

# HYDROGEN IS ACCELERATING THE CO<sub>2</sub> COUNTDOWN

Low-carbon hydrogen is a market-driven  
path to decarbonization

Honeywell  
Uop

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# THE CO<sub>2</sub> COUNTDOWN PREPARING FOR THE HYDROGEN ECONOMY

The stakes—and opportunities—have never been higher: Aggressive climate targets could increase the demand for clean hydrogen as a low-carbon energy vector sevenfold in the next 30 years.<sup>1</sup> In the US alone, this could create \$750 billion in revenue and 3.4 million jobs by 2050.<sup>2</sup> Globally, this could mean \$2.5 trillion in revenue and 30 million jobs by 2050.<sup>1</sup>

With the world uniting to net zero, Honeywell UOP is enabling decarbonization. We have accelerated the development of scalable technologies that will significantly impact the CO<sub>2</sub> countdown and help refineries and other industries play a pivotal role in the world's transition to a lower-carbon energy system.

Ready today, Honeywell H<sub>2</sub> Solutions is a suite of proven carbon capture technologies to help you meet stringent emissions goals and gain fast, profitable entry into the growing hydrogen economy.

**In a decarbonized world, hydrogen demand could grow exponentially by 2050:<sup>1</sup>**

18%

of final energy demand

6Gt

annual CO<sub>2</sub> abatement

\$2.5tn

annual sales (hydrogen and equipment)

30m

jobs created

<sup>1</sup>Hydrogen Council. *Hydrogen—Scaling Up*.

(Analytical support provided by McKinsey & Co.)

<sup>2</sup>Fuel Cell & Hydrogen Energy Association. *Roadmap to a US Hydrogen Economy*.

(Analytical support provided by McKinsey & Co.)



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# HYDROGEN THE KEY DECARBONIZATION

In today's refineries and petrochemical plants, hydrogen production emits substantial amounts of CO<sub>2</sub>. But it doesn't have to. Globally, industry produces 75 Mt of hydrogen per year, associated with more than 800 Mt CO<sub>2</sub> emissions per year.<sup>1</sup>

The fact is, hydrogen is a clean-burning fuel that can decarbonize hard-to-abate segments as long as it's produced using a low-carbon route. Low-carbon hydrogen can be an economical solution for decarbonizing petrochemical, refining, transportation, and power generation businesses.

Honeywell H<sub>2</sub> Solutions can help improve your bottom line. Capturing CO<sub>2</sub> from hydrogen production is relatively low cost compared to other carbon capture options because a significant portion of the CO<sub>2</sub> is available at high pressures and high concentrations.

**CO<sub>2</sub> is separated, transported, and injected deep underground, enabling decarbonization of hard-to-abate industries.**



Steel



Cement



Refining



Chemicals

<sup>1</sup>International Energy Agency. *The Future of Hydrogen*.



