

Hydrogen, Renewables and Energy Storage

A compilation of studies, reports and announcements



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Reports and Assessments

British Columbia Hydrogen Study Executive Summary

https://www2.gov.bc.ca/assets/gov/government/ministries-organizations/zen-bc-bn-hydrogen-study-final-v6_executivesummary.pdf

Description: Deployment of hydrogen in British Columbia will be required for the Province to meet 2030 and 2050 decarbonization goals and emissions reduction commitments.

Hydrogen: A renewable energy perspective

<https://www.irena.org/publications/2019/Sep/Hydrogen-A-renewable-energy-perspective>

Description: This paper from the International Renewable Energy Agency examines the potential of hydrogen fuel for hard-to-decarbonise energy uses, including energy-intensive industries, trucks, aviation, shipping and heating applications.

Oil and gas company strategies regarding the energy

<https://iopscience.iop.org/article/10.1088/2516-1083/ab2503/pdf>

Description: This paper considers the role of oil companies in the energy transition, including their strategies and investments with hydrogen

The Future of Hydrogen

<https://webstore.iea.org/the-future-of-hydrogen>

Description: International action can scale up hydrogen to make it a key part of a clean and secure energy future, according to new International Energy Agency (IEA) report, drafted at the request of the government of Japan under its G20 presidency.

Economics of converting renewable power to hydrogen

<https://www.nature.com/articles/s41560-019-0326-1>

Description: Stanford and German researchers apply their model to the current renewables environment in both Germany and Texas and find that renewable hydrogen is already cost competitive in niche applications, although not yet for industrial-scale supply.

ITM Power, Mitsui, Chiyoda and British Columbia Hydro in 300MW Power-To-Gas-Study

<http://www.itm-power.com/news-item/itm-power-mitsui-chiyoda-and-bc-hydro-in-300mw-power-to-gas-study>

The study highlighted a number of attractive opportunities which provide the basis for BC to leverage its vast renewable electricity generation capacity to become a world leader in the production and export of renewable electrolytic hydrogen

Pathways for Deep Decarbonization in California: Summary for Policy Makers

<https://static1.squarespace.com/static/58ec123cb3db2bd94e057628/t/5cadebd04cd61c00017a563b/1554901977873/EFI+California+Summary+DE+PM.pdf>

Description: 11 breakthrough technologies were identified as major potential contributors to California's deep decarbonization over the long-term, including hydrogen produced by electrolysis, smart systems, offshore wind, energy storage, and clean cement, among others.

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GLOBAL WARMING OF 1.5 °C: Summary for Policy Makers, Intergovernmental Panel on Climate Change, October 2018.

http://report.ipcc.ch/sr15/pdf/sr15_spm_final.pdf

Description: This new assessment notes that, among other things, reductions in carbon emissions can be "achieved through combinations of new and existing technologies and practices, including electrification, hydrogen..."

National Hydrogen Roadmap: Pathways to an economically sustainable hydrogen industry in Australia, CSIRO, 2018.

<https://www.csiro.au/en/Do-business/Futures/Reports/Hydrogen-Roadmap>

Description: The National Hydrogen Roadmap provides a blueprint for the development of a hydrogen industry in Australia.

U.S. National Electrification Assessment, Electric Power Research Institute (EPRI), April 2018.

<https://www.epri.com/#/pages/product/00000003002013582/?lang=en>

Description: The assessment calls for exploring the role of hydrogen as a clean carrier of energy and the economic and policy impediments to its development. It also identifies hydrogen as one of several options to explore for dealing efficiently with daily and seasonal variability.

Gas for Climate: How gas can help to achieve the Paris Agreement target in an affordable way

https://www.gasforclimate2050.eu/files/files/Ecofys_Gas_for_Climate_Feb2018.pdf

Description: Ecofys (Navigant), concludes that it is possible by 2050 to scale up renewable gas (biomethane and renewable hydrogen) production in the EU to 122 billion cubic metres by 2050.

BRINGING NORTH SEA ENERGY ASHORE EFFICIENTLY, World Energy Council, 2018.

https://www.worldenergy.org/wp-content/uploads/2018/01/WEC-brochure_Online-offshore.pdf

Description: Looks at the growth of wind power in the North Sea and how to best transport it to consumers, including hydrogen. The report concludes that to create an affordable and reliable energy supply in NW Europe, a hybrid system of (green) power and (green) hydrogen is key.

Study on Early Business Cases for H2 in Energy Storage and More Broadly Power to H2 Applications, Fuel Cell and Hydrogen Joint Undertaking, June 2017.

<http://www.fch.europa.eu/publications/study-early-business-cases-h2-energy-storage-and-more-broadly-power-h2-applications>

Description: The focus of this study is to identify these early business cases and to assess their potential replicability within the EU from now until 2025.

Energy from Gas: Taking a Whole System Approach, Institute of Mech. Engineers, May 2018.

<http://www.imeche.org/policy-and-press/reports/detail/energy-from-gas-taking-a-whole-system-approach>

Description: Government and industry should boost investment in technology to promote the use of hydrogen as a way of storing energy, which would make the UK energy system greener and more efficient.

