



# **“Blue” Hydrogen**

The *Future* for Fuel Cell Vehicles, Distributive Power  
Generation & Industry Applications

## **Innovations in Sustainable Energy**

### **White Paper**

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## INTRODUCTION

**Hydrogen Innovations Co. (H2I)** is a hydrogen production company created by a dedicated team of engineers to produce affordable Hydrogen to meet the massive existing industrial gas market and the long-awaited and overall alternative fuel for electric vehicles and alternative energy storage. A report published by McKinsey envisions 2050 a need for Hydrogen and hydrogen technologies with revenues of more than **\$2.5 trillion per year**. This vital gas will represent around 18% of global energy demand, help reduce CO<sub>2</sub> emissions by around six gigatons and create 30 million jobs.

H2I's technology will enable the low-cost production of 99.999% hydrogen gas from various feedstocks, including clean natural gas, bioethanol, and biomethane gas. We can optimize fuel and electric energy production by integrating our systems with hydrogen-electric storage systems. We can contribute to an economically sustainable energy infrastructure for many applications with application-level load management. In addition, HHO can provide a carbon neutrality approach to hydrogen fuel production from its natural gas feedstock operations by combining CO<sub>2</sub> sequestration (deep well and otherwise) and its commitment to silviculture (replanting of forests) that we can offer. As a result, H2I's technology will provide the fuel for producing inexpensive pure Hydrogen for long-established industries and technologies and the ideal fuel for the emerging electric vehicles market.

The interest in using Hydrogen as an energy source has expanded over the last few decades, mainly because energy production from Hydrogen can reduce greenhouse gas emissions, bolster energy security, and reduce local air pollution. Hydrogen as a feedstock in petroleum refining, ammonia production, and steelmaking has a growing demand. The world consumes billions of cubic meters of Hydrogen annually.

R & D programs worldwide have increasingly focused on developing & improving technologies for hydrogen production. There is a constant demand for hydrogen production—these processes of steam, hydrocarbon, carbonaceous species or an inert sweep gas result in many byproducts. Therefore, an energy-efficient hydrogen separation technique is crucial to large-scale hydrogen production.



Hydrogen purification usually happens by pressure swing adsorption (PSA), cryogenic distillation, or membrane separation. Commercial hydrogen production uses PSA and cryogenic distillation. However, these processes are typically energy-intensive techniques.

The membrane separation processes require far less energy and can operate continuously. Thus, the industry considers hydrogen-permeable membranes a promising technology for inexpensive, high-purity hydrogen production.



Figure 1. H2I MST Technology Mobile Test Unit

Furthermore, PSA and cryogenic distillation require vast amounts of expensive auxiliary equipment, making them economically viable for large economies-of-scale applications only. **The membrane separation technology developed by H2I is much simpler. It is scalable to a localized and decentralized (also called "distributed energy") production,** for example, for businesses such as a gas-stations or as backup power for buildings, industrial parks, or housing estates, including stand-alone microgrid installations. A decentralized production eliminates the freight costs of hydrogen delivery to the end-user.



## MARKET

1. For decades, Fuel Cell vehicles, material handling equipment such as forklifts, and stationary fuel cell power units for backup power low-temperature polymer electrolyte membrane (PEM) proton-exchange membrane) fuel cells. They have proven to be the most effective and economical fuel cell versus competing fuel cell types, such as solid-oxide fuel cells, molten carbonate fuel cells, proton-conducting oxide fuel cells, and many more. All fuel cells require high-purity hydrogen (99.95% pure), as in H<sub>2</sub>I, to avoid poisoning the catalysts used in their anodes; this hydrogen purity requirement makes fuel cells operate most effectively.
2. Steel production - Hydrogen is an alternative to coke to reduce iron ore for pig iron production in blast furnaces. Instead of coke, Hydrogen dramatically reduces carbon dioxide emissions and other pollutants, providing higher steel production, and helping steel producers stay within the existing limits of environmental regulations. Billions of cubic feet of Hydrogen a year are now used for steel production.
3. Metal refining for specialized alloy production. - The production of metal alloys uses large quantities of Hydrogen as a reducing agent, eliminating carbon as an added source. This is necessary for some alloys, preventing using a standard reduction technique, such as a rich natural gas flame containing carbon monoxide.
4. Petroleum refining for specialized chemicals and fuels. The most important uses of Hydrogen in the refining industry are producing plastics and refining crude oil into shorter hydrocarbon chains that are more desirable, such as gasoline.
5. Fertilizer production (the production of ammonia). - The most significant use of Hydrogen is for producing ammonia-based fertilizers. Nitrogen (N<sub>2</sub>) and Hydrogen (H<sub>2</sub>) are combined to make ammonia (NH<sub>3</sub>) using commercial scales via the Haber-Bosch process. Hydrogen and nitrogen react at moderate temperatures (~450 C) and high pressure (~100 atm).
6. Semiconductor fabrication - High-purity Hydrogen is necessary in the production of semiconductors.



