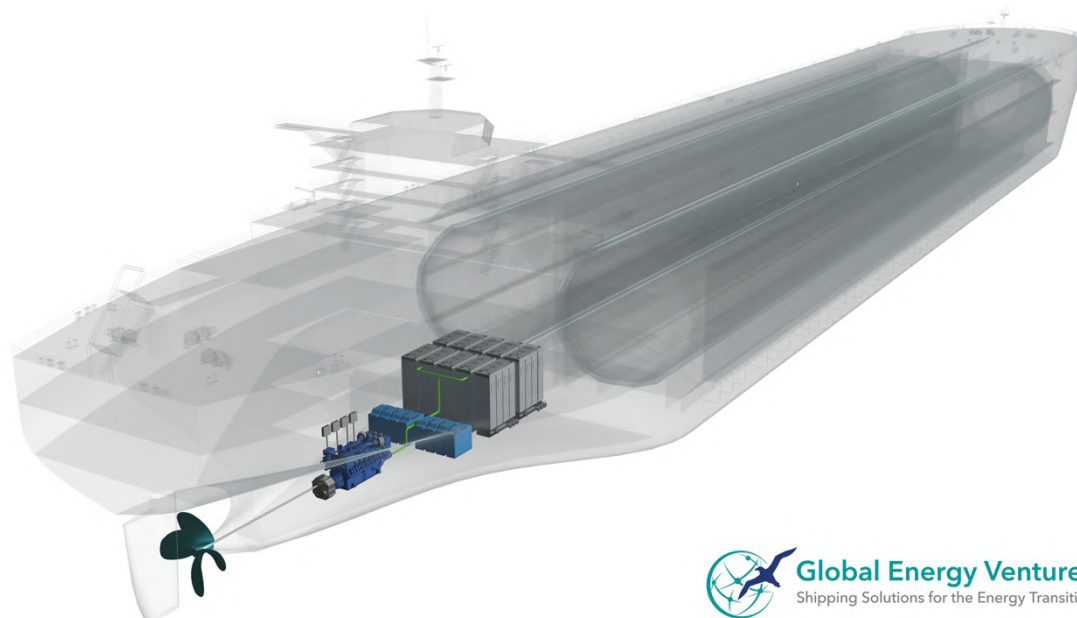
## MOU WITH BALLARD POWER SYSTEMS TO DEVELOP HYDROGEN FUEL CELL SYSTEMS

In February 2021, GEV and Ballard Power Systems Inc. (Ballard) executed a Memorandum of Understanding (MOU) to design and develop a hydrogen fuel cell system for GEV's C-H2 Ship.

GEV and Ballard will work to power the C-H2 Ship using Compressed Hydrogen from its storage tanks, providing a zero-emission marine transport supply chain. Ballard will be responsible for the design of the fuel cell system (FC System), utilising its FC Wave™ Technology and to assist GEV with the integration of the FC System into the design of the C-H2 Ship.

During 2021-2022, both parties will work collaboratively to complete a final design and procure all necessary approvals, and full costing for the C-H2 Ship, utilising a Ballard FC System.

**Figure 8: GEV's C-H2 Ship fuelled by Hydrogen Fuel Cells (Illustrative example)**



Source: GEV

- END -

This ASX announcement has been authorised by the Board of GEV.

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## ABOUT GLOBAL ENERGY VENTURES LTD

Global Energy Ventures Ltd was founded in late 2016, with the Company's mission to create shareholder value through the delivery of integrated compressed shipping solutions transporting energy to regional markets. The business model is to build, own and operate integrated energy transport projects for either natural gas or hydrogen.

The primary focus is the development of integrated Compressed Natural Gas (CNG) marine transport solutions with the Company's construction ready **CNG Optimum ship**. CNG is a well proven gas transport solution with design and commercial advantages along with being safe and a 'lower emission' solution for the transport of gas than in the form of liquefied natural gas (LNG).

With the world's focus on Energy Transition to zero-carbon fuels, the Company has also introduced the world's first large-scale **compressed hydrogen Ship (C-H2)** design that will support the transport of hydrogen as a green energy fuel of the future. Hydrogen's role in the future energy mix will greatly assist governments and corporations with their respective 'net-zero carbon' targets through the decarbonisation of heavy emitting industries.

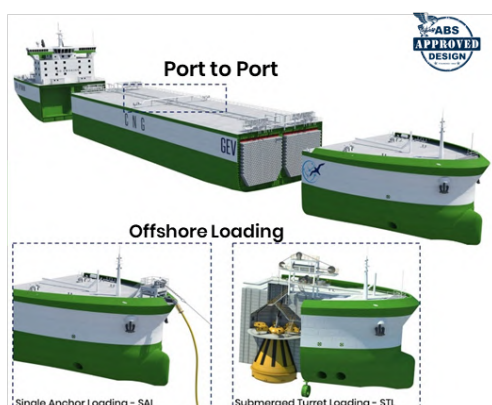
### Value creation for shareholders will be achieved by:

- Continue to maintain global leadership in marine pressure vessel designs and intellectual property.
- Pursue a portfolio of CNG Optimum projects to improve and mitigate against binary outcomes and offer CNG project stakeholders' flexible commercial arrangements.
- Advance the future transport of green energy through the development of the compressed H2 Ship.
- Employ world class management and staff that are leaders in their chosen discipline.
- Maintain the highest standards of efficiency, safety and environmental responsibility.

For more details on the Company please visit [www.gev.com](http://www.gev.com)

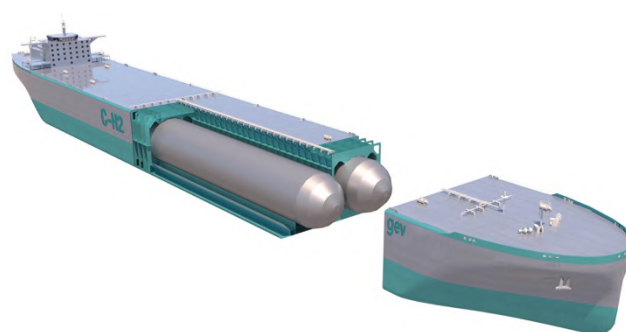
### CNG Optimum Ship

*Approved for Construction & Ready for Commercialisation*



### C-H2 Ship

*Under Development*



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\$ refers to Australian Dollars unless otherwise indicated.