JUST SOLUTIONS

HYDROGEN ENERGY

A Critical Review to Ensure Community and Climate Benefits

Shining a light on the just path forward.

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Introduction

The United States' reliance on fossil fuels has been a central cause of the climate crisis and a principal element in environmental injustice. Meeting the need for a reliable energy supply will require complex technologies. Hydrogen, until now mainly a chemical commodity, has been proposed as a major energy source.

Just Solutions initiated an innovative approach to comprehensively analyze hydrogen as a clean energy technology, particularly within the context of environmental and climate justice. We created the following analysis utilizing a multi-faceted approach, including active and prominent engagement with and the direction of community-based environmental justice leaders, accessing and commissioning technical experts, and reviewing and compiling existing environmental justice frameworks.

This critical review aims to promote equity, fairness, and transparency in distributing environmental benefits and burdens, ensuring all individuals and communities have equal access to a healthy and sustainable environment while advancing just solutions to the climate crisis. It seeks to rectify historical and ongoing systemic inequalities by addressing environmental racism, discriminatory policies, and practices perpetuating economic and environmental injustices.

This community-created and collaborative resource is designed to support climate and environmental justice advocates as they advance the best clean energy technology to address the climate crisis and, as needed, prohibit false solutions from taking root in their communities. This community-created and directed analysis utilizing an environmental justice framework is paired with a technical analysis that looks more deeply at the environmental impacts and potential benefits. This framework provides values for communities to evaluate hydrogen energy concepts and critically analyzes the implications to inform community decision-making. Ultimately, our interests are finding the best solutions to protect marginalized communities from further harm and advance just solutions to address the climate crisis.

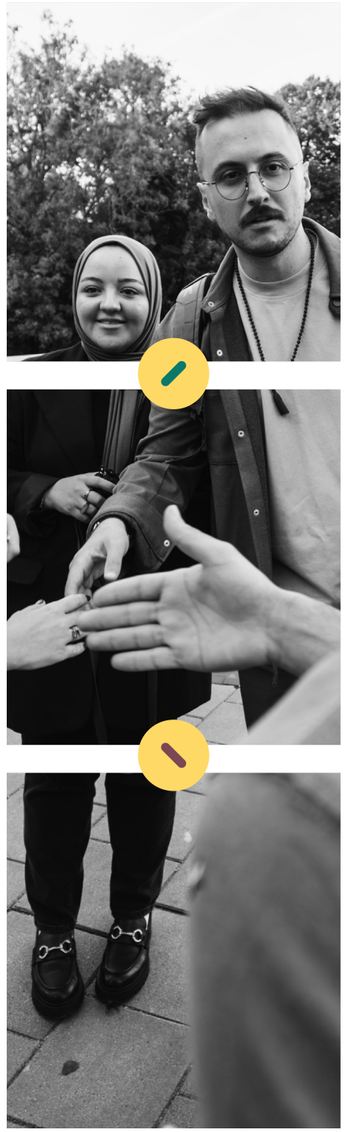
Our Approach

Just Solutions convened a Research Collaborative of nine community-based climate and environmental justice organizations, and ensured that the perspectives of various communities and geographies were represented. We identified organizations with relevant experience and interests in hydrogen energy and its societal impacts and a willingness to deepen their collective understanding of the technology and produce a comprehensive review.

The selected organizations shared a keen interest and capacity to engage in a rigorous six-month review and development process. Each organization was compensated for its time and expertise. Just Solutions coordinated and facilitated monthly structured meetings, ensuring a safe and collaborative process.

To set in motion this community-directed analysis, first we conducted a content review and compilation of existing Environmental Justice frameworks to ground our thinking in established practices. Second, for the Research Collaborative members to build a foundational understanding of hydrogen technology, Just Solutions commissioned an external research team of subject-matter experts through the Institute for Energy and Environmental Research (IEER). IEER conducted a detailed technical analysis of hydrogen and its proposed applications, laying out hydrogen energy's scientific and technological aspects and potential role in a clean energy transition.

