

Readily available, low-cost **green hydrogen** is the key enabler to achieve deep economy-wide decarbonization, particularly in hard-to-abate sectors that today depend on fossil fuels.

HYBUILD™ CAROLINAS

ARCHITECTING THE GREEN HYDROGEN ECOSYSTEM TO ENABLE A CLEAN ENERGY ECONOMY IN NORTH AND SOUTH CAROLINA

HyBuild™ Carolinas is an initiative to catalyze momentum to achieve mass-scale, low-cost, delivered green hydrogen in North and South Carolina. This initiative is poised to drive multi-sectoral decarbonization and foster local economic development.

Governments and institutions around the globe have extensively studied potential pathways for economy-wide decarbonization and have come to the same conclusion: **green hydrogen is pivotal**. Green hydrogen, a carbon-free renewable resource, can replace fossil fuels in some of the most polluting and challenging-to-electrify economic sectors. To attain this goal, green hydrogen must be delivered with supply certainty and at prices competitive with current fossil fuels. This necessitates scale.

The Green Hydrogen Coalition (GHC) established HyBuild™ North America as a platform to design low-cost, mass-scale green hydrogen hubs across the continent. The first focus region, Los Angeles, brought together stakeholders from the green hydrogen value chain and broader environmental and community ecosystem in the LA Basin. Together, this collaborative group unlocked a vision to achieve less than \$2/kilogram (kg) of delivered green hydrogen by 2030, and quantified significant air quality and family-sustaining employment benefits that would result from the HyBuild™ LA vision.



Industrial Applications



Heavy-Duty Trucking



Maritime Shipping



Clean, Dispatchable Power



Aviation



Agriculture



Mining



Long Duration, Seasonal
Energy Storage

HyBuild™ Carolinas leverages community and stakeholder engagement best practices from HyBuild™ Los Angeles while considering the unique energy and stakeholder landscape of the Carolinas. The platform combines robust technical analysis and stakeholder engagement to facilitate alignment and identify key areas for action to advance a green hydrogen economy at scale.

HyBuild™ Carolinas conducted an assessment that estimated the demand, or off-take potential, for green hydrogen, evaluated production pathways, and considered the infrastructure needed to deliver it. The effort developed and modeled a pathway to achieve near-term, mid-term, and long-term progress of green electrolytic hydrogen production and use across the Carolinas and identified potential centers of demand in the Charlotte, Charleston, Clemson, and Wilmington regions.

HyBuild™ Carolinas determined that **the Carolinas are well-positioned to launch a mass-scale, low-cost green hydrogen hub.**

Contributing factors include:

- Significant hydrogen off-take potential across multiple economic sectors
- Several forward-thinking infrastructure development partners that are committed to making progress for clean fuels call the Carolinas home
- Availability of key infrastructure to enable hydrogen production, transport, and storage

HyBuild™ Carolinas Roadmap for Accelerating Progress 2030-2040

Near Term (pre-2030)	Mid Term (from 2030)	Longer Term (from 2040)
<p>Delivered Cost Goal: ~\$5/kg</p> <p>Production: Local electrolyzers close to demand (at factory/site-level)</p> <p>Storage, & Transportation: Local production and local storage (above ground tanks)</p> <p>End Users:</p> <ul style="list-style-type: none"> • Up to 105,000 tons H₂ / yr. • <i>Primarily:</i> Co-firing¹ and some industrial demands 	<p>Delivered Cost Goal: \$1.49/kg to \$2.13/kg¹</p> <p>Production: Centralized production sites (co-located electrolyzer + renewables)</p> <p>Storage, & Transportation: Distribution pipelines (greenfield)</p> <p>End Users:</p> <ul style="list-style-type: none"> • 406,000 tons H₂ / yr. • <i>Primarily:</i> Flexible applications including co-firing (power generation, CHP, and industry) and mobility 	<p>Delivered Cost Goal: \$1.10/kg² (\$3.09/kg)³</p> <p>Production: Potential to utilize renewable resources across the two states</p> <p>Storage, & Transportation: Distribution pipelines (greenfield)</p> <p>End Users:</p> <ul style="list-style-type: none"> • 1,388,000 tons H₂ / yr. • <i>Primarily:</i> Use as industrial feedstock (e.g., fertilizer and steel), mobility and process heat/co-firing
HyBuild™ Carolinas Roadmap Notes		
<p>¹ Includes announced H₂ Investment Recovery Act (IRA) tax credit</p> <p>² Assumes IRA tax credit extension through 2040</p>		<p>³ Without IRA tax credit</p> <p>⁴ Blended use of green hydrogen and natural gas at the off-take site</p>



The Carolinas have a rich industrial sector that can play a key role in accelerating the broader US green hydrogen economy, from expertise in power generation to the manufacturing of electrolysis equipment, vehicles, and airplanes.