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GENerating energy secure COMMunities through Smart Renewable Hydrogen, 2017.

<http://www.nweurope.eu/projects/project-search/gencomm-generating-energy-secure-communities/>

Description: GENCOMM will address the energy sustainability challenges of NWE communities through the implementation of smart hydrogen-based energy matrixes.

Commission Staff Working Document: Energy storage – the role of electricity, European Commission, February 2017.

https://ec.europa.eu/energy/sites/ener/files/documents/swd2017_61_document_travail_service_part1_v6.pdf

Direct Air Capture of Carbon Dioxide, ICEF Roadmap, Innovation for Cool Forum, Oct. 2018.

[https://www.icef-](https://www.icef-forum.org/pdf2018/roadmap/ICEF2018_Roadmap_Draft_for_Comment_20181012.pdf)

[forum.org/pdf2018/roadmap/ICEF2018_Roadmap_Draft_for_Comment_20181012.pdf](https://www.icef-forum.org/pdf2018/roadmap/ICEF2018_Roadmap_Draft_for_Comment_20181012.pdf)

Description: Describes carbon capture processes that have the benefit of generating hydrogen.

News stories and op-eds

Norway's Statkraft: Green hydrogen will win on price

<https://www.tu.no/artikler/statkraft-gront-hydrogen-vil-vinne-pa-pris/471446>

German econ minister says hydrogen key part of future energy system

<https://www.cleanenergywire.org/news/german-econ-minister-says-hydrogen-key-part-future-energy-system>

Siemens Backs Mega Green Power Hydrogen Project in Australia

Project will convert power from solar and wind into hydrogen

Total investment is estimated at A\$10 billion, developer says

<https://www.bloomberg.com/news/articles/2019-10-08/siemens-backs-mega-green-power-hydrogen-project-in-australia>

Hydrogen's Plunging Price Boosts Role of Gas as Climate Solution

<https://www.bloomberg.com/news/articles/2019-08-21/cost-of-hydrogen-from-renewables-to-plummet-next-decade-bnef>

The Truth About Hydrogen

<https://rmi.org/the-truth-about-hydrogen/>

Europe Stores Electricity in Gas Pipes

<https://www.scientificamerican.com/article/europe-stores-electricity-in-gas-pipes/>

Converting excess wind and solar power into hydrogen can extend renewable energy's reach

Hydrogen can save unrealized small power plants

<https://www.sintef.no/siste-nytt/hydrogen-kan-redde-urealiserte-smakraftverk>

Small hydropower plants that do not sell electricity, but green hydrogen and oxygen instead, can become part of tomorrow's energy Norway.

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Former salt cavern to be transformed into green hydrogen storage facility

<https://www.gasworld.com/salt-cavern-to-be-transformed-into-h2-facility/2016687.article>

Hydrogen Power Storage & Solutions East Germany (HYPOS) is developing the largest hydrogen storage unit in Europe.

Understanding Hydrogen Energy Storage

<https://www.azom.com/article.aspx?ArticleID=17077>

Interview with Nel Hydrogen about hydrogen as energy storage. A good and easy-to-understand overview of the subject.

What would it take to decarbonise the global economy?

Lots of clean electricity and a revolutionary shift towards the lightest gas, writes Henry Tricks

https://www.economist.com/technology-quarterly/2018/11/29/what-would-it-take-to-decarbonise-the-global-economy?fbclid=IwAR2GXR6USVfuw-3DGAAI2VH_9pZTCgvLiRqTyiPD1Y6gjHYSqaoCKHSNBo

Hydrogen, the missing link in the energy transition

<https://www.iea.org/newsroom/news/2018/october/hydrogen-the-missing-link-in-the-energy-transition.html>

Nel ASA: Awarded Australia's First Power-to-Gas (Solar-to- Hydrogen) Project

<https://www.businesswire.com/news/home/20180927005945/en/Nel-ASA-Awarded-Australia%E2%80%99s-Power-to-Gas-Solar-to--Hydrogen>

Description: The project incorporates the production, storage and use of hydrogen, as well as the commercial application of clean energy in micro-grid systems. Some of the experience gained from this project include optimizing hydrogen storage solutions, blending hydrogen with natural gas and using hydrogen as a direct fuel.

Hydrogen gas trial in western Sydney could unlock \$1.7bn in renewable exports

Chief scientist estimates Australia could reap benefits from hydrogen technology

<https://www.theguardian.com/environment/2018/oct/31/hydrogen-gas-trial-in-western-sydney-could-unlock-17bn-in-renewable-exports?fbclid=IwAR2KbnPBbb1FhDbf1oWx2XPJdjpsd4LKJ2oCIEWF0RRRIHKeX-C9jUeYmzk>

EU countries agree to explore hydrogen as energy source

<https://www.reuters.com/article/us-eu-power-hydrogen-co2/eu-countries-agree-to-explore-hydrogen-as-energy-source-idUSKCN1LY24N>

Description: The non-binding initiative, seen by Reuters and endorsed by 25 EU nations, calls for governments to increase cooperation on research into the potential for hydrogen use in energy storage, transport, power and heating.