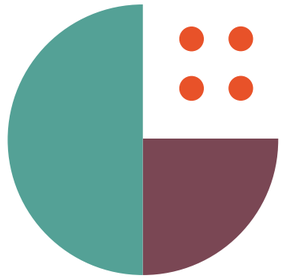
The Research Collaborative members participated in learning and discussion sessions with the research experts. They shared questions and perspectives on the technical analysis, which resulted in a companion final report that can also be found on the Just Solutions website. Through the learning, discussion, and application of an environmental justice framework, the Research Collaborative members co-created and co-authored this critical review.



Our Review of Hydrogen Energy

A comprehensive evaluation of potential environmental and health repercussions is essential while considering hydrogen energy alternatives. We must carefully evaluate climate solutions to ensure they are not perpetuating environmental injustices. Hydrogen is being presented as an energy source that could be a major element of mitigating climate change by significantly reducing greenhouse emissions and reducing overall warming impact. **The criteria and considerations discussed below establish the minimum baseline that hydrogen proposals must meet; proposals that fail to protect our communities and reduce climate warming should be rejected.**

In some cases, there may be opportunity costs associated with spending when hydrogen is used in preference to other options (notably electricity) due to hydrogen's relatively smaller climate benefit in specific applications. Furthermore, careful analysis is required to avoid spending billions on less efficient types of hydrogen technologies, limiting more promising investments in renewable technologies. **The impacts of producing and using hydrogen as an energy source depend centrally on the production methods and inputs and the end use of hydrogen.** These impacts range from perpetuating environmental injustices and the fossil fuel industry to potential EJ and net environmental benefits. Most pertinently, there are environmental and health benefits when green hydrogen displaces fossil fuels.



Impacts must be evaluated at various geographic scales because hydrogen production and use have different effects in different locations; **even when net global benefits exist, local negative impacts could still be significant. Thus, net global, site-specific, and application-specific impacts must be considered,** including alternatives to hydrogen with lower overall environmental impact and/or more significant climate mitigation benefits for the same or similar inputs. Community consent is always essential, even when there are global benefits.

Ban New Hydrogen From Fossil Fuels

Producing hydrogen from fossil fuels perpetuates fossil fuel use, as does Carbon Capture and Sequestration (CCS). In addition, fossil-based hydrogen often fails to reduce greenhouse gas emissions: when methane leaks are taken into account – and accounted for at a 20-year warming potential – even blue hydrogen (produced from natural gas with CCS) cannot meet climate criteria. In the case of fracked gas, it will also perpetuate water pollution and other injustices. Therefore, **coal and natural gas-based hydrogen should be ruled out on climate and environmental justice grounds, as should hydrogen produced in whole or in part from any other fossil fuel, such as coal. Because electricity generation in the United States remains dominated by fossil fuel sources, electrolytic hydrogen made with electricity from the grid should also be ruled out.**

Produce Only Green Hydrogen

Among the various ways to produce hydrogen, only green hydrogen should be considered. For this purpose, "green hydrogen" means hydrogen produced from water using dedicated new solar and wind power plants or renewable energy that would otherwise be curtailed. Assess what mix of hydrogen production and other long-duration storage methods, such as seasonal thermal storage, would most benefit the energy transition, energy system resilience, and economic and environmental justice.

Require "Additionality" for Hydrogen Produced Using Decarbonized Electricity Sources

Producing hydrogen using electricity generated by existing grid-connected sources does not eliminate carbon emissions. Instead, the original electricity demand will still need to be met using grid electricity, which, in the current context, is likely to result in increased climate-warming emissions. Due to the disproportionate impact of fossil fuel production and use on frontline and EJ communities, climate and environmental justice considerations require that **carbon-free electricity serving existing loads should not be diverted for producing hydrogen.** In other words, to mitigate the risk of increasing carbon emissions through induced demand for electricity, electrolytic hydrogen must be powered only by demonstrably additional decarbonized energy sources.