7. Laboratory use and pharmaceutical manufacturing - *Hydrogen* is a crucial element used in laboratories across the globe for all types of research and experimentation and the manufacture of pharmaceuticals.

## MARKET ECONOMICS

Hydrogen is a \$110 billion per year business in the US alone. By 2050 it is expected to create revenue exceeding \$2.5 trillion worldwide<sup>1</sup>.

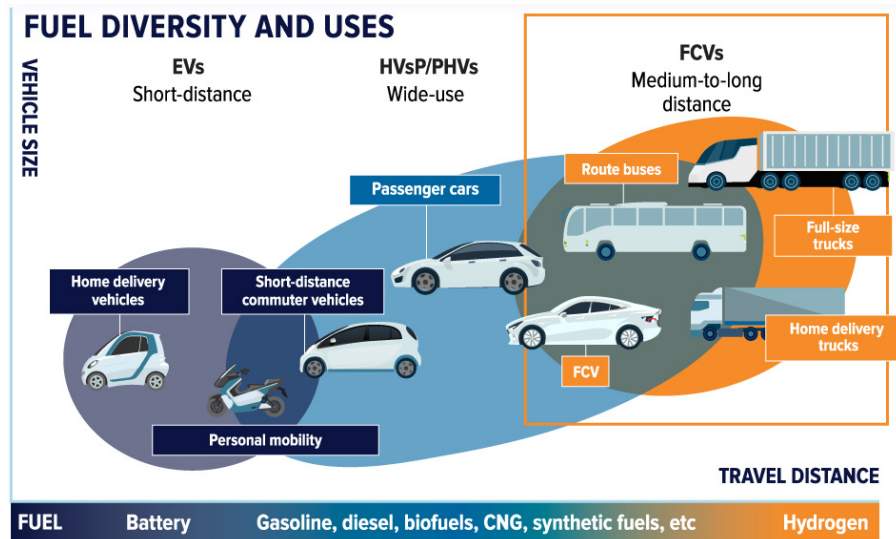


Figure 2.

Retail prices for Hydrogen vary greatly depending on the requirements of the end-use. The purer the Hydrogen required, the more expensive the processing costs leading to higher wholesale and retail prices. The current production cost of 99.95% pure hydrogen ranges from as low as \$4/kg to more than \$8/kg. Retail rates for hydrogen range from \$12/kg to as high as \$17/kg in California, with an average retail price of around \$14/kg. **With H2I's proprietary Membrane Separation Technology (MST), we can produce Hydrogen at well below \$2/kg.**

H2I is aggressively pursuing the full range of hydrogen off-taker opportunities, with a primary goal of selling wholesale blue Hydrogen directly to existing industrial gas Distributors such as Praxair, Air Products, and Air Liquide. Our flexible fuel separation technology optimally blends hydrocarbon resources to produce inexpensive and

<sup>1</sup> <https://www.forbes.com/sites/energyinnovation/2019/10/07/how-hydrogen-could-become-a-130-billion-us-industry-and-cut-emissions-by-2050>



reduced carbon impact hydrogen. For example, we have worked with an ethanol producer to develop deployment mechanisms to expand their markets by converting ethanol into higher commodity value hydrogen, increasing profitability and reach. In addition, by blending pipeline natural gas with renewable ethanol in ratios determined by real-time feedstock pricing, we can produce wholesale Hydrogen at price points well below the current average wholesale hydrogen price of \$8/kg.

This price deduction allows us to further reduce our costs by taking advantage of the oil industry Renewable Identification Number (RIN) credits as a blend of ethanol with natural gas. These RIN credits can increase profit margins significantly and offer profitable carbon reduction options.

We also intend to exploit our ability to store and make available on-demand electric power at well below market prices. Since we do not require the sun or wind to produce energy, we will fill the void of power deficits by exploiting the opportunities presented by the limitations of those technologies. Integrating H2I's on-demand power generation capabilities will help level output, making these installations more profitable for the power producers and H2I. The opportunities presented are a fraction of Hydrogen's already available global market.

## OPPORTUNITY<sup>2</sup>

H2I is seeking strategic and investor partners to allow the company to progress its membrane separation technology from its proven R&D stage achieved over the past 2-years and demonstrate the performance and versatility of these metallic membranes on its mobile test-bed that it also developed fabricated during the period. Leveraging the nearly 80 years of combined experience in this field, H2I's team has created a pragmatic 6-month plan to fully demonstrate its natural gas-fed hydrogen separator that will produce 99.95% pure hydrogen gas required to power a fuel cell.