Advanced Power and Energy Program Receives CEC Grant for California Renewable Hydrogen Deployment Roadmap

Roadmap to Provide Significant Detail Through 2025, Higher Level Outlook Through 2050

http://www.apep.uci.edu/NewsAndEvents/APEP_Receives_CEC_Grant_For_California_Renewable_Hydrogen_Deployment_Roadmap_090518.aspx

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SoCalGas Builds on Clean Energy Advancements with Hydrogen Council Membership

International initiative brings together more than 50 companies that share a common vision for clean energy hydrogen technologies

<https://www.prnewswire.com/news-releases/socalgas-builds-on-clean-energy-advancements-with-hydrogen-council-membership-300712426.html>

North America's First Multi-Megawatt Power-to-Gas Facility Begins Operations

Energy Storage Site to Help Grid Stabilization in Ontario

<https://globenewswire.com/news-release/2018/07/16/1537941/0/en/North-America-s-First-Multi-Megawatt-Power-to-Gas-Facility-Begins-Operations.html>

SoCalGas, Énergir, GRDF and GRTgaz Announce Collaboration on Low-Carbon and Renewable Gas Initiatives During World Gas Conference

<http://markets.businessinsider.com/news/stocks/socalgas-energir-grdf-and-grtgaz-announce-collaboration-on-low-carbon-and-renewable-gas-initiatives-during-world-gas-conference-1027331418>

Hydrogen, batteries to share workload at 140MWh dispatchable PV power plant in French Guiana

<https://www.energy-storage.news/news/hydrogen-batteries-to-share-workload-at-140mwh-dispatchable-pv-power-plant>

Massachusetts Power-to-Gas Feasibility Study

<http://www.itm-power.com/news-item/massachusetts-power-to-gas-feasibility-study>

Description: The study will assess the potential for P2G energy storage and hydrogen fuel for the Massachusetts region in collaboration with Holyoke Gas and Electric (HG&E), a local gas and electricity utility, and will determine the technical and economic feasibility for P2G and hydrogen fuel derived from renewable energy sources.

The Coming of Electrofuels

<https://www.linkedin.com/pulse/coming-electrofuels-david-white/>

“Hydrogen caverns are a proven, inexpensive and reliable technology”

An engineer by training, Louis Londe has been working at Geostock on underground storage since the early 1990s. Specializing in hydrocarbons from the start, Geostock is increasingly focusing on the energy storage possibilities offered by hydrogen caverns.

<https://medium.com/@cH2ange/louis-londe-technical-director-at-geostock-hydrogen-caverns-are-a-proven-inexpensive-and-346dde79c460>

Engie buys majority in hydrogen-based storage specialist EPS

<https://www.reuters.com/article/us-eps-m-a-engie/engie-buys-majority-in-hydrogen-based-storage-specialist-eps-idUSKBN1FD2IA>

Description: EPS, listed on Euronext, sells hydrogen-based systems for energy storage with capacities up to hundreds of megawatthours.

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Electrification and clean hydrogen key to decarbonising economies

<https://windeurope.org/newsroom/press-releases/electrification-and-clean-hydrogen-key-to-decarbonising-economies/>

Description: Wind energy together with clean hydrogen can play a vital role in decarbonizing economies, WindEurope CEO Giles Dickson will tell delegates at the Gas Infrastructure Europe conference today in Prague.

The Unique Potential of Hydrogen in Energy Infrastructure, Storage and Resiliency

<https://www.rdmag.com/article/2017/10/unique-potential-hydrogen-energy-infrastructure-storage-and-resiliency?platform=hootsuite>

Description: Op-ed by Dr. Sunita Satyapal, Director of the Fuel Cell Technologies, Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy.

Hydrogen and wind: Allies for sustainable energy

<http://m.dw.com/en/hydrogen-and-wind-allies-for-sustainable-energy/a-19330382>

Svalbard's electric power could come from hydrogen

<https://www.sintef.no/en/latest-news/svalbards-electric-power-could-come-from-hydrogen/>

Energy solution: Renewable proposal for Svalbard

The island community of Svalbard, lying between Norway and the North Pole, currently receives its electricity from a coal power plant. But what happens when the coal is gone and Svalbard must become climate neutral? Statkraft proposes using renewable hydrogen produced from wind power in Finnmark and shipped by boat to Svalbard.

<https://explained.statkraft.com/articles/2018/energy-solution-renewable-proposal-for-svalbard/>

Websites and pages

European Power to Gas, European Power to Gas Platform.

<http://europeanpowertogas.com/projects-in-europe/>

Description: Map shows the power-to-gas demonstration projects that are operational or planned at this moment.

Hydrogen, the Fabulous Fuel, Siemens.

<https://www.siemens.com/innovation/en/home/pictures-of-the-future/energy-and-efficiency/the-future-of-energy-wonder-fuel-hydrogen.html>