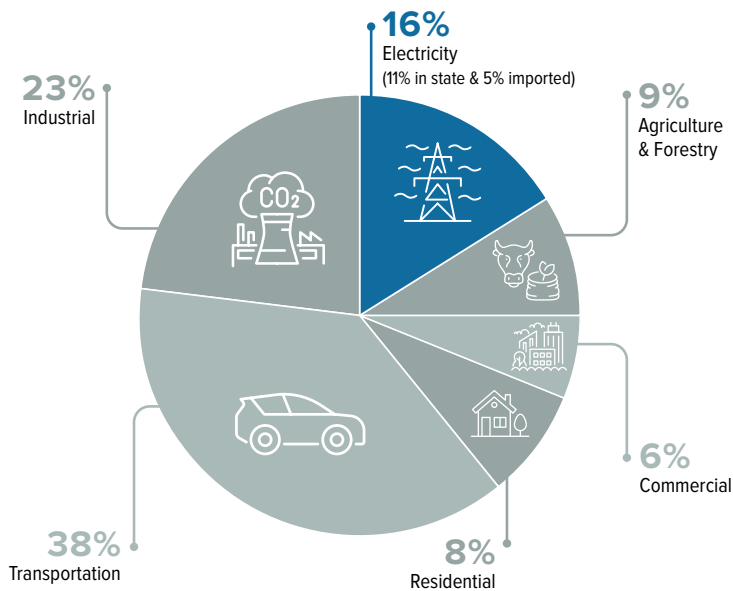


RENEWABLE HYDROGEN

The Missing Piece to Achieving 100% Clean Energy in California's Power Sector

To achieve its ambitious goal of attaining 100% clean electricity by 2045,¹ California must implement alternative energy sources to fossil fuels that can provide reliable and clean power to its approximately 40 million residents.² As California's electricity consumption exceeds that of every other state but Texas and Florida,³ the solution must be able to operate at a scale sufficient to meet the state's demand. The issue remains that California relies on natural gas-fueled power plants to achieve grid reliability — and will continue to until at least 2045.⁴

California's power sector accounts for about 16% of the state's greenhouse gas (GHG) emissions.



Source: California Air Resources Board. n.d. "Current California GHG Emission Inventory Data." Accessed May 11, 2023. <https://ww2.arb.ca.gov/ghg-inventory-data>.

Studies find that in order to reduce this reliance on fossil fuels, California must embrace on-demand, clean resources to bolster grid resilience. To fully replace fossil fuels, the Environmental Defense Fund estimates that California will require between 25 to 40 gigawatts of clean and dependable power.⁵ In addition, the state will require robust energy storage solutions to manage the fluctuations of multi-day and seasonal energy demand, which cannot be achieved with current battery technology.

Renewable hydrogen (RH₂) offers a solution, since it can fill the state's need for clean, firm power and long-duration energy storage. Without access to such a resource, the state will continue to rely on natural gas plants. RH₂ can be a key element in mitigating power sector emissions and supporting the state's emission reduction objectives.

California has abundant renewable resources to produce RH₂ for the decarbonized energy future.



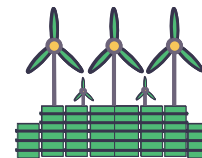
1ST

California produces the most electricity from solar energy and geothermal resources than any other state.⁶



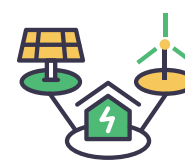
2ND

California is the state with the second-highest total electricity generation from renewable resources.⁷



4TH

California is poised to become the fourth largest economy in the world.⁸



2022

For the first time, in 2022, California ran off of 100% renewable electricity for a single day.⁹



702,883 MWh

California curtailed 703,883 Megawatt hours (MWh) of solar and wind in April 2023 alone. This is equivalent to powering almost 850,000 homes* for a month, which highlights the need for RH₂.¹⁰

The average monthly household energy use in the U.S. is 840 kWh. Typical American home energy use per month = (840 kWh/1 month)(1 MWh/1000 kWh) = 702,883 MWh/0.84 MWh = 836,765 homes per month ~ 850,000 homes per month

HOW SHOULD RENEWABLE HYDROGEN BE DEFINED?