After completing the MVP demonstration, the hydrogen generator will scale up to meet the requirements of several integrated applications for customer production needs. For example, a few production areas are 500 to 1000 kg/H H2 modules to fully service forklift

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<sup>2</sup> H2I and iBBT Network Society members must investigate the merits and risks of any current or future token offer opportunity or tax advice.



fleets in a medium-sized warehouse or fleets of EVs, vans, school buses, city public transportation, and delivery vehicles servicing local communities.

The customer's hydrogen production can expand by exploiting H2I's MST technology scalability by simply expanding the membrane modules in one device.

**Investors should** look to **Hydrogen** as more than a Chemistry class molecule. The future fuel will lead to power vehicles, machinery, and buildings with zero emissions.

Sustainable investments in **Hydrogen** will help foster new industrial and technological developments worldwide. H2I's MST technology is the leader in the cost reduction of hydrogen production.

Moreover, according to the EIA's report, the cost of **Hydrogen production** from renewable electricity is expected to fall 30 percent by 2030 due to decreased costs for renewables and scaling up of **Hydrogen production**.

No one can deny the H2I's allure. **Hydrogen** is by far the most abundant element on earth, or in the universe, for that matter. It is a highly efficient form of energy and burns the cleanest of all fuels, emitting only pure water vapor. Such an elegant solution to our energy needs makes **hydrogen** stocks seem like a perfect investment.

One of the primary problems is that Hydrogen is expensive to produce because it does not occur naturally as a fuel. Consumer prices make hydrogen products an obstacle. For example, a fuel cell engine can cost up to 10 times as much as a conventional engine. In addition, like other renewable energy sources, there needs to be developed hydrogen infrastructure, which further holds back its adoption.

However, that may all be changing. Before the global lockdown that crushed global oil demand, many companies were developing solutions that would give Hydrogen a chance to become more than a someday idea. Furthermore, they are starting to put their money where their mouth is, at least on paper.



In August 2020, the European Union<sup>3</sup> announced an ambitious plan backed by many billions of euros to enable the continent to derive a substantial share of its energy from Hydrogen by 2050.

The good news for investors is that publicly traded companies involved with Hydrogen and fuel cell technology offer a long runway for growth. However, many still need to be profitable, which means they carry a sizable risk. However, if an investor is willing to dabble in the sector, H2I is an opportunity for the best hydrogen stock to hold for the future.

## CONCLUSION

We believe natural gas and oil producers will significantly benefit from our business model by taking advantage of our ability to create much higher-value hydrogen from their in-the-ground resources. We are presently working with one of the largest natural gas producers in the United States to deploy our first demonstration project in Wyoming. H2I's **MST** hydrogen separation technology can offer the most cost-effective means of producing Hydrogen from an array of hydrocarbons and sustainable bio-produced feedstocks. H2I units can be scaled to virtually any capacity from 10kg/day to over 1,000 kg/day, making them attractive to distributed facilities sites. Current PSA technology is economically tied to much higher economies-of-scale production facilities with added gas transportation cost burdening.

Using today's pricing, the cost of MST hydrogen production from a natural gas resource will be \$1.25 to \$1.50/kg compressed H2 gas range.

Given that wholesale rates are in the +/- \$8/kg range and retail rates in the +/- \$14/kg range, it is likely that distributed H2I gas production will have a viable and expanding role and facility-specific niche market that it can effectively serve. In addition, because the H2I MST technology is also cost-competitive against even large-scale, PSA-type production plants, H2I MST technology will also be highly sales competitive in the head-to-head competition for contracts of any type.

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<sup>3</sup> Gas grid operators outline plans for expanded EU 'hydrogen highway'. Gas network operators from 11 countries have joined the European hydrogen backbone initiative, presenting an updated vision for a pure hydrogen network of nearly 40,000km by 2040. - Source: <https://www.edie.net/>







Figure 3. Hydrogen pipes at an oil refinery and gas processing plant in the Uralsk region, Kazakhstan

## DISCLAIMER NOTICE

**Disclaimer:** The information of this whitepaper does not constitute an offer to sell or a solicitation of an offer to buy an H2I Security "Common Stock" or Convertible Fractional Token "CFT" to the Public or anyone who does not have a direct relationship with H2I or the H2I Network. Alternatively, the Hydrogen Innovation Tokens (HHO)<sup>4</sup> is Rewards, Energy Discounts, or Social Money within the iBBT Network Society. H2I and iBBT Network Society members must investigate the merits and risks of any current or future token offer opportunity or tax advice.

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<sup>4</sup> Hydrogen Innovation Token or HHO is an Ethereum based ERC20 token created by iBBT in partnership with Sustainability Creative Co. The H2I vision is to provide a swappable multipurpose energy token with full, built-in accountability.