Safeguard Water Resources

Hydrogen production requires large amounts of water. Water is a basic human right and must be managed responsibly. Water policy should uphold the Public Trust Doctrine[1] and serve the broader community, not interest groups. Any proposal for water use must respect the sovereignty and the free, prior, and informed consent of Indigenous communities under doctrines like the Winters Doctrine and Prior and Paramount Water Rights.

Water use should be a central consideration in siting hydrogen production, especially in areas such as the Southwest, where water resources are already stressed. Climate change impacts on water resources must also be taken into account to ensure that hydrogen production will be reliable and not add to the vulnerabilities of the energy system as climate extremes worsen. Local water use priorities must be considered on a site-specific basis in selecting sites for hydrogen production. The use of water resources for hydrogen production should be limited to avoid causing harm to human health and the environment.

[1] The public trust doctrine is a legal principle that holds certain natural resources, like air and water, in trust for the public, requiring the government to protect and maintain them for the public's use and benefit.

Ensure Safety

Hydrogen, like other combustible and explosive materials, presents potential safety hazards. As a combustible gas, it can ignite, making its production, transportation, storage, and usage stages susceptible to fires or explosions. Hydrogen production, transportation, and storage, especially when it impacts communities, need consistent safety protocols and oversight infrastructures, which currently do not exist and must be carefully designed, including regulations governing permitting, siting, and maintenance, given the larger role projected for hydrogen technology. The precautionary principle should be applied to ensure our lack of knowledge and systems do not cause further harm.

Developing and applying strong global, federal, and local safety rules is necessary to ensure that communities are equally protected, regardless of racial, ethnic, or socio-economic background; special vigilance regarding safety is needed for frontline communities and communities already disproportionately impacted by the energy industry. Consistent with well-established principles of environmental justice,[2] frontline communities must be meaningfully involved in all levels of decision-making, including assessment, planning, implementation, and enforcement. Establishing mechanisms for timely and effective ongoing enforcement, monitoring, reporting safety incidents, and implementation of safety measures will be essential to holding industry and regulators accountable for maintaining strong safety standards.

It is important that strict standards of hydrogen safety are maintained independent of the scale of production and transportation, especially in the case of decentralized production, where lax standards or enforcement could have especially negative impacts on communities. This notably includes pipeline safety, especially if aging natural gas pipelines are repurposed for transporting hydrogen.

[2] www.ejnet.org/ej/principles.pdf

Protect Against Risks From Feedstock Uses in Fuels

Hydrogen may also be used as a feedstock, along with CO_2, to produce synthetic hydrocarbon fuels including jet fuel, to which various toxic chemicals, including toluene, are added. Ammonia, made with hydrogen as a feedstock, has also been proposed as a fuel. Ammonia emissions create air pollution, including NO_x and $PM_{2.5}$ particulate pollution, and may result in climate warming impacts greater than burning coal, while exposure to other chemicals involved in such fuels presents various hazards to human health, as well as environmental risks. Therefore, preventing and managing emissions from ammonia and other air pollutants is essential to protect communities, including both routine and accidental emissions associated with the production, storage, and transportation of ammonia or other hydrogen carriers. Using hydrogen to produce such fuels should be ruled out where it would add to the toxic burden of already overburdened communities.

Demand Transparency

Transparency is essential to realizing the foundational environmental justice principles of self-determination and meaningful involvement in decision-making. Therefore, proposals for projects that produce or use hydrogen must be based on scientifically validated methodologies and factually accurate and publicly accessible information. This information must include comprehensive disclosures of inputs, outputs, long and short-term health, safety, and environmental impacts, especially those that would increase risks or could cause detrimental effects to neighboring communities. These impacts should also be evaluated for and made available to communities within the radius of potential impact in worst-case scenarios.