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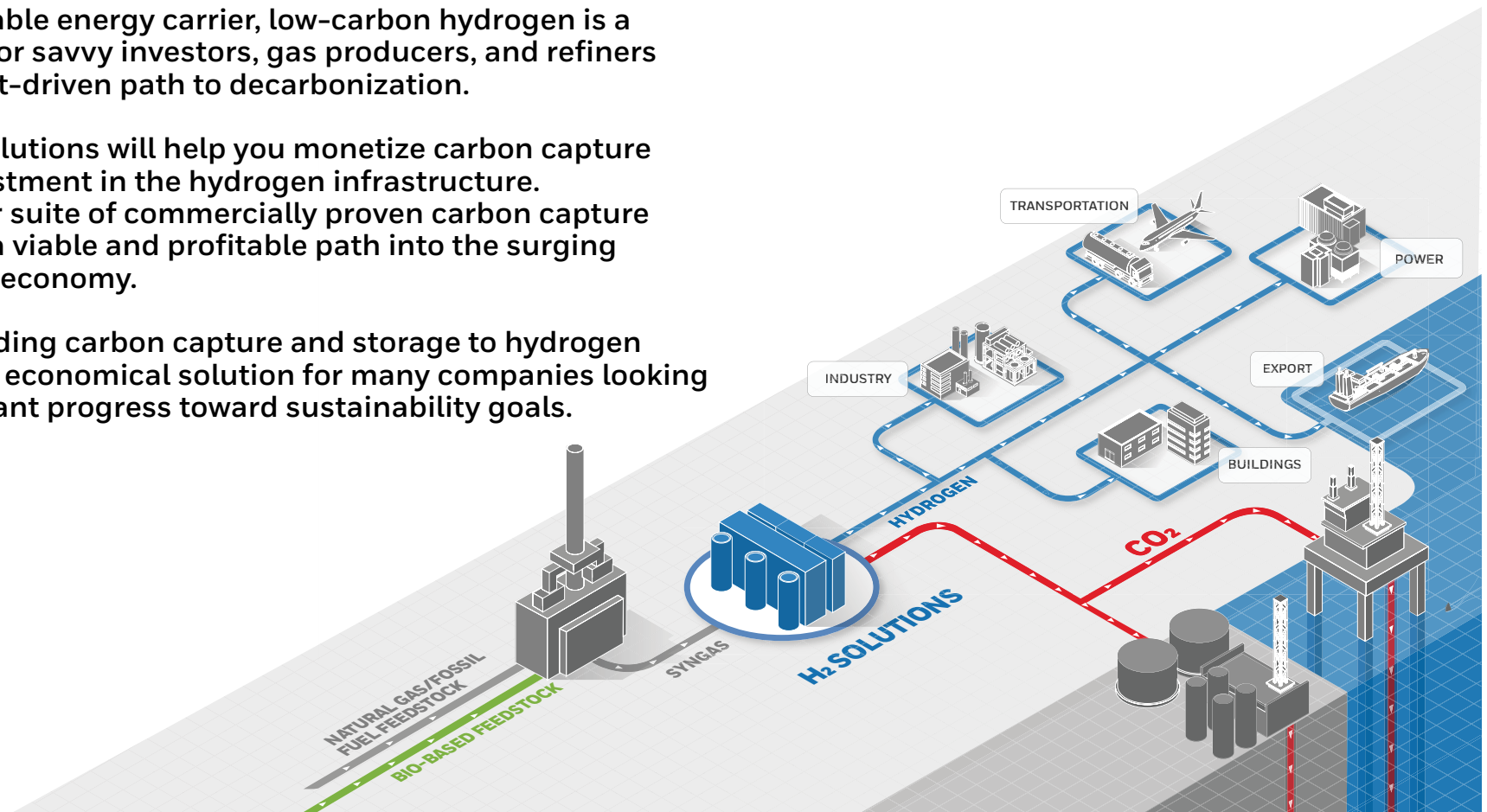


# YOUR COST-EFFECTIVE PATH TO CLEAN HYDROGEN

A versatile, valuable energy carrier, low-carbon hydrogen is a game-changer for savvy investors, gas producers, and refiners seeking a market-driven path to decarbonization.

Honeywell H<sub>2</sub> Solutions will help you monetize carbon capture and enable investment in the hydrogen infrastructure. Ready today, our suite of commercially proven carbon capture technologies is a viable and profitable path into the surging clean-hydrogen economy.

What's more, adding carbon capture and storage to hydrogen production is an economical solution for many companies looking to make significant progress toward sustainability goals.



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# RETROFIT YOUR FUTURE

Honeywell UOP technology can help you retrofit existing assets and transform idle units into revenue generators. For example, we've developed a low-cost path for retrofitting steam methane reformers with CO<sub>2</sub> capture, resulting in an extra 10-20% hydrogen yield from the plant, depending on the recovery of the existing hydrogen PSA, and flexibility to operate with the CO<sub>2</sub> capture equipment on or off.

Technical innovation in adsorbents, membranes, cryogenics, and solvents, along with process design and control expertise, make UOP the industry's choice to provide technology and equipment for your new installation or revamp – from initial development to commissioning and startup.

Wabash Valley Resources LLC has selected a range of Honeywell UOP technologies to capture and sequester up to 1.65 million tons of CO<sub>2</sub> annually and to produce clean hydrogen energy from a repurposed gasification plant in West Terre Haute, Indiana. The project is expected to be one of the largest carbon sequestration initiatives in the United States to date.

"By implementing Honeywell UOP's proven technologies for the capture of CO<sub>2</sub> and hydrogen purification, we will significantly reduce greenhouse gas emissions," said Dan Williams, Managing Director of Wabash Valley Resources. "This project will allow for market access to clean hydrogen, as well as support the domestic growth of the hydrogen economy."