The Carolinas host key research, development, and production of proton exchange membrane (PEM) electrolyzers and fuel cells. These will be critical to the development of the worldwide green hydrogen economy. Accelerated GH₂ development in the Carolinas can continue the states' world leadership as a manufacturing and innovation powerhouse.

Credit: Siemens Energy <https://www.siemens-energy.com/global/en/offersings/renewable-energy/hydrogen-solutions.html>

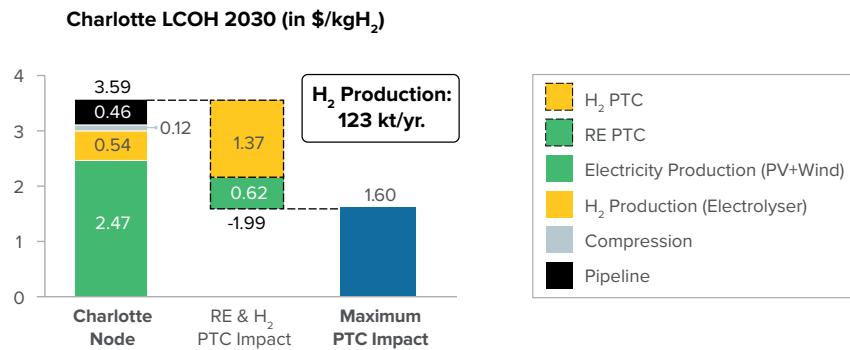
HYBUILD™ CAROLINAS UNCOVERS PATHWAY TO A GREEN HYDROGEN ECONOMY IN 2030 AND 2040

4 Key Findings from the HyBuild™ Carolinas Off-Take & Infrastructure Effort

1 Using federal incentives from the Inflation Reduction Act, the regions of Charlotte, Clemson, and Charleston can achieve under \$2 per kilogram of delivered green hydrogen by 2030.

Green hydrogen is critical to achieving deep economy wide decarbonization but will not be adopted if it is more expensive than other fuels. Achieving \$2-\$3 per kilogram (kg) delivered cost makes green hydrogen an attractive and cost-competitive substitute for fossil fuel use. The Inflation Reduction Act's inclusion of a hydrogen production tax credit (PTC) of up to \$3/kg is essential to achieving this low delivered cost target. As shown in the figure below, the HyBuild™ Carolinas analysis found that by 2030, and at a scale of 123 kilotons production per year, Charlotte can achieve \$1.60/kg delivered hydrogen, after factoring in the hydrogen PTC and renewable energy production tax credits.

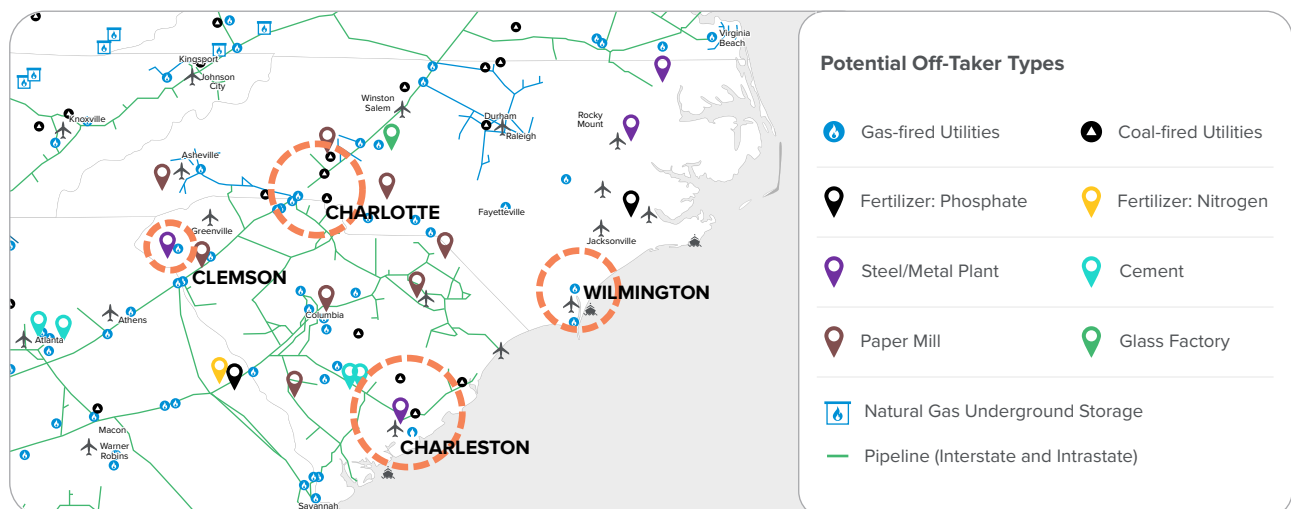
Projected Levelized Cost of Hydrogen (LCOH) in Charlotte in 2030, Including Tax Credits