Disclosures:

- Health, safety, and environmental impacts must account for all directly associated infrastructure to hydrogen projects, including storage, transportation, and refining.
- Outputs must include all water and air emissions, including accidental releases, from all directly associated sources, stationary and mobile.
- Inputs must include feedstock, additives, and catalysts.
- Emissions should be publicly reported and accessible to communities, including full disclosure of chemical hazards.
- All hydrogen projects must include the implementation of transparent, timely, and reliable multilingual communications during emergencies, as well as early warning systems.

Ensure Green Hydrogen Uses are Essential and Beneficial

Hydrogen use proposals should be evaluated and compared to other feasible options (i.e., energy conservation, efficiency, transmission upgrades, direct electrification) and whether the end use itself could be phased out entirely in favor of more environmentally just and less resource-intensive methods of accomplishing the same goal. Green hydrogen should be considered essential only after other feasible options have been thoroughly studied. There are uses of hydrogen – even green hydrogen – that are counterproductive or would have only marginal climate benefit compared to other uses of renewable energy. Some, such as mixing hydrogen with natural gas for use in heating, would perpetuate environmental and economic injustices and create safety and leak-related issues. Hydrogen burning is generally inadvisable from an environmental justice and air pollution point of view. Hydrogen is also generally less efficient than direct electricity use when the latter is technically feasible in a given application.

In certain cases, hydrogen can potentially have a positive local and global impact. One of the most notable possibilities is if green hydrogen displaces coking coal in producing steel from iron ore. This use could avoid significant water pollution, even as energy efficiency increases and greenhouse gas emissions are reduced. Even in such cases, it is crucial to assess whether the need for steel can be met in other ways, for instance, by increasing recycling.

In the longer term (2030s and beyond), significant amounts of green hydrogen can serve as a method of long-duration energy storage for meeting peaking power production needs within an electricity grid powered with a large fraction of solar and wind energy. Such hydrogen should be produced in fuel cells from renewable electricity that would otherwise be curtailed, including water recovery and reuse.

The following applications of hydrogen should never be implemented:

- Mixing hydrogen with natural gas, including in existing natural gas pipeline infrastructure;
- Hydrogen as a fuel for light-duty vehicles and other vehicles whose normal conditions admit of electric vehicle use;
- Hydrogen for peaking power production in the short-term, when solar and/or wind energy plus storage can generally fill the need; and
- Water-intensive hydrogen production in areas facing water security issues.

Take Into Account the Climate Impact of Hydrogen Leaks

Hydrogen is not a greenhouse gas but still has a significant indirect warming impact. Therefore, the indirect climate impact of all hydrogen leaks (including during production, transportation, storage, and use, especially when combusted or used as a feedstock) must be included in assessing the climate impact of hydrogen projects and proposals. For proposals that are implemented, leaks must be monitored and minimized. Comprehensive system design, including leak prevention and detection measures, is crucial to accurately account for the full climate warming impacts of potential leaks.

Promote Global Environmental Justice Metrics and Standards

Hydrogen production requires scarce materials – such as iridium, platinum, and nickel (depending on the production method). The mining and processing of these materials occurs disproportionately in the Global South and on Indigenous lands. Even when the global impact is positive because hydrogen is displacing fossil fuels, the local impact can be devastating, as is the case, for instance, with nickel in Indonesia or platinum in South Africa. Creating standards for labor, mining, and environmental impacts – such as on local water resources – and global supply chain reporting and transparency are essential.

Conclusion

As the federal government makes significant investments in hydrogen energy, this community-driven review can provide insights from an environmental justice perspective on whether or how this technology could be used. If the recommendations are not heeded, we potentially stand to maintain or perpetuate harm in communities and our reliance on fossil fuels. The engagement of communities, especially disadvantaged ones, is paramount to ensuring there is a just transition.

THANK YOU

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Collaborative members participated in this project to share environmental justice concerns. Their participation does not encompass all concerns regarding Hydrogen and is not an endorsement of its use.

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