GHC recommends that renewable hydrogen is defined using the following set of parameters:

- + The feedstock used to produce the hydrogen is non-fossil fuel derived and is consistent with RPS eligible resources
- + The definition is technology neutral (e.g., does not specify the production or conversion process)
- + Eligibility is based on a well-to-gate a carbon intensity framework consistent with the U.S. Department of Energy

THE BENEFITS OF RENEWABLE ENERGY IN THE POWER SECTOR

RH ₂ BENEFITS	CHALLENGES IN THE POWER SECTOR	THE ROLE OF RH ₂ IN THE POWER SECTOR
RH ₂ can help California affordably transition from fossil fuels by repurposing electric generation facilities.	Substantial amounts of clean, firm power are needed to ensure grid reliability. Today, much of that is supplied by burning natural gas in power plants.	Existing power plants can be used to combust RH ₂ in place of natural gas. Retrofitting power plants to run on RH ₂ offers a pathway to reach 100% clean energy affordably. Combustion generators using RH ₂ will be required to meet current EPA standards on NOx emissions, which can be achieved through Selective Catalytic Reduction and Selective Non-Catalytic Reduction.
RH ₂ can provide reliable, clean backup power in lieu of gasoline, propane, or diesel.	California has been subject to multi-day Public Safety Power Shutoff blackout events, which have increased over the past several years. Today, backup power is typically provided using propane, gasoline, and diesel-fueled generators. To achieve a clean future, the state needs renewable alternatives.	Distributed RH ₂ -fueled power plants (turbines, linear generators, or fuel cells) can supply on-demand, reliable backup power when the grid is under stress.
RH ₂ can store large amounts of renewable energy to cover daily, weekly, or even seasonal changes in power supply.	Currently, when there is a surplus of renewable electricity on the grid, the state does not have the ability to make use of this excess; instead, the energy is curtailed. At other times when renewable electricity production is not sufficient to meet demand, other sources of power must fill in to meet demand. Today, on-demand power is primarily met by burning fossil fuels, such as natural gas.	RH ₂ will enable California to capture excess solar and wind generation, store it, and utilize it as needed to balance the grid. Stored renewable electricity in the form of RH ₂ can be converted to renewable electricity to achieve 100% renewable energy in the power sector.
The power sector is an important near-term offtaker for RH ₂ , which can help catalyze California's RH ₂ economy.	To jump start the ecosystem and attract the necessary capital investments for shared transport and storage infrastructure, California will need visibility into bankable, large-scale offtakers.	The power sector offers concentrated, predictable demand, which will help drive economies of scale and lower the cost of RH ₂ . As a result, RH ₂ will become more accessible for adoption in other highly polluting sectors, such as heavy-duty trucking, maritime shipping, and aviation.

Resources:

- 1 California Energy Commission. n.d. "SB 100 Joint Agency Report." Accessed June 7, 2023. <https://www.energy.ca.gov/sb100>.
- 2 U.S. Census Bureau. n.d. "Quickfacts: California." Accessed May 11, 2023. <https://www.census.gov/quickfacts/fact/table/CA/PST045221>.
- 3 U.S. Energy Information Administration. n.d. "Profile Analysis: California." Accessed May 11, 2023. <https://www.eia.gov/state/analysis.php?sid=CA#24>.
- 4 California Energy Commission. n.d. "California releases report charting path to 100 percent clean electricity." Accessed May 11, 2023. <https://www.energy.ca.gov/news/2021-03/california-releases-report-charting-path-100-percent-clean-electricity>.
- 5 Long, JCS, et al. n.d. "Three Detailed Models of the Future of California's Power System All Show That California Needs Carbon-Free Electricity Sources That Don't Depend on the Weather." Environmental Defense Fund. Accessed June 7, 2023. <https://www.edf.org/sites/default/files/documents/SB100%20clean%20firm%20power%20report%20plus%20SI.pdf>.
- 6 "U.S. Energy Information Administration - EIA - Independent Statistics and Analysis." n.d. Eia.gov. Accessed May 9, 2023. <https://www.eia.gov/state/analysis.php?sid=CA>.
- 7 *Ibid.*
- 8 Office of Governor Gavin Newsom. 2022. "ICYMI: California Poised to Become World's 4th Biggest Economy." Accessed on June 15, 2023. <https://www.gov.ca.gov/2022/10/24/icymi-california-poised-to-become-worlds-4th-biggest-economy/>.
- 9 2022: Sommer, Lauren. 2022. "California Just Ran on 100% Renewable Energy, but Fossil Fuels Aren't Fading Away Yet." NPR, May 13, 2022. <https://www.npr.org/2022/05/07/1097376890/for-a-brief-moment-calif-fully-powered-itself-with-renewable-energy>.
- 10 California ISO. (n.d.) Managing Oversupply. Accessed May 11, 2023. <http://www.caiso.com/informed/Pages/ManagingOversupply.aspx>.

LEARN MORE ABOUT US & ACCESS FREE RESOURCES:



© June 2024, Green Hydrogen Coalition. All rights reserved.

Founded in 2019, the Green Hydrogen Coalition (GHC) is a 501(c)(3) educational nonprofit that is focused on the role of green hydrogen to accelerate a clean and just energy transition. As California works towards carbon neutrality by 2045, GH₂ will be a critical tool to achieve economy-wide decarbonization alongside other clean energy technologies. The GHC works to advance education, policies, and practices to achieve progress for GH₂. For more information, visit ghcoalition.org