2 The Carolinas have significant potential for multi-sectoral demand for green hydrogen. This demand is essential for launching a new green hydrogen ecosystem, as it provides visibility into bankable revenue streams and scalable future off-take.

A long-term, viable green hydrogen hub starts with bankable revenue streams and scalable off-takers. HyBuild™ Carolinas identified and interviewed potential scalable buyers in North and South Carolina and identified the power and industrial sectors as the likeliest for early adoption of green hydrogen. Buyers in these sectors can serve as an important catalyst to jumpstart the green hydrogen economy in the Carolinas. In the longer term, the transportation sector is expected to be the largest and most impactful green hydrogen consumer in the region, delivering the greatest air quality benefits by displacing the use of diesel for heavy duty trucking with zero-emission fuel cell vehicles.

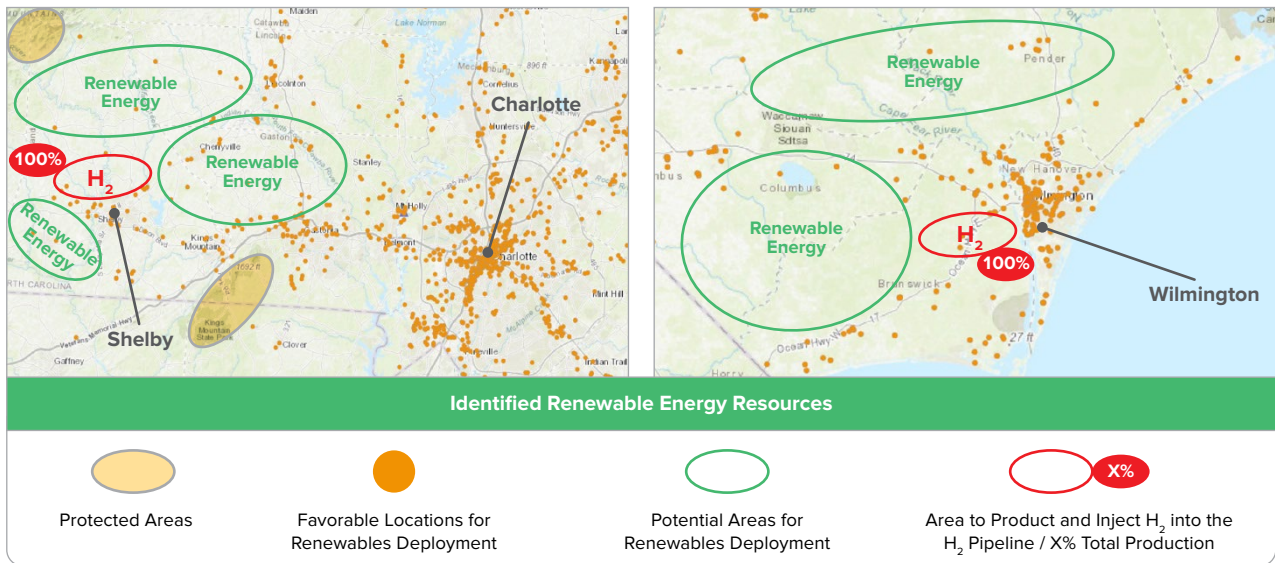
Potential Off-Taker Types and Locations in the Carolinas



3 North and South Carolina's green hydrogen demand can be met with electrolytic green hydrogen produced from nearby wind and solar resources, along with distribution infrastructure to move it from production centers to demand centers.