Honeywell. (2021, April 12). Honeywell Technology Enables Large U.S. Carbon Capture And Storage Project [Press release]. <https://uop.honeywell.com/en/news-events/2021/april/honeywell-technology-enables-large-u-s-carbon-capture-and-storage-project>



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# IMPLEMENT HONEYWELL H<sub>2</sub> SOLUTIONS AT SCALE

Honeywell UOP has provided innovative hydrogen processing solutions to refineries and other industries for five decades. Today, refineries can implement Honeywell H<sub>2</sub> Solutions at scale and low cost, achieving significant sustainability impact.

Honeywell H<sub>2</sub> Solutions include multiple carbon capture flow schemes you can tailor to your requirements for hydrogen yield, hydrogen purity, CO<sub>2</sub> purity, steam use, or capital and operating cost needs.



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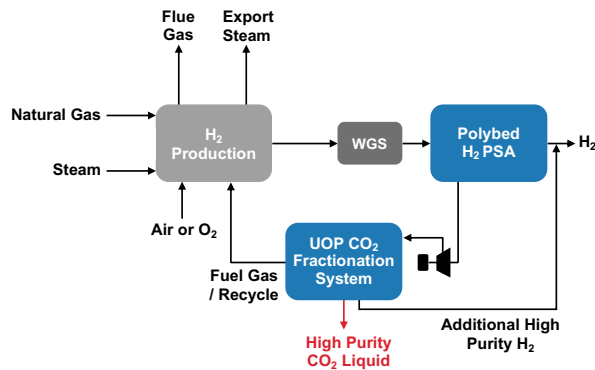
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# OPTIMIZE CARBON CAPTURE AND HYDROGEN RECOVERY

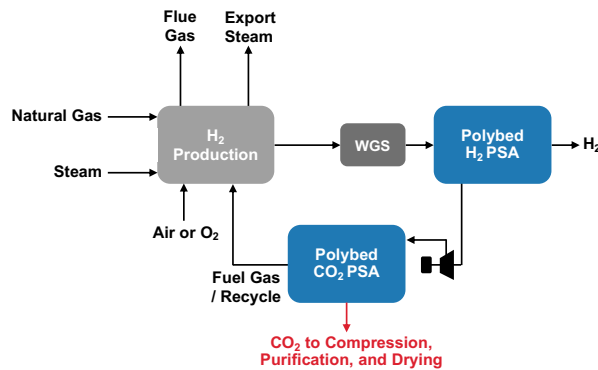
Honeywell H<sub>2</sub> Solutions commercially proven cryogenic, pressure swing absorption (PSA), and solvent technologies can be tailored to your needs.

## CO<sub>2</sub> Fractionation System



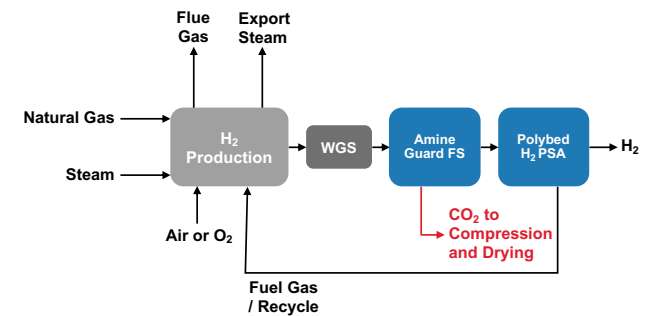
- ~10–20% additional H<sub>2</sub> recovery in retrofit application
- Ultra-high-purity CO<sub>2</sub> liquid (99.0–99.9+ mol%)
- Liquid CO<sub>2</sub> product ideal for rail or ship transport
- No steam usage for carbon capture

## Polybed™ CO<sub>2</sub> PSA



- Lowest CAPEX compared to cryogenic and solvent systems
- Optimal when lower CO<sub>2</sub> purity or recovery is acceptable
- No steam usage for carbon capture

## Amine Guard™ FS on Syngas



- Lowest electricity requirement compared to cryogenic and PSA systems
- Requires significant LP steam usage
- Vast experience in solvent technologies



# THE HYDROGEN ECONOMY IS HERE. ARE YOU IN?

Honeywell technologies across the hydrogen value chain—H<sub>2</sub> production, transportation, distribution, end-use, and safety—paired with our leading carbon capture technologies make us ideal experts in creating a reliable and lucrative hydrogen economy.

Be part of the global energy transition with Honeywell H<sub>2</sub> Solutions and accelerate your CO<sub>2</sub> countdown.



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