The scenario modeled by HyBuild™ Carolinas found that using electricity produced from 80 percent solar and 20 percent offshore wind could produce a consistent supply of green hydrogen at a competitive price. However, since permitting and construction of new renewables is complex and time-intensive, the near-term (i.e., 2025 to 2030) production of green hydrogen could occur using smaller electrolyzers paired with renewable electricity purchased from the grid.

Significant Renewable Energy Resource for GH₂ Production Identified Near Charlotte and Wilmington

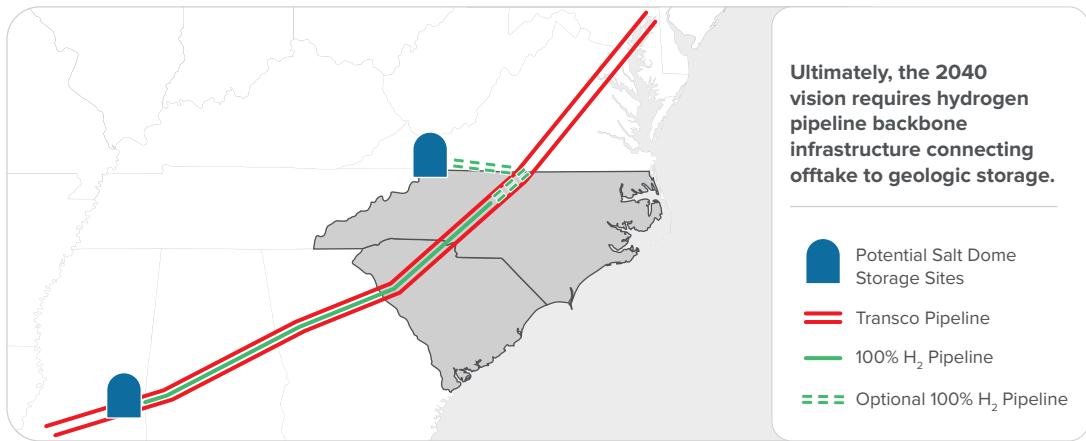


4 Mass-scale pipeline and geologic storage are needed to seasonally balance mismatches in the demand and supply of green hydrogen and achieve low delivered cost throughout the year. Accordingly, the HyBuild™ Carolinas 2040 system design includes a connection to out-of-state geologic salt cavern resources.

Geological storage of hydrogen in purpose-built salt domes is a commercially proven and safe means to store large quantities of hydrogen. It enables economic delivery and system-wide balancing of hydrogen production and demand. GHC's analysis finds that establishing this seasonal storage capability will enable a reduction in delivered cost of \$0.50/kg.

By 2040, geologic storage and 100% hydrogen-dedicated interstate pipelines will be required to aggregate and store GH₂ supply from remote solar and wind sites to consistently meet large, multisectoral demand throughout the year.

Potential Hydrogen Pipeline Backbone Infrastructure and Salt Dome Storage





Launching a Green Hydrogen Economy Begins with Scalable GH₂ Buyers.

The Green Hydrogen Coalition, a 501(c)(3) educational nonprofit organization, is dedicated to facilitating practices and policies to advance the production and use of green hydrogen in all sectors where it will accelerate a carbon-free energy future.

The GHC, through its HyBuild™ North America platform, is engaging with green hydrogen buyers across the country, helping to aggregate demand and identify collaboration opportunities with state and federal incentives.

HyBuild™ North America is the GHC's platform to architect low-cost, mass-scale green hydrogen hubs throughout the continent. The first regional focus of the platform, HyBuild™ Los Angeles, was launched in 2020 and has identified a pathway to achieve \$2.05/kg delivered green hydrogen costs in the Los Angeles Basin to serve multi-sectoral off-takers, reduce air pollution, and create diversely skilled local jobs.

The GHC's second platform, the Western Green Hydrogen Initiative, is a public-private partnership to assist interested states and partners in advancing and accelerating deployment of green hydrogen infrastructure in the Western region for the benefit of the region's economy and environment.

For more information on the GHC, visit ghcoalition.org.